

ing in *Antimony*; *Silver*, 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 *Laminae*, or Flakes, but break every way with great Difficulty, and naturally throughout smooth.

Their Figure comes nearest to that of the *Ombrie*, and many of them are very *Ombrie* in Shape. Other transparent *Ombrie* 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 *Ombrie* I ever yet saw, and having no *Vestigia* of any *Spine* in any part of them, I may reasonably enough conclude them to be Stones of their own Kind.

I am not averse to think, after so manifest and considerable Discoveries as *Augustino Scilla* hath made in *Sicily*, that most of the *Ombrie* have been *Echini*, and yet some of the Prickled, which Naturalists have hitherto call'd *Lapides Judaici*, may have belong'd to some of those *Ombrie*. But there are only 2 or 3 *Echini* yet discover'd, either in ours, or the *Mediterranean Sea*; whereas of the *Ombrie* 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. Among the excellent *Diamonds* brought from the *East-Indies* by *M. Tavernier*, there is one weighing $112\frac{3}{16}$ Carats, of a very fine Violet Colour, and two of a Rose pale Colour; all three of an *Adamantine Hardness*, and upon that account esteemed *Diamonds*. Diamonds
By
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 Earl
Marshal of
England, 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 conjoining, others scatter'd; 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 threatening Greatness of *Aurunge 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 dried; but wetter 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, tho' the Heart of the Stone be purely white; but the Veins of these *Mines* are almost worn out.

* A Mangelin is 4 Grains in Weight, faitb Linschotten.

2. The *Mines* of *Codawillikul*, *Malabar* and *Buttepallem*, consist of a reddish Earth, inclining to an Orange Colour, (with which it stains the Clothes of the Labourers that work in it;) they dig about 4 Fathoms deep. They afford Stones generally of an excellent Water, and chrystalline Skin: smaller Sizes than those of *Quolure*, *Ramiab*, *Gurem*, and *Muttampellie*, have a yellowish Earth like *Quolure*; their Stones like those of the two former *Mines*, but mixed with many of blue 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 ancient) 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 $81\frac{1}{2}$ *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 spread, large Stones (it yields few or none small) they have generally a bright Skin, which inclines to a pale greenish Colour, but within they 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 Day's Expence, he had prepared a Cup of Poison, resolving if that Night he found nothing, to drink his last with the Conclusion of his Money; but in the Evening the Workmen brought him a very fair spread Stone, of 20 *Pago's* weight, in Commemoration whercof 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 Clothes, nay, make your self a Slave:
But Money get, then to Currure make haste,
There search the Mines, a Prize you'll 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.

Jonagerre, *Pirai*, *Dugulle*, *Purwillee* and *Anuntapelle*, 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 thro' high Rocks, till they go so far below their Basis, that they can go no farther for Water, in some places 40 or 50 Fathoms deep. The Superficies of the Rocks consist 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 quenched 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 anew. 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 Furlongs, sometimes much farther. This they dig all out and search, and if their first Attempt prove successful, they go to work again, digging again after the same manner, as deep as they can, till they come to Water; for the drawing whercof, wanting the Help of Engines known in *Europe*, they can go no deeper, altho' the Vein lie lower: all Lumps of the Mineral they break in pieces, and frequently find Diamonds inclosed in them. The Earth is red, many large Stones are found here, the smallest about 6 in a *Mangelin*. They are mixed Waters, but the greatest part good, only of ill-favour'd Shapes; many cragg'd Pieces of Stones, some as if they had been Parts of very great ones; others with bro-

broken of them ; yet I never heard of any that found two seeming Fellows, altho' 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 lies near *Currure*, and affords Stones of a like Magnitude, Shape and Waters ; 'tis employ'd only to the King's 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, insomuch 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 *Kishma*, of excellent Waters, is but 9 Miles distant, but the Miners or Merchants will not be at the Charge of fetching their Water from thence. Divers are of the opinion, that besides the Water, the Town lying in a Bottom, environ'd with Hills, and a Morass adjoining, the Air may be infected, and contribute to its Unhealthfulness.

Melwillee, or the *new Mine*, so call'd, 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 Complaints being made at *Quolure*, that the Vein was worn out, the King again licens'd 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 *Mangelin* to those of 14 or 15 each, and of some bigger ; but the 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 chrystalline Water and Skin. They are reported to be apt to flaw in splitting, which occasions those People to esteem them something softer than the Product of many of the other *Mines* ; several that flatter by their seeming *Whiteness*, when rough, discover their Deceitfulness, having passed 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 supplied by the plenty they find, which, together with their Properties, make them the cheaper.

2. *Visiapore* is known to contain Mines enclosing *Stones* as large and good as those of *Golconda*, 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 *Mangelin* Weight, but small, to 20 or 30 in a *Mangelin*. They are generally of an excellent *chrystalline 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 *Banugunnabelle*, *Pendekul*, and *Moodawarum*; at *Cummerville*, *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 *Mangelin*.

Lungepoleur Mines are of *yellowish Earth*, like those of *Quolure*; its *Diamonds* are generally well shaped, globular, few, pointed, a very good *chrystalline 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 *Mangelins* downwards, but few very small. *Pootloor-Mines* are of a reddish Earth, but afford *Stones* much like those of *Lungepoleur*, only smaller: under a *Mangelin*, the general Sizes are of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, of a *Mangelin*.

Punchelingul, *Sbingarrampent*, and *Tondarpaar*, are also of red Earth, their *Diamonds* not unlike those of *Quolure*, 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 *chrystalline 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 esteem'd 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 it's rare to find one in digging, or till they have prepared the Stuff, and do search purposely for them. They are also frequently inclosed in *Clods*: and some of those of *Melwillee* have the Earth so fixed 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 have broken a *Diamond*.

Near

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 itself into a little Pit made in the Earth to receive small Stones, if by chance any should run thro'. 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, lest 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 *Mussulman*, that ever I heard of, followed the Employment. These Labourers and their Employers are *Tel-linga's*, commonly Natives of or near the Place. The Merchants are the *Banians* 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 Countrymen in *Surat*, *Goa*, *Golconda*, *Visapore*, *Agra* and *Dillee*, and other Places in *India*, furnish them all with Diamonds.

* A Pagoda's
Weight is 9
Mangelins.

The Governours of the Mines are also Idolaters. In the King of *Golconda's* Dominions, a *Feulinga Bramme* 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 *Visapore* 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 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 *Visapore* are, there is no Seizure, all Stones are free: and the late deceased King, *Abdub Cutopshaw* of the former, and *Edelshaw* of the latter, would

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not only give very great Prices 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. *John Schefferus* conceives Amber to be a kind of Fossile 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 *Sweden*, on the Shores of the Isle of *Biorkoo*, 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. John Schefferus. n. 19. p. 349.

2. I am also of the same Mind with Mr. *Schefferus*, that Amber is a kind of Fossile 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. The Virtues of Amber, which were known several Ages before *Christ*, got it a celebrated Name amongst the *Greek* Writers. Afterwards it began to be admired amongst the *Romans*, and was rendered a memorable Gem by these Authors; especially when the dissolute Manners of *Nero* taught them to abuse it, by introducing it into their Luxuries. But how much soever Amber was esteemed in former Ages, yet the Countries which produced it remained still unknown; whence arose such a great Diversity of Opinions; some saying, that this Treasure was concealed in *Africa*, others in *Asia*, and others in *Europe*. In this last, *Italy* especially near the *Po*, and the Coast of the *Adriatic* Sea, was reckoned richest in Amber, which however more authentick Accounts, when the victorious *Romans* over-run all *Germany*, have given the Honour of to the Islands on the *German* Ocean and *Baltick*, *Spain*, and *Britain* coming in for a Share of it.

An Account of Amber; By Mr. Phil. Jac. Hartman. n. 248. p. 5.

But though the Ancients might be excused for alledging so many Countries to be productive of Amber, I know not whether the last or this present Age, is to be pardoned for deriving the native Amber even to this Day from *Africk*, *Asia*, and even from *America*, published likewise by the Name of Oriental Amber. The most Part of these Authors, asking their Pardon, have no Witnesses for what they assert, giving too much Heed to Report; and as to Eye-witnesses, that can be depended upon, you can scarce meet with any. I have enquired myself, and my Friends have done the same, both by word of Mouth and Letters, of a great many Persons who have lived long in Eastern Countries, and well skilled in Physicks, but never met with one who could affirm any thing certain upon this Subject, and the greatest Part of them condemn whatever has been said or wrote concerning the Oriental Amber, as false or very uncertain. And the Name of *Ambarum* or *Ambra*, which has been common a long while amongst most Nations to Amber, and a precious fra-

grant

grant *Oriental Bitumen Amber-grease*, has led a great many into a Mistake, taking for *Amber* the *Ambræ*, which they had heard grew in some Parts of *Africa, Asia* or *America*. Unless another Mistake has given Rise to *Amber's* being an *Oriental Production*, viz. the *Resine Copal*, so called by the *Apothecaries*, and the fittest from its Resemblance for counterfeiting *Amber*.

Nor is *Amber* produced in all the Countries of *Europe*, which are mentioned for it, that of its being found about the *Po*, in the *Adriatick-Sea*, and other Parts of *Italy*, being only mere empty Fictions of Authors. Neither are the Proofs of *Spanish, British, or Hungarian Amber*, more certain than the former; and the *Gagates* seems to have imposed upon Writers by the Name of *Black Amber*. But it is plain from unquestionable Experience, that in *Poland, Silesia, and Bohemia*, *Amber* has been dug up, though the Annals of these Countries make seldom any Mention of it. The *German Amber* however, is better attested and more frequently mentioned. That it is gathered upon the Sea-Shore in the *Dutch Islands in Holstein Jutland*, as also on the Banks of the Rivers, and even dug out of the Bowels of the Earth too, is attested by Authors of undoubted Credit. In *Saxony, Misnia, Eisleben, and Sweden*, it has frequently been dug up; and in the Coal-Pits at *Hall*, discovered not long ago by the Encouragement of *Frederick the Third*, have been found several Pieces of coarse *Amber*; as is attested by *Dr. Krug*, chief Physician and Counsellor, and a skilful Director of the Mines to his Serene Highness the Elector of *Brandenburg*. Nor does the famous *Marchia* afford us less worthy Testimonies: In the last Century *Jodocus Wilichius* mentions a Kind of *Amber* called *Falernum*, to have been found upon the Bank of a great Lake near *Neomander*, called *Nova Cella*, about three *German Miles* distant from *Frankfort* upon the *Oder*; and in this Century the famous *Becman*, in the Banks of *Viadrum*, near *Custrin*, hard by the Village of *Schaumberg*; as also *Elsholtius*, in a Ditch in the Island *Pottamensis*, in the Reign of the great *Frederick Wilhelm*. But there is a greater Quantity of *Amber* on the Shores upon the *Baltick*. In *Sweden* it is frequently found thrown out upon the Bank of the Lake *Meler*, or digged up there. And in *Denmark* there has been found very fine *Amber*, in a Ditch at *Copenbagen*, and in the Inland Hills of the Island of *Zealand*, they mention its being got, both in pretty large Lumps, and in considerable Quantity. *Borrichius* too, in his Letters says, that in the Islands which border upon *Cimbria* and *Holstein*, (*Forma Manda* of the *Romans*) near the Shores there is a great deal of *Amber* fished up. But there is still much greater Plenty of it in the Shores of the *Baltick*, in *Samogitia, Courland* and *Livonia*, so that the Peasants find a good deal of it covered with the Sea-Weeds and Sands. In plowing likewise, and digging near the Sea, they frequently light upon it, without any farther Trouble; so that formerly it was sold there at a very low Price.

But none of the maritime Provinces upon the *Baltick*, is so rich in *Amber* cast up by the Sea, as *Prussia*, nor is it dug up in such Quantities in any other Country; so that the *Electrides* of the Ancients might more justly be placed here than any where else. I have had Pieces, which were found accidentally, brought to me from *Sambia, Natangia, Hockerland* and *Pomerania*;

rania; some too that were discovered near the Towns of *Holland* and *Leibstat*; as also some dug up in the Country of *Lituania*, and from *Varmien* and *Elbing*. Some time ago, a Friend of mine, who was a Consul, told me, that in the Year 1641, in a Wood called *Kerbswald*, in the District of *Elbing*, in a very moderate Space of Time, there was dug up seven hundred Pounds Weight of *Amber*; and my Friend gave me lately a very beautiful Piece, which was got in the same Place. I have some Pieces too that were found upon the Banks of the *New Lake*, and that of *Courland*, as also of the Rivers *Pregelas*, *Vistula* and *Elm*. Wherefore, I make no Scruple to affirm, that *Prussia* is founded, as it were, upon *Amber*; especially as the Fountain, which burst out all at once, near the Town of *Barenstein*, in the Year 1666, threw out such a Quantity of *Amber*, as to increase the King's Revenues; which most certainly was tore from the Bowels of the Earth, and never had seen the Sea.

After *Prussia*, *Pomerania* comes next for producing of *Amber*, especially upon the Sea Coast, along the Shores of the Electoral Districts, and consequently those of *Oliva* and *Dantzick* to *Neria*, lately so called. A great deal of *Amber* is thrown out upon this Coast, by the Violence of the Waves, and is purchased of the Senate, at a reasonable Rate, by the *Amber-Workers* of *Dantzick*, who have a considerable Profit upon it. This Treasure is spread as far as the Island *Rugen* upon the *Baltick*; and near *Hiddensee* I have seen it both gathered and dug up. Neither are the Inland Parts of *Pomerania* void of this Commodity; for the Peasants frequently light upon it in that Country, when they are labouring the ground: So that *Pomerania* may dispute it with *Courland* and *Samogitia* for Plenty of *Amber*.

I have said before that *Prussia* every where produces *Amber*, but especially the Shore which is situated in that Part which is called *Sambia*, from *Neve Tils* to *Vrantz Vrug*, about ten German Miles. This Seat of *Amber* was formerly divided into seven Recesses, as the *Angles* commonly term them, viz. *Kreeke*, *Nodums*, or *Nodems*, *Lassniaken*, *Kuckse*, or *Kuyck*, *Paimenick*, *Nempe*, *Sbierskeim*. *Nempe* goes, at present, by the Name of *Kray-äpellen*, or *Crapellen*, between *Paimenig* and *Subenig*, and *Tbierskeim* more frequently by that of *Burster*, and there are others besides these now reckoned into the number. The whole Shore is surrounded with high Mountains, and a shallow Sea, at first three or four Fathoms deep, presently after thirty or forty, then shallower again, and afterwards very deep; whence you may have a Notion of the *Flats* or *Sbelves*, which render the *Sudavian* Shore, and its Sea-Port *Bruster* infamous amongst the Mariners. Those Recesses, some of which are very high, rugged and steep, and others rise more gently, towards *Pillaw*, terminate in a Plain. The Ground is not firm, in some Places concealing Water under it in such a manner, as that Men and Horses have been swallowed up as in a Gulph, as they say. The greatest Part of it is covered with Sand, and some little Spots have Herbs, viz. *Butter-Bur*, *Eringo* and *Bur-Dock*. Trees and Brambles are scarce here, but at *Bruster* they have Woods, Part of which sometimes sink with a Portion of the Mountain. There are no Rocks nor Stones, except at the Roots of the

Mountains, and from their Tops flow down Water diffused here and there, which being collected below, form little Rivulets. In the Bowels of this Shore, whose Outside we have now described, there is abundance of Minerals. Here are several Kinds of *Vitriol*; in some Places it has white Streaks intermixed with a black Earth; in others it resembles melted Glass, laid *Stratum super Stratum*, with woody Fibres shining through it here and there; and in others it seems mixed with a shining kind of Dust. Besides the *Vitriol*, there is an Earth mixed with Bark, of which there are whole Hills, and Wood which divides the Mountains on the Shore, a long Way in the Middle. There is likewise a yellow Earth, like Ockre, and a blue Clay spread upon the Shore at certain Distances. Amongst the Stones the most remarkable are the *Dactyli Fidei*, dispersed amongst the Rocks and Sands, and dug too out of the Mountains. The Rocks near the Sea, in one Part, are very hard, and in another very brittle. I found likewise petrified Wood there, and Stones covered with Sea-Weed of both Kinds. I pass over various *Lusus Nature*, which I observed there. Besides the common Stones, this Shore discovers sometimes both *Adamant* and *Jasper*. The neighbouring Plains are extremely barren; the Woods are very rare, and no Pines. I must add, however, that there are Herds of Seals frequently seen basking themselves, and playing together upon the Rocks and Shelves, or Sand-Banks near the Shore.

Upon this Shore there is *Amber* found amongst the Sands and Stones, but it does not appear that it is bred there, far less that it is produced from the Sea-Weed, although little Pieces are often wrapt up in it, when it is thrown out upon the Shore. And though it is found every where in the Bowels of the Mountains upon the Shore, blended, as it were, with the *Crystals* of the *Vitriol*, with the yellow Earth, with the Sand, and the blue Clay, yet we are not to imagine that it is generated from these. What is found in the *Vitriol*, yellow Earth and Sand, is but seldom met with, is always very small, and of very little Value. That which is got out of the blue Clay, is not sufficiently proved yet, being so difficult to come at, although the Peasants tell you of a great deal of very fine Amber found in it; and having broke a Bit of the Clay, I could observe the Fœtus of the Amber, so to speak, wrapt up in a thin shining Bark, of a deep yellow Colour, which I still keep in my *Museum*, amongst the valuable Presents of Amber from Nature.

But as the barky Earth and, besides it, the Wood divides this Shore, so the Experience of many Years confirms, that the Wood which divides the Mountains is productive of Amber. And its Course the Diggers search out and observe, and always find their Account in it, as long as the Firmness of the Ground will allow them to pursue it. The barky Earth contains only Pieces of Amber, that are small, less solid, and of an ugly Colour. But the Wood is by no means to be derived from the Trees which grow here; for such prodigious large Trunks, lying flat, and stretching their Roots and Branches a great many Fathoms round, are not to be seen any where else. Neither is it like the Wood of Trees; because there are no Signs neither of

Pith

Pith nor Bark, and there are no Divarications or Knots of the Branches, nor Stalks for Leaves. Neither is there any Change of Fibres, but they are all alike in every Part of the Trunk; not to mention that it appears of a woody Structure, but not to have grown in round Layers of Fibres, but rather plain.

But your *Connoisseurs* have, long ago, left off admiring subterraneous Woods, after a great many different Kinds of them dug up in *Europe* were submitted to their Examination. *Franciscus Stellutus Lynceus* describes a Kind of Wood, found in the Pits in the Dukedom of *Spoletto* or *Umbria*, very elegantly waved, and fit to exercise the Genius's of Artists, first discovered by Prince *S. Angeli Frederick Cosius*; and *P. Kircher* mentions the same. Another Kind of fossil Wood of *Germany*, was discovered by the Industry of *D. Pillingen* in *Misnia*, who explained the Production of it in a learned Commentary. I have a Piece of subterraneous Wood transmitted to me from *Lunenberg*, which is both more solid and heavy than that of *Prussia*. But I have been made acquainted with the Wood dug up together with the *Amber* upon the *Sudavian* Shore, and in the inner Parts of *Prussia*, by Letters from several Friends, which I can very well give Credit to. And *Bartholini* and *Berricbeus*, whose Testimonies I make no doubt of, mention both Barks and Wood dug out of the Pits at *Copenbagen*, out of which there was got Amber in considerable Quantity. And a happy Omen of Success is taken from the Fragments swimming upon the Coast of *Neringa*.

But of the Matrix of Amber, I have discovered, by Experience, these Beginnings or Rudiments. The little Hills here and there upon the *Sudavian* Coast, especially at *Kraxteppelin*, which, at a Distance, look like Earth, when you approach nearer them, seem to be nothing but prodigious Heaps of Barks laid upon one another. The upper Part, being dried by the Sun, is greyish; and that being removed, there appears next an Earth of a pithy Blackness, bound together with great, smooth, shining Crusts, and upon cutting it with a Knife, it seems to be only a Mass of a great many soft Barks. At the Roots of these little Hills, there is a slabby Earth, fastened with a gluey tenacious Liquor; it retains exactly the Impressions of the Hands and Fingers, and makes them black when you touch it. I judge this baky fat Earth of these little Hills, to be the Original of the fossil Wood of *Prussia*; nor does this Wood differ from these Barks, except in Driness and Solidity, which makes it more compact, its Fibres thereby adhering more closely to one another. For these little Hills of Bark are produced from the moist tenacious Earth above-mentioned; and this, after the Sea-Water, together with other subterraneous Salts, has macerated and subdued it, the superfluous Liquor being separated from it, is dried by the Air or the Heat of the Sun. But those Parts, whose Oil is either exhaled, or driven more inwards, being dried separate from one another. Others again, which abound with this Glue, cohere mutually, compacted into Crusts, and resemble a kind of Wood, when a sufficient Driness has made the Crusts so cohere, as to put on a ligneous Appearance. But that both the Bark and Wood is of a bituminous Nature, not only the earthy Oil, but the Fire demonstrates.

monstrates. For if you set them on fire, it spreads through them immediately, and they strike your Nose with a strong Smell of Sulphur; and if you distil them, as we shall see below, they yield some oily Particles, which smell like Petroleum or Stone-Oil, and besides, the distilled Liquor exhales something oily of the *Amber* kind. After the Bitumen, the subterraneous Salts promote the Production of the Barks and Wood; for to these is owing the Driness and the Form of Crusts, seeing they adhere intimately both to the Wood and Barks. We have shewn above, how the Vitriol surrounds entirely the Barks, and grows intimately together with them. The other Salts cannot be so plainly demonstrated; I have found, however, in the Interstices of the Barks of the driest Woods, sparkling saline Stars and shining Threads, having no Resemblance of Vitriol, but either quite insipid, or somewhat sweetish, and very gently astringent. By pouring Water upon them, I have extracted these saline Stars, and the Lixive thereby produced was of a sweetish Taste like Alum, or rather like Steel; but at last, however, you might perceive something of Vitriol, which, upon the Lixive's being inspissated, became still more evident, but still joined with something sweetish like Allum or Steel. I some time ago discovered Nitre too concealed in this Wood, the vitriolick Particles being first taken out of it by a strong Lixive; although there seems to be Nitre mixed too with the *Prussian* Vitriol; and perhaps these Stars and saline Threads mixed with the Fibres of the Wood, are of the Nature of Nitre. Allum likewise lies concealed in the Crystals of Vitriol, if you do not allow those to be quite aluminous, which are laid *Stratum super Stratum* on one another, and appear like *Earth-Flax*, or *Alumen Plumosum*; for the acid Taste of these comes very near to that of the volatile Salt of *Amber*.

The *Matrix* being known, and the *Bitumen* and *Salts*, with which it is impregnated, it is easy to conceive in what manner the *Prussian Amber* is produced. You must imagine the Ground in *Prussia* to be every where bituminous; for there are frequently large Pieces of concreted *Bitumen* found accidentally by the Peasants, in the Earth or Mud. I myself have seen a Piece of some Pounds Weight dug up out of the Mud, not far from *Koningsberg*. Nay, I am credibly informed, that small Streams of Oil have been known to issue out there, and bituminous Turf is dug in most Parts of that Country. The subterraneous Heat then, in the *bituminous* Soil of the *Sudavian Coast*, gathers together, from all Quarters, the more subtle Particles of *Bitumen* dispersed under Ground, and forms them into Drops; but especially it collects those from the cortical or woody Matrix, and, at the same time, penetrates the neighbouring Salts, and carrying their *Effluvia* along with it, unites these with the *bituminous* Drops. The saline *Spiculæ* being driven, as it were, into the *Matrix*, stop the Fluidity of the *Bitumen*, and, if there are no Supplies of *bituminous* Drops afforded by the Heat, this Clod serves for a Rudiment, which takes its form within the Wood where it happens to be placed, and all Motion of the Exhalations being entirely quieted, and the Heat dissipated, the saline Particles recover their Rigidity, and the watery Parts of the *Bitumen* being exhaled, these combined together produce the *Amber Gem*, which

is bright, splendid, fragrant, and solid, according to the Purity and Proportion of the *bituminous* and *saline* Particles. This is the true Generation of Amber, which has never been explained to the learned World till now.

There remains, however, a Doubt still with some, whether the *Amber* thrown out by the Sea, is generated the same Way as the other? But as it is known to every Body in that Country, that the Amber is produced from the Hills upon the Sea-Coast, torn by the Violence of the Tempests, and then cast out upon the Shore, so that they can judge whether to expect a great, or small Quantity of it, in proportion as they see these Hills more or less torn; when it is certain, I say, that *Amber* is generated in these Hills, what other Method of Production will be more likely? There is no doubt, but the Hills under the Sea, in that Part, are stored in the same manner as those upon the Shore; and there is Plenty of fossil Wood thrown out by the Sea, as well upon the *Sudavian* as the *Neringian* Shore. And what if those Hills are covered with the Sea, which were once a Part of the dry Land? If other Minerals too are generated the same Way in Hills under the Sea, why not Amber likewise? But though Amber has happened to be produced without a woody Matrix, in blue Clay, in a cortical, yellow, sandy, or vitriolick Earth, yet this does not alter the Method of its being produced; for these Pieces were generated the same Way as the others, from *bituminous* Exhalations concreted into Drops, with a due Mixture of Salts. Neither is the native Seat of *Amber* to be placed always wherever it is found; for it is frequently thrown out in Places distant from those where it is produced, being torn from its *Matrix* by the Violence of the Sea. Nay, I have known *Amber* found lying in the Stomachs of Animals; and I have some of that Kind sent to me from my Friends; but I would not conclude from thence, that Animals generate *Amber*. I have been informed, by the People who live upon the Coast of *Sudavia*, that all Kinds of Animals, both those of the Land and Water, and Fowls, greedily swallow down Pieces of Amber, which are therefore frequently observed in their Bowels when they are killed. Both Crows and Ravens devour it so plentifully, that they are obliged to throw it up again in the Evening, and a great many little Bits of it are found amongst their Excrements, under the Trees upon which they roost. I have met with several Pieces that had been swallowed by Stock-Fish, the most remarkable of them was three Inches long, and two broad. There is an extraordinary Ball of *Amber* taken from a Sheep, covered over with a Crust of *Parget*, from the Mucus of the Stomach, which being imprudently rubbed off by the Amber-Polisher, appeared to be composed of several Pieces, formed into one by the Heat of the Animal.

Both Sea and Land then bestow the Gift of *Amber* upon *Prussia*; but what comes from the Sea is partly gathered upon the Shore, and partly drawn up out of the Water. Where the Sea is sufficiently shallow, the Peasants rake the Bottom of it with little Baskets made on purpose, fixed to long Poles, or turn the hollow Side of the Basket opposite to the Current; and what is got this Way is said to be drawn up. The rest, which is thrown up by the Tide, and was discovered by its swimming at Top, is carefully separated from

from the Sea-Weed, Twigs of Trees, or Sand, and is called *gathered Amber*.

That Amber again which is dug up from the Earth is called *Fossil*; and in order to come at it, they fix a long Hook, like a Scythe, to a very long Pole, and this they strike into a Vein, wherever they see it, in the Ridges of the Hills upon the Shore, trying if they can light any where upon the *Amber* in the Wood, and as soon as they have found it, they gently pare off the Wood; which being done, they take out the Piece of *Amber* and put it into a Bag, which they hang about their Necks. But digging into the Veins of the Mountains, which was unknown in former Ages, was begun first under the Direction of *Frederick Wilhelm*. Nor is the Shore fit for being dug into every where, but only certain Districts of it, *viz. Eross, Gubnicken, Ekrofs, Dirschkeim, Warnicken, Strobschnec* and *Palmnig*: And wherever the woody *Matrix* appears, and there is an easy and safe Access to it.

Amber, when it is first taken from its *Matrix*, as I have had occasion to observe, by seeing it dug, is hard and very solid. It happens some times to be broke in digging, but then it is faulty; for some *Amber* is a great deal harder than other. Several Authors formerly, and even at this Day affirm, that they have seen *Amber* hard in one Part, and soft in another: But what I have seen of that kind did not resemble *Amber*, neither in Smell, Taste, nor upon being burnt; and therefore I suspect it be only a *Bitumen* which happened to be dug up accidentally with the *Amber*; on which Account they have referred it to the Class of *Ambers*. But at that Rate both the Pitchy *Bitumen*, the Fossile Coal, and those Shreds which are found covered over with Pitch, with a great many other Bodies which are cast out upon the Sea Shore, ought all to be reckoned under the same Class of *Ambers*. What has given Rise to the Notion of soft *Amber*, is owing to the Opinion which some have of the Sources of a Liquid *Bitumen* in the Bottom of the Sea, which is hardened into *Amber* by Means of the Sea-Water. But those who are mostly employed about *Amber*, all of them affirm, that neither in digging nor gathering, nor drawing it up from the Sea, do they ever meet with it soft. I have carefully examined great Heaps of unpolished *Amber*, as it comes from the *Matrix*, but never could light upon one Bit soft, that was able to stand the Trial of an Examination. It is a common Opinion, that the Difference between the Fossile *Amber*, and that taken out of the Sea, consists chiefly in the Hardness, Purity, and Crust. But they are deceived who believe this: For by lying buried some Time after it has been taken from its *Matrix*, it loses both of its Hardness, and Colour, and a thick Crust grows over it; but these Accidents by no Means demonstrate a Difference in the native *Ambers*. I am very well persuaded, that the *Amber* produced in the Hills under the Sea, as well as that on those upon the Shore, is good or bad according to the Quantity and Efficacy of the *Bitumen* and *Salts*.

In forming the Lumps of *Amber*, Nature shews a great deal of Fancy and Variety, so as to make them resemble Pears, Almonds, Onions, Peas, and other Kinds of Fruit, or Outlandish Bodies, and these are called Drops by the Polishers of *Amber*, because they are mostly of a roundish Figure. But the

the Painting upon it when the Crust is taken off, is still more admirable. I have seen a great many Pieces, that were fairly lettered ; and I have one myself with the *Latin S* very distinctly writ upon it in white, and all the rest of the Piece is yellow. Some of them express roughly the *Arabian* and *Hebrew* Characters, and in others you may see represented Shrubs, Leaves, Clouds, Rubbish, and almost every Thing you can think of. I have one where there is the Picture of an old Man done as well as you could wish, holding a Child lying upon his Arm, which Picture done by Nature, when I first saw it, put me in Mind of little *Jesus* in the Arms of *Simeon*.

Those Things which are found concreted with *Amber*, I think deserve likewise to be taken Notice of here ; amongst which the Stalks of Sea-weed, both the vasicular and the slender Kind, formerly fixed to their Roots, and sprouting out from the *Amber*, ought not to be passed over ; as also small Flint-Stones, with their Points sticking out, and all the rest quite involved in the *Amber* ; so likewise Plates of Iron, Pieces of Wood, Shell-Fish, and various other Bodies which are found concreted with it.

But those little Animals which are found buried in *Amber*, and are taken Notice of both by *Pliny* and *Martial*, require a more attentive Examination. In the *Amber* which I have by me, I can number above thirty different Species of Insects, as Flies, Spiders, Gnats, Ants, Butterflies, Bees, Hog-lice, Moths, Weazels, Canker-worms, Beetles, and some of the horned and gilded Kind, whose Names I have forgot. Some Authors mention more perfect Animals being found buried in *Amber*, as Frogs, Lizards, and small Fishes ; but I can hardly believe it. That famous Story of *Herman's*, of a *Frog* and a *Lizard* being buried together in *Amber*, I suspect the Truth of, on several Accounts. That Fishes have been inclosed in *Amber* by Art, has been observed by former Authors. But you may distinguish those Creatures which are buried in *Amber* by Nature, from those which are inclosed in it by Art, thus, *viz.* those which are done by Nature, lie near the Surface of the *Amber*, whereas those which are done by Art are in the Middle of the Piece ; for the Workers in *Amber* could not conceal the Artifice so well if they hollowed the *Amber* near its Surface, and so put the Insects into it ; because the Crust being thin and transparent, would discover the Trick. If you observe the *Amber* too in which Insects are buried to be solid, pure, without any Fissures in it, or distinct Crusts, you may know that it is not the Work of Nature ; for I have observed a thousand Times, that the most Part of those Pieces of *Amber* which have Insects contained in them, cohere cortically, or are intersected with Fissures here and there, out of which Part of their *Exuvia* is sometimes exposed externally. Neither is the Position or Condition of these Insects always the same ; for some of them are obscured by their Position, others of them appear very plain, and some of them have a shining Cast from the *Amber*. I have two Bees, a Canker-worm, and a Weazel's Nest hid by their Position ; the Beetle glistens, and some of the Flies shine. Besides, you will see some of them appear lively, and others of them languid ; nay, some of them as if awaking and attempting to extricate themselves from their Bonds ; and there are some Pieces where you can examine the whole Insect distinctly.

Hence has arose that troublesome Question of the curious, how come Insects to be involved in the *Amber*? Several Authors perplexed with the Difficulty of answering this Question, will have *Amber* to be produced from the Juice of a Tree, and so these little Animals creeping upon the Trees are easily entangled in the *Resins* or *Gums*. But in this Opinion they are not supported by Experience; for, if I am not mistaken, there are very few Insects, if any at all, that have hitherto been discovered inviscated in this Manner in *Resins* or *Gums*. We see them indeed adhering externally to these Substances, but not involved in them as they are in *Amber*. Others again have been driven to this Point to deny that they were real Insects, but only delusive Appearances resembling them. But upon breaking or washing the *Amber*, this Opinion was refuted, evident Tokens of the Insects still remaining; for although the Force of the *Bitumen* so subdues the slender Bodies of these little Animals, that they become quite of a Piece as it were with the *Amber*, yet you may still observe the Remains of an extraneous Body; and the Exuvia of the Bees which I have in *Amber*, with their Bowels quite consumed, make that evident to the Sight.

In order then to account for that Fate, which Insects meet with in *Amber*, we must remember, that it is usual for them in stormy Weather, or upon the Approach of Winter, to seek Shelter every where in Caves and Holes of the Earth, and there to lie concealed in a State of Sleep. As then several Kinds of Insects shelter themselves in those Places nigh the Sea-Shore, and are obliged to remain there some time, or fall sound asleep, the *bituminous* Exhalations being collected into a Fluid, when this Liquor drops into the *Matrix* of the *Amber*, which now serves as a *Dormitory* for these little *Insects*, it inviscates and covers them over, and displays them thus contained in it. After it is become *Amber*, sometimes those little Creatures, thus confined in their *Dormitories*, happen to awake by means of the subterraneous Heat, or involved in the bituminous Fluid while awake; but as it is impossible for them to escape even while in this State, they are obliged to suffer the same Fate with those that are asleep, but so as they leave the Tokens of their having been awake, by a more lively and animated Representation of their Bodies. To strengthen this Opinion, the most part of Insects that are found buried in *Amber*, are of that kind that retires into Caverns to sleep. The greatest part of them too appear languid, sleepy, or drowsy, through the *Amber*. The more lively ones again, which seem as if they were struggling, or expanding their Wings, in order to get away, these, I say, are a great deal rarer than the others. But I don't think, that such a Vivacity as is required in Coition, is at all suitable to that subterraneous Habitation, and therefore I should be very apt to suspect those, who shew Flies and Knats copulating together in *Amber*, as wanting only to put a Trick upon me.

I come now to examine a more beautiful Kind of *Amber*, containing in it little Branches or Twigs of Plants. I have a Piece with the Leaves of the *vesicular Sea-Weed* spread out, in some measure resembling the Wings of an Eagle expanded, together with the Feet and Body. There is another with

a Seed of the Tile Tree, and Part of a Twig of it; another contains a Husk gaping, with the Leaves turned back, having in it four Seeds, with a middle Apex rising up from them, the little Calix extending as far as the Surface of the *Amber*, and prominent. Another contains Moss in it, woven in the Form of a Vault. In another there is a very small Flower decayed. In another a small Branch with three Leaves of the wild Rosemary, called by the *Prussians* *Korbi*; and another which is not polished, has in it a large Branch of the *vesicular Sea-Weed* abovementioned. There are severals of Moss representing ruined Towns. But one of the noblest is that, in which the white Part represents a Valley and little Hills covered with Moss, but as it were by the Means of a Mirrour, the Reflection of the fiery Colour of the yellow *Amber* from that Part serving as a Glass to represent this beautiful Sight so, as that the Moss might have a more elegant Appearance: Nor is that one to be despised of the Colour of Milk and Water, which is distinguished by a Group of little mossy Villages. I look upon these *Amber* Monuments of Vegetables as more to be esteemed than those of the Insects. Those Pieces with Barks of Trees, Pieces of Wood, and Shoots of Plants, are still more numerous. There are Shoots of Pines, in Form of those which the Ants build their Nests with; but upon an accurate Examination, you can discover the Marks of the Fossile Wood and Bark.

There are likewise found *Minerals* inclosed in *Amber*; very often *Vitriol*, which is easily discovered by the Taste: Sometimes the *Marchasite*, but more frequently *Iron*, which the Polishers of *Amber* complain much of, because they cannot take it out without spoiling their Instruments. There is likewise something of *Gold* and *Silver* found sometimes in the unpolished *Amber*, upon separating those Pieces that were adhering to one another: Nay, there are Pieces of *Amber*, which contain Drops of Water within them, in some of which, when it flows out, it tastes saltish, and sometimes insipid; and it increases and decreases with the Moon, according to some People. I have one in which the Water is dried up, and another in which it remains still the same. But whatever Parts, either of Plants or Minerals, are found inclosed in *Amber*, I imagine they have probably dropt accidentally into the *Matrix*, and so have been inclosed in the *bituminous* Fluid. The Manner how Drops of Water came to be inclosed in *Amber*, has something singular in it, which I take to be this; the warm *bituminous* Exhalation surrounds a moist *Matrix*, and the Water being drove inwards, cannot be consumed by the subterraneous Heat, while, upon account of the *bituminous* Fluid that surrounds it, it can find no Chink whereby to make its Escape, and therefore it must necessarily be confined in the *Amber*. There are some Pieces of *Amber*, where you plainly see the Marks of the Water attempting to get out after it was confined.

I have declared *Amber* to be of the fossile Kind; but it is not to be ranked with *Metals*, because it is neither ductile, nor can it be melted; so likewise after it has been by any means dissolved, it loses much of its Solidity, which is not the Case with *Metals*. There have been some who have affirmed, that they had the Art of melting *Amber*, and uniting several small Pieces

Pieces into one Lump, without hurting its Solidity. But I found out this to be false, when I was engaged in melting of *Amber* by various Experiments; for the Force of the Salts, upon which the Solidity of the *Amber* principally depends, flies off in dissolving it, nor is possible to hinder it, without adding something else which impairs its Solidity; but if such a gentle Heat as that of the animal Body could be applied and continued, I believe the Affair might be brought about. For that Ball of *Amber*, that was found in the Stomach of the Sheep, is composed of several small ones, as you may see by the Marks of their joining every where remaining; which shews, that the Heat made use of by Nature, was not of the melting Kind, but very gentle, so as to glue them gradually together. Fused *Amber* with which Skeletons, and extraneous Bodies buried in *Amber* so much boasted of, are done over, is a Varnish, as my Friend Mr. *Vogeding* very well observes. I melted *Amber* long ago with the Heat of the Fire alone, without mixing any thing else with it, but I found it became more brittle, and its Colour less beautiful, occasioned by the fine saline Particles which escaped, and stuck to the Sides of the Vessel. But *Amber* is still less to be referred to the Class of *Earths* or *Salts*, because it coheres more than *Earths*, is fatter than *Salts*, and moister than either of them; it approaches nearer to *Bitumens* and *Sulphurs*; but its Hardness distinguishes it from these, for no Body can shew pure *Bitumens* or *Sulphurs* so hard and solid.

But *Amber*, on account of its Hardness, is placed amongst the *Stones*, and for its Splendour amongst the *Gems*; neither can its Brittleness be any Obstruction to this; for the *Agate* is brittle, and *Gems* differ from one another in Solidity, yet still are retained in the same Class. Your Polishers of *Amber* find it sufficiently hard, especially the white Sort, so as to blunt their Tools; and the small Cannon and Mortar made of it by way of Toys, which bear the Force of Gun Powder, shew its Solidity. *Amber* too is chiefly valued according to its Hardness and Solidity, that which is brittle, being in no Esteem at all. But that which properly distinguished *Amber* from other *Gems*, especially amongst the ancients, was its attractive Quality; so that those Bodies which had the Power of attracting, were called *Electrick*, which Term *Plato* himself has been at Pains to explain. But the Moderns, who have been at more Pains in making Experiments in natural Philosophy, have found, that the Power of Attraction is common to other *Gems*, *Stones*, *Glass*, *Bitumens*, *Resins*, *Sulphur*, *Asphaltum*, and *Lack*. *Amber* however attracts stronger than other *Gems*, because, upon rubbing, it sends forth a greater Quantity of oily and tenaceous Effluvia: For that this Quality is owing to the oily Particles, I am convinced from an Experiment which I made upon two Pieces of *Rosin*; one of which, after the Oil was distilled from it, still retained something of its attractive Quality; but the other, after all the black Balsam was distilled from it, although it appeared shining, and as it were glossy, exerted nothing of an attracting Force; because the first still retained something of Oil in it, while the other was quite drained of it like a *Caput Mortuum*. The Ancients excepted some Bodies which it could not attract, owing to the surprizing Qualities of Sympathy and Antipathy,

pathy, which however was not just; for I can demonstrate both Basil, and oily and moist Particles, and even Drops of Water, to be attracted by *Amber* at pleasure, provided the Piece you make use of for the Purpose, be large enough, and well polished. 'Tis a beautiful Sight, when the Effluvia entering the Water, the Drop rises up into a Bubble, or when it jumps over to the *Amber*. But *Amber* acts by this Quality upon the human Body likewise; for upon tying a Bit of it about the Neck, you will perceive the Part that it touches, though it is but slightly, covered with a gentle Sweat. Mr. *Boyle*, formerly the Honour of *England*, the first learned Nation in *Europe*, told me, and affirmed it to me for a Truth, that a young Lady of Family, upon wearing a Set of large Beads, of milk white Coral about her Neck, was seized with a Tremor and Convulsion of her Mouth, which always came upon her whenever she wore them, and went off again as soon as she laid them aside. But the Efficacy of *Amber* in attracting the Humours in Issues, has been experienced by some People, who use Peas of it for that Purpose.

There is a Fragrancy proper to *Amber*, such as none of the *Gems* exhale; nor does any of the Aromatick Tribe scatter such a Flavour, neither Frankincense, nor Myrrh, nor Camphire, nor Mastick. You have something like it from the Balls of Resins found in the Nests of Ants, but upon rubbing and burning them, you immediately discover the Difference. There is a Difference of Smell between the yellow, or fiery-coloured *Amber*, and the white; the first being oily, and therefore more bland, whilst the Effluvia of the other are salt, and more acrid, and therefore affect the Organ of Smelling differently. Taste likewise is peculiar to *Amber* amongst the *Gems*, and this too is different, according to the different Mixture of oily and saline Particles; for the white is pungent to the Taste, while the other is not so. It differs from most *Gems* too in the Variety of its Colours; there is none of it black, very little of it opaque, and it shines in the Class of pure pellucid *Gems*. Lastly, you can hardly name one of them equal to it in Smoothness.

But its chief Virtue consists, in its salutary Effects upon the animal Body, in which none of the *Gems* is able to come near it. It is wholesome even crude, without the Assistance of Art, whether it is taken inwardly, or externally applied. The *Indians* and *Chinese* are so fond of this Perfume, that they use it by way of Luxury. Every body knows, that Fumigations of it are serviceable in Catarrhs arising from Phlegm; and the *Amber Polishers* at *Koningsberg* attributed it to the alexipharmick Exhalations of the *Amber*, that they remained free of the Plague, when it was there. Certainly there is no Fumigation more efficacious against Contagion, than that from *Amber*; nor has it been known, that unwholesome or pestilential Vapours have burst out at any Time from the Pits upon the *Sudavian* Coast. The white polished *Amber* is of great Service in Defluxions of the Head; being tied round the Neck, it draws back the Humours. The yellow *Amber* is useful rubbed upon the Eyes; and in Issues little Balls of *Amber* are sometimes of Service, as I observed before: When powdered, it is of great Use to promote the
Discharge

Discharge of Urine, to propel the Stone in the Bladder, and assist in bringing down the Menstrua, when other Circumstances are favourable, as daily Experience teaches us. I had a Present of a Stone from a Lady weighing several Ounces, upwards of two Nails in Breadth, and three in Length, which had lain in the Vagina of a Country Woman for the Space of three Months, and gave her very great Pain, upon giving her white *Amber*, to the Quantity of a Spoonful, she was freed from this troublesome Guest, and I had her brought to me to examine her, that I might know the Case more thoroughly. The Powder of *Amber* too, infused in Wine, and afterwards boiled in a close Vessel, then the Wine drank warm, is serviceable in Obstructions of Urine, the Calculus, and promoting the Menstrua, though it is not so efficacious as the Powder itself. The white *Amber* is best for the above Purposes, because the Virtue of the Salt is strongest in it.

The resinous *Magistry* of it is very wholesome in Form of Pills, and nothing inferior to *Balsam Copaivi*, either for promoting the Discharge of Urine, generating Mucus, or mitigating a Gonorrhoea; the same likewise is good in cephalick Plaisters. The Resin of it is useful, mixed with Diaphoreticks, and in stomachick Plaisters; it is also of great Service against the Palsey, Apoplexy, Epilepsy, and in preventing Mortifications; and the Price is but small. The Oil of *Amber* rubbed upon the Joints weakened by the Gout, strengthens them, and has been famous both over *Europe* and *Asia*, but by the Imprudence of Quacks has fallen into Disgrace, because they have frequently hurt their Patients, both in the Gonorrhoea, Stone, and Suppression of the Menses, by giving too much of it; for the Dose ought to be but small, a Drop or two being sufficient to saturate some Drachms of Sugar. In a cold pituitous Brain, one Drop received upon Cotton, and rubbed upon the Crown of the Head, or Sutures, cures it; or applied to the Ear, removes Noise and Tinkling. It restores Vigour to the Parts almost mortified with Cold, and assists in difficult Labours, as even the old Women in *Prussia* have observed, though they use the Powder mostly in those Cases. The best Oil of *Amber* is that, which is light, free of all Empyreuma, whitish, subtile, and very fragrant. The volatile Salt of *Amber* is very much cried up against the Epilepsy, and other Diseases of the Head arising from Phlegm; and it is likewise an excellent Diuretick. The *Essence* of *Amber* is the more subtile Portion of the Oil, and therefore it will have the same Effects with it; but if it is mixed with Spirit of Wine, it may be taken in larger Quantities. This is likewise of Service outwardly, in preventing Mortifications. The *Phlegm* too is reckoned amongst the Class of Medicines by some, but any Virtue that it has, is owing to the Remains of the Oil and Salt in it, which, when intirely drawn off, leave it absolutely useles, and only impregnated with smoaky Fumes. The *thick Oil*, which comes last off in distilling, is only used in cold Diseases of the Joints; for it has a very fetid Empyreuma, so that I should rather think it better to keep from it altogether, and use the *Colophony* instead of it.

I shall only add, that led by a just Analysis of Nature in separating the pure from the impure Parts, with the Help of a gentle Fire, I can unite all the Qualities of *Amber* in such a Manner, as to make it a very proper Medicine both for external and internal Use, without hurting either its native Fragrancy, or the Efficacy of its oily and saline Particles. This I call the *Balsam of Amber*, in which, the more earthy fetid Particles being removed, the more pure and volatile are intimately combined together, without any thing extraneous being allowed to enter the Composition. Whatever can be expected from *Amber*, either crude, or prepared by Art, in what Manner you please, will be produced sooner, safer, and more agreeably by my *Balsam*. Internally it may be taken conveniently in the Form of Pills, or Bolus; externally it may be applied after the Manner of the *apoplectick Balsam*, whose Colour it resembles very much, to the Gums, Tongue, and Palate, in Faintings, Hystericks, Epilepsy, and Palsey, with very good Effect; and it may be taken safely by Way of preventitive, two or three Times a Week, to the Quantity of seven, ten, or even fifteen Grains. So likewise mixed with Anodynes, it is a more certain Remedy than the Oil, in certain Diseases of the Genitals, Kidneys, and Bladder, as also against Noise in the Ears. Both *Hoffman* and *Ebmuller*, have very judiciously joined the Virtues of the *Peruvian Balsam*, with the Oil of *Amber*. But the *Peruvian* will make a happier Mixture with my *Balsam of Amber*, especially against the Gonorrhœa and Fluor Albus, or the Whites.

The Distillation of *Amber* is too well known to need here to be described. Either the Alembick or Retort may be used for this Purpose, but a great deal both of the Oil and Salt escapes through the Chinks, if you use the Alembick; for no Luting in the World is able to restrain their violent Force. The best Way then is to use a Retort, and if you want a Quantity of Salt, take the white *Amber*, if of Oil, take the yellow. From a Pound of *white Amber*, I have had Half an Ounce of *volatile Salt*, which you'll scarce get the same Quantity of from a Pound of the *yellow* Kind. The Oil too will come easier off and be sweeter, if the *Amber* is smooth or shining with a thin transparent Cortex, than if it is rough, and has a thick Crust, or if you use the common Shavings of *Amber*; but you must add nothing to the *Amber*, though formerly they used to mix Sand and Flints with it. You must take Care that the Fire be very gentle, little more than a Sand Heat, and then in constant Order the Æthereal Portion of the Oil ascends with the Phlegm, and is quite limpid. This then you put into a proper Vessel, and as soon as the yellow Oil with the volatile Salt is come over, leave off Distilling.

By persisting in the Operation and increasing the Heat, you may indeed force a thick black Liquor from the *Amber*, leaving only a Caput Mortuum, black and shining like Colophony, by Way of Residuum, but then it is bereft of all the Virtue of the Oil and Salts. Of half a Pound of the white *Amber*, there remained an Ounce of this Caput Mortuum. But it is better to leave the Strength of the Colophony behind, seeing this is more agreeable than the fetid black Balsam. The volatile Salt, which rises up to the Beak of the Vessel, or adhered to its Sides, must be washed with warm Water, and in
order

order to separate the oily Particles from it, the Solution must be filtered thro' wet Paper, through which the Salt passing leaves the Oil behind. The Solution being filtered, the Water must be evaporated, so as to leave only a third Part, which being exposed to the cold Air, there will be formed Crystals of a particular Kind, resembling Millet-Seed, or small Hail-stones. There is another Method too of depurating the Salt, by putting the Liquor into a Glais with a long Neck, and exposing it to a Sand Heat. For the white Flakes or Spiculæ, flying up to the Top of the Vessel, the grosser feculent Parts remain in the Bottom; but this Operation is attended with the Loss both of the Vessel and Part of the Salts. Some People are anxious to separate the Phlegm, but it is better to mix it with Water, which imbibes the volatile Salt, in order to deprive it likewise of its Salt; neither will a repeated Distillation communicate any Virtue to it, unless it receives it from the volatile Salt, nor is the Flavour of the Phlegm grateful, so as it can be recommended for preserving that Salt.

From Half a Pound of white Phlegm, I drew off Half an Ounce, which tasted of Salt of *Amber*, but upon repeating the Distillation, it tasted of nothing but Smoak, and smelt very disagreeably. In the Calaphony, when it is not quite burnt, there is concealed something of Salt; which you can extract by macerating it some Time in warm Water. This by some is called the *Fixed Salt of Amber*, but improperly, because it has the same Virtue with the volatile, the same Taste and Smell. But whatever Kind of Salt this is, the Virtues of the Colophony depends chiefly upon it. As to the Oil, there is no need of another Operation for depurating it, provided you change the Receiver at a proper Time, and the Distillation is right carried on, you will have it very pure at once. The Qualities of the Oil of *Amber* are derived chiefly from *Bitumen*, or Oil of the *Earth*, in which Opinion I agree with *Ol. Borricbius*, but that all the Virtues of the Oil of *Amber* are common to the *Petroleum*, in this I differ from him, for both the Smell and Taste shew them to be different. But the Smell of the Oil distilled from the Fossile Wood, agrees with the *Oleum Petre*, and not with the Oil of *Amber*, and I believe the Difference between these two Oils to be owing to the intimate Combination of the Salts with the Oil of *Amber*. What Kind of Salts these are I cannot determine, but they must be of the same Sort with those which produce the volatile Salt of *Amber*; for there is no *Amber* of whatever Colour, that is without a volatile Salt, upon which its particular Fragrance depends; and the more it abounds with Salt, the more fragrant you will find it when it is rubbed. But though it is rash to attempt to explain the Secrets of Nature, yet I will take it upon me to affirm, that the Salt of *Amber* is composed mostly of the vitriol of Iron; for in the white *Amber* which abounds with volatile Salt, you can evidently discover the *Chalcanthum* both in the Smell and Taste. But I don't at all attribute the *Sal Succini* to common Vitriol, for it is necessary that the Vitriol should be considerably altered, to produce a volatile Salt of such singular Efficacy. But that the *Prussian* Vitriol is of a different Nature from the *Chalcanthum* or red Vitriol of other Countries, will appear below from its Analysis.

That

That this volatile Salt is produced originally from an Acid, its Taste which is acid, and not unpleasent neither, but almost vinous, declares. This grateful Acidity of the volatile Salt of *Amber* brings it near to the Spirit of Vitriol of the Philosophers; it is pungent, not at all corroding, and upon pouring Spirit of Vitriol upon it neither effervesces, nor is wasted, but being mixed with the Spirit of Sal Armoniac, it raises a great many Air Bubbles, and is absorbed with a hissing Noise. This subtle, grateful, and volatile Acidity of the Salt of *Amber*, I attribute to the Influence of the Bituminous Exhalations; in the same manner as Spirits of Wine mixed with those of Nitre or of Salt, renders them so mild, that they are even called sweet. For while the subterraneous Heat collects the dispersed Particles of Bitumen together, these Particles must pass through the Apartments of the Vitriol, and in passing through these will carry along with them more or less of the subtle Effluvia raised by the same Heat from the Vitriol, and convey them to the *Woody Matrix*, where mixing their Seeds together as it were, they produce *Amber* for their Offspring.

The reducing *Amber* to a Powder is an easier Operation again; and indeed it is no great Matter whether you do it by beating it in a Mortar only, or grinding it afterwards upon a Marble; for it will do either Way, as we may learn from the Brutes themselves, who devour little Pieces of it greedily, as I before observed. However, as reducing it to a Powder will make it mix more easily with the Animal Juices, it will be right to prepare it in that Way before we give it. I should pass over the Infusion and Decoction of *Amber*, if these Preparations of it did not justly claim a Place from their being so easily made. It is certain that *Amber* yields its Virtues to Wine by boiling; nay, even by Infusion or Digestion, you can have a medicated Wine of *Amber*. The Essence or Tincture is prepared by pouring Spirit of Wine upon the *Amber*; but that which is made with the pure white *Amber* is not tinged yellow. Whether the Spirit of Wine ought to be strong or weak for this Purpose, is I think doubtful, because the oily Particles of the *Amber* require a strong Spirit to extract them, and the saline ones a weak Spirit: But *Amber* yields to them both, and as after standing in Digestion for some Time, the Spirit of Wine is rendered at last more diluted, I think therefore that the stronger ought to be preferred. You will have a better Tincture, if you infuse the thin Shavings of *Amber* in Spirit of Wine. Some add Oil of Tartar per Deliquium, or of the fixed Salt, or sharpen the Spirit of Wine with these, that the Spirit may extract a Tincture sooner and more effectually, which is well enough judged, only the Tincture by that Means partakes of something foreign. But if you want to extract the Virtues of the *Amber* quickly, and to have the Spirit entirely saturated with it, the best Way is to dissolve the *Amber* by boiling it in a Glass with a long Neck; you can do it too by Digestion, but it requires a longer Time.

Formerly they used to prepare a *Magistery of Amber* by the Help of an Acid, which was not worth the Pains; for if you want to combine an Acid with the Powder of *Amber*, you'll do it much better by rubbing alone. The Tincture extracted with Spirit of Wine, will give a much better Magistery; for this is

resinous, say the true Resin or only Part of the *Amber* a very little changed by being intimately united with the distilled Spirit of Wine.

Some bruised Fragments of the Fossile Wood I macerated in warm Water, the Lixive produced from it was of a sweetish Taste, with something of that of Allum, or rather of Steel, and at last you could be sensible of something of vitriol. But upon inspissating it in order to make the Salt Crystalize, it had more and more of a vitriolick Taste, and the Crystals had the same, except that at first they had a little of the Sweetness of Salt of Iron; and I observed the same again upon repeating the Operation. The Wood thus deprived of its Salt, I put into a Retort, and with a Heat so intense that the Fragments grew red within the Glass; I drew off all the Liquor from it, which was quite milky, like an Emulsion of Almonds, with a fine Pellicle at Top, after standing some time, and Particles like Calx falling to the Bottom of it. It had a strong, disagreeable, sulphureous Smell, which spread all over the Room, but upon putting your Nose nigher the Liquor, you could smell something of *Amber*, not indeed of the fragrant *Amber* itself, or the Oil, but of the Phlegm that remains in the Retort after Distillation. The Taste likewise resembled that of the Phlegm, smoaky from the Empyreuma, and something of a sowerish Saltness. The milky Colour of the Liquor disappeared after awhile, leaving however the fat Palliate behind it. I distilled a Part of this Liquor again, to try if I could obtain any volatile Salt and purer Drops of Oil from it. But there was no volatile Salt ascended, the oily Particles however swimming at Top were more subtle, and did not cohere as before in the Form of a Pellicle. There were likewise some fell to the Bottom like pellucid little Globes, of a fiery *Amber* Colour. A small Portion of the Oil, viz. a few Drops from a Pound of the Liquor, entirely resembled the *Oleum Petræ* both in Taste and Smell. But the little Globules which appeared resinous in the Bottom of the Vessel, upon being gently shaken mixed with the Liquor. The limy Particles were produced from the finer earthy Portion forced upwards by the Fire.

The Wood when taken out of the Retort was of a rusty Colour, exhaled a great deal of Sulphur, set on Fire burnt like Fewel, and had its Surface gently sprinkled over with a fine red Dust.

I exposed it to the Fire for three Hours in a Crucible, and after it was cold it was likewise covered with a fine Dust like Cinnabar: Upon holding a Candle to it, it did not catch Fire so readily as before, neither did it keep it long, nor burn like Fewel, but it smelt like golden Sulphur, and tasted like it too when it was chewed. When it was kindled it exhaled less Sulphur than that which was left in the Retort, and was of a brighter Lustre. I put it afresh into a Crucible for upwards of nine Hours, and then it could not be kindled any more, but like Earth Flax appeared white after having been burnt, and smelt nothing of Sulphur. The Colour of it after remaining so long in the Crucible, from grayish became partly white, and partly splendid; and when examined with the Help of a Microscope, some Parts of it appeared formed like *Scoriæ*, some like *Chrysololla*, and some like *Calx*. I exposed the Wood after it was sufficiently burnt, mixed with the *Gall of Glass*, to a melt-

ng Heat, and they easily run together into a Mass, which afterwards shewed little Grains of *Regulus of Iron* dispersed through it. But as I was trying to unite these little Grains by a stronger Heat into one Body, the Mass melting with the *Regulus*, from black became splendid, and at last turned into Glass.

The native *Vitriol*, both that resembling the *Earth-Flax*, and the other which melted, being rubbed with Iron, discovered itself to be combined not with Copper, but with Iron, for it leaves no Redness, which is a Sign of Copper behind it. The same is confirmed by that resembling *Earth-Flax* after it is dissolved and formed into Crystals; for there is a sweetish and plain Taste of Iron to be perceived in it at first, such as you find in the Salt or Crystals of Iron; but not those that are produced at *Goslar*. But I first cleared the Solution by pouring Urine to it, and the Feaces being removed, there was collected a flaky Earth in them, and the remaining Liquor yielded Crystals of almost a *Sappharine* Colour, with very unequal Angles. But from the Solution inspissated and afterwards filtrated and evaporated, there is produced a white Oil, which being put into an armed Retort, and exposed to the Heat of a Baker's Oven not too violent, in twenty-four Hours it throws off an excellent Oil of *Vitriol*, such as is commonly prepared in the Shops from the Oil of Steel. I could discover, by the Help of a Microscope, a great deal of that Oil still concealed in the *Colcothar*, whence it appears how you are to understand Oils being regenerated in *Colcothar* exposed to the Air.

That the *Cortical Earth* is of the same Nature with the *Fossile Wood*, appeared from examining it by the Help of the Fire. It required to be gently toasted, before I could extract any Thing metallick out of it, although what I did get at last, was but very small. From the *Blue Clay* some time ago by Distilling, I obtained a volatile Spirit that had the Smell of Sulphur and something of Bitumen swimming at Top. But the yellow Earth I said before inclined to Iron with something of *Vitriol* too, as is manifest both from its Taste and Smell.

This Treasure of *Amber* was formerly laid up in the royal Treasury by the Kings, who held the Grounds which produce it, of the *Amber-Gatherers*, that they might equal other Princes in their Munificence. *Solinus*, King of *Germany* (here *Prussia* is to be understood, for *Germany* was never so productive of *Amber*) sent a Present of thirteen thousand Pound Weight of it to *Nero*, not gathered in one Year, but collected in a great many. It was appropriated to the *Regalia* of the Order of the *Crucigeri*, the Bishop of *Sambia* being allowed to have some Share in it, and it was gathered by publick Authority, with severe Laws against those who should steal or embezzle it. When the States revolted, the Revenue of *Amber* being thereby very much lessened, the Treasury of the above Order was considerably hurt by it, though they did all that they could to get the entire Possession of it. After the *Crucigeri*, the Dukes of *Prussia* were at a vast deal of Pains to separate the *Amber* from the Revenue. The Annals of that Country give a better Account of the Affair, than I can pretend to do here: They mention the Peasants upon the *Sudavian* Shore being appointed for this Office, to which were added others out of the Districts of *Schagen* and *Irschhausen*.

They have no set Days for working, but whenever they observe a proper Time for gathering it, they keep to it Night and Day, in Winter as well as in Summer. They have a Salary allowed them, a House with a little Farm, and are free from all Taxes, and have a Measure of Salt for every Measure of *Amber* which they gather or fish up; and for the Overplus of the *fossile Amber*, they are paid in ready Money. The *Crucigeri* called him who had the Overseeing of the *Amber*, the Lord of the *Amber*; and in some Places that Care fell likewise upon the Commanders. Under *Albert* they were called more frequently Masters, and afterwards Lord Chamberlains, being always Knights. At present the Governor of the District of *Fischebausen* takes a Part of this Office, and the Director of the **Feloni* another, together with a particular Surveyor of the Coast. Under the Surveyor there are Horsemen always ready to guard the Coast; and to those are added Foot, who take it in Turns with the Horse, and sometimes supply their Place, when there is occasion.

* *Feloni*
rum.

The Surveyor's Business is to give out Orders what they are to do, to receive the *Amber*, transmit it to *Koningsberg*, prevent its being stole, to judge of what Places are discovered, and to preserve inviolably the King's Right and Authority: It is his Business likewise to distribute Salt to the Peasants. The Horse and Foot ride and run about the Shore in the Day Time, lest any body should steal the *Amber*: They likewise observe the proper Seasons, and convene the Peasants to gather and dig the *Amber*, and receive it at their Hands. None of the Peasants are allowed to carry home the *Amber*, but they deliver it to one of the Horsemen, or some other Person who is intrusted with it; but that which is gathered upon the Coast of *Pilau* and *New Neringia*, is taken off their Hands, by the Clerk of the *Felons*. If they happen, for Want of Time, to have gathered only a small Quantity, they are allowed to carry it home; but then they return it next Morning with an Oath. While they are fishing and digging, they have a Bag tied about their Necks, into which they put the *Amber*, and whoever hides any of it about his Cloaths, is reckoned guilty of Theft. After it is received from the Peasants, it is put into the Hands of the Surveyor, who lays it up in the *Amber Ware-house* at *Koningsberg*, and it is divided and sold in Presence of the Director of the *Felons*. Formerly there were several *Amber Ware-houses* at *Lochstet*, *Dirschkeim*, *Memmel*, and *Germow*, and each of them had an Overseer.

Without the Shores, whatever *Amber* is found in the Territories of the Crown, is given in to the Governors of these Districts, and that in the private Funds, which cannot be lawfully claimed by some Master, must necessarily likewise go to the Revenue; but hitherto I don't remember, that these Funds have had any considerable Quantity of *Amber*.

The gathering of *Amber* at one Time belonged to private Persons, for which they had an annual Allowance of ten or twelve thousand Dollars, besides what was allowed for the Expence of the Peasants: But there came more Profit from it into the Treasury, after it came not only to be gathered, but
fold

sold by publick Authority, a certain Price being put upon each Kind of it, according to Mixture.

The unpolished *Amber* is valued according to the Size and Kind of the Pieces; the capital ones (*Haupt Stuck*) weighing some Ounces, come the dearest; those which are fit for turning (*Dubly*) about the Size of one's Palm, are of less Value; and the smallest Pieces (*Krausis*) are the least valued of all; but Pieces of some Pounds Weight have no certain Valuation. The Purity and Fineness of Colour enhances the Value; the impure (*Diblue*) is the cheapest, and the *Milk-white* the dearest.

The Merchants of *Lubeck* and *Stolpen* first rivalled the *Crucigeri* in the Commerce of *Amber*; and afterwards those of *Dantzick* and *Koningsberg*. At present the Merchants of *Dantzick* have the chief Profit of it, after getting into their Hands the *Prussian Amber*, and the Company of *Amber-Turners* upon the Coast of *Neringia*. The crude *Amber* is sold at a great Price to the eastern People, and the *Armenians* and *Persians* used formerly to transport it from *Koningsberg*, to the no small Profit of the Inhabitants. But the Art of turning *Amber* is still more profitable, being cut into various Figures engraved, or Bodies inclosed in it, so as to be reckoned amongst the most precious Workmanship. It increases the Value much, if it is made of one entire Piece, if the Colours of it are very fine, and the rarest Colours of Nature are superadded.

I was the first who advised them to imitate the *French* and *Italians*, who form the *Amber* very dextrously into Figures of Things and Animals; and it would have succeeded, had the Sovereign given Orders about it, and they had the Liberty of picking out the checquered and mosaick Pieces which are fit for the Purpose; for opaque Colours which are properest for that, rarely occur in *Amber*. And not only the Art of *Turning*, but that of *Pharmacy* might be improved and enriched by *Amber*, seeing your itinerant Quacks get so much Money by adulterated Oils and Balsams of *Amber*. Besides, it is of very great Use in *varnishing*, and nothing inferior to *Lac*, if rightly prepared. The Dyers of Skins too, especially the *Jews* and *Russians*, make Use of it; so that from this Branch likewise the Value of *Amber* may be enhanced.

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 other *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, wherein lay buried a Fly.

That Kind of *Amber*, which yields to the Impression of a Seal, is deservedly reckoned amongst the rarest of all found with us; for except those two Pieces which I have got by me, I have never in all my Life seen the least Bit of it, though I have been searching after it very assiduously for a great

An odd sort
of Amber, by
M. Hevelius
n. 64. p. 206.

n. 66. p. 2023

great many Years bypast; and I question very much, if ever I shall be able to find a Piece of it, that is soft on one Side, and very hard on the other.

White Amber; by Mr. Kirby. n. 83. p. 402. Vid. Sup. Cap. II. § XXIII.

LXVI. The chief Fisher upon the *Inland Poisonous Sea* near *Dantzick*, informed me, that 2 or 3 Years ago fishing in this Sea, his Net brought up a considerable large Piece of *white Amber*, which was a Rarity he presented to one of the chief Fathers of the *Olives Abby*, to which the Sea belongs. Now since this Sea lies 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*, hardened by the *Aqua-aerial* Particles upon it, may receive some Confirmation from this Account.

The Electrical Power of Stones, in relation to a Vegetable Resin; by Dr. Lister. n. 110. p. 224.

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 Resin, like *Venus Turpentine*; though after diligent Search, there appeared no manner of Exudation in any Part of the Cabinet.

Of the many sorts of Stones I there had, divers escaped, but not any of the *Hematites* kind; having therein *Munganes, 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 farther observed that Stones of a soft and open Grain, as well as those of a hard and polished Superficies, were concerned in a manner alike.

It is 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 *Camphire* 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 Effluvia, 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.

A Catalogue of Electrical Bodies; by Dr. R. Plot. n. 245. p. 384.

LXVIII. Not only *Amber* and the *Agate Stone* attract small Bodies, but also the *Adamant, Sapphiro, Carbuncle, the Iris Gem, the Opal, Amethyst, the false Diamond, Bristol-Stone, Beryl and Crystal*; so likewise the *Jacinth, Garnate, the Bohemian Stone, Glass, and Preparations of Glass and Crystal; false Gems, Glass of Antimony and Lead, all the Bitumens of the Pits, the Lynx-Stone, Sulphur, Mastick, Sealing Wax of Gum Lac, hard Resin, Arsenick*, but weakly, and in dry Weather *Sal-Gem, Talk, and Roch-Allum.*

LXIX.

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, tho' 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 Superiors, 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 registered at their chief Colony *Batavia*, which was lately taken in a *Dutch East-Indian Prize*. And it appears by the Paper itself, 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
a Vegetable
Production,
By... com-
municated by
R. Boyle, n.
97. p. 6113.*

“ *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. Where ever 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 it floats on the Sea.

“ There was found by a Soldier $\frac{1}{4}$ of a Pound, and by the Chief, two Pieces weighing 5 Pounds. If you plant the Trees where the Stream sets to the Shore, then the Stream will cast it up to a great Advantage.”

2. An ignorant Fellow in *Jamaica*, about two Years ago, found 150 Pound Weight of *Ambergreece* dashed on the Shore, at a Place in these Parts called *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 it is 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.

*An Animal
Production,
by Mr. Rob.
Tredway, n.
232. p. 711.*

LXX. 1. S. *Boccione* 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 Signior *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 feel whether the *Coral* was soft under the Water, before it was drawn up in the Air, and found it altogether hard, except the round

*The Production
of Coral,
by S. P. Boccione,
n. 99
p. 6158.*

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 called *Fluvialis Pistana Foliis Denticulatis*, spoken of by *John Bauhinus*.

This *Coralline Juice* he calls *Leven*, because, having tasted it himself, as well as the Mariners did, they always found it of a sharp and astringent Taste, in such Pieces as they 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 astringent: 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.

By M. Guifony, ib. p. 6159.

2. M. *Guifony* is of Opinion, that *Coral* is so far from being a Plant, that it is a mere *Mineral* composed of much *Salt*, and a little *Earth*; and that it is formed into that Substance by a *Participation* 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 formed, and increased by the Settling and Combination of *Mercury* and *Silver*, dissolved in *Aqua Fortis*, and afterwards cast into common Water; the Parts of this *Mineral* and *Metal* joining 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 formed. This Sentiment he confirms, by alledging, that he can shew a *Salt* of *Coral*, which being cast into Water, and there dissolved, upon the Evaporation of that Water by a gentle Heat, is presently coagulated, and converted into store of small Sticks, resembling a little Forest.

Trochitæ & Entrochi described; by Dr. Lister, n. 100. p. 6181.

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 Spar*; tho' I have of them from some Parts of *England*, of a *white Spar* or *Cawke*, as our *Miners* call it. They all break like *Flint*, polished and shining.

Vinegar, as a *Menstruum*, will corrode and dissolve them, (as well as all *Fossils*, of what *Figures* soever) provided they be broken into different 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 Joint, 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* joined together, make up that other Stone, which is called *Entrochos*.

ebos. The *Trochites*, or single Joints, are so set together, that the Rays of the one enter into the other Furrows, as in the *Sutures* of the *Skull*.

Fig. 93.

They are found very plentifully in the *Scars* at *Broughton* 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 *Trochite*, 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 *Bicaine*, *Serpentine*, *Turbinate*, &c. as at *Broughton*.

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 Glass. Again, These Stones Fig. 92. consisting of many *Vertebrae* 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. Farther, 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 *Mortar*.

There is great Variety as to the Thickness of the *Trochite* 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 Extremes, there are Joints of all Measures in divers 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 distilled *Vinegar*, the seeming *Sutures* will vanish, as in some I had out of *Staffordshire*, from about *Biresford* upon the *Dove*: Others, and all here at *Broughton* and *Stock*, are really jointed, and the *Sutures* indented; which Indentures being from the terminating of the Rays, they are more fair or large, according to the Difference of the Rays, 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 Thickneffes.
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 at *Stock*.
3. There are likewise of these, with a Circle of Knots, which have many Knots beside 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 tho' it were all over knotted; and these are found at *Broughton* 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 alternatively.
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 tho' 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.

Fig. 92. 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 Stem, and by be-

Fig. 93. ing separated, leave great Holes in the Sides of it. The Rays in the Joints of the Branches, run cross to the Rays of the Stem. On thick Stems 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 entire, 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 Stem, by being a little crooked, and something tapering or conick.

We meet but with few Pieces (besides the Branches) that are not exactly cylindrical, setting aside the *Injuries* abovementioned. 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 joint-

ed,

ed, notwithstanding this Shape: Upon a small Stalk of two or three Joints, is suddenly raised an oval Bottom, broken off also at both Ends.

To these we shall add, what seems to have been *Summitates*, or *Fastigia*; Fig. 95. 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.

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 *Cinquefoil*; and the Rays of the Joints of these *Entrochi*, Fig. 91. 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.

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 Fig. 96, been the Roots of them. And when these have been a little cleaned in *Vinegar*, 97, 98. these Impressions appear more than casual; for the Substance that covers them (if not the *Stones* themselves) is *Spar*, 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*. The 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 an Inch and 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-described *Stones*. Some of the fairest of them, at *Broughton* and *Stock*, are *Pentagonous*, and as broad as my Thumb-Nail, hollow on the side like a Dish; convex on the other side, where are certain eminent Knots about the bigness of a small *Pin's Head*, set in a kind of square Order: This Plate is somewhat thin at the Edges, and yet blunt. Others are *Pentagonous*, and somewhat convex above, but not hollow underneath, and without these eminent Knots; the Edges as thin as of a Knife, and sharp. Others of these *Penta-*

gonious Plates are convex on one side, and somewhat hollow on the other, thick-edged, one of the five Sides only is indented; the indented Side is ever the thinnest, and the Stone is most stopped 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 *Pentagonal 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 antique Shields, and round about the Sides a List of smaller *Studs*; and some from *Bugberp*, under the *Woods* 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 *Braughton-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 five broader Sides, and one very small; again, two Sides broad, and four much narrower, and infinite other Differences as to the Inequality of Sides.

By Mr. Ray,
ib. p. 6190.

2. 'Tis strange that these main *Stems* 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 Batons*, 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 their putting forth of their *Bran-ches*. 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; tho' being of no Use, they neglect and cast them away. Certain it is, there is a sort of *Coral* jointed.

By Mr. J.
Beaumont,
n. 129. p.
724.

3. All the *Trochylæ* and *Entrochi*, described 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 *Entrochus* 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 third 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 *Cinquesoil*, 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

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, tho' 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 2 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 gentle 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 arises a little Ray near the *Trunk* where the Forks join, which shoots to the Circumference; (but, *Note*, That these Differences are scarce discernible, 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 thro'; 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 these 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 Dr. Lister calls it; some *Trochites* hold of an equal Thickness or 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 seldom passing thro it; tho' 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

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 itself with 2 *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 *Triagonal, 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 itself, 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 blueish within, like some *Sea-Shells*. When it was first found, it was full of a sort of Ash-colour'd gristy Clay, which is the evident material Cause of it, it being found in a Bed of the same.

I easily pick'd out the Clay with a Needle, so that it is now all hollow; the *shell-like* and *sparry* Substance being scarce as thick as a Half-Crown. I have one *Sexangular Plate*, whose *convex Part* has on it a *Star* consisting of six emboss'd *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 Fathoms; and doubtless there are of them deeper. But I find them most plenteously in certain Beds of an ash-colour'd 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 defaced) if not a Species thereof; it is about the Bigness of an *Acorn*, with *Ridges* and *Furrows* running the long-way; it differs from those described 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*, tho' (as *Dr. Lister* says) some *Trochites* are of a dark-coloured *Spar*;

Spar; 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 tho' an ash-colour be the chief in it, yet there are some Veins of red in it, some of white, some of a light blue, some of a dark blue, &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 spongy 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 filled 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* called *Cornu Ammonis*, shaped 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 Budgings out of it about the Bigness of a young Cock's 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 between these two, tho' very few of any Bigness are to be found entire, but all broken and imperfect Pieces. And I take the seeming *Summitates* of Dr. *Lijster* 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 grows thin flat Cells, or small Pipes of *Spar*, set edge-ways 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, tho' 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 on 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

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-mention'd; 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 *Carwk* will very freely, and most of our *Mineral Stones*. This Motion seems to proceed from the Contest betwixt the *Acid Spirit* of *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 two Inches in Length, and other small Branches issuing from those; and upon a nearer Search, I discover'd 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.

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 Forests 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 three Inches about) they must have been much higher than those before-mentioned. The Branches are all jointed, and have the same Bore with the Trunks, and are terminated with round and blunt Joints, but very small. I find the Bores, or Hollows of such as are found to be commonly filled with a milky curdled 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 *Cinquesoi Bore* on the Top; others with the Impressions of *Oval Joints* there, and many other Differences: so I am now fully satisfy'd, 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 four Inlets in their Hollows, and others with seven.

Some

Some have a *circular Edge* on every other Joint, the intermittent Joint being smooth without Edge or Knot. Some Trunks have circular Edges on the middle of every Joint ; 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 Joints 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 second and fourth Joints are round and blunt, the other three 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 Joints 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 specific Distinction ; it may, perhaps, be as hard to make them out to be distinct Species, as to shew a specific Difference betwixt several Snow Blossoms.

The Reason of that strange Disorder which these *Plants* usually lie in, and *Fig. 101.* 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 Joints being very tenderly set together : And hence these Stones are generally found in *Leirey* Places (as they call it) that is, *Cavernous*.

These rocky 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 refreshed 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 those *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 shaped 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.

And though a Salt of *Carol* after Dissolution, will upon Coagulation shoot into a little Grove of Plants, as it were, resembling the Growth of *Carol*, yet this cannot disprove its *Vegetation*; for it's 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 inclined to the Opinion, that these *Rock-Plants* are *Lapides sui generis*, and not *Parts of Plants* or *Animals Petrefied*. 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 Joints of the Plants, and by the Impression of *oval Joints* there) may give us some Suspicion that they once belonged to an *Animal*, whether it were a Species of the *Stella Arborescens*, 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 Jointings, scarce either of them to be matched in any *Vegetable*, I have by me above 20, if not 30, Species of these *Rock-Plants*, differing outwardly from each other in their *Joints*, *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.

The *Astroites*; By Dr. Lister, n. 112. p. 274.

LXXII. 1. I have procured a good quantity of the *Astroites* from *Bugthorpe* and *Leppington* at the Foot of the *Yorkshire Woods*: At the former Place I have seen them dug out of a certain blue Clay on the Banks of a small Rivulet, betwixt the Town and the Foot of the *Woods*. There are plenty of them wash'd into the Brook; but the most fair and solid are those we get out of the Clay.

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 *Bellemnites*, to a very strong and white Lime.

These Stones (as we now find them) are all *Fragments*; either one single Joint, or 2, 3, or more Joints 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 Joints; but I have seen one Piece, somewhat shorter than the former, which had 25 Joints. These last thin-jointed Pieces are quite of a different Make, as to all Circumstances, from the other.

Every Joint consists of 5 Angles, which are either drawn out and sharp, and consequently the sides of Pieces made up of such Joints are deep channel'd; (and this is the Condition of some of the thick-jointed Pieces, as well as of all the thin-jointed ones) or the Angles are blunt and round,

and

and the Sides 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 distinguished 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 hand, 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 straight, 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 the 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. Fig. 104.

In the deep-jointed Pieces, just under the Top-Joint above describ'd, are 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. Farther, 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 Fig. 105.

Figure and smooth-jointed, being set together *per Harmoniam*, and not indented Sutures. Nothing that I can think of, is so like these Wyers, as the *Antennæ* of *Lobsters*. Lastly, Some of these Wyers are knotted, and others of them fairly subdivided or branched.

By Mr. Ray,
ib. p. 278.

2. If you can allow the *Trochites* and *Entrochi* 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 Wyers springing out of the Furrows or Concave Angles of some of the *Internodia*, and incircling 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 jointed: But no *Vegetable* either of Land or Sea, that I know of, hath such frequent Joints 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.

The Leaves of some sort of *Equisetum* are jointed, as well as the Stalk; else I know no Plant that hath jointed Leaves, except some sort 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.

Lapides Judaici, by Dr. Lister, n. 110. p. 224. Fig. 107.

LXXIII. We have plenty of Stones called *Dactyli Idæi* and *Lapides Judaici* (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 a *Date-Stone*, round and long about an Inch, and sometimes longer. They are a little swelled in the middle, and narrow 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 *Belemnites*.

Vertues of the Ostracites; By Dr. C. Y. n. 250. p. 81.

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 *Nepbritick Pains* since; that his manner of giving it, is in fine Powder mixed with about a third part of *Flores Chamæmelis*; Dose from *half a Dram* to *one Dram* in *White-Wine*: That the greatest Dose

Dose is often apt to offend and nauseate the Stomach; that he once gave it alone with a weak Infusion of *Chamomile 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 powder'd *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 followed her Medicine thoroughly, 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* (though weakly) do. It yields no *Volatile Salt*, tho' I tried it in a naked Fire; nor do 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 dried and exposed to the Weather, they would lose even that, and yield no more *Volatile Salt* than the *Ostracites*. I confess I was somewhat surprized at this Matter; since there are who say, that even the other Shells, that are commonly called petrified, yield a *Volatile Salt*: And I had myself from the Shells of *Crustaceous Fishes*, (particularly of *Lobsters*) a *Volatile Salt* and a *Fetid Oil* in no inconsiderable Quantity, even in a *Sand Furnace*. But these sort of Shells differ from other Shells (as Dr. *Lister* has exactly observed) 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 *Tocaphaceous* Substance that coats many of them on the inside, and which perhaps may be somewhat a-kin to the *Selenites*. I have observed 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 Ancients were found in Beds of somewhat yet more Valuable, since *Pliny* says they were of a Golden Colour, and were reckoned *inter Saceratissimas 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 fiunt.* And I am ready enough to think 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 Appearance of Colours
in

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 formed 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 Toys and Trifles, fit only for furnishing out a *Museum*, may have other remarkable Virtues, that may, in time, bring even them to be taken notice of, and valued, as well as the long neglected and despised *Ostracites*.

By Dr. Lister, ib. p. 85.

2. The *golden Colour* is from its being a *Pyrites*, that is, Iron-stone. Again, all the *Conchitæ* kind, but more particularly the *Belemnitæ* and *Lapides Judaici*, were known to the Ancients for *Specificks* in *Gravel*.

Several regularly figured Stones; By Mr. Edw. Lhuyd, n. 200. p. 746.

LXXV. The *Pod-Stone*, as far as I know, is entirely new to us, extremely rare, and not unbeautiful. I call it the *Pod-Stone*, from the great Resemblance it has to a Part of the Pod of a Lupine, or other Pulse, only it is not hollow. The general Characters of this Stone are these, viz. That its Figure for the most part is like that of the Part of a Pod, without any Cavity, and always more convex on one Side than on the other; and (if you except those that are found accidentally polished like Marble) very minutely plaited, or to speak more plainly, very thick and elegantly hammered; its Surface is shining, as if done over with Oil; and upon breaking it, its Texture is strious, almost like the *Lynx-Stone*. Of this Stone there are a great many different Kinds, the principal of which only I shall describe at present.

Fig. 108. 1. The *Pod-Stone* resembling Part of the Husk of a *Kidney-Bean*, or the *Kidney-Bean Pod-Stone*. The Figure of it appears from its Name; as to its Size, it is an Inch and a half long, half an Inch broad, and hardly a quarter thick. With Regard to its Sides, one of them is a little bended like the Back of a Scythe, and the other (which is the sharpest of the two) is straight. One Extremity is shut up by an oblong Line with two Angles, but the other is not so. On the flat Side, the Surface is marked with straight Lines, and somewhat rugous, of a coal-black Colour, except at each Extremity, where it becomes a little greenish; on the other Side it is spoilt by a stony Accretion, of a rusty Colour. This one I found in a Quarry at *Whitney*, seven Miles from *Oxford*; but it is very rarely to be met with. I have some of them three or four times less than the above, and somewhat different from it in other Respects, which were got in a Pit at *Stunfield* in the same County.

Fig. 109. 2. The *Lupine Pod-stone*, somewhat resembling the *Husk* of a *Lupine*. It is frequently shorter than the above described Stone, but always broader. Its

Its Colour is uncertain, but for the most Part on its flat Side it is black, or blackish, and on the other of a rusty Colour; but in both of them it varies, both as to Colour and Surface. On its crooked Part it is marked with little white Lines, and I don't know what Kind of Spots, which you may sometimes observe in the *Toad-Stones* and *Tongue-Stones*. I have likewise found one or two having a Sort of Appendix growing to the opposite Side, where you could see some cross Stalks, appearing as if something since lost, had formerly been connected to them. This Stone differs from the other, in that it is broader, and straighter, and is not bended. In the Inland Parts of *England* this Stone is not very rare. I have seen of them in the Stone Quarry at *Garvord* in *Berkshire*, at *Whitney* and *Charletown* in *Oxfordshire*, at the Village of *Rance* in the County of *Northampton*, and at *Honey-Comb-Lash* in *Wiltshire*, &c.

There are likewise Stones of this Kind resembling the Husks of common Peas and Tares.

3. The *lesser triangular Pod-Stone*, or the *lesser Pod-Stone*, with a Beak *Fig. 110.* like that of a *Cockle*. It agrees in Colour and Surface with the others, but it resembles more a Kind of *Winkle*, or (if you please) the *small English Cockle* of *Lister*, than a *Husk*; but both from its external and internal Appearance, it discovers itself to be of the Pod Kind. They have them at *Stunfield*.

4. The *Pod-Stone*, resembling the Stone in the Head of the *Cod-Fish*. *Fig. 111.*

5. The *Gibbous*, and sometimes *Tertous-pointed Stone*, akin to the *Pod* *Fig. 112.* Stone, with a Surface like that of *Marble*, or the *Gibbous marble Pod-Stone* for the most part nicely pointed. This *Pod-Stone* is more smooth and polished than the former. On its lower Side it is sometimes more, and sometimes less gibbous, and for the most part of a blackish Colour, or else greenish, or whitish, &c. On the opposite Side it has added to it a Kind of stony Appendix, of a black reddish Colour, but this for the most part is wanting. On both Sides it ends in a sharper Point than the former ones; and in many of them you will see, upon turning the gibbous Part to the Sun, the Appearance of a great many very minute Points. This Stone is found here and there in *Berkshire* and *Oxfordshire*; I found some of them in the Quarries at the Villages of *Markham*, *Garvord*, and *Stunfield*.

6. A greater Variety of the same Kind of Stone. *Fig. 113.*

7. The *Mole-wort-Stone* resembling the *Pod-Stone*, or the least Kind of *Pod* *Fig. 114.* Stone like a *Kidney Bean*. This *Mole-wort Stone* is the least of all the *Pod-Stones* that I have ever yet seen, in a good measure resembling a Grain of *Mole-wort Seed*, or a very small *Kidney-Bean*. Its upper Part is rough, and may properly be called Pod-like, of a brown, or shining black Colour. Below it is tawny and ill shaped. Some of them I found at *Whitney* of a shining Black, like a *Beetle*, but some I had at *Stunfield*, both of this Colour, and of the brown.

I imagine that at least future Philosophers (if not those even of this Age) may safely call those Stones which I have named *Silicquastræ*, or *Pod-like*, the Teeth and Bones of Fishes. Certainly, as to the *lesser triangular Pod-like Stone*,

I have seen some of that Kind very like those little Bones, which are commonly known, taken from the Heads of *Cod-fish*.

Fig. 115. 8. *The greater Toad-Stone, of a blackish red Colour, and like the Husk of an Acorn.* Its Colour every where is a blackish red; as to the rest, it agrees in every Respect with *Boetius's* Figure of it. I found it in the Stone-Quarry at *Faringdon* in *Berkshire*, but it is rarely to be met with.

Fig. 116. 9. *The middle-sized rotular Toad-Stone, with a small Hollow on each Side.* Its Colour is palish, excepting in each Hollow, where it is of a rusty Colour. I had it with the former.

Fig. 117. 10. *The middle-sized orbicular Toad-Stone, or the common English Toad-Stone.* It is three or four Times less than the larger blackish red one above-mentioned. It varies very much in its Colour; sometimes of a coal-black, sometimes brown, or Liver-coloured, and sometimes of some other Colour; sometimes too I have seen it marked with blue Spots, and little Lines. I have one of them pretty thick, and less depressed than the rest, of a pale or whitish Colour, bordered with black.

They are found here and there in the Quarries and Sand-Pits in the inland Parts of *England*; but the one mentioned above, I had in the Stone-Quarry at *Faringdon*. There are likewise found the lesser orbicular Toad-Stones, of a flatish oval Figure.

Fig. 118. 11. *The smallest sized Toad-Stone, rugous on its convex Side.* This is found with the others in *Glostershire* and *Oxfordshire*, but is more rarely to be met with.

Fig. 119. 12. *The lesser Toad-Stone, pointed at Top like a Trochilus, or the Toad-Stone, called the Trochilus.* It is of a blewish black Colour, with a black Border. This I had from the Sand-Pit at *Faringdon*.

Fig. 120. 13. *The least Toad-Stone, akin to the Trochilus, with a longish streaked Bud, or Process standing out from it.* This streaked Process is of a chefnut Colour; the Knob has almost the same Appearance with that of the preceding one. I have frequently observed it in the Sand-Pit at *Faringdon*.

Fig. 121. 14. *The Boat-like Toad-Stone, high at one End.* In the Stone-Quarries at *Marcham* and *Garvord*, and at *Faringdon* not very rare.

I must observe once for all, that all the *Toad-Stones* vary in their Colour; but the *English* for the most part approach to a blackish Brown, and Liver-Colour. It does not appear, that those Stones have been found in *England* before; for the *Toad-Stones* mentioned by *Mr. Plot* in his *History of Oxford*, does not belong to this Class; and those of *Mr. Christopher Meret* (if I remember the Thing right) were not *Stones*, but the *Teeth, &c.* of *Sturgeon*. And this was happily enough conjectured, either by himself, or somebody else; for those *Stones*, in my Opinion, are nothing else than the *Teeth of Sturgeon* and other *Fishes*, which have put on the Appearance of *Stones* externally. In the Quarry at *Garvord*, seven Miles from the *Academy* (which upon account of the rare *Stones* I found there, I frequented pretty much) I

Fig. 122. met at last with a Fragment of the Jaw-Bone of a Fish, as it appeared to me, to which three *Toad-Stones*, in the Form of a Triangle, stuck very close. Two of them were of the lesser orbicular Kind, and one of the least. But

what

what we have said already is sufficient upon the *Toad-Stones*, which, if that is more agreeable, you may call for the future very justly the *Fish-Tooth Platter-Stones*.

15. *The small Cock-Spur-Stone with a sharpish Point.* This Stone is nothing *Fig. 123.* else than a roundish Kind of *Fish-Tooth*, resembling a *Cock-spur*, with a hollow Root, like the *Toad-Stone*. These *Fish-Tooth Stones* differ like the others both in Colour, Surface and Size. They are found up and down, with the *Toad-Stones* and *Tongue-Stones*, in the Stone-Quarries in *Berkshire*. Such of them as are found smooth and polished like Marble, I imagine have been freed of the *Periosteum*.

16. *The greater Cock-spur-Stone more deeply streaked, and with the Point* *Fig. 124.* *more obtuse.* I have only happened to see two of this Kind which were found in the Quarry at *Stunsfeld*.

17. *The Lesser or Middle Rhombus.* It is a flattish Kind of Stone, about *Fig. 125.* the Size of a Cucumber-seed, and of a Rhomboidal Figure. One Side of it is more convex, and for the most part black; the other is more flat, and laid over with a Kind of testaceous Lamella, which shines surprisingly, of a Coal-black or reddish black Colour. This likewise constitutes the Rhomboidal Figure of the Stone, with its Edge sometimes gently sloping; and which adds to the Elegance of it, it very much resembles the polished Tortoise Shell. These I found in the Quarries at *Marcham* and *Charleton*. There are both larger and lesser of this Kind, and some of them are quite of a different Figure from the Rhombus, only they resemble it in their Substance and the Elegance of their Colours.

18. *The Pen-knife.* This Stone is quite different from all the rest in its *Fig. 126.* Figure. As to its Size and Colour, it agrees in some Measure with the Rhombus; but its Figure is only proper to itself. I have called it the *Pen-knife*, because it somewhat resembles the Point of a Knife. For it is a thin little Stone, having three Corners, one of which is less prominent than the other two. One side of it is quite plain and even, but the other, upon Account of its sloping Margin, or if you please of some transverse eminent Lines, is every where gently slanting. This I had along with the former at *Charleton*.

19. *A gibbous Stone a-kin to the Toad-Stone: Or, The gibbous Toad-Stone,* *Fig. 127.* as it is called. This gibbous Stone has its Name from its Appearance, for it is not like the rest even below, but quite arched; so that if you set it upon a Plane, it admits the Light below it, and hence from its rising Back, it is called gibbous, or hump-backed. In its gibbous Part it has a Foramen but a broad Basis, very like that of the lesser *Toad-stones*. This was found in the Sandy Stone-Quarries at *Marcham* by Mr. *John Archer*, of *Queen's-Colledge*, a very hopeful young Gentleman, who amongst a great many other Stones has two or three of this Kind. I observed them afterwards in the *Sand-Pit* at *Faringdon*.

The Stones hitherto described, together with a great many others which I *Fig. 128.* found in the Inland Parts of *England*, I take to be the Teeth, or other little Bones of the Heads of Fishes. Besides, I have observed a great many of their

Vertebræ scattered up and down every where in *Glocestershire*, *Berkshire*, and *Oxfordshire*; all which I commonly call by the general Name of

Fig. 128. 20. *Ichthyospondylis*, or *Fish Vertebral Stones*. They are variously coloured according to the Places where they are found; some black, others brown, others of a Clay or Ash Colour. They are no less variable too, both as to their Size and Figure, than the *Ichthyostea*, or *Fish-bone-Stones* above described. I have found some of them larger than your *Table-Men* or *Chefs-Men*, and some of them smaller than a *Vetch-Seed*. I have seen them preserved in the Sand-Pit at *Marcham*, almost without any Loss of their bony Substance, as far as I could observe. Besides, these Stones are very seldom or never found joined together like the *Vertebræ* of Fishes, which is a strong Sign, in my Opinion, that they are not natural Stones formed after the Manner of some particular Bones. For if Nature does attempt to do the same Thing under Ground that she does in the Sea, why might not she with the same Pains and Dexterity with which she makes a single *Vertebra* make out a whole Skeleton?

Fig. 129. 21. *A strong Fragment of the Jaw-bone of a Fish*, with *Toad-stones* growing to it found at *Garwood*.

Fig. 130. 22. *A small Tongue-stone*, with a stony Fragment of the *Jaw-bone* growing to it, found at *Faringdon*.

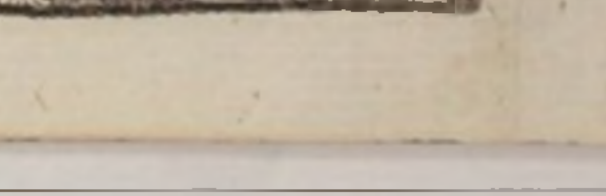
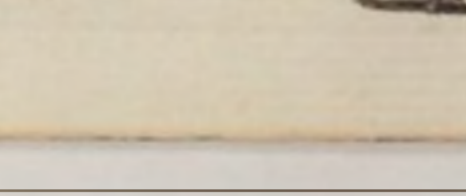
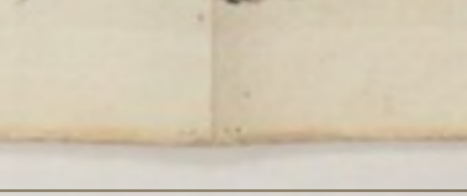
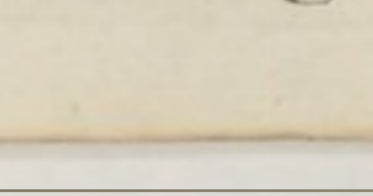
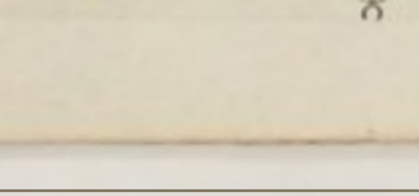
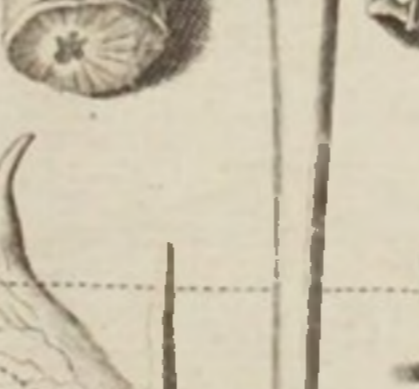
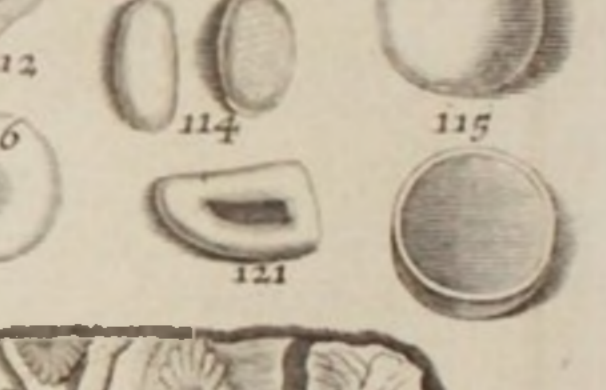
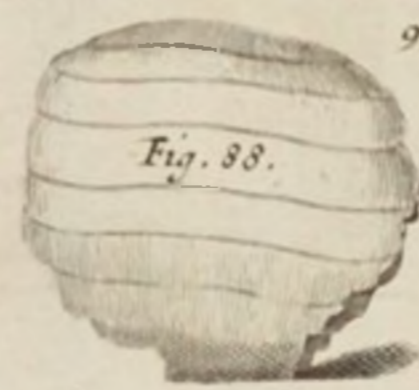
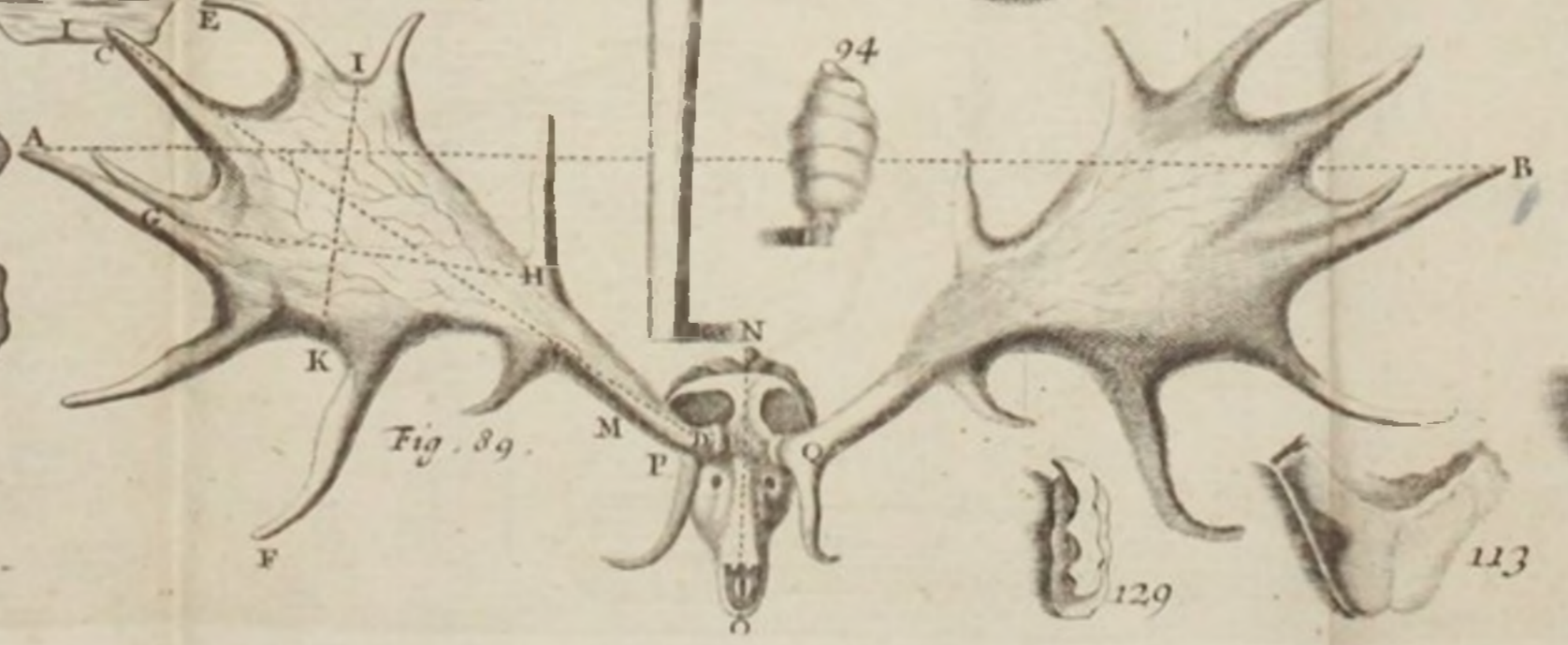
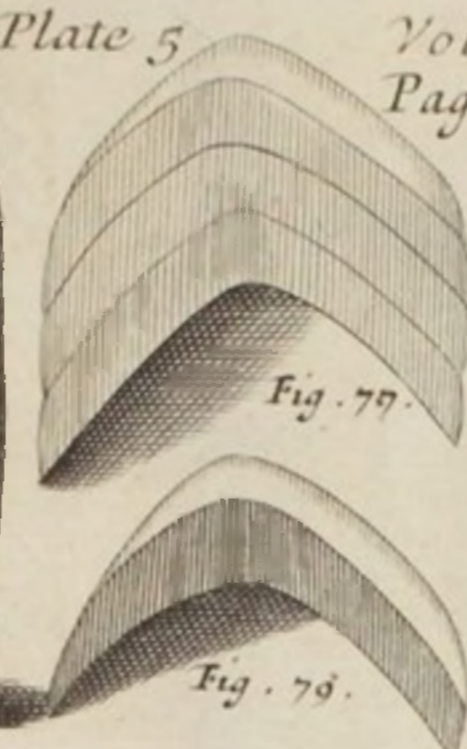
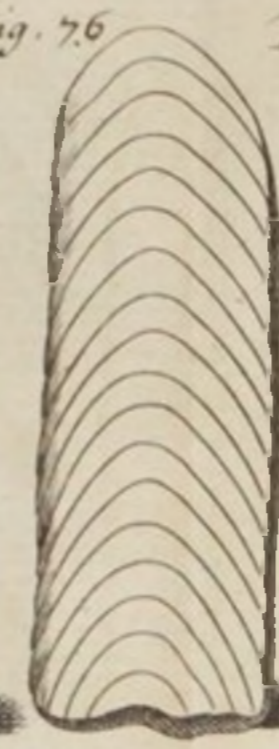
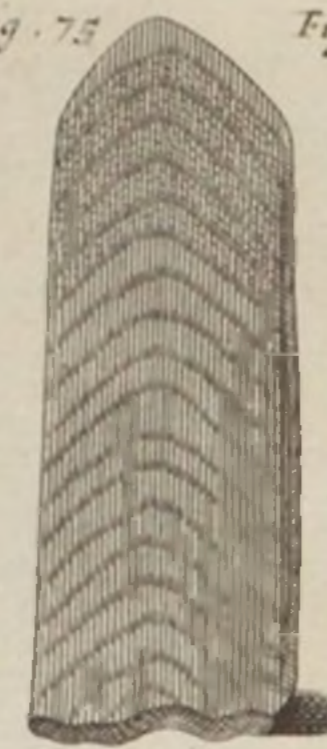
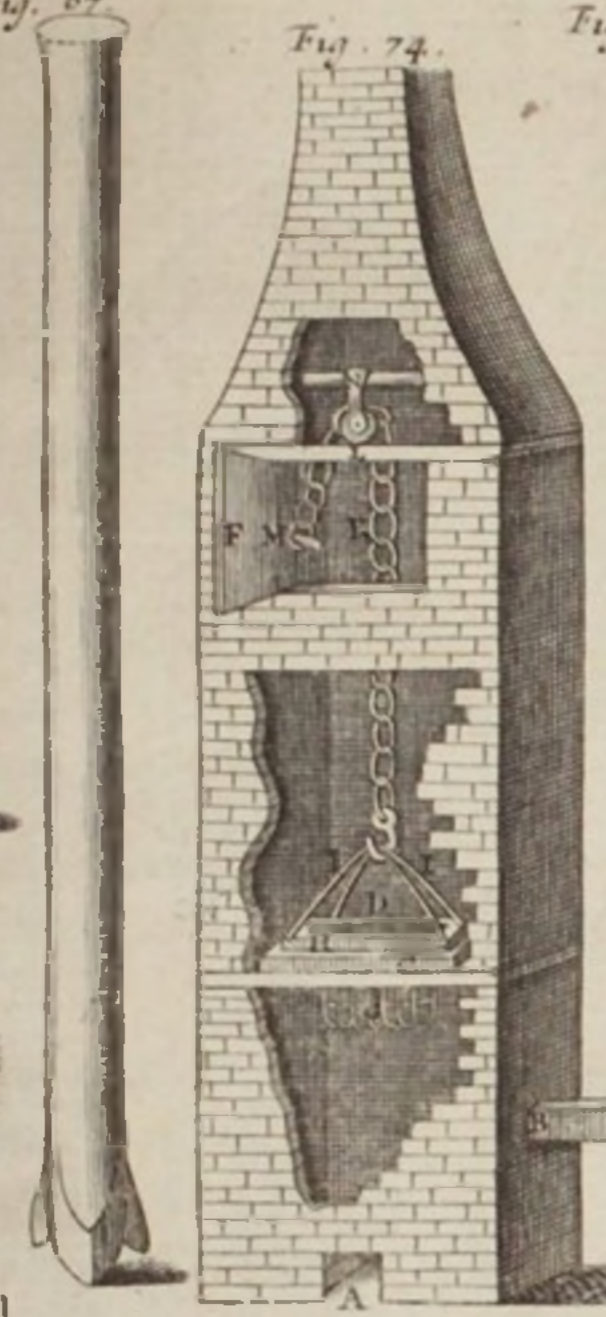
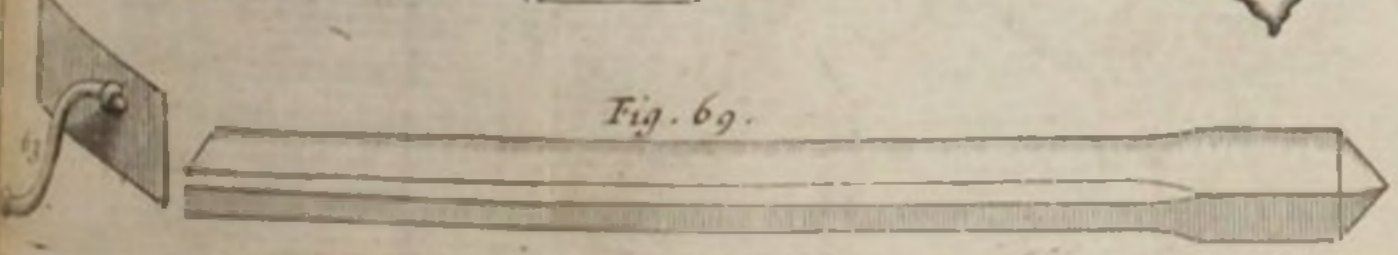
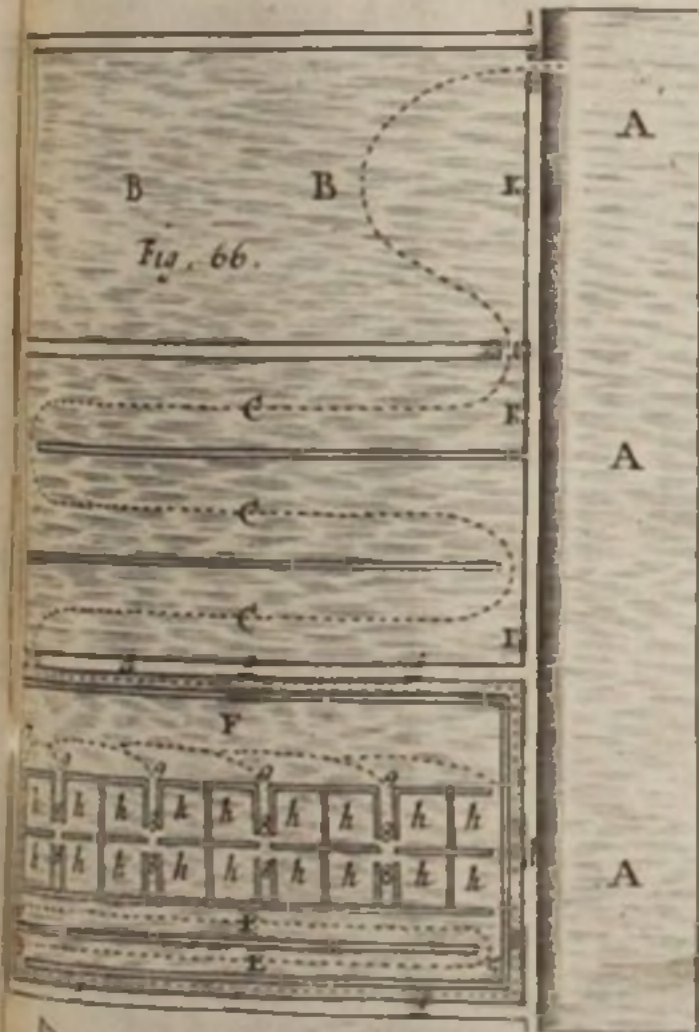
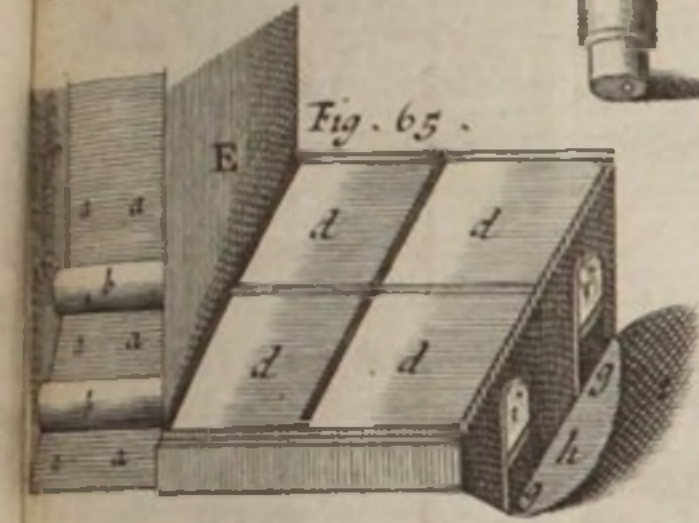
23, 24, 25, We found near *Lhan Deilo* in *Caermarthenshire*, 26, 27, 28, *Fig. 130.* 29, on the *Severn* Shore in *Glocestershire*; 30, at *Gold Cliff* in *Monmouthshire*, and all the rest in the *Isle of Caldey* in *Pembrokeshire*. The 25th, *Fig. 132.* whereof we found great Plenty, must doubtless be referred to the Skeleton of some flat Fish; the 23, and 24, 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 referred thither; not that I conclude that either of these, or any other marine terrestrial Bodies, were ever really either *Parts* or *Exuviae* 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.

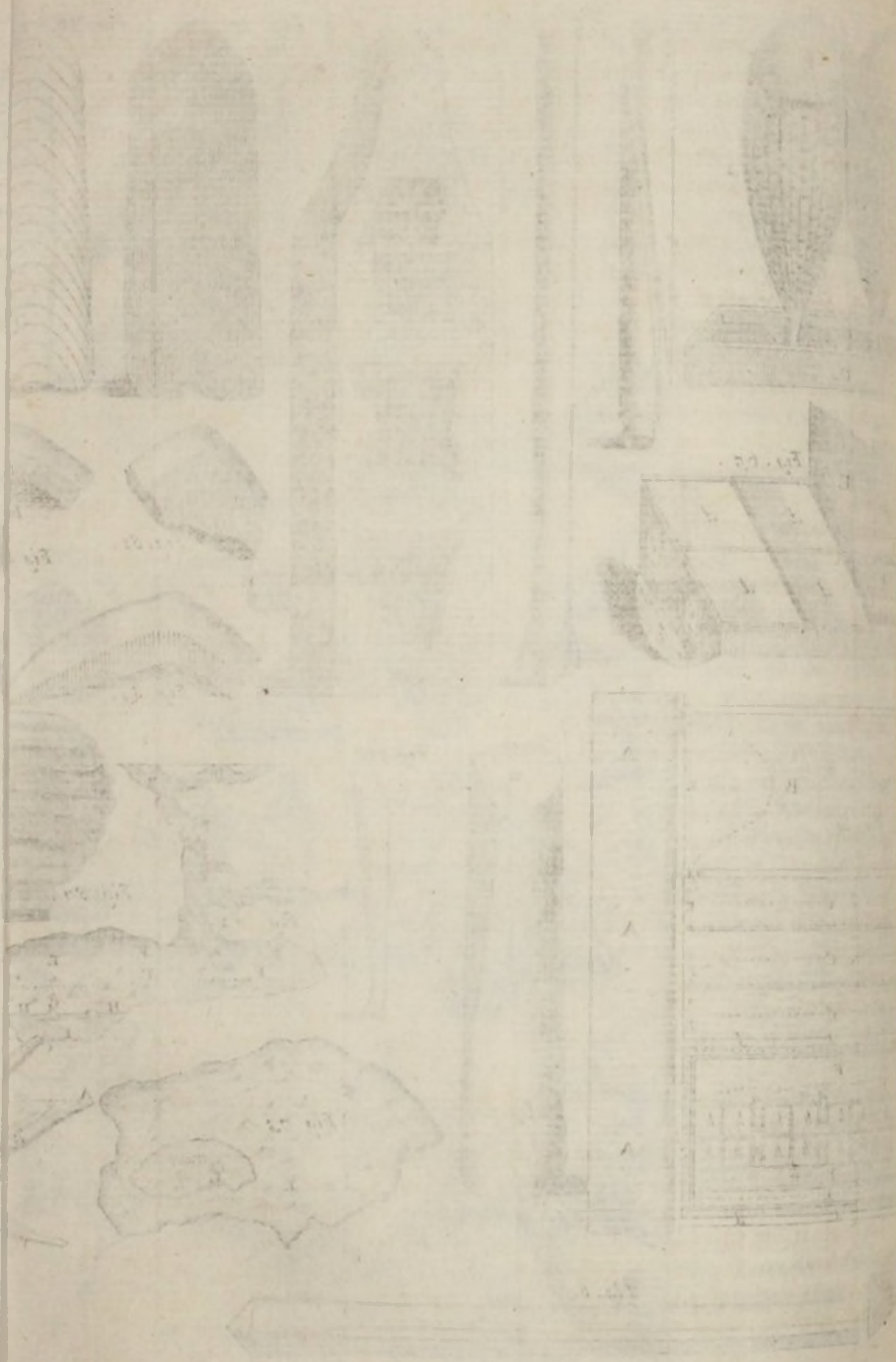
Fig. 149, 150. Represent a *Lime-stone Marble*, we have lately discover'd in *Wales* when polished. We have Plenty of it, but few Pieces exceed 6, 9, or 12 Inches Diameter, for 'tis only a Sort of *Alcyonium*, incorporated in several small Blocks of the *Lime-Stone*, whereof *Fig. 149*, represents a Piece polished perpendicularly, and *Fig. 150*, horizontally. 'Tis to me more beautiful than the *Florentine Marble*, but much more hard and substantial.

By Dr. Sloan, ib. p. 188. N.B. This Stone is a Sort of *Coral*, and the *Lapidis Astrotidis* five *Stellaris primum Genus*. *Boet. de Bodt*; or *Astroites*, *Worm. Mus.* It grows in the Seas adjoining to *Jamaica*. It is frequently found *Fossil* in *England*. I have some of it that will polish as well as *Agat*, which was many Years since found out by *Mr. Beaumont*.

The Giant's Causway in Ireland, by Sir R. Buckley, n. 299. p. 708.

LXXVI. 1. This Description of the *Giant's Causway*, I received from a Scholar and a Traveller, who went on purpose the last Summer 1692, with the





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*, *Hexagons* and *Pentagons*, of about 18 and 20 Inches Diameter, but so justly shot 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 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 ever so different Angles; for there are also Four-squared upon the same Shore.

2. The *Giant's Causway* is somewhat more than 8 *English Miles* North-East from the Town of *Colrain*, 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 Joints or Pieces, as we may call them, of which some are 6, some 12, some 18 Inches, some 2 Foot deep.

These Pieces lie as close upon one another as 'tis possible for one Stone to lie upon another; not jointing 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 these kind of Joints, which lie loose upon some part of the *Causway*, and on the Strand, which were blown or washed off the Pillars. These Joints 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

them asunder, both the *Concave* and the *Convex* Superficies are very smooth, as are also the sides of the Pillars which touch one another, being of a *whitish Fire-stone* Colour, but a finer closer Grit; whereas when we broke some Pieces off them, the Inside appeared like dark *Marble*.

The Pillars stand very close to one another, and tho' some have 5 sides, and others of them 6, yet the Contexture 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 surprizing and a 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 lie 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 lies next it, and towards the Sea, seems to be for the most part composed of the common sort 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 on 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.

66. p. 174.

NB. The several sides of one and the same Pillar are as in the Planes of *Chrystals*, 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 *Chrystals*.

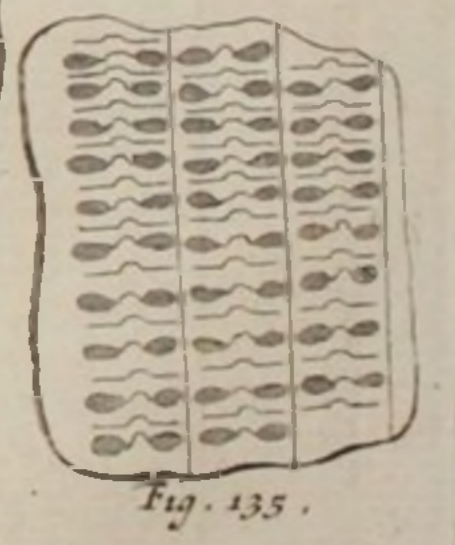
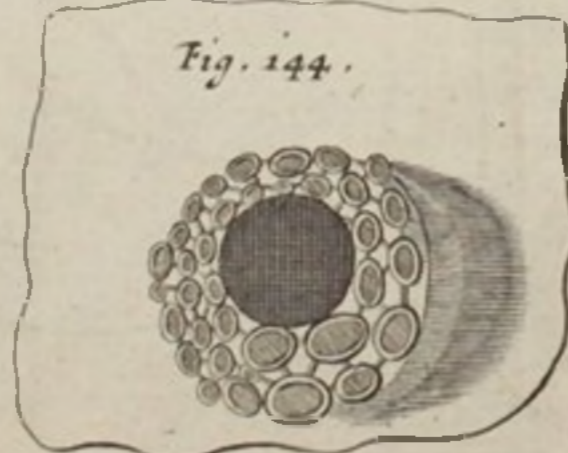
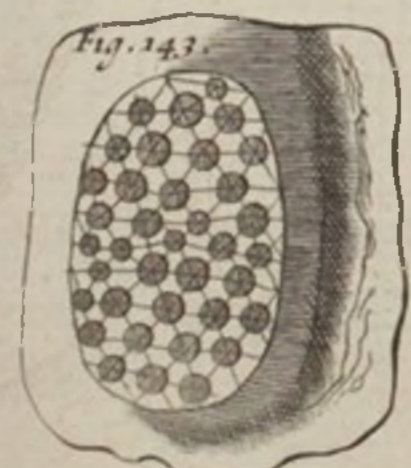
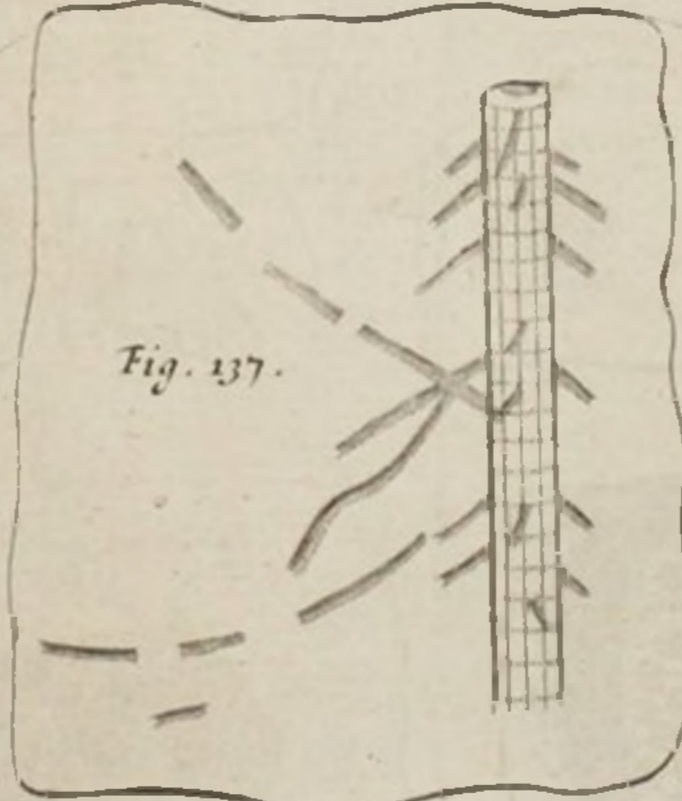
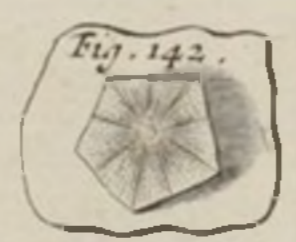
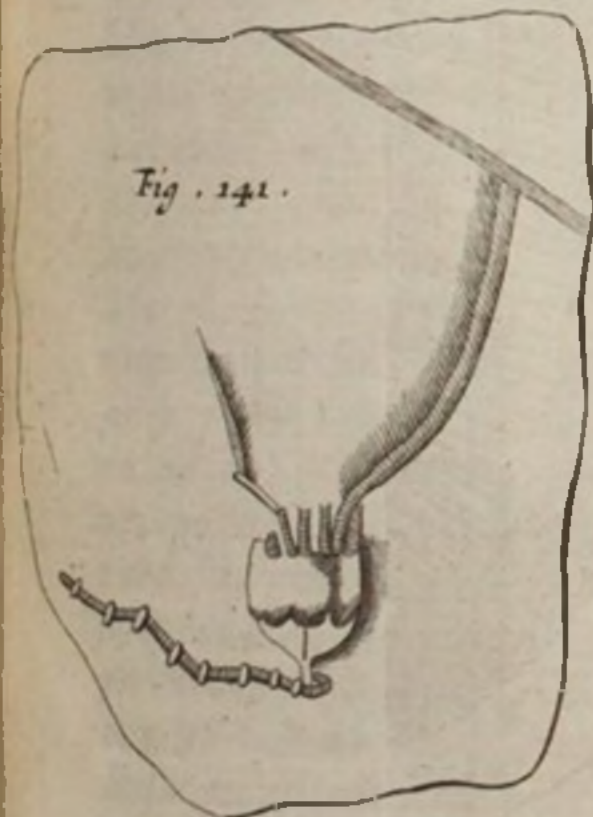
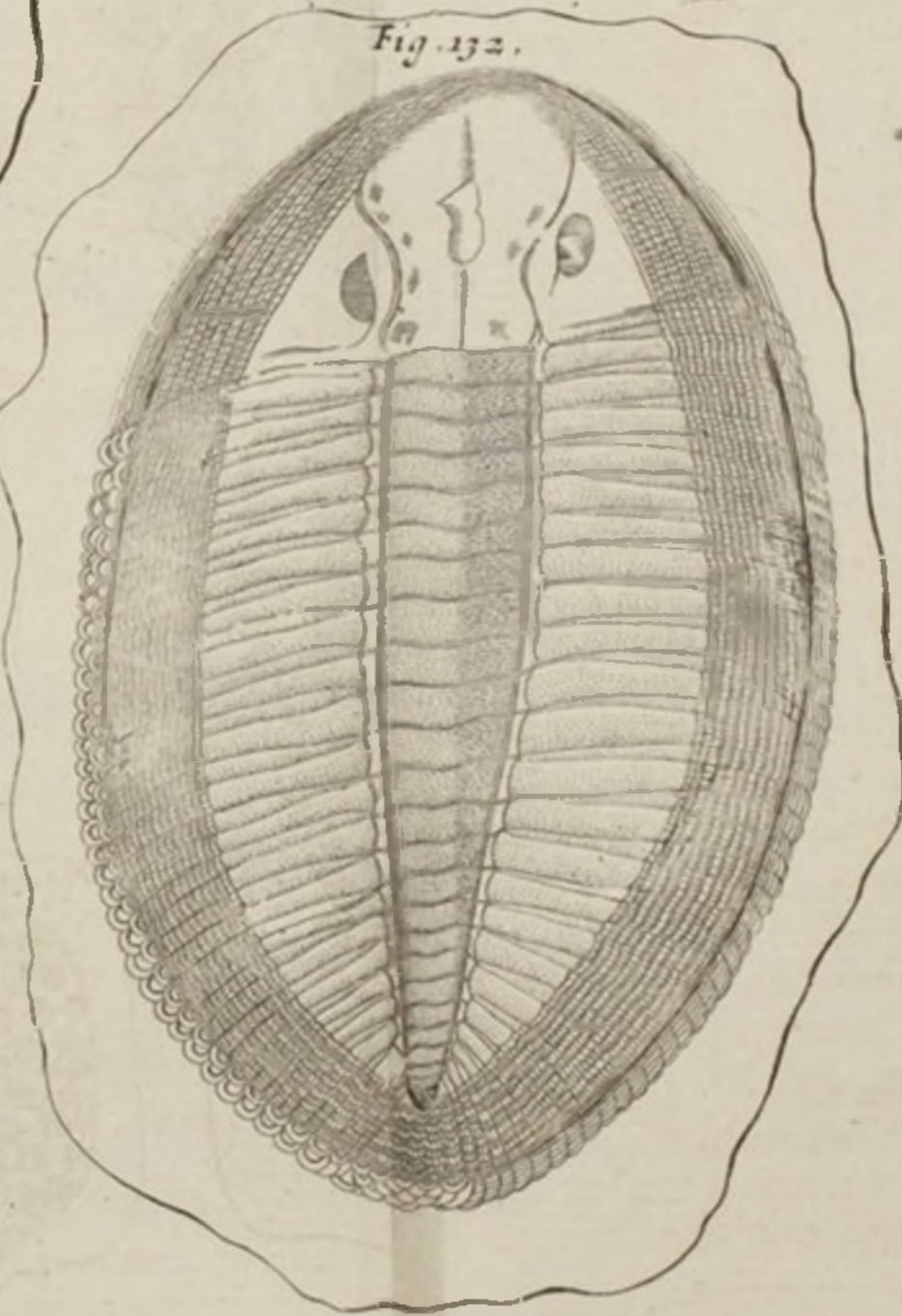
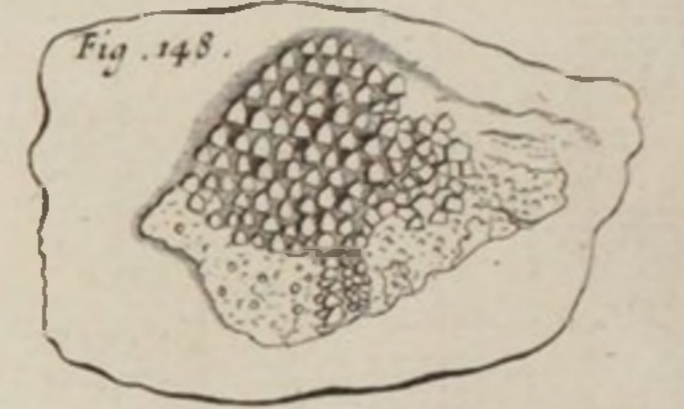
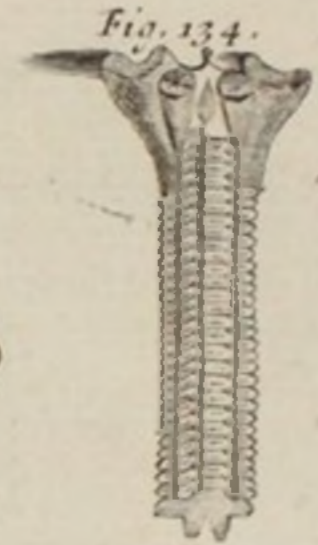
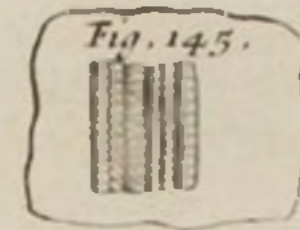
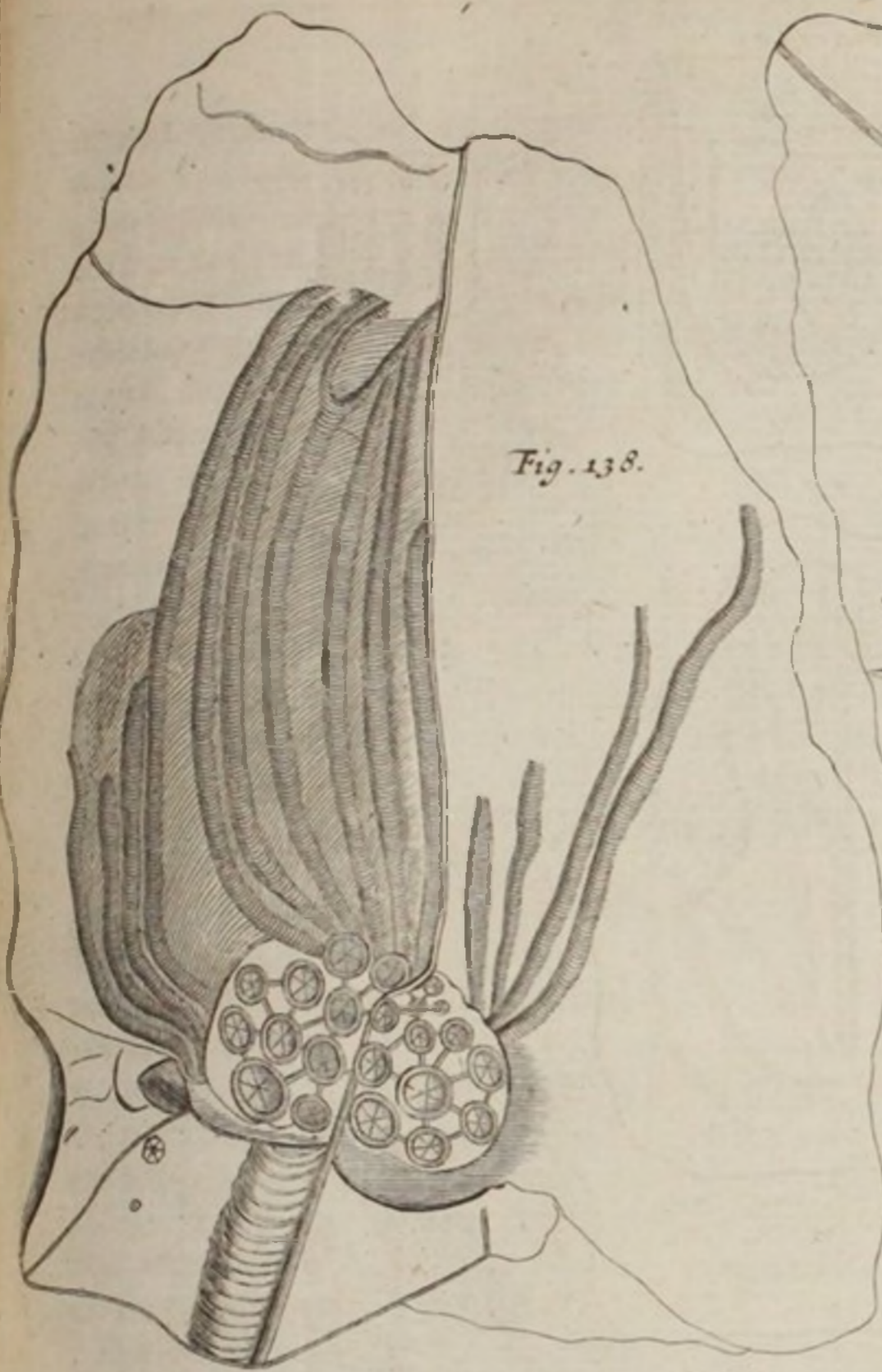
By Dr. Tho. Molyneux. ib. p. 175.

3. Among the several *Figur'd Stones* already described by Authors, I find none that has more Agreement with those which compose our *Giant's Causway* than the *Entrochos*, the *Astroites* or *Lapis Stellaris*, and the *Lapis Basanus* or *Basaltis*: And yet for all the great Resemblance they have in some Particulars, they differ very much in others.

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 *Joints*, 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 *Pit*, run from top to bottom through all the *Joints*; in the setting on, or way of fitting one Joint to another; and in its Size and Magnitude.

The *Astroites* or *Lapis Stellaris* is not only shaped *Column wise*, as the *Entrochos*, and jointed with several *Internodia* closely adjusted to one another, but its Sides are *Angular*. But then it must be observed that the Sides of the *Astroites* are always *fulcated* or a little furrowed, and are constantly *Pentagons*;

tagons;



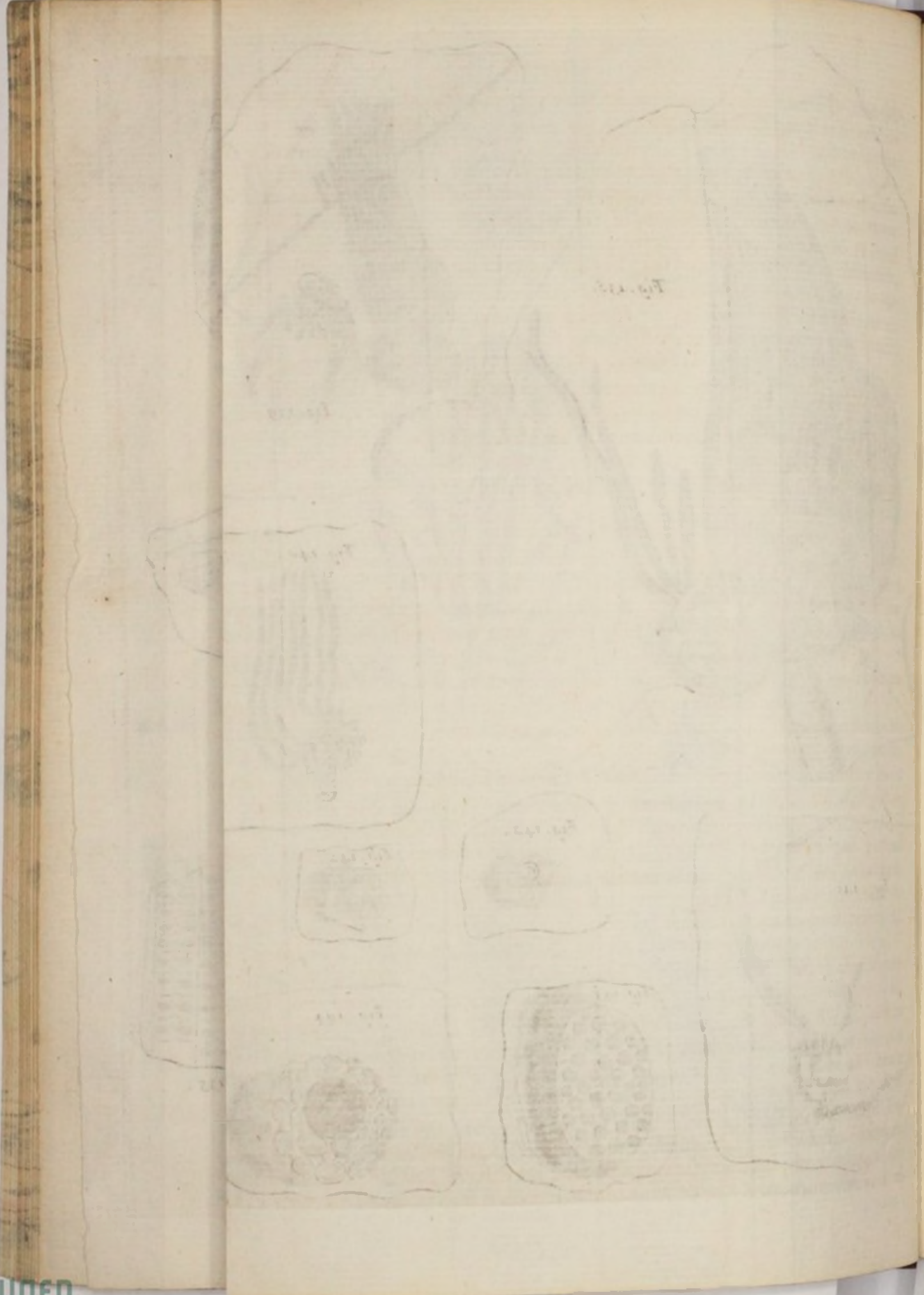


Fig. 12

Fig. 13

Fig. 14

Fig. 15

Fig. 16

Fig. 17

Fig. 18

Fig. 19

Fig. 20

ragons; whereas the *Irish-Stone* has its Sides perfectly smooth, and plane, and sometimes in *Hexagons* and *Heptagons* as well as *Pentagons*. Moreover, the *Asfroites* 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 Cohesion of the Joints 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 Joint, 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 Joints that were sent up from the Place hither to *Dublin*, I observed likewise, that the bottom or top of each Joint 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 Joint either above or below it: so that each Superficies in the *Articulations* adapt themselves on all sides so exactly one to the other, as 'tis possible for two Bodies, that are only Contiguous and not Cohering.

The *Asfroites* 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 two Foot in Diameter. Yet this disproportion of Bulk is not so considerable a Difference, since we observe that Nature effects the like Disparity in other of her Works, and those too nearly allied, and evidently of the same Tribe, or Family. Our small *Jointed Rushes* or *Reeds* and the largest *East-Indian Rambou*, 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 Clafs.

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 Basaltes Misneus*, described by *Kentmannus* in *Gesner de Figuris Lapidum*, whereof he says there is a great large Bed within three Miles of *Dresden* in *Saxony*. He gives the following Account of it thus; —
A great many angular Stones glued as it were together, represent that kind of Marble called Basaltes. They are of the Size and Shape of a middling Fig, very singular but Plenty enough of them, and so joined and fitted to one another, as if it was done by Art. They have seven, six, five, and some times though rarely, only four Angles. All together they have the Figure of a Beam standing up, polished on the Outside, smooth to the Touch, of an Iron Colour, heavy and hard like Adamant. These Stones thus cemented together stand up, some seven, some ten Ells above Ground. How far they sink down into the Earth no Body yet knows. But I find this Difference between these and the Misnean Basaltes, that its Columns were one entire Piece from top to bottom, whereas our Irish Basaltes, is composed of Columns divided into many Joints. So that I think it may not improperly be called, to distinguish it from this and all other Fossils,
The

The great Irish Lapis Basaltes or Basanos, having three Angles at least, and at most eight, very neatly articulated at several Joints with one another, but easily separable and knotty.

Whether our Irish Basaltes can pretend to the Name Basanos, on the same account the Misnean does, from the Greek Word Βασανισ, 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, partakes of that Property.

A farther Account of the Giant's Causeway; by Dr. Tho. Molineux, p. 235. and p. 241. p. 209.

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 employ at our common Charge, one Mr. Sandys, a good Master in designing and drawing 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 Causeway, 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 Causeway, which is 120 Yards long.

I. Stones the same as those of the Causeway, which lie 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 Causeway.

M. The Chimneys, which are Stone and make that Figure.

The Pricked Line in the Causeway, shews how far the Sea flows at High-Water.

Fig. 152. Fig. 152. The Prospect of the East-Side of the Causeway.

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 Joints and Columns that have been found by careful Observation to make up the Causeway.

Fig. 153. N. A Joint but of 3 Sides.

O. A Joint of 4 Sides.

P. A Joint of 5 Sides.

Q. A Joint of 6 Sides.

R. A Joint of 7 Sides.

S. A Joint of 8 Sides.

Fig. 154. 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 plainly appear, how the Convexity or Rising of the

the Joint below, marked *c.* was let into the Hollow of the Joint above, marked *d.* when that was in its native Posture, standing a-top and covering it. By this sort of *Articulation* the several Joints 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. 155. Is a Collection of 7 *Columns* as they stand together in the *Causway*; Fig. 155. 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 filled 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 Joints placed one above another, from top to bottom; and these Joints so closely contiguous, that only a small Crevice or Line seems to sever them; some with their *Convexities* uppermost, as those marked *c.* others with their *Concavities*, as those marked *d.*

The *Triangular*, *Quadrangular*, and *Octangular Pillars* are much fewer in Number than those other figured *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 itself 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 on 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 it were 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 Joints, 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 half distant from the Sea, three Miles from the Town of *Colrain*, and about two from *Dunluce,*

Dunluce, an old Seat of the Marquis 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 *Balliwillan 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 Joints placed one upon the top of the other; but in these respects they differ.

1. That some of these Inland Pillars are of a 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 Joints of these do not observe that kind of *Articulation*, by Cavities and Convexities, as those of the *Causway* do; but their upper and 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 Joints 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 Joints actually want this Cavity and Rifing, 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 Planes that run a little slanting and not parallel to the Horizon. Yet this may be only a chance Formation, since the universal Jointing of the whole *Causway*, is certainly otherwise. But I must take notice, that the Hollows and Convexities are not constantly formed 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 Joints as are uppermost, and lie exposed to the open Air on the Surface of the *Causway*, afford no small use and advantage to the poorer Sort of 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 four 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 Joints 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 Joint be *Concave* at one end, the other end is *Convex*.

The vast towering Height of those strait-joined Pillars, especially of those that are most slender and the perfect among them, is truly very surprizing. There are in the *Causway*, some of 33, 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 traced one of the tallest

tallest *Pillars* of the *Causway* by digging into the Strand, and it continued still of the same Make and Figure, jointed as it was above, for the Depth of 8 Foot together, and he found no reason to doubt but he might have traced it much farther.

This is observable, that commonly the Joints, as well of the Inland 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 Joints, 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 the Joint that is flat on the upper 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 itself on its Surface like a very minute small glistning Sand thickly interspersed with the rest of the Solid; which by reason its Parts are so firmly combined 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*, *Furrows*, *Striae*, or any manner of Lines running along its Surfaces; 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 rubb'd or drawn along the Surface; but being a Stone naturally divided into small Pieces or Joints, 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 is exposed to the open Air, and beating of the Weather, is of a whitish Colour, much the same with what we see on common Rocks, and Lime-Stone; but the Inside when you sever one Piece from another, is of a blackish Iron-Gray, like that of the best black Marble before 'tis polish'd, 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 extremely 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, *Lackmand de 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 *Giant's Causeway*.
 “ In *Hildesheim* likewise over against the Castle of *Marburg* there is a Hill
 “ full of stony Beams, some of them standing up a little above Ground;
 “ they are long, placed in Heaps, and the Earth that is mixed with
 “ them is of a black Colour. Upon striking them with Iron or a Bit of
 “ other Stone, they smell like burnt Horn the same as the Marble at *Hilde-*
 “ *sheim*, and are quite of the same Substance with it.” He does not indeed tell us the precise Figure of these Marble Beams, yet it seems probable at least that some were square, which makes him call them, *Trabes Lapideae*. But however that might be, this I am assured 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.

The Growth
of Spar, and
Formation of
Rock-
Plants; by
Mr. J. Beau-
mont, n. 129.
p. 744.
Vid. Sup.
§. LIX.

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 Steams alone; or, 2. from Steams coagulating either Dew as it falls on the Ground, or Waters issuing from the Joints of the 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 Steams 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 Steams about the *Baths* at *Buda* in *Hungary*, according to the Relation of *Dr. Brown*. An Example of the 2d is given above; where 'tis said, that at a certain Place in *Italy*, *Chrystals* (which are a sort of *Spars*) are produced in clear Evenings, by a Coagulation of Dew falling on *nitrous Steams*. We have some of the like Rise on *Mendip-Hills*; our Miners finding sometimes in Roads, where the Earth is bare, *triangular Chrystals*, 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 *Cocoa-Nut*; none of these being ever found in digging. I have also seen of the same Sort, which were taken up in *Gloucestershire*. So again it is commonly seen in *Grotto's*, that *Steams, coagulating Waters*, issuing from the Joints of the Clefts, produce *Spars* of all Colours. As to the 3d 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.

Vid. Sup.
Cap. II. §.
XXXIX.
Vid. Sup.
§. LX.

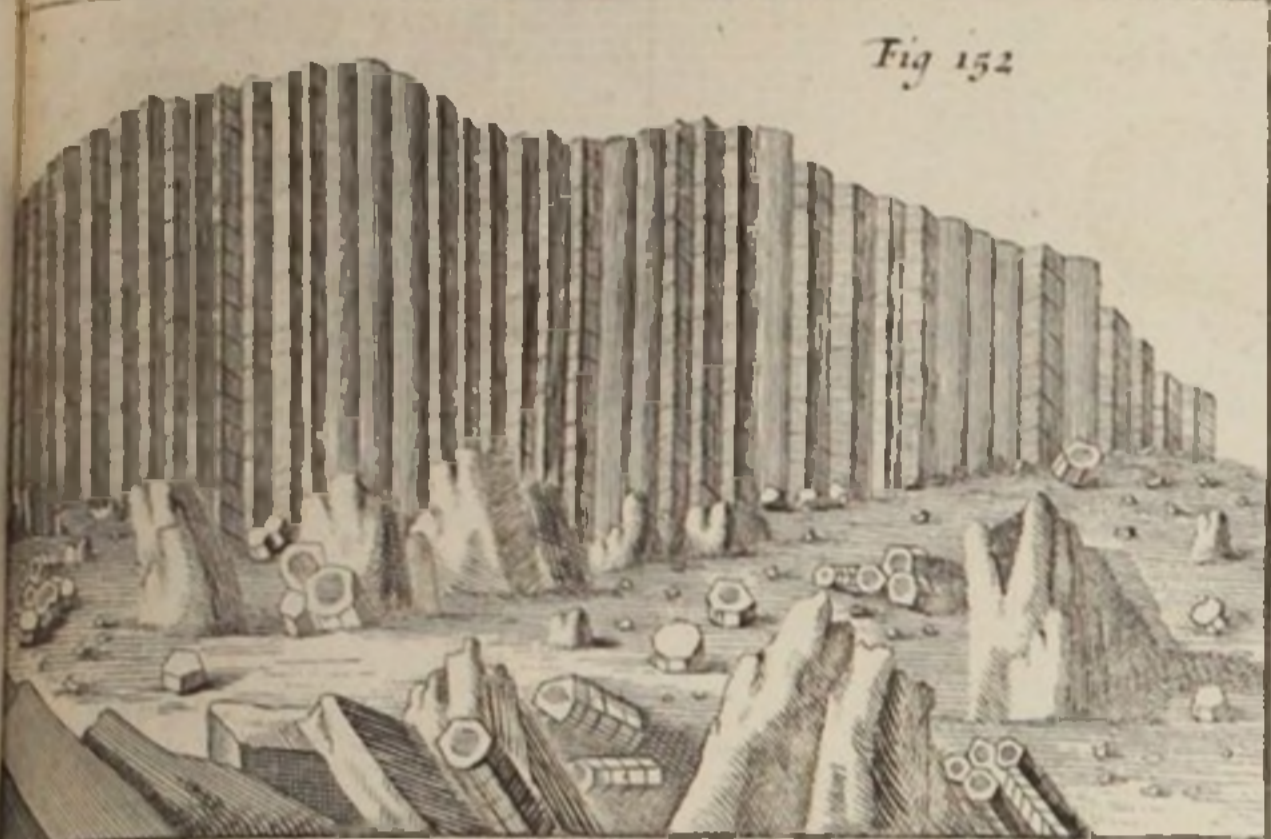


Fig. 152



Fig. 156.

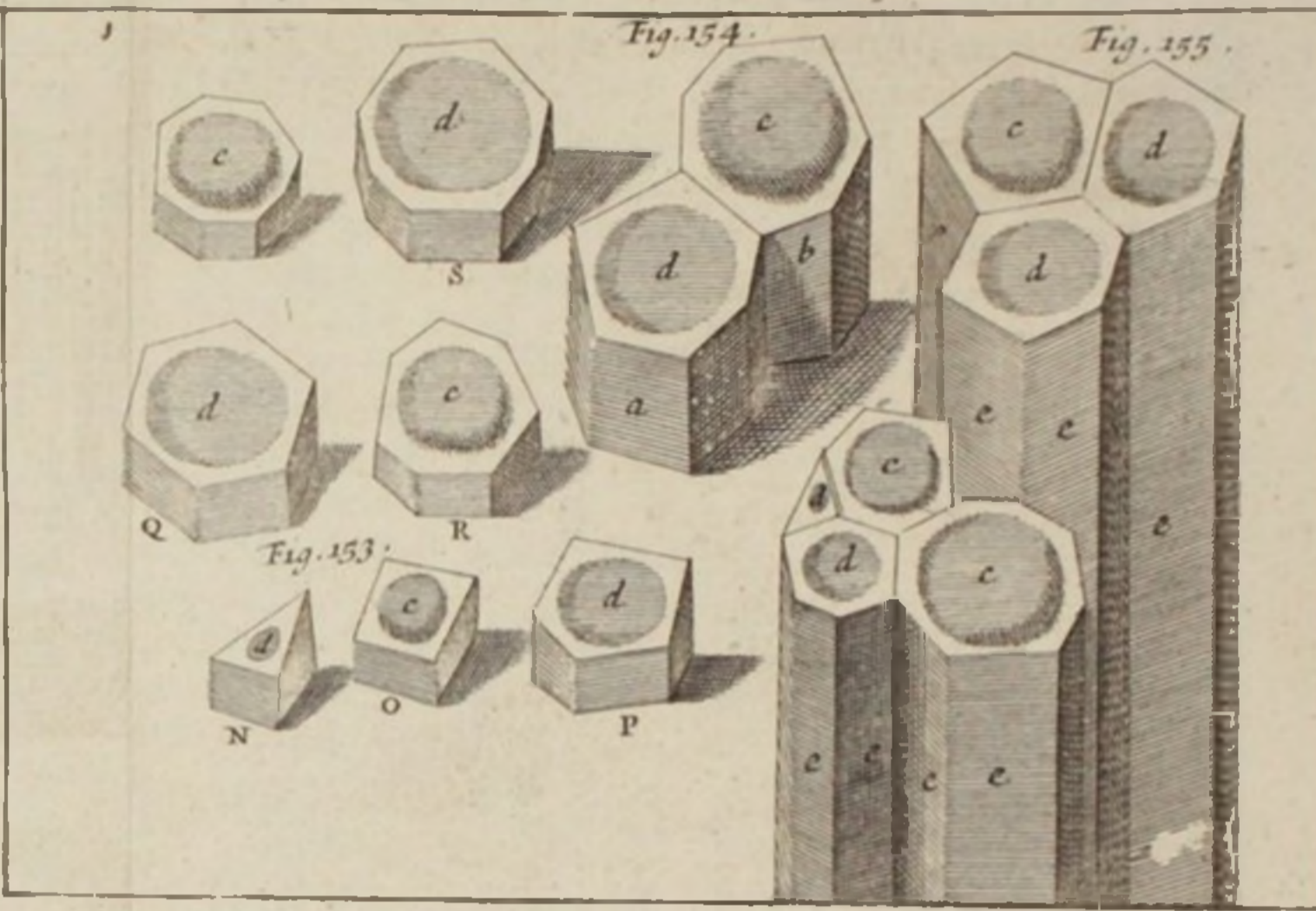


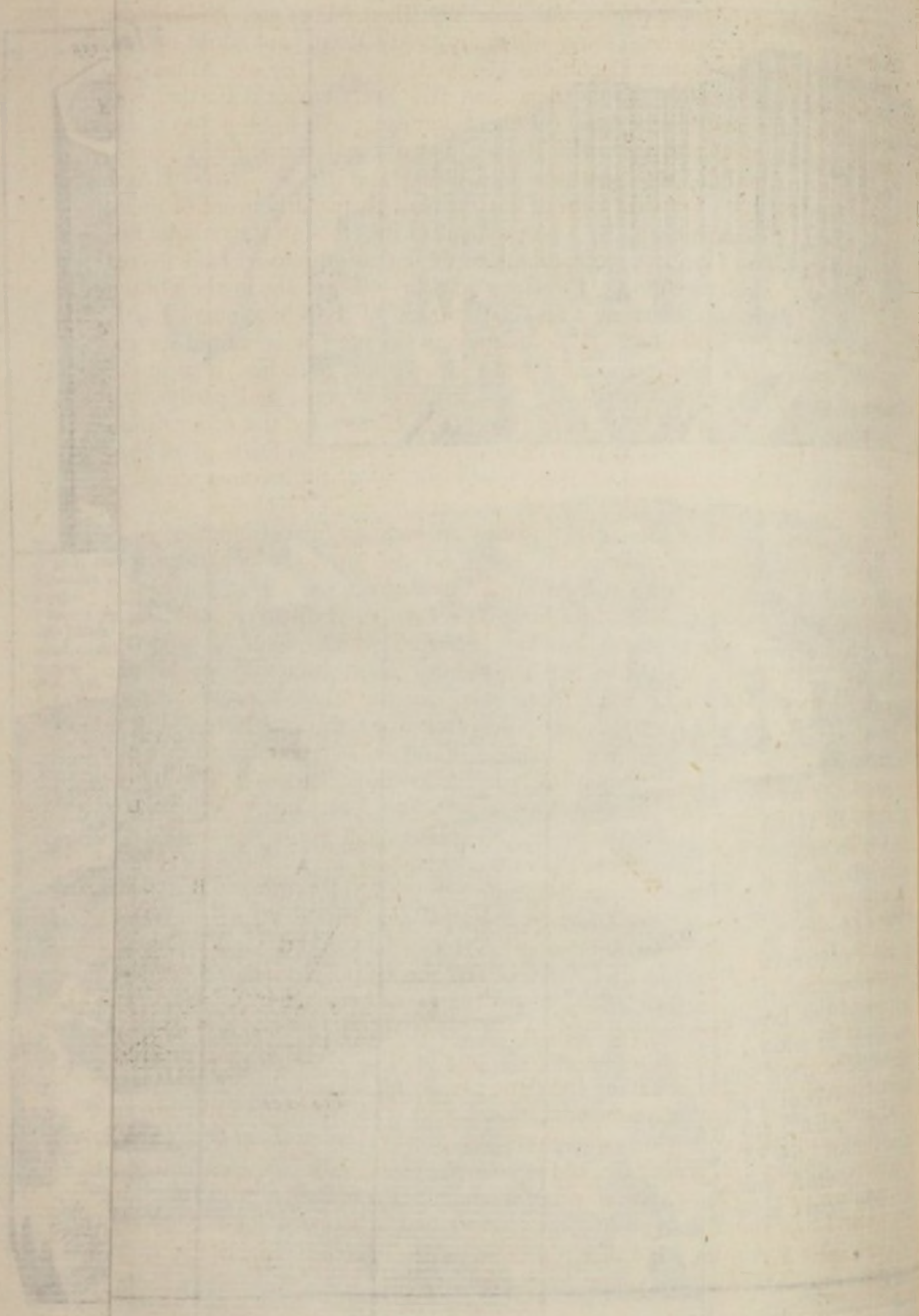
Fig. 154.

Fig. 155.

Fig. 153.



Fig. 151.



There are in *Mendip-Hills*, and generally where Mines are, *subterraneous* Vid. Sup. §. II. *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-colour'd 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 Fathoms deep, by a perpendicular Line (though the oblique Descent of it, makes it above 50 Fathoms to those that go into it) I discovered 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 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, is still sticking in its Bed; but afterwards, as it comes to be crusted over, and at last to be turned 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 Pin's-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 Talk 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* itself 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 petrefied; 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 fly to Petrefaction, as though they had been brought there by the Sea, or otherwise, and so petrefied; but we must take that to be (as it is truly) the natural Place of their Birth; some of them being raw Clay, others with 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 being no want of saline or earthy 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 sort 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* itself 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 Arborecentes 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.

Vid. Sup.
§. XXV.

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 yield 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 ploughed 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 *Petrefaction* further; I only find, that the Thing supposed to be *Petrefied* becomes first crusted over with a stony Concretion, and afterwards, as it rots away inwardly, the *Lapidescent Juice* insinuates itself 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 *Petrefied*. But, though a real *Petrefaction* 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 *Petrefaction*, because they are prepossessed 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 said concerning
our

our *Stone-Plants*, may suffice to prove their *Vegetation*, so it will be as easy 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* called 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 *Petresaction*, it being only a *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 *Petresaction*, 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 busy 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 figured *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

Lib. d. Nat.
Iviii.

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fell into these 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 its 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 Reason* 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 no equivocal Birth.

A Rock of Natural Salt in Cheshire; by Mr. Adam Martindale, n. 66. p. 2015.

LXXVIII. Here is lately found in *Cheshire* 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 Rindle (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 *Alum*, 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.

The Salt-Mines in Transylvania and Hungary; by Dr. Brown, n. 53. p. 1101.

LXXIX. There are two kinds of *Transylvanian Stone-Salt*: The *Sal 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 Emperor in *Austria*, who hath a considerable Profit upon the boiled Salt brought from *Halls* in that Province.

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

of 2 Foot in Length, and one in Thickness; and for use, it is broken and grinded between two Grind-Stones.

The Mine is cokol 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 boiled 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 even 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 Blue; 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, tho' kept without Care, remained 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.

LXXX. The Mines of *Sal Gemma* 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 itself, 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 through 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.

*Sal Gemma
Mines in Po-
land; By ..
n. 61. p. 1099.*

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 tied 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 touched 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

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.

Cut of these Mines they dig and cut out 3 sorts of Salt; one is common, coarse and black; the second somewhat finer and whiter; the third very white, and clear like Chrystal. The coarse 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 greatest Pieces lie before their Doors, where the Cattle passing to and fro, lick off 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 Grey, 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 two 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 it is cut and digged out, to those whence it is, by the abovementioned 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 Hoofs 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 conveyed to several Places, where it is boiled 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 several other Places in *Poland*, and in *Russia* also, which yield Salt; as at *Holuz*, *Colomeja*, *Solum*, *Pintz*, *Oswentz*, &c. In the *Podelian* Desert, near the River *Boristhenes*, is a Salt-Lake, whose Water is by the Heat of the Sun walted, and turned to Salt, like unto Ice, so that the People there ride into it with Horses and Waggons, and cut it into Pieces and carry it away; as the *Polish* Historian *Cromerus* at large relateth: who also affirms, That in the aforesaid *Salt-Work* at *Bochna* they find a frozen Substance, which by them is called *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 described by *Pliny*, *Matthioli*, 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; 1st, because a *Solution* of the *Natron* has the same *Taste* that a *Solution* of *Sal-Marine* hath; 2^{dly}, In *Evaporation* the *Particles* of the *Natron* incrustated upon the *Surface* of the *Water*, as the *Particles* of *Sea Salt* do in *Evaporation*. 3^{dly}, Because the *Natron* is *Perforated*, which proceeds (as I suppose) from a *Sal-Marine*, for that, when it *Crystallizeth*, shoots with little *Cavities*. 4^{thly}, 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 *Cesalpinus*, says he, *Efflorescit etiam sponte non solum in Salinis ad similitudinem Lanugenis Canescentis; sed etiam in Vasis in quibus Sal continetur.*

But here it is to be noted, that though the *Nitrian Water*, is of a bluish 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 bluish 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 rather conjecture, because, after a *Solution* of the *Natron* had pass 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 *Efferescency* with an *Acid*; and in this I was further confirmed by these two Experiments. I found that if into a *Solution* of the *Natron*, I poured an *Acid*, while the *Water* looked whitish or disturbed, the *Salt* not being perfectly dissolved, 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 a *urinous Salt*: 1st, because, if mixed with *Salt of Tartar*, it smells like *Sal-Armoniack*, when mixed with the same *Salt*. 2^{dly}, When it was distilled with *Salt of Tartar* in a *Retort*, it afforded a *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 Alkali* from the *Air*: First, because it is 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 three or four Days before the *Nile* begins to overflow, there falls a certain Dew, which hath a fermenting Virtue, and leuens a Paste exposed to the *Air*; and, at the same time, saith *Pliny*, and *M. de la Chambre*, the *Nitre-Pits* grow full of *Nitre*. And *Sands*, *Vanslebius*, and several say, That

The *Natron* of *Egypt* and *Nitrian Water* examined; by *Dr. Ch. Leigh*, n. 160. p. 609.

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 Alkali*: 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 this *Volatile Spirit*, especially in pestilential Distempers. Lastly, About that time that the *Nile* begins to overflow, those Specimens, which we have here at *Oxford*, grew heavier by being exposed to the Air.

Here it is to be noted, that this *Alkali* 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 *Aegypt* call'd *Nitria*, which gives Name to the *Nitrian Desert*, where there is a Lake call'd *Latron*, taking up an Area of 6 or 7 Acres, situated about 30 Miles W. by S. from *Terena*, 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* called *Natron* riseth 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 *Phenomena* 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 *Nitrian 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 straggling 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 skimmed 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 all other Mineral Waters, when the Water is not strong enough to hold up the Salt, it is generally covered with a thin *Film*; so, I suppose, in Evaporation of the *Natron*, some Parts of the Water being blown 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 confirmed by this Experiment: I took some of the *Natron* and dissolved it in Water, and set it to evaporate; and I found

found that the *Salt* did not incrustate upon the Water, till three 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* branched one into another, some of the Aqueous Parts being exhaled.

The Reason why its *Volatile Alkali*, in Evaporation, does not fly quite away, is, because it is held there by the *Sal-Marine*.

By the Testimony of *Hippocrates*, *Galen*, *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 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 is said by *Junken* in his *Medicus*, the *Nitre* 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 *Phenomenon* which is afforded in *Evaporation*: when the Salts had spread themselves over the Water in an Ice, those thin Plates, after a while, would spread 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, its *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 the *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*.

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 hardened 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-mentioned Mass, the *Nitre* contained within it, being pregnant with Spirit, will force itself thro' the very Pores of the Glass.

M. de la Chambre says, *Plants* do grow in *Agypt* in such abundance, that they would choak one another, if they were not hindered by throwing Sand upon the Fields; insomuch that the *Aegyptians* must take as much pains to lessen the Fatness of their Lands, as other Nations do to encrease the Fatness of it.

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 *Aegyptian Nitre* out of their Ships and make Walls, upon which they hung their boiling Kettle:

Mund. Sub-
ter. Cap. de
Nitro.

Cap. de Vitri
Invent.

the *Nitre* being heated by the Fire, mixed 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*, 1. By its fermenting: It will ferment with any *Acid*, but *Salt-Petre* will not. I found that it would ferment with *Vinegar*, as the old Commentators observe in their Comments upon *Jeremiab* 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 distinguished 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 Alkali*, but from the other a *Corrosive Acid*.

4. The *Natron* affords a red clammy Substance, insipid, 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 Nitrariæ in quibus & Rullum 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-Armoniack* it may be distinguished: First, by its Colour; for the *Natron* is ruddish, the other not: Secondly, by the Texture of its Parts; in *Sal-Armoniack*, the Parts seem close and firmly knit together, but the *Natron* is spongy and perforated: Thirdly, if mixed with *Sal-Armoniack*, the *Sal-Armoniack* emits the same Spirit, as it doth, when mixed with *Quick Lime*.

But I think it comes much nearer to the Nature of *Sal-Armoniack* than *Salt-Petre*; 1st, Because it is composed of a *Sea-Salt* and an *Urinous alkali*: 2^{dly}, 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.

The Original
of the Nitre
of Egypt; by
Dr. Lister,
n. 267. p. 837.

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 furnished with fresh Water from the Overflowings of the *Nile*; also that vast Tracts of Land there, and all over *Asia*, are naturally covered with *Fossile Salt*; again, that those Lakes are furnished with vast Animals, as *Crocodiles*, *Hippopotami*, and without doubt great Variety of other lesser Vermin: these things, I say, well considered, it is easy to think, that in a Year's Time, most of the salt Water of those Lakes has passed through the Bodies of those Animals, and consequently is become *Urinous* or *Salino-Urinous*, as is the Nature and Composition of *Fælitious Sal-Armoniack*.

LXXXII. I am convinced that Sulphur is sublimed from the Pyrites, according to the Opinion of Dr. Lister; especially that gathered upon Mount *Aetna*, *Vesuvius*, the *Solfatara*, and in the Stoves of *St. Gennaro*, not far from thence: for most of the Stones and Cinders, 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 forementioned Places, it appeared to me to be a kind of *Nitrum Calcarium*; for as I remember, it had not any *Urinous* Qualities, that I could perceive by slight Trials of Mixture; and I was the more confirmed in my Opinion, after I had seen and considered, the great Quantity of *Lime-Stone* round about *Naples*; many Beds of it lying up and down the *Terra di Lavoro*, or *Campania Felice*.

The Pyrites and Lapis Calcarius consider'd; by Dr. Tanc. Robinson n. 169. p. 924.

LXXXIII. The Master of a *Copperas* Work at *Whitestable* in *Kent*, having engrossed 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 fetid, sulphureous, or stinking Exhalations, that the People in the Neighbourhood were miserably afflicted, and forced to use all their Endeavours to extinguish it.

The Spontaneous Firing of the Pyrites; By Dr. Fred. Slare, n. 213. p. 218.

LXXXIV. The *Mineral* out of which *Brimstone* and *Vitriol* are extracted is one and the same, not much unlike *Lead-Ore*, having also sometimes *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.

A Mineral at Liege, yielding Brimstone and Vitriol; by Sir Rob. Moray, n. 30. p. 45.

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 Pyramid-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 four Hours in melting. This done, the Ashes are drawn out with a crooked Iron, and being put into an *Iron Wheel-Barrow*, are carried out of the Hutt, and being laid in a 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

Pipes into the Kettles, adding to it half as much *Mother-Water*, which is that Water which remains after the Boiling of the *Hardened 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 the boiled Liquor suffered to cool somewhat, and then it is tapped out of the said Kettles through Holes beneath in the sides of them, and conveyed through Wooden Conduits into several Receptacles, three Foot deep and four Foot long (made and ranged not unlike our Tan-Pits) where it remains 14 or 15 Days, or so long till the *Copperas* separates itself from the Water, and becomes icy and hard. The remaining Water is the above-mention'd *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.

Sulphur, Vi-
tritol, Alum,
and Minium,
from a Stone
in Sweden;
By Sir Gibb.
Talbot, n.
21. p. 375.

Fig. 153.

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. Then 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*.

The remainder of the burned *Stone* is carried out, and laid upon a high Hill, where it lies exposed to the Sun and Air for the space of two Years; and then taketh fire of itself, casting forth a thin blue Flame, scarce discernible in the Day-time. This being consumed, leaveth a blue Dust behind it; which the Workmen observe, and mark with Wooden Pins. This they dig up, and carry it into the Work-House, and put it into great *Tubs* of *Water*, where it infuseth 24 Hours, or more. The *Water* they afterward boil in Kettles, as we do *Salt-Petre*, and put it into cooling *Tubs*, wherein 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 boiled very strong, and being set to cool in *Tubs*, cross Sticks are likewise fastened, and thereon the *Alum* fastens.

In the Water, which remains after the *Alum*, 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.

The same in
England;
By . . . ib.
p. 376.

2. There is a kind of *Stone* in the North of *England*, yielding the same Substances, except *Minium*.

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 Cop-
peras Works;*
By Mr. Da-
niel 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 sometimes 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 Foot 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 dried, they lay on the Stones about two Feet thick.

These Stones will be five or six 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 the 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 four 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 jointed 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 tried 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. Sometimes 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 Wool*, 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-wise they lay ordinary flat Iron Bars, as close as they can lie, 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 Fuel 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 waxes 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 Days 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 three 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 ten Hours, *Sir Nicholas* hath now a Vessel of Lead, which he calls a Heater, placed at the end of the Boiler, and a little higher, supported by Bars of Iron as before, and filled 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, tapered towards the bottom, made of Tarras. Into this they let the Liquor run, so soon as it is boiled enough. The *Copperas* herein will be gathering or shooting 14 or 15 Days, and gathers as much on the Sides as in the bottom; scil. 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 Days 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* 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.

LXXXVII. Some Druggists have accidentally taken notice of an Increase of Weight in Oil of *Vitriol* exposed to the Air (and perhaps have improved 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 occurred more particularly on this Subject.

Oil of Vitriol increasing in Weight; by Dr. Will. Gold, n. 156. p. 496.

Nov. 4. 1683. Three Drams of *Oil of Vitriol*, so far dephlegmed as to burn or corrode a strong Packtread alunder, 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; its Increase for seven natural Days, divided by less Portions of Time, was according to the following Table.

Vid. Sup. Cap. v. §. XVI.

Nov. 1683.	Gain.	Space of Time.	Weather.	Wind.	Sum of Gain.	Natural Day.
D. 9	H. 3. 3 ̄. gr. 3 0 00	H.	Moist.		5 ̄. gr.	
10	11 p. m. 0 0 19 8 m. 0 1 12 11 m. 0 0 08 5 p. m. 0 0 09	6 h. 9 3 6	Moist and Windy. Rainy Morn. Clear.	Southerly. N. Westerly.	1 0 08	1st.
11	11 p. m. 0 0 18 8 m. 0 1 07 11 m. 0 0 04 5 p. m. 0 0 09	6 9 3 6	Star-lig. Cold, bright Morn. Mild. Mild, Dry Weather.	N. W.	0 2 18	2d.
12	11 p. m. fere 0 10 8 m. 0 0 17 11 m. 0 0 05 5 p. m. 0 0 07	6 9 3 6	Mild, Dry, Clear Morn. Frosty. Over-cast.	N. W. N. N. more. W.	0 1 19	3d.
13	11 p. m. 0 0 06 8 m. 0 0 09 11 m. 0 0 03 5 p. m. 0 0 05½	6 9 3 6	Cloudy, Rain. Cloudy. Mild.	Westerly. S. W.	0 1 3½	4th.

14	11 p. m.	0 0 06	6	Cloudy, Misty.	S. E.	0 0 18	5lb.
	8 m.	0 0 08	9	Cloudy, Misty.	Southerly.		
	11 m.	0 0 02 $\frac{1}{2}$	3	Misty.			
	5 p. m.	0 0 01 $\frac{1}{2}$	6	Very warm.			
15	11 p. m.	0 0 02	6	Cloudy, unusu- ally Warm.	More S.	0 0 15	6lb.
	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 04 $\frac{1}{2}$	6	Dry Starlight.	Easterly.	0 0 17	7lb.
	9 m.	0 0 09	10	Cold, Cloudy but Cold.	S. E.		
	11 m.	0 0 02	2	Cloudy, Windy.			
	5 p. m.	0 0 02	6	Cl. very Mild.			

From the 16th, in the successive Spaces of 24 Hours, each gained 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 (Decemb.) 4, 4 $\frac{1}{2}$ 4, 3, 3, &c. still irregularly decreasing till the Liquor was satiated. The *Diary* was continu'd to Jan. 4. 168 $\frac{3}{4}$. 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, Driness 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 appeared, 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, *ceteris paribus*, than when Southerly or Westerly, and was less in the Day than in the Night. The primary Cause of this *Phenomenon* 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 mentioned, 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 14th of *Novemb.* from 11 m. to 11 p. m. (at which time, especially 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 thereby the Moisture might rather be exhaled, or at least might be suspended, agitated, and intimately mixed 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 *Oil 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 evinced, by an Inquiry made into the Nature of the Substance gained with the Increase of Weight: For by the ordinary ways of Trial it appeared, 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 disposed to receive one sort rather than another. Thus the Mortar in the Joints of old Walls and Vaults, from Corpufcles attracted from the Air, spouts out and frames a peculiar kind of Salt. I have known a Deal Shelf, moistened only with the Liquor of *fixed Nitre*, frosted over with *Chrystals* of a perfect *inflammable Nitre*, by regaining the proper *Acids* from the Air, all one as if so much Spirit of *Nitre* had been poured on the said Liquor. I have seen a Viol half filled with *Oil of Tartar per Deliquium* (by being left open to the Air) beset above the Liquor with peculiarly figured *Chrystals*, and at the bottom were flat *Chrystallized 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, *Oil 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 Taste of our augmented Liquor was still purely *Acid*, and only weaker than before; whereas it would have been saltish, had an *Alcali* been combined with it, and its Colour, from a deep reddish, became *limpid*, all one as if the like Quantity of fair Water had been mixed. But to be more certain in this Point, I distilled of the new-gained Substance: At first it came over as insipid as clear water; and urging the Fire farther, the Drops proved sour, and the remaining *Oil* in the *Retort* was altogether as *corrosive* as at first. Whence we may infer, its Edge was not at all blunted by any adjoined *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 Oil of *Vitriol*; for it appears by the Table, the more diluted the Liquor, the less attractive it proved. This here employ'd (as highly dephlegm'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 came to a Stand.

Which Proportion of *Increase* I found confirmed in lesser Quantities also; as 3 *gr.* increased to more than 9 *gr.* and one Grain gave the *Weight* of somewhat more than 3 *Grains*. But beside 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 *Sun-less Room*, than in a Room not so qualified.

All these Circumstances, which relate to the Quantity, will also influence very much the Time of the *Increase*, but what 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 *Increase*. Thus 3 *Grains* dropt and diffused to near $\frac{1}{2}$ Inch breadth on a Piece of Glass, gained 3 *Gr.* in 6 Hours; 1 *Gr.* in 6 more; 1 *Gr.* and $\frac{1}{2}$ in 12 Hours more; in the next 12 Hours it gained $\frac{1}{2}$ *Gr.* and in the last 12 Hours it gained 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 exposed in the same Room, and to the same Temper of the *Air* (as near as I could guess) 3 *Drams* of the same Oil 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*, gained (as in the *Table*) near 19 *Gr.* the first 6 Hours, this less Surface gained 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 1 the Square of the less, is to 9 the Square of the greater Glass's *Diameter*, so was the Weight of a little more than 2 *Grains* gained in the narrower Glass, so near 19 *Gr.* gained in the broader: Wherefore the *Time* of increasing bears, as near as can be expected, an exact Proportion to the Surface of the Liquor exposed, 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.

White Vi-
trid. by *Dr.*
Lifter. n.
256. p. 331.

LXXXVIII. All I can find of the Origin of *White Vitriol* is out of *Borrichius de Docimastice Metallica*, that it is produced from a certain *Lead Ore* boiled raw. (*Plumbi Nigri Vena Nitriolam Album producit, etiam non cremata.*)

None that I know 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, or any

any coloured *Lead Ores*, did give me any Reason to suspect, after divers Experiments upon them, that they yield *white Vitriol*.

As to the *Chrystals of white Vitriol*, they are very difficult to describe, and seem to me to be a Congeries of infinite small Needles; for which reason they are of a most speedy Operation, and irritate the Stomach suddenly, before they can be well dissolved or broken.

LXXXIX. *Alum* 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 blueish Colour, and will cleave like *Cornish Slate*.

Alum
Works; by
Mr. Dan.
Colwal, n.
142.p.1052.

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 *Mines*, which sometimes lie 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 dig 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, it is fit for *Alum*. 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 *Alum*.

The Mine is calcined with *Cinders of Newcastle 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 Fuel, and 5 or 6 of them so covered; then they begin to kindle the Fires, and as the Fire rises towards the top, they still lay on fresh *Mine*: So that to what Height you can raise the Heap, which is oftentimes about 20 Yards, the Fires without any further help of Fuel 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 calcined, 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* or *Mine*; so that every *Pit* of Liquor, before it comes to the 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 steeped in each of the several Liquors 24 Hours or thereabout, 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 increaseth 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 Goodness of the *Mine*, and the well calcining 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 *Alum* than that of 10 or 12 Pound Weight, either thro' the Illness of the *Mine*, or, as usually, the bad calcining thereof. And if by passing the weak Liquor thro' another *Pit* of fresh *Mine*, you bring it to 10 or 12 Pound Weight; yet you shall make less *Alum* 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 poisons 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 calcining 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 dried, it will burn and run like *Pitch*; when cold and hard, it is beaten to *Ashes* steeped in Water, and the *Lees* drawn off to 2 Pound Weight, or thereabouts.

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 *Yeast* 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 2 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 *Boilers* 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 2 Penny-Weight, which will reduce the whole *Boiler* 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 *Yeast* 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 *Settler*, 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 a Power strong enough to cast off the *Slam* and *Nitre*; but when the *Mothers* are used, the *Kelp Lees* are needful to make the said Separation.

Then the said *Liquor* is scooped out of the *Settler*, into a *Cooler* made of *Deal-Boards*, and rammed with *Clay*. In 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 3 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 hardening 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.

Experiments
about Vitriol,
Sulphur, and
Alum; By . . .
n. 103. P. 41.

XC. *Vitriol* is of several Kinds, being for Colour, *White, Yellow, Green, or Blue*; usually of the two last mentioned: And is made either of *Mineral Waters*, boiled up to a convenient Consistence; then set to *Chrystallize*: Or extracted by common Water out of Earths impregnated therewith. 'Tis also afforded by many sorts of Stones, commonly called *Pyrites* and *Marchasites*, which exposed some Months to *Aerial Influences*, are resolved into Powder, and the Saline Part dissolved in Rain or other Water; then boiled 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 *Mjss, Sory, Chalcitis*; from which 'tis usually separable 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 *Spagyricall* Uses. Lastly, it is copiously contained in common *Mineral Sulphur*.

Vitriol consists of *insipid 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 *Chrystallize* 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 separated. Dissolve *Vitriol* in fair Water, immediately a yellow Powder will separate, 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, seconded by *Filtration* and *Coagulation*, and each time separated some Quantity of this Earth: And I am persuaded, had I long continued the Operation, the Success would have been the same, only I observed the Quantity separated each time, sensibly to diminish. But I have found a more easy and expedite way of effecting this Separation: Take a good Quantity of the common *Dantzick* or *Hungarian Vitriol*; having powdered 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 Additament, become
fluid,

fluid, as if 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 *ChrySTALLIZETH*; 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 *Dulcified Colcothar* is *Inspid 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 separated from *Metalline* and *Saline* Parts, by a Method I shall hereafter mention, there remains a great Quantity of an *Inspid* Substance nearly resembling *Burnt Alum*. Besides, whereas *Salt*, *Nitre*, &c. require in *Distillation* a large Quantity of *Earthy* Substance to disjoin the *Saline* Parts, and prevent *Fusion*; *Vitriol* and *Alum* 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 rises, hath a highly sulphureous Smell; as hath also that we shall hereafter mention, distilled from *Vitriol* deprived of its *Metallick* Parts. The *Colcothar Dulcified*, or *Metallick* Parts precipitated by an *Alkali*, or *Immature Mineral* sublimed with *Sal Armoniack*; an *Inflammable Sulphur* may be many ways separated, both from the *Sublimate* and *Caput Mortuum*. The common Oil 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 Oil of *Vitriol* digested with *Spirit of Wine*, and distilled, yields an Oil, and at the latter End, store of sulphureous inflammable 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 the *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 *Marchasites* into the great Cistern. I distilled therefrom, in Glass Vessels, two Thirds of *inspid 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 called *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 in 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 *Oleagenous*.

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 to 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 as clear as Rock Water, almost, nay I think altogether *Insipid*; yet the Smell so subtle 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 separated 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 *Geslar 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 Mortuum* of the common *Vitriol*, but *White*, *Light*, and *Spongious*, like *burnt Alum*, and altogether as *Insipid*; although, after

after it was some time exposed to the *Air*, it received many strange Impressions and Alterations.

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 Oil of *Vitriol*, the *Acidity* of *Sulphur* afforded by Brimstone inflamed under a Glass Bell; which being rectify'd, is not to be distinguish'd, by any sensible Property, from the well *Rectify'd Acidity*, or Oil of good *Vitriol*; and they may, I am confident, be safely substituted for each other, producing in Men and Metals the very same Effects, being in my Apprehension no less alike in their internal and secret, than in their *external* sensible Qualities. n. 104. p. 66.

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 Drams, 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 myself 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 *Cobobation* 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 Earthy and Metallick Particles, the Sulphureous being capable of a fluid Form, and are copious in Oil, in *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 Oil 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 Oil of *Turpentine*, and distilled, at the latter end store of Brimstone will sublime: I suppose none will ascribe this to the Vegetable Oil, which is only the means of its Separation, 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 Balsam of *Sulphur* with the said Oil of *Turpentine*:

pentine: After the Oil is fatiated with *Sulphur*, it lets fall store of fair *Chrystals*; an evident Proof of its *Saline* Nature. For although these *Chrystals* broken, within will appear full of *Sulphur*, their outward Parts or Superficies seem perfect Salt, by virtue whereof they are disposed to *Chrystallization*. I may indeed be objected, that *Chrystallization* is not a sufficient Proof of a *Saline* Nature, the *Essential Oils* (as they are called) of *Anniseeds*, *Fennel-Seeds*, and of many other Substances being very prone to *Chrystallize*. But most *Essential Oils* 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 Chrystals*. The same may be effected with *Iron*. Or, take the *Acidity* of *Sulphur* (corruptly call'd its Oil) 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 chrystallized 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 easily 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 itself 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 *Acidule* 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

Alonso Bar-
ba's Art of
Metals.
Lib. I.

Ores

Ores and *Pyrites* being distilled *per Descensum*, yield abundance of common *Sulphur*: The Remainder thereafter affords store 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 *Marchasites*, 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 Principles, (the *Primordials* of all *Species* in the Universe being in my Opinion *Spermatical*) but being once at the Command of the *Architeetonick* 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 imployed in almost every Operation; especially the Salt, without which no perfect Animal can subsist a Minute, and all Vegetables deprived thereof, do immediately decay. It's 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 to the Air are resolved into a Powder, and afford some *Alum*, 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 easy ingress. And it is, I think, by most allowed, that after all the Salt is extracted out of Earth impregnated with *Vitriol*, *Alum* 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 *Alum*, 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 cracked 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

multuating 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, Alum, 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 Alum: which may by several Methods be separated from each other. The Mineral of Alum, if mature, *Elixivated* 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 Alum, as that is, being produced by the *Sulphur's* acting on, corroding of, and coagulating with, some mineral Substance, which usually partakes more of a *Terrene* and *Stony*, than *Metallick* Nature: although Metal is often found to be contained in the Alum-Stone or *Ore*. And that the *Sulphur* is the chief efficient and material Cause of its Production, appears from hence, that many Alum-Stones (as the *Vitriolate*) distill'd *per Descensum*, yield good Brimstone; and all Alum-Stone 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, Alum, 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 *Alum* into *Vitriol*, or *Vitriol* into *Alum*, which shall be the *same*, to all Intents and Purposes (as we commonly speak) with the *Natural*.

Alum distilled into an *Acid Spirit* with Copper or Iron, becomes good Vitriol; and Vitriol freed from its metallick Parts, becomes *Aluminous*; and distill'd, yields a Spirit scarcely to be distinguished, not only by Taste, but even by the nice and accurate Scrutiny, from that of Alum. And (which doth in some measure illustrate this *Affinity*) I have often observed rectified Oil of Vitriol and Spirit of Sulphur, to coagulate, and become solid transparent Concretions, exactly resembling Alum chrystallized, 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

call'd *Naptha*, 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 extinguished 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 *Alum*, hardly distinguishable from the natural.

XCI. I kept by me certain big Pieces of *Crude Alum 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 *Marchasite* of the-Coal-Pits, which here we call *Brass Lumps*. The Efflorescence of certain Mineral Glebes, by Dr. Lister, n. 110. p. 221.

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 chrystalline. These *Tufts* did as often repullulate, as they were struck and wiped clean off.

The *Aluminous Fibres* were of a Taste very *Alumy*, and pleasantly pungent: The *Vitriolick*, *Stiptique* and *Odious*. Again, the *Alum* ones, being dissolved in fair Water, raised a small *Ebullition*: Whereas the *Vitriolick Fibres* dissolved quietly. The *Alum Fibres* were generally smaller, and more opaque, Snow-like. The *Vitriolick* larger, many Fibres equalling a Horse-Hair in thickness, and more *Chrystalline*. The Water wherein the *Alum Fibres* were dissolved, 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 *Marchasite* 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 *Alum* and *Vitriol* to be most genuine and natural, and their angular Shootings, after Solution into *Cubes* and *Rhombodies*, to be forced and accidental; *Salts* of very different Natures, as well Vegetable as Fossile, by a like Process in chrystallizing of them, being observed to shoot into like Figures.

XCII. 1. Signior *Marco Antonio Castagna*, Superintendant of some Mines in *Italy*, hath lighted, in one of them, upon a great Quantity of that lanuginous Stone called *Amiantbus*, 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,

Amiantbus,
By . . . 72a
p. 2167.

while, the fiery Colour presently disappeared, and it became cold and white again as before; the Fire it seems passing only through, without wasting or altering any thing of it: whereas some of the hardest and solidest Metals, 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 ancient and so much admired *Amiantus*; 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 tried in the Fire, and there it remained likewise without any visible detriment, or without the least change of its first whiteness, fineness or softness. Of the same Matter this Artist hath wrought a Wick, never to be consumed as long as 'tis fed, nor altering its Quality after the Aliment is wasted away.

By Mr. Edw.
Lloyd, n.
176. p. 823.

2. The *Lapis Amiantus*, or *Linum Fossile Asbestinum*, is found in no small Quantity in *Llyan Fairyng Hornwy* in the Northern Part of *Anglesey*, where it runs in Veins through a thick 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 *Amiantus*, 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 Filament 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 is a very thin *Septum* of terrene Matter, betwixt the *Amiantus* and the Stone whereto it adheres. I put a small Quantity of the Lint in the Fire, which grew red hot; but tho' 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 Wick, and dipping it in Oil, it gave as good a Flame as other Wicks, till the Oil was consumed, the Wick 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 thro' a fine Searce, by which means the terrene Parts (being reduced to a Powder) came thro' 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 that 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 coarse, and too apt to tear: But this being the first Trial, I have some reason to believe it may be much improved.

Incombustible
Cloth, by Mr.
Nic. Waitc,
n. 178. p.
1049.

XCIII. I here send you the Account of the incombustible Linnen Cloth, which I received from one *Conco*, a natural *Chinese*, Resident in the City of

of *Batavia* in the North-East Parts of *India*, who by means of *Keayarear Sukradana* (likewise a *Chinese*, and formerly chief Customer to the old *Sultan 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 turning, I have seen diminish almost half. They report also, that out of the said Tree there distils 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.

2. A Handkerchief, or Pattern of this *Incombustible Linnen*, which was shewn the *Royal Society*, was a Foot long, and just half a Foot broad. By . . . ib.
p. 1050.

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 Oil 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 one Ounce, six Drams, sixteen Grains, and lost in the burning 2 Drams, 5 Grains.

The second Experiment of it was publick before the *Society*, *November 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 Charcoal Fire, it was permitted to continue red hot in it for several Minutes: When taken out, tho' 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.

Decemb. 3. Mr. *Arthur Baily*, one of the Fellows of the *Royal Society*, presented them with a piece of this Linnen in the Name of Mr. *Waite*. 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, *Decemb. 16.* it being put into a strong Charcoal 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.

3. This kind of *Linnen Cloth* was esteemed by the Ancients, though then more common, and perhaps better known, than it is yet amongst us, equally precious with the best of *Pearls*. By Dr. Rob.
Plot, ib. p.
1051.

Nor is it now of mean Value even in the Country where made, a *China Coveit*, (i. e. a Piece 23 Inches and $\frac{3}{4}$ long) being worth 80 *Tale*, i. e. 36 *l.* 13 *s.* and 4 *d.*

The *Reality* of such a Being has been doubted, or denied by very good Authors: Who though they owned such a *Mineral* as *Amiantus*, out of the woolly Part whereof, this sort of Linnen was always anciently 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 of 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 washed 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 called from its strange Qualities, sometimes *Amiantus*, quod in Ignem injectus non *mutatur*; the Fire being so far from defiling it, that it rather gives it a Lustre.

2. It is called *Asbestos*. And,

3. *Salamandra*, in *English*, *Salamander's Wool*: I suppose from the *Thryalides*, or *Candle-Wicks*, said to be anciently made of it, which being put into *Lamps* of *inconsumable Oil*, would never waste 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 called *Alumen*, having the distinguishing Epithet *Plumeum* added to it, taken from its downy Filaments, to discriminate it from all the rest of the *Alums*.

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-Wood*, *Spartapolia*.

6. From the Capacity it has of being spun into Thread, it is also called *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 besides the Places that have given these Epithets to the Thread made of it, it is also found in *Tartary*, at *Namur* in the *Low-Countries*, at *Esfield* in *Thuringia*; among the *Mines* in the old *Noricum*; somewhere in *Egypt*; and in the Mountains of *Arcadia*; also at *Puteoli*, and lately in some *Mines* in *Italy*; and it has been yet lately met with in a small Island belonging to *William Robinson*, Esq; called *Ynis Molroniad*, i. e. the Island of *Sea-Cales*, in the Parish of *Llan-Fairing 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 hardened to Perfection by the Heats in Summer; which *Sal Johannes Hesus* proves by a very cogent Argument to be *Alumen Liquidum*,

quidam, describing it as *Matthiolus* also does, to be of a whitish lacteous Substance, somewhat 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 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 plumbeum*; 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 cinerous; 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. Robert 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 Thrum of the *incumbustible 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-ercar Sukradana*, mentioned in *Mr. Waite's* Letter, I say, render it probable there being several Woods, such as *Box*, *Red-Wood*, *Persian Wood*, &c. that will sink in Water.

Marcus Paulus Venetus acquaints us, that it is found in *Tartary* in a certain Mountain in the Province of *Chinchintbalus*, and made into Cloth, as he was informed by one *Cursicar*, a *Turk*, who was Superintendant of the Mines in that Country, after this manner: The lanuginous Mineral of *Amiantbus*, being first dried in the Sun, is next pounded in a brass Mortar, and the earthy Part separated from the woolly, which is afterwards 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 Hour's time, whence it will come forth unhurt, as white as Snow. Which very Method (as *Strabo* describes it) seems also to have been used in ordering the *Cretan Amiantbus*; 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.

*De Region.
Orientalibus.*

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 *Keayarear Sukradana* was credibly informed (and I have it well confirm'd 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 render'd altogether useless. Some of the Antients 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 *Milan*, had Thread, Robes, Net-works, and Paper of it. *Marco Antonio Castagna*, who lately found this Mineral somewhere 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 a very white Skin, or a very white Paper. We have also made Paper of our *West Amiantbus* 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 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 *Striae* of liquid *Alum*, 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

pass thro' 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.

XCIV. The *Lapis Calaminaris*, or *Calamine*, which is digged 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 lies as in any other Place. But this I obſerve, that the Groovers always dig for it upon or near Hills; for they expect none in thoſe Grounds which have no Communication with Hills.

Lapis Calaminaris, By Mr. Giles Pooley, &c. 1672. p. 672.

To find out a Vein, they dig a Trench till they come to the Rocks, where they expect it lies; which Trench they generally dig 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 the Calamine lies, is generally a yellow Grit, but ſometimes black; for all Countries, as they term their underground Works, are not alike.

The Calamine itſelf 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; tho' I think, in Lead Mines, they do not always find Calamine. In landing of the Calamine, ſome Pieces are bigger than others, and mixt with a gritty Earth. I have been inform'd, 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 antient Works, Damps and Stenches 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 raked 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 thrashy 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 itself 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 four or five 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 Plank, 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 it is frequently made use of, for the taking off Films from the Eyes of Horses and other Beasts.

To vitrify
Antimony
with Cawk;
By Dr. Mat.
Lifter, n.
110, p. 225.

XCV. 1. Take of *Antimony* one Pound, flux it clear; have one Ounce, or two, 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*.

This Process gives us above 15 Ounces of *Vitrum* of *Antimony*, like polished *Steel*, and as bright as the most refined *Quicksilver*. The *Cawk* seems not to be diminished in its Weight, but rather increased; nor will it be brought to incorporate with the *Antimony*, though fluxed in a strong Blast.

Vid. Sup.
§. XLVI.

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*.

Cawk

Cawk is a ponderous white Stone, found in the *Lead-Mines*; it will draw a white Line like *Chalk* or the *Gallatites*; but it is more fine, and hath a smooth and shining Grain, *Sparr*-like, yet not at all transparent.

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 in 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 Purifier 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 two 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, and notwithstanding extream running Legs; so that after he had passed the Course of Farriers twice, to be cured, it was not done; but upon my giving him *Antimony* one Week, he was presently healed.

*The Virtue
of Antimo-
ny; By —
n. 39. p. 774.*

The manner of using it is this: Take one ʒ of *Crude Antimony* powdered for one Horse, and when you give him his Oats in a Morning, shake it out amongst his Oats; or make it in Balls.

XCVI. A small Vial filled with ordinary white Sand, and containing only lb i. gr. xi. being filled with *Virginia Sand* was found to contain ʒ ii. ʒ ii. gr. i.

*A black shi-
ning Sand
from Virgi-
nia; Exa-
mined by
Dr. All.
Moulen, n.
197. p. 624.*

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 calcined with powdered Charcoal, and kept in a melting Furnace for about an Hour, yielded no *Regulus*, but applied more vigorously to the *Load-stone* than either of the former.

I fluxed a Parcel of this *Sand* with *fixed Nitre*, in a melting Furnace, for above an Hour, but could obtain no *Regulus*, nor any Substance that would apply to the *Magnet*, except a thin Crust that stuck firmly to a Piece of Charcoal that dropt into the Crucible when the Matter was in Fusion.

I fluxed it also with *Salt-Petre* and powdered 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 fluxed another Parcel of it with *Salt-Petre* and *Flowers of Brimstone*, without being able to procure any *Regulus*.

I poured good *Spirit of Salt* on a Parcel of this *Sand*, but could observe no *Lullation* thereby produced.

I poured *Spirit of Nitre*, both strong and weakned with Water, on Parcels of the same *Sand*, without being able to discover any Conflict.

I poured single *Aqua Fortis* upon another Parcel of it, without being able to perceive any *Ebullition* worth noting.

I poured 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 produced, I weakened 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 could scarce observe a Bubble produced 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 Ore that some of these *Menstruums* will not work on.

I powder'd a Fragment of a Load-stone, 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 aforementioned *Menstruums* upon ordinary Sand taken out of a Sand-Furnace, where it must have suffer'd some Calcination; but could find no more Bubbles produc'd thereby, than what might rationally be supposed to be produc'd from Lime, and other Dirt mixt with the Sand.

*A black Sand
from Italy;
By Mr. Butterfield, n.
244. p. 336.*

XCVII. The black Sand, which in *Italy* they use instead of Dust to their Letters, is found six Miles from *Genes* near *St. Pierre d'Araine* on the Sea-shore. It hath the Properties of the Load-stone, and I do believe that it is Load-stone, or Powder of Load-stone, for it followeth the Load-stone; it sticketh to a Knife that is touched with the Load-stone; 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-shore after great Storms.

*To make
Metal run
smooth and
close; By
Mr. Frankfort
on the Main,
n. 94. p. 6040.*

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 boring, 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 Demi-Cannon, weighing 34 Hundred, which was tried 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 endured 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.

This Powder is not only easy to make, but also of small Expence.

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.

Iron Works
in Gloucester-
shire; By
Mr. Hen.
Powle, n.
137. p. 931.

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 bluish 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 *Cinder*, which is found in great Quantities thro' 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 useles. This is called *Cinder*, and being mingled with the Ore in a due Quantity, gives it that excellent Temper of Toughness, for which this Iron is preferr'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 Outside, and near 30 Foot in height: Within not above eight or ten 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 *Cinder* 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 thro' 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 con-

tinues boiling for a good while. The Furnaces are kept at work Night and Day for many Months; still supplying the Waste of the Fuel, 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 three or four of them together behind the Fire, with a little of one End thrust into it: Where softning by Degrees, they stir and work them with long Bars of Iron, till the Metal runs together in 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 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 Sand.

In Lancashire; By Mr. John Sturdy, n. 199. p. 695.

2. At *Milthorpe* Forge in *Lancashire*, they have several sorts of Iron Stone, some of it making *Coldshire 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 two 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, six or seven Yards square-wise, but tapering; so that the top Hole (where they throw in Baskets of Stone and Fuel) is but half a Yard square. When they find it to have subsided about a Yard and an half, then they fill the Furnace again.

The *Ore* is got in *Furness* (a Division of *Lancashire*) at least 15 Miles from *Milthorp*, 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 *Hematites*.

2. The Forge is very much like that of a common Black-smith's, about a Yard and a half over, and the same height. The Hearth is all Sow-Iron, much of the shape of a broad-brim'd Hat, with the Crown downwards. This hollow Place they fill and heap up with Charcoal, and lay the *Ore* (first broken into pieces as big as a Pigeon's 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 twelve Hours. Then they pull out a Stopple at the bottom of the Wall, and out comes all the Glassy Cinder, 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 (play'd with Water) which at the same time beat off, or rather squeeze out, the fluid *Scoriae* (especially at first taking out of the Furnace) and from it, after several Heats, into Bars. They use no Limestone, or other things, to promote the Flux. They get about an hundred weight of Metal at one melting, which is the product of about three times so much *Ore*.

Steel is not made from that they call *Steel Ore*, but Iron, such as is made from the rest.

The several sorts of *Ores* lie in one Vein, which is sometimes an Inch, sometimes a Foot, and sometimes three or four Yards broad, and many Fathoms deep, between grey Limestone Rocks; but the hard *Ores* lie 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.

3. This Clay *Hematites* is as good, if not better, than that which is brought from the *East-Indies*; witness the Tea-Pots made of it in *Staffordshire*.

C. Those famous and stupendous Monuments of Antiquity, the *Egyptian Obelisks*, are all of *Porphyry*, and most of them curiously carv'd with a vast number of Figures, one way of Writing of the antient *Egyptians*: These witness the Facility that Nation had of Graving in *Porphyry*; a Stone which no Tool will now touch, nor nothing less affect, than Emery or Diamond 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 suffer'd 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

Ibid, p. 697.

Ib. p. 699.

By Dr. Lister. ib.

The true way of making of Steel; By Dr. Mart. Lister. n. 203. p. 865. Vid. inf. Vol. III. par. II. Cap. II. §. XLIV.

poisoning of Iron by certain mineral Salts, rather than a true making of Steel.

Meteor. l. 4.
c. 6.

Aristotle tells us, “ that wrought Iron it self may be cast so as to be made 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 Excrement it hath.” This Account is a little confused, and not well understood : 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 itself, how oft soever it is purged and refined, will never become *Steel* ; yet of this so purged, the best *Steel* doubtless may be made.

De Re Metal.
l. 9.

The manner of making true *Steel*, is thus faithfully described by *Agricola*. And this way by *Kircher* is said to be now in use in the Island of *Ilva*, a Place famous from all Ages, even from the Times of the *Romans*, for that Metal alone, down to our Days.

“ Make choice of Iron which is apt to melt, and yet hard, and which may easily be wrought with the Hammer ; for altho’ Iron which is made of *Vitriolick Ore*, may melt, yet it, is soft, or fragil, or eager. Let a parcel of such Iron be heated red hot, and let it be cut into small pieces, and then mixt with a 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 a half broad, and a Foot deep ; fill the Dish with good Charcoal, and compass 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 thoroughly kindled, and the Dish is red hot, give the blast, and let the Workman put on, by little and little, all the mixture 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 five or six 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 consume, 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 Workman 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 temper’d, let him again work it on the Anvil, and break it ; and looking upon the Fragments, let him consider whether it looks 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

“ 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 Wa-
 “ ter. And thus Iron is made into *Steel*, which is much harder and whiter
 “ than Iron.

Pliny, speaking of Iron, says, *Fornacum maxima differentia est; in iis equi-* Lib. 34. c. 14.
dem Nucleus ferri excoquitur ad indurandum aciem, alioque modo ad densandas
incudes malleorumve rostra. From this Passage it should seem that the An-
 tients had one way to make the *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 *εργασμέτος σίδηρος*) was melted down in both. But, in my
 Opinion, with this difference, in making *Steel* they not only boiled their
 Iron in its own Sow-Metal, or liquid Iron, but hammer'd it also, and after
 quenched it in cold Water.

And this Opinion those other Words of *Pliny*, in the next Chapter, favour,
Ferrum accensum Igni, nisi duretur iētibus, corrumpitur: And again, Aquarum
summa differentia est, cui subinde candens immergitur. And this way was suffi-
 cient for Sword-Blades, and Knives, Razors, &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 *Den-*
sare is, by *Pliny*, aptly and elegantly used. And this way was used when
 the strongest Temper and Hardness was required, as to Picks and Anvils:
 For it is certain that *Steel*, as well as Iron, by Ignition, is spoiled or cor-
 rupted. Hence it was that the Antients 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.

Cl. 1. *Herru-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 *Newfol.* In this Town is the Entrance into a large *Copper*
 Mine, very much digged.

Copper
 Mines in
 Hungary; By
 Dr. Edward
 Brown. p.
 59. p. 2042.

I went in thro' a *Cuniculus*, called *Tach-stolu.* 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 in the Rock, that it is separated
 with much difficulty. There are divers 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 *Quick-silver* here; the *Mother* of the *Ore* is yellow, and the *Copper-Ore* heated and cast into Water, maketh it become like that of some sulphurous Baths.

They separate the *Metal* from the *Ore* with great Difficulty. The *Ore* commonly passes 14 times through the Furnace: Sometimes it is burned and other times melted, sometimes by itself, and sometimes mixed with other Minerals and its own Dross.

There are divers sorts of *Vitriol* found in this Mine, green, blue, reddish, and white. There is also a green Earth, or Sediment of a green Water called *Berggrun*; there are likewise Stones found of a beautiful green and blue 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 Zimeut*; these Springs lie deep in the Mine: The *Iron* is ordinarily left in the Water 14 Days; I took divers Pieces formerly *Iron*, now appearing to be *Copper*, out of the *Old Zimeut*; 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 Substance.

They make handsome Cups and Vessels out of this sort of *Copper*.

In Lanca-
shire and
Cumber-
land; By Mr.
Dav. Davies,
to Dr. Lister.
200. p. 737.

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 six Foot; there are no Shafts now in being either at *Newlands* or *Caldbeck*, there are divers Adits, but they are useles, the Workmen have wrought down the *Ore* far below them; there is part of an Adit wrought at *Caldbeck*, but it is uncertain what it 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.

A Thousand Pound Stock will be enough to begin with, to get *Ore* at *Caldbeck* Mines, and then there must be melting 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 itself, it will be six or seven Years at least, and by that time 10000 will be Stock little enough.

By -- to Dr.
Lister. ib. p.
741.

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 hath 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 three 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 mixed with some *Silver* or *Lead-Ore*.

The second Work is called *White Work* or *New Work*, about Forty Fathom

Fathom from the first, was wrought about 10 Fathom deep; the Seam then left was about 22 Inches of good Copper-Ore.

The third is called *Tung-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 30 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 two Fathoms; a small Seam, but excellent Ore.

The sixth Work is called *Sunny-Work* at *Lewers Water*, at the Water-side, and a little above that, *Hanch Clocker's Work*; a little above that, *George Tower's* and *William Dixson's Work*; *Bartle Clocker's Work*; near the last, *Richard Tower's Work*; then *John Saclock's Work*; and *Hanch Mire's Work*; being all seven Works, and lie all together, 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 Turn was drained, it is thought that all these seven 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 but a little, the Seam about 18 Inches thick, of as good Ore as any of the other Works.

The eighth is called *John Dixson's Work* in *Brumfel*, was wrought about two 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 two Miles.

The tenth Work is called *Three Kings* in *Tilburthwait*, being Three Works, and wrought about 40 Fathom a-piece, the Seam being about 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 gray sort of Ore in small Thread.

There are lately discovered Three Veins in *Torverwel*, 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 that was got at *Coniston*, 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 were 140 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 eight Shillings a Kibble to two Shillings and Six-pence, every Kibble being near a Horse-Load in Weight, it being first beaten very small, washed and sifted through 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 ordered, and they had two Shillings and Sixpence for their Pains.

To make
Brass, by
Mr. Tho.
Povey, n.
200. p. 733.
n. 200. p. 474.

CII. *Calamine* is digged out of several Mines in the *West* of *England* (as about *Mendip*, &c.) about 20 Foot deep. It is burned or calcined in a Kilm or Oven made red hot, then ground to Powder, and sifted into the fineness of Flour, then mixed with ground Charcoal, because the *Calamine* is apt to be clammy, to clod, and not so apt or capable of incorporating. Then they put seven Pound of *Calamine* into a Melting-Pot, of about a Gallon content, and about five Pound of *Copper* uppermost; the *Calamine* must be mixed with as many Coals as will fill the Pot. This is let down with Tongs into a Wind Furnace, eight Foot deep, and remains 11 Hours therein; they cast off not above twice in 24 Hours. One Furnace holds eight Pots. After melting, it is cast into Plates or Lumps.

Forty-five Pound of raw *Calamine* produces 30 Pound burnt or calcined.

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 procured 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 coarser 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 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.

The Tin
Mines in
Devonshire,
and Corn-
wal, By . . .
n. 69. p. 2096.

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 called 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 these Mineral Veins, were loosened, and torn off; and by the descending of the Waters into the Valleys, both the Earth, or
Great,

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.

1st, Upon these Suppositions, we proceed in training a Load, thus :

Training a Load.

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 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 haply we can discover any metalline Stones in the Sides and 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 thoroughly calcined; yet Tin sometimes lies in the firmest Stones: Or by Vauning, which is performed by Pulverizing 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 Side 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 two Foot over, and as deep as the Shelf, in which we turn the Water to run two or three Days; by which time the Water, by washing away the Filth from the Stones, and the looser parts of the Earth, will 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 Squat.

4. Sometimes *Sboad* may be found upon the open Surface of the Ground, but then it is 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, heightened 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 six Foot long, and four Foot broad, and always as broad 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 three 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, as the former. And in case none appear in,

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 *Sboad* 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 12 Fathom, to six or less, as our Conjecture guides us.

8. If finding *Sboad* 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 the Hatch, wherein we last found *Sboad*.

9. Sometimes we find two different *Sboads* 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 *Sboad* of a third. Some Tanners affirm, that seven Load may lie parallel to each other in the same Hill, but yet only one Matter Load; the other six, 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 *Sboad* in a greater quantity, the nearer the *Sboad* lies to the Load, and so lessened by degrees to about a quarter of a Mile's Distance; farther than which, that peculiar Grewt is never found with the *Sboad*.

11. A Valley may so lie, as at the Feet of three several Hills; and then we may find three several Deads, *i. e.* common Earth, or that loose Earth which was moved with the *Sboad* in the Concussion, but not contiguous to the Load in its first Position, which is also term'd by us the Run of the Country, with as many different *Sboads* 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 *Sboad*, whose Form is about two or three 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 itself, and may go down into the Shelf five or six Fathom deep, and there terminate.

Digging the
Ore. ib. p.
2101.

2dly, When we have found the Load, the last Essay Hatch is then called a 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 nigh 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 divers; as *Mundick*, 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 ; *Iron-mould*, black, and rusty ; *Caul*, red, (differing both from *Mundick* and *Sparr*, enduring the Fire) which *Marchasite* will not ; *G'ister*, blood-red, and black.

2. We then begin to make a Drift three Foot wide, and seven high : And if the Load be not broad enough of it self, as some are scarce half 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 eight Pound or 10 Pound weight, sharpened at both Ends, well steel'd and holed in the middle : it may last in a hard Country half a Year, but new pointed every Fortnight at least. 2. A Sledge, flat headed, from 10 Pound to 20 Pound weight, 'twill last about seven Years, new order'd once a Quarter. 3. Gadds or Wedges of two Pound weight, four square, well steel'd at the Point ; they will last a Week ; two or three Days, then sharpened. 4. Ladders. 5. Wheel-Barrows, to carry the Deads and Ore out of the Drifts or Adits, to the Shambles.

4. There are two Shovel-men and three 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 two 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 ; sometimes they underlie, that is, slope down towards the North, three Foot in eight perpendicular : Yet in the higher Mountains of *Dartmoor* there are some considerable Loads, which run North and South, these underlie 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 separate again, and keep their former Distances : Such a Knot hath been observed and wrought on *Hingston*, a known mineral Down or Common in *Cornwal*.

7. The Breadth of Master Loads may generally be from three to seven 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 six Foot at once place, and not two at another, nay, sometimes scarce half an 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, Spars, and other Weeds, as 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 petrefied.

9. In most Places we meet with Water at some Feet deep from the loady Surface, in other some not at many Fathoms deep. It runs continually thro'

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 big 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 *Mundick* 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 inclines, 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 lead him, till he comes exactly over the Place where he ended in the Mine.

*Dressing of
the Tin.*

3. When the Ore is landed, and the greater Stones broken at the top of the Mint by the Shovel-men, 'tis brought on Horses to the Stamping or Knocking Mills, and unloaded at the head of the Pass (*i. e.* 2 or 3 bottom Boards with 2 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 Listers, plac'd between 2 strong broad Lones, having 2 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 Listers 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 over-shot Water-wheel, on two Boulsters, which exactly, but easily, meet with the Tongues so placed in the Listers, as that they quickly slide from each other, suffering the Listers to fall with great force on the Ore, thereby breaking it into small Sand, which is washed out by the Cock-water, thro' a Brass Grate, holed very thick, and placed within two Iron Bars at one End of the Coffer into the Launder, *i. e.* a Trench

Trench cut in the Floor, 8 Foot long and 10 Foot over, stopped 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 two 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 lower End is tied 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 is another Pin set in one of the *Lifters*, at such an exact height, as that if there be no Ore in the Coffe 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 Coffe is emptied, the Mill rests of its own accord.

3. The *Launder* is divided into three parts, *i. e.* the *Forehead*, the *Middle*, and the *Tail*. That Ore which lies in the *Forehead*, *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 four Foot deep, six long, and three 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 long-ways, 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 stroaks 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 separated 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 it is 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, thro' 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 justly shake it, so that the Filth gets over the Rim of the Sieve, leaving the
Black-

Black-Tin behind, which is put into Hogheads, covered and locked, till the next Blowing.

7. The *Tails* of both *Buddles*, 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 *Boards* about three Foot and a half broad, and six long, which turns upon two *Iron Pegs* 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 moved either *Way*, with the *Shovel* and *Water*.

Blowing of
Tin.

4. When we perceive much *Mundick* in our *Tin*, which makes it brittle 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 six Foot long, and four 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* thro' 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 thoroughly 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 2d, 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 blue; 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 *Ashes*, 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) is in the open *Air* to cool, which will scarce be in three *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 *Mortar*. Albeit we let it cool of itself, 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*, charked: But our *Tin* which lies in the *Country*, runs best with an equal *Proportion* of *Charcoal* and *Peate*, i. e. *Moor-Coals*, for the first *Run-ning*; but when we come to remelt our *Slags*, then we use *Charcoal*. When

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 most an Iron Body, though of a Tin Colour; as I accidentally assured myself, by applying one of the Poles of a *Load-Stone* to it, and quickly attracted it, yet not such a quantity, by far, as that of Iron.

2. The Stones from which *Tin* is wrought, is most usually found betwixt two Walls of Rocks, which are generally of an Iron Colour, of little or no Affinity with the *Tin*, in a Vein of *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 Cinders 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.

By Dr. Chro.
Merret, n.
138. p. 949.

The Load being very rich and good, above that is 10 Fathoms from the Grass or thereabouts. And below that, there is a strange Cavity, or empty Place, wherein is nothing but Air for many Fathoms deep, as the Miners have tried 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 of 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 separated with bare Washing: This gravelly *Tin* is called *Pryan Tin*; and is scarce of half the Goodness of the other.

The *Mundick Ore* is easily discovered 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 is 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 separates it from the *Tin*, and evaporates it into Smoak. Little Sprigs or Boughs being set in the Chimney, the Smoak gathers upon them, into a Substance which they call Poison, 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 changes 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 the drinking of *Mundick* Waters. When they burn it, to
separate

separate it from *Tin*, there proceeds from it a Stench very loathsome and dangerous.

There also occurs a sort of a *Sparr*, of a shining whitish Substance, which casteth a white Froth upon the Water in washing it. When first taken out of the Earth it is 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 Sparr*; and some of them think it is the Mother or Nourisher of the Metal. But it is 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 it was 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 separated from the parts not metalline (which they call the *Causalty*) they dry it in a Furnace on Iron Plates, and then grind it very fine in a *Crazing-Mill*. After this they rewash 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 six or seven 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.

Lead Mines
in Somerset-
shire; By Mr.
Jof. Glanvil,
n. 28. p. 525.

CIV. 1. I am well informed, 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 healthy, 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

fore the 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 wholesome; 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 Firestones or Lime-stones, but no way clayie, marly, or chalky. The Trees have their Tops burnt, and their Leaves and out-sides discoloured, and scorched with the Wind, and grow to no Bigness. The Stones that are washed 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 a Clay, or Firestone, 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 Mens 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.

2. I am farther informed, by experienced Mine Men, that they have sometimes known the Veins 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 *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 Swerd [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. It 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.

*A further
Account by
Mr. Glanvil,
n. 39. p. 767.*

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 called a Cut: Then they sink plum again four or five Cuts, one under another. They find Ore at 50 Fathom. Their best Reaks are North and

South; East and West are good, tho' not so deep. The Groove is Four 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 lain above 200 Years) will serve in new Works. It is tough and black, and being exposed to the Sun and Wind for two or three Days, will scarce yield to an Ax.

For the Supply of Air they have Boxes of Elm exactly closed, of about six Inches in the Clear, by which they carry it down above 20 Fathom. But when they come at Ore and need an *Air-shaft*, they sink it four or five Fathom distant, of the same Fashion with a Groove, to draw as well Ore, as Air.

They make use of Leathern Bags, of eight or nine Gallons apiece, drawn up by Ropes, to free the Water. If they find a *Swallet*, they drive an Adit, upon a Level, till 'tis dry.

If they cannot cut the Rock, they use Fire to anneal it, laying on Wood and Coal, and the Fire so contriv'd, 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 three or four Days, as it happens. They work clothed in Frocks and Waist-Coats, by Candle-Light of Tallow, 14 or 15 to the Pound, each whereof last three 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 two or three Fathoms 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 Spar. About the Ore there is Spar and Chalk, and another Substance, which they call the *Crootes*, which is a mealy white Stone, matted with Ore, and soft. The Spar is white, transparent, and brittle 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 two 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 Inconveniencies of Smoak upon a shifting Wind. It contains half a Bushel of Ore and Coal. There is a sink

sink upon the sides 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 distinguished by its Weight) melts first.

There is a Flight in the Smoak, which falling upon the Grass, poisons those Cattle that eat of it. They find the Taste of it upon their Lips to be sweet. And when the Smoak chanches 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 washed, and be carried away into a Stream, it hath poisoned such Cattle as have drunk of it after a Current of three 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, three, four, or five 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 two Years since found in his Groove a Piece of Ore, in which they fancied the shape of a Man, Eyes, Arms, Legs, full Breast, &c. The whole was about four Inches in length ; the Mine proved rich.

3. There is a peculiar Lead Ore found in the *Upper Palatinate*, at a Place called *Freyung* ; and there are two sorts of it, whereof one is a kind of Chry-stalline 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 for what their 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.

In Germany;
By
n. 1. p. 10.

CV. Those who live near where Lead Ore is washed, 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, tho' 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 poison-ous Quality of Lead Ore;
By Mr. J. Beaumont,
Pb. Col. n. 2.
p. 6.

CVI. Pigs of clean and soft Lead are cast into thin Plates, a Yard long, and six Inches broad. These are rolled round, so that the Surfaces no where meet to touch : For where they do, no *Cerufs* 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 abreast, 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 four times makes one Heap, so called, containing 1600 Pots.

The Way of making of Cerufs ;
By Sir Philiber-to Vernati.
n. 137. p. 935.



After three Weeks the Pots are taken up, the Plate unrolled, laid upon a Board, and beaten with Battledores till all the Flakes come off; which, if good, prove thick, hard and weighty. These Flakes are ground with Water, between Mill-stones, to almost an impalpable 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.

It is 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 Contortions 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 taken 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 mere 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.

The Quick-silver Mines in Friuli; By Dr. Walt. Pope, n. 2. p. 21.

CVII. 1. The Mines of Mercury in *Friuli*, a Territory belonging to the *Venetians*, are about a Day's Journey and an half distant from *Goritia* Northwards, at a Place called *Idria*, situated on a Valley on 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 Firs, 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 other 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 when produced, they do not

not seem to make one 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: It is 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 an Ox's Belly. There are also several Marcasites and Stones, which seem to have Specks of Gold in them; but upon Trial, 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; it is 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 10 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, it is 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 itself 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 three Miles distant. The Water pumped 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 seven 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 die 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 Palsey.

They convey their Woods thus: Above four 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 Emperor 70000 or 80000 Florins yearly; but now they cost him not above 28000. They produced

<i>Anno</i> 1661.		<i>Anno</i> 1662.		<i>Anno</i> 1663.	
l.		l.		l.	
<i>Ordinary Mercury,</i>	198481	225066		244119	
<i>Virgin Mercury,</i>	6194	9612		11862	
In all	204675	234678		255981	

By Dr.
Edw. Brown,
n. 54. p. 101 B.

2. The Town *Idria* in the Country 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.

The Entrance into these Mines is not high, or upon a Hill, but in that Town itself. 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 itself 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 Quicksilver*, which is separated only by Water.

Plain Quicksilver they obtain by Fire out of the Ore, or out of the *Cinnabar* of Mercury, which they dig out of this Mine. The Ore of this Mine is of a dark Colour, mixed with Red.

The

The *Quicksilver* Ore of this Mine ordinarily contains half, and sometimes two-thirds of *Quicksilver*.

I went into the Mine by the Pit of *St. Agatha*, and came up again by that of *St. Barbary*, 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 Gulph 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 two Years, except they have great Plenty of Rain to bring down the Wood.

The Country is well stored with stately Firs, Larches, Pines, Pinafters, *Picea's*, and that noble crisped and well grained 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, give a dim 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 *Swartzenburg*, 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 *Provence*.

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.

Mercury found in Plants; By S. Manfred Septalius, n. 27. p. 49.

CIX. Tho' I have many things to object against the Sympathy of *Gold* with *Quicksilver*; yet perhaps there may be *Quicksilver* more subtle and ponderant

The Intalscence of Mercury with Gold; By B. R. n. 122. p. 515.

ponderant than that which is common, which may enable the Chymist 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, stiled *Mercurii Corporum*, or the Mercuries of metalline Bodies. But the Negative is more generally maintained, 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 apart ingeniously confessed to me, that they never actually saw any incalcescent Mercury, though they had sometimes heard it boasted of.

But notwithstanding all this, having for several Reasons looked upon Mercury as a Body which is not necessarily so homogeneous as it is supposed, the Opinion I most liked of was, that of a Possibility of an incalcescent 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 (unpractised that I know of by any *Chymist*) the one to discover whether a clean and careful distilled Mercury might not be a compounded Body, and have in it Parts that are not mercurial; and the other out of such a fine distilled Mercury to separate Parts, and that in no despicable Number, that are plainly heterogeneous: I found upon Trial, 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 *Tin*, *Lead*, &c. may be) by a skilful 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.

But 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 *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 Incalcescence 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 all together, or but half as much

much Gold as *Mercury*; but the Effect seemed to be much greater when they were employed in equal Weight.

I tried also the same *Mercury* with *refined Silver*, reduced to a very fine Powder; but I could not perceive any Heat or Warmth at all, though I am apt to think, with a sufficient Quantity of *Leaf Silver*, it might have been sensible.

I made Trial afterwards oftner than once, in the Hands of others, who were not a little surprized and pleased 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 *Brownker*, President of the *Royal Society* 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 Trials 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 subtle, 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 ever *metal-line Mercury*, tho' ever 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 subtle 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 *Amalgama* 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 *Amalgama* 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 Trial, that a single Drachm of *Mercury*, made after a certain manner,

manner, did the 3d or 4th Year after I had laid it by, grow so hot with Gold, that I feared it would have burnt my Hand.

It may be doubted whether the good that the Preparations of it (such as Precipitates and Turbiths of divers kinds, *Mercurius dulcis*, *Cinnabar* 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 skilful 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 itself.

I shall only admonish those inquisitive *Spagyrist*s, that may be desirous to try, whether their purify'd Mercury be incalcent, 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 hindered 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 cuppeled 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 *Aquafortis*, there will remain a Powder, which being well washed in fair Water, to dulcify it and keep a while in 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, reducing by beating only, without the help of Salts, to sufficient thinness, insomuch that between 70 and 80 Leaves did not weigh a Scruple: and putting 2 or 3 times the Weight of our Mercury to them, I have found, more than once, that a smart Heat was presently produced in my Hand.

*The Silver
Mines in
Hungary, by
Dr. Edward
Brown, n.
58. p. 1196.*

CX. There are divers Silver Mines at *Schemnitz* in *Hungary*; but the chiefest 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 *Hodritz* and other places, where are small Rivers, by which their Bellows and Hammers may be moved, (their Ore

Ore pounded, washed, and other Works requisite, performed. To draw about the Engines to pump out the Water, 12 Horses at a time are employed 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, pumped from the deepest Parts of the Mine, runs thro' a Cuniculus made on purpose, at the Foot of the Hill.

Trinity Mine is 70 Fathom deep, built and kept open with under-work at a great Expence. Much of this Mine being in earthly Soil, the Ore of it is much esteemed. Divers 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 strait 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 payed their Charges.

The blackish Silver Ore is esteemed the best; much of it hath a Mixture of a shining yellow Substance or *Marcasite*, 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 easy to be melted: But if it be in too great a Porportion, they are of Opinion, that it preys upon the Silver in the Mine, and in the Furnace carrieth it away while it melteth, by over volatizing it.

There is often found a red Substance, which grows to the Ore, called *Cinnabar*, *Cinnabar* of Silver, *Cinnabaris nativa*, *Minium nativum*, or *Berg-Cinnabar*. This Substance grinded with Oil, maketh a Vermilion, equal to, if not surpassing the *Cinnabar* made by Sublimation. I discovered a Sulphur in it, by casting it upon a hot Iron-Plate, on which it burned blue. The Miners say, they meet not with any Quicksilver, but they find Chrystals, Amethysts, or Amethystine mixtures, in the Clefs of the Rock, and sometimes nigh, or joined to the Ore, as also Vitriol naturally chrystallized in the Earth, in divers 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 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 called the *Probiierer*, 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 dried, burnt and powdered, 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 2½ 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 Cake 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 two Ounces in 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 a Hole at the bottom thereof, into the Pan which is placed in the Earth before it; and, thus exposed, it immediately acquires a 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 mixed 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 *Aqua fortis*, whereby the Gold is left at the bottom, and is afterwards melted. The *Aqua fortis* 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 mixed 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.

The Gold
Mines in
Hungary, by
Dr. Edward
Brown, n.
158. p. 1192.

CXI. Among the 7 Mine-Towns in *Hungary* (which are not far from one another, viz. *Chremnitz*, *Schemnitz*, *Newfol*, *Koningsberg*, *Bochants*, *Liben*, and *Tiln*) *Chremnitz* is the richest in Gold. They have also, at present, Gold Mines at *Bochantz* and *Koningsberg*; and they report in that Country, that there hath been formerly a rich Gold Mine at *Glass-Hitten*, but lost since

since that *Betlem Gabor* over-run those Parts, when the Undertakers stopp'd up the Mine and fled.

They have worked in the Gold Mine at *Cbremnitz* 900 Years. This Mine is several *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 thro' 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 Elector 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 *Cbremnitz*, altho' it be not esteemed Ore, affords some Gold: And in one Place I saw a great part of a Hill digged 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 thro' the Rock, and long disused, have grown up again; and I observed the Sides of some, which had been formerly wide enough to carry their Ore thro', to approach each other, so as we passed 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, called by them *Antimony of Gold*. There are Crystals found here, and some tinged yellow.

The Miners will not allow any *Quick-silver* 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 *Quick-silver* Mine, mentioned in the Answer to *Kircher's* Inquiries, *Mund. Subter.* is an *Hungarian* Mile, or seven *English* Miles distant from *Cbremnitz*; 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 boiled 7 Days in a Leaden Vessel, till it come to a thick granulated whitish Substance, which

is afterwards reduced to a Calx 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 fixed. But without Lead they proceed thus :

They break and pound the Ore in Water very fine ; then wash it often, and lay it in Powder upon Cloths, 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 Cloths. These Cloths 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 kneed 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, thro' coarse Cloths first, and then thro' 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 Charcoal 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 called *Golde-Crona*.

The extreme
Ductility,
and exceed-
ing Minute-
ness of the
constituent
Particles of
Gold. By
Mr. Edmond
Halley, n.
194. p. 540.

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 ever so loose or compact in Texture, with equal Velocity. It follows therefore, that there is seven times as much Matter in Gold as in a Piece of Glass of the same Magnitude (their Specifick Gravities being nearly as Seven to One) and consequently, that at least six Parts of seven 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-gilt Wire was made out of Cylindrick Ingots four Inches in circumference, and 28 Inches long, which weigh 16 Pounds *Troy* ; on these they bestow 4 Ounces of Gold, that is, to every

every 48 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 $\frac{1}{5}$ of an Inch long; which yet may be actually divided into 10, and so the 100000 Part of a Grain of Gold be visible without a Microscope. And by means of the Specifick Gravities of the Metals, viz. Silver $10\frac{1}{3}$ and Gold $18\frac{2}{3}$. I found the Diameter of such Wire, the $\frac{1}{188}$ part of an Inch, and its Circumference the $\frac{1}{137}$ part: But the Gold in thickness not to exceed the $\frac{1}{34320}$ part of an Inch; whence it may be concluded, that the Cube of an hundredth 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 itself of so even and united a Texture, as not to let the white Colour of the Silver under it appear (even with a Microscope) thro' any the least Pores; which argues that even in this exceeding thinness, very many of those Atoms may still lie one over the other.

CXIII. 1. *An.* 1664. I travelled into the Kingdom of *Mexico*, under the Character of a *Biscaneer*, and remained in that Country about two Years.

A Mineral like Leaf Gold near Mexico; By an English Gentleman at Seville, n. 41. p. 817.

Some of the Mine-men 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 gilded 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 gilded over with Gold, and they equalize the most refined Gold upon the Touchstone.

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 separate it from heterogeneous Substances by the mild Trial 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 began to make Experiment on the Sand, which had been the *Matrix* of the Mineral. I tried it in a strong reverberating Fire, but it did not afford any visible Fumes. I then boiled

boiled some of it in Water, and having poured that off, I observed the *alkali* left after the Water's 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 Magistral (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-petre* (kept as a Secret among the chiefest Mine-men) but with a little Signs of the Mercury's Operation as before. Then I boiled 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 or ordinary separated Water, impregnated with common Salt, and it made a Dissolution exactly like that of Gold: But having steamed 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 experienced 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 entering: But (as I told him beforehand) it only served to clog the matter with more sulphureous Unctuousity than it had before.

The use of Mercury in separating Silver from the Ore; By the same English Gentleman, ib. p. 820.

2. When Silver is generated, as commonly it is, in certain rocky Stones abounding with bituminous corolive mixture, so as it is impossible to free it totally from its corrupt *Matrix* by the violent Way of melting, whatever auxiliary Ingredient 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. They practise 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 mixed *per minima* with the fixed, 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 Labours 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 Flour, 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

ing 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 for 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, calcined and curiously sifted, they divide it into several Heaps, and then by lesser Essays, they find out how much Silver is contained in every Heap; where it is very ordinary to find only six Ounces in 100 Pounds; sometimes 12, but if it yield 18, it is esteemed 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 calcined *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 separating 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* flies 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 Mollinet, all the Dust of the heterogeneous Minerals, that embody 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 *Pellas*, is by the Weight of the *Mercury* depressed down to the Bottom of the Tubs. 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, of 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, the *Silver* is melted down with the *Liga* (as it is called) 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, 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 Scissars, 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 the *Silver* Branches, ceased not, as long as the Fire was continued, and fresh *Mercury* applied, for the due Nutriment of this mineral Vegetation. This whole Complex of Ingredients is known to consist only of vulgar *Aqua Fortis* (abstracted from two Parts of *Vitriol*, and one of *Salt-petre*) 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 Smoak, 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 imperfect Metal, joins itself (as I conceive) to those Parts, which being homogeneal, symbolize together with the Nature of the more perfect, whereby the pure metalline Parts are separated from the other heterogeneal impure Sulphurs.

The Art of
Refining; By
Dr. Chr.
Merret, p.
142 p. 1046.

CXIV. The End of Refining is the Separation of all other Bodies from *Gold* and *Silver*, which is performed four Ways, viz. by parting, by the Test, by the Almond Furnace or the Sweep, and by *Mercury*. 1. Parting is done with *Aqua Fortis*. Some Refiners, to make the *Aqua Fortis*, take *Salt-petre* 3 Pound, and *Dantzick* (not *English*) *Vitriol* 2 Pound (for the *English* *Vitriol* makes a weaker Water, and a dirty coloured Verditer, and wholly spoils it.) After they are well bruised and mixed in a Mortar, then distil 100 Pound of the Materials, put into a cast Iron Pot, after this manner:

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 Alembick for Chymical Oils, 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, Flour, 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 Loam, 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 *Aqua Fortis* 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 *Aqua Fortis*, which within four Hours will purge it from all Dirt and Impurity, and make it fit for Parting, which is thus done:

If their *Silver* gilt 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 dried, are put into a Glass taper-fashioned, a Foot high, and seven Inches at the Bottom; and then the Glasses are charged with *Aqua Fortis* about two thirds of it, and set in a Range of Iron covered two Inches deep with Sand, and a gentle Charcoal 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 does *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, it will 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 separate 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, dried 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 mentioned to be taken from the Verditer, is put into a Copper, and boiled, till it come to the thickness of Water-gruel, now principally consisting of *Salt-petre* 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 *Aqua Fortis*, is re-distilled, and makes a double Water, almost twice as good as that without it.

The Test.

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 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, two 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 Centre of the Test, where it is not above half an Inch deep.

The Test thus made, is set a nealing 24 Hours, and then it is 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* purified 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-mentioned Slit, 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*, it will rise in small red fiery Bubbles; then they lay, the Metal drives, and they 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 fined, it looks like most pure *Quicksilver*; and then they take off their Sogs, and let it cool. In the cooling, the *Silver* will

will frequently from the Middle spring up in small Rays, and fall down again. If moist *Silver* be put into that which is melted, it will 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.

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.

The Almond Furnace.

Those which stick but superficially to the *Silver*, they wash off thus: They have a wooden round Instrument two 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 Foot high, 4 Foot wide, and 2 Foot 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 Coals to one of the forementioned 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 blue Smoak proceeds from the Furnace, and all the By-Standers put on the Colour of dead Men.

To get the *Silver* from these Metals, and to refine their *Copper* from the Litharge, they now use no other Art than that of the Test.

By Quick-
silver.

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.

This *Amalgama* is put into an Iron, with a Bolt-head set into the Fire, having a long Iron Neck 3 Foot long, to which is fitted a Receiver. The Fire distills off the *Mercury* into the Receiver, and the Gold and Silver remains in the Bolt-head.

Experiments
of refining
Gold with
Antimony, by
Dr. Jonat.
Goddard. n.
138. p. 953.

CXV. 1. There was taken of Crown Gold (which is, as they call it) of 22 Kerats fine, or $\frac{1}{12}$; 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 Drams 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 separate, settle and cool in it. Upon the breaking of the Pot, the Gold (being very distinct in the Bottom, and easily separated from the Antimony) weighed 163 Grains.

N.B. That this Way of cooling all in the Pots was observed in all the following Experiments, for the more certain separation 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 $2 \frac{1}{2}$ Ounces of fresh Antimony and melted down, the Regulus weighed 74 Grains.

The other Pieces of $38 \frac{1}{2}$ Grains being refined on a Coppel, from the Antimonial Substance mixed with it, by Exhalation, prompted 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 $38 \frac{1}{2}$ to $30 \frac{1}{2}$, or the Gold almost $\frac{1}{4}$ 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 $\frac{2}{7}$ of the whole. So that the same Regulus of Gold and Antimony, in passing thro' new Antimony, tho' 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 half a 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 gr.

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 4th part of Silver, as the Sovereign Gold doth a 6th. Neither was it altogether free from Copper; because upon nealing, it always turned black on the Surface. But for the more exact Discovery, it was taken and first refined with Lead upon a Coppel, for separation 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 separation 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 Kerats 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, $14 \frac{3}{8}$ Grains for alloy, being deducted from the first quantity of Crown Gold, weighing 178 Grains, the Remainder is $163 \frac{1}{8}$ Grains. Then the several Parcels of fine Gold, which was recovered, and separated 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 $163 \frac{1}{8}$, the difference is $16 \frac{1}{8}$ Grains, which is more than $\frac{2}{25}$ 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 $163 \frac{6}{8}$ 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 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 gr. and upon refining yielding 30 gr. 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 second 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 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.

With the
same Anti-
mony, ib.
p. 958.

2. There was taken of Crown-Gold 141 $\frac{1}{2}$ gr. which was melted with 1 $\frac{1}{2}$ Ounce of *Antimony*, and the *Regulus* weighed 123 gr. from this a Piece weighing 30 gr. was broken off, and reserved for refining by itself; the remainder, being 93 gr. 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 second *Regulus*, a Piece was broken off and reserved for refining apart, 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 first Piece of 30 gr. being refined upon the Coppel, produced of fine Gold 24 gr. and the second Piece of 36 gr. produced 28 gr. and the *Regulus* (upon the third Melting) of 27 gr. produced 55 gr. So that each of the Pieces contained about 4 Fifths of Gold, and but one Fifth of Antimonial Substance in it, yet losing something of that proportion at each Melting, though 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 $17\frac{1}{2}$ gr. having lost $1\frac{1}{2}$ gr. and then with the *Aqua fortis*, 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 Kerats.

The Loss of *Gold* is thus computed. From the first Quantity of $141\frac{1}{2}$ gr. a 12th part or about $11\frac{1}{2}$ gr. being deducted for Alloy, the Remainder is $129\frac{1}{2}$ 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. $14\frac{1}{2}$ gr. all together make $121\frac{1}{2}$ gr. short of the first Quantity by $8\frac{1}{2}$ gr. or very near one Sixteenth.

3. A Parcel of Crown-Gold, weighing $82\frac{1}{2}$ gr. was melting down with an Ounce of *Antimony*, and the *Antimony* was exhaled in a Crucible to a *Regulus*. Then the *Antimonial* Part of that *Regulus* was exhaled on a Coppel: Whereupon there remained 84 gr. or $1\frac{1}{2}$ 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 $2\frac{1}{2}$ 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 merely by Exhalation; but doth only retain it with itself, 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.

By exhaling
the whole
Antimony,
ib. p. 960.

CXVI. Papers of less General Use, Omitted.

- n. 39. p. 530. 1. Articles of Inquiries concerning Mines; by Mr. *Rob. Boyle*.
- n. 56. p. 1139. 2. Some Uses of *Vaults* and *Cold Conservatories* in discovering Minerals, intimated; by Dr. *Jo. Beale*.
- n. 450. p. 73. 3. Several *Coal Borings* near *Leeds* in *Yorkshire*, in the Year 1659, for the Concerns of a private Family, communicated by Dr. *M. Lister*.
- n. 93. p. 6012. 4. Enquiries concerning *Quarries* and *Stones*, and the ancient Way of *Tempering Tools*, for cutting *Porphyry* and other hard *Marbles*.
- n. 249. p. 49. 5. Several *Curiosities* relating to *Amber*, lately sent to the *Royal Society* from *Philippus Jacobus Hartmannus*, and which are now in their *Repository* at *Gresham College*.
- n. 20. p. 359. 6. Enquiries about the *Salt-Springs* in *Worcestershire* and *Cheshire*; by Dr. *Beale*.
- n. 193. p. 50. 7. *Queries* concerning *Salt-petre*.
- n. 6. p. 103. 8. The Way used in the *Mogul's Dominions*, to make *Salt-petre*. Extracted from Mr. *Thevenot's Voyages*.
- n. 265. p. 632. 9. Some *Natural Curiosities* sent the *Royal Society* from *Sicily*; by Dr. *Petr. Sivester*.

CXVII. Accounts of Books Omitted.

- n. 6. p. 109. 1. *The Mundus Subterraneus* of *Atbanasius Kircher*.
- n. 77. p. 3016. 2. *Admirandorum Fossilium, quæ in Tractu Hildesheimensi reperiuntur, Descriptio; Iconibus Illustrata; de Frederico Lachmund Hildesheimi, 1669, in 4to.*
- n. 107. p. 38. 3. *Lezzioni alla Natura dele Moffette, &c.* Discourses concerning the Nature of *Damps*; by *Leonardus Capuanus*, a Member of the *Academy* of the *Investigantes*. *Naples, 1683. in 4to.*
- n. 219. p. 215. 4. *Dissertationes Medico-Physicæ de Antris Lethiferis; de Montis Vesuvii Incendio; de stupendo Ossium Coalitu, de Immani Hypogastrii sarcomate, a Bernardo Connor, M. D. Oxon. 1695. in 8vo.*
- n. 60. p. 1084. 5. *Franc. Travagini, super Observationibus a se factis tempore Ultimorum Terræ Motuum, ac potissimum Ragusiani, Physica Disquisitio; seu, Gyri Terræ Diurni Indicium. Lugduni Bat. 1669. in 4to.*
- n. 75. p. 2260. 6. *Historia & Meteorologia Incendii Ætnæi, Anno 1669. Joh. Alph. Borelli, Regio Julio. 1670. in 4to.*
- n. 203. p. 293. 7. *Epistola ad Regiam Societatem Londinensem, qua de nuperis Terræ Motibus differitur, & vera eorum Causa eruuntur. Lond. 1693. in 4to.*
- n. 41. p. 4030. 8. A *Philosophical Essay*, declaring the probable Causes of *Stones* in the 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.*

9. Histoire des Joyaux & des Principales Richesses de l'Orient & de l'Occident, par le Sieur Chapuzeau. n. 23. p. 429.
10. An Essay about the Origin and Virtues of Gems, by the Honourable R. Boyle, Esq; Lond. 1672, in 8vo. The same in Latin. n. 84. p. 4095. n. 87. p. 5082.
11. Erasmi Bartholini Experimenta Crystalli Islandici Dis. Diaclastici, quibus mira & insolita Refractio detegitur. Hafniae 1669. n. 67. p. 2039.
12. Historia Amber-Griseae, Auth. Justo Klobio. n. 28. p. 538.
13. Description de la piece de Ambergris que la Chambre d'Amsterdam a reçue des Indes Orientales, pesant 182 Livres: Avec un petit Traite de sa Origine & de sa Vertue, par Nicholas Chevalier, à Amster. 1700. in 4to. n. 263. p. 573.
14. Jo. Ludov. Gansii M. D. Coralliorum Historia, Francofurti 1669. in 12°. n. 58. p. 1202.
15. The Natural History of Nitre, or Philosophical Discourse of the Nature, Generation, Place, and artificial Extraction of Nitre, with its Virtues and Uses, by Will. Clark, Lond. 1670. in 8vo. n. 61. p. 208.
16. Scrutinium Chymicum Vitrioli. Auth. Job. Georgio Triumpho. Jenae 1667. in 4to. n. 40. p. 810.
17. Theod. Kerkringii M. D. Commentarius in Curram Triumphalem Antonii Basil. Valentini, a se Latinitate donatum. Amstelodami 1671. in 12°. n. 71. p. 2162.
18. Frederici Hoffmanni Fred. Fil. M. D. Exercitatio Medico-Chymica de Cinnabari Antimonii. Lugd. Bat. 1685. in 8vo. n. 176. p. 1208.
19. De Lacte Lunae Dissertatio Medica Joannis Danielis Majoris, P. & M. D. Kiloni 1667. in 4to. n. 60. p. 1086.
20. Metallographia, or an History of Metals, by Jo. Webster, Practitioner in Physick and Chirurgery, Lond. 1670. in 4to. n. 66. p. 2074.
21. 1. The first Book of the Art of Metals, written in Spanish by Alonso Barba, &c. and English'd by the Right Honourable Edward Earl of Sandwich, Lond. 1674. in 8vo. n. 108. p. 187.
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 English'd by the Right Honourable Edward Earl of Sandwich, Lond. 1674, in 8vo. n. 109. p. 211.
22. Pratica Minerale del Marchese Marco Antonio della Fratta, in Bologna, 1678. in 4to. Ph. Col. n. 3. p. 80.
23. Fleta Minor, or the Laws of Art and Nature in knowing, judging, and assaying, fining, refining, and enlarging the Body of confined Metals, &c. By Sir Jo. Pettus, n. 147. p. 189.
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. 132. p. 314.
25. Job. Joachimi Becheri Spirensis, M. D. Experimentum Chymicum Novum, quo artificialis & instantanea Metallorum Generatio & Transmutatio ad Oculum demonstratur. Francofurti 1671, in 8vo. n. 74. p. 223.

C H A P. IV.

Magneticks.

*Loadstone
found in De-
vonshire; By
Dr. Edward
Cotton, n. 23.
p. 423.*

I. 1. **A** Considerable Loadstone was digged 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 in its proper Place, adds much Strength; for without that, it moves not much more than 7 Foot.

*By Mr. J.
Beaumont.
Ph. Col. n. 1.
p. 8.*

2. I can assure you, that those Courses, Veins or Loads, where Loadstones are found in the lower parts of *Devonshire* (either as they lie 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 northerly Direction, because its natural Position in its Mine was (as they fancied) North and South.

*Magnetical
Observati-
ons; By . . .
n. 23. p. 423.*

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 with good *Loadstones*, and well librated, and that the Variation be truly placed.

*By Mr. Sel-
lers, n. 23.
p. 423. n. 26.
p. 478.*

3. I have often made Trial 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 conformed to the Magnetical Meridian, standing North and South, as other Needles, that were touched upon the very Pole of the Stone.

All Needles touched upon different *Loadstones* of several bignesses and different Virtues, 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 Virtue, without at all touching the Stone; it hath received the same directive Quality, tho' not altogether so strong as if it had been really touched upon the Stone itself. I have also touched 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 Virtue 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 Virtue of conforming to the Magnetical Meridian, without the help of a *Loadstone*, or any thing else; that hath received Virtue therefrom.

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 untouched 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.

*By Mr Sam.
Colepeck, n.
27. p. 500.*

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.

*The Respect
of the Needle
in a piece of
Iron, held
perpendicu-
lar, in sev-
eral Climates;
By --- n. 170.
p. 1213.*

Lat. $9^{\circ} 42'$ N. and Meridian distance from the *Lizard* $9^{\circ} 32'$ 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. $4^{\circ} 33'$ N. and the Meridian Dist. $5^{\circ} 18'$ W. from the *Lizard*, the North Point of the Needle begun to decline from the upper end of the Iron, and the South Point to incline more strongly to the lower end. Lat. $00^{\circ} 52'$ S. and the Meridian Dist. $11^{\circ} 52'$ 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, tho' not so strongly.

Lat. $5^{\circ} 17'$ S. and Meridian Dist. $15^{\circ} 9'$ W. from the *Lizard*, the South Point of the Needle would turn to the lower end of the Iron, about two 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. $8^{\circ} 17'$ S. and Meridian Dist. from the *Lizard* $17^{\circ} 35'$ 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. $15^{\circ} 00'$ S. and $20^{\circ} 00'$ 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 contrariwise, &c.

Lat.

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. $29^{\circ} 25'$ S. 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.

*The Polarity
of Iron; By
J. C. n. 214.
P. 257.*

IV. 1. It is 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.

I call that a mutable Pole, which may be North or South, as you hold it; and a fixed 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 attract the South End of the Needle: for Attraction is more sensible than Expulsion.

3. A fixed North Pole may be made with all the Ways and Rods that you can make a fixed South Pole; but not *vice versa*, for there are many Cases wherein you can make a fixed North Pole, but not a fixed South Pole: And whatever Way you get a fixed South Pole, it is weaker than a fixed 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 fixed South Pole primarily, yet you may consequentially; so you may make one End a fixed North Pole, and then the other Ends of those Rods may, without more to do, become a fixed North Pole. But this does not always hold, for the one may be a fixed North Pole, and the other may be a mutable Pole.

4. Fire destroys all fixed 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 it is otherwise in fixed 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 fixed North Pole; if cooled South it becomes a fixed 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 fixed Pole that Way. Take a round Wire whose Diameter is $\frac{1}{2}$ Inch, and length 10 Inches, you cannot produce a fixed Pole by Ignition; but if this Wire were longer, as suppose 30 Inches long, or never so much longer, it

it is capable of a fixed Pole by Ignition. Again, take a round rod 30 Inches long, and 1 Inch Diameter, this Rod is not capable of a fixed 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 fixed 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 fixed Pole. So when in a Rod I could not obtain a fixed Pole at 21 Inches length in that thickness, I could, by making the Rod thinner, produce a fixed Pole even in the length of one Inch and less, and the Pole should be of what kind I pleased. 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 thoroughly cool this End downwards or towards the *Nadir*, it will have something 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 thoroughly ignited. Nor can I find by many Experiments, what quenching in Water signifies to the producing or hindering 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 fixed 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, Drilling, Sawing; yea, a soft Rubbing, provided it is long, will produce fixed Poles. The more heavy the Blows are, *ceteris paribus*, the Magnetism is the more. I say, *ceteris 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 do not 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 *Loadstone* would have infused.

9. Beating many Rods Northward, whose Lengths I knew sufficient, I never failed of producing a fixed North Pole; but Hammering the same or like Rod Southward, I found that I could not produce a fixed 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 hammered 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 fixed South Poles in proper Rods.

10. Old Drills and Punches are fixed North Poles, because almost constantly used downward: But now Drills are either mutable Poles or weak North Poles. When I say, a new Drill, I do not mean one made upon the Spot, for that is probably a North Pole, because quenched 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 it is a Chance if you produce a fixed *South-Pole*, but much less, if you drill South downward : But if you drill South upwards, you may make it a fixed *South-Pole*.

11. The stronger the Polarity is, the longer it will last. A weak fixed 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 Virtue a great while, if kept from Air, and in a meridian Site.

12. The *Loadstone* itself will not make a fixed Pole of any Iron ; it must have a proper Length if it is thick ; or if it is 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 fixed Poles, it must not be thought that it can do absolutely nothing on such Rods ; for even then it may be found, that there is an Effect of Magnetism in them discernable enough otherwise, though not enough to make fixed Poles.

14. When you have the due Length for making of a fixed Pole, you will find the making one a fixed *North*, will consequently render the other a fixed *South-Pole* : But if keeping the same Diameter of this Rod, you increase its Length enough, the making one End a fixed *North-Pole* will not necessarily make the other a fixed *South-Pole*, but leave it a mutable Pole. So if you by a like primary Operation make the second End a fixed Pole, the first End will lose its Fixity, and become mutable.

I say, there is a certain Length suited to every thickness of Iron ; to leave one End mutable, while the other is fixed, 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 fixed *North-Poles*, or two fixed *South-Poles*. I say, the shortest Length (for there is 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.

By Mr. Ballard, n. 246.
p. 417.

V. 1. 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 worked, either in Iron or any other Matter, so that I cannot suppose

pose 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 very vigorous in such their Polarity, others shewed plainly a Tendency to such a Pole, rather than the other, yet so faintly, that it applied 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 *Æquilibrio*, *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 great Bulk.

3. I took my Knife which had been touched a quarter of a Year or more before, and proffering 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 the 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 touched the same Knife again with the *North-Pole* of my Load-stone, and it drew vigorously the *North* End of the Needle. I whetted it again strongly in the same manner, and it changed again. This I repeated five or six 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 *Load-stone* had inclined them to. This I tried 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.

The Declina-
tion of the
Needle, ob-
served by Mr
Ja. Cunning-
ham, n. 264.
p. 577.

5. Two Degrees to the Northward of the Line, the North Point of the Needle did incline 8 Degrees downwards; but as we went to Southward, it was inclined above 48 Degrees upward.

Magnetick
Variations,
near Bristol,
by Capt. Sa.
Sturmy, n.
37. p. 726.

VI. 1. An. 1666. Jan. 13. In *Rownham Meadows near Bristol*, by the Water-side, Capt. *Sturmy* took the following Observations,

☉ 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. *June 13. 1667*, and then he found the Variation encreased but 6 Westerly.

At Paris, by
M. Petit, n.
28. p. 527.

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 published and made known here to the Curious, and to Artists, some of whom counted 9 or 10 degr. according to the Tradition and Writings of *Orentius Fineus*, and *Castle Franc*; others, $11\frac{1}{2}$ deg. following *Sennertus* and *Officius*: all at first rejected my Observation, and as commonly new things meet with Obstacles and Contradictions, before they are established, 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 touched nearer to or farther from their Poles.

To remove the Objections, and to try another Quality which *Gilbert* had assigned to *Terella's*, I caused a Magnet to be turned with the Powder of *Emery*, till it became a spherical half 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 two 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 and a little Globe, it was so easily moveable, that I made it turn every way

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 Virtue 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 marked) served me also to find out, whether the Needles touched in different places, nearer to or farther from the Poles, had different Declinations. Which having tried 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 *Britany* to the *Valloline* amongst the *Alps*. I believed at first, that the Antients 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 convinced by myself, 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 applied 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 $1\frac{1}{2}$ deg. North-West: As I have prognosticated by my Hypothesis, which maketh the Declination to vary a Degree every 7 or 8 Years.

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 a deg. 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 comes to the other part, where we find it at present.

It seems not, that this Difference of 10 deg. 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 upon the Flux of a certain Matter, passing through the whole Earth, or the exterior 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; forasmuch as it would depend upon Causes that have no Regularity at all in them, as most of the Mutations of Nature are.

A: Dantzick,
by Nr. He-
velius, n. 64.
p. 2059.

4. *An. 1642.* I observed the Declination of the Magnet here at *Dantzick*, as did *M. Linnemannus* about the same time at *Koningberg*, and we both found the Magnetick Needle at that time to decline from the North 3 *deg. 5 min.* Westw. But now (*Jun. 22. 1670. S. N.*) it is far otherwise, for it declines at present, as I have very carefully observed, 7 *deg. 20 min.* to the same Quarter, so that in the space of 28 Years, that Declination is increased 4 *deg. 15 min.* In the Year 1628, if I remember aright, I found it near 1 *deg.* Westw. 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 *deg. 30 min.* Eastw. Hence it appears, that this Declination of the *Loadstone* doth here, at *Dantzick*, encrease each Year to 9 *min. 6 sec.* which is sufficiently confirmed by the observations made at *Lime-house*, near *London*, by those three famous *Englishmen*, *Burrows*, *Gunter*, and *Gellibrand*. Of whom the first found the Declination *An. 1580.* to be 11 *deg. 16 min.* the Second, 5 *deg. 36 min. 30 sec.* *An. 1662*; the Third, 4 *deg. 3 min. 30 sec.* *An. 1634.*

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.

At Nurem-
berg in Ger-
many, by
Joh. Chr.
Sturmius,
Pb. C. d. n.
2. p. 8.

5. The last Summer 1680, I was present with *Dr. Geo. Volcamer*, at *Nuremberg*, while he was making some Observations and Trials with his Magnetick Needle. He repeated the Trials 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 Magnetick 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.

M. G. C.
Eimart, n.
178. p. 1253.

In the Year 1685, about the Beginning of *August*, having taken all imaginable Care to be sure of our Meridians, we tried several Magnetick Needles, as well those old ones we had made use of about five Years before, as many fresh ones, of a middling Length, the longest of which did not exceed half a Foot, but were slighter and more active; and what is strange, we found the Declination of the Needle did not vary one Minute, but agreed exactly, in every Meridian with the former, that is, it was 5 *deg. 5 min.* to the West. Whether it hath gone further in the mean time, or its Deviation be retrograde now,

now, which indeed might happen by Chance, is not certain; for I am not willing to assert that, being rather inclined to think it hath been stationary at that Point, its Motion without doubt being circular.

7. An. 1633. the magnetical Variation here at *Cabo Corse Castle*, was 3 deg. 49 min. from the North to the Westward.

On the Coast of Guinea, by Mr. Heathcot n. 158. p. 578.

VII. Mr. *Henry Bond* having entertained an Hypothesis of the Variations of the Needle, hath (for the Examination of it) calculated the following Table.

Magnetical Variations predicted by Mr. Henry Bond, n. 40. p. 739.

Years.	Variation West.	Years.	Variation West.	Years.	Variation West.	Years.	Variation West.
1663	1° 56'	1701	7° 19'	1706	3° 1'	1711	8° 41'
1670	2 18	1702	7 28	1707	3 9	1712	8 49
1680	4 00	1703	7 36	1708	3 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

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.

Theory of the Magnetical Variation by Mr. Edm. Halley, n. 148. p. 208.

Names of Places.	Long. from London.	Latitude.	An. Dom.	Variation observed.
London	0° 0'	51° 32' N	1580	11° 15' E
			1622	6 00 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 53 E
			1672	3 45 W
Dantzick	19 00 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

<i>Bayonne</i>	1 20 W	43 30 N	1680	1 20 W
<i>Hudson's Bay</i>	79 40 W	51 00 N	1668	19 15 W
<i>In Hudson's Streights</i>	57 00 W	61 00 N	1668	29 30 W
<i>In Baffin's Bay at Sir Tho. Smith's</i>	80 00 W	78 00 N	1616	57 00 W
<i>At Sea</i> (Sound)	57 00 W	38 40 N	1682	7 30 W
<i>At Sea</i>	31 30 W	43 50 N	1682	5 30 W
<i>At Sea</i>	42 00 W	21 00 N	1678	0 40 E
<i>Cape St. Augustine off Brasil</i>	35 30 W	28 00 S	1670	5 30 E
<i>Cape Frio</i>	41 10 W	22 40 S	1670	12 10 E
<i>At Sea off of the Mouth of the River of Plata</i>	53 00 W	39 30 S	1670	20 30 E
<i>At the East Entrance of the Magellan Streights</i>	68 00 W	52 30 S	1670	17 00 E
<i>At the West Entrance of the Magellan Streights</i>	75 00 W	53 00 S	1670	14 10 E
<i>Baldivia</i>	72 00 W	40 00 S	1670	8 10 E
<i>At Cape d'Agulbas</i>	16 30 E	34 50 S	1622	2 00 W
<i>At Sea</i>	1 00 E	34 30 S	1675	8 00 W
<i>At Sea</i>	20 00 W	34 00 S	1675	0 00
<i>At Sea</i>	32 00 W	24 00 S	1675	10 30 E
<i>At St. Helena</i>	6 30 W	16 00 S	1677	10 30 E
<i>At Ascension</i>	14 30 W	7 50 S	1678	0 40 E
<i>At Jobanna</i>	44 00 E	12 15 S	1675	1 00 E
<i>At Mombasa</i>	40 00 E	4 00 S	1675	19 30 W
<i>At Zocatra</i>	56 00 E	12 30 N	1674	16 00 W
<i>At Aden, at the M. of the R. Sea</i>	47 30 E	13 00 N	1674	17 00 W
<i>At Diego Roiz</i>	61 00 E	20 00 S	1676	15 00 W
<i>At Sea</i>	64 30 E	0 00 S	1676	20 30 W
<i>At Sea</i>	55 00 E	27 00 S	1676	15 30 W
<i>At Bombay</i>	72 30 E	19 00 N	1676	24 00 W
<i>At Cape Comorin</i>	76 00 E	8 15 N	1680	12 00 W
<i>At Ballasore</i>	87 00 E	21 30 N	1680	8 48 W
<i>At Fort St. George</i>	80 00 E	13 15 N	1680	8 10 W
<i>At the West point of Java</i>	104 00 E	6 40 S	1676	8 10 W
<i>At Sea</i>	58 00 E	39 00 S	1677	3 10 W
<i>At the Isle of St. Paul</i>	72 00 E	38 00 S	1677	27 30 W
<i>At Van Diemen's Land</i>	142 00 E	42 25 S	1642	23 30 W
<i>At New Zealand</i>	170 00 E	40 50 S	1642	0 00
<i>At 3 Kings Isle in New Zealand</i>	169 30 E	34 35 S	1642	9 00 E
<i>At the Isle Rotterdam in the S. Sea</i>	84 00 E	20 15 S	1642	8 40 E
<i>On the Coast of New Guinea</i>	149 00 E	4 30 S	1643	6 20 E
<i>At the West point of New Guinea</i>	126 00 E	0 26 S	1643	8 45 E
				5 30 E

By this Table it appears,

First, 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 *deg.* at *Newfoundland*, nearly 30 *deg.* in *Hudson's Streights*, and not less than 57 *deg.* in *Baffin's Bay*; also that as you sail Eastwards 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 it's 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 *Plata* 20½ *deg.* and from thence, sailing South-westerly to the *Streights* of *Magellan*, it decreases to 17 *deg.* and at the West Entrance it is but 14 *deg.*

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* itself, 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, and West Variation decreases, so as to be but little more than 8 *deg.* at *Cape Comorin*, and then 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 Diemen's Land*, found out by the *Dutch* in 1642.

6. That to the Eastward of the *Molucca's* and *Van Diemen's 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 25 *deg.* East Long. from *London*, in the Latitude of 20 *deg.* South, a westerly Variation begins.

7. That the Variations observed by the Hon. Sir *John Narborough*, at *Baldivia*, and at the West Entrance of the *Streights* of *Magellan*, do plainly shew, that the 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 Mid-way between *Chili* and *New Zealand*, and between *Hound's 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 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 Plata*, being nearly under the same Meridian, at the one Place the Needle varies $29\frac{1}{4}$ 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, inclin'd 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, and that in those Parts of the World which lie near adjacent to any 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 lie, cannot as yet be exactly determin'd 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 *Land's End of England*, and not above 7 deg. from the Pole Arctick. By this Pole the Variations in all *Europe* and *Tartary*, and the *North-Sea*, are principally governed, yet with regard to the other Northern Pole, whose Situation is in a Meridian passing about the middle of *California*, and about 15 deg. 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 *Azores* 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 Meridian 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 *Pacific Sea*, and the greatest part of the *Ethiopic 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 of *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 Virtue throughout the whole Globe of the Earth.

By this Hypothesis it is plain that (our *European* North Pole being in the Meridian of the *Land's 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 Welterly Variation, which will still be greater as you go to the Eastwards, till you come to some Meridian of *Russia*, where it will be greatest, and from thence decrease again. Thus at *Brest* the Variation is but $1\frac{1}{2}$ deg. at *London* $4\frac{1}{2}$ deg. but at *Dantzick* 7 deg. West. To the Westward of the Meridian of the *Land's 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 Westward, so as to counterbalance the Direction given by the *European Pole*, and to make a small *West* Variation in the Meridian of the *Land's End* itself. 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 Counterbalance 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-England*, *Newfoundland*, 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 *Newfoundland*, 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*, *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 *Plata*, 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 Virtue of the *Southern-Pole*; as it is about mid-way between the *Cape of Good-Hope*, and the *Iles 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* itself, it arises to no less than 11 deg. where it is 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 *Equinoctial*, respect must be had to all 4 *Poles*, and their Positions well considered; otherwise it will not be easy to determine what the Variation shall be, the nearest Pole being always the strongest; yet not so, as not to be counterbalanced sometimes

by 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 Isle 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 aforesaid 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 Balance 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 itself requiring the same Variations we here find.

7.195.p.564. What I have here said does plainly shew the sufficiency of this Hypothesis, solving the Variations that are at this time observed.

But there are two Difficulties not easy 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 four, 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, fixed in the Earth, but shift from Place to Place, whereas it is not known that the Poles of the *Lodestone* 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 allowed, that the Needle's 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 deg. 15 min. East. In An. 1622, the same was found by Mr. *Gunter*, to be but 6 deg. East. In the Year 1634, Mr. *Gellibrand* found it 4 deg. 5 min. East. In 1657, Mr. *Bond* observed that there was no Variation at *London*. An. 1672, myself observed it 2 deg. 30 min. to the West; and this present Year 1692, I again found it 6 deg. 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 deg. 3 min. 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 deg. 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 deg. East. An. 1677, when I was there, I observed

observed it accurately on Shore to be 40 *min.* East; and now this Year it was found 1 *deg.* to the Westward of the North.

At Cape *Comorin* in *India*, in the Year 1620, there was 14 *deg.* 20. *min.* West Variation; in the Year 1680, there was 8 *deg.* 48. *min.* but in the Year 1688, it was no more than 7 *deg.* 30. *min.* so that here the Needle has returned to the East, about 7 *deg.* in 70 Years.

From these, and many other Observations, it is evident that the Direction of the Needle is in no Place fixed and constant, though in some it changes 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 *Egypt*. 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 increased; to the Eastwards thereof, as in the Example of Cape *Comorin*, 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 considered, 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 fixed 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; and if the internal *Nucleus* be likewise a *Magnet*, having its Poles in two other Places distant 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 four Magnetical Poles, as likewise of the Changes of the Needle's 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, though the Variations do increase and decrease regularly in the same Place, yet in different 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 Variation at *London* and *Paris* gave a notable Instance: For the Needle has been constantly about $1^{\circ}\frac{1}{2}$ more Easterly at *Paris* than at *London*, though 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 fixed in the Earth, and that if the Needle were wholly governed 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 Variation will return again as before.

If then two of the Poles be fixed, and two moveable, I think we may determine that the *European Pole* is that which is moveable of the two *Northern Poles*, and 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*, though the Pole be much farther removed from the Axis: And that the *Asian*, of the 2 *South-Poles*, is fixed, and consequently the *American* moveable; from the like Observation of the slow Decrease of the Variation on the Coast of *Java*, near the Meridian of the *Asian Pole*.

If this be allowed me, it is 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 impress'd 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 *Equilibre* 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 *αυμη* 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 environed with his Ring, is a notable Instance of this Kind, as having the same common Centre, 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 Centre of *Saturn* in its own, it follows that such a Concave Sphere may move with another included in it, having the same common Centre. Nor can it well be supposed otherwise, considering the Nature of Gravity: For should these Globes be adjusted once to the same common Centre, the Gravity of the Parts of the Concave would press equally towards the Centre of the internal Ball, which Equality must necessarily continue till some external Force disturb it; which is not easy to imagine in our Case. This perhaps I might more intelligibly express, by saying, that the inner Globe being posited in the Centre of the exterior, must necessarily ascend, whatsoever Way it move; that is, it must overcome the Force of Gravity pressing towards the common Centre, 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 fixed in the common Centre, 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 Petrefaction, and dispose the transuding Water to shoot and coagulate into Stone, so as continually to fortify, 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 Ad-
mixture

mixture 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 moulder 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 Effects 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 fixed 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. Igitur Corpus Lunæ densius, ac magis terreste 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 $\frac{4}{9}$ Ninths thereof to be Cavity, within and between the internal Sphere, 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 abound 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 to 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 though without Light there can be no living, yet there are many Ways of producing Light which we are wholly ignorant of: The Medium itself 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, adventure to assert the Impossibility of peculiar Luminaries below, of which we have no sort of Idea.

Thus

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.

IX. 1. Having determined as well as I could the *South-Pole* of a *Terella*, or spherical *Loadstone*, of 3 Inches Diameter, which accidentally had fallen into my Hands, I was much surprized 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 Virtue changed in the *Loadstone*, as we see they change in the Earth, one might derive great Advantages therefrom: 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 Virtue in the Earth, it is not to be doubted but a *Terella*, 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 Virtue 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 other 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

*An invariable
Compass;
By M. de la
Hire, n. 188.
P. 344.*

mixture 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 moulder 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 Effects 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 fixed in the Surface of our Globe?

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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.

IX. 1. Having determined as well as I could the *South-Pole* of a *Terella*, or spherical *Loadstone*, of 3 Inches Diameter, which accidentally had fallen into my Hands, I was much surprized 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 Virtue changed in the *Loadstone*, as we see they change in the Earth, one might derive great Advantages therefrom: 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 Virtue in the Earth, it is not to be doubted but a *Terella*, 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 Virtue would pass successively from one part to another, after the same manner as they change in the Earth.

*An invariable
Compass;
By M. de la
Hire, n. 188.
P. 344.*

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 other 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 Cup 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 fixed. 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 Virtue to the Ring. Then I observed that the Ring was strongly magnetical, and that the Point called the South Pole did readily turn itself 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 fixed upon the Ring a small *Fleur de Lis* of Brass in the Point, which exactly respected the North, the Ring being first well settled.

To inform myself, if a Steel Ring had the same Effects as a *Terella*, 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 surprizing; for according to the ordinary Hypothesis of the Magnet, the magnetical Virtue 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 Virtue appears stronger towards the Angles than in the other Parts; which may cause some Irregularity in this Experiment, if it be tried with a Stone that is very uneven.

Those Experiments gave me the Curiosity of making another, by touching two Semicircles of Steel. Having joined the two Ends, touched by the same Poles, I observed by the Steel-Dust the same Effect as in the Ring; but having joined 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 joined, and that the 2 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 Virtue 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 Virtue, 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 it hath been already noted, that when a magnetical *Virgula* is a little bent, it loses its Virtue, which cannot happen, but from the Alteration of the Pores of the Steel.

I farther remarked, that a Ring of Steel having been touched, does for a long time retain its Virtue, 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 Virtue; much as we see Magnets do, which being applied to another Stone, by the Poles of the same Denomination, lose their first Virtue and take a contrary, which they afterwards lose by Degrees, to re-assume their first.

After I had presented this new System of the Magnet to the Academy, there were made some Experiments upon a *Terella* of much the same Diameter with mine, but whose Poles were not diametrically opposite; and upon a half Globe, very much bigger than the *Terelia*: 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 anew 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 Virtue of the Stone which is applied to it, will come as near to it as possible: Infomuch, 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.

2. This Account having been read before the *Royal Society*, it was ordered, that the *Terella* 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 $\frac{1}{2}$ deg. since the *Terella* 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 *Society's* great *Loadstone*, the Sphere of whose Activity is above nine 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 skilled 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 Virtue should be transferred therein from Place to Place, either by length of Time, or by transport-

The Principles examined, ib. p. 250.

ing this Compass into those Parts, where the Variation of the Needle is considerably different.

IX. An Account of a Book, Omitted.

n. 143. p. 3. *Epistola invitatoria, ad Observationes Magnetice Variationis, communi Studios junctisque Laboribus instituendas, Aitorfi 1682.*

C H A P. V.

Botany. Agriculture.

To preserve
the Specimens
of Plants, by
Sir Robert
Southwell,
n. 237. p. 42.

I. **P**REPARE two Plants 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 lie 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 lie 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 Iron Plates, screw them 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 *Aqua Vite*, 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 twenty-four Hours will be dissolved in a Pint of fair Water; and with a fine Brush, rub the Backsides of your Flowers and Leaves, to make them stick; and then lay them into your Paper-Book, where they will lie fast, and always look fresh.

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.

An odd kind
of Mushroom,
by Dr. Lister,
n. 89. p. 5116.

II. 1. As I passed through *Marion 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 six Fingers

gers Breadth high above the Ground, and ordinarily as thick as my Thumb. If you cut any part of the Mushroom, it will bleed exceeding freely a Milk-white Juice, which tastes 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 Vial 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 Taste 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.

2. I doubt not but this Mushroom is that described in *Job. Bauhin, l. 40. c. 6.* under the Title of *Fungus piperatus albus, lacteo succo turgens.* For in almost all Points the Descriptions agree exactly.

By Mr. Wray, *ib.* p. 5117.

3. The *Fungus porosus crassus magnus J. B.* when fresh gathered, is of a Buff-Colour, inside and outside; and yet cut thro' the Middle, it will in a Moment change from a pale Yellow to a deep Purple or Blue, and stain Linen accordingly. A Drop of the Juice leisurely squeezed out, will change, holding it betwixt your Eye and the Light, thro' 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.

Another sort of Mushrooms, 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 called *Fungus porosus crassus magnus J. B.* The Texture of the Gills is like a Paper pricked 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, but it will to any Person that shall well examine it) that the Gills of this Mushroom 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 Mushroom, just as the Seeds of an Artichoke 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 an Artichoke. The like we do think of all other Mushrooms, however differently figured.

The Flowers and Seed of Mushrooms, by Dr. Lister, n. 110. p. 225.

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 in a volatile Dust, as all *Orchides* or *Bee-Flowers.*

IV. The *Tubera Terræ* observed lately at *Rushton* in *Northamptonshire,* by Dr. *Hatton* of *Harborough* in *Leicestershire,* are the true *French Truffles,* the *Italian Tartuffi*

Truffes, by Dr. Tanc. Robinson, n. 202. p. 814. 824. n. 214. p. 935.

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 fried in Slices with Butter or Oil, Salt and Pepper, or else out of Pickle, and often boiled in their Soup. These observed 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 of the Consistence of the fleshy Part in a young Chestnut, of a Paste Colour, of a rank or hircine Odour, and unfavoury, streaked with many white Veins or Threads, 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 called them *Ceraunia*.

Fig. 157. 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 sulcated *Papillæ* analogous to, if not Seed-Vessels; you know several Vegetables bear their Seed near the Root, as the *Trifolium subterraneum triccocum*, *reticulatum* *Flosculis longis albis*, most of the *Arachidna'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 *Latyrus tuberosus*, called commonly *Chamabalanus* and *Terræ Glandes*, in *English*, *Pease Earthnuts*, digged up and eaten by the poor People, *non nisi alta Fossione inveniendæ*, says *Jebn Baubine*. The Roots of our *Bulbocastanum* (of the umbelliferous Tribe) commonly called *Kepper-nuts*, *Pignuts*, and *Gernuts*, in the North, lie very deep, and fatten Hogs, which are very greedy of them.

A strange
sort of Rye
in France, n.
130. p. 738.

V. Some Years since M. *Perrault* related to the Royal Academy at *Paris*, that travelling thro' *Sologne*, he had been inform'd by some Physicians and Chirurgeons of that Country, that the *Rye* 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 view'd some of these Grains of *Rye* 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 Grain of *Rye*, as some pretend; but that they are true Grains of *Rye*, having their Coats like the rest, wherein may be distinguished the Place of the Germen, and of the Furrow.

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 *Rye*, and

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 Chirurgion at *Montgarris*, whence he saith he hath learned the Particulars following, viz. *Rye* 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 follows excessive Heats. The Constitution of the Air, or of the Rains, which impress this Malignity in the *Rye*, is rare, there having been found none at *Montgarris* 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 *Rye*, which holds some of this corrupted Corn, tastes neither worse nor better than other. The *Rye* thus corrupted hath its Effects chiefly when it is new, yet not till it hath been used a considerable time.

These Effects are, to dry up the Milk in Women, to cause sometimes malignant 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 itself, 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 Centre of the Part, and appears not at the Skin till 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 it is 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 itself.

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 *Ptyfan* 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 *Rye* 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 it is 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 Effects of this Corn eaten, or whether the Corruption of the *Rye*, 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. *Doddard*, That in the Year 1630, which was fatal to the Poor of the Countries subject to these Evils, he being at *Sully*, and having understood

understood by a Physician and Chirurgeon, that the corrupted *Rye* 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 died of it.

To make
Malt; By
Sir Robert
Murray, n.
142. p. 1069

VI. *Malt* is made in *Scotland* of no other Grain than *Barley*, whereof there are two Kinds; one of which hath four Rows of Grain on the Ear, the other two Rows. The first is the more commonly used, but the other makes the best *Malt*,

The more recently *Barley* hath been threshed, it makes the better *Malt*, but if it hath been threshed six Weeks, or upwards, it makes 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-dried; 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 get that right mellow Temper *Malt* ought to have, and so spoil 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 *Barley* 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.

Barley that hath been over-heated in the Stacks or Barns, 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 *Barley* that grows on several Grounds, never proves good *Malt*, because it comes not equally: So that the best *Barley* to make *Malt* of, is that which grows in one Field, and is kept and threshed together.

Take then good *Barley* newly threshed, and well purged from the Chaff, and put hereof eight Bolls, that is about six *English* Quarters, in a Stone Trough; where let it infuse till the Water be of a bright reddish Colour, which will be in about three Days, more or less, according to the Moistness or Dryness, Smallness 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 *Barley* which is prepared to make Broth of.

When the *Barley* is sufficiently steeped, take it out of the Trough, and lay it on Heaps, so let the Water drain from it: Then, after two or three Hours, turn it over with a Scoop, and lay it in a new Heap about 20 or 24 Inches deep.

This

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 Grain 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 spoiled, both as to the pleasantness of Taste and Strength.

If all the *Malt* comes not equally, because that which lies in the Middle being warmest, will usually come first, turn it over, so as the outmost may lie inmost, and so leave it till all become 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, cools, dries, 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 lie 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 a 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 Fuel is Peat, the next Charcoal, made of Pit-coal or Cinders, Heath-Broom and Furzes are naught. 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 Twelve Companies of *London*, and some other Companies, The Granaries in London by Dr. Merrit, n. 25. p. 464. 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 Lettice-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 about a Yard high, without any Shutters, and run on in a continued Series,

ries, 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, fortified with Spikes of Iron, that no Vermin might get up, would make that Story fitter for drying of Corn, and more profitable. 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 thro' them, 2 or 3 Foot deep. Others erect, on all 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 the Vermin moistening the Wheat or Rye, make them apt to corrupt and breed Weevils.

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 separate the Dust and other Impurities in it, when 'tis thresh'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 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 or 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 three 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, thro' the whole *Area*, empty of Corn; into which empty Places they turn the Corn as often as 'tis needful.

In *Kent* they make 2 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 2 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.

2. Dr. Pell mention'd at a Meeting of the *Royal Society*, that they keep Corn at *Zurich* in *Helvetia* 80 Years. *At Zurich; By Dr. Pell, ib.*

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 suffered to be built near them, to be thereby secured from the Casualties of Fire. *In Dantzick and Muscovy; By . . . ib. p. 466.*

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.

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 boiled Turneps with a small Quantity of Meal, and that it made better Bread for Whiteness, Pleasantness, Lasting and Wholsomeness, than is made of the finest Flour or Wheat. Turneps, Rapes, Carrots, Parsnips, 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 and Potatoes Bread; By Dr. Beal, n. 90. p. 5142.*

2. The Dearness of all Sorts of Corn in 1693, occasioned 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 and 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 distinguished 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. *Turnep-Bread; By Mr. Sam. Dale, n. 205. p. 970.*

IX. The Corn used in *New-England* before the *English* planted there, is called by the Natives *Weacbin*, and is known by the Name of *Maize* in some Southern Parts of *America*. The Ear is for the most part about a Span long, composed of several, commonly 8 Rows of Grain, 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, black, *The Culture of Maize; By Mr. Winthrop, n. 142. p. 1063.*

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 thro' 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 tried. And Meat 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 called *Mohawks-Corn*, which tho' planted in *June*, will be ripe in Season. The Stalks of this kind are shorter, and the Ears grow near to the bottom of the Stalks, and are generally of divers Colours.

The manner of planting is in Rows, at equal distance every way, about 5 or 6 Feet.

They open the Earth with an Hoe, taking away the Surface 3 or 4 Inches deep, and the breadth of the Hoe; 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 Mous-Squirrels.

The Corn grown up an Hand's length, they cut up the Weeds, and loosen the Earth about it, with a broad Hoe, 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 Husks 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, tho' exposed to all Weathers.

The Natives commonly thresh it as they gather it, dry it well on Mats 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 is 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 Foot 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 Hoe, or by running another Furrow with the Plough. When the Weeds begin to over-top 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 Hoe; and so the Ground is better loosened than with the Hoe, and the Roots of the Corn have more liberty to spread.

Where any Weeds escape the Plough, they use the Hoe.

Where the Ground is bad and worn out, the *Indians* used to put two or three of the Fishes called *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 Tith.

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 the 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, so either eating it alone, or with their Fish and 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 floury. 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 at home, and especially when they travel, being put up in a Bag, and so at all times ready for eating either dry or mixed 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 itself, 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, tho' their old store be gone.

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, 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 coarser part sifted from the Meal, and separated from the loose Hulls by the Wind, they boiled 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 Flour, 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 thereof, 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 Wort, either adding or omitting Hops, 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 thereof the ordinary way, but cannot effect it; that is, that the whole Grain be melted, and tender and floury, 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 lieth of a sufficient thickness for coming, it will quickly heat and mould, and the tender Sprouts be so entangled, that the least opening of the Heap breaks them off, and so hinders the further Maturation of the Grain into *Malt*: On the other, if it be stirred and opened to prevent too much heating, the Sprouts which have begun to shoot, cease growing, and consequently the Corn again ceases to be promoted to the Mellowness of *Malt*.

To avoid all these Difficulties, this way was tried 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 dried on a Kiln, or in the Sun, or spread thin on a Chamber-Floor.

This way every Grain that is good will grow, be mellow, floury and very sweet; and the Beer made of it, will be wholesome, pleasant and of a good brown Colour: Yet Beer made of the Bread as aforesaid, is as well coloured, as wholesome and pleasant, and more durable, this therefore is most in use.

X. 1. The greatest Profit that ever I have heard of the Field White Pease, has been 20 Barrels reaped 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 *Brandenburgh*) in good Orchard Ground, which had been indeed dunged for some other Legumes the last Year, and sowed 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 come up 3, 4, 5 or 6 Stems, (my *Swiss* 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

*Improvement
to be made by
Maize, by
Sir Richard
Bulkley, n.
205. p. 928.*

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 appear 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 joins 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 enveloped 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 Taste and Figure) either in Bread, (with Wheat) or Soup, or Pudding, or with Pork.

*Consider'd
by Mr. J.
Ray, ib. p.
930.*

2. If the *Maize* be equal in goodness to Peas, and an Acre planted with it, 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 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.

By Sir *Richard's* Description of it, I am confirmed in my Opinion, That there are two really distinct Species of *Maize*; for what I have seen cultivated in Gardens, and have myself planted, riseth 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.

*An extraor-
dinary Spirit
of Sugar, by
Dr. Lucas
Hodgeson, n.
130. p. 766.*

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 it in an open Vessel, without being made almost breathless; neither do I think the Person who 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 exceeding Volatile, that it would not be carried, but lost all its Force in the Carriage, tho' it was very well stopped.

*The Culture
of Saffron,
by Mr. Ch.
Howard, n.
138. p. 945.*

XII. *Saffron-beads* 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 ever 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.

Plough

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 to 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 asunder, which serve every Year to lay the Weeds to rot, that are to be weeded and pared off the Ground.

As soon as the Heads begin to shoot or spear within the Ground, which is usually a Fortnight before *Michaelmas*, hoe or pare the Ground all over very thin, and rake lightly all the Weeds and Grass very clean, lest it choak the Flowers, which will soon after appear; and are then to be gathered, 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 spear within the Ground. Then hoe, 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.

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 2 or more *Saffron*-papers, a piece of woollen Cloth, or thick Bays, and a Cushion of Canvas, or Sackcloth, filled with Barley-straw, whereon lay the Kiln Board.

Put into the Kiln, thoroughly 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 out-side of the Paper with a Feather dipped 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 a hundred Pound Weight laid upon the Kiln-board.

The *Saffron* Cake being sufficiently dried, is fit for Use, and will last a good many Years, being wrapped up and kept close.

The best *Saffron* is that which consists of the thickest and shortest Claves, 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 is usually observed, that an 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 Shillings per Pound, cometh to 24 Pounds per Annum.

The gathering and picking of one Pound of *Saffron* is worth one Shilling, which cometh to 12 Shillings per Acre.

The Fire and Care of drying may come to 3 Shillings more, at 6 Pence the Pound; which is in all 15 Shillings.

The Grass that is mowed 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* itself, 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 Shillings, which comes to 8 Pounds per Acre.

Twenty Loads of rotten Dung laid on the Ground, may be worth 40 Shillings 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 Year's Planting (at the least) 20 Pounds per Annum; besides the great Increase of the *Saffron*-Heads, which will be as three 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

Hearth to lay the Fire on: Level wherewith is to be made a little Hole to put the Fire. The outside may be plastered all over with Lime and Hair.

XIII. The first thing appearing of Melons are two Leaves united, here called Ears (marked 1. 1.) out of the midst of these two Ears there shoots some Days after, first one Leaf, which call the first Leaf or Knot (marked 2.) and out of the same place, after some Days more, shoots a second, called the second Knot (marked 3.) out of about the midst of the Stalk of this second Knot shoots the 3d Knot (marked 4.) And this 3d Knot it is, which must be cut at the place marked 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 one. You will 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 nourished in good Earth, and cherished 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, lest the Remedy come too late. I water twice or thrice a Week in very hot Weather, and that about Sunset; and I cover my *Melons* with a Straw-Mat from 11 in the Forenoon, to 2 in the Afternoon, when the Heat of the Sun is too violent, and too quickly consumes that little Moisture necessary for the Root. And when it raineth, I cover also my *Melon-Garden*, lest 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 (marked 7. 7.) betwixt the one Ear and the Leaf before spoken of. But when I join 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 knit, 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 trussed, 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, tho' I above spoke but of one: But this

Melons ordered by M. De la Quintinay, n. 45. p. 901.

Fig. 159.

happens but seldom, and when it does, such two Leaves must be reckoned but for one Knot ; 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.

n. 46. p. 983. 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 it is very hot.

There commonly need no more than forty 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 Melon, 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 Linen Cloth, until they be very clean and dry ; then put them up in some convenient Closet till Seed-time.

Remember not to eat the Melons but some twenty-four 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 requieth 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 yourself to have big Melons, but good ones. Those who covet great Melons, may have their Desires, either by sowing Seeds of the great Kinds, or by much Watering others. Which Watering is a thing, wherein great Care and Discretion is to be used. You may judge of the necessity

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.

XIV. 1. About three Weeks ago the Wife of one *William Mathews* near *Salop* gathered some Herbs, and (having first boiled them) fried them with Bacon for her own and her Family's Supper. And after they had been about two Hours in Bed, one of the Children (which is dumb, and about seven 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 asleep. They took the Children to Bed as they were asleep, and they themselves went to Bed too, and fell faster asleep than ever they had done before. The Man waked the next Morning about three Hours after his usual time, went to his Labour at *Mr. Newport's*, and so by 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 Hat full of Water by him all the Day long, and frequently dipped 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 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* three Weeks) till *Monday* Evening following (and then having just only opened her Eyes and made two Sprunts, without speaking one Word) died immediately. While she was asleep, Endeavours were used to waken her, but in vain. The other two Children slept about twenty-four Hours, and upon their waking 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 it is observed that the Cattle never browse it. It is branched and seeded like Spinnage or Mercury, but leaved rather like Lakeweed; the leaves are dented too.

Dog-Mer-
cury; By
Mr. T. M.
n. 203. p.
875.

2. *Mr. Will. Baxter* did me the Favour to send for a dried 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.*

By Dr. Sloan,
ib. p. 876.

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 unsuccessfully. 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 three or four Days 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.

Hemlock, by
Dr. Nath.
Wood, n.
231. p. 636.

*A poisonous
Root like
Hemlock, by
Dr. Nath.
Wood, n.
231. p. 634.*

XVI. 1. A certain Woman near *Kilkenny* in *Ireland* eating by mistake some Root, I suppose of common *Hemlock*, among Parsneps, was immediately seized 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.

*By Mr. J.
Ray, ib. p.
636.
Hist. Plant.
Tom. 3. P.
281.*

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. Baubinc*, 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*.

*Hemlock-
Water-
Dropwort;
By Mr. Er.
Vaughan, n.
238. p. 84.*

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 *Cenantbe Aquatica Succo Viroso* (in *Irish*, *Tabow*) 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 surprizing 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 fallen 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 *Diapbretick*) might have produced in this Case. Besides, I believe, the Draught of warm

warm Milk did act its part, by involving the acid or acrimonious poisonous Particles, and rendering them unactive, and preventing their seizing the *Genus Nervosum*, till they were expelled *per Diaphoresin*.

There was also a *Dutchman* about two Years since, within eight Miles of *Clonmel*, poisoned by boiling and eating the Tops of this Plant shred into his Pottage. I believe, he took it for *Apium Palustre*, which its Leaves much resemble.

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.

By Mr. Ray,
ib. p. 86.
De Nox. Ci-
cuta Aquat.

XVIII. Between *Penzance* and *Marketjew* in *Cornwall*, on the sandy Shore grows Abundance of *Papaver Corniculatum Luteum*, or *Horned Poppy*, with a yellow Flower, vulgarly called in *Hampshire* and *Dorsetshire*, *Squatmore*, or *Bruise 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 *Penzance* 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 were very pleasant to them) but on the eating of the aforesaid Pye, whilst hot, was presently taken with such a Kind of *Delirium*, that he called for a white earthen Chamber-Pot, and after having purged by Stool into it, he broke it into Pieces, and bid the By-standers to save them, for they were all Gold. The Men 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.

The Horned
Poppy; By
Mr. J. New-
ton, n. 242.
p. 263.

Perhaps the yellow Colour of the Flowers running in their Minds, which the eating of the Roots had now depraved, might beget that Idea of Gold in them.

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 fifteen Years ago: Which because I have not leave to publish, meeting about two Years ago with that obliging and 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 seemed to think it not inferiour and more parable.

The Hel-
montian
Laudanum;
By Mr.
Boyle, n.
107. p. 147.

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 it were

minced

minced 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 eight or ten Days, rather more than less. Then filter it, and having infused in it of *Cinnamon*, *Nutmeg* and *Cloves*, of each an Ounce, or an Ounce and half, let them stand three or four 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 obtained 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.

*The Use of
Opium a-
mong the
Turks; By
Dr. Edward
Smith, n.
221. p. 288.*

XX. One *Mustapha Sbatoo*, an Inhabitant of *Sediqui*, a Village six Miles from *Smyrna*, by Trade a Coffee-Man, about forty-five Years old, a most famous *Opium* Eater, told me, that his constant eating was 3 Drachms 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.

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 Drachms. He came to me at my desire, at 9 in the Morning, but excused his having taken half a Drachm before, because he had not Strength to rise out of his Bed without it. I laid before him my *Opium* made up in Pills, each weighing a Drachm, and desired him to eat what he pleased. He took one Drachm and a half, making it up in three Pills, and chewing it with a little Water: He commended the *Opium*, but was not willing to eat more at a 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 refreshed by my Entertainment; and I found him half an Hour afterwards labouring heartily at cleaving Wood to burn. At three 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 too much of it; that he entered upon
this

this Practice twenty-five 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 twenty Years, than he really is.

Opium is commonly taken by the Messengers in *Turkey*, who are employed in making quick Dispatches; it is 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. *Samuel Barnardiston*, a Merchant of *Smyrna*, at entering into the Gentleman's House, he fell down for dead; at which, when the whole House was surprized 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 called *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 becomes necessary, and grows upon them.

XXI. The famous *Irish* Herb called *Mackenboy*, or *Tithymalus Hibernicus*, is reported by the Natives to be so strong a Purge, that even the carrying it about one in their Clothes is sufficient to produce the Effect. But Dr. *Mullen* has lately proved this Story to be false, by carrying its Roots for three Days in his Pocket, without any Alteration of that Sort.

Mackenboy;
By the Bp. of
Cloyne, n.
243. p. 294.

XXII. The *Pistolochia*, or *Serpentaria Virginiana* hath a bushy Root, consisting of a number of small Strings of a yellowish Colour, and hot aromattick Scent and Taste: Thence grow one or two smooth, at least very little hair 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 *Pistolochia 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 Snake-
Roots; By
Mr. J. Ban-
nister, n.
247. p. 467.

The

The Lip is of a light russet, or dirty Colour. The Seed-vessel is hexagonal, shaped 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*.

Devil-bit,
by Sir The.
Mayerne, n.
211. p. 266.

XXIII. *Succisa*, or *Devils-bit*, is excellent for Poisons, 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.

Alcanna, n.
243. p. 295

XXIV. *Alcanna* is the Leaf of a Plant, dried and powdered; which when steeped a Night in Wine, will dye the Nails red.

AloeAmericana;
by Dr. Merret, n.
25. p. 455.

XXV. *An. 1556*. An *Aloe Americana, serrato Folio*, 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 Kitchen. It weighed,

		Weight.				Loss.				Weight.				Loss.	
		℥	ʒ	ʒ	gr.	℥	gr.			℥	ʒ	ʒ	gr.	℥	gr.
<i>Aug.</i>	4	21	6	0	2			<i>May</i>	1	20	7	0	01	0	0
<i>Aug.</i>	19	21	3	0	24	3	27	<i>May</i>	28	20	5	0	01	1	0
<i>Sept.</i>	6	21	1	0	01		14	<i>June</i>	12	20	4	0	42	26	
<i>Feb.</i>	20	21	1	0	12	0	11	<i>July</i>	1	20	1	0	82	18	
<i>Mar.</i>	16	21	0	2	00		32	<i>July</i>	20	19	6	0	13	7	
<i>April</i>	8	21	0	0	00		40	<i>August</i>	4	9	3	0	12	2	40

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 2 1/4 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 cold Garret, it perished.

These Observations I had about it, that every Year two of the greater Leaves first changed 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. Inasmuch, that all this time I had the same Number of Leaves. And then these new Leaves were more fresh and green, and not serrated, and thicker also in proportion to their other Dimensions. Whence perhaps it may probably be inferred, 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, which protrude their Leaves, placed in a Shop or House, have their Roots lighter and more spongy; 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.

XXVI. Fig. 160, represents what is commonly, but falsely, 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 Fern, both without and within. Most Part of the outside of this was covered 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 used for spitting of 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 the Capillaries have something like it. It seemed to be shaped by Art to imitate a Lamb, the Roots or climbing Parts 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 assured 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 used for spitting of Blood. But on Trials I have seen of it, tho' I may believe it innocent, yet I am sure it is not infallible.

The Tartarian Lamb, by Dr. Hans Sloan, n. 247. p. 461. Fig. 160.

P. 386.

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 *Striae* 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 Bason, 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.

A sort of Seeds which clarify Water, by Dr. Hans Sloan, n. 249. p. 44. Fig. 161. n. 45. p. 863.

XXVIII. Upon viewing the bunchy Fasciculus of Flowers of the *Tugus* *Birao*, or as some call it *Caropus*, and tasting its Grape with the Kernel or oblong Seed, and comparing them with the Descriptions of the *Anomum*: by Botanists, I am fully persuaded that the *Tugus* is the real *Anomum* of *Dioscorides*.

The real Anomum, or Tugus of the Philippine Isles, by P. Ge. Gamelli, n. 248. p. 2.

The *Tugus* is a Plant some Cubits sometimes high, with a Leaf like the Plant *Tagbac*, or *Bagongbonque*, except that on its under side, it is covered with a very fine Down; besides it is more veiny, longer and sweeter smelled. At the Root of the Plant, or the Trunk of the Stalk, from the Pith of the leavy Stalk, there buds out, more like a Bunch of Grapes than of the Flowers of the *Amomum*, a *Fasciculus* of Leaves of about six Inches long, adorned with very red Flowers, which are followed by the Grapes shooting out into a longish Neck, with a sweet thin Skin, whence being devoured for the most part, together with the Seed, by Mice and Birds, it can only be gathered in very small Quantity. Wherefore *Virgil* seems to insinuate that it was formerly very rare, when he says that, The *Assyrian Amomum* shall grow common in the Fields.

These Grapes contain commonly five or six reddish, oblong, unequal, aromatick Grains, or *Kernels*, less acrid than *Amuyong*, and more fragrant than the *Cubebs* of the Shops; of which the *Jewish* Girls at *Caropi*, use to make Necklaces and Bracelets, stringing them upon a Thread, either by themselves, or together with *Pearls* and *Coral*. Some make them of these and the Seed of *Abelmosch*, which they call *Maricom*; some of the Seeds of *Gromel*, with them *Tigbi*; some with those of the *Red-Cane*, with them called *Ticassius*, some with the *Saffron-Pea*, which they call *Saga*; as likewise with the Seeds of *Amomonti Bodiang*; and those of *Cardamoms*. But the Grains of the *Tugus* they wear about their Necks upon Account of their grateful Smell; and Experience has likewise taught them that these Grains are a Preservative against infectious Air, and cure the Bite or Sting of the *Scolopendria*, being chewed and laid upon the Wound. The Root is like that of the *Tagbac* or *Sweet-Cane*, insipid, white within, and externally covered with reddish, subodorous Films like those of Onions. I had it wrote to me from *Boronga*, that from the Tops of the Stalks, there grows another Kind of Fruit which is not aromatick; but this I never saw. The *Indian Indians* affirmed the same to me; but I imagine they were deceived, and had probably taken the Plant *Tacbac* (*Tagbac*) for the *Tugus*.

It is brought into *Boronga*, and the Head of *Pyrana* from other Places of the Islands *Samar*, and *Leyte*. And I do not doubt but it is found likewise in *Luzona*, especially in the Depths of the Torrents of *Silanium*.

Note, The recent tender Buds of the Flowers of the *Tugus*, in some Measure represent the false *Amomum* of *Garcia*, resembling the *Doves-Foot*. But that nothing might be wanting, I send you together with this, a Figure of the Plant; and some People will object, that a Chesnut has as much the Resemblance of an Egg, as the Leaves of the *Tugus* have with those of the *Pomegranate*, which I willingly grant them. But whatever *Dioscorides* and *Pliny* have said of the *Amomum*, is only to be understood in my Opinion, of the flowery Bunch of Grapes of the *Tugus* turged with Seed; for they were not acquainted with the whole Plant itself. For the *Tugus* has a Stalk about a Span high, more or less; of a reddish Wood, or woody Substance, with little Leaves and Flowers like those of the *Pomegranate*, rolling themselves

selves up in the Form of a Bunch of Grapes, or according to *Bartb. Meruia*, its Fruit is like a Bunch of Grapes, with Seeds like small Grapes, the outer Covering very aromatick and pungent to the Taste, of a heating, astringent, and drying Quality, with the other Marks of the true *Amomum*, the Plant, as on carefully examining it, resembling *Doves-Foot* in its Figure, *Job. Botero Benes*, says the *Amomum* comes from *Turcomania*, a Province of *Armenia*.

XXIX. There is an Herb called *Ahmella* by the Inhabitants of *Ceylon*, which of late is become very famous for the *Lithonriptick* Quality assigned to it. Whether it is found any where else I do not know, but I reared it when I had the overseeing of the Physick Garden at *Amsterdam*. It sends forth Flowers from the Tops of its Stalk like the *Chrysanthemum Curassau* with the high Stalk and the Orange Flowers, *Par. Bat.* Its Seed is forked, and the Stalks square, covered with a prickly kind of Down like that of the Nettle, or dead Nettle; whence it plainly appears, that it ought to be referred to a Species of *Hemp*, which *Cisalpinus* calls forked, and after him *Tournefort*; and perhaps not improperly, to the *Indian Lithonriptick Hemp*, or *Bidens* with the Leaf like the dead Nettle.

The Ahmella from Ceylon; by Dr. Horton, n. 257. p. 365.

XXX. 1. *The Nux Pepita*, or *St. Ignatius's Bean*, is about the Bigness of a Nutmeg, and triangular. This Fruit is very much esteemed in the *Philippine* Islands, for the Cure of many Distempers.

Nux Pepita, or St. Ignatius's Beans, by Dr. Sloan, n. 349 p. 44. Fig. 163. n. 150. p. 87.

2. 1. This Fruit has the Vertues of that Metal which we call *Tumbaga*, composed of that which is called *Ilingo*; it is good against Cramps and infected Blasts, and against that Kind of Spaim which we call *Sotan*.

2. It is good for bringing up any Kind of Poision, if the Raspings of it are drank in something cold, as also against the Bites of venemous Creatures, if they are applied to the Wound.

3. It is likewise of Service in Spasms of any particular part, if you apply the Raspings of it to the Part affected.

4. These Raspings likewise stop a Bleeding, applied to any Wound, and last Year, viz. 1692, being given to a Woman to drink for a violent Flooding, she was cured of that Complaint.

5. It also cures Fevers; for I was present the same Year, when it was given to a Child to drink who was ill of a violent Fever, and immediately after the Disease went off.

6. It assists Women in Labour, so as to render the Birth more easy and expeditious.

7. I come at last to talk of it from daily Experience. And it is of surprising Efficacy in every Repletion and Crudity of the Stomach, as also in a Dysentery and troublesome Tenesmus.

The Patient may divide each Nut into three Parts, and when he finds he has need of it, let him hold one of them in his Mouth for a Quarter or Half an Hour, and swallow his Spittle, and afterwards let him drink two or three Ounces of cold Water, and you will see its Effects.

Or, Let him take a Fragment of the hardest shelly Part of it, and into the Hollow of that pour a little cold Water, rub the Fruit in it, and put

by the Water in a proper Vessel with some Raspings; let this be repeated three or four Times, till he has two Ounces of that Concoction and the Lotion of the testaceous Fragment and the Nut or Grain of the Shrub, and then let him pour this off and drink it.

Also, If the Nut is divided into Pieces, rubbed with Oil (especially of Olives) and the Oil is drank, applied to Wounds, or rubbed upon Limbs that are taken with Cramps, it is medicinal as above.

By P. Soc.
Camelli, ib.
p. 88.

Fig. 164.

3. *Catolongay*, which others call *Cantara*, is a Plant bearing the true *Nux Vomica* of *Serapion*, and climbs winding up upon the highest Trees. The Trunk is woody, light, porous, sometimes as thick as one's Arm, and its Bark is tough, thick, and of an Ash-Colour. Its Leaves are large, stringy, bitter, and almost like the *Indian Leaf*. The Flower is like that of the *Balanstine*, followed by a Fruit larger than a Melon, with a very fine outer Skin, shining, smooth, and of the Colour of Alabaster, under which there is a Kind of Shell as it were, of a strong Substance. Within this Shell is contained a yellow, soft, bitterish Pulp, like that of the Fruit *Manga*, in which lie the *Nuces Vomicae* of *Serapion*, frequently to the Number of twenty-four, which when recent, glitter with a Silver Down, a little less than Acorns, but unequal and variously shaped. These the *Indians* call *Isagur*, and *Mananag*, that is victorious; the *Spaniards* the *Kernels*, or *Pepita* of *Byfayas*, or *Catbalogan*, and others *St. Ignatius's Beans*. When dried, they are about the Size of a Filberd, or rather a little larger, knotty, very hard, diaphanous, and as it were horny, of a bitterer Taste than the Seed of the Citron, between a white and a blue Colour, as *Serapion* likewise observes.

There are a great many, I do not know from what Principle, who put the Nut *Isagur* into a Bag of the Fruit *Salag-salag*, and hang it about their Necks; and by this Means they imagine they are preserved from all Poison, Plague, Contagion, Magick Incantations, and Philters, especially from that Poison which they call *Soptum*, and which they say only kills by puffing up the Body, and even from the Devil himself.

This *Cb. Miralles* affirms in his Collections, saying that they have not only a Vertue of driving away Diseases, but also of resisting evil Spirits in a special Manner; for by these Nuts the *Magi*, called *Barange*, are disturbed, disquieted, and most heartily sweated, as if they were engaged in some hard Task full of Dangers and Difficulties: Which he adds, he had learned by Experience; and besides, had it affirmed by others who had seen it, and whose Word he could very well rely upon. Whence he suspects that these *Barange*, or mischievous Simplers, are in Compact with the Devil: Especially as it is reported, that those wicked Physicians, oblige those who want to be instructed in the Knowledge of Simples, to put to Death the nighest of their Relations.

There are some who say, that *Alexius Lopez* in *Guiguan*, and *Peter Oriol*, and others, being provided with this Nut beforehand, were thereby preserved from the abovementioned *Soptum*, or blowing up by Poison, with which the malevolent *Indians* kill those they have a Spite at. They take, as is commonly said, the Poisons of the abovementioned Herbalist, which they are very

very familiar with, and put them in one Side of the Mouth, and in the other Check *Contrayerbas*, as they call them, that is Antidotes, to prevent their being poisoned. These Things being held in the Mouth artfully, and with a diabolical Dexterity, they breathe upon their Enemies, or those they hate, with a poisonous Breath like Serpents, whereby they are immediately struck down to the Ground, and die, unless prevented by this Remedy which they have found out, *viz.* the Nut. They add too, that if any one carries this Nut about with him, the Person who offers to infect him with his poisonous Breath will suffer, as happened to the *Indian* that in a Shew of Friendship, attempted treacherously to take away the Life of *Alexius Lopez*, who chanced accidentally to have his Nut about him; which first gave Occasion to the *Spaniards* to observe the Vertue and Efficacy of *Isagur*. But how *Isagur* naturally, as some will have it, can repel the Vertue of a Poison acting at a Distance, I leave others to judge.

I once gave a Scruple of the Powder of *Isagur* to *Vincentius Olzina*, who was of a melancholick Constitution, and troubled with Indigestion, a Diarrhæa, frequent Vomiting, sour Belchings, and a great deal of Wind. He had no sooner taken it than he was seized with an universal Tremor, which continued for three Hours, together with an Itching, and terrible convulsive Twitching, so that he could not stand, but they were still more violent and troublesome in his Jaws, so as to force him to a Kind of Laugh. The Pulse in the mean while suffered no Alteration, he had no Vomiting, nor any subsequent bad Symptoms; and afterwards he found himself somewhat relieved by it.

Johannes Ofeta suffered the same Kind of Tremor, and spasmatick Convulsions as *Vincentius Olzina*, together with a great Tightness in the Thorax, Giddiness, Faintness, and cold Sweats. This Man who was of a melancholick, hippish Constitution, and very desirous of Health, had swallowed an entire Nut fresh taken out. I relieved him by giving him Oxymel and Oil in warm Water, which made him throw up a great deal of viscid Phlegm together with the Fragments of the Nut.

Joachinus Assim, after taking a third Part of a Nut, was ill upwards of three Hours of the same Complaint with *V. Olzina*, and *Johannes Ofeta*. But besides the Contractions and involuntary Motions he felt a Sense of Crawling, especially about his Head. Lastly, *A. Varacna*, *A. Girau*, and others, suffered the same Symptoms from the same Cause.

But the common People exhibit the Nut *Isagur* indifferently in every Complaint, without any Regard either to the Time, Disease, Age, or even the Dose; and they tell a great many wonderful Things of it, extolling its good Success, and concealing the bad: And there is no doubt, but sometimes from such a violent Irritation of the animal Spirits, and Alteration of the Humours, occasioned by this Nut, some morbid, heterogeneous Particles must be purged off. And thus the Humours being restored to a better Crasis, the Health will be restored.

The common Way of using it is by steeping it whole for a little while in hot Water till it becomes bitter, and then giving the Infusion. Some give

give a small Quantity of the Powder in Substance. Some make the Patient swallow one or two little Bits of it; and some hang a whole Nut, by way of a Charm, about the Neck.

For the most Part it occasions Vomitings, and sometimes it purges; on the *Spaniards* it almost always causes spasmodick convulsive Motions, but not on the *Indians*. By way of Antidote against Poison, and in inordinate Tumults of the Spirits, it is to be taken whenever the Case requires it. But in other Accidents or Diseases, it is best in the Morning when the Stomach is empty; unless it is given by Way of a Vomit, and then it does better an Hour or two after eating, to the Quantity of ten Grains, mixed with some other gentle Emetick.

There are many who carry a whole Nut about with them, and affirm (I refer you to the Authors for the Truth of it) that it preserves them from the Plague, Magick Incantations, Philters, Septum, or the Breath tainted with venemous Herbs, as also from I don't know what Contagion of the Air, which the *Spaniards* call *Malairé*, and *Pasmus*, that is being stunned, and the *Indians* *Sautan* (from which they say they are likewise preserved by black Coral, the Hoof of the Rhinoceros, Dumbaga, Ingo, and the Shell of the Tortoise;) but it seems rather to be a kind of Catalepsy; for when they are seized with it they fall down as if struck with a violent Pannick, deprived of their Senses and Speech, they are stupified, and frequently grow stiff, as if they were really dead; but by a revulsory, and cruel Scourging of their Legs and Arms, whereby the Blood is collected there, and then evacuated by Scarifications, they are brought to themselves and cured.

F. de la Zarza informs us, that a Piece of the Nut, or a little of the Rasplings of it, is very good against the Bite of the Viper *Basil* (a Kind of Canker-worm, hairy and noxious, producing a violent Itching to the Touch) or of other venemous Animals; or applied to a Wound by an Arrow, or any other poisoned Instrument, adhering to it like the Snake-Stone, and extracting the Poison. Others recommend the Powder in an Hæmorrhage of the Nose, and to stop a Bleeding from a Wound.

In the *Malviento*, *Malairé*, *Sautan*, and *Pasmus* (a Kind of *Catalepsy*) *Stupor*, *Apoplexy*, *Palsy*, *Lethargy*, *Epilepsy*, *Asthma*, obstinate and suffocating *Catarrh*, *Tooth-ach*, and other *Defluxions*, a little Bit must be put upon the Tongue, to increase the Discharges of Saliva; for by this Means the Head being purged of a Quantity of viscid Phlegm, the Patients very often find themselves relieved, and frequently at the Point of Death, if I may say so, are recovered.

The Powder, Infusion, or Oil below described, is very much commended in Tertian and Quartan Agues. When there is Danger from Poison, or the abovementiond *Soptum Buyasso* (that is *Buyo*, or *Betele*, a deadly Composition, made with the Seeds I imagine of the Thorn-Apple, or some such Narcotick, which if it does not kill the Person, makes him dull, confused, stupid, torpid, and as it were stunned :) I say, such as have swallowed or chewed this Composition, I have known cured by this Oil, as also where there was a Suspicion of having eat the noxious *Betele Sardine*.

I have likewise found it efficacious in promoting Urine, the Menses, and Lochia when they were suppressed, in facilitating difficult Births, bringing away the Secundines, expelling a dead Child, and Worms. They gave it besides in Cholicks, Indigestions, Crudity of the Stomach and a bad Concoction, Diarrhæa, Tenesmus, and Obstruction of the Liver, and Spleen, as also in all the Diseases abovementioned.

But the Oil of *Ifagur* prepared simply by Infusion is a most efficacious Emetick and cures the same Complaints with the Nut itself. I was told by a Person of great Veracity, that at the Presence of the Magician *Barang* it effervesced and came running out of the Vessel. The same Thing is affirmed by other Authors.

Others again in order to make this Oil more efficacious, compose it of *Ifagur*, *Tambal de Garigara*, *Tambal de Sangil*, *Tambal de Bornei*, *Salag-salag*, *Camasa*, *Manungal*, *Alagao*, *Salibutbut*, *Tambalisay*, *Marbar Molavin*, *Borogtongon*, *Palyaccan*, *Panambac*, *Pancoro*, *Nolalasson*, *Bagatapon*, *Oringun*, and other Things: This is commonly called *Jazoite de Tambal*, viz. from the Emetick Bark *Mananangtang*; it purges violently both upwards and downwards, and its Dose is from one Ounce to two.

The *Lignum Sanctum* of *Luzo* is a good Succedaneum for *Guajacum*; farther it helps the Concoction, and excites the languid Appetite. N. B. It cannot be given to pregnant Women but it occasions Abortion.

The Snake Wood of *Manungal*, and the Decoction, is good against all Poisons, and the Bites of venomous Animals. It is febrifick and Anti-Asthmatick, opening inveterate Obstructions, and restoring a lost Appetite. It cures a Jaundice in eight Days taken in the Morning. It expels Worms, and mitigates cholick Pains. A Decoction of two Ounces of it, usually gives five Stools.

The Vomiting Bark *Mananangtang*, is given in Powder, from one Scruple to four. It purges off pituitous, viscid, and bilous Humours, both by Vomit and Stool; and hence it is of great Service in Fevers, Repletion of the Stomach, or a Turgency of viscid Humours, Cachexy and Dropsy. It is more effectual against Poisons, and for bringing away Worms than the Decoction of *Manungal*.

4. There is a Bean called *St. Ignatius's*, which is lately come into Vogue. It is called likewise *Ifagur*, *Faba di St. Nicolas*, and *de Cava Longa*. It is a very bitter Seed, having no Resemblance of a Bean, as you may see from the Seed itself. It is principally used for promoting Sweats, and curing of Fevers; as also in Loosenesses, Bloody-Fluxes, Cholick Pains, Convulsions, and the Epilepsy; and externally for the Itch. Its alexipharmick Virtues are also very much extolled. It comes from the *Philippine*, as they are called, and the neighbouring Islands. Its Species is not known; only I have been informed by *D. Râfaele de Roa Hispana*, a very learned Man, who lived long in those Islands, that it is a Plant of the convolvulous Kind climbing up upon the highest Trees, and bearing Fruit about the Size of a Pomgranate, in which are a great many Seeds, from which falling off new Plants spring up.

By Dr. Horton,
ton, 357. f.
365.

*Cherries
recovered,
tho' almost
wither'd, by
Dr. Chr.
Merret, n.
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 barred 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 *Lobelius*, or *Sorbus Procera* of *Baubinus*, growing wild in a Forest of *Worcestershire*. 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; and it 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*.

*By . . . ib.
p. 979.*

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.

*A double
Pear, by . . .
n. 260. p.
470.*

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 grow out of the Skin of the lower *Pear*, and had no Fibres rising from the carious 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 *Pedunculus*. The outer Coat of the *Pedunculus* was continued to the Skin of the lower *Pear*, and this Skin to that of the upper *Pear*. The inner Fibres of the *Pedunculus* go thro' 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.

*An unusual
way of pro-
pagating
Mulberry
Trees, in
Virginia, for
Silk Work;
By . . . n. 12.
201.*

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 two or three 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 Scissars; 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 Scythe, and ever to keep it under.

XXXV. The vulgar Husbandman (without the Expences, Curiosity, Care, or Trouble of grafting) may propagate the *Genet Moyles* by the knot-^{Choice of Fruit-Trees for speedy Propagation and pleasant Liquor; By Dr. J. Beal, n. 71. p. 2146.} ed Branches alone, in Ground that deserves not to be called fertile; as they do in the Rye-Land, and Gorsy Ground in *Wales*: And the Cyder 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 Case.

There is a Summer Apple called *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 Cyder 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 cut off below the Knot. It prospers best in a good Mould better than that of the common Field; yet in the dry Rye-land it bears plentifully every second Year, and when one of these Trees falls, the next of the same Kind may have a full Burden.

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 Confiner between *Worcester* and *Hereford*, from *Powick* to *Bosbury*, the *Bare-land-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 red of several Kinds yield abundance of pleasant Liquor. The *Ailets*, great and little, wild and gentle, the *Linton-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 every Year.

Where the Soil hath been tried and found kindest for Apples, it is 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 hardest Apples, to humour all Palates, and for a help to the Stomach, 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 Cyder, Sir *W. S.* recommends the *Hamlin-Apple* of *Devon* for Cyder equal to the best, if not excelling.

*An easy way
of raising
Fruit-Trees,
by Mr. Lew-
is, n. 95.
p. 6067.*

XXXVI. Take a piece of the Root of an Apple-tree or Pear-tree, &c. about six 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 join to the Sap of the Root, as much as you can. Lap the jointed Place about with a little Hemp or Flax-hurds; set the Root so grafted into the Ground about ten or twelve Inches deep, so as the Joint may be covered at least four 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 the 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 plucked 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 two Quarters of Apples upon a Tree; and are bigger than most of those Trees among 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.

*The best Sea-
son of trans-
planting, by
Mr. R. Reed,
n. 70. p. 130.*

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.

For either we take our Stocks out of Woods or out of Nurseries; in either Place they lie 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 purlingly, and die 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 a Hide-bound Horse, they will not admit the Sap which the Root would send up; and other Suckers grow out of the Earth; and the Trees grow dry, and turn 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,

Bark, as we can. Now on the other side, if the Summer proves moist, the Danger and Fear of late Setting is over, and they will thrive and come forward amain; 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 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. *Lauremberg*, a Person of much Experience, agreeth with Mr. *Reed*, that Plants which cannot well bear the hardship of the Winter, should be 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 he only differs that he saith, *Poma, Pyra, Cerasa vulgaria, Coryli, Oxyacanthi, Prunâ, &c. facile frigus ferunt, & Autumno transplantari optimo successu solent*; and then for the Spring, he refers *Juglandes, 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 it is 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 them after Candlemas, and intreat them to grow.*

By Dr. J. Beal, n. 71. p. 2148.

Lauremb. de Hort. Cult. l. 1. c. 28.

XXXVIII. It is to be noted, That the Blossoms of Fruit-Trees do not forthwith discover the Blast; for an old experienced Countryman having once given me notice of a blasty Noon (it being then sultry Weather and somewhat gloomy with the Thickness of Exhalations, almost like a very thick Mist) within a Day or two after shewed the Proof upon the Cherry-Blossoms, then flagging, but not much altering their Colour till two Days more were past.

Blossoms do not forthwith discover a Blast; by Dr. Beal, n. 23. p. 424.

XXXIX. 1. I do commend for the advancing of *Cyder* 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 *Cyder*.

Cyder, by Mr. R. Reed, n. 70. p. 2128.

The best *Cyder* I ever had, was Redstreak grafted upon a *Gennet Moyle*-stock. For, as those Kinds do best agree, and the Trees so grafted seldom

canker (as do the old Redstreak upon a *Crab*-stock) so the Fruit is far more ingenious and milder; and being ripe, both rich and large, and good to eat; and the *Cyder* 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 a Redstreak 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.
Colpresh, n.
27. p. 501.

2. A Composition of the Juices of good *Cyder*-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. 601. 6.

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 of 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 direct upon the Vines, he hath riper, sweeter and greater Plenty of Grapes, than when their Vines are placed as Wall-Fruit.

To make
Muscadine
Wine; By
M. de Mar-
tel, n. 58. p.
3183.

XLI. 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 turn 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 Grapes with it. Lately a certain Person thought fit to pass *White-Wine* of another Kind upon the 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*.

The Way
of making
Vinegar in
France: By
M. . . n. 61.
p. 2002.

XLII. 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 sours the Wine. The two Vessels being almost quite filled with the Rape, one of them is filled 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, there-
with

with 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-filled 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.

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 filled 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 unfilled, 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, 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.

The Rape, as soon as it is 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 itself and be spoiled. *ib. p. 2004.*

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 Linen, 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 one's Hands. No body that I know hath hitherto examined what this Grease is.

I have been lately informed, that there have been Merchants here, who made *Vinegar* with Phlegm of Wine, remaining after the *Aqua Vita* is extracted from it.

XLIII. A Provincial at *Paris* pretends to keep Orange-Trees in that Town all the Winter long without any Fire, tho' 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. *Orange Trees ; By n. 29. p. 554.*

XLIV. 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. *One individual Fruit half Orange and half Lemon ; n. 29. p. 453. By Mr. . . . ib.*

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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 Lemon on another Branch, as also (consonant to the *Florentine Information*) one and the same Fruit half Orange and half Lemon; and sometimes three quarters of one kind, and one of the other.

By Pet. Na-
tus, n. 114.
p. 313.

3. About thirty 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 Lemons or Citron, some partaking of both Forms in one. And particularly as to the Fruit, some of this Tree are mere Oranges, yet some of them of an oblong Shape like Lemons, some round like common Oranges, some between both: Others taste like genuine Oranges, others have an Orange Shell, but a Lemon 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 a Citron-Lemon, yet not so many as of the former kind. And not only so, but it produces also a Fruit, that is in one both Lemon, Citron and Orange; so as you may see outwardly two sorts of Fruit represented in one Piece; one, Citron-Lemon, the other Orange. But this Fruit is so diversified, that some of them are half Citron-Lemon, half Orange; others have two thirds of Citron-Lemon and 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 Lemon begins; and on the contrary. Again, the Orange Pulp is narrower than that of Lemon; 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 Insidious 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-Lemon-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 Juices, permeating the common Fibres, had for a long time nourished, there emerged at length a *German* or Graft, perfectly retaining the Nature and Species of both; into whose different Branches when sometimes one, sometimes both Kinds of Juices did pass, it produced on one of those Branches a mere Orange, on another a Citron-Lemon, on a third a Citron-Lemon-Orange, and even sometimes upon one and the same Branch, all the three sorts of this Fruit together.

An Account
of the Coffee-
Shrub; By
Dr. H. Sloan,
n. 208, p. 63.

XLV. Mr. *Edw. Clyve* (and he is the first) who brought a dried Branch of the *Coffee-Shrub A. A.* from *Mecha* 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 grey almost smooth Bark. The Wood is white, and the Pith

Pith not very large, the Twigs are covered with a dark-coloured 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 two Inches distance, each Pair of Leaves from the other one. The Leaves have $\frac{1}{4}$ Inch Foot-Stalks, being about four Inches long, and two broad in the Middle where broadest; whence they decrease to both Extremes, ending in a Point. They are smooth, whole, and without any Incisures on their Edges, somewhat like the Leaves on 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 one, two or more, at the same Place.

Fig. 165.

These *Shrubs* are planted in *Arabia Felix*, called *Jaman*, every where in a rich Ground or Mould, 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 three, four 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 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 the Drink more cooling, it being sourish to the Taste.

A. A. Represents the *Shrub*, wherein is observable the manner of its Branching, and of the growing of the Leaves and Fruit.

a a a a. The Fruit, growing two, three, 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.

Explication
of the Fi-
gures.

XLVI. I cannot learn the Use of any part of the *Coffee-Shrub* except the Berries; of which, boiled in Water, a Drink is made, and drank much among the *Arabians* and *Turks*. Perhaps it was 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.

An Account
of Coffee;
By Mr. J.
Houghton,
p. 256. p. 317.

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. *Rastal*, an *English* Merchant, whom I knew, found a Coffee-House at *Leghorn* in 1651. The next Year Mr. *Daniel Edwards*, a Merchant from *Smyrna*, brought into *England* a *Greek* Servant called *Pasqua*, to make his Coffee: So that it is likely that

that this Merchant was the first who used it in *England*, (though 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, it is 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, although they are tolerably swelled, 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 a Semicircular Hearth, wherein is made a large Charcoal Fire: By the help of a Jack, the Spit turns swift, and so it roasts, being now and then taken up to be shaken. When the Oil arises, and it is grown of a dark-brown Colour, it is 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, it is a sign it is well done.

Of this, when fresh, if an Ounce be ground, and boiled in something 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 reddish 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 Oil, 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 Chymist 1 Pound of clean Coffee, 1 Pound of husked Horse-Beans, and 1 Pound of picked Wheat; and I received back,

	Coffee.			Horse-beans.				Wheat.		
	℥	ʒ	ʒ	℥	ʒ	ʒ	gr.	℥	ʒ	ʒ
Spirit ret.	VI.	VI.	o	VI.	I.	o	XII.	VIII.	II.	I.
Oil	II.	IV.	II.	I.	III.	o	X.	I.	o	gr. VI.
Cap. Mort.	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 Oil as Beans, and almost treble as much as Wheat.

The



Fig. 163.



Fig. 161.



Fig. 158.

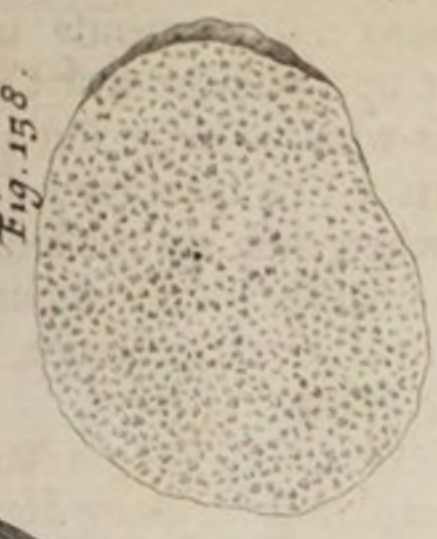


Fig. 165.



164



165

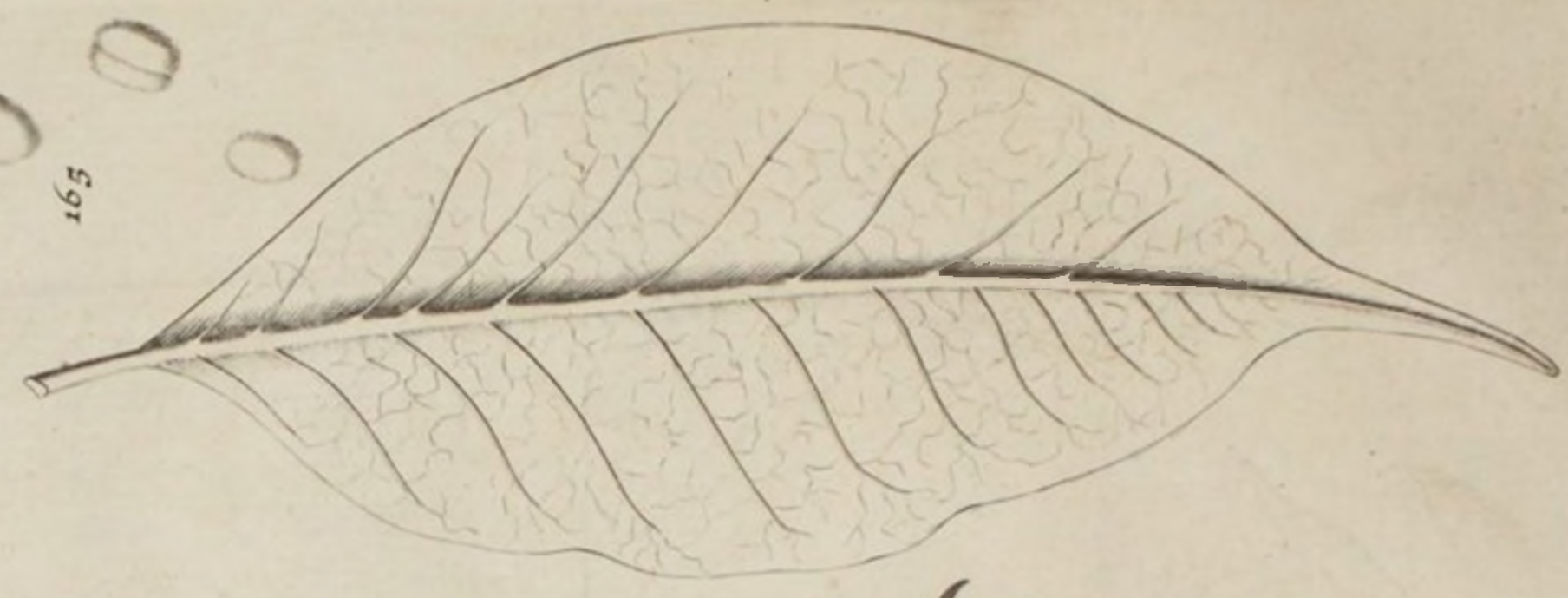
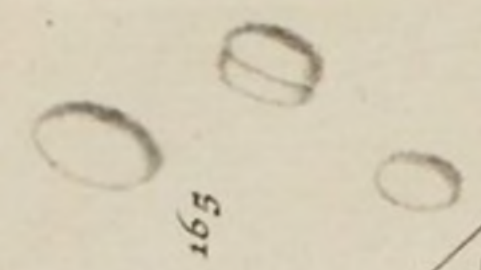


Fig. 165.

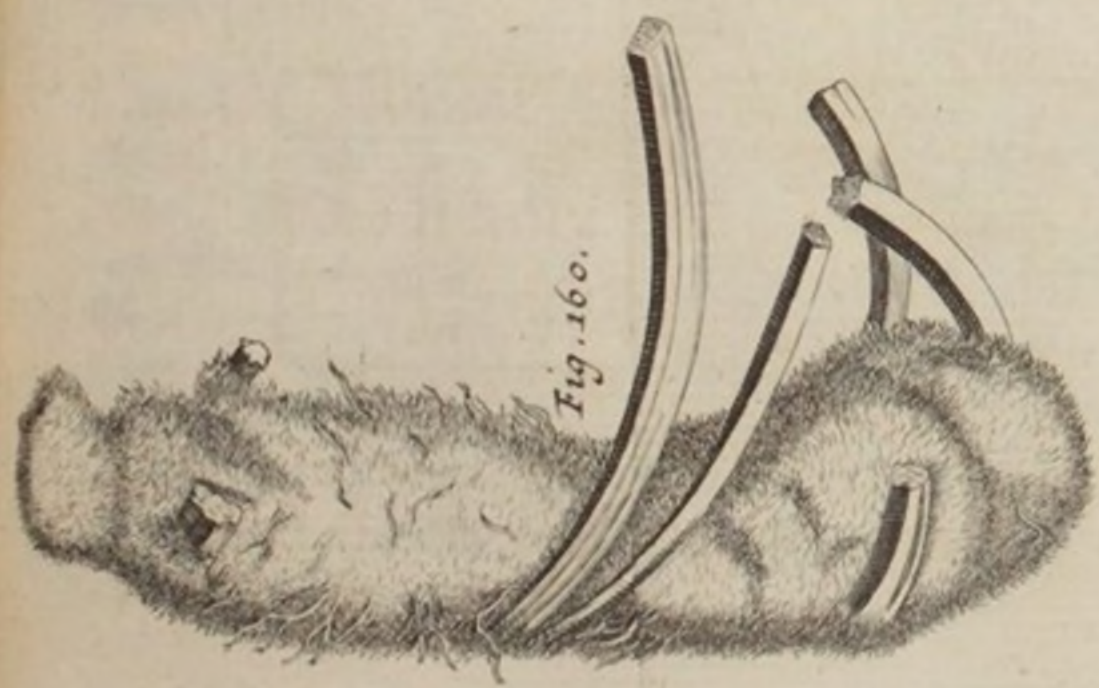
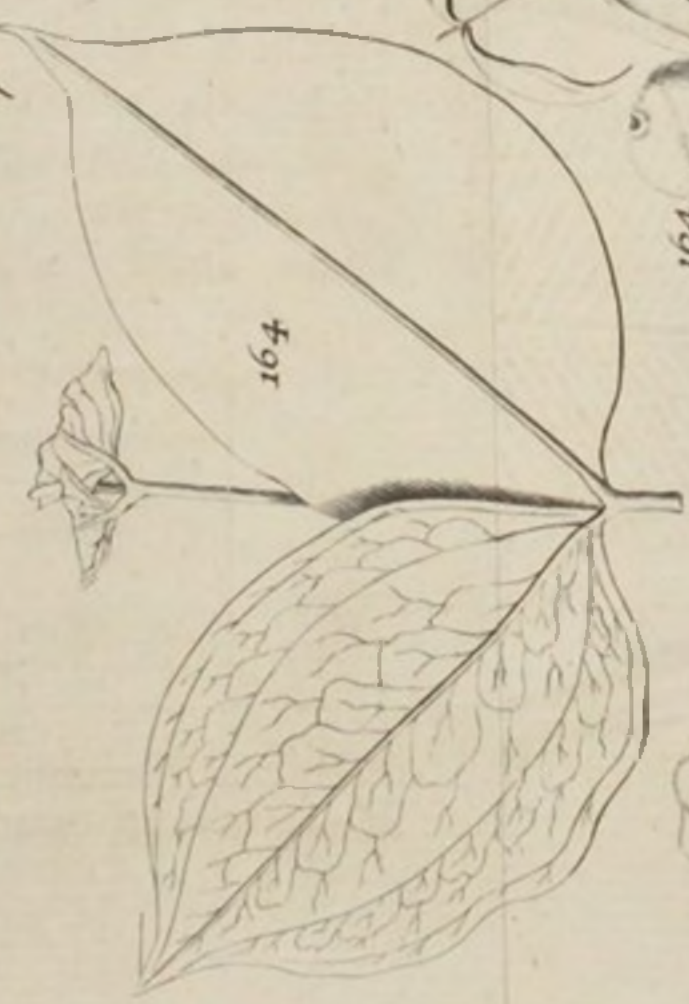
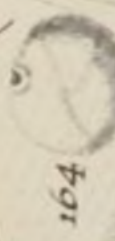


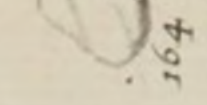
Fig. 160.



164



164



164

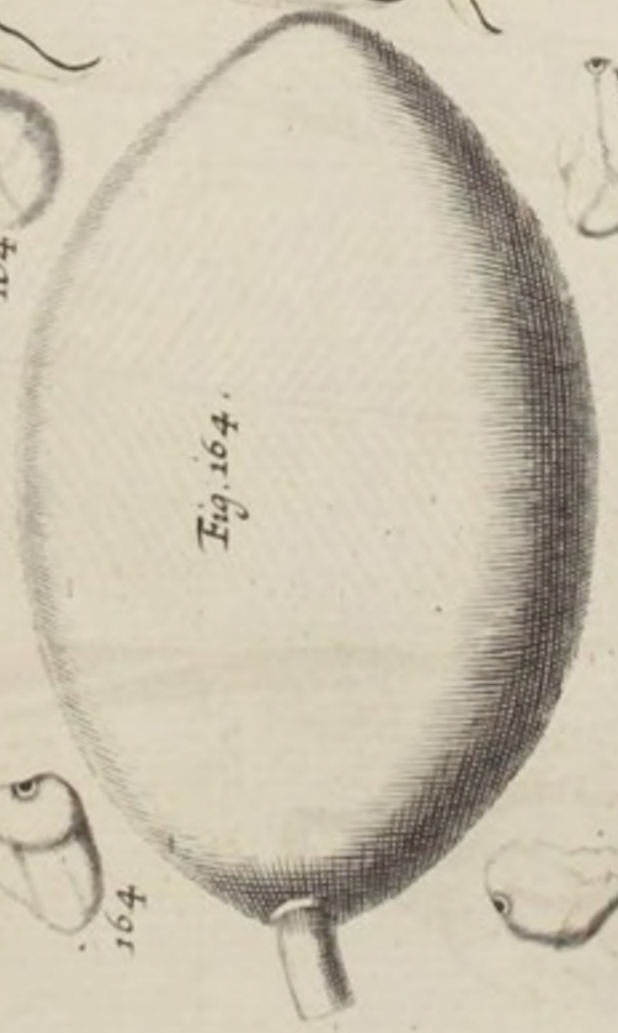
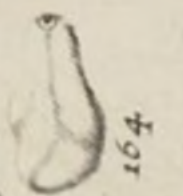


Fig. 164.



164



164

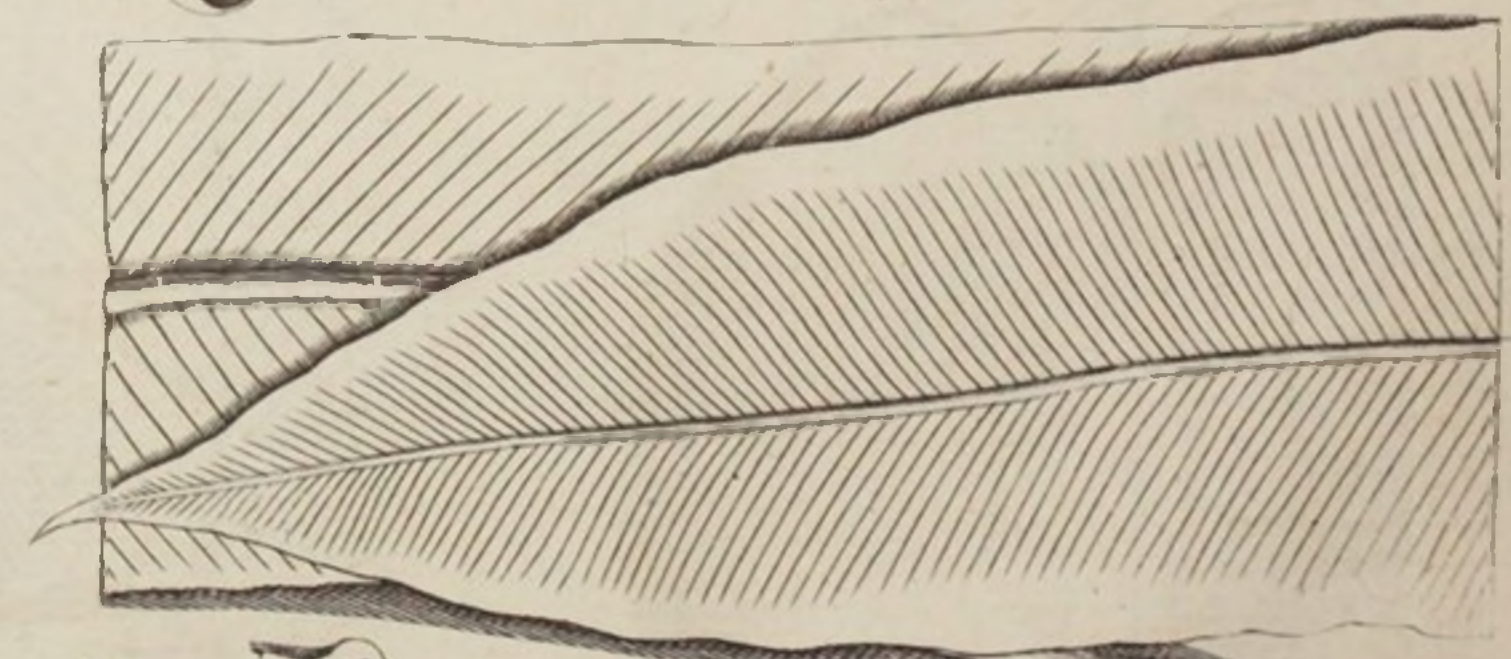
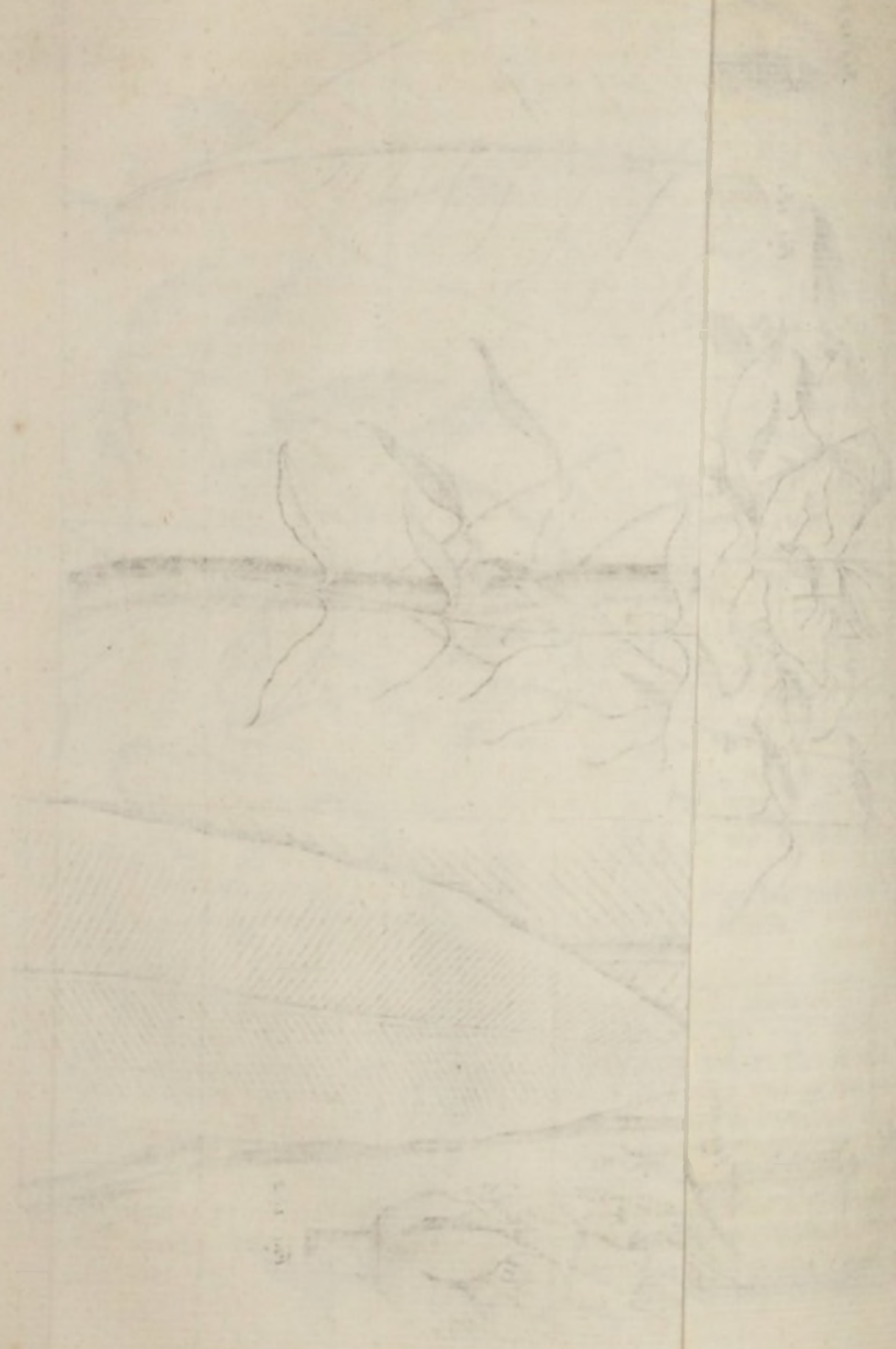


Fig. 162.



The Oils 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 Phlegm.

The *Capita mortua* have no Smell. They have been calcined 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 called Coffee, there is little good can come from any part but its Oil, because its other thin Parts are evaporated, and its thick subsides; but its Oil I suppose to be nutritive *quasi* an Oil, and warm *quasi* a Chymical Oil, 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 Juices, and nourish weak Parts within, as other Chymical Oils do the Parts external when rubbed, 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 *l. 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 Employment for 9174 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 Drams, which, if there be 8 Millions of People, is not 2 Drams, 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.

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 discoloured, 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 Cods, which is done by laying them

on Heaps. After this, they cut the Cods 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 Cod are knit together by certain Fibres, and have about them a white kind of Pulp, that is 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 Cods grow only out of the Body, or great Limbs and Boughs, and at the same Place there are Blossoms, and young and ripe Fruit.

The greatest Crop at most of our *Cacao* Walks in *Jamaica*, is in *December* or *January*: But at one of *Col. Muddiford's* Walks, they bear most in *May*; yet it is 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 is planted first in the Nut, always under shade. Some do it under *Cassava*; others, under *Plantain-Trees*, and some in the Woods. The *Spaniards* use a certain large shady Plant, called 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 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 Year's time the Plant comes to be 4 Foot high, and hath a Leaf six 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 three 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 is 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 kills both.

Cacao was originally of these *Indies*, and wild; towards *Maracajo* are divers Spots of it in the Mountains; and I am informed the *Portuguese* 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.

The *Jamaica* Pepper-tree; by Dr. H. Sloan, r. 192. p. 462.
 XLVIII. The *Myrtus Arborea*, *Folii Laurinis aromatica*, *Pimenta*, or *Jamaica Pepper-Tree*, has a Trunk as thick as one's Thigh, rising straight about 30 Feet high, covered with an extremely polite or smooth Skin, of a grey 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 when it decreases to both Extremes, ending in a Point, smooth, thin, shining, without any Incisures, of

of a deep green Colour, and standing on such 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 four herbaceous or pale green *Petala*, bowed back, or reflected downwards, within which are many *Stamina* of the same Colour. To these follow a Bunch of crowned or umbilicated Berries (the Crown being made up of four *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, aromack and biting Pulp, two large *Acini*, or Seeds, separated by a Membrane lying between them; each whereof is an Hemisphere, and both joined make a Globe or Spherical (appearing one) *Acinus*, whence *Clusius* makes it one Seed divisible into two 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 felled, 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, August*, but in several Places sooner or later, according to their situation and different Season for Rains; and after it flowers, the Fruit soon ripens; but it is to be observed, that in cleared open Grounds, it is sooner ripe than in thick Woods.

There is no great Difficulty in the curing, or preserving of this Fruit for Use; it is for the most part done by Negroes, 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 Clothes, 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 mixed 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 the 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 Oil, sinking to the Bottom of Water like Oil 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 astringent and balsamick. *Clusius* says, that it takes away, if chewed, a stinking Breath: *John de Barrius* tells us, it is one of the Ingredients in 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 *Epilepsy* and *Gutta serena*, which he in divers Persons tried but without Success; but he at the same time says, he thinks it a good Stomachick and Cephalick Medicine, moderately given.

Exper. Nat.
p. 132.

It has been taken by *Clusius* for *Pliny's Cariophyllon*, and by others for *Amomum*; but it is not likely that it was known to the Antients, not being known to grow in the *East*, but *West-Indies*.

It is very likely that *Hernandez* does describe this under the Name of *Koxite seu Piper Tavasci*; his Description agreeing in every thing but the Flower; which no ways agrees to this. And perhaps this is the Tree which *Piso* describes under the Name of *Anhuiba Miri*.

Cinnamon &
Milium, n.
172 p. 1031.

XLIX. *M. de Villermont* has a sort of *Cinnamon*, which comes from *Guadaloupe*, which is white; and another sort, which comes from *Maragnan*, which is like that of *Ceylon*.

He has an Ear of the small *Milium* of *Guinea*, 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 Negroes making their finer Cakes of them.

The wild
Cinnamon-
Tree, by Dr.
H. Sloan, n.
192. p. 465.

L. *Arbor baccifera, laurifolia, aromatica Fructu viridi calyculato ramoso*, or *Wild Cinnamon Tree*, commonly but falsely called *Cortex Winteranus*, has a Trunk 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 as thin as a milled Shilling, of a whitish ash or grey 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 milled 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 1 Inch broad, near the End where broadish 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 stands five scarlet or purple Petals, within

within which is a large *Stylus*. To these follow so many caliculated Berries, of the bigness of a large Pea, roundish, green, and containing within a mucilaginous pale-green thin Pulp, four black shining Seeds, or *Acini*, of an irregular Figure.

All the Parts of the Tree when fresh are very hot, aromattick 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 *Antegoa*, and other the *Caribbee 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* at 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 *Moloffus*, or bad Sugar fermented with Water, if it be mixed with some of this Bark, it loses in part its loathsome empyreumatick Smell.

This Bark, if mixed with Water, and distilled *per Vesicam*, yields an aromattick 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, & Caryophylli suavem Odorem præ se ferens*. *Nic. Monardes* describes 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. Trappam* calls it *Winter-Bark*, or *West-India Cinnamon-Tree*: *Hernandez* and *Ximenes*, *Caminga*.

But it may be doubted whether this be the *Ascopo* of *Hariot*.

LI. Capt. *Winter*, who went out with Sir *Fr. Drake*, when he went round the World, at his Return brought with him from the Streights of *Magellan* an aromattick 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 true
Cortex Win-
teranus; by
Dr. H. Sloan,
n. 204. p. 922.

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 Weert*, 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. 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 *Periclymenum*; and therefore I shall call it, tho' it differs in many things from the *Honyfuckle*, *Periclymenum rectum Foliis laurinis, cortice acri aromatico*.

Fig. 169. 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 $\frac{1}{4}$ Inch long Stalks; 2 or 3, or more of them together, something like those of the *Periclymenum*, each of them are Milk-white *Pentapetalous*, and smell like *Jessamine*; to which succeeds an oval Berry, made up of 2 or 3 or more *Acini*, 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 Drachm 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 *Seol* in those Parts, called a *Sea-Lion*; with which they had a very great Amendment, although they had been so ill with feeding on this Creature, as to lose most of their Skins, which peeled off their Bodies by degrees, and in large Pieces; so that the Antidote to this strange Poison was to be had very near it, and was very much extolled 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 the 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, though 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; though the true be much to be valued beyond the false, being much more aromatick.

LII. I have discoursed a poor mere *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 followed the Propagation 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 s. a Hundred, and will carry them any where within five Miles, and plant them into the Bargain.

An Account of the Propagation of Elms-Seed; by Sir Rich. Bullkey, n. 265. p. 971.

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 evaporated eight Pounds of the Liquor, there remains one 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*.

A Sort of Sugar from Maple, n. 271. p. 988.

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*.

LIV. Every Part of the *Oak-Tree*, of what Age or Growth soever, and all Oaken Coppice 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.

Oak prepared for Tanning, by Mr. Ch. Howard of Norfolk, n. 105. p. 93.

This Material being gotten in its proper Season, it must be very well dried 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 dried very well upon a Kiln, and then ground as Tanners usually do their Bark.

Such Wood, as it is to be used presently after it is gotten, will require the better and more drying upon a 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 or Plate of Iron about 4 Inches deep, 9 Inches broad, and 12 Inches long. The Hammer for bruising the Stuff may be of 6 Pound 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 Pound 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 steeled 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 near 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 it is done, causes the outsides of the Trees to rot and grow

grow Worm-eaten; whereas, if the Trees had been felled 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 Underwoods.

*A Dwarf
Oak from
New-Eng-
land; By Mr.
F. Willough,
n. 58. p. 1700.*

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, having large Acorns, and hath a prickly Leaf like Holly. If it prove that, it will be a luciferous Discovery.

*The Way
of making
Pitch, Tar,
Rosin, and
Turpentine,
By Mr. Tho.
Bent, n. 243.
p. 291.*

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 Grocer's 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 *Oil of Turpentine*, and the *Calx* that remains is common Resin. 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.

*A Sort of
Mistletoe in
Jamaica;
By Dr. Hans
Sloan, n. 251.
p. 113.*

LVII. In *Jamacia*, 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; though they differ very much from it, and almost as much amongst themselves.

*Catal. Jam.
Plan.*

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

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 *a a a a*, after the manner of Leeks, *Ananas*, whence the Name of Wild-Pine, or Aloes, being folded or inclosed one within another; each of which is two Foot and a half long; from a 3 Inch breadth at Beginning, or Base, ending in a Point; having very hollow or concave inward-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 come 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 *Cariophylli*; having under it three short capsular Leaves, and within several long pappous Seeds, the Seed itself being oblong, pyramidal, and very small, having very soft Hair, 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*, *Lysimachia*, &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 the Trees. So soon as it sprouts or germinates, although it be on the under Parts of a Bough, or 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 itself, 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*, or wild Teasel, (and most Plants called Perfoliated) has its Leaves inclosing 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 though 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 fastening 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 *Fundus*, called by *Clusius*, *Fungus minimus anonymus*; and by *Dr. Merret*, *Campaniformis, niger multa semina plana in se continens*, (which I have shewn the *Royal 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 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.

Hnt. Biss.
p. 10.

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 *Herba Impatientes*, *Cucumis aspinus*, *Cranes-bill*, and many others, have this Artifice to sow themselves. Amongst those who have this Property, none is more surprizing 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 itself; and with a smart Noise, throw 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.

Lycbni'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.

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 $\frac{1}{4}$ 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*, onely 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 thro' a 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 itself.

The Silver
Pine from
the Cape of
Good Hope;
By Dr. H.
Sloan, n. 198.
p. 664.
Fig. 171.

Fig. 172.

Dr. Plucknet has figured it under the Name of *Leucadendros Africana, Arbor tota argentea, sericea Foliis integris; Atlas-Tree, D. Herman.*

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 coloured 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 $\frac{1}{2}$ 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 $\frac{1}{4}$ Inch long, yellow, fine, silken Down, M. having 2 Inches long *Stylus*, or String N.

Another Co-
niferous Tree
from the Cape
of Good
Hope; By
Dr. H. Sloan,
n. 198. p. 666.

Fig. 173.

and yellowish Membranes *O*, enclosing the *Stylus* and *Tomentum*, being feathered at top with Feathers, like the Silver Pine, and for the same Purposes.

*Observations
and Experiments
concerning Ve-
getation, and
the running
of Sap, by
Dr. J. Beal,
and Dr. Ez.
Tonge, p. 43.
p. 853.*

LX. 1. There are several sorts of Vegetables that will grow the wrong end set downwards in the Ground, as Elders, Bryars, Sallies, Willows, the black Elder, Vines, and most Shrubs; two or three of their Joints being covered in the Mould, and the Stem cut off near the overmost Joint, which should be half covered in the Mould, and the Mould somewhat raised as it spurts out and grows. Dr. B. Currant-trees, and such like as are of soft Wood, and quick Growers, seem most apt to this Improvement. Dr. T.

2. The Branch of a Plant being laid in the Ground, whilst yet growing on a 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 Joint, 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 thro' the Root, it descends (as Liquor in an Alembick) 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 Alembick, 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 its alternative Visits, and the assiduous intercourse of the free Air with the Spirits of the Plant, yet living and growing, may have a more effectual Influence for a specifick Virtue than we are apt to imagine. Tho' we cannot see nor hear the Lungs of Vegetables beating, yet we may sometimes smell their Breath strong enough both to please and offend exceedingly; as in Savin, Firs, Cypress, Elder, Rosemary, Myrtles, 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 manacled for many Years (and sometimes my Arms also) with deep corroding Tetter, to the blush of my many friendly Physicians, and in despite of many of the best Medicines and Purgations, all was suddenly healed, and has 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 applied Vine-leaves, and sometimes opened Raisins to draw a moisture from these Tetter, 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

forced over the Helm ; yet somewhat imitating the Motion of Blood in Animals, forasmuch as it continually supplies the want and expence of Sap in the exterior 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 subsisted. 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 Balsam 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 Inoculation, 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 Maples ; the Sycamore, which is the greater Maple (some call it a Plane) at a Gash made on the Bark of his Body, and at the Root 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 quantities of Sap in the cutting of them, whereof having drank, they quenched their Thirst without any prejudice. To these add the Whitting or Quicking-tree (*Lat. 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 Splenetick. I have kept (saith Dr. T.) some of the Juice of the Berries (which being expressed ferments of itself) these 2 Years in Bottles, and it hath the taste of an austere Cyder ; and I suppose, from its grateful smell, that it may be kept till it ripens, 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. Tonge's Attempts upon the Poplar, Asp, Elm, Oak, Ash, Elder, Whitting-Berry 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 Grains 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. Thro' 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 Year's Growth, or something like it, between the nature of Wood and Bark. The Sap rises within and without that superadded Coat.

n. 46. p. 913.

To perfect the Experiment about Sap, and to find whether it ascends more or less in the prick'd 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 Augre, only thro' 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 a half deep, and so round about on every side of the Tree, some deeper and some shallower, with a good large Augre, and one quite thro' sloping. From which Experiment, after various Trials, 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 be also 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 Augre-hole in the middle of a greater, and fitting it with a long Pipe adjusted to that inner Orifice.

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 die 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.) shewed 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 covered 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 of speedy Growth, if cut off below the Baring, and set at a fit Depth at the

End

End of Autumn, or about *Candlemas* rather. Where such transverse Hackings are made, or Contusions in the Bark, many Vegetables are apt to gather Knobs, and sometimes small Branches will spurt 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 cracked, 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.

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 third Observation. *Vide infra,*
lxix.

6. The Juice 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 Bryars, it is 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 Juice 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 *January* 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, tried by myself, are best to tap about the middle of the 2d Season; and the Walnut, towards 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.

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 very 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.

By Dr.
Tonge, n.
43. p. 862.
n. 44. p. 880.
n. 58. p. 1199.

10. Trees afford no Juice 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 Juice, as hath condensed in the Hole to a stiff Gelly.

11. Rain being scarce, the Juice 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 Pullion 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 Pullion will still supply Juice 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.

n. 44. p. 877. 12. In the Change of the Nature of a Tree, the Application of Juices is, in my opinion, not otherwise considerable than from the scarcity, plenty, or goodness, of the Nourishment of such Juices; not from the Taste, or Relish in them. Yet probably hot Nourishments, whether in Juices 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, tho' 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 itself in the Earth, as the Branches do in the Air, but also receives its Nourishment: And that tender Part moves itself towards the best moistened 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 in Trenches where the Amendment may remain, rather than above; throwing out the dead Mould out of the Trenches, and spreading it about 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 Tryal, 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

Fibres of the Root carefully laid about with fresh Earth, and watered till they 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 itself is made on the part raised after the ordinary Way. When it is done, let it be carefully covered with some soft Wax, as is known, to defend it from the Rain; it is to be stopped, and ordered 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 increase 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. Some young Plants, if their Heads be kept moist, will live all Winter, if mild, though their Roots be in the Air, as I tried in Seedlings of Apples and Crabs. Their Roots 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 Bays, 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.

19. I am informed 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 felled 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 felled. To prevent which Corruption, it is advised that such Timber be forthwith thrown into Water.

20. *Ethelbert Jay*, an ingenious and expert Planter in *Leimster*, supposeth, that the fittest Time to inoculate, is presently after *Midsummer*, because, saith he, the Sap descends; but I say, because it is then most plentiful, and begins to Jelly. The same ascribes it to the Sap ascending, to take the Bud inoculated

before *Midsummer*; and to the Sap descending, to take it after *Midsummer*. The time he limits to a few Days before *Midsummer*, and to eight or ten Days after it. Mr. *Austin* limits fourteen Days before, and as many after, and would have the Bud untied after fourteen 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 *Midsummer* the greatest Plenty of Sap in Apple-Trees, a Bud then inoculated will thrive, especially before *Midsummer*; 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 *Midsummer*.

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 subside 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, near the Body. Hence it may seem, that Plowing helps Fruit-Trees.

24. Cross-Hackings promote Fruitfulness, cure the *Pbyllomania*, whereof the Reason seems to be, that (as was above intimated) outward Circles and Barks feed the Wood, and the inner only reach out to the outermost Sprigs of the last Year, to which the Fruit is appendant. For some Trees bear only on this Year's Shoot, and some only on that of the last, possibly some only on the third Year's Shoots; and cease bearing when they shoot no new Sprigs. Seasonably bearing 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, rob 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 applied 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 through all the Circles, and the inner Rind itself, on both Sides of
the

the Pith, leaving only the outermost Circle and the Bark on the North-East side unpierced. But this Hole is to be bored sloping upwards, as large as the biggest Augre 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 a 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 four Bushels of ordinary Water; though you should brew even in *March*, held the properest time for Brewing, in regard to the Goodness of the Water at that Season. Sycamore I take to yield the best brewing Sap, being very sweet and wholesome.

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-Paste, till they be very dry, you may expect a very wholesome Drink. If you put a few Cloves into every Glass into which the Sap runs from the Tree, it will certainly keep a Twelvemonth: But I have wondered, whilst I observed how speedily it drew the Taste 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 tied them up, in such a Season, as not to change Colour nor Taste; and yet I preserved the Birch-Sap by that slight Fermentation, above a Twelvemonth without any Alteration, which else would have soured in a few Days.

27. Some propose Oil of Sulphur to perfume the Bottles with.

28. Spirit of Wine ferments the Juice of some Berries, and possibly may not only preserve but advance the Virtue 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* Gardiner. 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-Balm, which converted my delicate Birch Juice, kept in Bottles, into pitiful small Beer; which I wondered 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. Honey will not mix with Cyder, though boiled therein to make Meath: But after a while the Cyder lets fall the Honey, and becomes simple Cyder again.

33. Some affirm, That the Tops and Leaves of Birch decocted in the Sap

will preserve it from souring the whole Year; and that any sort of dried aromatick Herbs, as Sage, &c. boiled in Beer, will keep as well as Hops, Ling, Heath, Broom, or Wormwood. I had a Friend who used Bay-Leaves in his Beer and Ale.

n. 58. 34. The Asps run only (as Mr. *Milford* relates) before *February*; the Hop, about Hop-Harvest, withers in *April*.

n. 68. 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.

Vid. inf. 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.

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 betwixt 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.

Ib. p. 2075. 38. I kept some Sap in a large Retort of two or three Gallons, exposed Night and Day (without any other stop than the Obliquation of the Retort's Neck, and a little Paper to keep out Insects) many Months, and it contracted a Coat on its Top; the Taste pleasing my Palate, I adventured to brew with it at Cyder Season, and made a good Quantity of good Cordial-Drink, with eight Bushels of chopped Apples, brewing them like Malt with hot Water, and putting my Juices and Saps into my Water Cyder at the latter end of their Boiling. I filled a Stand with it, which contained half the Quantity of the largest *Rhenish* Wine Vessel, viz. about forty 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 five Gallons 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 Juice of Borrage Roots and Herbs (at that Season usually thrown out of Gardens) which Borrage-Liquor works and purges itself 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.

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 commendable 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 Year's 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 Juices red, by taking Grafts from such Trees as have been grafted on Mulberries. Perhaps the Blood-red Pears and Redstreaks were thus raised at first, or may be thus propagated to Advantage.

2. 1. In Birch-Trees, the Sap issues out at the least Twigs 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 tends 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 Narrowness of the Pores is not the sole Cause of the ascent of the Sap; for, Water that hath ascended into little Glais 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 pared, 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 bleed.

6. The Bark being quite pared off, above an Hand's-breadth round, about several Birches, did much abate the bleeding of those Trees above the pared Places, but did not quite stop it.

7. The Sap doth not only ascend between Bark and Tree, and in the prickd 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 most of the Paper became wet, taking it away, but leaving the Pins sticking, we found them without any

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p. 963.

any Order, 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 pricked 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 boared 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 sawed just above this Hole to the same depth, the bleeding from the Hole ceased quite; and from the sawed Furrow below decreased about half: And it continued bleeding a great while after at both the sawed 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, ceased 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 preceding Experiment.

13. We set several Willows with the wrong Ends downward, and cut off several Briars 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 Briars 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.

By Mr. Willoughby, n. 57. p. 1105.

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 a Fort-night before. In January 1670 making Incisions in the Sycamore and com-

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mon Maple immediately upon the relenting of the first Frost, we found that they both bleed, 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 promoteth their bleeding, but always Cold. From a wound made in a Walnut-Tree in *January*, and the beginning of this present *March* 16⁶⁹/₇, in mild Weather, nothing issued; but the Weather changing and growing colder, it bled plentifully.

16. *March* 11. 166⁸/₉. 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, *May* 3. 16⁶⁷/₈, bled three Weeks sooner the Year before.

17. It was observed in *Autumn* 1669 by Mr. *Mart. Lister*, that upon the first Frost, which happened 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.

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 inferred, 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 viscus yellow Juice, out of the Buds of a black Poplar.

20. Our Walnut-trees bleed here at *Middletown* in *Warwickshire* in *January*.

21. I am very much confirmed in my Apprehensions, that Trees and other Plants, if we could contrive them, as I have (but slenderly) projected in my Sap, wiser to that purpose, would far better indicate the Alteration

By Dr.
Tonge, n. 68.
p. 2070.

of

of Weather, as to Heat, Cold, Moisture, Drought, or 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 tolerably this Forenoon, yield not a Pint of Sap this Afternoon; and tho' one of them ran most part of the Day, the rest ceased about one or two a Clock in a fair, clear, sunshiny 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, April 26. 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, April 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 *Sweden* Merchant, importing that Birch-water in *Sweden* worketh alone (perhaps collected in great Quantity :) Only I put a few Cloves into my Sap, boiled to a third or less, it keeps well, especially when boiled 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 Stomach as strong Wine, and pleased the Palate; tho' the Taste in the Mouth was somewhat waterish.

By Mr. Fr.
Willoughby,
n. 70. p. 2125.
Vide infra.

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 Tips does not sensibly promote the bleeding.

We doubt not of Mr. *Lifter'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 Spring, *An. 1671.*

167 $\frac{1}{4}$ it began something sooner than ordinary, about the beginning of *February*.

23. In a very sharp Frost the Bleeding is stopped till the Weather begins to change, but in a moderate Frost, tho' 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. 2142.

24. We cut off pretty big branches of Birch, and having tipped the Ends, inverted them, and fastned 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, whercinto we poured Water, which in a few Minutes sunk into the Pores of the Wood, and running quite thro' 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 fastning such Rings of Wax to the lesser Ends, and pouring in Water, which ran thro' the Wood, and dropp'd out of the greater Ends as fast or faster: This we tried once upon a Sycamore without success; but afterwards I made trial both upon Sycamore and Walnut, and found that Water runs through both, but nothing so fast as thro' Birch. Ib. p. 2126,

3. 1. About the beginning of *Nov.* 1669, I pierced a Sycamore growing in a sandy Soil at *Nottingham*, the turgescence of the buds inviting me there-to, and engaged my 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 Frost did not always set a bleeding the Wounds they found made before they came, tho' 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 3d of *January*, the second about the 12, 13 and 14 of *Feb.*) 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. By Dr. Lister, n. 68. p. 2067. n. 701. p. 2120, 2126.

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 Augre, in a many quite grown up, and would scarce admit a Pigeon's Feather. Wherefore the 30th 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 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 8th of *August*, which in like manner bled the next Morning, but stopped before 9 a Clock. It did so for 2 or 3 Days; but then totally dried.

3. *November 1. 1670.* Here at *York* I pierced and otherwise wounded 2 *Sycamores* growing in a wet *Clay*, but they never stirred till the beginning of *February* following. Yet *Mr. Wray* hath assured me, that those of *Warwickshire* bled the 16th of *November* 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 strefs of *Weather* may in these *Trees* probably be looked upon as a *Violence* done to their *Natures* from an unkind *Climate*, considering the *Walnut* and *Sycamore* as *Strangers*, and not *Natives* of *England*. It is 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. 1670*, 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 7th 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 7th 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 *Hawthorn*, *Hazel*, *Wild-Rose*, *Gooseberry-bush*, *Apple-tree*, *Cherry-tree*, *Blather-nut*, *Apricock*, *Cherry-Laurel*, *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*, *Walnut*, *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*, altho' we held it some pretty *Time* with the cut *End* downwards; but if this separated *Twig* was ever so little tipped 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 shew no *Moisture* at all from any *Part*. But I have since been convinced, that it was rather some unheeded *Accident* which caused this new *Motion* of the *Sap*, than merely the striking off their *Tops*.

5. Because *Sap* is said to ascend from the *Root*; when it is found, to move in tapping, I lopped 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.

This *Experiment* repeated, afforded me divers *Phenomena*, 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-bine, Blather-nut, Vine, Elder, Barberry, Apple-tree, Ivy, &c. Whicking and Egge-berry-tree (*i. e. Padus Theophrasti*) tried in the same manner in *Craven*.

2. Briar and Raspberry-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 returned 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 ballanced in the Hand, and often inverted to hinder the falling and expence of Sap; yet being often heated, they will at length quite cease, tho' 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 Juice.

6. An hard Ligature made within a quarter of an Inch of the End of a Wood-bine Rod did not hinder its Bleeding at all, when brought within the Warmth of the Fire.

7. Maple and Willow-Poles, &c. quite pared 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 itself exsudate and shew a liquid and yellowish Resin from the Bark and near the Pith; but when brought to the Fire side, 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, sealed up with hard Wax, will yet freely bleed by the Warmth of the Fire.

14. *March 33, 1677*, 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. *Mar. 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 7th 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 observed Wounds of some Months standing, to bleed apace at the breaking up of every hard Frost. For 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 stopped in all of them, for some Reasons, which things did undoubtedly defend them much from the Air and Winds, and kept the Wounds still green and open; whereas the Tops of these Maple-twigs spoken of in the last Experiment, were exposed in an open Hedge to the Air and Winds; as also the two Sycamores here at *York*, mentioned above to have been wounded in *Nov. 1670.* and not have shewed any Signs of Moisture, for that very Cause, that they were not fresh struck at Bleeding Times.

The Circulation of Saps, by Dr. M. Lister, n. 70. p. 2122.

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 Attrahilis*, and *Cbelidonium 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 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*, *Lob.* 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
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in drawing the Razor round about the Branch just above or below the Tye, the milky Juice would suddenly spring out of infinite small Holes, beside the made Orifice, for more than half an Inch above and below the Tye: which seems to argue, that tho' 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 streightened Juice.

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 way 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 bushy and thick, as the *Summer-Bonchrestein*: their Roots run wide, and are matted below, and all are so. This Diversity of the way of growing of the Root, must be by grafting; and could not be but by the Intercourse of Sap, which it received from the Graft; and that cannot be, but by the Return of Sap.

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 of 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 Coyns 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 Roots and Timber, as also from the differing Leaves, if accurately inspected, and considered, 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

*The Descent
of Sap in
Winter, by
Mr. Rich.
Reed, n. 70.
p. 2129.*

*By Dr. J.
Beal, n. 71.
p. 2144.*

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 *Offification* in young Animals, is described by Dr. Kerkringius. *Anthrop. Ichn.* 'Tis a large Quantity of Sap, which is expended on the Fruit and Growth of some Trees, or Acorns, Walnuts, Chesnuts; 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.

*Plants in
Plants obser-
ved by Dr.
M. Lister, n.
79. p. 3052.*

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 Opinion that they will prove Vessels analogous to our humane Veins. Those Parts of a Plant, which *Pliny* calls by the names of *Vena* and *Pulpa*, are nothing else in my opinion, but what Dr. *Grew* calls Fibres and Infortments, 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 Doctor's Terms) is plain in a transverse Cut of *Angelica Sylvestris magna vulgatio*, *J. 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 *Spondilium*, *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 dried Fennel-stalk, following them by Dissection quite thro' 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 Roots, are clothed, is most plain in some Plants, as in Fern

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 filled 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 sudden springing of the milky Juice out of the 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.

Vid. supra
Sect. LXL.

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, tho' specified by divers Accidents in Figure and Texture; so of these Veins, which tho' 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-Rhubarb do sometimes shoot (by what Accident we enquire not here) a transparent and very pure chrySTALLINE Gum, tho' 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 Rhubarb 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 Mushrooms, that seemingly inferior 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

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.

6.90.p.5132.

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 stripped 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 pervading 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 Ribs and Nerves (as we vulgarly call them) and are distributed into all the Parts of the Leaf, according to the Subdivisions of those nervous Ligaments, and are disposed with them into a certain Net-work; whether by Inosculation or bare Contact only, we pretend not to determine.

2. That in a transverse Cut of a Leaf, the middle 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 these 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 Smallest 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 either hand, with the Subdivisions of the Fibres, and 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

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 clothing 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 has 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 apart by itself. We indeed have found it very difficult, so to exhaust the Plant of its milky Juice as to kill it, though we have given it very many Incisions to that purpose. Divers 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 *Cbelidonium majus*, for Example) a Tincture of Saffron in Chrystalline 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, though 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 itself so great a Degree of Fermentation, that it preserves itself, and consequently the whole Plant, from the 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 concerned 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 limped 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 itself. Witness, besides 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 thing 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 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 Ventings 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 of Animals, *viz.* The hindring of its breaking and clodding; or we must grant the same Motion to the venal Juice of Plants. We have undeniable Experiments to shew, 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 Jelly 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.

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* observed) go together in that which seems the common Trunk, like a Branch 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.

By Dr. Willis, n. 95. p. 606.

Dr. *Willis* observes also, that there are two sorts of Nerves: One arising from the *Cerebrum*, subservient to voluntary Motions, which properly belong to the Functions of Sense; the other from the *Cerebellum*, subservient 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.

De Cerebo, c. 15. 19.

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 that Exsudation seems to be often accidental too, that is, by a Cancer, or some other such like Chance.

The Nature and Difference of the Juices of Plants; By Dr. Lister n. 224. p. 365.

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 called an exsudated and coagulated Juice, or no. Our Observations of those of this Tribe, are what follow:

The small green Leaves, next encompassing the yellow Flowers of *Androsamum 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 yellowish 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.

Purple Juices.

Hypericum Ger. The purple Juice yielding Blebs, in this Point are upon the Edging, on the outsides of all the Leaves. Also the Stalk, though round, hath a double Edge, on each Side one; and the Blebs or Bags, though but thinly, are yet observable on these very rising Edges too of the Stalks. As for the yellow Flowers themselves the outmost green Leaves, next and immediately encompassing them, have but 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.

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Hypericum

Hypericum Ascyron diEum, Caule quadrangulo J. B. In like manner all the Edges on the outsides 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 are yellow Leaves, and the green ones encompassing them, have very few purple Spots or Streaks visible.

Hypericum pulebrum 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 *Spondylium Ger.* is of a Brimstone Colour; but in the Stalk white.

Amongst those Juices that coagulate and are clammy, some there are which readily break with the Whey.

In the Middle of July I drew and gathered of the Milk of *Lactuca fyl. costa 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 mixed 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 Cags 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 Day's 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 of 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 insipid 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

Juices smell sour, something like the Slices of green Apples, which have been long cut.

The thin Milk of *Tithymallus 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 bluish; and indeed it is both of the Colour and Consistence of blue skimmed Milk; made up with Wheat Flour into Cakes, it shews itself greasy or oily, and scarce ever dries; it very hardly breaks or coagulates. I kept some of it pure and unmixed, in little Essence-Bottles, stopped 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 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 Flour and a little Gum Arabick, dried well, and kept sweet.

Other clammy Juices there are, which do not let go a Whey when they coagulate, but cake together.

I made Cakes of the sole or unmixed Juice of *Sonchus lavis, & asper*, without any Addition, and it parted not with any Whey.

Papaver Rbeus 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, and is very resinous and oily.

Note, The Milks or Juices of Plants seem to be compounded, and mixed 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.

Trogopogon flore luteo J. B. yields a Juice which, upon the first springing from the Wound, is white and thick, but immediately turns yellow, and then redder and redder. It is of no unpleasant Taste; it is something glutinous and oily, and parts not with much, if with any Whey, and therefore it is easily formed into Cakes alone.

Convolvulus major J. 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.

There is also a Juice of a Saffron Colour, which *Cbelidonium 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 out of 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 persoliatum C. B.* in July, and after, even where the Seeds therein contained are turned black and ripe, yield plentifully and freely enough. (These Juices, which

*Juices ca-
king and not
letting go
their Whey.*

*Saffron-co-
loured Juice.*

which the Heads, or Seed-Vessels of Plants afford, may be thought of the same Nature with those Juices which the Pulp of Fruits affords, 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 the 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 one's 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 ever so little be exposed to the Heat of the Sun or Fire, it straightway became exceeding soft. But as for the Cakes I made up of it and Wheat-flour, them I found in my Cabinet in Winter very hard and firm, and the unmixed Cakes still soft. These burn with an unpleasant Smell; they emit a lasting Flame; they still keep their Amber Colour, and draw out into Threads, in burning like Wax.

To this we may add 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 these two years) yet I perceive it stiffens, and will draw into Threads.

Gums. The next sort of coagulate or clammy Juice we have taken notice of, are Gums; and some of them seem long to abide liquid, and perhaps inflammable; 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 at it were liquid and ductile; 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 is 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 Summer's 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 Dops and Threads, or Hairs, in either of these

two

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 the middle of *August*, the Chats of the Alder to be gummy. Perhaps it did exsudate from the Plant itself; as I guess the Honey-Fall, or gummy Dew to be observed upon the Leaves of the Oak, &c. are nothing else.

The *American*, or *Indian* Rhubarb, sown in our Gardens, is the only Plant Hard Gum. 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 *Lapatba*, 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, 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 exsudates from all Parts of the Stalk and Ribs, on (*Note well*) the underside of the Leaf itself. I gathered some in 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.

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 dried Root of *Acetosa* (a Plant of the Family with Rhubarb, which may well be called the *Indian* Sorrel, or four Docken) 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 Juices yielding Blebs. *Note*, also here to this Purpose what we have set down above, Rhubarb, Sorrel, &c. do when they decay turn red. Cat. Pl. Aug.
App. p. 325.
33+

The Juice extracted from the Roots of our *English* Rhubarb, by a Tincture of fair Water steam'd away, is nothing else but a lean uninflamable Gum; and tho' it differ in Colour, (perhaps from the yet woody Parts in it, as being of a deep Liver Colour) from the exsudating Gum, yet in other Natures, as this of being uninflamable, ductile 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 Taste 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 Gellee*, or the frozen Apple: Tho' 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

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 sour Juice of Rhubarb is a specifically distinct Liquor from the Gum, which I believe to be only an accidental Coagulation.

Green Plums, 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 seemed to be cankered, 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 Court-Walls with, yields a clear Gum very plentifully; it is very white and very clear.

There are other sorts of Juices, which will not of themselves, that I have observed, exsudate out of the Wounds of their respective Plants.

*Lime or
stringy
Juices.*

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 betwixt 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.

*Bird-lime
Cat. Plant.
Aug.*

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 then it 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 peeled, and cover it over with green Nettles or Fern, or such like, *S. S. S.* in a Cellar for about ten 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 they once engage 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.

Further,

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 mixed. Oily Juices.

We will instance in the Juice of *Helenium*, *sive Enula Campana* J. B. You may take it off with a clean Knife, whereon its looks like Oil mixed 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 watry one. It springs freely enough; it is of a dark green Colour, and I took it in Wheat-flour, and made it up in Cakes.

Also the Fruits of many Plants afford Oil, as *Oliva*, *Baccæ Lauri*, *Hedera*, *Juniperi*, *Cornus Famina*, &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*, are very milky, and by Insolation are 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 where 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 ach, as when after extreme Cold one has the Hot-Ach in them; and that Pain continued in them for several Days; at length the Skin of my Finger's End peeled off.

Diacodium Album is a Medicament of the Seeds of *Poppy*.

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. Rosin.

In the Chops of Ivy made in *March*, there did exsudate 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 hardened and crufted on the Wounds like coarse brown Sugar. It burns with a lasting Flame, and smells very strong.

Also on the topmost Leaves of *Lactuca syl. Costa spinosa* C. B. In *July* many small Drops or Pearls of an oily Juice, like coagulated and hardened Rosin, are plain to be discerned, especially with a single Microscope: They are of an Amber Colour, and transparent; easily to be wiped off, as be-

ing an oily Juice exfudated. And I am of the Mind, that even the blue Flower of ripe Plums is nothing else but a fine resinous Coagulation of the transfudated Juice.

On the under-side of the Leaves, and all over the Stalk of *Bonus Henricus* *J. B.* do stick infinite small transparent Pearls: Those clear Drops are hard to the Touch, and feel like greasy Sand; not clammy, and therefore it was well called unctuous by *C. B.* and we put this spontaneously exfudated 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 of *Clicyrrhiz* will ferment: Also the Juice of Cane, as Sugar. Again, the tapped Juices of Vegetables (wherein my Observations are limited) are susceptible of a Ferment. As for Instance:

The 21st of *April* 1665, about eight 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 three 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 Basin 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, Wicking, 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 deurate or defecate the *Opium*: For *S. V.* says *Mr. Boyle*, will dissolve *Gum. Lac. Benzoin*, and the resinous Parts of *Jallap*, and even of *Guaiacum*, which are Cogulations and mixed Juices; and the same we may think of the Juices that are extracted by *S. V.* from other Herbs that are mixed.

Also those other Ways 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 dried Juice less offends the Nose; that is, smells not so strong.

The Whey of *Lact. syl.* 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 deurates.

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 Taste have great Affinity, so of course their Virtue likewise cannot be very dissonant.

Herbs of the same Make and Class, for the Generality have the like Virtue, by Mr. Ja. Petiver, n. 255. p. 289.

1. As for Instance, the Tribe of umbelliferous Herbs. It is 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 five 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 Taste and Smell; they are powerful Expellers of Wind, and therefore are good in all flatulent Diseases, and of great Use in the Cholic, &c. To instance a few, for Example, as Annise, Caraway, Cummin, Angelica, Smallage, Parsly, Lovage, &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 Rundles or Whories, 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 five 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 others are constantly the same; that is, always lie 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 distinguished under the *Flores Galeatæ, seu Labiatæ*. 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, four Seeds set close together upon a Plain, which Nature lets fall out when ripe, the Husk being always open, and commonly divided into five 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, *Stachas*, 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, Baulm, Penny-royal, Savory, Thyme, Hyssop, Marjoram, Basil, Origanum, Dittany of *Crete*, *Marum* or common Mastick-Thyme, with *Marum Suriacum*, and some other.

3. We proceed next to those Herbs which have a retrapetalose regular Flower; (by Regular, I mean, such as have four equal *Petala* in each Flower.) These, in relation to their Seed-Vessels, are subdivided under two Heads, *viz.* *Siliquosa*, and *Capsulata*; being such as have their Seeds contained in long or short Receptacles, as Pods 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, they are the Flowers and Pods.

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 *Tblapsi Dioscorides* or Treacle-mustard, the *Eruca* or Rocket, and *Sophia Chirurgorum* or Flixweed; the Seed of which last, I am informed, hath 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 Reputation, 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, though 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, Jaundice and other ill Habits of the Body, where the Blood is vitiated, rather in its Particles than irregular Motion; carrying off its Impurity by diuretic *Discrasis*, or Discharge of the offending heterogeneous Salts therein contained; and consequently by Purification, disposing of it to a better, or more sanative Disposition.

LXVI. In the midst of *March*, *An.* 1664. I made a Section of the Rinds of *Ash*; and of the Tree falsely called *Sycamore*. The first Section of each of the Rinds was square, whereof three Sides were cut, the fourth uncut. The Success was, that the whole Bark did unite, by binding it with *Packthread*, leaving a Scar in each of the Sides cut.

The Separated Bark of a Tree reunited to the Tree, by Dr. Ch. Merret. n. 25. p. 453.

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 itself; both in the Trunk and Branches, from an Inch-square to less Dimensions, and some of them I bound close with *Packthread*, all which were separated, a new Rind succeeding in their Place. Some I covered over, beyond the Place of Incision with a *Diacbylon* Plaster, and tied them fast with *Packthread*. All which thus bound and plastered, did, within the Space of three 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 appeared 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 fastening of it to the Branch again. This Twig I exactly fitted to the Branch from whence it was cut, in the same Posture it before grew in. I firmly bound it, and covered it with *Diacbylon* Plaster. The Success was, that in three Days time the Twig that was cut off withered.

LXVII. Wanting to find out the Motion of the nutritious Juice of Plants, I made a Trial upon several different Kinds of Trees, both by cutting the Bark, and tying it round, having first removed the annular Portion; and the upper Part of the Plant, *viz.* about the Section, constantly swelled, and increased in its Growth naturally, whereas the lower Part did not increase, and only sometimes gave off Twigs. I tried the same Section on the lower Part of the Trunk, and in the Roots themselves, and constantly the upper Part of the Trunk or Roots swelled considerably, and from this Part little Roots sprouted out very plentifully, but the lower frequently decayed, and at last became rotten. This seems to confirm the Reflux of the nutritious Juice from the smallest Branches to the Extremities of the Roots; whence the Nourishment being intercepted, either by compressing, or cutting of the Vessels, the remoter Parts of the Plants are deprived of their proper Nourishment, and a Swelling is produced by the reflux Juice; but it is propagated from the Leaves to the Extremities of the Roots. For which Reason your Florists having made a circular Incision in the Bark, lop off a small Branch from the Parent Stock, and surround it with moist Earth, in which the new Branches springing out above the Incision, begin to vegetate.

Observations concerning the Bark- ing of Trees, by S. Malpi. n. 161. p. 645.

tate. For the nutritious Juice being pushed or pressed downwards, not only by stagnating, occasions a Swelling near the Part where the Bark is cut; but bursting out, is absorbed in the Roots; whence the young Plant being nourished of itself, at last is disunited from the Parent Stock. Frequently enough in Roots upon the Brinks of Rivers, where the Part that has been lopped is exposed to the open Air, from the Extremities of the Stump, spring up Twigs in Place of Roots, branching upwards.

Experiments of the barking of Trees, by Mr. Tho. Brotherton, n. 187. p. 306.

LXVIII. 1. *Anno* 1671. A Crab-Tree about 4 Inches in Diameter, was hacked 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 third Year it died to the very Root.

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 increased to the third Year, when it died also.

Fig. 174

A Scots Firr of three 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 Joint, was observed to grow and shoot out its Top about half a Yard, and the Parts all about the Ring to encrease 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 second Year it also increased considerably but not so much as the first, but the third Year it died.

A Branch of the Tree had a Ring cut off from it, *April* 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 Parts about the Ring shot out a new Joint 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 swelled 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*.

Trial was made upon some young Trees, cutting a Helical Swath of the Bark, about half an Inch in breadth, by leaving a little Helical Swath of Bark to communicate between the upper and under Part. In this Trial 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

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 joining 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 thickened not at all.

A Scots Fir of three Years Growth, which shoots forth every Year both from the Body and the Branches a new Joint and circumambient Sprouts, to a determinate length, was barked with three Rings of about $1\frac{1}{4}$ Inch broad, each about the middle of the *Internodia* or Parts of the Stock between the Joints. In a Year, this Stock, which was about the bigness of a Quill, below the Ring to the next Joint, continued of the same bigness, but above the Ring it increased and grew to the bigness of one's Finger; and from the new Joint 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 Joint shooting out new Body and Limbs, at the Top or Body. And the Body of the Tree below the Joint to the second Ring, increased more than if the Ring had not been made: But the Part of the Stock below the Ring to the next Joint, increased not at all. The like shooting and increasing was observed in the second Limbs, Joint and Stock below it, between which and the lowest Joint it increased not.

On one of the lowermost Branches of a young Scot Fir of two Years 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.

A young Hazel was cut into the Body with a deep 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. Fig. 175.

Four young Poplar Trees, all of equal Bigness, Growth, Situation and Soil, as near as could be found, were thus ordered. 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 pruned 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, Height, Bigness, most of all; swelling in
Bigness,

Bigness, and stretching in Height, and spreading in its Boughs, much more than the third; and in about ten Years, was more than four times as big as the first.

*Of the
Growth of
Trees, Ib.
311.*

In the great Frost, 1684, of twenty-five Poplars that had been pruned, nineteen were killed 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 pruned the Spring before the great Frost. Divers also of those which had been pruned two Summers before the Frost, were killed by it; but none of those which had not been pruned at all, were hurt by it. And both in *Lancashire* and *Cheshire*, Trees of 60 Foot in height, that had been pruned, and had only a small Top left, were also killed 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 suffer 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.

Where these Prunings had been tried upon Trees 20 Foot high, the Difference of their Increase was sensible the following Summer; but in seven or eight Years time the Difference is prodigious; the unpruned Trees growing several times bigger than the pruned, 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 Fir*, the Joints above the Rings barked round, would increase and grow much bigger, in three Years, than they would in five Years, if the said Rings were not cut off.

A very large Pinaster, about 2 Foot and a half in Diameter, and of a Height proportionable (*viz.* of about twenty 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 three 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 E. H. ib.
p. 313.*

2. To me it seems very probable, that the Bodies of Plants, as well as those of moving Animals, are nourished and increased by a double Food; the

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 clogged and fettered, 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.

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 Burden of the Fruit always wreathed towards the Ground, the Branches were all curled and full of Knots at every turning, and these Branches are apt to grow, if a good Knot be set in the Ground, as soon as it is cut off, especially about *Candlemas*. 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, appeared Cork-coloured and rotten at the Heart of the Timber. And so it was generally all over the Roots; and it is 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 pithy 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 tho' it was the same Fruit, growing from the Root of the same Tree, yet it seemed not altogether so tender, delicious, and juicy, as 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 consumed, and thereby was wholly appropriated for the Leaf, Blossom and the Pulp of the Fruit. For I do not undertake, that the Sap yields no Relief to sustain the Life and Growth of the Timber ordinarily, 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.

The Communication of the Parts of the Tree with the Parts of the Fruit; by Dr. J. Beale n. 48. p. 860. n. 46. p. 919. Vid. sup. Sect. LX. 6.

Some are of Opinion, that there passes into the Timber no Part of mere 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 five or six 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 *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 midt 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 Falsehood, but concealed 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, Turnips, 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 hollowed 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 it is 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 found, when the Body of the Tree is much decayed by Rain beating in at the lopped Tops, or by other Passages thro' the Bark. We see that Beans, Wheat, and other Grains, grow kindly, if the Eye and Parts next adjoining be whole, tho' the Beans be full of great Holes in other Parts, or the main Body of the Wheat be cut off with Scissors. 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 or Firmness of the Timber: and these are recovered 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 mere Graftings, how oft soever reiterated. But if 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 Almond, 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.

LXX. It is very difficult to determine whether Salt or Water be the nearer and more original Principle of all mixed 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 Elm, 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 Sustenance, 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 Contexture of their Bodies, from the first spurring of the 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 Alembicks, where the common Rain-Water and Air, are

Observations concerning Vegetation; By Dr. J. Beal. n. 56. p. 1: 51.

digested into very much differing Leaves, Fruit, Seed, Rosins, 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 dried into a very sweet Sugar; and the Juice of some other Pears is so fierce, that at the opening 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 divers 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 Heaters 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 Boilers 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 Fancy, that the Sap in Winter descended to the Root, since I saw an Apple-Tree, that yielded four or five 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 co-operating, from the very Fibres of the lowest Roots of the Top Leaves.

Vid. sup.
§. LX. 1.

Some
Thoughts and
Experiments
concerning
Vegetation;
by Dr. J.
Woodward,
a. 1719. p. 193

LXXI. The Antients 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 Vote 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 assert, Water to be

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 watered 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 it is much advanced in bigness. Then they take it up, and though 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, it is not the Earth, but Water that nourishes, and is 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 increase intirely to that.

Some Waters indeed, are 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, though 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 *Aqua fortis*, 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, disseminated thro' 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 of the Nourishment of one sort of the same Plant, and some another. The other kind of Particles sustained in Water, are of a mineral Nature: In some Springs we find common Salt, in others Vitriol, in others Alum, Nitre, Spar, Oaker, &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, the Water of Springs contains more of it, than that of Rivers,
especially

especially when at a 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 Vial, stopping it close to keep Dust, and other exterior Matters out, and let it stand without stirring it, for some Days, he will then find a considerable Quantity of terrestrial Matter in the Water, however pure and free it might appear when first put into the Vial. He will 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 to each 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, it will 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 mere 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 *Moleculæ*, 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 itself, but frequently intangling with the Vegetable *Nubeculæ*, forces them down along with it.

Upon the Whole, it is 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 increase.

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 Vials, 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 tied over the Orifice of each Vial, 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 Vial ; 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 through the Plant that is to be set therein. Then I made choice of several Sprigs 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 Vial, ordered as above ; and as the Plant imbibed,

and

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 *October* 5th, which was just seventy-seven Days. Then I took them out, weighed the Water in each Vial, 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 follow:

Distinction of the Glasses.	The several Sorts of Plants and Water.	Wt. of Plant		Weight gained in 77 Days.	Expence of Water.	The Proportion of the Excrease of the Plant to the Expen. of W.
		when put in.	when taken out.			
<i>A.</i>	Common Spear-Mint set in Spring-Water.	gr. 27	gr. 42	gr. 15	gr. 2558	1, to $170\frac{2}{3}$
<i>B.</i>	Common Spear-Mint, in Rain-Water.	$28\frac{1}{4}$	$45\frac{3}{4}$	$17\frac{1}{2}$	3004	1, to $171\frac{2}{3}$
<i>C.</i>	Common Spear-Mint, in Thames-Water.	28	54	26	2493	1, to $95\frac{2}{3}$
<i>D.</i>	Common Solanum, or Night-Shade, in Spring-Water.	49	106	57	3708	1, to $65\frac{2}{3}$
<i>E.</i>	Latbyris, seu Cataputia Gerb. in Spring-Water.	98	$101\frac{1}{2}$	$3\frac{1}{2}$	2501	1, to $714\frac{2}{3}$

The common *Solanum* in the Vial *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 Vials *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 myself, 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 Vials above. In this I suspended a Bit of Stick about the Thickness of the Stem of one of the afore-said 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 Vials. Thus they stood the whole seventy-seven Days, in the same Window with the rest; when upon Examination, I found none of the Water in these wasted or gone off; though 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 Vials 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 chuse. The Vials were set in a Line in a South Window, where they stood from June 2, to July 28, which was just fifty-six Days.

Distinction of the Vials.	The several Sorts of Waters.	Wt. of Plants			Weight gained in 56 Days.	Expense of Water.	Proportion of the growth of the Plant to the Expense of Water.
		when put in.	when taken out.	gr.			
H.	Hyde-park Conduit Water.	gr. 127	gr. 225	gr. 128	14190	1, 10 110 $\frac{110}{111}$	
I.	Hyde-park Conduit Water.	110	249	139	13140	1, 10 94 $\frac{94}{119}$	
K.	Hyde-park Conduit Water, in which was dissolv'd an Ounce and an half of common Garden Earth.	76	244	168	10731	1, 10 63 $\frac{147}{161}$	
L.	Hyde-park Water, with the same Quantity of Garden-Mould as in the former.	92	376	284	14950	1, 10 52 $\frac{112}{112}$	
M.	Hyde-park Water distilled off with a gentle Still.	114	155	41	8803	1, 10 214 $\frac{29}{41}$	
N.	Residue of the Water which remained in the Still after that in M. was distilled off.	81	175	94	4344	1, 10 46 $\frac{10}{44}$	

The Plant which was set in *H.* was all along a very kindly Plant; and had run up to above two Foot in Height. It had shot but one considerable collateral Branch, but had sent forth many and long Roots, from which sprung very numerous, though small and short lesser Fibres. These lesser Roots come out of the larger, on two opposite Sides, for the most part; so that each Root with its *Fibrilla*, appeared not unlike a small Feather; to these *Fibrilla* adhered pretty much terrestrial Matter. In the Water, which was at last thick and turbid, was a green Substance, resembling a fine thin Conserve.

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.* though 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, though 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 six 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 died 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 $\frac{1}{8}$ of an Inch in Diameter, filled with very fine and white Sand, which I kept from falling down out of the Tube into the Vial, 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 little and little ascended quite to the upper Orifice of the Tube. And yet in all the fifty-six 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 Vial it had precipitated a greenish Sediment mixed with black; to the Bottom and Side of the Tube, as far as it was immersed in the Water, adhered pretty much of the green Substance described above.

Q. R. S. &c. Several Plants set in Vials, 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.

Some Re-
flections on
the foregoing
Experi-
ments, ib. p.
207.

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 Grains, drew off but 2558 Grains of the Fluid: And that in *B.* which weighed only 28 $\frac{1}{4}$ took up but 3004 Grains, whereas that in *H.* which weighed 127 Grains, spent 14190 Grains of the liquid Mass.

The Water seems to ascend up the Vessels of Plants in much the same manner as up a Filtre; and it is no great Wonder that a large Filtre should draw off more Water than a lesser; or that a Plant that has more or larger Vessels should take up a greater Share of the Fluid in which it is 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, though disposed of in like manner as the rest, remained, 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 so 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 cleared 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 Honey's, and other gummous Exsudations 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 the 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, which is mixed 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 Vegetables, take up into them mere mineral Matter also, in a great Abundance. Such are our Sea-purslains, the several sorts of Alga's, of Samphires 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 distinguished 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 Recelles, is manifest, not only from the Instances above alledged, but many others. Percolate it with all the Care imaginable, filter it with ever so many Filtrations, yet some terrestrial Matter will remain; it is 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 filtered Water through several Sheets of thick Paper, and after that, through very close fine Cloth, twelve times doubled; nay, I have done this over and over, and yet a considerable Quantity of this Matter discovered itself in the Water after all. It is true, filtering 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

light, and such consequently, as 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 upon 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 prolific. 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 Root. 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 Extremities of the Roots of those Plants; others of them intangle in a looser manner, and form the *Nubecule*, and green Bodies so commonly observed in stagnant Water. These also when thus conjoined, 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 loose. '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 are 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 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 mixed 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 smaller or greater quantity of proper terrestrial Matter in it.* The Truth of this Proposition, is so eminently discernable through the whole Process of these Trials, that I think no doubt can be made of it. The Mint in the Glass *C* was much of the same Bulk and Weight with those in *A* and *B*. But the Water, in
which

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, though 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 mixed with it; yet in a short time, the Plant not only overtook, but much outstripped 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.* though 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 Increase 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 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 Vegetable requires a peculiar and specifick Matter for its Formation and Nourishment. Yea, each Part of the same Vegetable does so, and there are very 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, 'twill grow and thrive there, otherwise 'twill 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, 'twill not prosper at all. If there be these, and not in a sufficient Plenty, 'twill 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, 'twill be defective in Taste, in Smell, in Colour, or some other way.

But though 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 among 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,

on, Magnitude, Figure and Gravity, should ever constitute Bodies so egregiously alike 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 its Veins; one afford a fragrant, another an offensive Smell; one be sweet to the Taste, another bitter, acrid, acerb, austere, &c. that one should be nourishing, another poisonous, 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 the 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 thro' 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 *Cambridgeshire*; 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 loses 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 Ground's 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;

Earth; these are chiefly either Parts of Vegetables or 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 drained thence the greater Parts 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 Gardiners 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 an half of Increase from all that. The Mint in *L*. though 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*, though 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 the Earth was dissolv'd, 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*, though at first a great deal less than that in *M*, yet being set in the foul cras 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 $2\frac{2}{7}$ 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 in 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*, thro' 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 contributes vastly to the ordinary Fertility of the Earth, we have an illustrious Instance in the *Nile*, the *Ganges*, and other Rivers, that yearly over-flow 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 Production, and those who have not seen them, will hardly be induced to believe the mighty Returns those Tracts made, 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 itself 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 13140 gr. of the Water, gaining itself 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 2409 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 itself 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 itself 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, 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 conveying other Matter, that is not so active and voluble. Then the Intervals of Bodies of that Figure are, with respect to the Bulk, of all others the largest; and so the most fitted to receive and entertain foreign Matter in them. Besides, as far as the Trials 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'll pass Pores or 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 itself such Particles as are suitable to its own Nature; letting the rest pass on thro' 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, or the Corpuscles of Water sustained

in the Air, pervade and insinuate themselves into Cords, however rightly 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, thro' 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 Encrease by much, as those that were set in *June, July*, and the hotter. That the Concourse of Heat in the Work is really necessary, appears, not only from the Experiments before us, but from all Nature; from our Fields and Forests, our Gardens and our Orchards. We see in *Autumn*, as the Sun's Power grows gradually less and less, so its Effects on Plants are remitted, and their Vegetation slackens by little and little. Its Failure is first discernable 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 Nutriment, 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 thro' 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, 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 tho' the

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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, Raspberries, Currants, 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 ripened, 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 number and goodness, of what the hotter and kinder Seasons were wont to shew us. As to our Grapes, Apricocks, 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 we shall have occasion to admire this, and the better 'twill compensate our Industry.

LXXII. I do often ask Gardiners, and skilful Husbandmen, whether all sorts of Land are more fertilized, 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 fertilized by Frost; By Dr. Beal. n. 56. p. 1140.

LXXIII. All the Ground (at *Namptwich*) where Salt or Brine is spilt, is, when dug up, excellent Muck for Grazing-Ground; and even the Bricks that are thoroughly tinged with it, are very good Muck, and will dissolve with other Muck, and fertilize Land considerably (especially Grazing-Ground) for at least four Years.

Ground improved by Brine; By Dr. Jackson. n. 54. p. 1079.

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 itself 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 give you once an experimental Proof, that either the saline Steams, which ascend from a Heap of Salt, do pierce through very

Improvements with Salt; By Dr. J. Beal. n. 55. p. 1135.



thick Sone Wall: Or, which I did much rather conceive, they generate more Salt, to the great depth of Thickness, in the Lime and Mortar of the Walls.

Improvements in
Cornwall,
with Sea-
Sand, by Dr.
Dan. Cox.
n. 113 p. 293

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, 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 bluish, or grey like Ashes, which I conceive to be from the breaking of Muscles chiefly and Oyster-shells mixed with it. Westward, near the *Land's-End*, the Sand is very white, and in *Scilly* glistering: This, I think, comes from the mouldring of Moor-stones, as a kind of Free-stone mingled with very white Shells, such as are called (when the Fish are preserved) Scallops. On the North Sea about *Padstow*, and Eastwards to *Lundy*, 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 tho' 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, tho' there be not so much, yet that which is there is fatter and better than that which is taken in the South Sea.

Now besides these Colours of Sands, there is also a difference in the bigness of the Grain, even in the same Harbour of *Plymouth*; in some Caves 'tis very small, in others greater grained. '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 grained (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. Maw's Castle*, there is a sort of Sand, or rather Coralline, that lies a Foot under the Ouze; which Ouze being removed, and the Bed opened, this Sand is taken up by a Dredge, and is used about *Truro*, *Probus*, &c.

Vide Cap.
III. Sec. LX.

West of the Mount in *Portcutbnoe-Cave* is a large shelly Sand. In *White-Sand-Bay*, and about *St. Ives*, it is very white and small.

About *Minver*, *Perinsand*, and *Lelant*, the Sands are blown up by the Wind, and drown abundance of good Land, some Houses, yea, and some Churches and Chapels 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 blue, then the white; as to kinds, the most shelly, and the coralline

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 takes off much of its Virtue.

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 shore, from whence they are fetched in some Places by Wheels, but in most (by reason of the hilliness, and narrowness and badness of the Ways) on horseback; one Horse carrying about 13 or 14 Gallons. Seven or eight of these Horses tailed together, are called 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, tho' 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 Country, to about 32000*l. per An.*

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 160 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 Burden;) where Men go three Turn a Day, about 200; where two 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 Barley, 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, tho' 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 Fruit 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 six Weeks before what is within 6 or 7 Miles of 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 Country almost all kinds of Soil, 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 *Tbames* 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-heap 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.

A sandy Soil manured with Clay, by Dr. Lister, n. 225. p. 413.

LXXVI. There are some Towns in the *North-Riding* of *Yorkshire*, standing upon a light sandy Soil, viz. *Tolletorp*, *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 bluish 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 *Tolletorp*, 48 Years: And then the Ground must be clayed again.

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.

Improvements by Marling, by Mr. Thomas Wright, n. 37. p. 725.

LXXVII. The greatest Improvement of our Husbandry in *Suffolk*, hath been by marling: For 50 Load of Marle to an Acre of dry, barren, liny 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 *Norfolk* Gentlemen; one of whom, the last Year, had of 7 Acres of Nonsuch, or Hop-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 (or 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.

LXXVIII.

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 *Gauls*, *Germans* and *Britons*, 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 Donald* 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 *Clanrickard* was generally loyal; and there is a great Tract of Ground, now a Bog, that was then plow'd Land; and there remains the Mansion-House of my Lord ——— in the midst of it.

*Improving
and draining
the Bogs and
Loughs in
Ireland, by
Mr. W. King.
n. 170. p. 943.*

*Origin of
Bogs.*

But to shew how want of Industry causes Bogs, it must be remember'd, 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 Scurf 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 whither 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 stop'd, and the Scurf grows thicker and thicker, till at last it make that which we call a Quaking Bog: And as it grows higher and drier, 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 sulphureal 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 cover'd 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 Moss, 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,

ities, 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 and Bogs are generally fill'd with it: And truly I chiefly impute the red or Turf-Bog to it; and from it even the hardened 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 observ'd it.

3. It is to be observ'd, 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 Drop-sic does the Skin.

4. 'Tis to be observ'd, 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 thro' 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 through a Flat, if the Passage be not tended, it fills with Weeds in Summer; Trees fall across it and dam it up; then in Winter the Water stagnates farther and farther every Year, till the whole Flat is cover'd. Then there grows up a coarse kind of Grass peculiar to these Bogs; this Grass grows in Tufts, and their Roots consolidate together, and yearly grow higher, insomuch that I have seen 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 interwoven on the Surface of the Water, and this becomes by degrees thicker, till it lie like a Cover on the Water; then Herbs take Root in, 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.

Inconveni-
ences of Bogs.

The Inconveniences of these Bogs is very great.

1. A considerable part of the Kingdom is render'd useless by them; 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 we suppose a thousand Men live on Four contiguous Acres, they can both better assist and defend one another, than if they liv'd on Four not contiguous.

2. The Land which generally should be our Meadows, and finest evenest Plains, are covered with Bogs. This I observ'd through all *Connaught*, but more especially in *Longford*, and likewise at *West Meath*, and in the North of *Ireland*.

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 Tories and Thieves, who can hardly live without them.

5. The Fogs and Vapours that rise from them are commonly putrid, stinking, and very unwholesome: 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 away, which must of necessity affect the Air.

6. They corrupt our Water, both as to its Colour and Taste: For the Colour of the Water that stands in the Pits, or lies on the Surface of the Bog, is tinctur'd 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.

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 unpassable, and the fewer Strangers came near them, they liv'd 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 set down by the Fire. *Advantages.*

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 impolitickly destroy'd our Wood, and not as yet found Stone-Coal, save in few Places, we could hardly live without some Bogs. I have seen Turf chark'd, and then it serves to work Iron, and, as I have been inform'd, will serve to make it in a Bloomery or Iron-work. Turf chark'd I reckon the sweetest and wholesomest Fire that can be, fitter for a Chamber and consumptive People, than either Wood, Stone-Coal or Charcoal.

3. A Turf-Bog preserves things strangely; a Corps will lie entire in one for several Years. I have seen a Piece of Leather pretty fresh, dug out of a Turf-Bog, that never in the Memory of Man had been dug before. Butter has been found, that had lain above 20 Years: And though not fit to be eaten, yet it serv'd well enough to grease Wool.

Trees are found intire in them, and those Birch or Alder, that are very subject to rot. The Trees are suppos'd by the ignorant Vulgar to have lain

there ever since the Flood; but the Truth is, they fell on the Surface of the Earth, and the Bog, as is 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.

The inconveniencies remedy'd by dreining.

All the Inconveniencies of our Bogs may be remedy'd, and they may be made useful to us by dreining; for I never observ'd one Bog without a Fall sufficient to drein 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 *Annium*, 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 very believe it would be removed.

1. An Act of Parliament should be made, that who did not at such a time make some progress in dreining their Bogs, should part with them to others that would, and allow a Passage to them thro' their Lands.

2. 'Tis to be consider'd, that in Quaking Bogs one Trench dreins many Acres: And when dry, it is generally Meadow, or the best grazing Ground.

3. Every Bog has about it, a deep, marshy, sloughy Ground, which they call the Bounds of a 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 reduc'd to good grazing Ground, worth 3*s.* an Acre, for 25*l.* which is less than three 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 Tenants, 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 observ'd.

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 itself. It serves likewise as a common Sink, into which all your Dreins vent themselves.

2. Observe which way the little Sloughs run in the Bog, and be sure to cut your Dreins a-cross them.

3. The first Dreins on the Bog ought not 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 dry'd, 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 to 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 Drein; and if his Pits be once dry'd, there will grow Grafs or Heath at the bottom, fit for grazing, and they will be a Shelter for Cattle in Storms.

7. When his Bog is dry'd, 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 remov'd, 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 manur'd will bring Corn 12 or 14 Years. They say, Gravelling is bad for Grafs; but the contrary is apparent, especially in Bogs. I have observ'd by the Way-side, where the Ways pass thro' Bogs, if a little Earth had fallen on the Bog, as sometimes 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 Scotch Grafs on it: And I doubt not but the same Charge, that sands or gravels Land, would reduce a dry'd Bog even to be arable.

The natural Improvements of *Loughs* or *Lakes*, is first to drein them as low as we can, and then to 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.

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 stiffness 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 dreined, 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 Country, and the Hills have Cavities in them through which the Water passes; it is common to have

*Improvements
of Loughs.*

*And Tur-
loughs.*

*Vide supra
Cap. II.
Sect. XLX.*

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; inso-much as that in some Places where they are overflowed 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 itself into the Hole: And the Noise doth, in all likelihood, 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 drein; 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 spoiled by the Water.

*The Motion
of a Bog in
Ireland; By
—n. 233.
p. 714.*

LXXIX. 1. *June 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 here-upon 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 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

it had before stood ; leaving great Branches behind it, and spewings of *Water*, that cast up noisome Vapours.

2. The Line *A. B.* is the *Meridian* ; *C.* a *Meadow*, containing 3 *English Acres*, and 32 *Perches* ; *D.* firm *Pasture-Land* (but of a coarse *Boggy substance*) containing 4 *Acres* 3 *Roods*. The Line 1, 2, was a *Hedge* of 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 pricked 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*. By Mr. J. Honoant, ib. Fig. 176.

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 *Chasms* and great *Cracks* throughout the whole *Surface* of the *Bog*, represented by the *Stroaks* about *E.* The *Bog* contains 40 *Acres*.

LXXX. In the *Description* of this *Sembrador* (published by Don *Josepb de Lucatello*, Knight, Inventor of the *Engine*, and dedicated to Signor Don *Geronymo de Camargo*, Counsellor of the *Consejo Real de Castilla*, and of the *Hazienda Real*) it is represented ; The Spanish Sembrador and its Uses; By the E. of Sandwich, n. 60. p. 1056.

First, That both the Antient and Modern Husbandman 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 *Handfuls*, 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* sow'd 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* : That upon these *Considerations* Don *Josepb de Lucatello* hath, after much *Experience*, perfected an *Instrument*, which being fastned to the *Plough*, at once ploughs, sows, and harrows ; 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 five parts of *Seed*,

Seed, four parts are saved ; and then the Crop is gained incredible Abundance.

3. That the Inventor presented it at the Feet of his Catholick Majesty, who caused Trial 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 Husbandman, 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 Assigns 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 Trial of it before his Imperial Majesty, in the Fields of *Luxemburg* 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 at *Vienna*, *Aug. 1, 1663, N. S.* by an Officer of the Emperor, appointed to see the said Ground sowed and reaped.

6. That this Privilege being dispatched, he published his Contrivance and Instructions, as follows.

Fig. 177,
178.

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. b. g. k. l.* the two Sides which cover that part of the Box, where the *Cylinder*, which is struck 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 convey 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.

Fig. 179.

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 sowed 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 *September*, and making an end at the middle of *November*.

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, deepening 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 drein the Land of Water, according to the use of each Country, without doing any thing more extraordinary till the Harvest.

The following Instructions were also published:

1. Before they sow the Ground, they must give it so many *Tilts* as is accustomed in that Country where the Land lieth.

2. When they go about to sow, the Plough-man 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 tie 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 picked 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 the Mould again; and so must the *Sembrador* also be lifted up, the Weight thereof being but very little, and no considerable Trouble to the Plough-man.

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 little inclining to Moisture: 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 five *Celamines* (or $\frac{1}{12}$ of a Bushel) of *Barley*, on as much Land as would take up about one Bushel and half 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 bigness.

8. You must plough the Furrows very close one to another, that so the Plough when its 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 same manner the Land should be made as plain as can be, and no such Furrows made to carry away the Water as hitherto hath been used: But it will be sufficient, that at every four 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 the greatest Damage by Drought; and therefore this ought more especially to be observed in *Spain*, one of the driest 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 proveth 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 Noon* in *September*, and so go on, and end with the *New Moon* in *November*: But in *Germany*, and the *Low Countries*, they begin in the End of *August*, and end with the *New Moon* of *October*.

LXXXI. It is vulgarly known, that the Surface of some Ground is so hollow, 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

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 thro' the 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 that 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 five or six 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 Ever-greens well sheltered from Winds, and flowery Gardens, all the hard Winter, and do us better service in an extreme hot Summer. I have been perplext in observing myself 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 *Pebble-stones*, as if a Causey had been pitched there ; yet was it a thick and pregnant Land for *Flowers*, *Fruit-Trees*, and *Vines*, these *Pebbles* being dislodged, and some of them carried away. I have seen Fields, where the Surface did seem covered with *Pebbles*, not *Flinty* nor *Lime-stone* ; yet they bore full Burdens of the best and cleanest *Rye* and *Oats* : The Husband-men took away the *Pebbles* 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 sustained 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 encrease 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 *Pebbles* 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 Sir *Robert Murray*, 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 strong and sprightly Liquor, which resembles the *Wine* of the *Grape*, that the Return of Gain from *Gardens* is great and speedy; *Nurseries* neither are chargeable nor a burthensome Addition, but a congruous Engagement of the Multitude to persevere in the noblest kind of *Agriculture*. Sir *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 Firs* and tall *Holly* from the Sea-Winds; and they have lofty *Firs*, and goodly *Pines* in *Scotland*; and *New-England*, where the Winds are as keen, and the Snow and Frost 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 rejoice in the Exchange of *Northern America*, for the North of this Island.

This I told Sir *R. M.* I durst undertake, that when *Edinburgh*, and their *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 Day's Journey of the Heart of *England*, I could shew 3 Gardens the best that I have seen for flowery Beauties, *English Ever-greens* 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 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 seized 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 Plowing 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

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 Leathern Aprons before them to save their Cloaths. For the Causes of this hardy Fertility, *Viderint Philofophi*. 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*, *Launc*, and *Cambrick*, as now they do *Scotch Clotb*.

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*, *Liquorice*, *Hops*, *Nadder*, *Oade*, or what other rich Commodities do prosper there; but this I know, that our *English Saffron* and *Liquorice* do far excel all the Foreign, which our Druggists do sell us from the South. And since *Vines* and *Mulberries* have travelled from the remotest East, through all the hottest Countries, and have abundantly enriched our next Borderers, and have received acceptable Hospitality, as far as they have been tried, in this our Island; we have Encouragement enough to adventure the cheap and easy Trial.

Some of my Correspondents tried the *Mulberry* and *Silk-Worm* as far in the North as *Huntingdonshire* and *Cheshire*, and Sir *James Craig* tried them in the moistest Place in *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.

*Ibid. p. 364.
n. 133. p. 816*

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 whollome and stout Wine.

'Tis strange, that in 9 or 10 Years since this was published, the Practice 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 Averseness from Planting *Mulberries*, which they shewed near the Beginning of King *James's* Reign, to our great Loss and Shame.

*Vide supra.
§. XXXIX.
2.*

The *Mulberry* 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 *Wine-Mulberries* (as we call them) are for the finest Silk; but to mingle with Cyder, and for our Junkets, (as *Palladius* hath hinted to us) we should send for the most delicious black *Mulberries* which may be had in *Naples*,

ples, 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 furnish'd, they might easily be dispersed into other Parts, without more ado: 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 covered, 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 Mould, 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 Mulberry upon that of the same kind; it being certain, that it takes better upon that than upon the white Mulberry.

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, Metheglin, and other Honey-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.

m. 134. p. 366.

Many discourage themselves from Planting Cyder-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 Hogsheads of Cyder, yearly, and much more, do pound all their Fruit in Troughs, made for the purpose, deep and strong, with Broad-footed 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.

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 Alembicks, which attend to that divine Work constantly all the Year; they need no Furnaces to send forth a corroding Smoke to choke all the City, to strangle them into Consumptions, and 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 of Vehicle for any Healing Vegetable, or other medical Matters.

The Cyder of the best Pepins duly ripen'd and kindly fermented, is a peculiar

cular Remedy for the Consumption, and generally all strong and pleasant Cyder exciteth and cleanseth the Stomach, it strengthens 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 streak* of *Irebin-Field*, when it escapes all Sophistications. But that which makes Cyder fit to accompany the Tradescmens Granary, is, that if it be made of right Cyder 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. Tradescmen should not be for bottled Cyder, 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 60 or 70 Statute-Gallons: I have been often told, that Sir *John Winter* had a Vessel which contained 30, or at least 28 Hogsheads.

When the Citizens shall ordinarily drink Cyder well diluted, as the *French* drink Wine, and as the sober People in all our Cyder-Countries drink their *Washings* of Cyder, as they call it, or Cyder well diluted in the Grinding-time, and as they drink in *London* their 6 *shilling* Beer, I am persuaded it will much conduce to their Health: And I have often heard labouring People affirm, that they are more strengthened for hard Work by Cyder largely diluted, than by very good Beer.

Yet I have much more to say for *Household Gardens*, as a fit Match for *Granaries*. *Coleworts* and *Cabbages*, with a little Care, hold out 7 or 8 Months in the Year. We 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 dress'd without much Waste of Time. But Roots of all sorts, *Rapes*, *Turneps*, *Carrots*, *Parsneps*, *Skirrets*, *Potatoes*, do challenge the Precedence before *Granaries*; they are a kind of Under-Ground Granaries, and do oftentimes hold out, when Corn faileth; especially the *Potatoes* of *Barbadoes* or of *Virginia*.

The *Potatoes* of *Barbadoes*, in our fresh Memory, relieved *Ireland* from two Years Famine, when their Corn failed there; as *Chestnuts* reliev'd *France* in the Extremity of their Civil War, when their Ploughs were forsaken. These *Potatoes* cost little or no Culture for ten Years together, being only covered with *Fern*, or other light Muck, and that turn'd in with the Earth, and two or three 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 *Wells* at the Price of 4 *Shillings per Bushel*; dear enough in respect of their easy Propagation and Culture, and cheap enough in respect of their Use. Children of poor People thereabout can eat them raw, instead of *Bread* and other Food, without hurt; some do roast them in Embers, as they do *Wardens*; some do boil them, peel them, and eat them with *Butter* and *Pepper*, either served

Vide supra
§. 8.

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 strong and wholesome Nourishment for Labourers. Some do parboil them slightly, peel them, and mince or cut 'em in small Bits, mingle 'em with the Slices of fat Flesh, seasoning all to their Palate, and bake them in Pies or Pasties, and they esteem them a restorative Delicacy, not much inferior to *Artichocks*. I observe them to grow and prosper abundantly in much differing kinds of Soil, from the North of *Shropshire* to the 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 *Potatoes* 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 *Potatoes* of *Barbadoes* and *Virginia*, for both have the same Resemblance above Ground: Or, whether the Difference which we find be only from the Diversity of the Soil.

That the Soil makes a great Difference, and that all may be careful to choose a fit Soil 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 Field of *Mariot*, 8 Miles from hence, Westward, far to excel other very good *Turneps* and *Carrots* in Fatness and pleasing Relish. And *Cabbage-Plants* from the wild Fields of *Lydiard*, Westward of *Taunton*, where they have a rich reddish Soil, 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 drouthy Summer, the *Plague* then being hot in *London*, we had *Carrots* in *Northamptonshire* from a kind Soil, 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 *Turneps* of *Hackney* are better than any 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 Emperor himself nurseth them in his Garden.

The *Spanish Potatoe* requires diligent Culture, much Sun and a light and pregnant Garden-Soil. 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 *Seville* in *Spain*, fully Freightened with these *Potatoes*, and were soon dispersed all over *Spain*. We say, the *Spaniard* is slow at every thing: But they may say, the *Englishman* in many Parts of *England*,
is

is more flow at the best Improvements of our own Country ; Witness our Want of Vineyards, of Groves, of Mulberries, of the best Chestnuts, Walnuts, Figs, Almonds, &c. which are wanting in most Parts, and do not refuse to grow in our Climate.

LXXXII. For the Improvement of sandy, light Ground, or any Clay well sanded, I recommend upon Experience, *Vicia multiflora Nemorensis Perennis, sive Dumetorum*, J. 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 itself under Ground, like *quick Grass* ; above Ground it is so rampant, that it will climb a Fathom and half upon Measure, and will preserve itself 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 *September*, as well as the ripe Seed then gathered ; by this means the Growth of it would be mightily advanc'd ; for the older the Roots are, the stronger and fuller of Buds and Shoots they are. I sowed the latter End of *March* the Seeds I had gather'd in *September*, and had that Year a very great Increase ; the Bed being very thick cover'd 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 flower'd by the middle of *June*, and bore a wonderful Crop, the Roots being innumerable. I have observ'd this Pea very common in all the Mountains as well as Plains of *England*, where Bushes or Hedges are. Both the Pea and the Grass are very sweet, and very agreeable to Cattle, as I have tried.

Improvements
of Agriculture,
by Dr.
M. Liſter,
n. 25. p. 412.

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 recommend this List :

Latyrus major Latifolius Ger.

Latyrus Luteus Sylvestris Dumetorum L. B.

Astragalus Sylvaticus Ger.

Vicia Sylvestris Semine rotundo, Nigro, C. B.

Orobus 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 J. B.

Linum Sylvestre Floribus Cæruleis Ger.

Corona Fratrum ; of the *Tbistle-Kind*. This Plant is generally a Yard tall ; its Fibres are exceeding tough and strong, beyond any I ever tried ; 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 Woolds 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 Fruits : 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 at *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 distinguish'd by the Eye from that of our Gardens; but is intolerably bitter, which Garden-Culture alone has Civiliz'd, 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 liv'd 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 Flour. '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.

To make
Plants grow
to an extra-
ordinary big-
ness, by M...
n. 156. p. 356

LXXXIII. Sow all sorts of Grains, and plant Kernels in Beds of Earth, at the very time when the Sun enters into the *Vernal Æquinox*, 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.

But now, to know the Moment, or very near the Moment, of the said *Æquinox*, take some Ashes of *Vine-Wood*, put them in an Earthen Pot Leaded, or in a Pot of the white Earth of *Toyence*, very clean; pour upon it common Water, or Fountain, or Rain-Water, that is very clear, from the $\frac{1}{2}$ of *March* to the $\frac{1}{11}$ of the same; and at the time when the Sun enters into the *Æquinoctial Point*, you will see the Ashes make the Water Turbid, and then is the Time of sowing your Grains and planting your Kernels.

Gardening
improved, by
Dr. Hans
Slane, n.
251. p. 119.

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

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 the *Centaurium Minus*, which not growing the ordinary way, was tried, 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.

LXXXV. I have made a Stove in my Green-house, according to Mr. Evelyn's Invention, publish'd 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, covered 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. Evelyn 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 admirably.

*The Success
of a new
Stove, by Sir
Dudly Cul-
lum, n. 212.
p. 191.*

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 *Sal Armoniac*, and about Lent Fruit will appear.

*To make
Fruit and
Flowers grow
in Winter, by
Sir Robert
Southwell,
n. 237. p. 44.*

As to Flowers, Take good Earthen Pots, and therein sow your Seed at *Michaelmas*, Watering it in the same manner with the like Water, and by *Christmas* you will have Flowers, as *Tulips, Lilies, &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.

LXXXVII. Take *Salt Petre* one Pound, *Bole Armoniack* two Pounds, ordinary clean Sand three Pounds; mix all together, and observe this Proportion in other Quantities.

*To keep Fruit
and Flowers
the whole
Year, by Sir
Rob. South-
well, n. 237.
p. 44.*

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 an Oily Cloth, close tied down; then in a dry Cellar, put each of these Glasses four Fingers under Ground, and so as that quite round each Glass, and above and below, there remain two Fingers thick of the said Mixture.

Flowers also may be used in the same manner.

Remedies for
decayed E-
vergreens, by
Mr. J. Eve-
lyn, n. 158.
p. 561.

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, Ruffet, or altogether shrivell'd and falling, but to cut them to the Quick, plaister the Wounds, and plunge their Cases and Pots, trimmed with fresh Mould, &c. in a warm Bed, carefully refreshed, shaded, aired, and treated as sick Patients, and as the prudent Gardiner 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 Gardiners 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.

Cautions a-
bout exposing
Evergreens,
by Mr. Jacob
Bobart. n.
165. p. 777.

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 receiv'd Detriment, with their Tops shrivell'd, 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 Gardiner is especially try'd, gradually to help and recover his sick Patients, sometimes by due Trimming, Earthing with fresh Sustenance, 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.

Vide supra,
cap. 1. §. 53.

In the Flower-Garden, especial Observance ought to be taken of the choicer Roots of the *Asian Ranunculi*, *Aulmoneys*, tender *Narcissi*, and divers 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 cover'd and kept from the Frost, if possible, till the too rigid Moisture of the Earth be digested, which would prove pernicious even to the Death and Rotteness of many such Roots and Plants.

XC. Papers of less General Use, Omitted.

1. Directions for Transporting Vegetables. n. 40. p. 793.
2. *Phytologia Tingitana*: Or, an Alphabetical Catalogue of Plants growing within the Fortifications of *Tangier*, 1673, by Mr. *Spotswood*. n. 200. p. 239.
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. 232. p. 677.
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. 244. p. 313.
5. An Account of Part of a Collection of curious Plants and Drugs, gathered by Mr. *Sam. Brown*, a Physician 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. 236. p. 1.
n. 204. p. 579.
n. 267. p. 699.
6. Quæries concerning *Indico*, by ——— n. 193. p. 504.
7. Quæries concerning Vegetation, especially the Motion of the Juices of Vegetables, by ——— n. 40. p. 797.
8. Quæries concerning the Circles of Wood in the Bodies of Trees, and the Motion of Sap, by Dr. *Ez. Tonge*. n. 43. p. 858.
867. n. 46. p.
919.
9. Quæries concerning Vegetation, and the Motion of Sap in Fruit-Trees, by Dr. *Ez. Tonge*. n. 44. p. 881.
n. 46. p. 914.
10. Quæries concerning Vegetation, and the Motion of Sap, by Dr. *Ez. Tonge*. n. 57. p. 1165.
11. Enquiries about Retarding the Ascent of Sap, and the Motion of Sap, by Dr. *Ez. Tonge*. n. 68. p. 2073.
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. 68. p. 2074.
13. Enquiries relating to the Circulation of Sap in Trees, by Dr. *Martin Lister*. n. 70. p. 2121.
14. An Enquiry suggested from *Italy*, whether it be likely to find something in Plants, analogous to the Heart in Animals. n. 74. p. 2118.
15. An Invitation to make further Trial of the Juices of Trees, by Tapping them, by Mr. *H. Oldenburgh*. n. 40. p. 801.
16. Two Problems concerning the Texture of Plants, and the Discovery of Poison by *Ogium*, proposed by ——— n. 252. p. 186.
17. Enquiries concerning Agriculture, by the Committee of the *Royal Society* for considering of Agriculture. n. 5. p. 91.
18. Enquiries concerning the Use and Culture of the *Kitchen-Garden*, and *Winter-Greens*, by ——— n. 40. p. 798.

XCI. *Accounts of Books, and Additions, Omitted.*

- n. 243. p. 304 1. **B**asis Botanica: Seu brevis ad Rem Herbariam Manuctio, omnes Plantarum Partes, una cum earundem Virtutibus secundum Novissima Botanicorum Fundamenta, Generali quadam Methodo commonstrans; à D. Christiano Ludovico Welckio. Lips. 1697, in 12mo.
- n. 36. p. 716. 2. Abr. Couleii Angli, sex Libri Plantarum, Poemate Latino conscripti, Lond. in 8vo.
- n. 46. p. 934. 3. Prælua Botanica Roberti Morison, Scoti Abredonensis, Lond. 1669, in 8vo.
- n. 114. p. 327 4. Dr. Morison's New Universal Herbal.
- n. 46. p. 935. 5. Cl. Salmasii Præfatio in Librum de Homonymis Hyles Iatricæ. Eiusdem de Plinio Judicium. Divione An. 1668, in 4to.
- n. 76. p. 2291 6. Quadripartitum Botanicum Simonis Pauli, Med. Reg. in Dania Argentorati, in 4to.
- n. 111. p. 247 7. Waare Oeffening der Planten, door Abraham Munting, M. D. Amsterd. 1672, in 4to.
- Pb. Col. n. 1. p. 39. 8. Memoires pour servir à l' Histoire des Plantes; dressez par M. Dodart, M. D. Paris, 1679.
- n. 186. p. 283 9. Historia Plantarum, species hæctenus editas, aliasque insuper multas noviter inventas & descriptas complectens. Auth. Job. Rai, è Soc. Regia. Lond. 1686, in Fol.
- n. 193. p. 528 10. Phytographia. By Leonard Plukenet, M. D. Lond. 1691, in Fol.
- n. 196. p. 618 11. Almagestum Botanicum; S. Phytographiæ Plukenetianæ, Onomasticon, &c. Lond. 1696, in Fol.
- n. 225. p. 434
n. 63. p. 2058
n. 133. p. 834 12. Catalogus Plantarum Angliæ, & Insularum adjacentium tum Indigenas, tum in Agris passim Cultas complectens. Opera Jo. Raii, M. A. 1670, in 12mo & 1677, in 8vo.
- n. 83. p. 4078 13. The American Physician: or, a Treatise of Roots, Plants, Trees, Shrubs, Fruits, 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 12mo.
- n. 221. p. 93. 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 Christophori, nascuntur. Seu Prodromi Historiæ Naturalis Jamaicae, Pars prima. Aut. Hans Sloane, M. D. 1696, in 8vo.
- n. 104. p. 87. 15. Icones & Descriptiones Rariorum Plantarum Siciliae, Melitæ, Gallia, & Italiae; Auth. Paulo Boccono, 1674.

16. *Museo de Pianta Rare della Sicilia, Malta, Corsica, Italia Piemonte e Germania, &c.* di Don Paolo Boccone, &c. To which are here added, some Remarks, by Mr. J. Ray. n. 247 p. 462

17. *Hortus Indicus Malabaricus*, continens Regni Malabarici apud Indes Celeberrimi, omnis generis Plantas Rariores, Amstel. An. 1678, 1679, 1682, &c. To which here are added some Remarks, by Tancred Robinson, M. D. n. 145 p. 100
n. 198 p. 622
n. 200 p. 202
n. 214 p. 276

18. *Hortus Medicus Amstelodamensis*, sive Plantarum tam Orientalis quam Occidentalis Indiae, aliarumq; Peregrinarum Descriptio & Icones; Autore Johanne Commelino; Latinitate donatus, Notis & Observationibus illustratis à Frederico Ruyschio, M. D. Botan. Profess. &c. & Francisco Kiggelario. Amst. 1697. Here are many Additional Remarks by Mr. James Pettiver. n. 236 p. 29

19. *Paradisus Batavus*, continens plus centum Plantas, &c. With Additional Remarks, by Mr. Jo. Ray. n. 249 p. 63

20. *Catalogus Plantarum Horti Academici Argentinenfis in Usum Rei Herbariae Studiosorum*; adcurante Marco Mappo, M. D. Argentorati. 1691, in 12mo. n. 199 p. 729

21. *Histoire des Plantes qui naissent aux environs de Paris*: avec leur Usage dans la Médecine; per M. Pitton Tournesort, M. D. à Paris 1698, in 8vo. n. 245 p. 385

22. *Flora Noribergensis*, &c. Being a Catalogue of such Plants as not only grow spontaneously about Nuremberg, but also of such Exoticks as the Physick-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 4to. n. 265 p. 651

23. *Plantarum Umbelliferarum Distributio Nova per Tabulas Cognationis & Affinitatis*, ex Libro Naturæ Observata & Detecta; à Rob. Morrison, Med. & Prof. Bot. Regio, &c. Oxonii, 1672. n. 81 p. 4027

24. *De Absynthio Analecta*, per Job. Michael Febr. M. D. Lipsiæ, 1668, in 8vo. n. 74 p. 2235

25. *Crocologia*, Auth. Job. Ferdinando Hertodt. M. D. Jenæ, 1671, in 8vo. n. 74 p. 2236

26. *Cochlearia Curiosa*: or, the Curiosities of Scurvygrass; written in Latin by Dr. Andr. Molimbrochius of Leipsig, and Englished by Dr. Tho. Sberly, Lond. 1678, in 8vo. n. 125 p. 621

27. *Job. Nicolai Pecblini*, M. D. *Theophilus Bibaculus*; sive de Potu Theæ Dialogus Fran. 1684, in 4to. n. 167 p. 870

28. *Epistola de Generatione Plantarum ex Seminibus*, à Josepho de Aromataris. Frankf. 1625. n. 211 p. 150

29. *The Anatomy of Vegetables begun*; with a general Account of Vegetation founded thereon. By Neb. Grew, M. D. F. R. S. London, 1671, in 12mo. n. 78 p. 3037

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 Neb. Grew, M. D. & F. R. S. London, 1673, in 8vo. n. 97 p. 6151

31. *The Comparative Anatomy of the Trunks of Plants*; together with an Account of their Vegetation grounded thereupon. By Neb. Grew, M. D. in 8vo. n. 120 p. 486

- n. 150 p. 303 32. *The Anatomy of Plants, with an Idea of a Philosophical History of Plants; and several other Lectures, read before the Royal Society.* By *Neb. Grew*, M. D. 1682.
- n. 117 p. 401
Pb Col. n. 1
p. 38. 33. *Marcelli Malpighii Anatome Plantarum; cui subjungitur, Appendix, iteratas & auctas ejusdem de Ovo Incubato Observationes, continens.* Lond. 1675, & 1679, in Fol.
- n. 226 p. 320 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. 228 p. 545 35. *Marcelli Malpighii Philosophi & Medici Bononiensis, à Regia Soc. Lond. Opera Posthuma: Fig. Æneis illustrata; quibus præfixa est Ejusdem Vita, à seipso scripta.* Lond. 1697, in Fol.
- n. 119 p. 454 36. *A Philosophical Discourse of Earth, relating to the Improvement of it for Vegetation and the Propagation of Plants.* By *J. Evelyn*, Esq; Lond. 1676, in 8vo.
- n. 114 p. 320 37. *The Epitome of the whole Art of Husbandry; with Additions of New Experiments thereunto belonging.* Written by *J. B.* Lond. 1675, in 8vo.
- n. 136 p. 922 38. *Systema Horticulturae: Containing in English, the Art of Gardening, in Three Books.* By *J. W. Gent.* in 8vo.
- n. 22 p. 398. 39. *Sylva & Pomona.* By *E. Evelyn*, Esq; Lond. 1669, in Fol.
- n. 53 p. 1071
n. 84 p. 5002 40. *Dr. Richard Sharrook's History of the Propagation and Improvement of Vegetables, by the Concurrence of Art and Nature.* Oxon. 1672, in 8vo.
- n. 86 p. 5049 41. *A short and sure Guide in the Practice of Raising and Ordering of Fruit-Trees.* By *Fran. Drepe*, B. D. Oxon. 1672.
- n. 113 p. 302 42. *The Garden of Eden; or an Account of 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 Sir Hugh Plat,* in 8vo.
- n. 116 p. 373 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. 129 p. 748 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 Majesty's Dominions, and more particularly Cambridgeshire, the Champain Countries, the Northern Parts of England: In several Letters out of the Country.* By *Dr. J. Beale*, and *Mr. Anth. Lawrence*.
- n. 168 p. 733 45. *The Art of Pruning Fruit-Trees; and 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. 15 p. 62. 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 8vo. n. 126. p. 646

48. *Vini Rebnani imprimis Baccaracensis*, Anatomia Chymica, à Job. Davide Portzio, Phil. & Med. D. Heidelbergæ, 1672, in 12mo. n. 93. p. 6019

49. Joh. Henr. Meibomii de Cerevisiis, Potibusque & Ebriaminibus extra Vinum aliis Commentarius, annexo Libello Turnebi de Vino. Helmestadii, 1668, in 4to. n. 69. p. 2116

50. *Vinetum Britannicum*: Or, a Treatise of Cyder, 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 Cyder. Also the Method of making Metheglin and Birch-Wine. With Copper Plates. By J. W. (Author of *Systema Agriculturae*) in 8vo. Advertisements on this Book are here added, by Dr. Beale. n. 123. p. 574
n. 115. p. 352

51. The Manner of Raising, Ordering, and Improving 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 4to. n. 124. p. 583
n. 126. p. 644

C H A P. VI.

Z O O L O G Y.

1. 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. *Observations in the Ordering of Silk-Worms; by Mr. Edward Digges, n. 2. p. 26.*
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 Hatched; some half way in their Feeding; others Spinning their *Silk*; yet I found none of them concerned 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 (wherewith 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.

*The Nature
and Qualities
of Silk; by
Mr. Will.
Aglionby.
1752. p. 183*

II. 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 spoils 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 Midsummer (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.

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 obliged to hazard all their good, at the price of the worst; which is commonly practised: But if the Season promise 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 better or not.

*To know the
best Silk.*

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 note, 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 joined, 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 heavist of all. It is likewise convenient that the Skeans be even, and all of an Equality, which shews 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 *Essay*; for unless one buys that which one knows by Trial, there is a Hazard of being cheated, and so for one sort have another.

*To Estimate
it by Essay.*

To estimate the *Silk* by *Essay*, fix the *Essay* upon the eighth of a *Portee-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 *Portee*. Now to calculate what these 1100 *Aunes* weigh, which is the eighth Part of a *Portee*, or of 110 *Aunes* of *Lyons*, it will be proper to take a Skean out of
the

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 *Cantrè* (*Beam*;) and from thence pass it through the (*Combe*) *Hourdissair*; this done, you cut off your *Silk* and weigh it, and multiply the Weight by 8, 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 *Picardmont* which are very light and clean, and to be preferred before any in *Sale*. The *Portée* 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.

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 poisonous 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 Mouths (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 seven 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 attends 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 applied 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 pounded by *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 die, 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

The Con-
nought-
Worm: By
Mr. Will.
Molyneux:
n. 103. p. 876.

this Worm between his Hands, and let the expressed Juice dry thereon ; ever after the Water he first Washes in the Morning, given to the Beast to Drink, Cures it.

But I am very apt to suspect, That this Worm is no more Poison 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 the Worms to one Dog, which shewed no Alteration thereon, but another Dog, to whom he gave the Skin of the Creature, was found dead three Days after.

But whether his Death proceeded from the Poisonous Skin, he could not assert ; for the *Dog* ran at Liberty, and might have been killed (for ought as he knew) by some other Accident ; tho' no external Sign of any Violence offered to him did appear.

Fig. 181 AB, is the *Worm* lying on its Belly, long two Inches and half almost ; *c*, his Head ; *dd*, two *Variiegated 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. 182 *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* ; *hh*, *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.

The true Origin of Caterpillars ; By Dr. Geo. Garden, m. 237 p. 54.

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 Hatch'd in the Spring. The Seasons which usually destroy them are, when there comes 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 Generation of Insects.

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 discernable 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 Hatch'd of them, are to have their Food :

Vid. Inf. §. 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.

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 in the Box, and the *Worm* into the Paper, it shined through the Paper and Box both.

*Observations
on a Glow-
Worm, by
Mr. J. Tem-
pler, n. 72.
p. 2177.*

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 herself, 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. *b. v.* I set the Box with the *Worm* in it, about 4 Yards from me, in a Window, where I perceived it shine through the Box, for almost an Hour.

31. 4. *b. m.* I found it shining, and observed it in plain Day-Light, for about half 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 herself, 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 third part beyond its usual Length; and, if my Senses fail me not, she emits a sensible Heat in her clear shining.

June 1. Upon several Trials 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.

June 8. Putting her into an *Urinal* of white Glass, at 9 a Clock at Night, she crawled nimbly into it, and extended herself 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 half an Hour, it gave a very delightful *Irradiation* of the *Water*. When this Light seemed wholly *extinct*, although it was in Motion, if I depressed the *Urinal* into the *Water*, till the Bottom almost touched the Bottom of the *Bason*, I could (upon looking in at the top of

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 Minute's time (for I tried it twice over, by a Watch) almost ten times increase her former shining in the *Urinal*.

14. The *Worm* seemed 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 pricked 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 increased.

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 quarter of an Hour after I pricked her, than before.

N. B. The three last 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. Halleback* of *Cald-Newton* near *Melton-Marebury*, that he kept a *Glow-Worm* near six 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.

The Flying
Glow-worm
by Mr. Rich.
Waller, n.
176. f. 841.

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, though the Animal be easie enough to be met withal Winged, when it shines not, and without Wings shining, which is the *common Glow-worm*.

Lib. 4. c. 8.
c. 11. p. 108.
De Luce A-
nimalium.
Lib. 2. c. 12.

The Description of it by *Aldrovandus* agrees very well with the Animal: But both *Mouset* and *Tho. Bartolin* 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. Its 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 too small Specks on the under-side 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

on

on the upper 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 Objects, 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. The Conjecture is also favour'd 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 Lanthorn.

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, unpolish'd: When the Case-Wings are open'd, it extends two very large Membranous Wings, fasten'd to the upper part of the *Thorax*. Its Head is cover'd, as it were, with a Shield, or broad-brimm'd Hat. *Fig. 183.*

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 two Hairy Feelers, or perhaps Brushes to cleanse the Eyes. Between these Eyes and the *Thorax* lies the Mouth. On the *Thorax* are six Legs, almost all of a length. The Tail is made of seven shelly Rings; at the last of which are visible, two shining Points. *Fig. 184.*

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 Butterflies; 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 Tortoise-shell. *C C* The Two Eyes compos'd of Innumerable small Glassy Hemispheres in Rows; as hath been observ'd by the ingenious Mr. *Hook*, in his *Micrography*, to be the Make of the Insect's 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 in Rows, with long Hairs growing out of each space, left by the Connexion of the Hemispheres. *DDDDDD* The Legs, of a Shelly Make like *Lobsters*, and so Jointed. As well in this as other Flies, they are covered with many stiff Hairs, though not so full as those of the Blue Fly, Figured by Mr. *Hook*. The Mechanism of the Feet, as I take it, are much the same; only what is there called 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 e e* of the Feet were shining, and very sharp-pointed. The Legs were of Two long Joints, and the Feet of Four more, besides that which was armed with the Talons. These seem'd to be Jointed one into another, and were all thick beset with Hairs or Bristles. *E* the *Thorax* of but one Shell, of a polish'd Copper-Colour, stuck *Fig. 185.*

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-Colour. *ff*, 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, though there was now nothing to be seen, except that Part being a little lighter coloured than the rest of the Tail. *G G G*, the membranous Wings, in every particular like those of the Blue Fly, with Hairs upon the Veins, or Quilly Parts. *H H*, the Inside of the Case-Wings, which were Hairy, pointing all downward; the Outside of these Cases is also very Bristly.

*An odd sort
of Maggots
by Dr. M.
Lifter, n.
160. p. 593.*

VII. In the Harvest-time, 1666, the Sickness then raging at *Cambridge*, at *Bassenbourn* in *Cambridgeshire* 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 Pidgeon's 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 produc'd some sort of *Moth*. 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 Flour, like that of *Barley*.

*Swarms of
Orange and
mischievous
Insects in
N. England,
by — n. 8.
p. 137.*

VIII. Some few Years since there was such a Swarm of a certain sort of Insects in *New-England*, that for the space of two hundred Miles they poisoned and destroy'd 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 Flies that had a kind of Tail, or Sting, which they stuck into the Tree, and thereby Envenom'd and kill'd it.

*The Libella,
by M. Pou-
part, n. 265.
p. 673.*

IX. The *Libella* is a Flying Insect, called in *France*, *Demoiselle*, from the Variety of its Colours, Transparency of its 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.

These different Sections serve to the Motion of this Insect, as we know the Tail doth in Birds; and as they are Lengthen'd or Contracted, they carry themselves according to their various Inclinations, the Point or Center being fixed between their Wings. All Modern Naturalists know,
the

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 itself 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 myself 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 herself 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 Interior 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 lie between the Wings and Legs (Eight on each side) of the Thickness, Length, Colour, and almost Figure or Shape of a Grain of Barley, 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 joined 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 hinder'd; for as long as the Wings play, the Feet lie still, and serve for a Prop to the Muscles which stir the Wings, and when the Feet are

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in Action, the Wings are quiet, and in their Turn serve to support the Tendons which direct the Feet.

The Eyes are like two oblong thick Pearls, which begin at the Fore-part of the Head, and end in the Hinder-part; their outward Membrane is dry, thin, transparent, and encloses a small soft Ball, filled with a very black Liquor; 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 derive the Air contained 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 inward Parts will putrify, and come to nothing: But these Canals will remain entire, and as solid and firm as they were before.

Of spontaneous Generation, by Mr. Ray, n. 74. p. 2219.

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.

Gener. digl' Insetti.

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 Excrescences of *Vegetables*, which the said *Redi* doubts not to ascribe to the Vegetative Soul of the Plant that yields those Excrescences: 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.

The Grain of Kermes, its Use, and the Fly formed out of it, by M. Verney, n. 20. p. 362.

XI. 1. *M. Verney*, a French Apothecary at *Montpelier*, having described the Grain of *Kermes* to be an Excrecence 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; subjoins 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 Linen; 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 thro' a Searce; and then again, they spread abroad the Grain upon the Linen, 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.

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In the Beginning, when the small red Grains are seen to move, as they will do, they are sprinkl'd over with strong Vinegar, and rubb'd between ones Hand. 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, depriv'd of all the Bitterness, the Grain, whence they are generated, had before.

The Grain being altogether emptied of its Pulp or red Powder, 'tis wash'd in Wine, and then expos'd 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 adher'd to the Plant, and that that, which about the end appears sticking on the Grain, hath been alive in the Husk, having pierc'd its Cover; tho' the Hole whence it commonly issues, remains close, as to the Eye.

2. Some Years ago, I gather'd off our *English Oak*, round Worm-Husks, very like *Kermes-Berries*; and I have often observ'd 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 *Corruption* with *Ly* and *Stand*. In *May 1671*, I observ'd the same *Patellæ*, or Husks, indifferently on *Vine-Branche*s, *Cherry-Laurel*, *Rose-Bushes*, *Plumb-Trees*, and the *Cherry-Tree*. The Figure of the Husk is round, save where it cleaved to the Branch; for bigness, somewhat more than half a *Gray-Pea*: These, I say, cleave to their Branches, as *Patellæ* do to *Rocks*; for Colour, they are of a very dark *Chestnut*, extremely smooth, and shining *Membrane-like*. They adhere most commonly to the under-side 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 fasten'd to the Branches single, and sometimes many in Company. They are seldom found without *Vermin*, as *Pismires*, &c. which I guess, pierce them, and prey upon them. If you cut off dextrously 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 cleared the Husk, you rub the empty *Membrane* upon white *Paper*, it will freely and copiously tinge the *Paper* with a beautiful *Purple*, or *Murrey*.

Jan. 10, 1671, I found several of these *Patellæ Kermiformes* hatch'd 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 *Coal-black Colour*. There is a remarkable *Spot* on their *Backs*, white, or *Straw-colour*, large and round. The upper part of their *Wings* are shaded, or dark-spotted, the undermost *Pair* are clear. We may entitle them, according to our Custom, *Apeculæ Nigræ, macula super i-numeros subflavescente*

The Insect-
Husks of the
Kermes-kind,
by Dr. M.
Litter, n. 71.
p. 2165. n.
72. p. 2177.

n. 73. p. 2196.
n. 76. p. 2294.

vescente insignitæ, è patellis sive Pavis 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 compar'd 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*-Branches, and are not Excrecences 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 also are certain, *viz.*

1. That we have seen the very Gum of the *Apricock* and *Cherry-Laurel*-Trees transfused, 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 described, which are sometimes found to make these *Mites* their Food, Dr. *Johnson* having opened one Husk, with only one 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-coloured 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* enclosed in the Cotton, as also the whole Husk itself, if taken early in *April*, while soft, will

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 Mr. *Verney*, is to be understood of those Mites, and that they are to be distinguish'd from the Bee-Grubs, which are changed into the Skipping Fly; that is, the *Bee*, for Kind at least, here describ'd by us.

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 Excrecences, 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.

*Observations
on Vegetable
Excrecences
and Insects
generated in
them, by Dr.
M. Lister,
n.75.p.2256*

2. Generally, *Insect* Liggs laid upon the Leaves of Plants, their respective Worms feeding on them, do not occasion, or raise Excrecences.

n.76.p.2284

Thus, for Example, the Eggs of the common Red *Butterfly*, laid upon the *Nettle*, are thereon hatched, without blistering the Plant into an Excrecence; and the stiff-haired, or prickly *Caterpillars*, 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.

n.77.p.3003

3. Some *Insect*-Eggs laid upon the Leaves, or other Part of Plants, do as soon as hatch'd, pierce and enter within the Plant to feed. I had a convincing Instance to the Truth of this Proposition.

May 22, 1671, When I observed on the Back or Under-side 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 unhatch'd, but on many of the same Plants I found the Egg-shells or Skins yet adhering to the Leaves, and the little Maggots already enter'd, 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 Excrecences. Thus the *Heads* or *Seed-Vessels* of *Fopaver*, *Spart. Sylv. Emat.* &c. are disfigured for having *Worms* in them, and grow thrice as big as the not sciled ones. This is also plain in the Excrecences of *Pseudo-Teucrium* and *Barbarea*.

5. The Substance or Fibrous Part of many vegetable Excrecences seems not to be the Food of the *Worms* found in them; that is, the *Worms* in those vegetable Excrecences which produce *Ichneumon*s (to which kind of *Insect* we would limit this Proposition) do not seem to devour the Substance or

Vide infra,
§. XIV.

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 nourish'd in and upon some part of them) the Vegetable Excrecences still mightily increase 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 Excrecences*, 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 Excrecences seem to evince. For if you cut in pieces a *Wild Poppy-Head*, for Example (or the great and soft Balls of the *Oak*) you will find in those Partitions, wherein these Worms are lodg'd, nothing but a pithy Substance, like that of *Young Elder*; and if there chance to be any Cells yet unseiz'd, which I have sometimes observ'd, the Seeds therein will be found yet entire and ripe; whence 'tis very probable, that they feed upon, and 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*.

The Gall-
Bee, by Mr.
Ben. Allen,
n. 245. p. 375.

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*; they have long Wings, a deep Belly, and on the Back, near the Commisure to the Body, it is of a *greenish Black*, the rest reddish, near a *Cinnamon-Colour*.

These *Galls* are very gummy, and the Cavity round them was so extremely gummy, that not the least Room or Entrance of it appear'd, tho' the Bee was beginning to making its way out. Some of the *Galls* had a Stem to them, and may give some Light to the Reason of Life, that the Atmospheric Air is not necessary to the Essence, before the Organs of the Body are employ'd; but that that is maintain'd by a subtler Air, that pervades more minute Pores, as it is convey'd to Fish through the Water.

I have also found in the greyer sort of *Gall*, not so rich in Gum, a small *Ichneumon* of a bright Green.

Ichneumon-
Wasps, and
the manner of
laying their
Eggs in the
Bodies of Ca-
terpillars, by
Mr. Fran.
Willoughby,
n. 76. p. 2279.

XIV. 1. As I remember, Mr. *Lister's* Opinion is, that the *Musca Ichneumon* lay their Eggs in the Bodies of Caterpillars; which I look upon as very ingenious and true. These *Ichneumones* have all four Wings, *Antennæ*, like Bees; their Body hanging to their Breast by a slender Ligament, as in *Wasps*; most, if not all, had Stings, and are made of a Maggot, that spins herself 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 surprising to observe, that a great Caterpillar instead of being chang'd into a Butterfly, according to the usual Course of Nature, should produce sometimes one, sometimes 2 or 3, and sometimes a whole Swarm of *Ichneumones*. I have observed this Anomalous Production in a great many sorts of Caterpillars, both hairy

hairy and smooth in several 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 Spider's Eggs. But none of them feed upon the Spider's Eggs; but it is the Similitude of those *Theca*'s conglobated together to the Eggs of Spiders, that hath occasioned this 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 herself a *Theca*, and to be turned into an *Aurelia*.

I have often seen a great *Ichneumon* dragging a *Caterpillar* in the High-way. This Year, 1671, Mr. *Wray*, 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 Peach, she laid down, and then takes out a little Pellet of Earth, with which she had stopped the Mouth of the 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 herself, 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 two *Pine-Tree-Leaves*, and lays them near the Mouth of the Hole, and flies away. Not taking notice that she came any more in three or four Days, we digged 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 Flies; 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 Flies they catch, creeping backwards into the Ground, and drawing the Flies after them. I suspect they may at first lay their Eggs in the very Body of a Fly; but one Fly being not enough to bring the young one to its full growth, they feed it with more. Their *Theca*'s are at last all covered over with the Wings, Legs, and others Fragments of Flies.

2 This kind of Insect is one of the greatest Puzzles in Nature, there being few Excrecences 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 *Jacobæa 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 *Cbryfallis* 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 *Verniculo*, feeding upon the very Cakes of Spiders Eggs, before they wrought themselves *Theca's* for further Change; and they seldom 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.

n.77.p.305. Concerning the Name *Ἰχνημῶν*, 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 treated of, are, for kind, the *Ichneumones* of the Antients.

Hair-worms,
by Dr. M.
Litter, n. 832.
p. 4064.

XV. It hath been credibly reported, that Horse-hairs thrown into Water will be animated; and yet I will shew you, by an unquestionable Observation, that such things as are vulgarly thought animated Hairs, are very Insects, nourished within the Bodies of other 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:

April 2, 1672, There was thrown up out of the Ground of my Garden, a certain Cloal-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 three, in others but only one. These Particulars we carefully noted:

1. That upon the Incision, they crawled forth of themselves.
2. That putting them into Water, they lived in it many Days, and did seem to endeavour to escape, by listing 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 *Amphibæna*; but do move forward only by the Head; which is fairly distinguishable from the Tail by a notable Blackness.
4. That the three I took out of the Body of one *Beetle*, were all of a dark Hair-colour with whitish Bellies, somewhat thicker than Hogs-Bristles; but I took out of the Body of another *Beetle*, one that was much bigger than the rest, much lighter coloured, and by measure just 5 Inches and half long, whereas all the rest did not exceed 3 Inches and 3 quarters.

XVI. M. *Leeuwenhoek*, in 1673, took notice of five little Instruments, which are upon 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.

Some Observations about Bees, by Dr. George Garden, n. 175. p. 1157.

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 easy to discover what Liquor they make use of, to cause them to stick together.

On the inner side of the hinder Legs of Bees, on the Joint towards the Toe, next to that on which they carry 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.

XVII. 1. About the beginning of *May* 1670, Sir *J. Bernbard* 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 to another as to touch; in others, at some considerable distance. These Insects observe this Method in placing themselves, that sometimes they made 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 wrapped Leaves, all regularly wrought. In which I find either something alive, or Appearances of something that had died there, and is putrified: 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*,

The Generation of a sort of Bees in old Willows, by Sir Edm. King, n. 65. p. 2098.

or

or Bag, and put them in warm Places in the Sun, and they thereupon grew something bigger, but changed not Shape nor Colour, but died. The rest I kept close in a Box till the 8th 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 a 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 Opinion, that they are common Bees.

By Mr. Fr.
Willoughby
ib. p. 2106.

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 great *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* thereabouts, 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 wherever they do not lie close to one another, the intermediate Space is filled up with a Multitude of these little round Pieces, laid one upon another.

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 fore-mentioned Matter, till it grows to its full bigness, and then makes and encloses herself in a *Theca* or Husk, of a dark-red Colour, or 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 through 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.

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 Exotic Plants; such as *Blue Pipe* or *Syringe-Tree*. Here is a very strange Oeconomy of Nature yet unsolved: The furthestmost 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 it is probable that the Eggs in the Mother are all fit for laying, or all equally ripe and 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 Recompence, the Warmth of her Body, or rather the daily increasing 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 Dr. Lister,
n. 160. p. 594.

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 lie 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 lie 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 die; and then it is no Loss nor Inconvenience, tho' their Cells be perforated.

By Mr. Fr.
Willoughby.
n. 74. p. 222.

*A Strange
sort of Bees in
the West-Indies
by Mr. Villermont,
n. 172. p.
1030.
Fig. 186*

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 shaped 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 closed up as soon as the Vessel of Wax is filled with Honey; and then the Bees go to work with another Vessel.

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 liable 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 itself 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 $\frac{1}{2}$ 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 Glass, or about half a Pint, it will give you 2 or 3 Stools in about two hours time, according to the Temperament of the Party; but if you drink it at Meals, it does not purge at all.

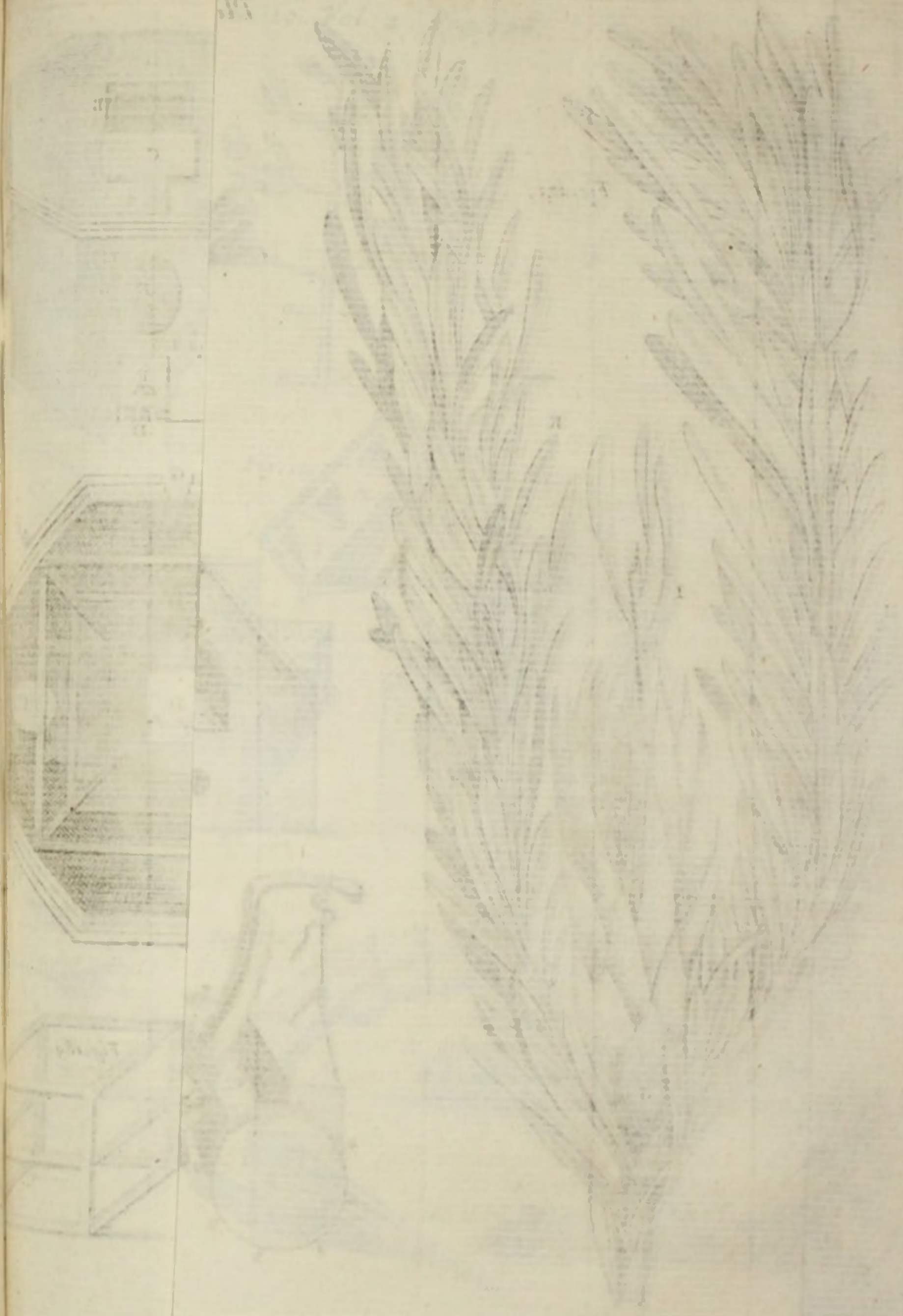
*An Early
Swarm of
Bees; by Mr.
Rich. Reed,
n. 70. p. 2128*

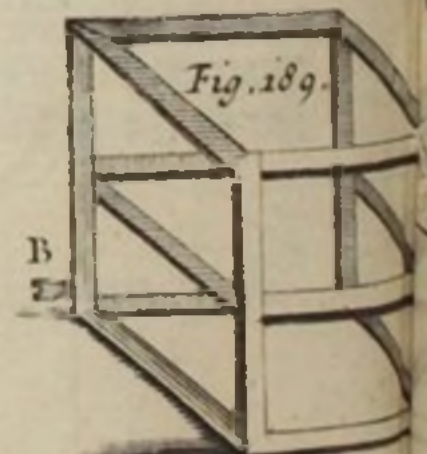
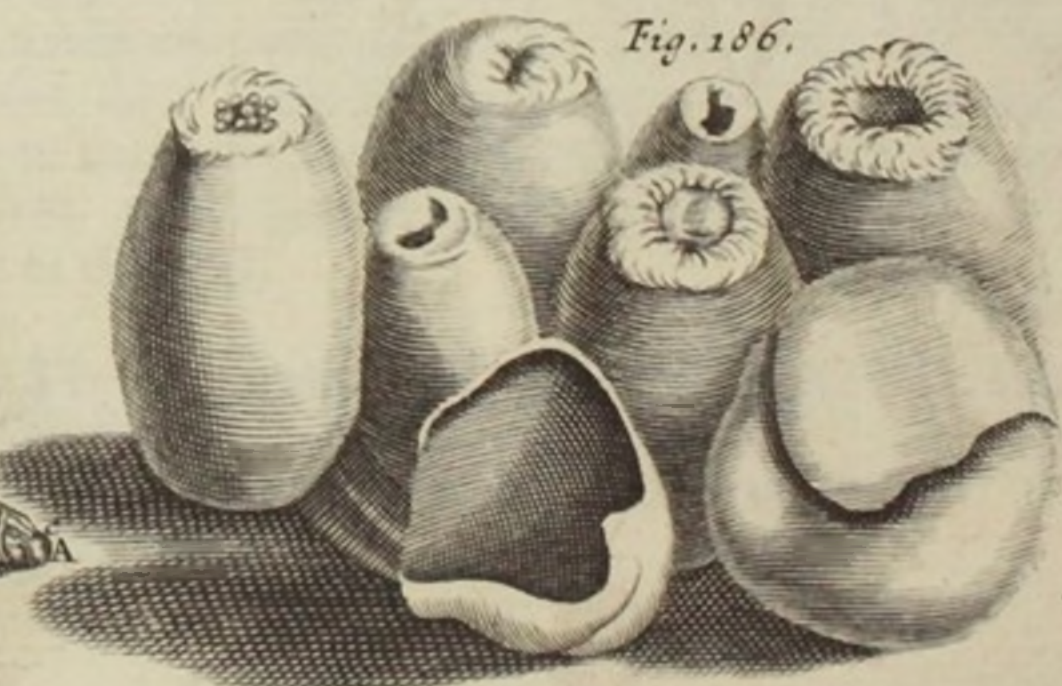
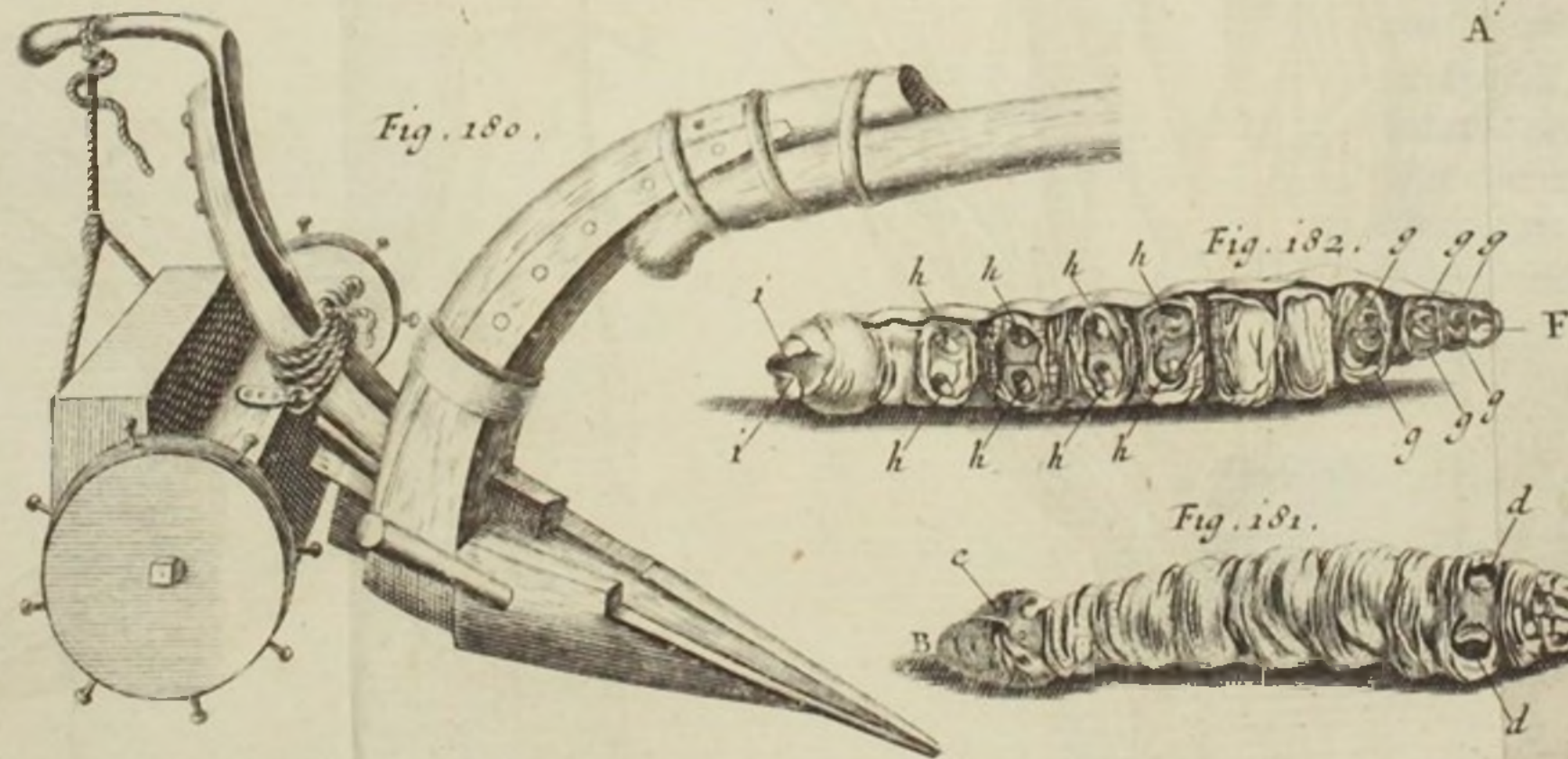
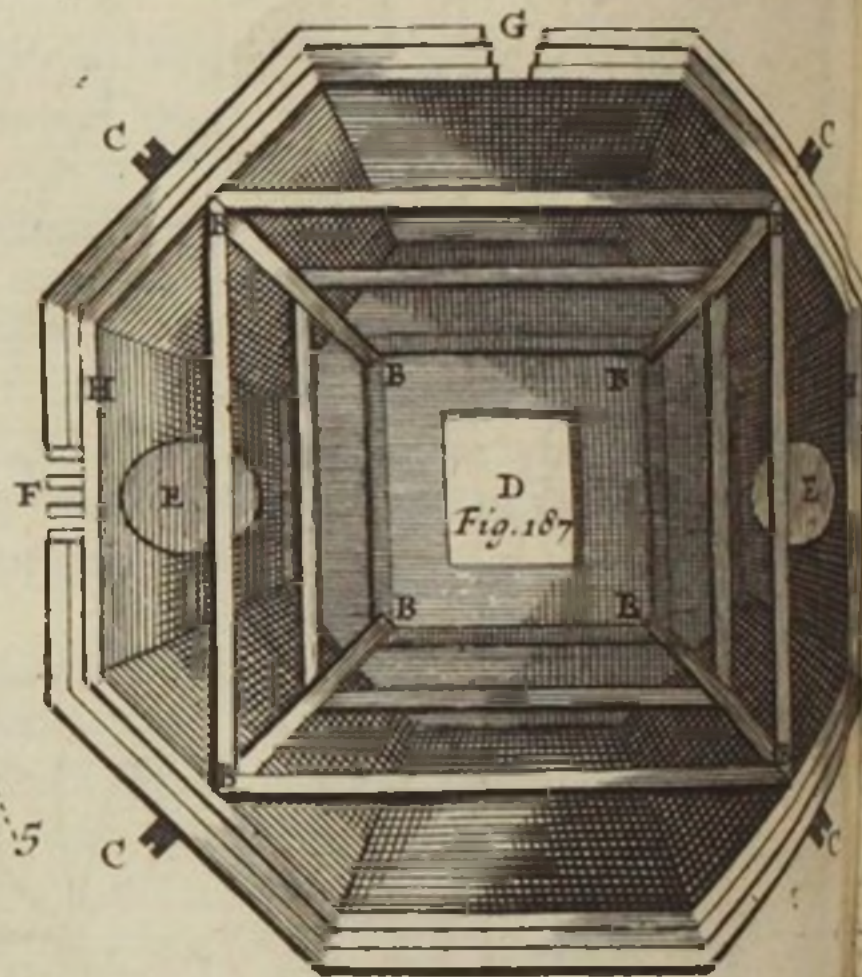
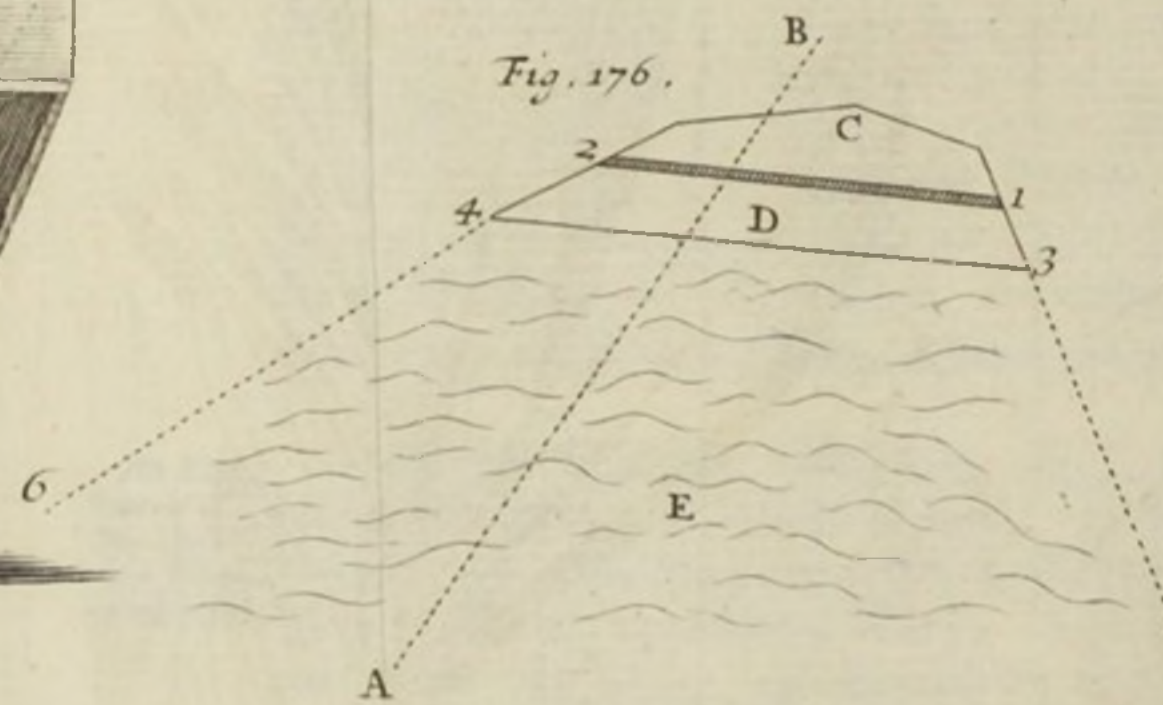
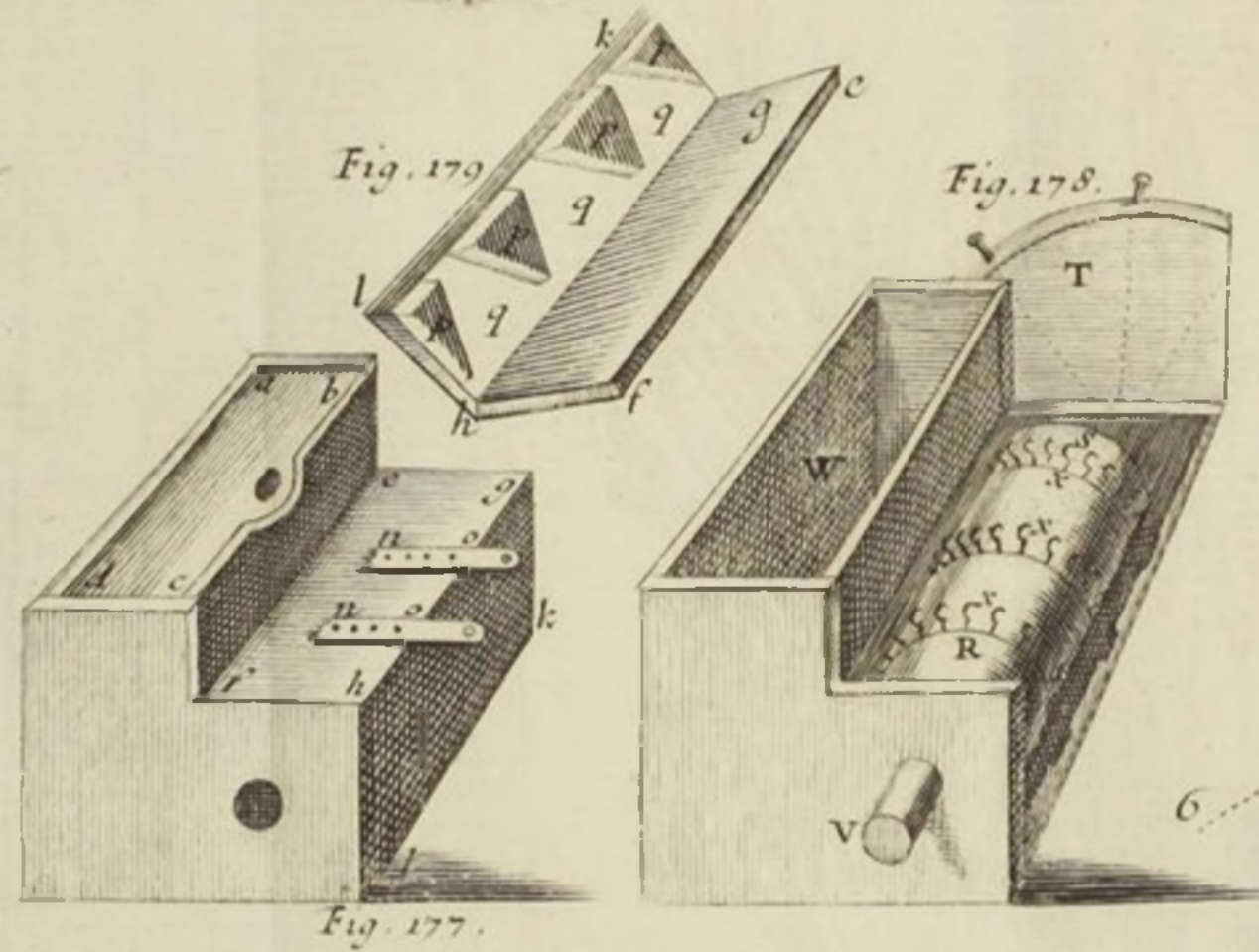
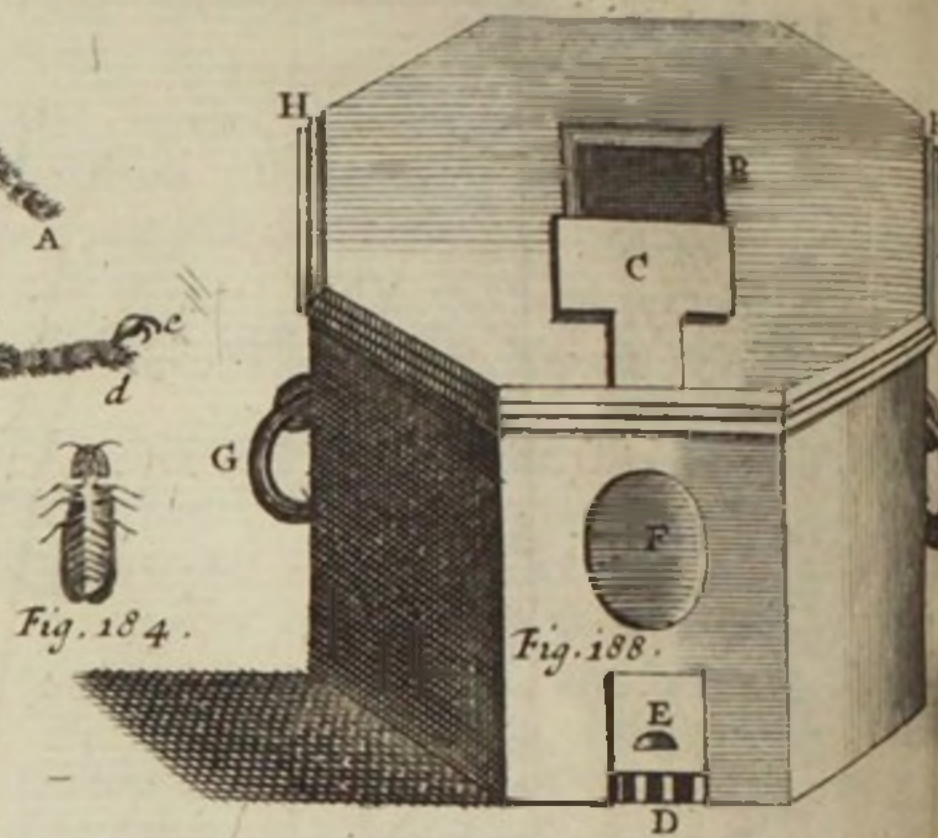
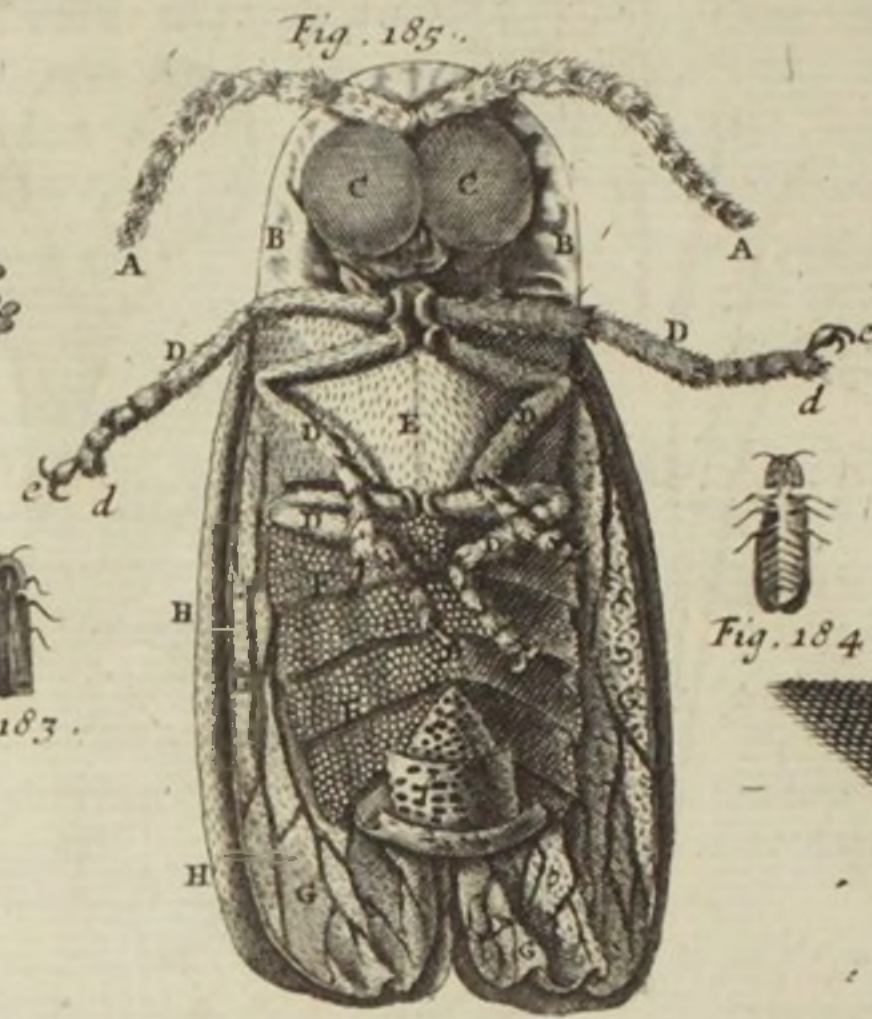
XIX. On *Thursday, March 9, 1677*, there was at the next House to mine (in *Herefordshire*) a Swarm of Bees. It was a very fair Day to entice them; but else we never have them till the Middle of *May*. I had it from the Owner, one *Parry*, now in my Work. And I enquired of him, whether they did not leave 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 sometimes studied the Regimen 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 Commonwealth, as to send part of their Company abroad to shift, before their whole Stock of Food should be consumed, to the Destruction of them all.

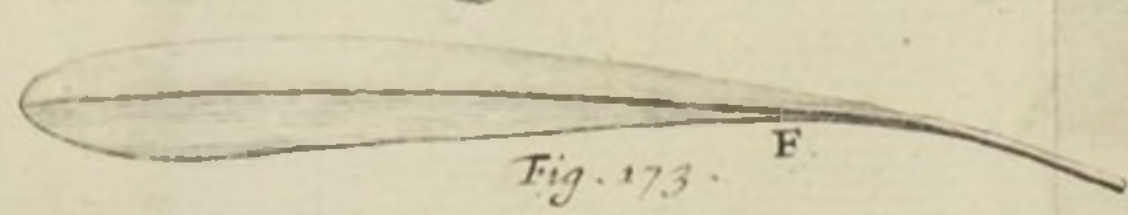
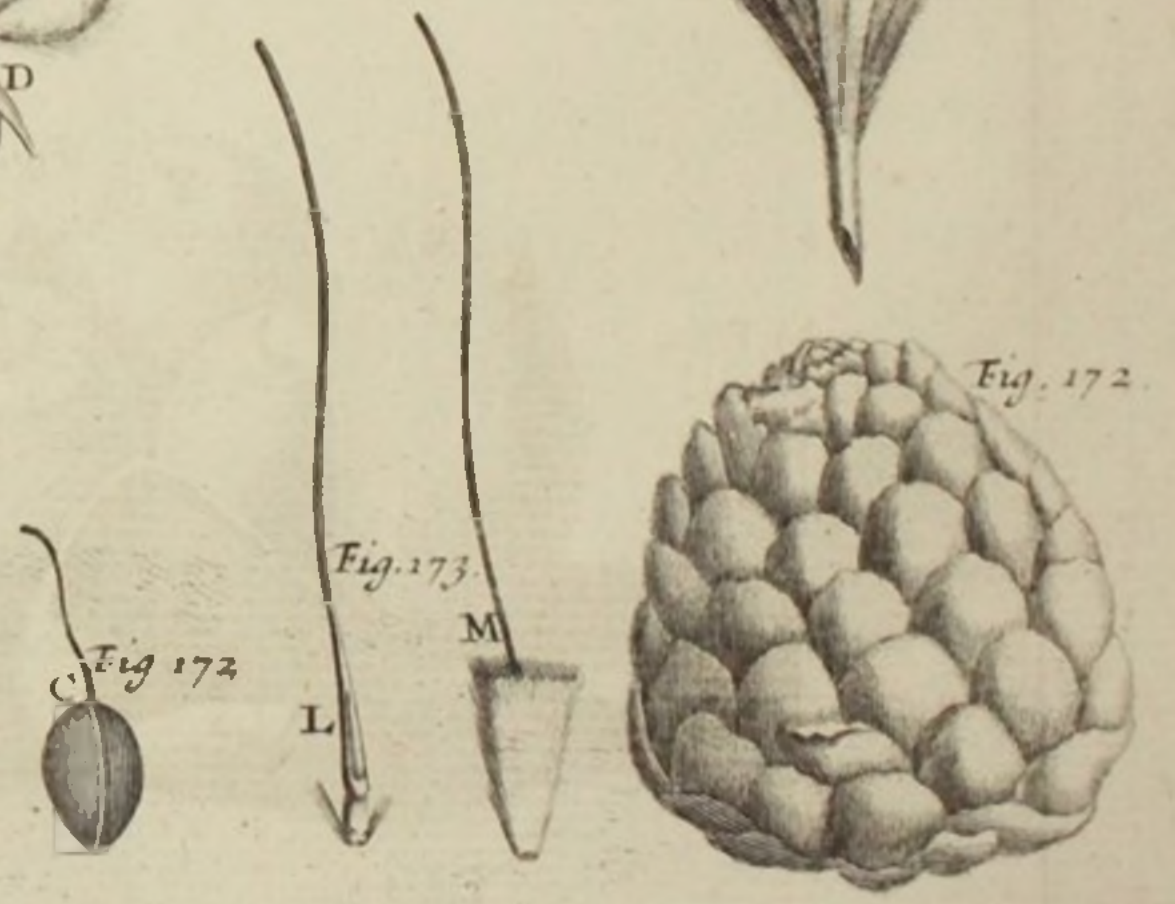
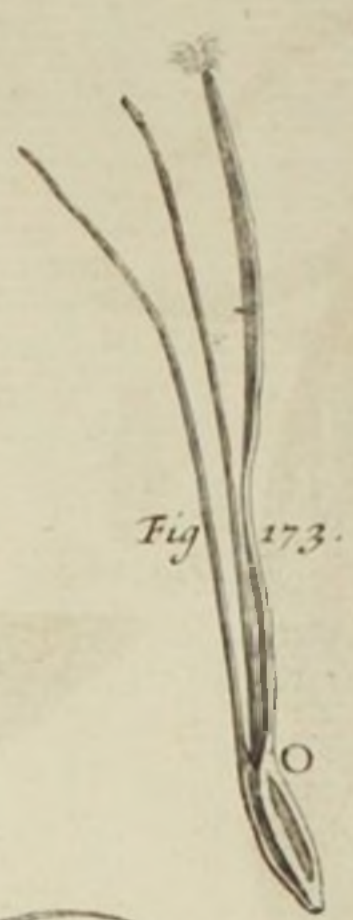
*A Bee-House
as it is in Scot-
land; by Mr.
H. Olden-
burg, n. 96.
p. 6076.*

XX. A, The *Bee-House*, lying on one Side, with the Frame placed in it.
B B B B B B B, The Frame.
C C C C, The Screw-Pins that hold the Frame fast.
D, The Square Hole at top o pen.

11







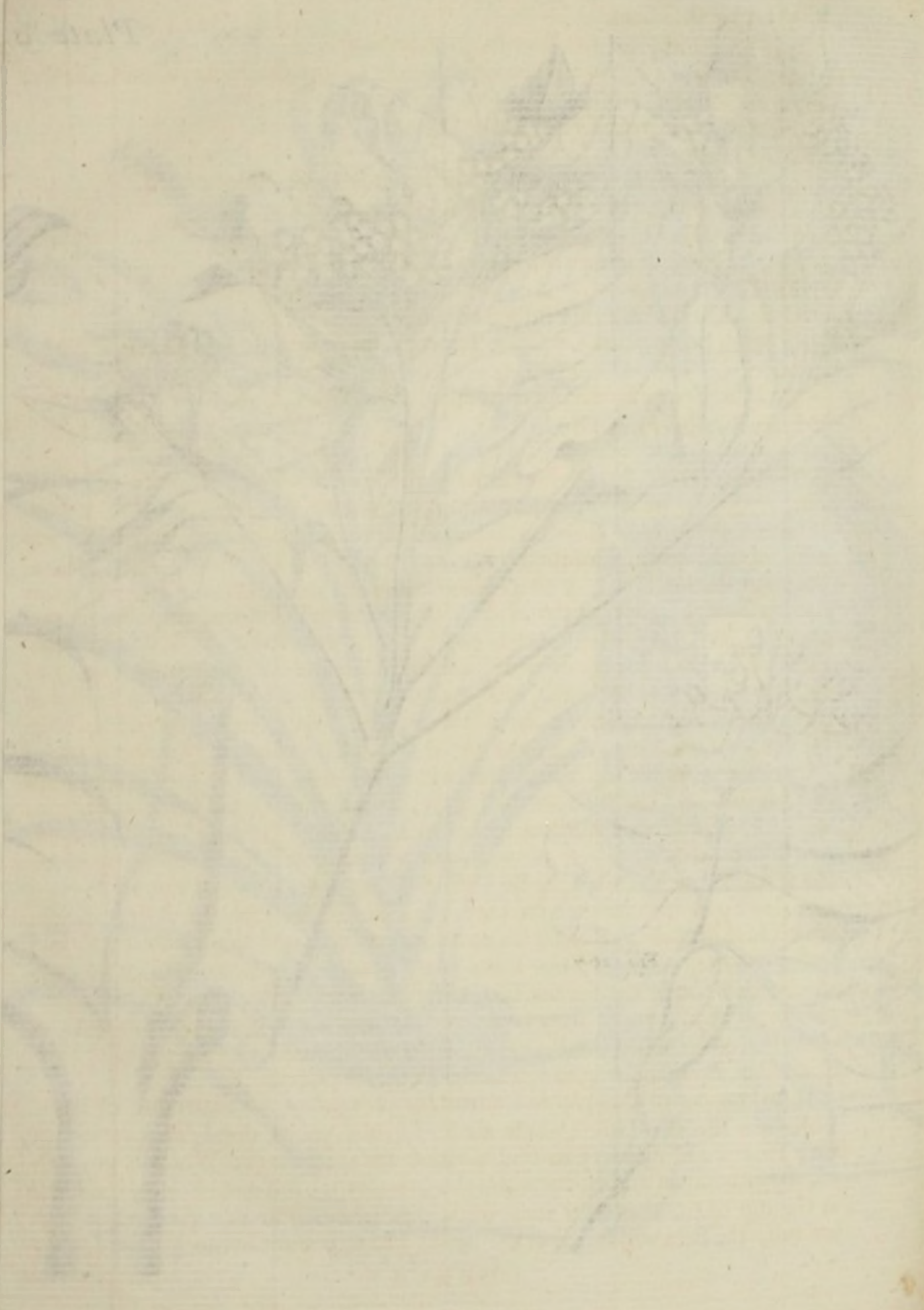


Plate 1

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-Comb asunder upon occasion. Fig. 187.

HH. The inward Crease at the bottom.

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. Fig. 188.

D. The Door for the Bees.

E. A Sliding Shutter that covers the Door in Winter.

F. The Window.

G G. The Handles for lifting all.

HH. The outward Crease at the top, for fastening one Bee-house over another.

A. The Frame for the Bees to fasten their Work upon.

B B. The Screw-Nails. Fig. 189.

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, five Inches long, and about four Inches broad, with a *Shutter* that slides to and fro in a Groove about half an Inch longer than the Hole. It hath two 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 three or four Holes about half an Inch wide, and as high, with a Shutter that slides in a Groove to cover them in Winter. It hath 2 Iron Handles with Joints, 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, half an Inch in depth on the outside, and one Inch and half high; and another on the inside at bottom, which serves to fix them when set upon one another. It hath also a Hole about two 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 Four Posts joined at top, at bottom, and in the middle, with Four Sticks for the Bees to fasten their Work upon: Which, tho' they may serve, yet it may be securer to have Two 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 be all in the lowest House; and then to get the Honey

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 Bees-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.

Swarms of
Locusts in
Wales, by
Mr. Edw.
Floyd, n.
208. p. 45.

XXI. I am informed that great Swarms of Locusts have lately appeared in *Wales*. They were first seen about the 20th of *October*, 1693, scattered about the Fields in *Marbery-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 bigness, 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.

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 Ichthyocolla adinstar Pellucidis, Reticulatis Maculis confersis*. It is in length (from the Head to the tips of the Wings) three Inches and a quarter, 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 *Antennae* are about the bigness of a *Hog's Bristle*, and curiously *Genuiculated*. The first pair of Legs are not quite an Inch long; the Second somewhat above that length; but the Third two Inches and a quarter. 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 two orders of small sharp Prickles, placed not opposite to each other, but alternately. The Wings are about three Inches long, resembling very much those of the larger *Libelle*, or *Dragon-flies*, but all over garnished (the outer Wings at least) with reticulated black Spots.

Plin. Lib. xi.
c. 19. Jul.
Obsequens
in Lib. Pro-
dipiorum,
Moufett.

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.

XXII. I find in a *MS. History of Pembrokeſhire* (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 three 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 *Mean-Clochog* above *Hynnon Dhewi* or *Pbynnon 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 white like Tallow. And after they had continued there three Weeks, there reſorted thither an infinite Number of *Sea-Maws* and Crows, as if all of many Countries had been ſummoned thither, who in a few Days conſumed them all. Alſo Swine fed upon theſe *Worms* eagerly, and waxed very fat.

Green
Worms in
Wales; by
M. Edw.
Floyd, n.
108. p. 45.

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 *Hedford*, a Place belonging to Sir *George St. George*, Bart. 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 is the manner of Bees when they ſwarm. In this poſture, or lying ſtill and cover'd 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 Sunſet, 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 darkned the Air for the ſpace of two or three Miles ſquare.

Swarms of
Beetles in
Ireland; by
Dr. Tho.
Moigneux,
n. 234. p. 741

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 irksome; 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 loathsome 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 check'd several ways; high Winds, wet and misting Weather destroyed many Millions of them in one Day's 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 them of Motion, if not deprive them of Life.

During these unfavourable Seasons of Weather, the Swine and Poultry of the Country watched under the Trees for their falling, and eat them up in abundance, being much pleas'd with the Food, and thriving well upon the Diet. Nay, I have been assur'd, that the poorer sort of the *Native Irish* (the Country then labouring under a Scarcity of Provision) 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

their

their Gardens 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 difappeared, that in a few Days you fhould 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 diftant Country and warmer Climate. But the true Reason of their difappearing, I take to be, that after their Coition is over (for 'tis about this time they are feen to couple by faftening to one another by their Tails) they retire under Ground, in order to lay their Spawn there, for a fucceeding Generation ; and likewise to compofe and fettle themfelves to fleep for the reft of the enfuing Year, as feveral other Animals are known to do ; for Instance, *Snails* among Infefts, the *Hedge-Hog* among the BeafTs ; and I have good Reason to think, the *Ortygometra*, or *Rail*, among the Birds. And what confirms me in this Opinion concerning thefe Infefts, is, that I am certainly informed by feveral good Hands, that in the Spring-time, by accidental Digging and Ploughing up the Ground, great Hollows or Nests of them are frequently difcovered and broken up, where they find whole Bushels together in one heap, but in fuch a quiet Condition, they feem to have but little Life and Motion ; for they do not ftir, unlefs you touch or difturb them, and then move but little and feebly, as if they had been afleep, and were awaken'd out of it. Thefe large Caverns, to which they retire, are often met with under a firm, folid, Surface of Earth, that has not been ftirred or ploughed in many Years before ; and no manifelt Passage can be difcovered how they got there.

In the Summer (1695 or 96) all along the South-Weft Coaft of the County of *Galloway*, for fome Miles together, there were found dead on the Shoar fuch infinite Multitudes of this Vermin, and in fuch vaft Heaps, that by a moderate Estimate, one computed there could not be lefs than forty or fifty Horfe-Loads in all. Thefe, as I take it, were a new Colony, or fupernumerary Swarm, from the fame place whence the firft 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 infefted with this Infeft, and that lies very open and expofed to all thefe Parts of *Ireland*, and from whence *England* heretofore has been pefter'd in the fame manner with Swarms of this Vermin. But thefe meeting, by good Fortune, with a contrary Wind before they could reach Land, their Progrefs was ftopt, and tired with their Voyage, they were all driven into the Sea, which by the Motion of its Waves and Tides caft their floating Bodies in heaps upon the Shore. And this was a moft lucky Accident ; for had this fecond Supply arrived, they would have exceedingly increafed the Numbers of thofe which are already very troublefome to us.

Manfett de
Infeft. p. 160.

It is obferved, that they feldom keep above a Year together in a Place ; and they compute their ufual Stages, or March, to be about fix Miles in a Year. Hitherto they have directed their Progrefs Wefterly ; following the Courfe of that Wind which blows moft commonly in that Country.

And

And this last Year, 1696, they reached as far as the *Sbannon*, and some of the scattered loose Parties cross the River, and got into the Province of *Leinster*; but they were met there by a stronger Army of *Jack-Daws*, 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*.

Hist. Anim.
Aldrovand.
de Insect.
l. 4.

Wherever the Country has been infested with this Vermin, with one Consent, though erroneously, they have given them the Names of *Locusts*. But the true *Locust*, much resembling in Shape a common *Grashopper*, tho' larger, is quite a different sort of Insect from this, which belongs to that Tribe, call'd by the Naturalists, *Κολεόπτερος*, *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 *History of Animals*, *Μελολάδου*, from its devouring the Blossoms of *Apple-trees*; and is the *Scarabeus Arboreus* of *Moufett* and *Charleton*; called by the *English*, *Dorrs* or *Hedge-Chafers*. They are much of the bigness of the common black Beetle, but of a brownish Colour, something like that of *Cinnamon*; they are thickly bespersioned with a fine, short, downy Hair, that shews as if they were powder'd 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 Joints of each side of their Belly, appear much whiter than the rest. They are exactly figured by *Dr. Lister*, *Scarab. Tab. Mut.*

I am fully convinced that this Insect is the self-same to which the *Septuagint*, and the *Vulgar Latin Translation* retaining the *Greek Word*, give the Name *Βρῦχος*, or *Bruchus*, derived from *Βρῦχω Freno vel Strideo*, intimating the remarkable Noise it makes both in its eating and flying. It is often mentioned in Holy Scripture, *Levit. xi. 12. Joel i. 4. and ii. 25. Nabum iii. 16, 17.* But I find our *English Version* almost constantly translates this Word *Βρῦχος*, 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 *Βρῦχος*, *Nabum iii. 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 ariseth 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 *Βρῦχος*, better translated *Locust* or *Beetle*, in that odd Clause of the *Jewish Law*, *Lev. xi. 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 human Nourishment, *Beetles*, and those 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 Expe-

rience

rience of what has happened among ourselves, I cannot but admire the sagacious Prudence of that Divine Lawgiver. 'Tis certain, *Palestine, Arabia, Ægypt*, and the other Neighbouring Countries about them, were all extremely 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 Βρῦχο, 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 *Ægyptians* 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 *Ægyptians* 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 nocendam venerabantur, eamque variis Templis exstructis colebant*; says *Valerius Maximus*, L. 2. c. 5.

XXIV. I was amazed to see that the Genitals of the Beetle, as to the Vessels of the Testicles, agree exactly with those of the human Testicle, and consist of only one very slender, long, hollow Rope, prodigiously tortuous, and (which I have not yet seen in Men) with a blind Beginning or Apex.

The Vasa testicularia of a Beetle; by Dr. Swammerdam, n. 94. p. 6041, 6042.

I have therefore thought it proper to transmit a Figure of them to you, in which are chiefly represented not only the Testicles composed of one Rope, two Feet and six Inches long, but likewise the Vasa Deferentia, spewing out Plenty of white Semen, when they are pricked; likewise six very beautiful Vesicles, or rather Seminal Glands; as also the Ducts of the Seminal Glands stretched, containing a yellowish Seminal Liquor, in the same Manner as is observed both in Men and Brutes.

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 *Stag'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 itself 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.

A Musk scented Insect, feeding upon Henbane, by Dr. M. Lister, n. 72. p. 2176.

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 *Henbane*: I therefore in my private Notes, intitule it *Cimex Ruber, Maculis nigris distinctis, 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 aromack and agreeable; and therefore we may expect, that that dreadful *Narcosis*, so eminent in this Plant, may likewise be usefully tempered in this Insect.

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 sometimes 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 *Paper*, 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; *Cochineal* scarce excepted, when assisted with Oil of *Vitriol*.

Other Musk-scented Insects; by Mr. J. Ray, n. 74 p. 2220.

XXVII. 1. I have seen two sorts of Insects which smell of Musk. The one is like the common *Capricornus*, or *Goat-Chaser*, 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.

By Dr. M. Lister, n. 76. p. 2280.

2. The two Insects mentioned by Mr. Ray, smell of Musk to an high Degree. The small Bees are very frequent in the Woods 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 improper

proper 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 scentless.

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-Chaser*, or *sweet Beetle*, out of Season as to that Smell. Perhaps it might be at the time of the *Coit*: Forasmuch 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 *Brailetto-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.

The Cochineel-Fly; by n. 40. p. 796.

There grows a Berry (by report) both in *Bermudas* and *New-England*, called the *Summer-Island Reed-Weed*; which Berry is as red as the *Prickle-Pear*, giving much the like Tincture; out of which Berry come out first Worms, which afterwards turn into Flies, somewhat bigger than the *Cochineel Fly*, feeding on the same Berry; in which we read there hath been found a Colour, no whit inferior to that of the *Cochineel-Fly*; and as to Medicinal Virtue, 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 (do this in the Sun, or in a proportionable Heat:) or if dried, 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 Mass, and put it into an earthen or wooden Vessel, covered with some Straw, or something else of that Nature, that it lie not too close, and so proportion the quantity to the Vessel, that the Air may come about, and into the Mass, 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 *Concrete*, but durable, and somewhat more advanced.

To generate other Flies, for like use.

And as for Berries, stamp and boil them, evaporating them to the Consistence of a *Rob*, and then use them as the former.

Lastly, for Woods, infuse them in Water, being first pulveriz'd, and boil out their Tincture, and then evaporate 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 dried and kept.

By — n.
191. p. 509.

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 becomes 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 unto the Heat of the Sun until they are dry, and their Bodies shrivelled up, which being rubbed 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, wherein the Reflection of the Sun will dry them sooner.

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.

Figures of
the *Cochineel-Fly*, by
Dr. Tyson,
n. 176. p.

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 the Microscope.

1202.
The Death-Watch, by
Mr Ben. Allen,
n. 245.
p. 376.

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 Minute's distinct beating, would forbear for the other to answer.

The

The Part it bears with, is the extreme Edge of the Face; which I may call the upper Lip, the Mouth being protracted by this bony Part, and lying underneath out of View.

It was $\frac{5}{16}$ 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 *Macule* Fig. 194. are designed for the greyish Spots. 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 covered 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 Bars of the Helmet greyish. Two *Antennae* 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.

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 transversely descending towards the Nose. These Eyes were not moveable, but contiguous to the Face, without any Cavity to receive them; and they were very opaque. The *Antennae* 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 depressed Places. Under this Lip are visible four *Forcipes*, two of each side, to lay hold on its Food. Fig. 195.

XXX. 1. I have observed, that that sort of Flies which *Mouffet* calls *Musca-Lupus*, and some others, (as the *Tabani*, *Afili*, &c.) that have but 2 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 unsteady, nor can they, though 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.

2. Dr. *Hook* has observed these *Penaculums*, and described them in his *Micrographia*, *Obs.* 38. p. 273.

The *Musca-Lupus* in Virginia, by Mr. J. Banister, n. 198. p. 690.

A Note by ib. p. 692.

A viviparous Fly; by Dr. M. Lister n. 72. p. 217. n. 160. p. 595

Lib. I. de In.

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 *Oestrum-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 checquered 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, and 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 kind of Worms eating out Stone, by M. de la Veye. n. 18. p. 321.

XXXII. 1. In a great and very antient Wall of Free-stone, in the Benedictines 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.

These Worms are inclosed in a Shell, which is greyish, and of the Bigness of a Barley-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, thro' which they put out their Heads, they 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 three quarters of a Line large. They are distinguished into several Plyes, and near their Head they have three Feet on each side, which have but two Joints, resembling those of a *Louse*. 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 four kinds of Jaw-bones, lying cross-wise, which they move continually, opening and shutting them like a pair of Compasses with four 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; 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 ten Eyes, very black and round; which appear to be bigger than a Pin's Head; they have five of them on each side of the Head, standing as in the Figure.

Fig. 196.

2. I have also found, that *Mortar* is also eaten by an infinite Number of small Creatures, of the bigness of *Cheese-mites*; these have but two Eyes, and are blackish; they have four 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 of 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 eight Days alive. Without a very good Microscope, and a great deal of Attention, 'tis difficult to see them well.

Another sort eating Mortar, ib. p. 322.

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 turned; all which I believe to be little Animals petrified.

XXXIII. The *Scolopendra*, which is by *Bruerus* ascribed to *Muffet*, in the latter part of his Chapter *de Julis*, p. 202, I saw in the Cloysters of *Trinity-College* in *Cambridge*, 12 or 13 Years ago.

A Scolopendra, by Mr. J. Ray, n. 74. p. 222.

XXXIV. These Insects appear to Sight, in nothing different from the common sort of *Grashoppers*; 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 four 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 three hours they devoured 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 struck 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 fifty 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 lie not above a Finger's breadth in the Earth; and we took of them 118 Quintals, being 9 Tuns. Since their Hatchings, they have taken above 15 Tuns of the young *Grashoppers*, which are not yet bigger than Flies: And there are yet a Multitude

A Swarm of flying Grashoppers in Languedoc, by — communicated by Mr. Justel, n. 182. p. 147.

Vid. supra §. 21, 22, 23.

itude 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.

*The Genera-
tion of Fleas,
by S Diacin-
éto Cestone,
n. 249. p. 42.*

XXXV. *Fleas* bring forth Eggs (or a sort of *Nits*;) 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 and other Animals infested with them; or in Places where they sleep, which being round and smooth, slip ordinarily streight to the Ground, or fix themselves on the Plyes, or other Inequalities of the Coverlets and Cloaths. From these are brought forth white Worms of a shining Pear-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 roll 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 soul'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, altho' 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 streight leaps away.

Fig. 199. Represents the Eggs. *Fig. 200.* The Worm. *Fig. 201.* The Bag. *Fig. 202.* The Flea. But all magnified by the *Microscope*.

*The Emmet
or Ant; by
Sir Edmund
King, n. 23.
p. 425.*

XXXVI. There have occurred to my Observation but three sorts of *Ants*, commonly without Wings; viz. very black, dark-brown and *Philemors*. 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 sensible of the strangeness of the Place they are in, that there they will not meddle with the red; but as if they were frightened, 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 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 Bird's 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 lie in Multitudes upon this (if I may so call it) Spawn of theirs: And after a little time every one of these small Adherences 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 having 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) are not so.

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 furnish'd 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 Creatures, 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 those 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 Ant's 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 called 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 Crumbs 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 ten in the Morning until five or six in the 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.

*The Acid
Juice of Pil-
mires, by Mr.
J. Wray, n.
68. p. 2003.*

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 through 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 Oil 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 Colours of the Flowers in the least.

“ This Observation holds true, not only in *Cichory-flowers*, but also *Lark-Spur*, *Borage*, and all others of a Blue-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.

“ A

“ 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 *Viridi Æris*; 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 a *Repetition*, a *Crocus*
 “ *Martis*. Take *Saccharum Saturni* thus made, and distil it, and it will af-
 “ ford the same Acid Spirit again, which the *Saccharum Saturni* made with
 “ Vinegar will not do; but returns an inflammable Oil with Water, and no-
 “ thing that is *Acid*. *Saccharum Saturni* made with *viridi Æris*, 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 we ever 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 blue 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 itself with the interior 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.

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 with dangerous *Forcipes*. The Body of this *Julus* being bruised, strikes the Nostrils exceeding fiercely.

Another Insect yielding an acid Juice, by Dr. M. Lister, ib. p. 2067.

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 distinguish'd from all, at least, that I have seen.) Those without Wings, were of a Light-yellow, or Flaxen, and being broken at one's Nostrils they emitted, like others, an acid or sovre Scent, but those of the same Bank with Wings, were Coal-Black, and those bruised and smelt to, emitted a fragrant Smell like Musk, And an Apothecary in *York*, famous for his Diligence in Chymical Operations,

Musk-scented Ants, by Dr. Lister, n. 77. p. 300. Vid. supra §. XXVI. & XXVII.

did compare them (unseen and not yet made known to him) to an Excellent *Balsam*, he is wont to prepare.

*A Table of
SPIDERS
found in
England, by
Dr. M. Lister,
n. 72.
p. 2175.*

Of Spiders.

They either *send forth Threads*; such as are those who either *weave* to catch their Prey;

or make the *round Nets*, and are in Number IX.

1. *The Yellowish-Spider*, with the Belly a little pointed and crooked.
2. *The Red-Spider*, or *Cross-bearer*, having on each Side at the upper Part of the Belly a kind of prominent Tubercle.
3. *The Ash-coloured Spider*, having the Figure of the Buttock divided into five Parts, almost separated from one another, and very full.
4. *The Yellowish-Spider*, of a leafy Colour, and marked in the Buttocks with four white Spots.
5. *The Blackish-Spider*, with the Buttocks painted like the Leaf of an Oak.
6. *The Greenish-gelded Spider*, with a long slender Belly.
7. *The Ash-coloured Spider of the Woods*, with the Belly pointed, or three-square.
8. *The Green-Spider*, with the Tail marked above with *black Spots*, and the Anus of a *Saffron-Colour*.
9. *The Black Cross-Bearer Spider*, with a full Belly.
Or the *Globular Nets*, N. IV.
10. *The Variegated Spider*, with a globular Belly;
11. *The Red-Spider*, having the Top of its round Buttocks radiated like a Star.
12. *The Black House-Spider*.
13. *The Least Ash-coloured Spider*, marked with a *black Spot* upon the Top of the Hips.
Or *Webs, or Sheets*, N. VIII.
14. *The Yellowish-Spider*, hairy, with long Feet, and of the Domestic Kind.
15. *The Blackish-Spider*, with a large Spot on the Top of its Buttocks, which is striped. This too is Domestic.
16. *The Sooty-Spider of Craven*, shining remarkably, and having its Tail bifurcated.
17. *The Yellowish-Spider*, marked in the Buttocks with a Train of four-square *blackish Spots*, and having oblique *Yellowish-Streaks* on the Sides of each Buttock.
18. *The greatest Ash-coloured Spider*, with a bifurcated Tail.
19. *The Black or Chesnut-coloured Spider*, smooth, and its Buttocks here and there very bright.
20. *The Ash-coloured Spider*, soft, and having a pretty broad *blackish-red Spot* upon its Belly, which is marked with oblique Streaks.
21. *The Spider* for the most Part *livid*, without any particular Spots or Streaks upon its Belly, and therefore it does not weave (unless the

the throwing out of Threads and its Flight refer to that ;) though it can upon Occasion, viz. Webs to preserve its Fetus, or against the Winter ; but they hunt the Flies openly ; and they are either, *The Lupi*, N. V. And these with all the former have eight Eyes.

22. *The Reddish-Spider*, little, and very swift.

23. *The Crab-like Spider*, with Eyes of a Violet, Purplish Colour, and slow.

24. *The Ash-coloured Spider*, with the Belly streaked in a wavey manner, remarkably tall, and peaked.

25. *The Brown-Spider*, with the Belly obliquely streaked.

26. *The Black-Spider*, Inhabitant of the Woods.

Or *The Phalangia*, or *jumping-Spiders*, N. III. These have only six Eyes.

27. *The Ash-coloured Spider*, variegated with a Silver-Colour and Black.

28. *The Yellowish-Spider*, with Eyes resembling an *Emerald* ; and having three small Saffron-coloured Streaks along the Buttocks.

29. *The Reddish-Spider of Craven*, or the Spider of the Heath, or of the Rocks.

Or such as send out no Thread at all, as are most of those which have very long and slender Legs ; and these have only two Eyes, and Claws upon their fore Legs. N. IV.

30. *The Red-Spider*, untufted, living in Troops.

31. *The Ash-coloured Spider*, tufted.

32. *The variegated black and white Spider*, exceeding small, and living in the Woods.

33. *The Saffron-coloured Spider*, as I think it is commonly called, in England, a *Tant*.

XL. 1. I have discover'd, that all *Spiders* that spin 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 wondred 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.

Spiders darting their Threads into the Air, and swimming in it, by Dr. Lister, n. 50. p. 1014.

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 sort 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 ;

sage; there being often 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; whereas when they first flew up, the Thread was still single, or but little tangled, 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-feet 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 *Christmas* 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 Autumn's 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.

By Dr. Hulse, n. 65. p. 2105. 2. I have seen *Spiders* shoot their Webs three Yards long before they begin to sail; and then they will, as it were, fly away incredibly swift. Which *Phenomenon* 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 still 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.

Fig. 205. 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 winged, 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 Tails 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,

creep, they elther 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.

3. I had the first Notice of this Darting of *Spiders*, from Dr. *Hulse*, which was not long after communicated to me by Mr. *Lister*; nor is it any great Wonder, that inquisitive Persons, applying themselves to observe, and consider the same Subjects, should make the same Discoveries.

By Mr. J.
Wray, ib.

4. Mr. *Lister* 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 the Darting of *Spiders*?

By — ib.
p. 2104.

Whence it appears, that this Observation is as well Mr. *Lister*'s as Dr. *Hulse*'s.

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 *Sbeaf* 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 forcibly 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 jointed, 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
Webs.

By Dr. Li-
ster, n. 160.
p. 192.

Webs 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.

*The Inven-
tiveness of
Spiders and
Toads, by
Dr. Nath.
Fairfax, n.
22. p. 392.*

XLII. S. *Redi* having affirm'd, that Creatures reputed *venomous* are indeed no *Poisons* when swallowed, 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 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 tho' a *Toad* be not Poison to us in the whole, yet it may invenom 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 bruised *Toad* chanced to light upon his Lips, whereupon they swell'd, each to the thickness of about two Thumbs; and he neglecting to use what might be proper to restore them, they have continued in that mis-shapen size ever since.

*Spiders tinge
Water of a
Sky-colour,
by Dr. Fair-
fax, n. 12.*

p. 219.

*The Anatomy
of a Rattle-
Snake, by
Dr. Edw.
Tyson, n.
144. p. 25.*

XLII. Mr. *Nath. Fairfax* relates that a *Spider* bruised into a small Glass of Water, tinged it somewhat of a Sky-colour; and he is informed, that a Dozen of them being put in, they would dye it almost a full Azure.

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*.

It was four or five Inches long, the Girth of the Body in the largest Place, which was the Middle, was six and a half Inches; the Girth about the Neck three Inches, near the *Rattle* two Inches, the Head flat on the top as in the *Viper*, and by the Protuberance of the *Maxilla*, 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 two 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 a quarter of an Inch Diameter: There was a large Scale jetting over the Eye, which seemed to serve as a *Palpebra* for defending it from any thing falling on it; but I could not perceive 'twas capable of closing, though inwards it seem'd to have a *Membrana Nictitans*, which moves 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 *Parsnip-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 four larger and more remarkable: Those on the Back were of a dark *Feuilmort*, 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 rising 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 numbered 168; beyond the *Anus* were two half Scales, thence nineteen whole Scales of a black Lead-Colour, with yellowish Edges; from thence to the *Rattle*, six Orders or Rows of smaller Scales of the same Colour. The Scales of the Belly were joined to each other by distinct Muscles; the lower Tendon of each Muscle being inserted upon 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 side was appropriated a Rib, whose Point did join 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 tho' it covers the whole Body, yet by its frequent Jointings it admits of all Motions.

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.

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 joined 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 *Trachea* or Wind-pipe was twenty 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 *Trachea*, near the Beginning were $\frac{3}{4}$ of an Inch, but towards the End half

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.

Fig. 205.

The Lungs begin from the Throat, and run down three 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 *Vesiculae*, or Cells, like the Lungs of a *Frog*; but from the frequent Branchings and Checquer 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 five Inches and a half; a little lower, for the space of four Inches, the Cells gradually disappeared, so that they seemed at last to form only a Reticular *Compages* of *Valvulae conniventes* on the inside of the Membrane of the Lungs, and the Compass of the greatest Place here, was about six Inches and half; but from thence to the end of the Lungs, was only a large Bladder, without any Cells, composed of a thin, but a strong transparent Membrane, the Compass of which, blown as the former, was eight Inches and a half.

Fig. 205.

The Lungs of the *Salamandra Aquatica*, and some other Animals, are only two large Bladders; in the *Frog*, *Crocodile*, &c. are two large Lobes, fill'd with *membranous Vesiculae*, or Cells. Our *Rattle-snake*, and all that Family, tho' they have but one Lobe of Lungs, yet in that they comprise the two former sorts; the fore Part being filled with numerous *Vesiculae*, the latter an entire large Bladder.

In the *Land Tortoise* there are two Lobes, one on each side; but these are sub-divided 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 lowest Part of the Body. But what I would remark is, that where the *Bronchiae* first enter these Sub-divisions, '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 Vitae*, in these large 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 in 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 two large Bladders, not unlikely for this Reason, that it might not be forced so often to raise itself 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 died, it expired, and they

they

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 four Months at least had eaten nothing, so that altho' 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 Oil, or otherwise, they are strait suffocated, and die 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 Extention as these were. The whole length of the *Oesophagus* was two Foot three Inches and half; the length of the proper Stomach five 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 half an 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 Gut, I observed abundance of *Lumbrici Tertes*, which is a Disease *Vipers* likewise are subject to. I take the swelling 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 it 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 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 itself; 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 convoluted, 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 useless, 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. k. The Heart was placed near the bottom of the *Trachea*, on the Right side of it. The Length of it was one Inch and half, its Figure rather flat than round; encompassed with a *Pericardium*, and the Article larger than the Heart

Fig. 205. l. itself. It hath but one *Ventricle*, the Valves small and fleshy, and the inside of the *Ventricle* distinguish'd by four or five cross Furrows. Why *Charas* should make the Heart of the *Viper* to have two Ventricles, I see no reason: I should

Fig. 205. m m. 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. 255. oo. 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 two 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

Fig. 205. p. red, and its use, no doubt, for the separating the Gall that was contained in a Bladder seated at some Distance below it. This *Gall-Bladder* was two 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 Taste 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 itself into the Intestine, is evident enough. It arises from the top of

Fig. 205. d. the Bladder; so gently descending, passes thro' that part which *Charas* takes for the *Pancreas*, by which the Ancients call'd the *Spleen*, and so enters the beginning of the larger Intestine. In *Vipers* indeed, the Colour of this Part, and Situation so near the *Intestine* seems an Argument for *Charas* his Conjecture; but here its 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 Ancients. 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.

The Fat, which was very plentiful, is said to be used by the Physicians of *Mexico* with good Success in the *Sciatica*, and all Pains of the Limbs, and for discussing Preternatural Tumours. The Membrane it adhered to I take for the *Omentum*, which encompassed all Parts contained in this lower Belly; and

and was joined to both sides of the Ribs, so running to the *Rectum*, and forming a Bag that enveloped 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 *Diaphragm*.

The two Kidneys which lay to the Back on each side of the *Spine*, but not *Fig. 206.* very firmly conjoined, were about seven Inches long, that on the right side something longer than the left, and about half an Inch broad each: And though 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 twenty-five, 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 *n n n*, the other, where the *Vas deferens* runs, but is not here represented, and from these arise several lesser Branches, *o o o* at set Branches, 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 *p p p* 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 *Q Q* shews the large Blood-Vessel, whence arise the *Emulgents*, *r r r*, which spreading themselves very thick into the Bodies *s s s*, make them appear all bloody; between which for a little Space, there appears a small Body of the *white Secretory Vessels*, *t t t*. 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.

The *Ureters* did run almost the Length of the Kidneys, being a com- *Fig. 208. u u u.* mon Trunk that received the lesser Branches, that went to each single Gland, and did terminate near each other in the *Cloaca*, making a Rising 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.

Fig. 200. mm 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 crass, 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 Snake* emits a far greater *Fetor* (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 dried 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 *Lion* I dissected, the Liquor contained in the Scent-Bags was in the Opinion of all that smelt it, much like that of Oil of *Anise*, or *Fennel-Seed*; which was almost the only Difference I could find between the *Lion* and a *Cat*; for in a *Cat* this Liquor is ill scented.

Fig. 206. bb The *Testes* are very unproportionate in length, the Right being two Inches and a quarter long, the Left one Inch and a quarter long, scarce so big in Compass as a Goose-Quill. 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 Preparantia*

Fig. 206. ii had nothing uncommon: But the *Deferentia* were remarkable; for though they did run in a streight 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 *Testes* is but a *Congeries* of curiously convoluted Vessels which terminate in the *Epididymis*, whose Continuation makes the *Deferens*. And where its *Convolution*s are many upon the Body of the *Testes* itself, there the *Deferens* is an even *Ductus*: But as in our Subject it making no such Body there,

there, or but a very small one, in its Passage downwards it was every where crimped, and about the middle of the Kidneys often convoluted. 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 *Vesiculae Seminales* or *Prostates* here to receive them. Fig. 207. ●

There were four *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 fastned 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 three quarters of an Inch long, of a red Colour, but the whole, as protruded, was above an Inch long. When protruded, I found they could be easily 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 need 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 Differentia*, 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 four *Penes*, when the Female has but two *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 entred the *Pudendum*, they must needs lock them in, and retain them there, till such times as the parts being tired and subsiding, have leave to retreat. For in Animals they have no *Vesiculae 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 beforehand stored up in the *Vesiculae*, 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 *Vesiculae* Fig. 206. † †

Vesiculae 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 forcibly 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 Female, and so by this means, tho' its *Penis* be very short, yet be able to perform a *Cottus*. *Cats, Lions, &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 Shrieks and hideous Yowlings. Therefore in our *Rattle-Snake*, (where, as we have observed, there are no *Vesiculae*, 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 although 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.

Fig. 209. g. The Head was but small, yet the *Rectus* was very large. The Tongue in all respects like that of a *Viper*, was composed of two long round Bodies, contiguous and joined together from the Root two thirds 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.

Fig. 209. i. For if it were conjoined 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.

Fig. 209. f. Over the Tongue did lie the *Larynx*; not formed with that Variety of *Cartilages* as is usual in other Animals, but so as not to make a Ruin or Slit, for Receiving or Conveying out the Air. Nor was there any *Epiglottis* for preventing

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.

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 Poisonous 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 *Molares*. Of the first sort of Teeth, in the lower Jaw there are two Rows on each side; five in a Row, the inward lesser than the outward, so that there are here twenty in all. In the upper Jaw are but sixteen, five on each side placed backwards, and six 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 Lion or a Cat does its Claw. 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 six or seven, 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 Gum; for then we did perceive that the Poison did readily arise through the hollow of the Teeth, and issued out of the Slit.

This Poisonous Liquor I observed to be of a Water-colour lightly tinged Yellow. What the Poison of *Serpents* is, and how it produces its dire Effects, has been of late contested between *S. Redi* and *M. Charas*. 'Tis *Redi's* Opinion, that the yellow Liquor contained in the *Vesicles* of the Gums of *Vipers*, is the only and true Seat of the Poison; that this Juice is not Venomous, 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 dried. But *M. Charas* wholly opposes this, and asserts, that the Poison is no where but in her enraged 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

Fig. 209. ccb

Fig. 209. dd

Fig. 210. b.

Fig. 211. b.

Fig. 210. g.

Fig. 210. f.

than Nourishment; for if so, by giving them so large a Vent the 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 Poison? 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 Poison 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 Poison, and the difference of them; and that this Practice is common with them. Having therefore pulled 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 called *Cobras de Cabelo*, which was lesser, and enlarges much upon the greatness of its Poison; and to shew them in part an Instance of it, grasping it about the Neck, he expresses out some of the Liquor in the Bags of the Gums about the quantity, as he thought of half a Grain, and this he puts to the Coagulated Blood on his Thigh; which as soon as mixt with it, streight put into a great Fermentation, and Working like *Barm*, 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 Poison acts, and confirms the known Observation, that the biting of a *Viper* will cause the *Yellow Jaundice*. A present Antidote for this Poison is said to be the Snake-Stone; *Pierre de Cobras de Cabelo*, 'tis called by the *Portuguese*, and is famous all over the *Indies*; 'tis described by *Garcias 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 Physician 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 Symptoms violently returning, he had recourse to his Antidote, and then suffered it to continue there till it fell off it self, and

Vide infra
XLVIII.

and so was cured. One Trial 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 Joint 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 joined to them ; as forwards over the Nostrils were two small Bones, to which were fastened the *Cartilages* or rather Bones, which divided the Nose. The other Bones seemed admirably contrived for the great Extension, and widening of the *Maxille* : 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 joined to the Bone that receives the Poisonous 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 conjoins it to the *Cranium*. This Articulation seems advantageous, both for the Motion of the Fangs, which lie 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 *Maxille* backwards to the *Cranium* by two 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 conjoined 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 two 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 conjoined. 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 piece in the lower. But this upper Jaw, towards the *Poisonous Fang*, divided into two Bones ; one was fastened to the Bone of the

Fig. 210. a.

Fig. 210. c. d.

Fig. 209. b.

Fig. 210. e. f.

Fig. 210. g. h.

Fig. 210. i. j.

Fig. 210. k. l.

Fig. 220. ii.

Poisonous Fang outwards; the other, which received the small Teeth, was inserted into some Bone more inwards.

The *Vertebrae*, according to the whole Figure of the Body, were smallest towards both Extreams, 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, twenty-nine more in Number than the Scales.

Fig. 212. ab. The former *Vertebrae* had a flat upright Spine towards the Back; and a slender round Oblique descending one inwards to the Belly. To each *Ver-*

Fig. 212. c. d. *tebrae*, 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, was the round Ball in the lower part

Fig. 212. e. of the upper *Vertebrae*, which enters a Socket of the upper part of the lower *Vertebrae* like as the *Head* of the *Os Femoris* does the *Acetabulum* of the *Os Ischii*; by which Contrivance, as also the Articulation with one another, they have that free Motion of Winding their Bodies any ways. The Ribs in the Neck were small, but larger towards the middle

Fig. 213. bb of the Body, where they were about two 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 *Vertebrae* of the Tail inwards there were two Spines: Whereas in the other *Vertebrae* there was but one; as likewise there were here Transverse slender *Processus*'s something Analogous to Ribs.

Fig. 11, 12. To the last *Vertebrae* of the Tail was fastened the Rattle; in our Subject there was but five, but some others seemed to be broken off. That next the Tail was of a Lead-Colour; the others, of a Cineritious. '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 *Animai*, *ut illius Sonitu admonitus quilibet Homo non solum, sed & quaecunque pecus, vel jumentum, tempestive 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 sixteen Years; for so many Joints there are observed in some in our Repository; I have been told, in some there have been above twenty. These are placed with their broadest part Perpendicular to the Body, not *Horizontal*. And the First is fastened to the last *Vertebrae* of the Tail by means of a thick *Muscle* under it; and by the Membranes that conjoin it to the Skin.

Mus. R. S.
p. 51.

Explication
of the Fi-
gures, de-
signed by Mr.
Rich. Wal-
ter, ib. p. 55.

Fig. 205. Represents the upper part of the Body opened. *a a e.* The *Apera Arteria*. *B.* The upper part of the Lungs, which is *Vesiculous*. *c c c c c.* The lower part of the Lungs, which makes a large Bladder. *d.* The First Swelling of the *Oesophagus*, or False Stomach. *e e e.* 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*. *m m m.* Three Arteries, whereof there are two Ascending, and one Descending. *n n n.* Three large Veins, whereof two are Descending, and the third Ascending;

Ascending; which last does seem to divide the Liver into two Lobes. *o o.* the Liver. *p.* the Gall-Bladder. *q.* the Spleen, as 'tis call'd by the Antients; but by *Charas*, the *Pancreas*. *r r r.* a large Blood-Vessel that runs in the midst of the Scales of the Belly. *s s.* the *Muscles* belonging to the Scales of the Belly.

Fig. 206. The Parts contained in the lower part of the Body. *a a a.* The *Intestines*; *b.* the Gall-Bladder; *c.* the *Ductus Biliaris*, that passes through the middle of the *Spleen*, or as called by *Charas*, the *Pancreas*, and enters the large Gut; *d.* the *Spleen*, or *Pancreas*; *e e.* the *Intestines*, which were very large and winding, but short; *f f.* the *Rectum*; *g.* the *Anus* *h h.* the *Testes*; *i i i i.* the *Vasa Deferentia*; *k k.* the *Penes* on each side, which first at the Root are conjoined, and are thick beset with Bristles; *ll.* the *Muscles* that serve for drawing in the *Penes*; *m m.* the Scent-Baggs; *n n.* a large Blood-Vessel that runs on one side of the Left-Kidney; *o o.* the *Emulgents* that arise from the same; *p p p.* the *Secretory Vessels*; *Q Q.* the large Blood-Vessels of the Right Kidney; *r r r.* the *Emulgents* arising from it; *s s s.* a round Body of Blood-Vessels; *t t t.* *Secretory Vessels*; *u u.* the *Ureters*.

Fig. 207. The *Penes* of one side of a Viper. *a.* the *Vas Deferens*, 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*. *a a a a.* the *Arteria Aspera*, divided in the middle; *b b b.* some larger Branches of Blood-Vessels; *c c c.* 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 'tis thought to be for Hearing; *c c.* the small Teeth in the upper Jaw; *d d.* the large Fangs, or Poisonous Teeth; *e e e.* the Place where the Bladders of Poison lie; *f.* *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 *Scull*. *a.* The *Cranium*, without any Sutures; *b b.* the Orbits of the Eyes; *c c.* two small Bones over the Nose; *d.* the Gristly or rather Bony *Sepimentum* of the Nose; *e e.* a small Bone, that lies between the *Cranium* and that Bone in which is fixed the Poisonous Fang; *f f.* a Cavity in that Bone, to which is fastened the Poisonous Fang, whose outward Orifice is represented in Fig. 209. by the Letter *b.* and is thought to be the Ear; *g.* the large Poisonous Fang, which is fastened to the Ear-Bone; *h.* the other Poisonous Teeth, which are not fixt in the Bone, but to *Muscles*; *i i.* the upper *Maxilla*, which contains the small Teeth; *k k.* one side of the lower *Maxilla*, with its double Row of Teeth, which in the middle seems to be joined by a Suture; *l.* the distance at the *Mentum*, between the two sides of the lower *Maxilla*, or Jaw; *m m.* where the two *Maxilla* are joined together backwards, and by a Tendon are fastened to another Bone, which from its use, and for Distinction's sake, we call *Dilatores Maxillarum*; *n n.* the *Dilatores* of the Jaws; *o o.* a short Bone which joins the *Dilators* to the *Scull*, or *Cranium*; *p.* the *Vertebra* of the Neck.

Fig.

Fig. 211. The Poisonous Teeth.

Fig. 212. One of the *Vertebrae* of the Back. *a*. The outward Spine, of the *Vertebrae*, which is flat long ways; *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 Ribs; *e*. a round Ball, like the Head of the *Os Femoris*, which enters a Socket of the lower *Vertebrae*, as that does the *Acetabulum* of the *Os Ischii*.

Fig. 213. One of the *Vertebrae* of the Tail. *a*. The Spine towards the Back; *b b*. the two inward Spines; *c c*. the Transverse Spines Analogous to Ribs.

Fig. 214. The *Vertebrae* of the Tail, and the Muscous 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 three Joints: The first and largest appears when Conjoined with others, the two other serve for the fastening on the succeeding Rattles, and are covered by them.

Fig. 216. The Five Rattles as joined together.

*Away of
killing Rat-
tle-Snakes;
By Capt. Si-
las Taylor,
n. 3. p. 43.*

XLIV. The *Wild-Penny-Royal* or *Dittany* of *Virginia*, groweth straight up about one Foot high, with the Leaves like *Penny-Royal*, with little Blue Tufts at the joining 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 tied them in the Cleft of a long Stick, we held them to the Nose of the Rattle-Snake, who by turning and wriggling labour'd 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.

*The Brooding
of Snakes
and Vipers;
by —, n. 8. p.
138.*

XLV. There is this Difference between the Brooding of Snakes and Vipers; the Snakes lay their Eggs in Dunghils, 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 lie upon their Eggs, as Hens sit upon theirs.

*Experiments
made with
Vipers; By
Mr. Thomas
Plate, n. 87.
p. 5060.*

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 Publick Market for a couple of Pigeons, to be sure of having some that were not prevented by any Antidote. The Pigeons being

ing 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 serve 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 died in less than three or four 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 languish'd half a quarter of an Hour.

The next Morning six 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 *Viper* were not merely 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 five or six 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 Doctor took three 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 Yellow Juice to dawb two of those Stalks; which being thus moistened with that Liquor, were both put into the Breasts of two 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 no longer than the other two. In a word, the two first died within four or five 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 thrusting the Teeth of a Dead *Viper's* Head into another Pigeon, that had before got down one

of these Heads into his Belly. The Conclusion was, that both died, the Cock within a quarter of an Hour, and the Pigeon in less than four Minutes.

Some few Days after, Dr. *Francini* repeated the same Experiments, by causing two Pigeons to be bit by a *Viper's* Head that had been dead above ten Hours; they both died, one in six Minutes, and the other in eight. And with another *Viper's* Head he Poisoned a Chicken, which died in ten 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* being taken, four Chickens were bit by it one after another. The two first, either because the Liquor did not penetrate into the Wound, or the Blood expell'd it, appeared not to have any Distemper; the fourth looked as if it would die presently, but a little after, coming to himself, he got clear off for that time; but the third, 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 four 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 ghastly, 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 the next Morning; only her Respiration was yet weaker, and she appear'd just a drawing to her end. It was observ'd 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 surpris'd at Night by a Distemper, which in all likelihood proceeded from the Poison; for next Morning one of the Capons and Pullet were found Dead.

The Symptoms attending the Bite of a Serpent, By Mr. Azz. Goodyear. n. 245. p. 351.

XLVII. Mr. *Rob. Burdet*, an *English Merchant* at *Aleppo*, on the 4th of Oct. 1678, was bit by a *Serpent* on the left Wrist, near the Pulse towards his Hand. It seemed 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



Fig. 205.

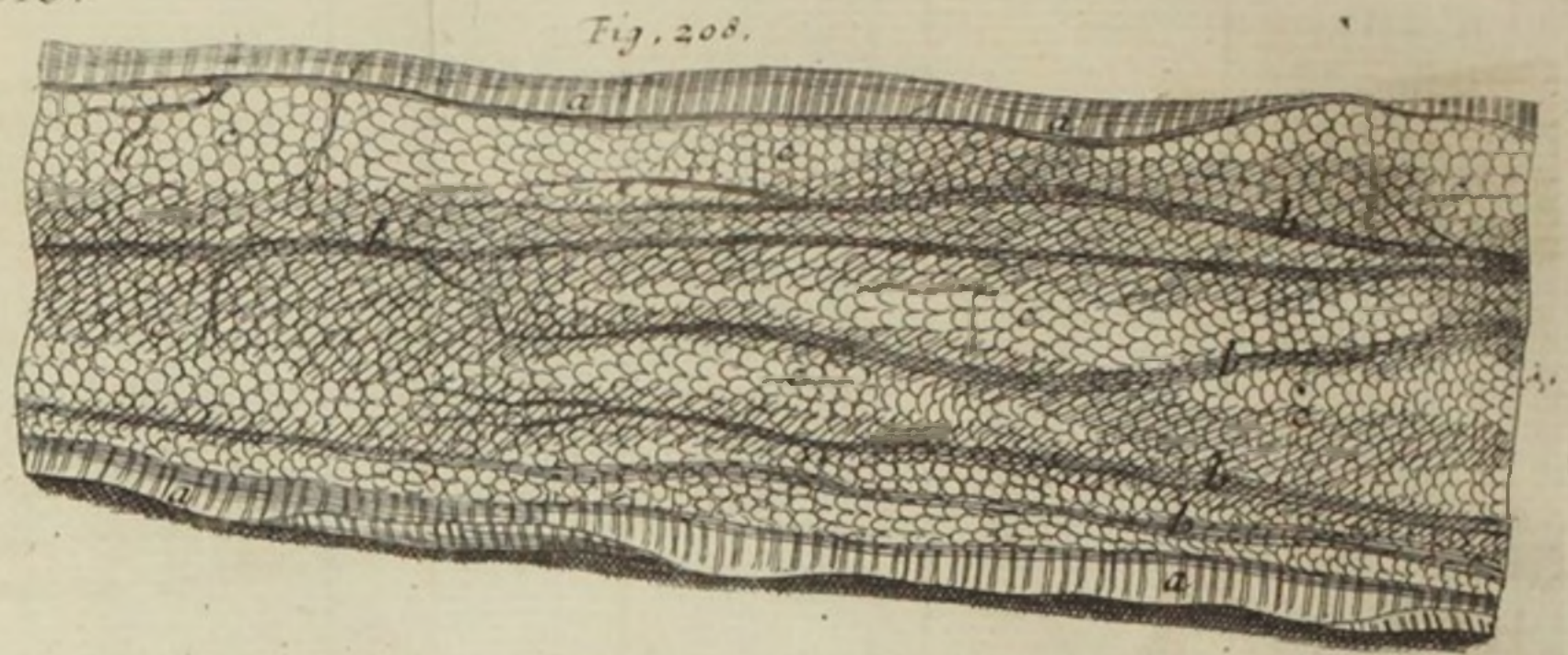


Fig. 208.

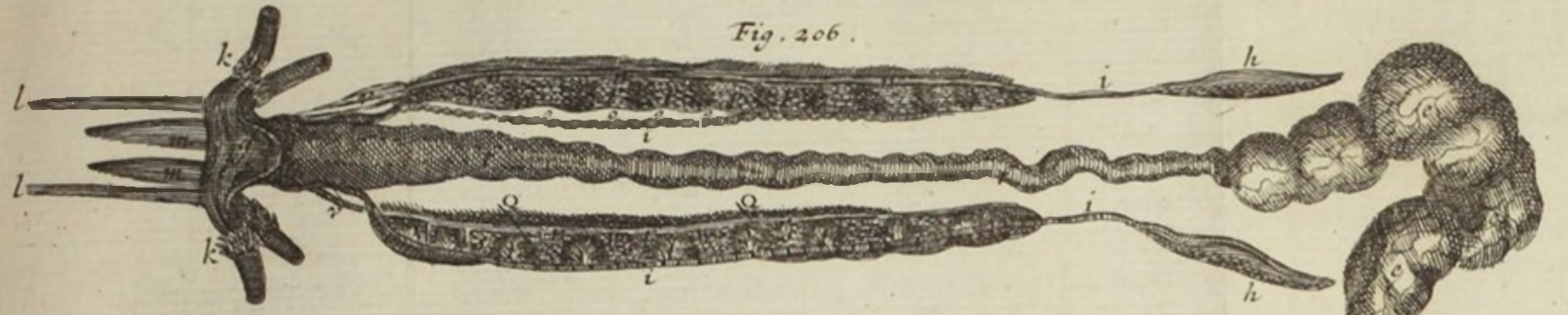


Fig. 206.

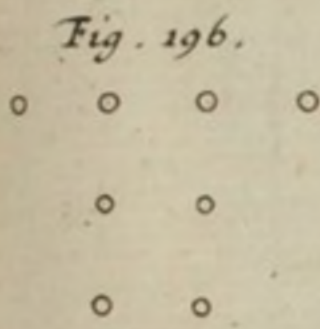


Fig. 196.

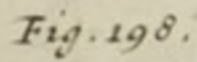


Fig. 198.



Fig. 207.



Fig. 195.

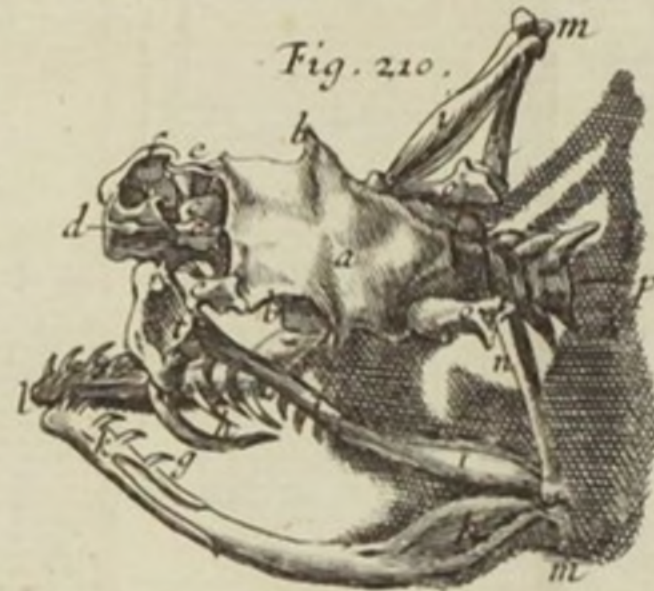


Fig. 210.



Fig. 209.



Fig. 190.



Fig. 200.

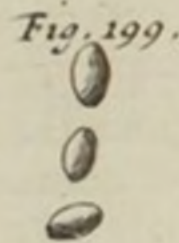


Fig. 199.



Fig. 202.

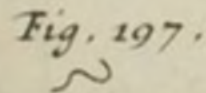


Fig. 197.



Fig. 201.

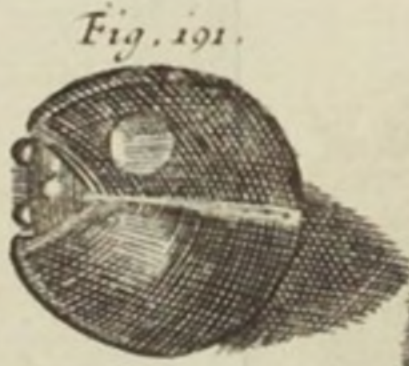


Fig. 191.



Fig. 192.



Fig. 193.



Fig. 195.



Fig. 212.

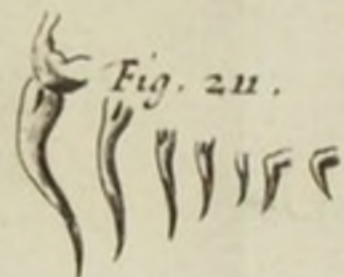


Fig. 211.



Fig. 216.



Fig. 215.



Fig. 214.

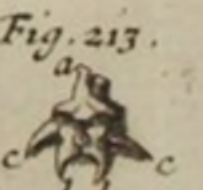


Fig. 213.



Fig. 194.

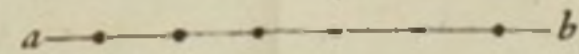


Fig. 204.

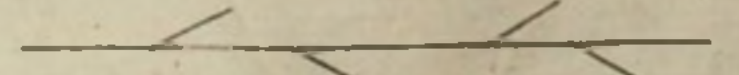
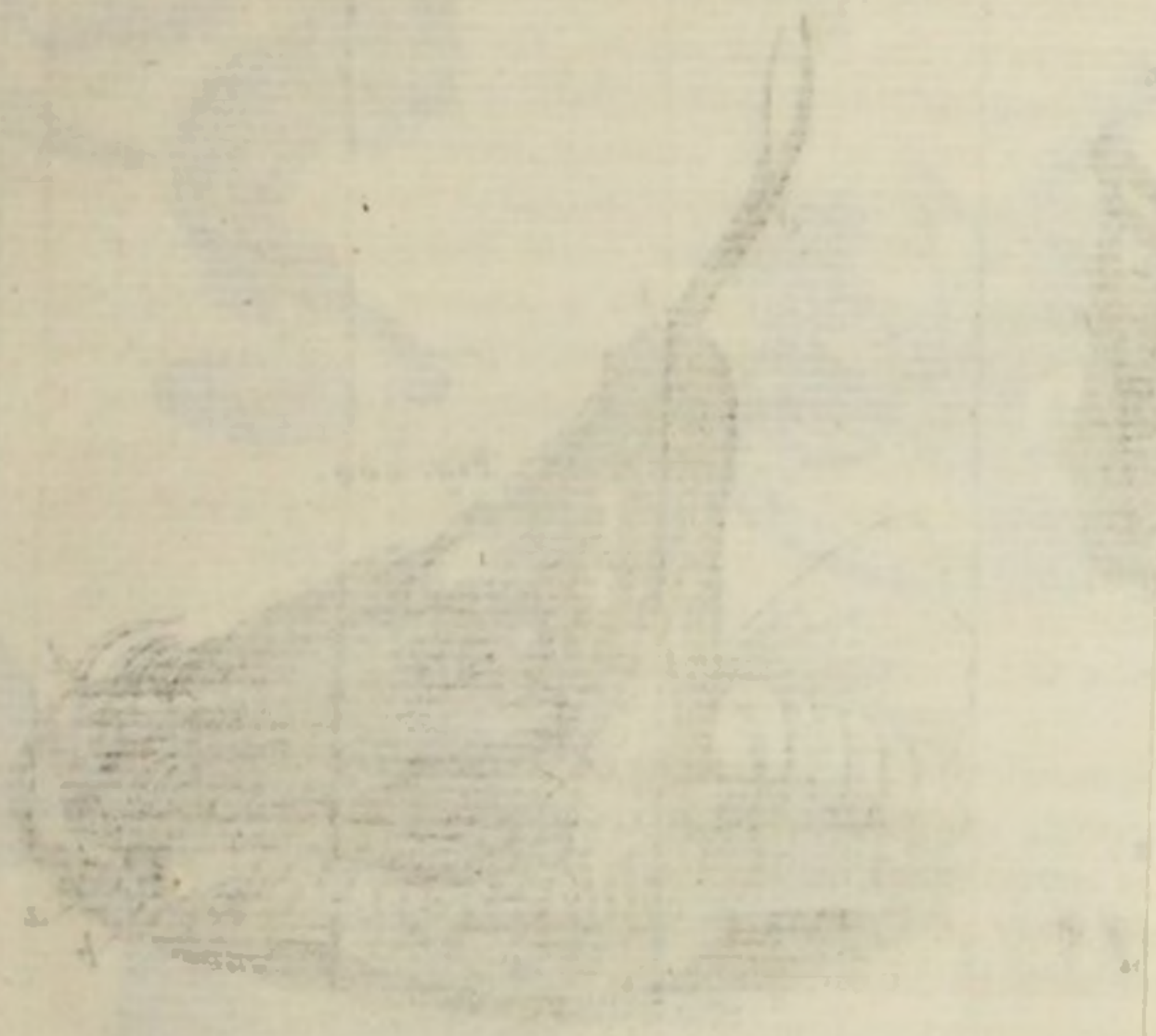
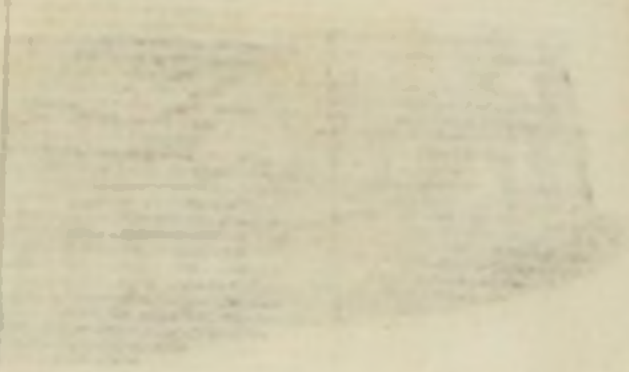
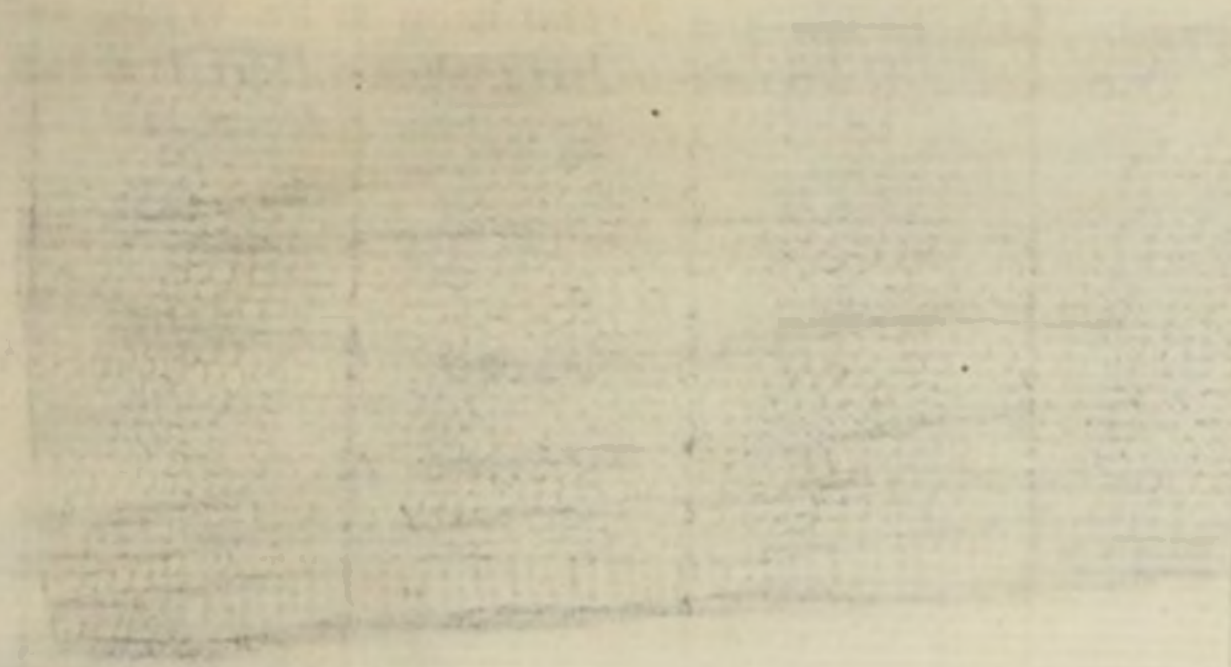


Fig. 203.



100
100
100
100
100



was bit, about two Miles from Home, and 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 perform'd 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 ten in the Forenoon, and died about three 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 two Teeth or *Fangs* are like those of a *Rattle-Snake* on the upper Jaw, the Poison lies in the Gums, and wherever they fetch Blood of any Creature they certainly kill, though in some parts sooner than 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 Oil, that none of the Poison may touch any place where the Skin is broken, and spit out immediately what they suck; every time washing their Mouth, and taking more Oil. This *Serpent* kill'd a Dog, in about eight Minutes time, biting him at the end of his Ear; and two young Turkeys afterwards in three or four Minutes each, biting them at the end of a Claw; and then, we poisoned him with the Oil 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 two or three Minutes, trembling as soon as the Oil was dropt into his Mouth.

XLVIII. Sir *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 Poison; and then being put in Milk, to void its Poison therein, to make the Milk turn blue; in which manner it must be used, till the Wound be cleansed. The like Account of such a Stone is given by Mr. *Tbervenot*, in the Relations of his Voyages and Travels.

*A Stone
Healing the
biting of a
Serpent; By
Sir Phi. Ver-
natti, n. 6.
p. 102.*

XLIX. The Venom 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, Phrenies, Convulsions, and Vomiting; yet in eight or ten Days at most these Accidents are over; and although the Patient may be very Ill, yet he recovers again; whilst the Poison, having run through divers Parts of the Body, at last throws it self into the *Scrotum*, or 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.

*Observations
on several
Poisons, by
Sir Theo.
de Mayerne,
n. 211. p. 60.*

It is observable, that the Perspiration being obstructed by the Poison, a Man bit by a *Viper*, and swelled up, in three or four 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 a short time by this Venom without speedy help. In the extream Nervous Parts, near the Pulse and Tongue, the Bites are dangerous, and the Accidents very painful. Fresh *Vipers* that have not bit, but have the Bladders of the Gnms 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 Press out the Poison.

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 Poison 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 Poison 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 Poison 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 die 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 die in half an Hour. He says, *Nux Vomica* never Vomits but shuts up the Stomach, and Contracts the Nerves by its Poison. To preserve the Dogs alive, you must give them with the Antidote or any thing else, three or four Grains of *Sublimate*, which immediately sets them a Vomiting, and so saves them alive.

He offers to take all sorts of Poisons, even Corrosives, after an ordinary Meal, and for trial of Skill he refuses them not on an empty Stomach. He much esteems *Morsus Diaboli*, *Succisa* or *Devil's-Bit*, against all sorts of Poisons. He laughs at the Poison of a *Toad*, which he says has none at all, no more than a *Frog*.

The manner of the acting of the *Vipers* Poison is thus: In about three quarters 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

as a *Bean* or a *Nut*, and increasing enlarges its 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, Blue and Yellow. It makes as it were Bags in the Skin which feel heavy when you Walk, as if fill'd with Quick-silver. Do what you will, the Poison will have its Course; and it is usually three Days before it comes to the heighth, and as long abating.

He says, the Gall of the *Viper* is no ways Venomous; all the Poison is in a Liquor in the Gums, which is yellow like Oil; of which you may easily disarm the *Viper*. The *Viper* is most venomous of *Serpents*; the *Asp* is but a Species of the *Viper*. The *Napellus* is a very dangerous Poison, acting by its Acrimony; but you must take a great quantity of it. It burns the Throat extreamly, as does *Allum*; but it is cured by the Antidote. *Crude-Antimony* does nothing if attacked by the Antidote.

The most mischievous of all Poisons is *Opium*; of which having given an Excessive Quantity to a Servant, at first he had Convulsions; then strange Vomiting, not able to let any thing go down into his Stomach; a Sleepiness following; all which time they kept him Awake as much as possible. At last all of a sudden, he grew well, and called for Victuals.

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 nine Months, that he had kept it eleven 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 dried afterwards, the Urine of the Animal served to moisten the same; but being put upon *Italian* Earth it died three Days after.

A Salamander, by S. Steno, n. 21. p. 377.

LI. This *Camelion* was a Female; the Skin appeared mixt of several Colours like a Medly-Cloth; lighter towards the Belly, otherwise near upon it, equally mixed. The Colours discernible are Green, a sandy Yellow, and 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 Pin's Head equally dispersed on the sides, with small black Streaks on the Eye-lids; all which afterwards 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

Observations on a Camelion, by Dr. Jonath. Goddard, n. 137. p. 930.

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 towards the End, like a Pestle, 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 Bilurcated. 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 Ribs from the Neck to the setting on of the Tail. The Ribs 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 fourth 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 two 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 five or six Eggs (of the bigness of the greatest Pin's Heads, and sticking to the Back) on each side; of the same Colour and Consistence with those of the Yolk of an Egg.

Observations
about the
Lungs of
Frogs, by S.
Malpighi, n.
71. p. 2149.

LII. I am very much surpris'd that Mr. *Thurston* in dissecting of Tortoises, Lizards, and Frogs, did not find out the Communications between the Bronchiæ and the Lungs, calling them Bladders produced from the Laxity of the external Membrane of the Lungs; when only by putting a Pipe into the Trachea, and blowing Air into it, the Lungs which are joined on to it, grow turgid every where about the Heart; and this happens whenever the Animal has a Mind. If you distend them with Air, tie them with a Thread, and afterwards dry them, upon cutting into them, you will evidently see the membranous Cells and Vesicles. And although in Frogs the Course of the *Bronchia* is but short, yet there are two Ducts coming from the *Larynx*, composed of semicircular Cartilages, opening into the Vesicles; and thus Respiration

ration is carried on. But in the *Tortoise*, *Lizard*, and such like Animals, the Air is conveyed into the Vesicles of the Lungs, by means of a pretty long *Trachea* divided into two Branches. I know that in *Frogs*, near the Mouth, there open two Vesicles some times turgid with Air (but at a good Distance from the Lungs) which are Appendages of the Cheeks, and are sometimes pushed outwards by the Air sent from the Lungs in Expiration into the Cavity of the Mouth. You must know the Reticular Muscles placed about the Lungs, whose fleshy Plexuses surrounding the Sinuses and Vesicles, I have given a rough Draught of elsewhere. Its extraordinary Texture appears plainly in *Frogs*, and especially in *Lizards*; for a great many fleshy Fibres are produced lengthwise, and others running a-cross are continued into one another, while the intermediate Spaces are occupied by reticular Plexuses, almost in the same Manner as in the Leaves of Trees. Lastly, these intermediate Spaces are occupied by streight Fibres from the Reticular Muscle, like little short Tendons. This extraordinary Muscle not only surrounds the Lungs externally, but likewise the most internal Vesicles and Sinuses, so that by compressing the whole Lungs in its Action, it promotes Respiration and Sound. The same Structure is observed proportionally in the Lungs of perfect Animals, and especially in the smallest Lobules of those of Lambs, when they are distended with Air, and still soft.

LIII. Mar. 12, 1689, I took some *Frog-Spawm* out of a Ditch, which I suppose might have been spawned about fourteen Days, and kept it in a Gallipot 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 in *Fig. 217.* being a round black Globule, encompass'd with a clear Liquor, as I afterwards found, and a Membrane encompassing that Liquor, and that encompassed with a larger Sphere of a more mucous Liquor. The second Day they appear'd as *Fig. 218.* The third Day as *Fig. 218.* The fourth Day as *Fig. 219.* About the sixth Day, several of them were loosed from their Eggs, and on the seventh and eighth 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 seventh and eighth Days, upon pricking of them with the Point of a Needle, they would contract themselves; some of them, on the eighth Day, would of themselves bend their Bodies, but not move out of their Place. When they first got thro' 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 ninth Day they were not visibly increased in bulk, only they moved themselves more freely at the bottom of the Vessel.

At about fourteen 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 three Weeks end their Mouths were to be seen, which they opened and shut, and emitted *Feces* from the other end. At a Months end

The Production of Tadpoles, by Mr. Rich. Waller, n. 193. p. 423.
Fig. 217.

Fig. 218.

Fig. 219.

Fig. 220.

Fig. 221.

Fig. 222.

Fig. 223.

end the Eyes were to be discerned, at which time they would swim near the 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 three Eggs, leaving a little space, which being fill'd with Air, made them specifically lighter than common Water.

*The Stomach
of a Leech,
by Dr. Edw.
Tyson, n.
144. p. 33.*

LIV. The *Ductus Animalis* in Animals, from its uses, may ordinarily be divided into four Parts. 1. That which conveys the Food, as the *Œsophagus*. 2. That which digests or corrodes it, the *Stomach*. 3. That which distributes the *Chyle*, the *Intestine*. 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 into several transverse Membranes, in 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 ten or twelve of these *Camera's*, besides these two long ones which at last run to the Tail) at least twenty-two, if not twenty-four Stomachs. But the *Rectum*, which lies between the Forking of the two last *Sacculi*, or Stomach, is but small, and short in Respect of the whole.

*The Anatomy
of a Leech,
by M. Fr.
Poupart, n.
233. p. 722.*

LV. The upper Lip of a *Leech* is stretched out into a Point, and falls upon the under, which is round like a *Crescent*, and shorter. Its Throat on the inside is covered with a great many white Muscles, about five or six 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 Greediness, that she makes it enter in Form of a little Pap into its Throat. So that all the Effects of Suction terminating in a very little Space, of necessity the Flesh must break in that Place.

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 its Cavity in its middle. This excellent Glue fastens so strongly on 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

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 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 Goose's 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 sharp'd Spiral-ways; and there is a great one of this sort near the Tail, fashioned like the *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 Bird's 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 Convolutions, 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 makes 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 destined to Generation are placed where the Neck ought to be. The *Yard*, which is about two Inches long, is white, round, hollow and gristly: A part of the *Yard*, which is always in the Body, is a Sheath, about 17 Lines of an Inch long, as big as a little Bird's 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 Ancients said. The other Part of the *Yard* which comes out nine or ten Lines of an Inch, is the bigness of a sowing Thread, and the End of it, for the Length of two Lines, is bigger than the rest. All the *Yard* is hollow, and has in his 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 Web, flat, oval, about two or three Lines long, resembling small Guts, twisted about with a Cartilaginous Body, as big as a double Thread, and two 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 two Webs, there is a little Gristly Globule, two Inches long, white,
hard,

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 *Epididymis*, whose little *Canal*, of the same Piece with it, creeps over the Globule, and is fastened at the Point of it, and above the *Epididymis* are two *Glands* 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*.

An extraordinary
Leech
which occurs
in the
Sword-fish;
by S. Paulo
Boccone; n.
99. p. 61 59.

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 itself into the Flesh, and sucking the Blood of the said Fish. He describes it to be of about four 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 *Augre* 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 Situation; 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 inner Vessels into the Orifice of the Trunk, and to draw them back again.

This

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 *Louse*, 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 small winding and hairy Threads. It hath not been observed, (as far as our Author could learn) to trouble, or to be upon any other Animal than this *Leech*.

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 therefore might well escape thus long the more curious Naturalists; neither of them much exceeding, at least in Thickness, a large *Oat-Corn*.

The odd Turn of some Shell-Snails, by Dr. M. Lister. n. 50. p. 1017. n. 72. p. 2171.

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 extream 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 ten 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 Snails towards a Perpendicular, and exert, with Part of their Body, two pair of Horns, as most of their Kind do.

In *March* I have seen many of them pair'd, and in the very Act of *Ve-* nery, 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 observed, 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.

Cat. Plant.

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 *Oaks*, &c. and in no other Place that I could observe.

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

Some sort of Virginian Snails; by Mr. J. Banister, n. 193. p. 671.

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 lies 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 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 Sailors call it) exerts, may be analogous to this.

By Dr. Lister,
ib.

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 M. P. P. P.
ib. p.
672.

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. I am apt to believe, that these (or 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-colour'd and spotted one, and milky, like Dr. *Lister's*, Fig. 16.

The Purple-
Fish, by Mr.
Will. Cole, n.
178. p. 1278.

LIX. In *October*, 1684, There were two Ladies at *Minhead* 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 any 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 obtained that delicate Colour they told me of. The whole Process is as followeth:

Fig. 223, 224,
225, 226,
227, 228.

The Shells being harder than most of other kinds, are to be broken with a smart stroke with 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 pick'd 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 digged 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

will scarcely be distinguish'd ; 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 Soap, will, (the Matter being again put into the Sun or Wind to dry,) be of 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 forty 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 and foetid Smell, as if *Garlick* and *Assa Fetida* were mixed together.

The Shells are of divers Colours, but most of them white, some are red, some yellow ; others of both these Colours ; some of 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 in the bottom of the Vessel, they creeping to the Superficies of the Water, and by extending a kind of Lip, 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 in the Sea-Coast of *Somersetshire* : I have found them also on the Shoars 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, tho' 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 divers sorts of the same kind, in the same Place.

I am assured by some, who have boil'd, dress'd, and eaten of this Fish, that they are wholesome Food ; as good at least, and taste as well as *Lympots* 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 Foetid Savour. 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 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 the Island on which the renowned City of *Tyre* was built, (now an inconsiderable Town called *Sur*;) this was celebrated and priz'd above all the rest, for that it excelled them all in its illustrious Colour, called 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 *Vespasians*) when the Artists of the Imperial City of the World, in Preparations of that *Tinging Succus* for *dying* the Robes and other Vestments of *Emperor, 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 dy'd Purple of *Tyre*, called *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 a Preparation, or Addition of any thing to it may now, or at least hereafter, by farther Improvement, vye with the *Tyrian Purple*.

Johnston, out of *Aristotle*, mentions a Species of these Fishes, under the Name of *Littorales quæ parvæ & Flores sunt rubro*; this agrees with ours, which may be named *Purpura Littoralis (sive Teniensis) parva Turbinata*.

Observations
on a Tortoise;
by Sir. Geo.
Ent. n. 294.
p. 533.

LX. October 7, 1651. I weighed my *Tortoise*, before he was put into his Hole, where he was to remain all Winter, and he weighed exactly four Pounds, three Ounces, and seven Drachms.

October 8, 1652. I had him dug up (for he had buried himself the Day before) and weighed a-new, and he weighed four Pounds, six Ounces, and one Drachm.

March 16, 1652-3. The *Tortoise* came out of his Hole of himself, and he weighed five Pounds, four Ounces.

October 4, 1653. The *Tortoise*, after having fasted for some Days, and hid himself under Ground, being taken up, weighed four Pounds, five Ounces, and his Eyes (which had been long shut) being then open were very moist.

March

March 18, 1653-4. The *Tortoise* coming out of his Hole, was weighed in a Scale, and his Weight was four Pounds, four Ounces, and two Drachms.

October 6, 1654. The *Tortoise*, about to take up his Winter-Quarters, weighed four Pounds, nine Ounces, and three Drachms.

The last Day of February 1654-5. The *Tortoise* creeping out from his Hole where he had remained all the Winter, weighed four Pounds, seven Ounces, and six Drachms. He had lost therefore an Ounce and five Drachms of his Weight.

October 2, 1655. The *Tortoise* going again into his Winter-Quarters, weighed four Pounds, nine Ounces. But he had fasted for some Time before.

March 25, 1656. The Weight of the *Tortoise* coming out of his Winter-Quarters, was four Pounds, seven Ounces, and two Drachms.

September 30, 1656. The *Tortoise*, about to hide himself again under Ground, weighed four Pounds, twelve Ounces, and four Drachms.

March 5, 1656-7. The *Tortoise* coming out of his Hole under Ground, weighed four Pounds, eleven Ounces, two Drachms and a Half.

Whence it appears plain of what fixed Particles these Animals are composed which fortify themselves under Ground, against the Cold of Winter, seeing that for so many Months such a small Part of their Bodies goes off by Sweat or Perspiration, that it may very well be questioned whether they live or not, while they lie buried in this Manner.

• A *Tortoise* living three days without a Head, by M. — n. 26. p. 48c.

A sort of Oysters in East-India, by M. Witzen, n. 202. p. 871.

LXI. S. *Steno* writes from *Florence*, that a *Tortoise* had its Head cut off, and yet it was found to move its Feet three Days after *.

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 powder'd is esteem'd a good Medicine.

Fig. 230. By Dr. Lister, ib p. 872.

2. The like sort of *Oyster-shells* are 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.

LXIII. 1. M. *Auzant*, 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 four or five Lines, and being put upon the Observer's Hand, continued to shine there for some time. And afterwards causing more than twenty 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 three sorts; one sort was whitish, having twenty-four or twenty-five Feet on each side, forked,

Shining Worms in Oysters, by M. Auzant, n. 12. p. 203.

forked, a black Speck on one side of the Head, taken by him for a *CbrySTALLINE*, and the Back like an *Eel* stripp'd of her Skin; the second was red, and resembling the common *Glow Worm*, found at Land, which 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 third sort was speckled, having a Head like that of a *Soal*, 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 two Horns on it, like those of a Snail, and with seven or eight whitish Feet: But these, though kept by him in the Night, shined not.

3. The two first sorts are made of a Matter easily resolvable; the least Shaking or Touch, turning them into a Viscous and Aqueous Matter, which falling from the Shell, stuck to the Observer's 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 two 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 *Carp*, the Light encreased 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 Finger's 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 Verminous 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 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 two Hours.

LXIV. The *Pearl-shells* in *Norway*, and elsewhere, do breed in sweet Waters. Their Shells are like to those, which commonly are called *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, (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 sides 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 this Figure.

*The Origin of
Pearl; by M.
Christopher
Sandius, n.
101. p. 11.*

This Account I received from a *Dane*, called *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.

LXV. There are four *Rivers* in the Country 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* called *Lough-Lean* in *Kerry*, which afford the like Fish ; and no doubt, there be many more that I do not know.

*Pearl-fishing
in Ireland;
by Sir Rob.
Redding, n.
198. p. 659.*

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 an 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 50s. that weighed 36 Carats, 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.* 10s. 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 Pound for it from the late Dutchess of *Ormond*. The young *Muscles* never have any Pearl in them.

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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 two Tendons, one at each end, whereas the *Oyster* and *Scallop* are with one only in the Middle. They lie 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 severat Crufts 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 Floods from the Neighbouring Mountains, which are most impetuous after any little Rain. The insides of the Shell are of an Oriental and Pearl-Colour and Substance, like a flat *Pearl*, 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 a 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 Fins, 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 Crufts, 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 avoided as it is able; and many Shells that have had Pearls in them, are now found to have none, which will appear in these Instances: The Shells that have the best Pearls are wrinkled, twitted, 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 believing 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 Sand.

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 ouzy. Many of these Muscles lie in brackish Water; being driven down the Rivers four or five Miles within the flowing of the Sea. I have sometimes observed the same *Pearl* clear at one end, and dark at the other.

LXVI. In the Beginning of *January*, having got a *Scallop*, I set about dissecting it with as great Accuracy as I could, considering I never had the Opportunity before. First, I observed the *Hinge* rising gently crooked from the *hollow Shell*, and laid over the other upon the *plain Shell*, the two being firmly connected together on that Part with a Kind of Cartilage: And likewise in the middle Part of the *Hinge* there was another Cartilage, very black, and strong. Hence arises that surprising Force of keeping the Shells shut, and perhaps of moving the *plain Shell*, like a kind of Oar, thereby to produce a certain Progression, and as it were Sailing; of which the Ancients frequently talk as peculiar to this Shell-fish.

*The Anatomy
of a Scallop;
by Dr. M.
Lifter, n.
229. p. 567.*

Upon opening the Shells we may observe the following. Towards the right Side, under the *Hinge*, the Mouth headed like that of an Oyster. The Coverings of the Mouth are composed of the conjoined external *Branchiæ*, which are musculous, and surround the whole Animal from the Head to the Anus, *viz.* towards the left Side from the Mouth, where they are again connected with one another.

But of that Pair of the external *Branchiæ*, the one which lies upon the plain Shell, adheres with its Center to the upper Border of the same large round Muscle, which is inserted at right Angles into the Middle of each Shell; and the other one is joined after the same Manner to the other central Head of the same central Muscle.

Both these two external or spurious *Branchiæ* arising from the *central Muscle*, consist of a thin and very pellucid Membrane; and being expanded as far as the Middle of the Shells adhere gently to them, so as they cannot slip from thence, defending the Back of the Animal from the Injuries of the Water contained within the Shell; while from the Place of that Adhesion, a very singular thick Muscle, in the Fashion of a Skirt, takes its Origin. I have painted that Muscle only as it is when not expanded; but in the living Animal it is very extensive, even so as to reach far beyond the Margin of the Shell. It is fringed too as it were, and beautifully variegated with little red Lines. Several Days after this Scallop was taken up, you could observe that Skirt evidently to move. The Use of the Skirt, I imagine to be this, *viz.* by being crooked inwards while contracted, after the Manner of a Kind of Net, when these two Branchial Muscles are thrust out without the Shell, whatever gets between them, being applied together, they carry in with them for the Nourishment of the Animal: While by the Fringes upon the Margins, the Sea Water seems to be separated, and the Food still retained. I don't know that that Part has any other Use. I might add however, that this Skirt may possibly serve, by its strong Compression, to kill a small Animal or little Fish; and by its *undulatory Motion*, which in it is very remarkable, may move about the Food; and, in whatever Part of the circular Net it was contained, convey it at last into the Mouth, thus in some Measure performing the Office of a Hand.

But I come now to the true *Branchiæ*, at least they are usually called such, and they are four in Number, a little upon the yellowish, and streaked very elegantly in the Manner of the Teeth of a Comb. These *Branchiæ* surround the great *central Muscle*, and contain betwixt them, or lie upon the *Uterus* with its *Ovarium*, at least Parts designed for Generation. I gave Figures of these Parts formerly which were very just, and now also in the living Animal I see the lower Part of a Saffron Colour, and the upper Part whitish, and near the Mouth a Process with a double Foramen. One of these Foramina is the Orifice of the Vagina; and if the *Scallops* are *Hermaphrodites* (which I suspect from the constant Similitude of that Part in all that I have seen of them, whether alive or pickled) the *other* is designed for the Penis to come out at.

I proceed next to the *Head*; and its *Mouth* is circumscribed with reddish *Lips*, after the Manner of the Internal *Branchiæ*, very short, and in this *Scallop* crumpled, very much diseased and mangled. Under the Middle of the Hinge are two pretty large Circles or Cavities like the *Eyes* (and they probably are Eyes) of a *Turbet*, placed obliquely.

The *Mouth* and *Head* are pretty large, turned towards the left Side, and full as it were of a blackish *Meconium*. Behind it lies the Heart, which you can see through the pellucid *Pericardium*, of a fleshy Colour somewhat red. The *Aorta* arising from the Heart is distributed through the *Branchiæ*. But I am in a Doubt whether that only is the *Pericardium*, which is placed next the *black Meconium*, or all that which is comprehended in the Rhomboidal Figure. I don't know whether the lower Part of it may not be the *Bladder*. But from the *Meconium* certainly rises the *Rectum*, which ascending above the *Pericardium*, is continued to the internal *Branchiæ*, and connected to the *Central Muscle*.

The *Central Muscle* is orbicular, white and smooth in a great Part of its Surface, where it adheres to the *Shell*; but on the left Side, it is distinguished by another lacerated Muscle, and is moulded more to the Shell.

Explication
of Figures.

Fig. 231.

a a a, The Mouth, and Head. *b b*, The *Meconium* very black. *c*, The Heart, as it lies under the Membrane. *d d*, The *Pericardium*, the Rhomboidal Part of it perhaps the *Bladder*. *e e e e e*, The *Rectum* climbing over the *Pericardium*. *f f f f f*, The great *Central Muscle*. *g g*, Another lacerated Muscle adhering firmly to the *Shell*. *h h h h*, The internal *Branchiæ*. *i i*, The Termination of the long *Uterus*, marked with two *Foramina* as in *Hermaphrodites*. *k k*, the upper Part of the *Uterus*, whitish. *l l l*, Its lower Part, of a Saffron-Colour. *m m m m m*, The variegated Border, or second Net-like Muscle.

A sort of
Cockles in
East-India;
by M. Wit-
zen, n. 293.
p. 870.

Fig. 232.

LXVII. There are found on the Coasts of *Calabar* 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. The long Body which is wrinkled like
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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 dried Fish.

LXVIII. The Stones in the Heads of *Craw-fish* are always on the outside of the Stomach, while the Old Coat sticks to 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 Craw-fishes; by Mr. Ch. King, n. 206. p. 672.

I have observed that the Males of *Craw-fish* 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 who shall seek after the *Purple-fish* will find, as I have done, some of those Shells in which are the *Cancellarii*, or rather *Astaci*, unto which they are more like, and so may mistake: For those little Crabs, 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 too and fro till they find a Stone to hide themselves under; which not finding, they bury themselves in loose Sand. This Observation gave me full satisfaction, that they were not, (at least all the kinds) *Connate* and *Coalescent* with their Shells; as other *Testaceous* Animals of the Sea and Land are.

Cancelli, or Soldiers, by Mr. Will. Cole, n. 178. p. 284. Vide supra §. LIX.

LXX. 1. I understand by the Fisherman who brought me this Fish, that he never saw, nor heard of any but six or seven 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 first hold upon the Bait on the Hook which he had sunk down to the bottom to catch other

A Stellar-Fish by Mr. Winthrop, n. 57. p. 1151. n. 74 p. 2221.

Fig. 233.

Fish,

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 can be discerned of all that curious Composure wherewith Nature had adorned it, seems to be, to make it 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 a *Mackarel* 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 *Mackarel*.

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 hardned. 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*.

By _____
n. 37. p. 1153.

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 *Fig. 233. Misseltoe*. This Fish spreads its 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 its self into two (as at *i*;) and each of those ten 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 forty. Those 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 11, 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 Threads, 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 precedent Joint was placed, were always about a fourth, or fifth part longer than those on the other side. Every of these Branchings seem'd to have, from the very Mouth of the smallest Twigs or Threads, 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 five Ribs or Ridges, and each of these seem'd to be kept out by two small bo-
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ny Ribs. NS. In the Figure is represented fully and at length, but one of the main Branches, whence 'tis easy to imagine the rest cut off at the fourth subdividing Branch; which was done to avoid Confusion.

3. This *Star-fish* is the *Stella Arborefcens Rondeletii*; first described by him, and since by other Naturalists.

By Mr. Fra.
Willoughby.
n. 58. p. 1200.

LXXI. 1. In *Decemb.* 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 four Inches and six tenths long; and where largest, as it was one Inch and one tenth broad, so it was about three Inches and a half in Circumference: At the smaller End, not above four tenths of an Inch broad. It hath neither Shells, Crust, Scales, or Bone, for its Covering, but was soft: Yet not Flabby or Fleahy, as the *μολυκία*, or *Mollia*, but rather Membranous.

A Scolopen-
dra Marina-
by Dr. Tho.
Molineux.
n. 225. p. 405.

Fig. 234, 235.

The Back or upper side, 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 about two tenths 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 to 'other, a List about two tenths 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 was very thick, and about a quarter of an Inch long, of a most delicate changeable red and green Colour, and of so sparkling and 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 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 two 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.

The bigger end, though it had not any Horns, Eyes, Ears, Nose, or Gills, yet because it was 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

'Twas broader towards the Head and grew narrower still towards the Tail; where for above the space of an Inch, it was curiously pinched with little Indentures, resembling the small Joints in the Tail 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, thro' the middle of each Foot pass four, five, or six, of the same sort of sharp hard Prickles, that were interspers'd amongst the soft Hair. These were larger or smaller, or more or less in Number, according to the size of the Foot, and give it strength and firmness instead of Bones: And likewise issuing forth beyond the end of the Foot serves 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 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 of their Size, still gradually diminishing the nearer they approached towards the Tail. I distinctly counted of these, as of the Feet, thirty-six 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 is 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 Brains, 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

This fleshy Stripe sent out from each side, like so many Rays, thirty-six 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 *Vertebrae*, 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 be properly ranged with the *Scolopendræ Marinæ* described by *Rondeletius*; but it may be distinguish'd from them, by calling it *Scolopendra Marina à Capite Latiori versus Caudam sensim gracilescens, Limbo Pulcherrimè Hirsuto Spinulisque crebris interstincto è Mari Hibernico.*

aaaaa. 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; *hhhhh*. the Feet of each side the Belly; *IIIIII*. the Fins with their hairy Fringe behind the Feet; *kk*. the large Mouth opened wide.

2. I observed at *Harwich* in 1698, divers of the Marine Animals brought up by the Fishermen, which they call *Sea-Mice*. They are described by *Rondeletius*, and by *Moufet* and *Johnson* (Figured under the Title of *Physalus*) but badly.

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

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 Poisonous; 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 Aurcus vel Species Erucae Marinae rarior*, which I am confident is the same with mine; tho' *Bartholine*'s 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*; though his *Icon* be much worse than *Bartholine*'s, and requires some Strength of Phancy, to guess whether it be really so or not.

A Way of catching Carps by Mr. J. Templer. n. 95 p. 6066.

LXXII. At Sir *Just. Ibbam*'s, I lately saw four 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.

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 a 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*.

Eels discovered plentifully in Frosts in Somersetshire by Dr. J. Bale, n. 18. p. 323.

LXXIII. From *Lampton* towards *Bridgewater*, *Eels* are so cheap in the Frosts of Winter, that they vend them for little. Their Abundance is from hence, that as 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 *Eels*.

Two very large Eels, by Mr. Dale, n. 238. p. 90.

LXXIV. I have lately met with Relations of two very large *Eels*, caught upon the Coast of *Essex*; they both had all the Characterising Notes of the *Eel*, and wanted those Barbles which the *Eel* sometimes hath not, but the *Conger*

Conger is never without. The first was taken somewhere about *Cricksea*: Its Length from the Tip of the Nose to the Tail's end, was five Foot eight Inches; and in Circumference it was twenty-two Inches. The other was taken in *Malden-Channel*, about a Mile below the Town; the length of which was seven Foot; the Circumference twenty-seven Inches, the Weight thirty-six Pound, and out of its Belly was taken five Pounds of Fat; its Skin was black, and being stuf, is still preserved at *Malden*. The 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.

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 two Years since, in some taken at a Mill, in which Holes they breed, especially near gravelly Shallows; and found one with Egg, another with six young ones, in the great Intestine, which I call the *strait Bowel* that descends immediately from the *Pylorus*, until the Winding begins. They were fastned to very small *Plucentæ* 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 lie still till they have discharged their Young. The Parts distinguishing the Sex are discoverable; those of the Male affix to the Extremity of the Kidney; the Female had a slender Gland transversly lying near the Bowel; but of this I dare not say much.

The Generation of Eels, by Mr. Benj. Allen. n. 231. p. 664.

In *Salt Water-Eels*, I have not found the like, though search'd 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.

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*, *Leeuwenhoeck*, *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 the Learned Naturalists whether *Eels* have distinct Sex, or are Hermaphrodite. *Mr. Allen* affirms, the Parts distinguishing the Sex to be discoverable; but *Mr. Leeuwenhoeck* could never find any such thing; for all those that he hath dissected, he declares, were provided with an *Uterus*; from hence he doth conjecture

By M. Dale. n. 238. p. 92.



them to be Hermaphrodites, and besides the *Uterus*, to be provided with Masculine Seed.

Another Controversy about the Generations of *Eels* 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 Chetwynd*, Esq; who in the Month of *May*, found them to be Viviparous, by cutting open the red Fundaments of the Females, from whence the young *Eels* 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 in Motion, should be the Place of Generation in any Animals, though we may allow *Eels* not to feed gross in the Winter. On the contrary, that the *Eel* hath an *Uterus*, is asserted by Mr. *Leewenboeck*, 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. *Allen's* 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, six 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 great Intestine; to be formed and invigorated, unless we may suppose they do, like the *Embryo's* of some sort of Insects, which for the Conveniency of Food eat their own way into their heterogeneous, or assumed *Matrices*.

Observations
on the Anatomy of a
Porpus; by
Mr. J. Ray.
n. 74 p. 2220
n. 76 p. 2274

LXXXVI. In *April* 1669, at *West-Chester*, I met with a young *Porpus*, caught upon those Sands. The length was three Foot seven Inches; a string of two Feet and two 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 Ancients report them. On his Back he hath only one, which was distant from the tip of his

Snout

Snout one Foot and nine Inches, and the Basis of it is in length five Inches and a half; so that measuring from the tip of his Snout to the end of his Tail, it was situate somewhat below the Middle of the Fish's length. On the Belly it had only one pair of Fins nine Inches and a half 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 lies 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 balance 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.

For doubtless, if violently detained under Water, 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 conceived 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 three Regions, or *Ventres*, like a *Quadruped*, 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* joined 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 two large Bags, beside other small 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 called in some Places Sand-Eels; by some they are called *Launces*, and by *Gesner*, *Ammodyta*. The Liver was of a moderate Size, situate in the Right-side, and divided into two Lobes, having no *Cistis Pellea*, or Receptacle of Gall annexed. The *Pancreas* large, sticking close to the third Bag of the *Stomach*, into which also its *Ductus* enters, and empties it 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 lie within the *Cavity* of the *Abdomen* on each side, as they do in an *Hedge-hog*, and some other *Quadrupeds*, of an oblong Figure; for their internal Substance, seminal Vessels, both *Preparantia* and *Desferentia*, *Epididymides*, *Vas Pyramidale*, *Corpus Varicosum*, and *Glandule Prostate*, exactly like to those of *Quadrupeds*. The seminal Vessels perforate the *Urethra* with many little Holes, whereof four are most conspicuous, somewhat above the Neck of the Bladder.

It had six short Ribs that had no Cartilages, and seven 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 two Ventricles, Arteries and Veins; 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 *Essex*.

The Pipe in the Head, through which this kind of Fish draw their Breath, and spout out the Water, lies before the Brain, and ends outwardly in one common Hole, but inwardly it's divided by a *bony Septum*, as it were, into two Nostrils; but below again it opens into the Mouth in one Hole. This lower Orifice is furnished with a strong Spincter, whereby it may be shut and opened at Pleasure, and above this Spincter the sides of the Pipe are lined with a glandulous Flesh, which if you press, you will see start out of the many little Holes, or *Papille*, 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 six 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; tho' opening the Brain, I could find neither Olfactory Nerves, nor *Processus Mammillares*.

The Eyes are small, considering the bigness of the Fish, and situate 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, lie 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 seven 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

Manner to the first *Vertebrae* 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 ancient Stories related by *Herodotus*, *Pliny* the Elder, and *Pliny* the Younger.

In each Jaw it had forty-eight Teeth, standing in a Row like to little blunt Pegs, the Tongue was flat, above an equal Breadth to the very tip, which was Toothed or Pectinated about the edges, tied 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 Delphinis Lingua est mobilis, quae modo exeri modo condi potest*; unless perchance in this Particular the *Dolphin* differs from the *Porpus*. For the *Porpus* is, as I take it, the *Phocæna* of the Ancients, which is a lesser sort of *Dolphin*, and not the *Delphinus*; at least if the Fish we are describing were a *Porpus*; 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 its 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 Ancients.

We observed not in this Fish any Nostrils, besides those in the *Fistula*, nor any Ear-holes or *Meatus Auditorii* at all; wherein also *Aristotle* agreeth 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 same *Porpus*, I agree with *Gesner*, that it was so called, *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.

LXXVII. In dissecting a *Porpus*, which had been dead at least three Days, I happened to wound the Inside of my Finger very gently; but it did not bleed, being only a slight Scratch of a Tooth. I felt no bad Effects from it for four Days afterwards; and then it began to swell near the Joint, and have a bluish Cast. The Swelling and livid Colour increased every Day, so that in four Days more it had run over two Fingers, and at last a third was beginning to be infected. I used a great many Things which I was advised to by Surgeons, but to very little Purpose; for now my Hand was seized, and the Pain got up to my Wrist; but the first Thing that stopt its Progress, was the following Fomentation. *Take of Frog-Spawn-Water, six Ounces, of Armenian Bole half an Ounce, of white Vitriol four Ounces, mix them.* This was applied warm twice a-Day. Sometimes this was made Use of. *Take of burnt white Vitriol and Armenian Bole, of each four Ounces, of Camphire*

*Avenant
scratch with
the Tooth of
a Porpus, by
Dr M Lister,
n. 233. p. 726.*

an Ounce, of common Water eight Pounds, mix them and make a Collyrium. Then by applying an Anodyne Linament, and a Plaister of Bole and Diapalma over it, I got well at last of this unusual and accidental Complaint. But besides the livid Colour, which sufficiently indicated a Poison, a very troublesome and disagreeable Itching, or a Kind of burning tormented, me Day and Night, and the Searf Skin came all off from the Parts that were affected. As to the Fingers, they did not recover their former Strength for some Months.

Poisonous
Fishes about
the Bahama-
Islands, by
M. J. L. n.
114. p. 313.

LXXVIII. The Fish that are here, (at *New-Providence* one of the *Bahama-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, Shape, Colour and Taste, are one of them Poison, 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 increased.

Whales and
Whale Fish-
ing about
Bermudas,
by —, n. 1.
p. 11.

LXXIX. 1. An understanding and hardy *Seaman* gives this Account of the *Whale-Fishing* about the *Bermudas*; that tho' many Attempts of Mastering the Whales of those Seas had been unsuccessful, by reason of the extraordinary Fierceness and Swiftnes of these monstrous Animals; yet the Enterprize was lately renewed; and six Persons having been out at Sea 17 times, and fastened their Weapons a Dozen of times, they kill'd in these Expeditions, two old *Female Whales*, and three *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 three Foot long, having great Bends underneath from the Nose to the Navel, 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, insomuch that one of these Creatures which he struck himself, towed the Boat wherein he was, after him, for the space of six or seven Leagues in three quarters 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 *Tuberses*; they are without Teeth, and longer than the *Greenland-Whales*, but not so thick.

thick. That they fed much upon Grasse 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 two or three Hogsheds of a greenish grassy Matter.

The largest sort of these Whales might afford seven or eight Tuns of Oil, if well husbanded; the *Cubs* 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 Oil of the *Blubber* is as clear and fair as any Whey; but that which is boil'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 boiling, yet one may run one's Hand into it without scalding; to which he adds, that it hath a very healing Virtue 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 Gulph of *Florida*, it having been observed, that upon their Fins and Tails, they have Store of *Clams* or *Barnacles*, upon which the 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 Oil whereof, to the Quantity of 50 or 60 Tuns, arrived in *Ireland* some few Months ago.

He adds, that about two 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 eight or nine Months in the Year; whereas those about the *Bermudas* are to be found there only in the Months of *February*, *March*, and *April*.

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 kill'd by a certain *Horny-Fish*, which is said by Mr. *Terrey*, in his *East-India 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

there snapping it asunder, as happened not long since to an *English Vessel* in the *West-Indian Seas*.

3. Within these two or three Years in the Spring-time, and fair Weather, they take sometimes, one, two or three *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 six Oars; such as they can row forwards or backwards, as Occasion requireth. They row 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 toward the Tail. Now the *Harping-Irons* are like those which are usual in *England* in striking *Porpus's*; but of singular good Metal, that will not break, but wind, 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 him up 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 *Eleutheria*, and others of the *Bahama-Islands* (where also they find often Quantities of *Ambergrease*;) 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 so much Oil as ours; but the Oil, I hear, is at first, like *Sperma Ceti*, but they clarify it, I think, by Fire.

By Mr. Rich.
Stafford. n.
40. p. 793.

4. We have in these Seas about *Bermudas* great store of Whales, which in *March, April* and *May*, use our Coast. I have myself 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 three 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 Oil: But there have been *Sperma Ceti-Whales*, driven on the Shore, which *Sperma* (as they call it) lies all over the Bodies of those Whales. These have diverse Teeth, which may be about as big as a Man's Wrist.

I have been at the *Bahama-Islands*, and there have 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 Swiftnes. One such Whale would be worth many hundred Pounds.

Pounds. They are 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 the 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 with 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 itself, 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 Fishes;
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 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.

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. Boyle
ib, p. 311.*

3. I think that — hath hit upon the true use the *Swimming-Bladder* of Fishes. For 1. It hath been observed, that if the *Swimming-Bladder* of a 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 *Seles*, *Plaife*, &c. which lie always groveling at the bottom, have no *swim-*

*By Mr. Ray,
n. 115. p. 349.*

ming 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 swelled: 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 lists: For, in many Fishes it is very thick and opaque, 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 Cartilaginous 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.

The Eyes of Fish, by Dr. Allen Moulton, n. 199. p. 716.

LXXXI. I have observed in the Eyes of Fish, that the *Processus Ciliaris* is not fasten'd to the joining of the *Cornea* or *Scelerotis*, as in all other Animals that I dissected, so as to hinder the Watery Humour to go any further backward. For I constantly observe, that the *Humor Aqueus* may move a good way backward in some, and in others almost as far as the Optick Nerves. 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 Nictitans* 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*.

I have also observed that the Eyes of Fish, as well as those of Fowl, are more or less Cartilaginous: For the *Scelerotis* is a *Cartilago sui Generis*, especially near the *Cornea*; and in the larger sorts of them, I have found the whole *Scelerotis* 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 *Bronchia*, that lie 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 Inter-
nal Parts of
Fish, by Dr.
Char. Pres-
ton, p. 223.
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 as 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 Vial with it, within two or three Fingers of the Top, which space he left only full of Air, and stopt the Vial well; and by shaking it, the Water imbibed the Air, so as to rise up and quite fill the Vial.

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 subtile, 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 *Bronchia* 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 die in Water frozen over, which happens plainly from their Communication with the outward Air being hindered 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 *Bronchia*, and is after Re-united; which Re-union 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 Re-union of these Capillaries of the *Bronchia* 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 breathe. It is always strait and tense, and perpendicular on the *Vertebrae*; 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, forcibly 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 Bags fastened to the Ventricle for the same use. Fish have usually many *Pancreas*'s so that in some there have been told forty-four. They have Kidneys, Bladder, &c.

They have the *Ovary* near to the *Vertebrae* 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 *Vertebrae* 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 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.

The Wild-
Goose; by
Dr. M. Lister,
n. 175.
p. 1. 1160.

LXXXIII. There are commonly reckoned five different Kinds of Wild-Goose frequent enough in *Yorkshire*, viz. 1. *The little Spanish-Goose*; as small as a * *Barnacle*, but in Shape and Colour somewhat resembling the *Tame-Goose*; it has its Name from *Spain*. 2. *The Barnacle*; well enough known. 3. *The Scotch Goose*, viz. the most common Kind of Wild-Goose, which comes to us from *Scotland* about the latter End of *August*, of which there are innumerable Flocks in the Plains called the *Woods*, and are here and there found white. 4. *The Whilk*; the largest black Goose, feeding on Grass; for the most part in Parks and Inclosures. 5. Our *Fen-Goose*, which is called the *Grey Lagg*, and is equal in Size to a *Tame-Goose*.

Its Head is a Brownish-black, and the Neck dusky down to the Middle; the Back between an Ash and a Blue Colour, and the Wings and Legs Blackish. The Tail is Whitish, and its external Feathers White, the Belly

* *Brenta*.

of an *Ash*-Colour, growing gradually White towards the Middle. The *Bill* from the Head to the Middle is *black*, below that *purplish*, and the Tip of it *black*. In the upper Part of it there is only a Row of small Teeth, and the same in the lower. The Tongue too is armed with a Row of little Teeth on each Side. The Feet are *purplish*, or of a *fleshy Colour*, the Nails almost white, except that of the middle Toe, which is mostly black. It weighs seven Pounds, and almost a Half. They build their Nests in the Fens in *Yorkshire*; and both they and their *Goslings* grow fat in *May*, and are reckoned very good Eating.

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 *Legs*. 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 two Foot and a half Diameter, and nine or ten 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 five Parts, near about the manner as in the Figure. The Barnacle,
by Sir Rob.
Murray, n.
137. p. 925.

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 opened, 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*. Fig. 236.

LXXXV. 1. The Bird which at *Paris* is called *Macreuse*, 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

The Scotch
Barnacle and
French Ma-
creuse; By
Dr. Tancred
Robinson, n.
172. p. 1036.

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 *Conchæ Anatiferæ*. But in truth these Shells contain a Testaceous Animal of their own Species, as the *Oyster*, *Cockle*, and *Muscle* do: 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 Mr. Ray. It is frequently taken in Nets placed under Water upon the Coasts of *Normandy* (most plentifully at the Mouth of the *Sein*) *Languedock* and *Provence*; and I am confident, I have seen it upon the *Laguna* of *Venice*, at the Mouths of the *Brenta*, *Addesis*, and the *Po*. A *Duck* very like unto this (if not the same,) I also saw upon the *Mare Mortuum*, and the *Lake Aver-nus*.

The Ma-
creufe, 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 Proportion to the bulk of their Bodies, and those also situate very backwards.

What he saith of the Smallness and Weakness of the Wings, and Shortness of their Feathers, is common to many Sea-fowl, viz. the *Tridactyle* 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 *Tridactyle*, 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 *Macreufe* also to do) and have a delicate and well-tasted Flesh.

I observe in this Bird, and in some others of the *Sea-Ducks* that are much under Water, that they want that Vessel, or *Ampulla*, situated 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 *Tracheæ*. 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 am 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

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 the *Labyrinth*.

LXXXVI. In the Houses built for this Use there is a long Entrance, *a b.* on each side of which are fourteen 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 Manner
of Hatching
Chickens at
Cairo, by Mr.
Jo. Graves,
n. 137. p. 923
Fig. 237*

The top of these Ovens are flat, and covered with Sticks, except two 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 stopp'd with Tow, &c. or left open, as they please, to govern the Heat in the Ovens below. The upper Ovens are made after this manner.

a. The Mouth of the Oven, opening upon the long Entrance above mention'd, *b.* and *c.* Entrances into the Ovens adjoining, *d, e.* two Hearths three or four Inches deep, in which they make the Fire, to heat this and the Oven below. The depth of the lower Oven is about two Foot and a half *English*, the Second above four.

Fig. 238.

They begin in the midst of *January* to heat the Ovens; spending every Morning 100 *Kintars* or 100 Pound Weight of *Camels*, or of *Buffalo's Dung*, and the like Proportion at Night, till the midst of *February*, about 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 Chickens; which they continue successively till the end of *May*.

The Eggs are first put upon Matts in the lower Ovens, which are upon the Ground, seven or eight thousand 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 their 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 lie treble under the Hearth, because the Heat is greater there, than on the sides.

These Eggs continue in the lower Ovens fourteen 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 twenty-four Hours.

The 21st or 22^d Day the Chickens are hatched; which the first Day eat not; the second, they are fetched away by Women, who give them Corn, &c.

The

The Master of the Ovens hath a third 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 Chickens 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 Chickens are hatched, they put them into the lower Ovens, which were covered with Mats. Under the Mats is Bran to dry the Chicken ; and upon the Mats Straw, for the Chicken to stand upon.

To breed up
Pheasants
and Partridges,
by Sir
Edm. King,
n. 23. p. 428.

LXXXVII. *Ants* are the principal Food of very young *Partridges* and *Pheasants*, both wild and tam'd, 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 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 that should keep them sweet, and often shift their Water, or by ill Diet, or 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 *Earwigs* ; either of which will do good ; but both together better, given in a good Quantity, and at least two or three 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 Sun-set.

Swallows
found in
Lakes in
Winter, by
M. J. Schefferus,
n. 19.
p. 350.
by M. J.
Hevelius, ib.
p. 347.

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 up with a Net, together with Fishes, and put to the Fire, and thereby revived.

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.

LXXXIX. The *Ortigometra*, 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 three or four Months in the Summer; during all the remaining Parts of the Year, it lies buried in the Ground.

The Rail, by
Dr. Tho.
Molinet, 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 Snapping 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 too 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: ut 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. I saw one or two little Birds which I hear are commonly called the *Silk Tail* by the Germans, shot at *York* the End of *January* 1680. It is a very beautiful little-Bird, almost of the Size of a *Black-bird*: at the Extremities of the Wings it has four or five small, naked, horny Points, of a *Saffron-Colour*, not covered with Feathers, and the Extremity and Side of the Tail is of the Colour of *Citron-Bark*, the rest of it is mostly of the Colour of the *Lanius*.

The Silk Tail,
by Dr. M.
Lifter, n. 175.
p. 1161.

But I have 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 among the *Jaces*.

XCI. 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 flieth, not lighting on the Flower, but hovering over it, sucking with its long Bill a sweet Substance. There are in the Nest two of that Bird's Eggs; whether they use to have more at once I know not.

The Hum-
ming Bird,
by Mr. Jo.
Winthrop,
n. 74. p. 2223.

2. These Eggs were so small, that being weigh'd by me, the one weighed but about five Grains, the other, three and a half: And the whole Nest weighed no more than twenty-four Grains.

By Mr. Ol-
cenburg, ib.

3. There is in most parts of *America*, a Bird call'd by the *English* the *Humming-Bird*, by the *Spaniards*, *Tomincius*. He is of a most excellent shining green Colour, and very resplendent; the Colour doth something resemble some of our *English Drake's 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 10th part of an Ounce *Avoirdupois*, which I take to be about the Weight of a coined

By Mr. Ha-
merfly, n.
200. p. 760.
n. 202. p. 815.

Sixpence : And I have weighed here in *England*, a *Tit-Mouse*, (which I take to be the least Bird 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 two Eggs of the bigness of a Pea, of an 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 called 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 Bird's Wing, and stand four or five Yards from a Candle (when dark) and open the Wing, and look thro' 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.

By Dr. Neh.
Circ. n. 202.
p. 815.

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, whereas a Bird that sucks hath a *Syphon* or hollow Probe.

Observations
on the dis-
tinction of a Pa-
roquet, by
Mr. R. Wal-
ter, n. 121.
p. 153.
History of
Brasil.

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 *Margravius*, comes very near our Subject.

Its 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 blue 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 Limon-Colour, inclining to a Green ; next 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

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 fasten'd 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 *Quadrupeds* to the *Thorax* only by a *Mediastinum*. Memb. des Animaux.

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 human Voices; but this Creature we Dissected, never attempts an Imitation of Words, making only a shrill chirping Noise, doubling the Tone, or making it eight 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 Bas 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 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 *ἀνθρωπόγλωττος*: The Extremity of it was armed with a Horny Cover.

It has, besides the *Gizzard*, two *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 *Quadrupeds* 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 Hen's 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 moistened in the *Craw*, to expedite which Action, the upper Bill is joined 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.

quired. From hence the Food passes into the Gizzard, or proper Ventricle, small in Comparison of the *Ingluvies* or Crop; where, by several 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*.

The Expli-
cation 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 *Venae exillares*; gg. the *Jugulars*; h. a small *Gland* on one of them; ii. the two *Auricles* of the Heart; kk. the *Liver*; l. the *Gizzard*.

Fig. 241. a. The *Trachea*; bb. the *Larynx*; by which Parrots are rendred *Ventri- loqui*; cc. the two Branches of the *Trachea*.

Fig. 242. a. a. The *Cornua* of the *Os Hyoides*; b. b. the 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 the *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 *Bill*; g. the upper *Bill* in another Posture, to shew the small *Ridges* therein.

XIV. The *Ostridge* is esteemed the largest and tallest of winged or feathered Fowl, as being sometimes eight Foot high: Which Bulk, if we compare with the *Tomine jo*, or *Hum-Bird*, weighing about twelve Grains, we may readily discern within what Compass and Latitude the Creation of Birds was ordained.

Observations
on the Dis-
section of an
Ostridge, by
Dr. Edward
Brown, Pb.
Coll. n. 5. p
147.

The whole Foot of this Bird, à *Calcaneo ad extremum Digitum*, is three quarters of a Yard; upon which he sits when he rests himself: But the Foot, properly so called, or longest *Claw*, is only a quarter, the lesser *Claw* one eighth and half a Nail. The Nail upon the longest *Claw* is a Nail long: Above which stand one above another sixty-three 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 eight or nine 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 five eighths of a Yard; the Thigh above a quarter, and very thick.

Upon

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 three eighths of a Yard, and his Neck a Yard, not measuring the Head with it.

The top of the Head is flat, in length three eighths 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 *Sereues* 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 its self down to each side of the Neck, the length of one Eighth of a Yard, and half a Nail.

Besides the many Muscles in the Neck, for the Motion of the numerous *Vertebrae* and the Head, there are two most elegant Muscles, which come from within the *Thorax*, arising within the Chest about the second Rib, which insert themselves on each side of the *Aspera Arteria*; these I may name *Directoros Asperae Arteriae*. At the first dividing of the *Aspera Arteria*, or its Divarication on every 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 bluish.

The *Peritonæum* doubles and encompasses the Stomach loosely. He hath seven Ribs, and the *Intercostal Muscles* are broad, plain, and beautiful. He had 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 *Ostridge* 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* lie very high, near the Kidneys and Back-bone, and were very small and slender, of a yellow Colour.

The

The Ear is round, and the Orifice will receive one's Finger; the Eye is large and bluish, and almost as big as a Man's.

The natural Colours of the Feather 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 curls all its Feathers.

The *Rimula* of the *Larynx* is long, and the Cartilages about it strong, but no *Epiglottis*, or likeness to a Human *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 had two 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 it is not placed without the *Breast*, but within the *Siernon*; 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 lie between the Coats of the Stomach, and every particular Glandule discharges it self by a peculiar Orifice, thro' 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 lie highest are roundest and thickest; those which lie 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 the 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 *Ostridge* 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 Scrue or *Spiral Valve* within them, after the Manner of the *Cæcum* of a *Rabbit*; this Scrue in both in 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,

crement, 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 three Eighths of a Yard deep or broad, measuring from the Center to the Guts.

The Liver hath four 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 lie both together, they are of the Shape of a *Guitar*. The *Ureters* are firm, strong, white, and long. Behind the Kidneys lie two Glandules, somewhat oval, of about an Inch and 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 *Ostridges*; but *Galen* and Physicians condemn it as hard of Digestion.

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, gives me this Account, together with the 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 amazed 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 afraid of these Birds, lest they should prey on, or injure their Children. The Feather he gave me is two Foot four Inches long, the Quill-part is five Inches three quarters long, and an Inch and half about in the largest Part, it weighed three Drams 17 Grains and half, 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 *Vulture*, of which kind, I believe this also is.

The Cuntur of Peru, by Dr H. Sloan, n. 208. p. 61.

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 Palate; whereas in Men, Quadrupeds, and some Amphibious Fish, there are always two. This Passage in Fowl is exactly in the middle of the Palate,

Observations on the Heads of Fowl, by Dr. All. Moulén, n. 199. p. 713.

Palate, 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 large Fowl, such as *Turkeys*, *Geese*, &c. and reaches backwards 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 forward as the aforesaid common *Aqueductus*, 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 observed) 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 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 Ecchoe.

3. In the Heads of *Woodcocks*, beside 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

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 *Plovers*, *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 *Epiphysse* or two on each Side, which were very flexible as it felt 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 three 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*, *Woodcocks*, *Curlews*, *Geese*, *Ducks*, *Teals*, *Widgeons*, &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 Eyes; 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 observ'd 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 those 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; *bb.* that in the lower.

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 sort 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.

By Mr. J.
Clayton, n.
206. p. 990.

2. Dr. *Moulen* and my self, when we made our Anatomies together at *London*, shew'd to the *Royal 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 Accuracy 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: But since in my Anatomies in the Country, in a *Rook* I first observed two Nerves, that came down betwixt the Eyes in 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 I not first seen them 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.

Ib. p. 991.

The Ears of Birds differ much from those of Man or Beasts, there's almost a direct Passage from one Ear to the other of Birds, so that prick but the small Membrane called 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 *Cochlea*; but instead thereof, there's a small *Cochleous*, 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 Hundred of small thread-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 shew'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, or 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

those Letters that are sharp, as *g. b. r.* and never have an Aptitude to learn to sing.

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 *Bronchie* 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* of Fowls are in malignant Distempers applied to draw the Infection out of the Body. For those *Anus's* being like *Cups* and *Ventouses*, the Fowl has often stuck by its *Anus* till it died; in which Case, I have known seven Chickens applied to the Groin of one visited by the Plague, that stuck till they died, and the eighth went quickly off, and lived above a Year and half after.

The Anus of Fowls applied in malignant Distempers, by Mr. J. Templer, n. 36. p. 503.

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 spongy Excrecence (commonly of a dark Musk-Colour) which grows out of the edge of that Coat of the Eye, called the *Uvea*. If this spongy 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 its 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 it self, 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.

A Blenish peculiar to the Eyes of Horses, by Dr. Richard Lower, n. 32. p. 613.

I cannot think that these Excrecencies 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 Eyes of two and four 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 Excrefcencies are, the more the *Pupil* of the Eye or the Sight is in danger of being quite obstructed; which you may further examine, by turning the Horse's 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 'em from being nakedly exposed to the Sun, whereby the *Pupil* will not be so closely contracted, and consequently, the Sight not so much obstructed.

By —, n.
17. p. 750.

2. Horses of an *Iron-Grey*, or *Dapple-Grey*, are frequently inclining to lose one or both Eyes, if back'd or hard ridden too soon.

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 pur-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 Ribbon, like a narrow Mask before her Eyes, the Ribbon-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.

A Horn
hanging at
the Neck of
an Ox, by S.
Malphigi, n.
166. p. 601.

XCIX. About twelve Years ago, I went together with *Mess. Charles Fracastatus*, and *Silvester Bonfilolus*, two very worthy Men, to view an Ox that had been killed, having a remarkable Horn hanging from the right Side of his Neck, at that Part of it where the Yoke rests. The Length of it was about sixteen Inches; and its Circumference not far from the Root, where it was thickest, eight Inches. Its Figure was conical, ending in an obtuse Point, and near the Extremity it was remarkably crooked. In the Basis however, where it was joined to the Neck, it became smaller: Towards its Extremity

it was of a shining blackish Colour, like that which you frequently observe in an Ox's Hoof. Externally it was rough, especially from the Basis to the Middle of it; for the Cuticle together with the *Corpus Reticulare*, and *Papille* below it (which in other Parts usually rise perpendicularly, and constitute the Organ of Touch) began gradually to stretch out and incline towards one another, almost in the same Manner as you may observe at the Roots of the Nails in the Extremities of the Fingers. These *Papille* then, surrounded with the crumpled Scarf Skin and *Corpus Reticulare*, and stretching themselves out in Length, were so inclined and fastened together at their Extremities, as to resemble a good deal the scaly Teguments of Fishes. Towards the Root these scaly Bodies were short, but became gradually longer, and were longest near the Point or Tip of the Horn. Its Texture was likewise different in different Parts; for in the Basis these *Papillæ* were not connected so strictly to one another, but that they allowed a rough crumpled Substance to rise up between their Extremities. But beyond the Middle their Connexion was more compact, and hence they put on a more smooth and shining Appearance. Within it was hollow, and the Thickness at the Basis was very little more than the natural Thickness of the Hide; but becoming thin, it put on the Appearance of a Membrane, plentifully supplied with Blood-Vessels, which lined the Horn internally; and that being removed, the smooth solid Substance of the Horn appeared. The whole Cavity of it was filled with a yellowish muddy Serum, which being exposed to the Fire coagulated almost like the White of an Egg. Under the Root there were a great many conglobated Glands, but remarkably depressed.

It is plain then from a careful Inspection of this Horn, that those *Papille* (which I have taken not unjustly to be the Organ of Touch) covered by the *Cuticula* and *Corpus Reticulare*, whenever they are produced longer than usual, and intimately united with one another, they end in a solid Body; as is common in Horns and Hoofs, which only differ from one another in the external Configuration, and the smaller or greater Density of their Parts. Whence they may be considered as an Addition to the *Sensorium*, and conducting not a little to the Touch. Observing the Production of the Horns sprouting out from the Skull throws a good deal of Light upon this Affair. I hope you will not be displeas'd then if I give you by Way of Supplement the History of this Vegetation or sprouting of the Horns in Oxen.

In the *Fœtus* then, contained in its Mother's Belly, the Skull in that Part from which the Horns sprout out, is almost cartilaginous, and is latest of becoming bony. The Hairs sprout first out there, excepting a few about the Lips, the Skin remaining still smooth in other Parts; and they are placed in such a Manner as together to form a Bone. In the last Months, before the *Fœtus* comes into the World, the bony *Lamellæ* of which the *Cranium* is composed, begin to stretch themselves in that Part obliquely outwards, containing within them little roundish empty Spaces, whence there rises upon the Skull a bony Tumour of a lenticular Figure. This is covered with the Skin, which is thicker here than elsewhere, and discovers several
turgid

turgid Glands between the Skull and the Skin and Periosteum, or Rudiments of the Horns, which shew themselves by Degrees. After the Calf is born, the lenticular bony Tumour gradually increases, by the bony Lamellæ becoming larger, and more turgid, so to speak. Over the Bone is spread a very thick Periosteum, the Rudiment of the future Horn, which again is covered by the Skin, as are also the *Papillæ* and Ash-coloured *Corpus Reticulare*: Here too grows Plenty of Hairs in different Directions. After it is one Month old, the bony Substance with its Lamina and void Spaces or Cells protuberates; so that you may see the Rudiment of the Horn fairly push out, representing a Kind of obtuse Cone. Its external Surface becomes gradually smooth and slippery, and of a blackish Colour. There is a Sort of thick Skin extended over it, from which the *Papillæ* bursting forth, and freed from the Ash-coloured Reticular Sheath, are stretched out, and glued together with a black Juice. These about the Root of the Horn are directed obliquely towards its Tip: But the others which rise towards the Top, sprout out almost perpendicular, and are contained within the *Corpus Reticulare*. These are scarce as long as the Pile of Velvet. In the mean Time the inclosed bony Appendix increases and has various Configurations internally. For the Root for the most Part is fistular, composed of bony Fibres woven together in a Kind of Net-Work; but the rest of it, even to the Tip, is a spongy Substance. There are Blood-Vessels running between, and the Tip which is always softish at this Time, is not of a firm Texture. The Skin likewise is extended over the bony Substance, and is thickest in the Basis. From this then the *Papillæ* of the Touch emerging, are lengthened out so, that inclining towards the Point, and united together by the *Corpus Reticulare*, they constitute a Number of hollow Cones, and from the Union of these (as of so many *Lamelle*, like those of Onions, placed within one another) the solid Body of the Horn is composed. The Rows of *Papillæ* that rise out from the Basis, although they do not all reach as far as the Tip, for the most Part however are produced streight forwards, and almost surround the Horn. Others are likewise propagated in different Planes from the Skin, the longer ones inclosing as it were the shorter; whence the Horn being cut longitudinally, not only the bony Substance occurs, but likewise the Skin from which the soft *Papillæ* push out, which being changed into the Substance of the Horn become solid and black, and the Bone being tore off with the surrounding Skin, the Tubes of the Horn appear composed of a bony Net-Work. You likewise meet with various Rows and Planes of the *Papillæ* of the Touch, and their Productions as far as the Extremity of the little Horn; and as these different Planes make up the Extremity of the Cone, hence it is that its Point is about the Thickness of one's Finger. These *Papillæ* which compose the Basis of the Horn are still soft, and easily torn, or fly off in Scales; but towards the Point they are so compacted, and so firmly connected together by the *Corpus Reticulare*, that they become quite solid, and put on a shining black Colour. Their Progress is very evident;

for

for they appear to be composed of a Number of Filaments running longitudinally upon the Horn.

As soon as the Horns become about twelve Inches long, the included bony Part is increased in its Length, and where it is not a continued bony Canal, you see it composed of a great many bony Cells. This Structure appears plainer upon cutting the Horn longitudinally; for at first you see the Bone externally formed into a Tube, from the Inside of which run a-cross bony Lamellæ, which meeting with one another, form a great many bony Cells of different Figures and Sizes, and all these Cells are lined with a thin Membrane, plentifully supplied with Blood-Vessels. Towards the Tip the bony Substance puts off its Cellular Appearance, and becomes more properly spongy, and appears very red from the great Number of Blood-Vessels with which it is supplied, and which are distributed all through it.

This bony Part above described is covered by the Skin or Hide become much extenuated, from which are produced soft *Papillæ* like those of the Touch, which being sheathed in the *Corpus Reticulare*, and closely compacted together, are stretched out towards the Tip, and compose the true Horn; by which Means the Sides of the Horn which are thin at the Basis, become gradually thicker by the Addition of new *Papillæ*, and at last towards the Tip, when they are all united together, the horny Substance is about two Inches thick.

The internal Surface of this bony Part is black, and made rough by a great many small Foramina directed towards the Tip, through which the *Papillæ* pass. Externally the Tip is sharp, solid, lucid, and black. Towards the Middle however the Horn on the Outside is whitish, and towards the Root inclining to black, and easily separating into Scales.

The Horns still persisting in their Growth, at length the first Rows of the *Papillæ*, which rise from the Basis, being pushed by the bony Substance are broke off from the Skin, whereby the Extremities and Borders of the *Papillæ* appear, not unlike what we see in the Shell-Fish, whose Shells seem composed of a great many smaller ones laid upon one another in so regular a Manner, as that the End of each Plane has a Resemblance to all the others. The same Structure is likewise conspicuous in the Horns of the Roe Buck, whence from their Roots to the Middle you may observe several Roughnesses like little Knots, which are produced from the different Layers of *Papillæ* tore from the Hide at different Times, and retracted upwards, as is evident from examining them carefully with a Microscope.

Last of all, the Horns being arrived at their full Growth, are considerably altered; for externally their Colour becomes various, their Substance more solid, almost diaphanous, and smooth by continual Use. Internally the bony Substance terminates in a blunt Point, and its whole Length is still covered with the extenuated Hide. The *Papillæ* of the Touch formerly emerging from this are obliterated, especially in the Point: For the internal Surface of the Horn, by the *Vaginulæ* or Extremities of the *Corpus Reticulare* disappearing, from the Redundance of that Fluid which glues the *Papillæ* together,

ther,

ther, towards the Basis becomes intirely smooth and polished, so that the Productions of the *Papillæ* are as it were obscured.

I have likewise observed the Production of the Spurs of Cocks analogous to this; for they also arise from the Cuticle and the *Papillæ* below, included in the *Corpus Reticulare*, so that the bony Substance increasing within in its Bulk, the Skin is stretched out upon it with different Layers of the Scarf Skin, and a new Horn as it were, though exceeding small, is produced.

From what has been said then we may conjecture, that the monstrous Horn in this Ox, took its Origin not so much from the further Production of the *Papillæ*, Hide, and *Corpus Reticulare*, but from the internal Tumour endeavouring to protrude itself, and the Compression made upon the Neck by the Yoke; for in the natural Production of Horns, the bony Substance sprouting out, gradually pushes forwards, and carries along with it the extended Skin, so that the *Papillæ* towards the Tip are considerably lengthened. But in the monstrous Horn these *Papillæ* were probably enlarged, or became luxuriant from the redundant Fluid passing through the reticular Filaments of which the Hide is composed, into the *Papillæ* continued from it, and into the mucous *Corpus Reticulare*, as happens on the growing of the Hoofs, which are produced from the Extremities of the *Papillæ*, and would grow into a deformed Length, if they were not either pared, or wore away by Attrition. It is probable likewise, that from the Weight of the incumbent Yoke, the neighbouring Part of the Neck must become callous from the Pressure: For the Motion of the Blood in that Part is thereby hindered; the Humours which used to flow through the Skin are stopped; and the Sweat and Perspiration obstructed in their proper Vessels; whence the *Papillæ* of the Touch are affected both as to their Substance and Situation or Direction, and the *Corpus Reticulare*, which is naturally mucous, becomes of a bony Consistence. But this gluing together of the *Papillæ* very probably happened from a vitriolick Humour flowing through the Excretory Vessels of the Skin, or at least from the acid Effluvia confined and fixed, while at the same Time the Alkaline and watery Particles flying off, there is produced a solid and almost lucid Body, like hardened Serum of the Blood.

A Lamb
suckled by a
Weather, by
Mr. Thomas
Kirke, n.
214. p. 263.

C. Sir Will. Lowther (in Yorkshire) had a Lamb, 1694, which, being left by the Ewe, suck'd a Weather (*aries Castratus*) 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 September, each side whereof was about the bigness of a Hen's Egg; and he had two 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 November 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.

There

There is no Token at all of a *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* died upon Shearing, when the *Lamb* was about five 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 Physicians, were invited to look upon an *Ox*, that had two or three 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-Pipe and Lungs of some Animals, by Mr. Rob. Boyle, n. 6. p. 100.

CII. 1. On the Borders of *Italy* a *Murrain* 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 *Blue-Mist*, that fell upon those Pastures where the Cattle grazed, insomuch that whole Herds have returned home sick; being very dull, forbearing their Food, most of them would die away in twenty-four Hours. Upon Dissections, were discovered large and corrupted *Spleens*, *Sphacelous Corroded Tongues*, some had *Angina Maligna's*. Those Persons, that carelessly managed their Cattle without a due respect to their own Health, were themselves infected, and died away like their Beasts. This Contagion may probably proceed from some Noxious Exhalations thrown out of the Earth, by three distinct Earthquakes perceived here, and in our Neighbourhood in the space of one Year.

A Murrain in Switzerland, and its Cure, by Dr. Winckler, n. 145. p. 93.

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 unwashed Linen; 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*, *Sali*, equal Parts, and as much Water as is necessary to wash it down; give a large Spoonful for a Dose.

2. I am assured, by two ingenious Travellers, that this Contagion reach'd the Borders of *Poland*, having passed quite through *Germany*; That it

By Dr. Fred. Slare, ib. p. 94.

was observed to make its Progress daily, spreading near two *German Miles* in twenty-four Hours; that it continually without Intermission made Progressive Voyages, and suffered no neighbouring Parish to escape; so that it did at the same time infect Places at great Distances, that Cattle secured at Rack and Manger were equally infected with those of the Field. It were worth considering whether this Infection is not carried on by some Volatile Insect, that is able only to make such short Flights as may amount to such Computations.

The Diseases of Dogs, by Sir Theod. Mayerne, 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 four Days. 2. The *Running Madness*, which is likewise Incurable; they fly only upon *Dogs*, and that by Fits, and may sometimes hold out nine Months. 3. *La Rage Mue*, which is a Disease that lies in the Blood. 4. The *Falling Madness*, which seizes on the Head, and is a sort of *Epilepsy*. 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* die sleeping. 7. The *Rheumatick Disease*, this swells the Head very much, and makes the Eye Yellow. In these five latter Diseases the *Dogs* will not eat, (nor at any time when they are sick,) but they live eight or nine Days without hurting any Body, and then die 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.

Observations on the Dissection of a Rat; By Mr. Rich. Waller, n. 166. p. 594.

CIV. The Fore-feet of a Rat resembleth those of the *Castor*; The Hair is also some Fine, some Coarse, 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.

Fig. 247. The *Penis* in the *Rat* has a particular Passage near the Navel, as in *Squirrels*, and not at the *Auus*, as in the *Castor*.

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 Thread rumpled up together, which was visible through the Coats of the Testicle. This Thread continued of near the same Size in the *Epididymides*, only towards the *Deferentia* it grew larger.

It

It was tender, and not easy to be unravel'd; so that I could not draw out above three Quarters of a Yard.

The *Prostrata* lay under the Spermatick Arteries.

The Kidneys were whitish, with their *Succenturiati*.

At the Neck of the Bladder were inserted the *Vesiculae 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*.

A A. The Kidneys; *a a.* the *Renes Succenturiati*; *b b.* the *Ureters*; *c c.* the *Crural Veins and Arteries*; *D.* the *Arteria Magna*; *e.* the *Vena Cava*; *F.* the *Bladder*; *g g.* the *Spermatick Vessels, Veins and Arteries*; *h h.* the *Testes, with the Branches of the Veins and Arteries*; *i i.* the *Epididymides*; *k k.* the *Deferentia*; *l.* the *Penis*; *m m.* the *Vesiculae seminales*; *n n.* two Glands, from whence a thick Juice might be pressed out; *o.* the *Balanus*.

*Explication
of the Figures*

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 two 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 Sir P. Ry-
caut, 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 lie 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, Lake, or Morass, 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.

T t t t t 2

These

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 the 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 those Guests, foretelling there will follow great Plenty of Game, as of Fowls 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 ——— 2. These *Mice* are the same with those called *Mures Norwegici*, described by *Olans Wormius* in his *Musæum*.

The Russian
Way of curing
Castoreum; By . . .
n. 163. p. 561.

CVI. Take *Bever-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*.

The Musk-
Quash, by . . .
n. 127. p. 653.

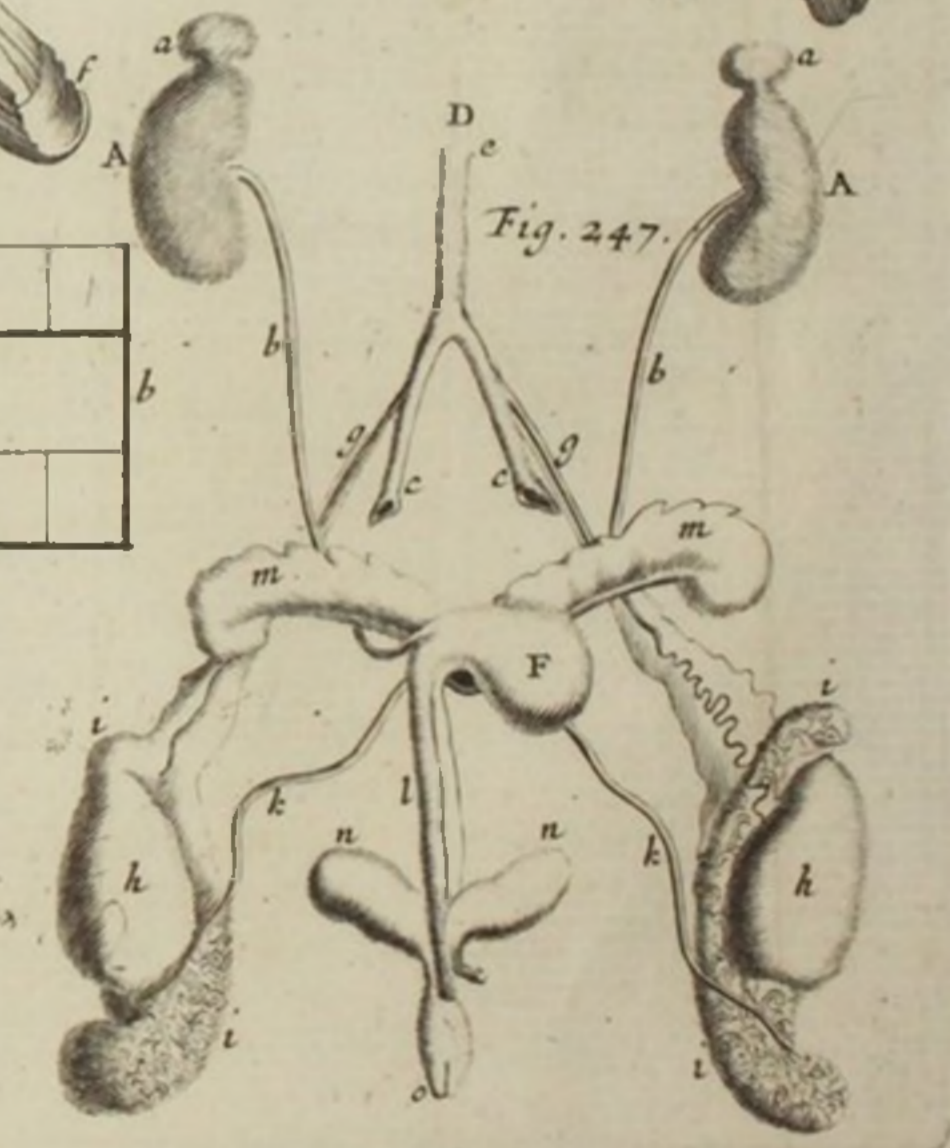
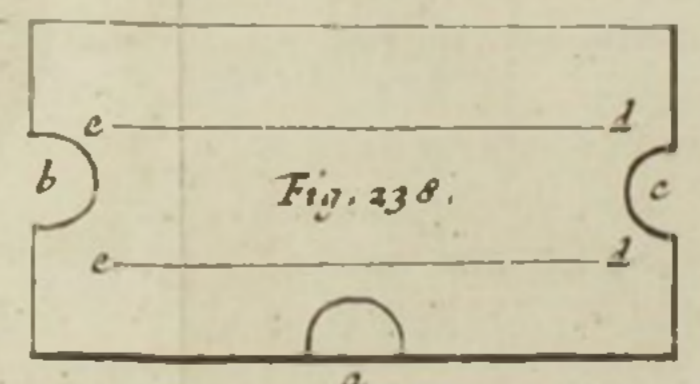
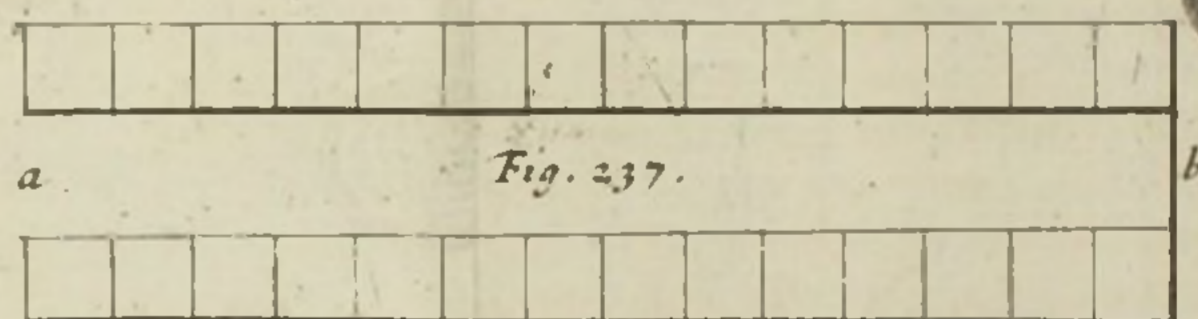
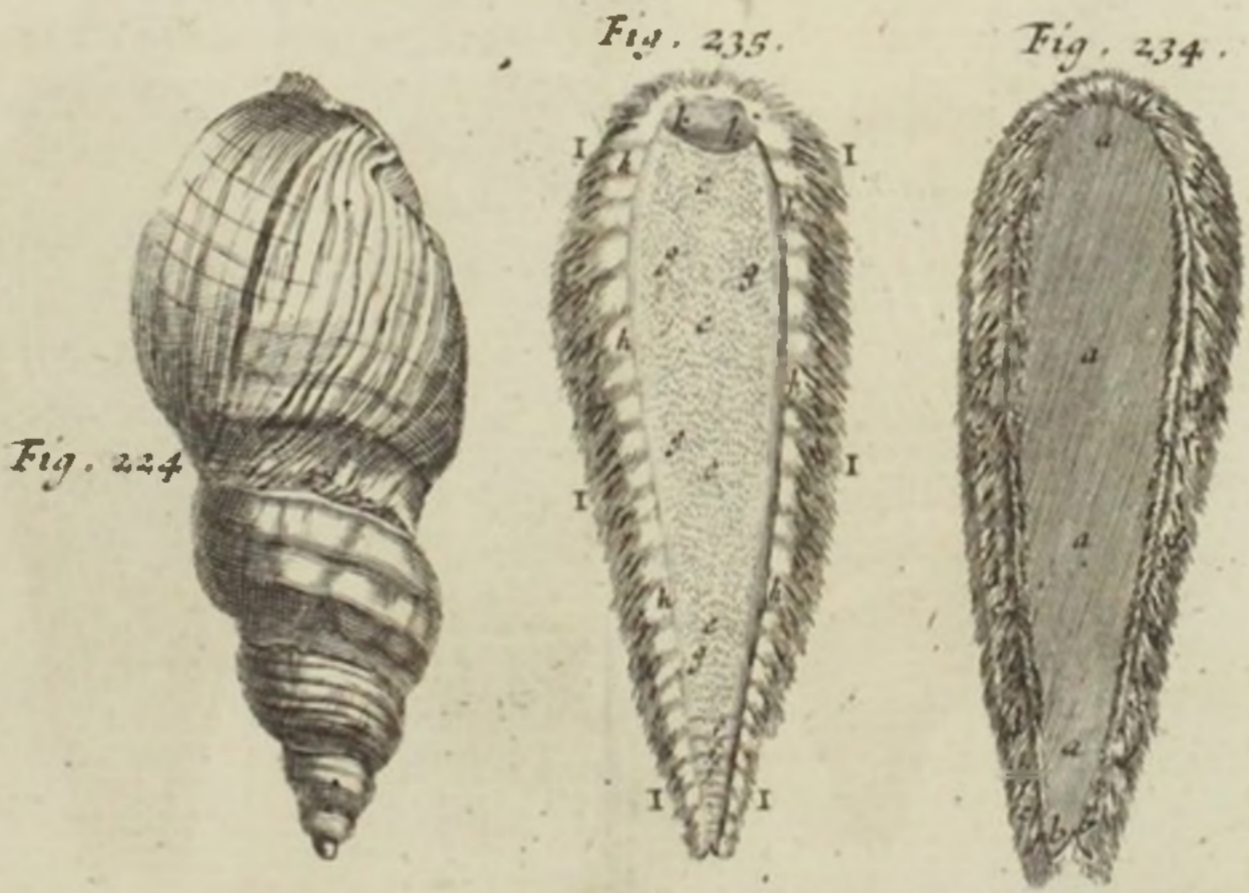
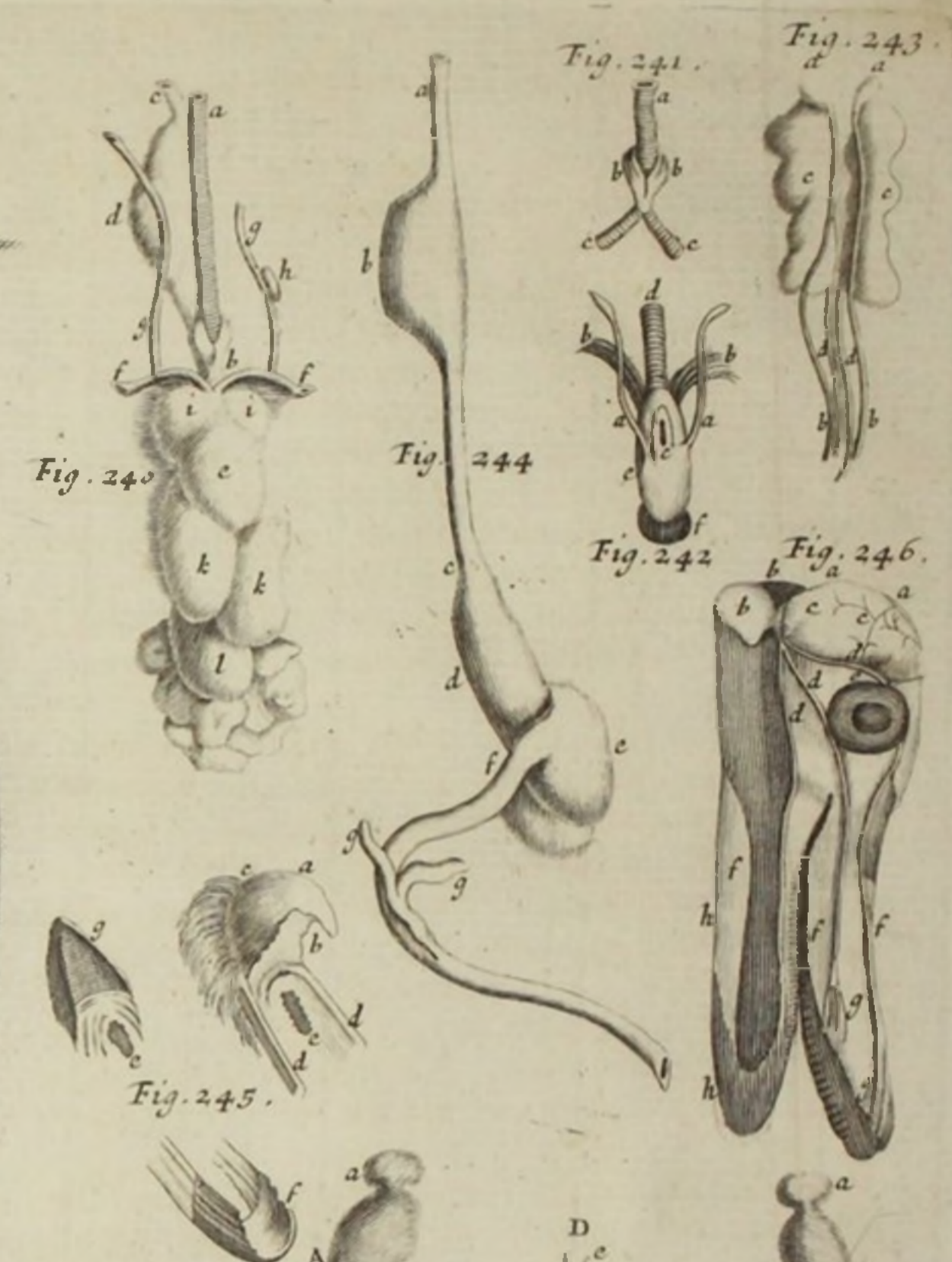
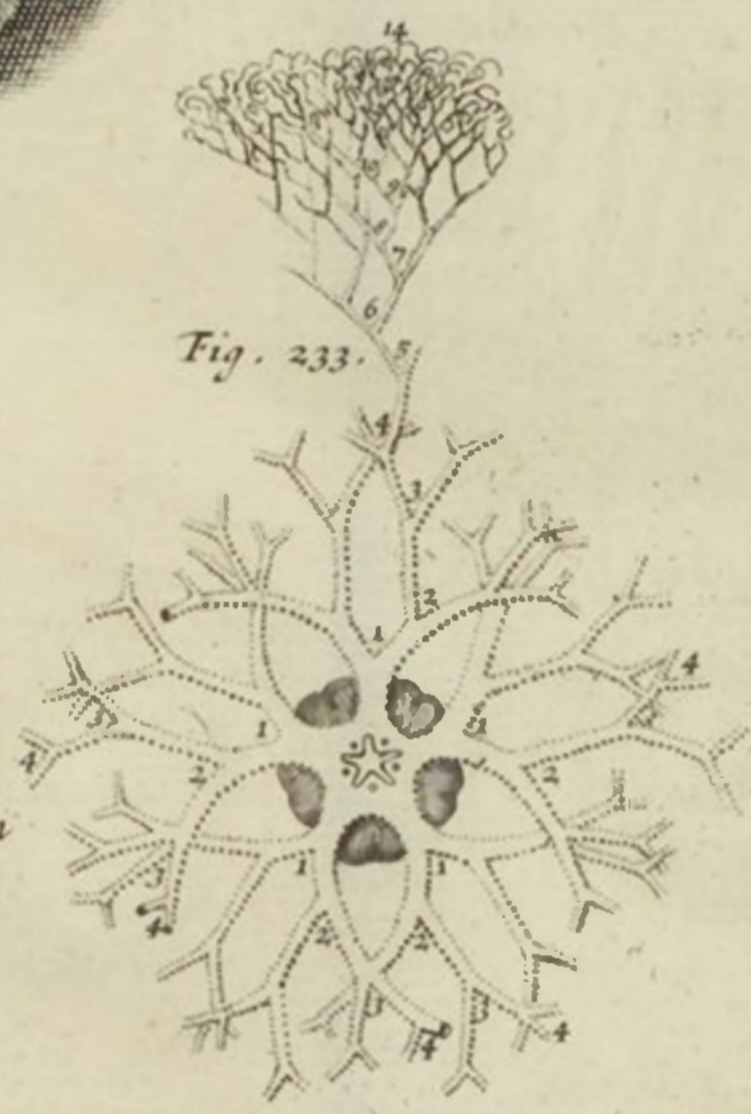
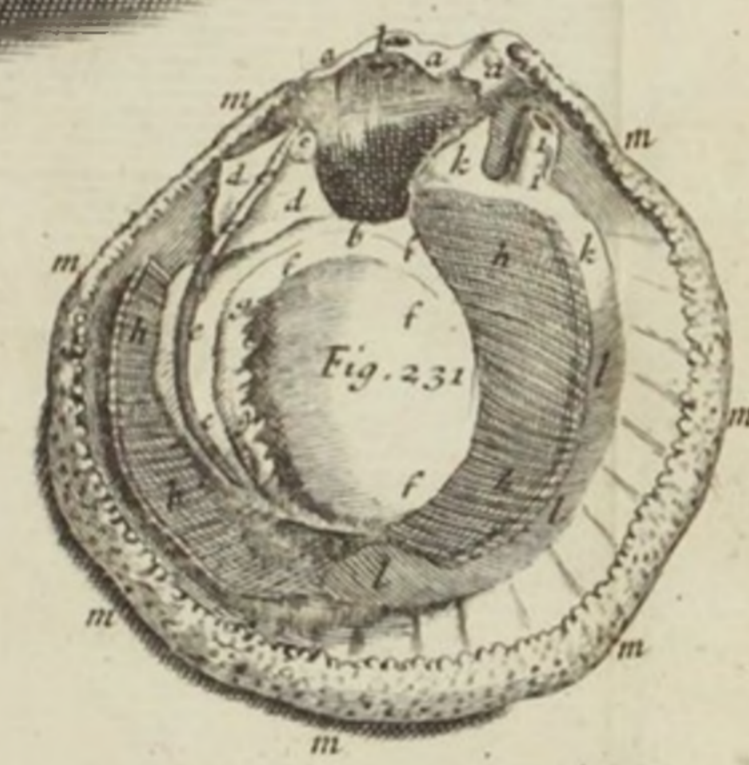
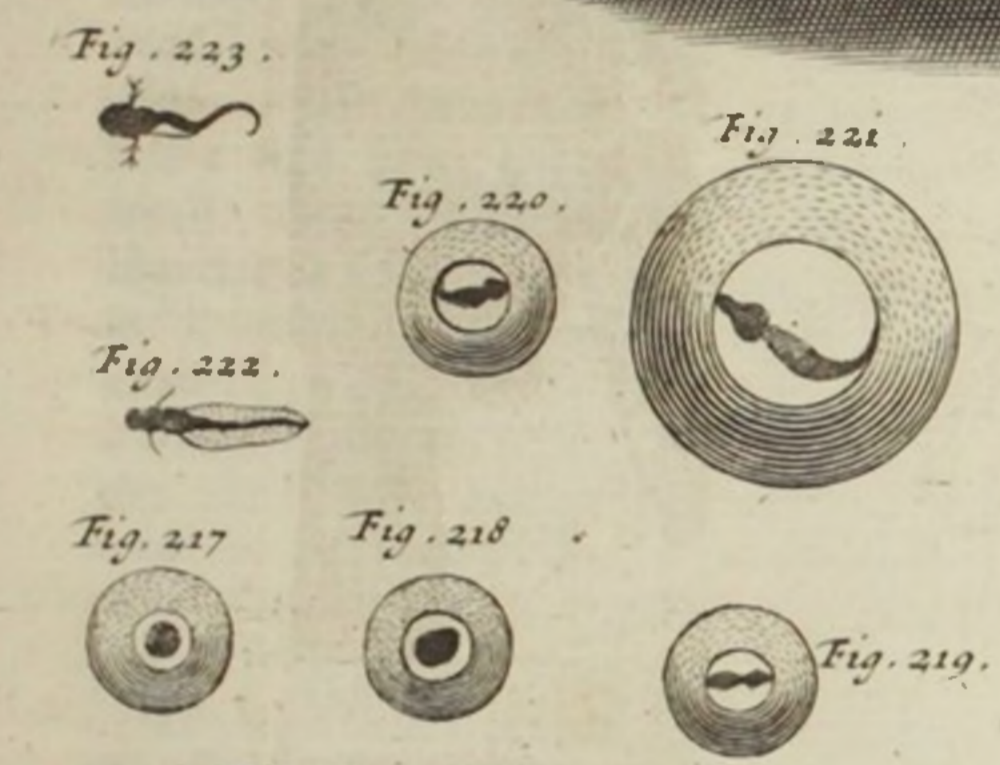
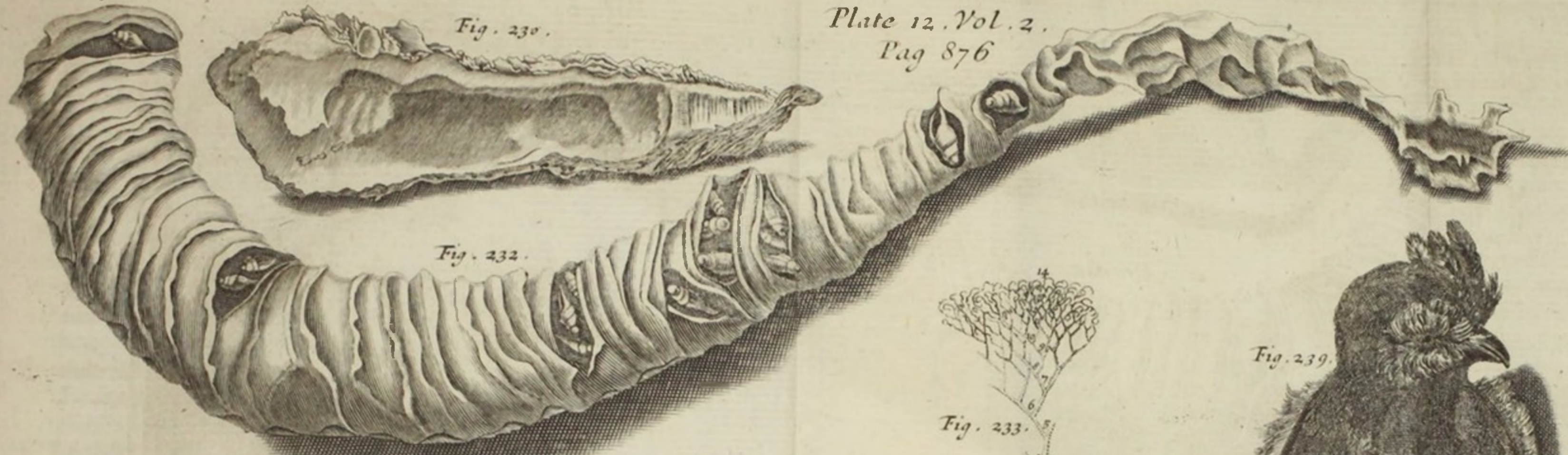
New-Eng-
land's Rari-

CVII. That the Testicles of the Animal in *New-England*, call'd *Musk-Quash*, do smell strong of Musk (as Mr. *Josselin* saith,) is most certain: For, I have known some of them kept a long time in one's 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.

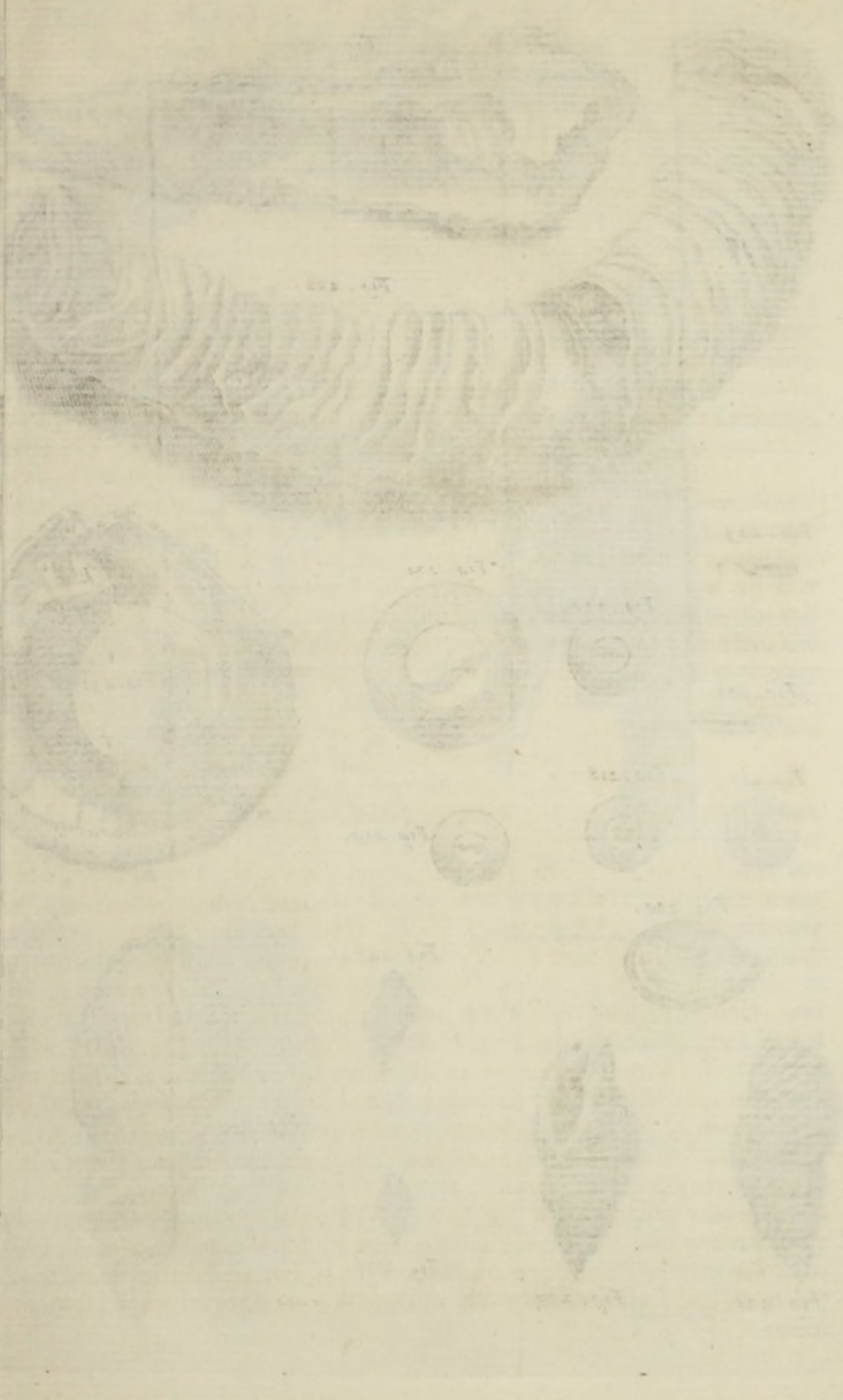
This Animal deserves to be further enquired into, especially if what M. *Thevenot* relates be true; viz. That *Musk* is nothing else but the *Testicles* of a Beast like a *Deer*, found in *China*, in the Province of *Honan*.

The Anatomy
of a Mexi-
can Musk-
Hog, by Dr.
Edw. Tyson,
n. 153. p. 359.

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



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tween the Ears, were two Foot and two Inches, from thence to the end of the Nose eleven Inches; the Girth of the Body two Foot; the Girth of the Neck sixteen Inches; of the Head, in the largest place, eighteen Inches; and of the Snout twelve 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 a *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 close to the Body, by the Insertion of that strong Ligament into the Poll 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'd the Ridge of the Back; where some were five 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 two Inches and a half long, and pricking up; the Eyes (as they are usually in Pigs) but small; from the lower *Canthus* to the end of the Nose, six Inches; the Nose like that of a *Hog*, the Mouth not large, one 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 in 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 Tail. But what is most particular, and differences it from any other Animal I know of in the World, is the Feet, or Navel, or *Foramen* rather, on the hinder part of the Back.

These Animals are bred in *New-Spain*, *Nicaragua*, *Terra Firma*, and *Brasil*: They are usually met with in the Mountains and Woods, and go in Herds together. They feed on Roots, Acorns, and Fruits; but, as the greatest Delicacy, they hunt for all manner of Poisonous Serpents and Toads; and having caught them, holding them with their Fore-Foots, 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 twenty-four Years) *Radicem seu certæ Arboris Corticem sibi notum querit, quem comedit, ne Veneno inficiatur; & hæc ratione optimè nutritur. Crescit & augetur.* When they are made tame, they will feed on any thing; but naturally they are very fierce.

Ovideus remarks, that the Swine, which the *Spaniards* left on the Islands of *St. Domingo*, *St. Joannes*, and *Jamaica*, multiply'd and encreased; but those in *Terra Firma* durst never go in the Woods, but were destroyed by the *Lions*, *Tigers*, and *Lupi Cervarii*: Yet in these Woods there are great Herds of these

Tajacu's

Fig. 248.

Fig. 250.

Hist. Anim.
Mexican.

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 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 furiously 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 *Œsophagus*, 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 Third, which emptied it self into the *Duodenum*. The first Stomach was lined within, with a white thick hard Mem-

Fig. 254.

brane, 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 inclining to the common make of that of *Carnivorous Animals*: The Third somewhat like this, but thicker and rimped 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 *Filberd-Kernel*, like a stopple to the *Pylorus*, for preventing (as he conjectures) a too 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 Nature's 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*.

Stomach and
Guts of
Quadrupeds,
c. 3.

Fig. 252.

The Small Guts, which in other Animals, being fastned 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 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 Centre or middle, made a *Spiral Line*, its End hanging loose, and its turnings

turnings closely united one to another by Membranes. The *Colon* was very large, in respect of the other Guts; and, as I measured it, it was nine 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 *Meseraick* 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 streight 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 the middle was one Inch and half broad; it was of a Lead-Colour, a little Speckled or Marbled. The *Liver* consisted of four large Lobes, and was of a dark red Colour; it appeared plainly Glandulous; and had no *Vesica fellea*, but it had a *Ductus Bilarius*, which went from the *Liver* to the *Duodenum* as usually. The *Pancreas* was about five or six 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 one Inch and half long, in some places a quarter; 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 rising in the Inside of the *Urethra*; which *de Gaaf* 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 three Eighths 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. The *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 three large Swellings out. The largest was that nearest the Heart, which after a small streightning, again emptied it self into the Second; which, though something less than the First, yet was much larger than the Third, 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 preternatural.

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 *Choroides* of a Pale Violet, and brownish Colour.

Just on the Ridge on the Back, over the hinder Legs, is seated a Glandulous Body, which all Authors call the *Navel*. It is so covered by the long Britles 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 myself, 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 cover'd with that Muscle, but only the Edges of it enclosed 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

Fig. 251.

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 Secretary Ductus's which terminating at last in one, discharged its separated Juice by a common Orifice.

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 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 *Pole-Cats*, in which, just at the Extream of the *Rectum*, were placed two Bags fill'd with a crassie 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 *Pole-Cat* kind, in our common Cats; in a Lion; in Dogs; in a Fox, &c. Those Bags in the Civet-Cat, or *Hyaena Odorifera*, are nothing but the same; as are likewise those of a *Musk-quash* 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 *Castorcum* we have in our Shops is not the Stones of a *Bever*, as formerly reputed, but of the same Nature altogether with our Scent-Bags.

Plot's Nat. Hist. Oxfordshire.

Vid. suprâ. §. CVII.

Vid. suprâ. §. CVI.

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-Snakes, in Vipers, in our common Snake, &c. two long Bags in the Tail, which empty their fœtid 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 three Pipes, or Secretary *Ductus*, arising on the Top of it, above the Surface of the Skin, which discharges a fœtid Liquor. I find these Glands the largest in Geese and 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 *Ostridge* 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 myself, 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-Glands* 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 Cats 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 *Factor*. So the same of *Rats*, of *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 make 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 as Ambergrease at the first, as *Gull. Piso* assures 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 foetid Liquor in the Scent-bags of a *Weasel*, having formerly put it on a Paper, and 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, eight Inches and a half. 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 so kept straight up, and 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 four Teeth, or *Incisores*; a little further, 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 six Inches

ches and half long, one and half broad at the first double Tooth, of which there were six of each side. The Bone of the lower Jaw here, from the *Dentes Morales* to the *Incisores*, seem'd spongy and curious; and the Tusks in this Jaw were rooted out; as were one or two of the *Incisores*, which in all were about four.

There were seven *Vertebrae* of the Neck, which measured in Length four Inches and a half: The first, or *Atlas*, had two broad transverse Processes, but no Spine, the second had a large Spine, the third, fourth, fifth, had no Spines, the sixth, and seventh, had large Acute ones. There were nineteen *Vertebrae* of the Back; the Spines of the first, second and third, were about three Inches long, but they gradually decreased, as they approached the Tail. The first *Vertebrae* of the *Os Coccygis*, was two Inches long; but I thought, that at first it might have been several, though now it was but one Bone. There were about six *Vertebrae* more, which ran no farther than the Extent of the *Os Ischii*. There were fourteen Ribs of each side; the *Os Sterni* jutting out about an Inch beyond the setting on of the first Ribs.

The *Scapula* was five Inches long, the *Os Femoris* of the Fore-foot, five Inches and half long; the *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 juttet 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 two to each Claw, and 3 Claws to each fore-Foot. The *Os Femoris* of the hinder Foot, was almost six Inches long; and near its Juncture with the *Os Tibiae* it had a small Bone, like the *Patella* in the Knee of a Man. In the Leg here were two Bones; the *Fossile Majus* and *Minus*, five Inches and a half long: But this Part in the Fore-Leg was only a single Bone, though in a Dog, a Monkey, and some other Animals, there are two Bones in the Fore-Leg likewise. The *Os Calcis* was almost two Inches long; and there were four other Bones of the *Tarsus* or Instep. The *Metatarsus*, or Foot, was composed of four Bones; and the two innermost much the largest, being two and a quarter long: there were four *Digiti*, and in each three Bones, whereof the last was covered with a Nail.

Fig. 248. Represents the natural Shape of this *Mexico-Hog*, and the Line *a*, points to the Scent-Gland.

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 Curious; *f*. the *Cranium*; *g*. the Orbit of the Eye; *h*. the *Porus Auditorius*, or Passage of the Ear; *i*. the Triangular Expansion of the *Cranium* backwards; *k*. the *Vertebrae* of the Neck; *ll*. the *Vertebrae* of the Back and Loins; *m*. the *Vertebrae* 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 Protuberance of the *Tibia*; *w*. the *Tibia*, or *Fossile majus* of the hinder Leg; *x*. the *Fibula* or *Fossile minus* of the hinder Leg;

U u u u u a

Explication
of the Fi-
gures.

Fig. 248.

Fig. 249.

Leg; *yy*. the *Tarsus* or Instep, on both Legs; *z*. the *Calx* or Heel, in the hinder Leg; *ααα*. 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 *Œsophagus*, or Gullet; *b*. the first Ventricle, or Stomach; *c*. the second Ventricle, or Stomach; *d d*. the *Cornua*, or Horns of the second Stomach, *e*. the third Stomach; *f*. the *Pylorus*; *g g g*. the *Intestina Tenuia*, or small Guts; *h h h*. the *Colon*; *i*. the *Cæcum*; *k*. the *Rectum*; *l*. the Mesentery; *m m*. the Meseraick 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 three Stomachs, more in their natural Situation; *a*. the *Gula*; *b*. the first Stomach; *c*. the second Stomach; *d*. the third Stomach; *e*. the *Pylorus*; *f f f*. the Blood-Vessels.

Fig. 254. Fig. 254. The Stomach opened; *a*. the *Œsophagus*, or *Gula*; *b*. the Entrance of the *Gula*, or Gullet into the first Stomach; *c c*. the inside of the first Stomach, which was invested with a strong, thick, white Pellicle or Membrane; *d d*. the second Stomach; *e e*. 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; *c c*. the *Ureters*; *d d*. the *Testes*; or Stones; *e e*. the *Vasa Deferentia*; *f f*. the *Vesiculæ Seminales*, which here were Glandulous; *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*. the two Muscles belonging to the *Penis*; *n n*. other Muscles assisting to the same.

Fig. 256. 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 Distention of the great Artery open, to shew its several Cells within; *e*. a streightning of the Artery again; *f*. the second *Aneurisma* open likewise; *g*. the third or smallest *Aneurisma*; *h h h*. the *Iliac Branches* of the great Artery.

The Anatomy
of an Opos-
sum, by Dr.
F. Tylon, n.
239. p. 105.

Fig. 257. 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 *Semi-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

receive its young; whence it may properly be named, *Marsupiale Americanum*: And I am apt to think it may be reduced to the Vermin-kind.

It measured from the Extremity of the Nose to the tip of the Tail, thirty-one Inches, the length of the Head was six 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 fifteen Inches and a half; when alive and well, it seemed much thicker. The Fore-Legs were six Inches long, the hinder Legs but four Inches and half. The Girth of the Tail, near the Root, was three 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, three Inches; thence gradually tapering towards the Nose, and more resembling that of a *Pig* than a *Fox*. The Apertures of the Eye-lids were not Horizontal, but lying in a streight Line from the Eyes to the Nose, and not large. The Ears were about an 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, measured two Inches and a half.

The Fore-Feet had five long Claws or Fingers equally ranging with one another, and a hooked Nail at the end of each Finger. The hinder Feet had four 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 Human 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-Feet in bringing the Food to its 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 the Scales makes the Tail to appear whitish, tho' 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 are 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 *Forus Auditorius*,

torius, 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 died, to be so shrivell'd, as if burnt up, not making 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 *Mustachio'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 dappled with black Hair in spots, intermixt with white, especially on the Back; on the Belly 'twas more of an *Amber*-Colour; and of a darker on the Legs. The longest Hairs, which were stronger and coarser than the rest, measured three 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 two Inches long; capable of a larger Extension, by dilating it with one's Fingers, even when it is alive. It can so exactly close and contract it, that the Eye does not

Fig. 259. 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

Fig. 260. not to be met with in any other Skeleton, which from their Office I take

15. 15. leave to call *Ossa Marsupialia*, or *Janitores Marsupii*. The Bones are so

Fig. 261. cc. 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 two Inches and an half. The Basis of these Bones, where joined to the *Ossa Pubis*, was half an 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 observ'd 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 a quarter of an Inch broad: And they were each two Inches, long. To these Bones there were bestowed four 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 Tendency 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 joined 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 joining 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 in the Spine of the *Os Ilii*. The two first of these Muscles must serve towards the *Dilation* 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 Pair, as they may serve to dilate the Capacity of the Pouch it self, so likewise may serve the better to suspend its Weight, when the Animal is *prono Capite*, and if it gravitates too much, they may retract it up; and the easier, because, passing over these Bones like a Pulley, their Force is more augmented. The Antagonist to their Muscles is the *Sphincter Marsupii*, an Oval Series of strong Fleishy 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.

The Pouch, or *Marsupium* it self, was a membranous Body, not very thick though 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 of a Man, it is observed.

The Liquor, thus emptied into the Pouch from the Glandulous Coat, I found was strong-scented, and had more of the peculiar *Fætor* of this Animal,

Fig. 259.
A.

Vid. supra.
168.

mal, 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-Bags in other Animals. And I am apt to think that 'twas by removing this *Marsupium*, rather than taking away the Kidney, that these Animals are made Edible, which otherwise stink so much, that the Barbarous Nations refuse them, as cut 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 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.

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 them: 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 usual in other multiparous Animals.

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.

Halientie.
Lib. 1.

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 Mothers 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 three 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,

al, but the Heart itself I thought proportionably larger, in respect to the bulk of the Body, than is commonly, nor was its Cone so sharp, but rather more obtuse. It had two *Auricles* and two Ventracles. About the Throat there were large *Glandulæ Maxillares*, the Tongue was a little above three Inches long, and above three quarters of an Inch broad; 'twas rough, having Protuberances whose Points looked inwards; the Voice, or Noise it made, was a little Growling.

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 rendred so the more, by Reason it often hangs by its Tail, and, when it does so, the *Viscera* in the *Abdomen* can't but press upon it.

The Ventricle or Stomach something resembled the Figure of a Half-Moon Fig. 263. B. 8. 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 Stomach, I found only a very slender *Isthmus*, or Wall parted them. These Orifices were inserted almost in the middle of the upper 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 three Inches and half in length, and about two Inches in Depth. The *Gula*, which conveys the Food into the Stomach, consisted of strong *Muscular* Fibres, and was in all about nine Inches in length. The *Pylorus*, that carries out, seemed 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 other Intestines.

At one side I observed a Perforation, or Hole through, about the bigness of Fig. 263. C. 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 uneasy Motion made its Keeper suspect, it had swallowed something that stuck in its Throat, or injured its Stomach. A like Accident I had three times met with in the Dissection of Human 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*; though 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 larger part of one side of the Stomach was sphaciated. So likewise upon a Corrosive Poison taken, its effect dilates itself 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
Stomach 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 *Tophi* 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 mis-informed, by this means it can fly or pass from one Tree to another, without descending; for thus hanging by its Tail, and waving and swinging its Body like a *Pendulum*, it can fling itself 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 Leg being made like Hands with a Thumb, it can more readily raise its Body up by them. But though 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.

Fig. 263. 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 *Periphery*, or outward Circumference of the *Mesentery*; but the outward Membrane of the *Mesentery* 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 *Mesentery*; 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.

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 *Cacum*) towards the middle of the *Spine*. Hence I found a Projection of the first *Mesentery* into a Spiral Line, like a *Coclea*, or Winding Pair of Stairs: So that upon Inflation, these Intestines here made several Convolutions, tho' not exactly *Spiral*. The second *Mesentery* was projected more in a Plane; and made almost a Circular Figure at its *Periphery*: So that the *Cacum*, and *Colon*, did almost entirely encircle the small Guts.

The

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 Plane. 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 *Woodcock*. Vide supra,
§ CVIII.

The small Guts measured about six Feet and a half in length; the *Cæcum* was about six Inches; and the *Colon* and *Rectum* two Foot long. The Girth of the *Duodenum* (I mean all along here as inflated) was three Inches; the *Ilium* two Inches and a half; the Girth of the *Cæcum* in the largest place was six Inches; of the *Colon* four Inches: And the *Rectum* was three Inches about. From the *Spine* to the utmost Projection of the small Guts, (under the same Circumstance of Inflation) we measured about six Inches; the greatest Diameter, that the *Colon* in this Circular Figure made, was somewhat above seven Inches. In the whole *Duct.* or *Canalis* of the Intestines, I could not observe any Valves, no, not in the *Cæcum* it self. 'Tis true, that the *Foramen* into the *Cæcum* was a great deal less than the Capacity of the Gut itself: 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 gave a greater opportunity to the separation of the Chyle into the *Vasa Chylifera*. And the *Cochlea*, or Spiral Figure of the first *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 the 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 four Feet.

The *Pancreas* was large, having one part (if I mis-remember not) running towards the Spleen, and the other down by the *Duodenum*. The Liver was very large, of a bright red Colour, consisting of three Lobes, two of them were much larger than the third, 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 rendred 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 three quarters 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 Fig. 267.
B B B.

X x x x x 2

Inside Fig. 264.
A A.

Inside of the Kidneys, towards the upper part, were placed the *Glandule Ranales*, which were very large, and of the same Colour with the Kidneys themselves, which was a deep Red.

Fig. 364. f. The *Ureters* were about five Inches and half long, and were inserted into the Neck of the Bladder of Urine, as is represented, first running under, then ascending up by two Extrems 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 *Uretkra*, (which was about an Inch long) lay over the *Vagina Uteri*; and here the *Uretkra* and the *Vagina 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 four 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 *Lamine*; which were easily separable from one another, in broad Flakes, so as I have never observed before.

Fi. 264, 265. Amongst the *Uterine* Parts, which were very surprising, we found two *Ovaria*, two *Tubæ Fallopiæ*, two *Cornua Uteri*, two *Uteri*, and two *Vaginæ Uteri*. The *Ovaria* were placed one of each side near the Extrems of the *Cornua Uteri*, being fastened to the *Alæ Uteri*, and were about the bigness of a *Vetch*. The *Vasa Præparantia* (the Artery and the Vein that did go to and from them) were very plain, and as I have represented them; though the greatest part

Fig. 264. n n n. 0000. of these Vessels were bestowed upon the *Cornua Uteri*. Near the *Ovaria*, I observed the *Fimbria Foliacea*, and thence a Passage into the *Tuba Fallopiana*. The *Tuba Fallopiana* were two fine slender *Canales* or *Ducts*, supported by the *Ala 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 *Ala 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 in our Subject, (having five or six 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 *Embryo's* here, so great a number of Blood-Vessels is highly necessary, and they were far more numerous here than in the *Uteri* themselves. The two *Cornua* do empty themselves into the two *Uteri*, just in the middle where they are conjoined together, and

Fig. 164. xx.
Fig. 265. cc.

Vide supra,
§ XLIII.

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 two, 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 *Ale*, as are the *Ovaria*, *Tuba*, 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 a Membrane, to the *Rectum*, where they are more separable. So that the Neck of the Bladder lies over the *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) was about an Inch and three quarters: Hence they were projected towards each side, and not according to the length of the *Spine*, gradually enlarging the inward Cavity, as 'tis extended; for here about the Angle of Reflection, if measur'd in Compass, two Inches and an half. The *Uteri* being thus extended towards each side about the space of an Inch and three quarters, 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 parts of the *Uterus*; the Capacity of each *Uterus* being the largest at the outward Elbow, where it begins to be reflected; for 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 the 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 *Fasciculi* 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 an Inch and half 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 *Fora-*

men

men 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 *Vagina*, 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 *Brasile*, described by *Margrave*, differs from our Subject, the *Possum*, only in Sex.

The *Skeleton* of the *Head*, from the End of the *Occiput* to the Extream of the *Nares*, was four Inches and three quarters long, of which the *Rostrum* measured three 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 *Quadruped*. 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 run slender towards the Extream of the *Nares*, yet these Bones towards the *Forehead* spread into a Triangular Figure, and as they are jointed together, they form a *Rhomboid*, or a *Lozenge*. There was a remarkable rising Ridge like a *Crest*, that runs the length of the *Cranium*, from the *Forehead* to the *Occiput*, just in the middle, where the *Sutura Sagittalis* is in other Skulls. This Ridge, for Distinction-sake, I shall call, *Protuberantia Ossa 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 *Lambdoïdal Suture*, may be those other Ridges in the Extream of the *Occiput*, which I shall call *Protuberantiæ Ossa Laterales*: Which arising on each side from the *Processus Styloides*, ascend oblique up the hinder part of the *Occiput*, and just in the middle in the top are joined 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 three quarters 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 strengthening
this

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 two Inches and a half long, and standing off from the *Cranium* an Inch in distance. In the Orbit of the Eye, at the inward *Cantus*, 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, are 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 an 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 Mammillares*, 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 *Lamina* it enjoys, so that the Membrane that covers them, by this means, is rendred 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 consisteth of two strong Bones, joined together only at the *Mentum*, each measured four 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 there 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 eight small *Dentes Incisores*, four of each side; then a Void Space, 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 on each side, with three *Dentes Incisores*: But these were much stronger and larger than the Fore-Teeth, and imitated the *Dentes Molares*, were flat and almost of a Triangular Figure; there were four *Dentes Molares*, on each side, in all 24 Teeth in the upper Jaw. But the Double Fangs of the *Molares*, and the *Incisores Majores*, were such as at the first Sight, one would think two Distinct Teeth, each Fang being inserted into a Distinct *Alveolus*, or Socket, in the Jaw, and remaining separated some way above the Jaw-Bone, and only joined at the Head. In the under Jaw-Bone, there were likewise of each side, four *Dentes Incisores Minores* before, then a little
Void

Void Space, after that the *Dens Caninus*, then three *Dentes Incisores Majores*, and last of all four *Dentes Molares*, answerable to those in the upper Jaw, but somewhat smaller. In both Jaws, in all 48 Teeth.

There were seven *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 three quarters of an Inch in height, about the 3d part of an Inch thick, and just at the top seem'd 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 to the top, but gradually lessening in height, as also thickning. 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 *Oblique Processes* before, and none behind, and two Acute *Transverse Processes*, and a very short and sharp *Spine*: So that upon holding up the Head, the *Spine* of the first *Vertebra* of the *Thorax* would touch the top of the 5th *Vertebra* of the Neck. These *Vertebrae* are so strongly and closely locked into one another, that tho' each of them are large in themselves; yet thus articulated, they do not make full two Inches in length. This Thickness and Strength of the *Vertebrae* of the Neck, and likewise of several of the *Vertebrae* 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.

Fig. 268.

Fig. 268. d.

Fig. 269.

Fig. 270.

Fig. 271.

The first seven *Vertebrae* of the *Thorax*, have three *Oblique Processes* forwards, which run 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 *Vertebrae* are slender, thin, and sharp, about three quarters of an Inch long. The six following *Vertebrae* 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 *Vertebrae* 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. four at each end of the *Vertebra*, and the undermost spreading them-

themselves out broad. The three *Vertebrae* 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 *Vertebrae* of the Tail, had only one small acute Spine, but in all the other *Vertebrae* of the Tail, both at the Head and Tail of each *Vertebra*, I observed two Spines, but those at the Head of the Joint the larger. In the six first *Vertebrae* of the Tail, there was on each Side, a broad transverse Process, the length of the Joint; in the other *Vertebrae*, only at the Head and Tail, a Jutting out at the sides. The *Vertebrae* about the middle of the Tail, were the longest; being there about an Inch long; 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 Under-side of the *Vertebrae* of the Tail, are a wonderful Piece of Nature's Mechanism. 'Tis true, the first three *Vertebrae* had none of these Spines, but in all the rest they were to be observed; but as they approached the extremity 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 Joint, and in the middle from the Sides, and seemed to be articulated, both to the preceding and following *Vertebrae*, not being an entire solid Body, but arising from the *Vertebrae* with two Legs or *Crura*, become afterwards perfectly united to 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 *Vertebrae*, for the receiving them, whereby they are the better secured from Compression, when this Animal hangs by its Tail. And for 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 Joint. But for the strengthening the whole, there were observed four 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, founding 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 Joint, or *Vertebra*, in curling and unbending the Tail.

To the *Vertebrae* of the *Thorax* are fastened the Ribs, and there are 13 on each Side. The seven Foremost are more perfectly articulated with the *Sternum*, the six succeeding may be reckoned, in some sense, *Costae Nothae*: 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 though 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, as 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 increase in length, for the 7th Rib was three Inches long, and its Cartilage was one Inch and a half. The four last of the *Costae Notae*, gradually lessen again in length; for the last Rib of all was only an Inch and three quarters long; and its Cartilage did not run home to the *Os Pectoris*, or *Sternum*, tho' the first, second, and third, of the *Costae Notae* did. The *Os Pectoris*, or *Sternum*, consisted of seven 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 extrem of the *Cavicula*. At the End of the *Sternum*, towards the Belly there was a broad, roundish Cartilage, which therefore I shall call *Cartilago Scutiformis*.

There were two *Claviculae* or Collar-Bones, each an Inch and half long, having one Extream fastened to the first Bone of the *Sternum*, or the *Cartilago Ensiformis*, and the other End to the Spine or *Scapula*, near the Conjunction of it to the *Os Humeri*. By means of this Bone, it can more advantageously bring its Fore-feet to its Mouth, as it uses to do when it feeds itself, as do the Monkey-kind, who have *Claviculae* too as well as Man; tho' many Animals want these Bones.

Fig. 262. The *Scapula*, or Shoulder-Blade, was about two Inches long, and about an Inch and half broad; its *Spine*, tho' 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, and to that Protuberance called the *Acromium* was fastened the End of the *Clavicula*. This Thigh-Bone of the fore Legs, was about two Inches three quarters 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 began to grow larger, and was afterwards united to that part of the Basis of this Bone, where the *Fibula*, or *Minus focile* is joined. 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

were not easily, if possibly to be put out of Joint. The *Tibia*, or *Focile majus*, was a strong Bone about two Inches long, which was extended upwards above a quarter 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 inwardly and forward, 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 two Bones of the *Tarsus*, having each a small *Sinus*, for the receiving the Heads of the *Fociles*. The Bones of the *Metatarsus*, were four, or it may be five, to which were joined four Fingers or Toes of the fore Feet. The innermost Toe had but two Articulations, or Joints, but at the end had a large hooked, strong Nail; the other four Fingers had each three *Articuli*, or Joints, armed with hooked Nails, as the first.

The hinder Legs were fastened to the Trunk of the Body by the *Os Innominatum*; which in the whole in a straight Line was three Inches long. In 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 Brims of the *Acetabulum* were not an entire Circle, but broken off here. Fig. 253.

Here also are the *Ossa marsupialia*, or *Janitores Marsupii*. The hinder Thigh-Bone was a little above three 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 to the *Os Calcis*, as the *Tibia* was to the *Talus*, or *Astragalus*; and these two Bodies I make the *Tarsus*; and joining to them were the Bones of the *Metatarsus*, and to these the *Phalanges* of the Fingers and Toes. In the innermost, or the Thumb, there were only two *Articuli*, or Bones, in the other four Toes, or *Digiti*, in each there were two *Articuli*, or Joints. 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 Joint of the Toes, on the under side 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.

Fig. 258. The Slit, or *Aperture* in the Belly, that goes to the *Marsupium*, or Pouch. Explanation
of the Figures
Fig. 257.
Fig. 258.

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. *B B.* the two hinder Legs cut off. *C.* the *Foramen* of the *Anus*: Which is also the common outward Vent, or *Exit*, the *Rectum*, the Bladder of Urine, and the *Uteri* too. *D.* the beginning of the Tail. Fig. 259.

Fig. 260. The *Skeleton*. *AA.* the *Rostrum*, 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

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Rostrum;

Rostrum; *d.* the lateral Ridge, which like a Pent-house, juttet 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*, open Jaw; *g.* a *Foramen*, or Hole, in the inward *Cantus* 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; *b.* 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 inferior Process of the under Jaw; *o.* the *Clavicula* of one Side; *p.* the *Cartilago Ensisformis* 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 *Foscile majus* of all the Feet; *u u.* part of the *Tibia* in the Fore-Legs extended beyond Articulation; *W W W W.* the *Fibula*, or *Foscile minus*, in all the Legs; *x x x x.* the Bones of the *Tarsus*; *y y y y.* the Bones in the *Metatarsus*; *z z z z.* the Toes; *a a.* 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 Loins; 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 *Janitores Marsupii*; * * * *. the Ribs, thirteen in all, \odot the *Cartilago scutiformis*.

Fig. 261. Fig. 261. The Situation of the *Ossa Marsupialia*, &c. *a a.* the *Ossa Pubis*; *b.* the Coalition, or the joining of the *Ossa Pubis*; *c c.* the two *Ossa Marsupialia*, or *Janitores Marsupii*; *d. e.* the Basis of the *Ossa Marsupialia*, where joined to the *Ossa Pubis*; *d.* the Inward Head of the Basis; *e.* the Outward; *f f.* the *Acetabulum*, or Socket, for receiving the Head of the Thigh-Bone; *g g.* the *Os Ilium*; *b b.* the *Vertebra* of the *Os Sacrum*; *i i.* the *Os Ischii*, or *Coxendicis*.

Fig. 262. Fig. 262. The fore-side of the Thigh-Bone of the Fore-Leg; *a.* the Head of the Thigh-Bone, where it is 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 outside; *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. 263. Fig. 263. The Stomach, and Guts; *A.* the *Gula*; *B B.* the Stomach; *c.* a Perforation of the Stomach caused by an Ulcer there; *d d.* 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 Convolution 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 *Ilicon* is discharged and emptied into the *Caecum*, or, if that is full; into the *Colon*, at the first Letter

S, R, R, the *Cæcum*; S S S, the *Colon*; T. the *Rectum*; V. the *first Mesentery*, or *Mesenterium minorum Intestinorum*; w. the *second Mesentery*; or *Mesenterium majorum Intestinorum*.

Fig. 264. The *Urinary*, and *Uterine Parts*; A A. the two *Kidneys*; b b. 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 *Vaginae Uteri*; K. the *common Passage from the Urethra, and the two Vaginae*; l. the *Arteria Aorta, or great Artery*; m. the *Vena Cava*; n n n. the *Spermatick Arteries*; 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 *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 Vaginae*.

Fig. 265. The *Uterine Parts* 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 its left Uterus to shew its Passage in the Vaginae 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 Vagina*; K. the *Urethra*; l l. the *Bladder of Urine cut off*.

Fig. 266. The *Hairy Tophus*.

Fig. 267. The *Liver*; A. the *Vena Cava*; B B B. the three *Lobes of the Liver*; C. the *Bladder of Gall*; d d d. the *Fissures of the Body of the Liver*; e e e. the *Incisures at the Edges of the Liver*.

Fig. 268. A. the *Spine of the 2d Vertebra of the Neck*; b. represents its *Thickness*; c. a large *Sinus for receiving the first Vertebra*; d. the *Dens, or Tooth of this Vertebra*; the *Processus Obliquus Superior of one Side*; f. the *Processus Obliquus inferior of the same Side*.

Fig. 269. A. the *Spine of the 3d Vertebra of the Neck, where is shewn its natural Thickness*; b. the *Hole through which the Medulla Spinalis passes*; c c. 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*; f f. the two *Processus Obliqui Inferiores before*.

Fig. 270. The *first Vertebra of the Thorax*; A. the *Spine, which is long and acute*; b b. the *Oblique Processes before*; c c. the *Oblique Processes behind*; d d. the *Transverse Processes*; e e. 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*; c c. the two *under Oblique Processes behind*.

Fig. 272. The *2d and 3d Vertebrae of the Tail*; a a. 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*; c c. a *Hollow, or Foramen, in the middle of these Spines, through which Blood-Vessels pass*.

*A monstrous
double Tur-
key, by Sir
J. Floyer,
n. 259. p. 434*

CX. At *Thorpe*, in *Staffordshire*, two young *Turkeys*, were taken out of an 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 Egg had two Yolks in it, from whence they were produced; which Accident is very common. But I have a dried monstrous Chicken which had but one Head, four Wings, four 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 thus it 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 joined 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 joining of two perfect Animals, or else the extraordinary Division of the *Original Vessels*, the *Arteries* and *Nerves*.

*A Mon-
strous Colt;
by Mr. R.
Boyle, n. 5.
p. 85.*

Fig. 273.

CXI. The Body of this *Colt* appeared to the Eye compleatly Formed, without any Monstrosity to be taken Notice of in it: But the Head being opened, and examin'd, 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 *Crow*, 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 *Scelerotis*, which contained both, was one and the same, but seemed to have a Seam, by which they were joined, to go quite round it, and the fore or pellucid Part was distinctly separated into two *Corneas*, by a white Seam that divided them. Each *Cornea* seem'd to have its *Iris*, (or *Rainbow-like Circle*) and Apertures, or Pupils, distinct, and upon opening the *Cornea* there were found within it two Balls, or *Chry-stalline 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 seemed to be a Production of the matter designed for the Nose, but diverted by this Monstrous Conception; perhaps the *Processus Mammillares* joined into one, and were covered with a thin Hairy Skin.

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, Triple, 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 Pounds and half, the outside was of a greenish Clour; 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 Free-stone, but intermixt with Veins of Yellow and Black.

*A Mon-
strous Calf,
by Mr. Dav.
Thomas, n.
1. p. 10. n.
2. p. 20.*

CXIII. *Jan. 11. 1677-8*, A Cow of Mr. *Will. Dabs's*, at *Milnecoat* 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 three Mouths. It had to each Head two Eyes, only those of the Monstrous were very small, and I believe had no Sight. It had only two Ears to both Heads, one of which was placed on the far-side of the Monstrous Head, the other as usual in other Calves. It *Breatbed* equally at both Mouths, and had communicated 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 looked very lively, and was at three Days Old, as large and strong as other Calves usually are at 10 Days, or a Fortnight.

*A Mon-
strous Calf
with two
Heads; by
Sir Rob.
Southwel, n.
238. p. 79.*

CXIV. *Feb. 24, 1666-7*. *Rob. Cloak*, of *Beer-Ferris* in *Devonshire*, had a *Black Ram-Lamb* fallen with one Head, but two distinct Bodies, with eight Legs, which Bodies were joined in the Neck. It had two 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 remain alive; but this Monster was found dead by the Hedge.

*Two Mon-
strous
Lambs, by
Mr. Cole-
prett, n. 26.
p. 480.*

About the same time, *John Cauce*, of the same Parish, had a *White Lamb* fallen, with two distinct Heads and Necks, joined at the Shoulders, but one only Body; and that well formed, yet having double Entrails in all respects. The Ewe remains well, but the Monster dy'd.

CXV.

A Mon-
strous Pig,
by ...
n. 147 p. 188.

CXV. In *December* 1682, Among many Pigs of a Sow, there was one which had no Passage for the *Fæces*, 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 through them appeared the *Fæces* 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 Distention, of an Hard Substance, which appeared exactly the same with hard press'd Curds. The Chyle came freely enough out of the *Ductus Pæqueletanus*, where it was inserted into the Jugular, upon the 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 crack'd.

Two Mon-
strous Pigs,
by Sir J.
Floyer, n.
359 p. 431.

CXVI. In *May* 1699, There was shewed to me a Pig at *Weedford* in *Staffordshire*, with a Face something representing that of a Man's, and the Chin was very like that of an Human *Fœtus*. 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 Pig's Face seemed to me to be broken, and the Nose drawn up to appear like an Human. The under Jaw was Inverted, to grow up to meet the upper; the Tongue and Mouth were made more like an Human, 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 itself 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 Depression 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 was; the Monstrous Pig was as big, and as well grown

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 Human 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 eight Pigs, the first five were Perfect Pigs, the Sixth was the Monster, and after that two more Perfect Pigs. This Monster was Pigg'd Alive, but died 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 Alteration 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 persuaded 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 four Hind-feet, two Tails, two Anus's, and two *Pudenda*; for they were Females. They were jointed 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 Mammillares*, to which the *Vertebrae* of both the Necks were joined.

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 six or seven 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 *Caecums*, within about three 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 *Celiacæ*; 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 Anatomy of a Monstrous double Cat, by Dr. Mullen, n. 174. p. 1135.

Fig. 275.

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 three other small Veins, one from each of the *Fore Feet*, 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 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 *Arteria Carotides* and *Vertebrales* do empty themselves into one Common Channel, from which all Parts of the Brain may easily be supplied with Blood.

Fig. 278. The Head was joined to two Necks about the *Processus Mammillares*.

Fig. 279. There were four Orders of *Ribs*, though the Body was but one above the Navel.

Explication
of the Figures.

Fig. 275. Expresses to the Life the outward Shape, when placed on its Back.

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 *Caecums*; 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

and *Vena Porta*; 9. 9. two large Branches of the big *Atery* 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 it to the *Aorta*; 9. 9. might be well represented; 8. 8. the *Liver* in the right Side, doubl'd 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. 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. 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 *Junctures* of the two Setts of Ribs that were at the Back; 4. 4. 4. 4. the two Setts of Ribs that were joined to the Breast; 5. the Tips of the *Diaphragms*, pull'd downwards to shew the Ribs plainly; 6. 6. the *Vertebrae* of the two Necks.

CXVIII. The Account you had from *Chester*, in 1695, of a *Greyhound-Dog* that voided an Animal, resembling a *Whelp*, *per Annum*, 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.

An Animal resembling a Whelp voided per Annum, by a Male Greyhound; by Mr. Edm. Halley, n. 222. p. 316.

CXIX. 'Tis notorious all over *London*, that divers Years since, a *Bitch*, yet alive, of a considerable *Nobleman*, after she had lost her *Spleen*, hath been several times with Puppies; of which some out of Curiosity were opened,

A Bitch with Puppy, who she has lost the Spleen; by — opened, 105. p. 117.

Z z z z z 2

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.*

*A Hen with
a Perfect
Chick in the
Ovarium, by
— n. 50.
p. 1019.*

CXX. I am informed, that this Year, 1699, at *Duncburch* in *Warwickshire*, a Cow calved *four Calves*, perfectly, and all Living.

CXXI. About two or three Years since, there was a *Hen* at *Wackton* in *Norfolk*, which being big with Eggs, upon some account could not Lay, but after a time died; 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 *seven Lines* from End to End, and four and a half 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.*

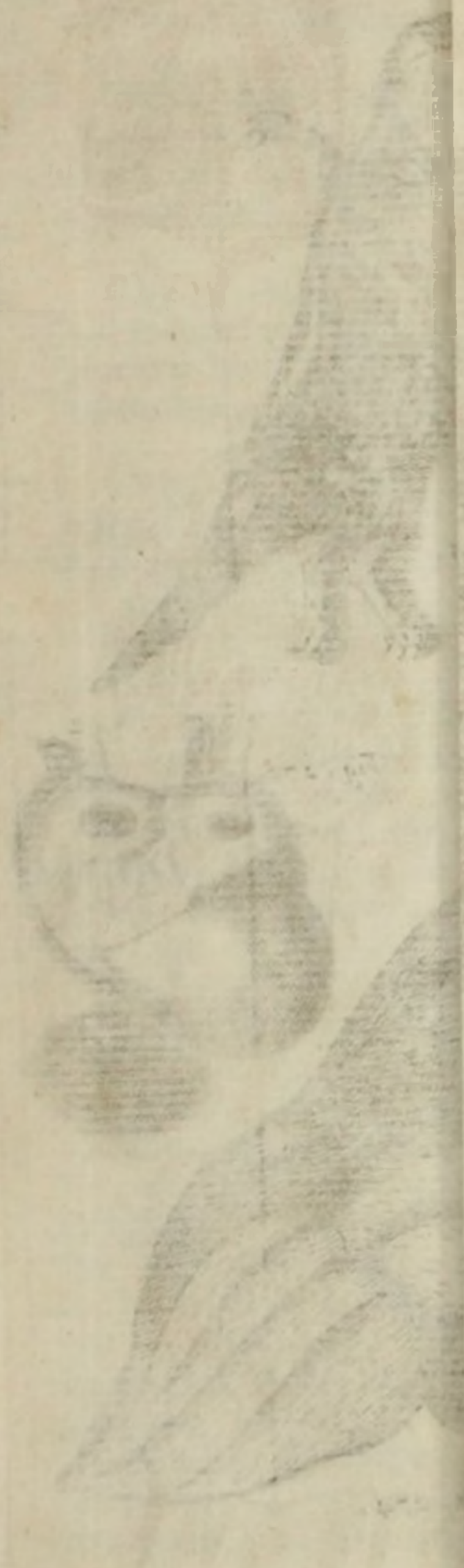
CXXIII. There hath been very lately made, by two Physicians at *Paris*, a Dissection of a *Cow*, in the *Testicles* of which there were found Eggs, as *Kerkringius* says he had observed, in his *Anthropogeniæ Ichnographia*.

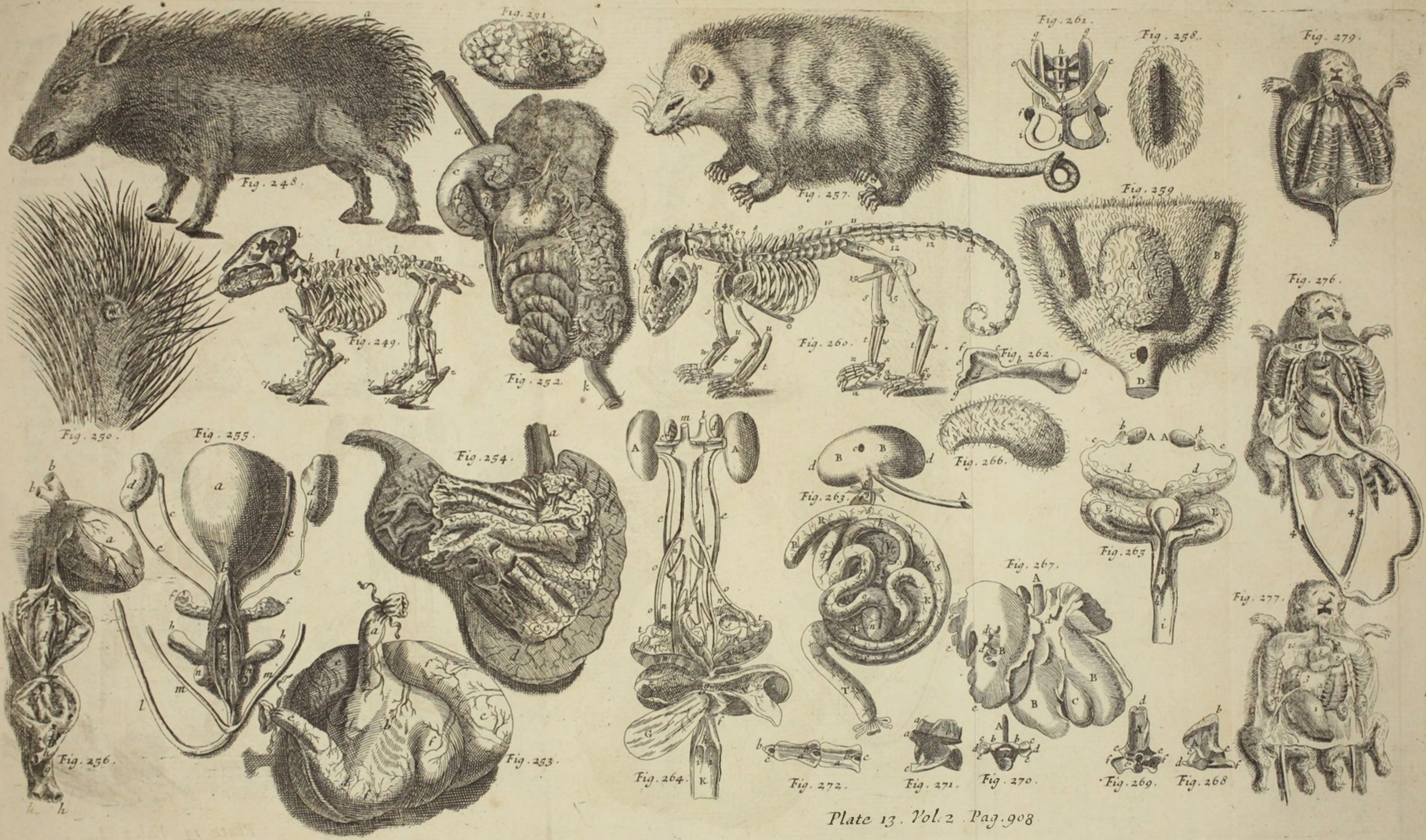
*The Ova,
after a 2d
Conception,
dispersed in
the Abdo-
men of a
Bitch, the
the Cornua
Uteri were
filled with
the Bones and
Flesh of a
former Con-
ception, by —
n. 147. p. 183.*

CXXIV. The Sagacious *Harvey*, after many repeated Dissections of *Impregnated Deer*, asserts, that nothing for about *six or seven Weeks* can be seen in the *Horns* of their *Wombs*; that 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 *Fætus*. He is well satisfy'd (after several *Trials*) 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 *Opinion* of the *Production* of *Animals* from the mixture of the *feminal Matter* of both *Sexes*, 'twas not so difficult to discover whence the *Egg* came, which he saw about *seven Weeks* after *Impregnation*. The *Fallopian Tubes*, which join to the *Horns*, and terminate very near the *Ovaria* (as the *Testes muliebres*, are generally now call'd) directed the ingenious and industrious *de Graaff*, 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 *Mr. Verney*, have endeavoured to confute this *Opinion* and expose it. The most considerable *Argument* they use, is taken from the narrowness of the *Fallopian*







pian Tubes, where they open into the Womb, and at their Extremities. But Dr. *de Graaff* 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 itself as the *Os Uteri* before the Birth: As Nuts and Peach-stones, &c. give way to a 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 it's possible a seminal Liquor might be transmitted into the Womb; in Women it's divided like a Knot of Ribbon, and is no more adapted to receive any thing but an Egg, than the Fingers expanding to receive and contain a Fluid. The Egg has not been able sometimes to get into the Womb; *Riolanus* speaks of a human *Fætus* seen in one of the Tubes, and Dr. *Harvey* assures you he has seen it himself.

Vid. inf. Vol.
III. Cap. 4. §.
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 are forc'd back again. She had been with Whelps; by a Blow she received the *Fætus's* 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 second Impregnation she was observed to have a very ill-shaped Belly; when dead, the Owner, a Person of Quality, sent her to *Oxford*. The Horns of the Womb were so stuff'd up with the Bones and firmer Muscles, and thicker Skin of the *Fætus'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'd 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 forced 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 *Animalcules* 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 esteemed 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

would disturb and distract the present Designs of the Plastick Power they speak of. The Humours 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 would 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. We see how very industrious Nature is in preserving the Species of Vegetables. When the tender Seed is first Formed, it is secured from external Injuries by various sorts of Cases. The *Embryo* of the Plant contained in the Seed hath three or four Coats to enclose it; the outermost is designed 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 Increase. 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 Shells and Membranes of Eggs (except those which are brought to Perfection in the Female Sex) 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 grosser can be received 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 supposes 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 be allowed, that the least and most inconsiderable Animal and Plants are this way Formed. But their Minuteness
makes

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 produced, why is the same Species and these very Individuals they suppose so made, furnished 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 produced 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 Graaff*, and M. *Leewenboeck*, with one another, these three things seem to me very probable. 1. That Animals are *ex Animalculo*. 2. That the Animalcules are originally in *Semine Marium* & non in *Feminis*. 3. That they can never come forward, nor be formed into Animals of the respective Kind, without the *Ova in Feminis*.

The modern
Theory of
Generation,
by Dr. Geo.
Garden. p.
192. p. 474.

The first of these seems probable from these three 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 form'd and nourish'd; 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 discernible by Glasses. After an Incubation of 30 Hours, are to be seen the Head, the Eyes, and the *Carina*, with the *Vertebrae*, distinct, and the Heart. After 40 Hours its Pulse is visible, and all the other Parts more distinct, which cannot be discern'd by the naked Eye before the beginning of the fifth Day; from whence it seems

seems very probable, that even the so early Discovery of those Parts of the *Fætus* by the Microscope, is not the discerning of Parts newly form'd, but only more dilated and extended, by receiving of Nutriment from the *Colliquamentum*; so that they seem all to have been actually existent before the Incubation of the Hen. And what *Swammerdam* has discover'd in the Transmutation of Insects, gives no small Light to this, whilst he makes appear in the Explanation in the 13th Table of the *General History of Insects*, that in those large *Eruca*'s which feed upon *Cabbage*, if they be taken about the timè they retire to be transform'd into *Aurelia*'s, and plung'd 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 chang'd into an *Aurelia*, none of these Parts can be discern'd, they are so drench'd with Moisture, though they be there actually form'd.

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 Organiz'd Creature as an *Animal*, is not the sudden Product of a Fluid, or *Colliquamentum*, but does much rather proceed from an *Animalcule* of the same Kind, and has all its little Members folded up, according to their several Joints and Piicatures, which are afterwards enlarg'd and distended, as we see in *Plants*. Now, though this Consideration alone may seem not to bear much weight; yet being join'd to the two former, they do mutually strengthen each other. And indeed, all the Laws of Motions which are as yet discover'd, 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 form'd by Laws yet unknown to Mankind; and it seems most probable, the *Stamina* of all the *Plants* and *Animals* that have been, or ever shall be in the World, have been form'd *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 which seems to our naked Eye but a Point, 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 *Animalcules* are originally in *Semine Marium*, & non in *Fæminis*: And this I collect from these Considerations:

1. That there are innumerable *Animalcula* in *semine Masculo omnium Animalium*. *M. Leeuwenhoeck* 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 foecundated by the Male, and the seeing no such Thing in those which are

not foecundated, as appears by *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. *Leeuwenhoeck* 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. 12.*

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 foecundated 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 mentioned, which we may rationally suppose between the Manner of 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 itself; and we may rationally conjecture some such Analogy in the Propagation of *Animals*.

The 3d particular which later Discoveries make probable, is, That *Animals* cannot be formed of these *Animalcula* without the *Ova in Feminis*, which are necessary for supplying of them with proper Nutriment; and this these Considerations seem to evince. 1. It is probable that an *Animalcule* 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 Centre of the *Cicatricula*; and perhaps the *Nidus*, necessary for their Formation, is so proportioned to their Bulk, that it can hardly contain more than one *Animalcule*; 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 *Fætus*, 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 *Fætus*; for they contain, not only the *Cicatricula* with its *Amnion* and the *Colliquamentum*, which is the immediate Nourishment of the *Fætus*, but also the Materials which are to be converted into that *Colliquamentum*, so that the *Fætus* 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 *Animalcule* cannot come forward without some such proper *Nidus*, M. *Leewenboeck* 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.

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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 *Tboulouse's* Belly; and the Little *Fætus* 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 *Fætus* in the *Abdomen* of the Woman of *Copenhagen*, mentioned in the *Nouvelles des Lettres*, for *Sep. 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

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four Years: And the seven Years Gravitation related by *Dr. Cole*. Now granting once the Necessity of a proper *Nidus*, for the Formation of an *Animalcule* into the Animal of its respective Kind, these Observations make it probable, that the *Testes* ate the *Ovaria* appropriated for this Use; for though the *Animalcules* 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 *Cicatricula* or *Ova* to be Impregnated, are *Testibus Fæmineis*; for if it were not so, the accidental coming of *Animalcules* 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 *Fætus 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 *Fætus* in the midst, which sends 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 *Animalcule's* Nourishment, does not sprout from the *Uterus*, but it has its Origin elsewhere, and falls in thither as into a fit Soil, from whence it may draw *Nutriments* for the Growth of the *Fætus*; else it cannot be easily imagined how it should not have an immediate *Connexion* with the *Uterus* from the Time of Conception.

If you join all these three Considerations together, *viz.* That an *Animalcule* cannot come forward without a proper *Nidus*, or *Cicatricula*; that there have been frequent *Fætus'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 Fæminis*. To all these I shall subjoin the Proposal of an *Experimentum Crucis*, which may seem to determine whether the *Testes Fæmineæ* be truly the *Ovaria*, *viz.* open the *Abdomen* of the Females of some Kinds, and cut out these Testicles, and this will determine whether this 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 Connection 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 those living for a considerable Time after Coition. And as to the former, we may either suppose that there is such an Inflation of the *Tuba*, 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 *Animalcules* 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 *Animalcules* 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 *Animalcules* are found to live a considerable Time in the *Uterus*, and that if they should Impregnate the *Ova* in the *Ovary* itself, the *Fetus* would encrease so fast, that the *Ova* could not pass through the *Tuba Uteri*, but would either burst the *Ovary*, or fall down into the *Abdomen* from the Orifices of the *Tuba*; and that from thence proceed those extraordinary *Conceptiones in Abdomine extra Uterum*.

But M. Leewenboeck, to weaken this Consideration, about the Conception's being like unto an *Ovum* in the Womb, proposes a Parallel between these *Animalcules* and *Insects*, and insinuates, that as the latter cast their Skins, and appear of another Shape, so that the other which at first seem like *Tadpoles*, may cast their outward 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 *Animalcules* 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 rounder Body is not the *Animalcule* thus changed, after having cast an outer Skin; but is 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.

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 of 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 supply it, of her Kind; whereas Monsters are observed to be a mixture of both Species.

CXXXVI. Papers of less general use Omitted.

- n.77.p.3004 **Q**ueries concerning *Vegetable Excrescences*, 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. *Queries* concerning *Tarantula's*, by Dr. *M. Lister*.
- n.105.p.96,99. 6. Some general *Queries* 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*, and to preserve them, and to improve the Race of *Sheep* for *Hardiness*, and for the finest *Drapery*, by Dr. *J. Beale*.

CXXXVII. Accounts of Books, Omitted.

- n.28.p.535. **H**istoriæ Generalis *Insectorum*, J. *Swammerdami*, Pars Prima. *Ultrajecti*,
n.64.p.2078 1699, 4to.
- n.77.p.2281 2. *Johannes Goedartius* of *Insects*, done into *English*, and methodiz'd; with the Addition of Notes, by *Mart. Lister, Esq;* 1682, in 4to.
- n.143.p.23. *Job. Goedartius de Insectis*: cum Appendice ad *Historiam Animalium Angliæ*; à *Mart. Lister, M. D.*
- n.166.p.838 3. *Marc. Malpighii* Dissertatio Epistolica de *Bombyce*; *Regiæ Societati* dicata, *Lond.* in 4to.
- n.47.p.987.

4. Instructions for the planting of White Mulberries; the breeding of^{n. 5. p. 8.} Silk-Worms; and the ordering of Silk in *Paris*, and the circumjacent Parts; by M. *Isnard*.
5. Esperienze Intorno alla *Generazione* degl' *Insetti*; fatte da *Francisco Redi*,^{n. 57. p. 1175} Academico della *Crusca*. In *Firenze*, 1668, 4to. *The Opinion of that Au-^{n. 75. p. 2254}thor concerning the Generation of Insects, is here opposed, by Dr. M. Lister.*
6. Ricreatione dell' *Occhio* è della *Mente*, Nell' *Osservatione delle Cbiocciole*; ^{n. 156. p. 507} dal. F. *Filippo Buonanni*, &c. in *Roma*, 1681.
7. Relatione del Ritrovamento dell' *Uova* delle *Cbiocciole*; di *A. F. M.* in ^{n. 152. p. 356} una *Litera* al. *S. Marcelli Malpighi*. In *Bologna*, 1683.
8. *Dr. Kormannus*, concerning the *Tinctures* of the *Excrements* of *In-^{n. 74. p. 2218}sects*.
9. *Swammerdam's M. S. Treatise de Apibus*; 'tis fear'd to be lost by *Dr. ^{n. 257. p. 365}Hotton*.
10. *Mart. Lister Historiæ Animalium Angliæ Tres Tractatus*; *Unus de^{n. 139. p. 982} Araneis*; *Alter de Cochleis tum Terrestribus, tum Fluvialibus*; *Tertius de Cochleis Marinis*. Quibus adjectus est *Quartus, de Lapidibus ejusdem Insulæ, ad Cochlearum quandam Imaginem Figuratis, Lond. 1671*.
11. *Mart. Lister Exercitatio Anatomica, in qua de Cochleis maxime Ter-^{n. 208. p. 65}restribus, & Limacibus agitur. Omnium Dissectiones Tabulis Æneis, ad ipsas Res affabre incisiss, illustrantur. Cui accedunt Digressiones de Respiratione, Generatione, Androgyna, Sepia, Loligine, & Polypo, aliis Rebus Naturalibus, 1694, in 8vo.*
12. *W. Sengwerdius Ph. D. de Tarantula*. In quo, præter ejus *Descrip-^{n. 34. p. 660}tionem, Effectus Veneni Tarantulæ, qui hætenus fuere Occultis Qualitatibus adscripti, Rationibus Naturalibus deducuntur, & illustrantur. Lugd. Bat. 1668, in 12mo.*
13. *A Dissertation of Vipers*; by *S. Redi*.^{n. 8. p. 145.}
14. *Nouvelles Experiences sur la Vipre*; par *Mr. Charas, à Paris, 1669, in^{n. 9. p. 160.} 8vo.*^{n. 54. p. 1091}
- Lettera di Francesco Redi sopra alcune Oppositioni fatte alle sue Osservationi^{n. 66. p. 2036} Intorno alle Vipre. In Firenze, 1670, 4to.*
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15. *Recherches & Observations sur les Vipres; faites par M. Burdelot; à^{n. 77. p. 3073} Paris, in 12mo.*
16. *Fran. Willoughbei Armig. de Historia Piscium, Libri Quatuor, Jussu &^{n. 178. p. 1301.} Sumptu Societatis Regiæ Lond. editi, totum Opus recognovit, coaptavit, supplevit, Librum etiam Primum & Secundum integros adjecit Job. Raius, è Soc. Reg. Oxon. 1686.*

- Pb. Col. n. 1.* 17. Osservazioni intorno alle *Torpedini*, fatte da *Stephano Lorenzini Fiorentino*, in *Firenze*, 1678.
P. 42.
- n. 28. p. 535* 18. Observations faites sur un *Grand Poisson*, & un *Lion*, Disseque dans la Bibliotheque du Roy, à *Paris*, le 24 & le 28 *Juin*, 1667.
- n. 205. p. 972* 19. *Phalænologia Nova*; sive Observationes de Rarioribus quibusdam *Balænis*, in *Scotiae Littus* nuper ejectis. Authore *Rob. Sibbald*, *Edinb.* 1692, in 4to.
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- n. 239. p. 125* 21. *Oppianus's* *Halieuticks*, Gr. Part of that excellent Poem, describing the *Philostorgia* of Fishes, is here turned into *English Verse*.
- n. 120. p. 481* 22. *Francisci Willoughbæi de Middleton*, *Armigeri*, è *Reg. Soc. Ornithologiae*, Libri tres, in quibus *Aves omnes* hæctenus cognitæ, in *Methodum Naturis* suis convenientem redactæ, accuratè 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. *Tb. Bartholini* *Dissertatio de Cygni Anatome*; nunc aucta à *Casp. Bartholino*, *F. Hafniæ*, 1668, in 8vo.
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n. 189. p. 372
- n. 263. p. 571* 26. *Godofredi Bidloo* *Observatio de Animalculis in Ovino*, aliorumque *Animantium Hepate* detectis; *Lugd. Bat.* 1698, in 4to.
- n. 8. p. 145.* 27. The Anatomy of a *Lion*, by *S. Redi*.
- n. 39. p. 787* 28. *Elaphographia*: sive *Cervi Descriptio Physico-Medico-Chymica*, Aut. *Jo. Andrea Græba*, M. D. *Jenæ*, 1698, in 8vo.
- n. 51. p. 1034* 29. *Discours de M. Stenon*, sur l'*Anatomie du Cerveau*, à *Paris*, 1662, in 12mo.
- n. 177. p. 1249.* 30. *Castorologia*, à *Jo. Mario*; aucta à *Jo. Franco Aug. Vindel.* 1685, in 8vo.
n. 256. p. 338
31. *Orang Outang*; sive *Homo Sylvestris*: Or the Anatomy of a *Pygmy*, compared with that of a *Monkey*, an *Ape*. and a *Man*: To which is added, a *Philological Essay* concerning the *Pygmies*, the *Cynocephali*, the *Satyrs* and *Sphinges*, of the *Ancients*; by *Edw. Tyson*, M. D. *Lond.* 1669, in 4to.
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- n. 10. p. 176.* 33. *Nicolai Stenonis de Musculis & Glandulis*, *Observationum Specimen*; cum duabus *Epistolis Anatomicis*.
- n. 147. p. 194.* 34. *Benjamini à Brookhuysen Œconomia Animalis*; 1683, in 4to.

35. Explication Nouvelle & Mechanique des Actions Animales ; ou il est-
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p. 1013.
36. *Job. Alphonsi Borelli Neapol.* Math. Profess. Opus posthumum, de Motu
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p. 35.
n. 144. p. 62.
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38. Le Discernement du Corps & de l'Ame par M. *de Cordemoy*. n. 17. p. 306.
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42. De Mente Humana, Libri 4, &c. Auth. *J. B. du Hamel*. *Paris*, 1672,
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