THE

PHILOSOPHICAL TRANSACTIONS

(From the Year 1719, to the Year 1733)

ABRIDGED,

AND

Diſpoſed under General HEADS.

By Mr JOHN EAMES, *F. R. S.*

AND

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Containing the PHYSIOLOGICAL Papers.

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THE Philoſophical Tranſactions ABRIDGED.

PART II.

CONTAINING THE

Phyſiological PAPERS.

CHAP. I.

PHYSIOLOGY, METEOROLOGY, PNEUMATICS.

Some Conſiderations about the Cauſe of the Univerſal Deluge, laid before the Royal Society, on the 12th of Dec. 1694. *by Dr* Edmond Halley, *R. S. S.* N°. 383. p. 118.

I. 1. THE Account we have of the Univerſal Deluge is no where ſo expreſs as in the Holy Scriptures; and the exact Circumſtances as to point of Time, do ſhew that ſome Records had been kept thereof more particularly than is wont in thoſe things derived from remote Tradition, wherein the Hiſtorical *Minutiæ* are loſt by length of Time. But the ſame ſeem much too imperfect to be the Reſult of a full Revelation from the Author of this dreadful Execution upon Mankind, who would have ſpoken more amply as to the Manner thereof, had He thought fit to lay open the Secrets of Nature to the ſucceeding Race of Men; and I doubt not but to all that conſider the 7th Chapter of *Geneſis* impartially, it will paſs for the Remains of a much fuller Account of the *Flood* left by the Patriarchs to their Poſterity, and derived from the Relation of *Noah* and his Sons. It muſt be

be granted, that there are ſome Difficulties as to the Conſtruction of the *Ark*, the Reception and Agreement of the *Animals* among themſelves, and Preſervation of it in ſo immenſe and boundleſs an Ocean, during that *Wind* which God ſent to dry the Waters away, eſpecially when it firſt came on Ground: But it muſt alſo be allowed, that length of Time may have added, as well as taken away many notable Circumſtances, as in moſt other Caſes of the Story of remote Times and Actions.

Certainty of an Univerſal Deluge.

This we may, however, be fully aſſured of, that ſuch a Deluge has been; and by the many Signs of marine Bodies found far from and above the Sea, 'tis evident, that thoſe Parts have been once under Water: or, either that the Sea has riſen to them, or they have been raiſed from the Sea; to explicate either of which is a Matter of no ſmall Difficulty, not does the ſacred Scripture afford any Light thereto. All that it ſays to help us is, that all the Fountains of the great Deep, תְּהוֹם רַבָּה were burſt, or broken up; that the Windows, or Cataracts, of Heaven where opened, and that it rained inceſſantly forty Days and Nights. Now the Rain of forty Days and Nights will be found to be a very ſmall Part of the Cauſe of ſuch a Deluge; for ſuppoſing it to rain all over the Globe as much in each Day, as it is now found to do in one of the moſt rainy Counties of *England* in the whole Year, *viz.* about forty Inches of Water *per Diem*; forty ſuch Days could cover the whole Earth with but about twenty two Fathom Water, which would only drown the low Lands next the Sea, but the much greater Part would eſcape. What is meant by the Fountains of the *Abyſs* being broken up, and the opening of the Windows of Heaven, ſeems not ſo eaſy to be underſtood, but is intended to indicate the *Modus* of the Deluge, which was, according to the *Moſaic Philoſophy*, from the letting in of the Waters above the Firmament, mentioned *Geneſis* i. 7. by the Windows of Heaven; and the riſing up out of the Ground of the Waters under the Earth, ſpoken of in the ſecond Commandment: Or, (if you will underſtand that by the תְּהוֹם רַבָּה is meant the great Ocean) by the overflowing of the Sea riſing upon the Land, which is expreſs'd by the breaking up of the Fountains of the great Deep. So that we may reaſonably conclude, that by the one of thoſe Expreſſions is meant an extraordinary Fall of Waters from the Heavens, not as Rain, but in one great Body; as if the Firmament, ſuppoſed by *Moſes* to ſuſtain a *Supra-aërial Sea*, had been broken in, and at the ſame Time the Ocean did flow in upon the Land, ſo as to cover all with Water.

Abyſs.

By an extraordinary Encreaſe of the Waters this could not be effected, for that at this Time there is not Water ſufficient of itſelf to cover any more of the Earth than now it doth; and to ſuppoſe a Creation and Annihilation of Water on purpoſe to deſtroy the Earth, is by much the moſt difficult Hypotheſis that can be thought of to effect it. A change of the *Center* of *Gravity*, about which Center the Sea

is formed, ſeemed not an improbable Conjecture, till it appeared that this Center of Gravity was the neceſſary Reſult of the Materials of which our Globe conſiſts, and not alterable whilſt the Parts thereof remained in the ſame Poſition; And beſides this Suppoſition could not drown the whole Globe, but only that Part thereof towards which the Center of Gravity was tranſlated, leaving the other Hemiſphere all dry.

I ſhall ſay nothing of Dr *Burnet*'s Hypotheſis, nor of the many Inſufficiencies thereof, as jarring as much with the Phyſical Principles of Nature, as with the Holy Scriptures, which he has undertaken to reconcile. Dr *Hook*'s Solution of this Problem, as he has not fully diſcovered himſelf, I cannot undertake to judge of; but his Compreſſion of a Shell of Earth into a *prolate Spheroid*, thereby preſſing out the Waters of an Abyſs under the Earth, may very well account for drowning two extream oppoſite Zones of the Globe: but the middle Zone, being by much the greater Part of the Earth's Surface, muſt by this means be raiſed higher from the Center, and conſequently ariſe more out of the Water than before; and beſides, ſuch a Suppoſition cannot well be accounted for from Phyſical Cauſes, but require a preternatural *digitus Dei*, both to compreſs, and aftewards reſtore the Figure of the Globe.

But the Almighty generally making uſe of Natural Means to bring about his Will, I thought it not amiſs to give this Honourable Society an Account of ſome Thoughts that occurr'd to me on this Subject; wherein, if I err, I ſhall find my ſelf in very good Company.

In Num. 190. of theſe Tranſactions. I have propoſed the caſual *Choc* of a *Comet*, or other tranſient Body, as an Expedient to change inſtantly the Poles and Diurnal Rotation of the Globe; at that Time only aiming to ſhew how the *Axis* of the *Earth* being chang'd, would occaſion the Sea to recede from thoſe Parts towards which the Poles did approach, and to encreaſe upon and overflow thoſe Parts wherefrom the Poles were departed; but at that Time I did not conſider the great Agitation ſuch a *Choc* muſt neceſſarily occaſion in the Sea, ſufficient to anſwer for all thoſe ſtrange Appearances of heaping vaſt Quantities of Earth and high Cliffs upon Beds of Shells, which once were the Bottom of the Sea; and raiſing up Mountains where none were before, mixing the Elements into ſuch a Heap as the Poets deſcribe the *old Chaos*; for ſuch a *Choc* impelling the ſolid Parts would occaſion the Waters, and all fluid Subſtances that were unconfined, as the Sea is, with one *Impetus* to run violently towards that Part of the Globe were the Blow was received; and that with Force ſufficient to rake with it the whole Bottom of the Ocean, and to carry it upon the Land; heaping up into Mountains thoſe earthy Parts it had born away with it, in thoſe Places where the oppoſite Waves balance each other, *miſcens ima ſummis*, which may account for thoſe long continued Ridges of Mountains. And again, the Recoil of this Heap of Waters would return

Choc of a Comet.

towards the oppoſite Parts of the Earth, with a leſſer *Impetus* than the firſt, and ſo reciprocating many times, would at laſt come to ſettle in ſuch a Manner as we now obſerve in the Structure of the ſuperficial Parts of the Globe.

In this Caſe it will be much more difficult to ſhew how *Noah* and the *Animals* ſhould be preſerved, than that all things in which was the Breath of Life, ſhould hereby be deſtroyed. Such a *Choc* would alſo occaſion a differing Length of the Day and Year, and change the Axis of the Globe, according to the Obliqity of the Incidence of the Stroak, and the Direction thereof, in relation to the former Axis. That ſome ſuch thing has happened, may be gueſſed, for that the Earth ſeems as if it were new made out of the Ruins of an old World, wherein appear ſuch Animal Bodies as were before the Deluge, but by their own Nature and Defences from the Weather, have endured ever ſince, either petrified, or elſe entire in *ſtatu naturali*. Such a *Choc* may have occaſioned that vaſt Depreſſion of the *Caſpian Sea*, and other great Lakes in the World; and 'tis not unlikely, but that extream Cold felt in the North-Weſt of *America*, about *Hudſon's-Bay*, may be occaſioned by thoſe Parts of the World having once been much more Northerly, or nearer the Pole than now they are; whereby there are immenſe Quantities of Ice yet unthaw'd in thoſe Parts, which chill the Air to that degree, that the Sun's Warmth ſeems hardly to be felt there, and of which the Poet might juſtly ſay, *Frigus iners illic habitat pallorque tremorque—Ac jejuna fames.*

Some farther Thoughts upon the ſame Subject, delivered on the 19th of the ſame Month, by the ſame. Ibid. p. 123.

2. I have been adviſed ſince the laſt Day, by a Perſon whoſe Judgment I have great Reaſon to reſpect, that what I then advanced, ought rather to be underſtood of thoſe Changes which might have happened to the Earth in Times before the Creation, and which might poſſibly have reduced a former World to a *Chaos*, out of whoſe Ruins the preſent might be formed, than of the Deluge whereby Mankind was in a manner extinguiſhed about 4000 Years ſince; that being much more gradually brought to paſs, and with ſome Circumſtances that this Hypotheſis cannot admit of, which abler Pens, perhaps, may account for: What I have advanced, I deſire may be taken for no more than the Contemplation of the Effects of ſuch a *Choc* as might poſſibly, and not improbably, have befallen this Lump of Earth and Water in Times whereof we have no manner of Tradition, as being before the firſt Production of Man, and therefore not to be known but by Revelation, or elſe *à poſteriori* by Induction from a convenient Number of Experiments or Obſervations, arguing ſuch an Agitation once, or oftner, to have befallen the Materials of this Globe. And perhaps in due Periods of Time, ſuch a Cataſtrophe may not be unneceſſary for the well-being of the future World; to bury deep from the Surface thoſe Parts, which by length of time are indurated into ſtony Subſtances, and become unapt for vegetable Production, by which all Animals are either immediately or mediately

ſuſtained

ſuſtained: the ponderous Matter in ſuch a Mixture ſubſiding firſt, and the lighter and finer Mould remaining for the latter Settling, to inveſt the exterior Surface of the New World. This may, perhaps, be thought hard, to deſtroy the whole Race for the Benefit of thoſe that are to ſucceed. But if we conſider Death ſimply, and how that the Life of each Individual is but of a very ſmall Duration, it will be found that as to thoſe that die, it is indifferent whether they die in a Peſtilence out of 100000 *per Ann.* or ordinarily out of 25000 in this great City, the Peſtilence only appearing terrible to thoſe that ſurvive to contemplate the Danger they have eſcaped. Beſides, as *Seneca* has it,

Vitæ eſt avidus quiſquis non vult
Mundo ſecum pereunte mori.

N.B. *The foregoing Papers having been read before the Society thirty Years ſince, were then depoſited by the Author in their* Archives, *and not publiſhed; he being ſenſible that he might have adventured* ultra crepidam: *and apprehenſive leaſt by ſome unguarded Expreſſion he might incur the Cenſure of the Sacred Order. Nor had they now been printed but at the Deſire of a late Committee of the Society, who were pleaſed to think them not unworthy of the Preſs.*

Here the Reader is deſired to obſerve, that Mr William Whiſton's *Book, entituled,* A New Theory of the Earth, *was not publiſhed till about a Year and a half after the Date hereof, and was not preſented before* June 24, 1696. *to the Royal Society.*

Queries concerning the Cauſe of Coheſion of the Parts of Matter, by Fr. Triewald, *Director of Mechanicks in the Kingdom of* Sweden. No. 408. p. 39.

II. *Query* I. Does not the ſtrong Coheſion of two Balls of Lead prove the Doctrine of Attraction, worthy its great Author, Sir *Iſaac Newton*; and that there is an univerſal Attraction between the Parts of Matter in Nature, though ſome at ſuch ſmall Diſtances as to eſcape our Obſervations, ſince we cannot make their Parts touch one another cloſe enough, ſo as to come within their Sphere of Activity? Which I preſume to be the Reaſon why I never have been able to make Balls of any other Metals to cohere: Nor do I believe that the Parts of any other Metal can come to ſuch a cloſe Contact, except by Fuſion, as the Particles of Lead may, by being ſo many Degrees ſofter than thoſe of any other Metal.

Query II. I have often found the touching Surfaces of ſuch Leaden Balls, as near as I could meaſure, much alike; yet the Force of Coheſion very different: Nay, I have found the touching Surfaces very ſmall, yet ſometimes 114 to 126 ℔ Weight has not been ſufficient to ſeparate them; when at other times a far leſs Weight (though the Meaſure of touching Surfaces far exceeded thoſe mentioned) was more than ſufficient to cauſe their Separation. Does it not prove that the Coheſion is ſtrongeſt according to the cloſeneſs of the Contact, but not as the touching Surfaces? For which Reaſon I always have found

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the Coheſion ſtrongeſt, when I gave a little twiſt in joining them; ſince by this Means the Particles muſt come cloſer together, than by ſqueezing the Balls barely on one another, though it was done with a far greater Force than I could apply with my bare Hands. And ſince the Force, Twiſt, and touching Surfaces can never be alike and menſurable when joined by Hand, I think it will be very difficult, if not impoſſible, to aſcertain the Forces of this Coheſion, which is incredible, and far exceeds Magnetical Attractions.

That the Preſſure of the Atmoſphere contributes little, and next to nothing in this Coheſion, I have fully proved and experienced laſt Winter, before a great and noble Aſſembly: The Coheſion of two Leaden Balls, which 126 ℔ could not ſeparate, proved as ſtrong in *Vacuo*, as in the open Air.

Query III. Does not this Experiment fairly account for the Coheſion of the Parts of Matter; and that this firm Coheſion cannot be derived from any Glue or Cement, any imaginary Hooks and *Funiculus*, nor *de gravitate Ætheris:* but that the Particles of all ſolid and fluid Bodies do attract one another by a certain Force (whatever be the Cauſe of the ſame) which acts moſt intenſely the nearer they touch one another.

I am confirmed in this Opinion by an Experiment I made this Summer at *Dannemora*, one of the moſt conſiderable Iron Mines, and where I have erected the firſt and largeſt Fire-Engine for drawing Water and Oar in this Kingdom; the Cylinder being two Lines more than thirty-ſix Inches in Diameter.

Our *Dahlkarlians* have, Time out of Mind, practiſed the ſaid Experiment, when they have had Occaſion to remove any unweildly Stones of the hardeſt Rocks, and ſo big as not to be moved intire by any Strength they could apply. They practiſe the following Means, not only to cleave and ſplit them in as many Parts and Pieces as they pleaſe, but to obtain Stones with one or more ſmooth Sides, fit for Uſe in Buildings.

They take Tallow, Greeſe, Train Oil, or any other fat Subſtances, and draw Lines on ſuch large Stones, according as they would have them ſplit, and think proper; then they lay either Charcoal or Wood at Top, and round the Sides of the Stone, ſo that it is all over covered, and then kindle the Fuel; which when burned out, they find the Stone divided according to the Lines they have drawn on it, with ſome of the before-mentioned fat Subſtances, which ſeldom or never fails.

May one not account for this odd *Phænomenon* thus? That as the Action of Heat and Fire expands the Parts of all hard and ſolid Bodies and Metals themſelves, ſo when the Action of the Fire about the Stone has made the Particles of the ſame recede farther from one another, than when in their natural State, the oily Subſtances inſinuate themſelves

themſelves more and more between the Particles of the Stone; by which Means, when the Stone cools again, and ſhrinks, they ſeem to prevent theſe Particles from coming as cloſe, and within their Sphere of Activity, as the remaining Particles may, where no ſuch foreign Matter has been applied; by which Means they alſo cannot attract one another ſo ſtrongly as the reſt, and muſt therefore remain ſeparated.

Fat and oily Subſtances ſeem to be moſt fit for this Purpoſe, ſince they are endued with a repelling Force.

I cannot but admire, that notwithſtanding ſo many *Phænomena* in Nature prove a Tendency and a ſtrong mutual Attraction of the Parts of Matter, whatever be the Cauſe, yet moſt learned Men, of ſeveral Nations, would rather charge ſuch manifeſt Qualities and Operations of Nature with the Nick-Name of occult Qualities, than give the Honour to the *great Diſcoverer* (*who is no more*) of thoſe manifeſt Qualities and Principles of Motion. However, I am confident, that as Nature is very uniform and agreeable to herſelf, ſhe will evince the Truth of her Operations.

III. 1. Having often obſerved in the Electrical Experiments made with a glaſs Tube, and a down Feather tied to the end of a ſmall Stick, that after it's Fibres had been drawn towards the Tube, when that has been withdrawn, moſt of them would be drawn to the Stick, as if it had been an Electrick Body, or as if there had been ſome Electricity communicated to the Stick or Feather; this put me upon thinking, whether if a Feather were drawn thro' my Fingers, it might not produce the ſame effect, by acquiring ſome degree of Electricity. This ſucceeded accordingly upon my firſt trial, the ſmall downy Fibres of the Feather next the Quill being drawn by my Finger when held near it: and ſometimes the upper part of the Feather, with it's Stem, would be attracted alſo; but not always with the ſame Succeſs. I then proceeded to try whether Hair might not have the ſame property, by taking one from my Wig, and drawing it 3 or 4 times through my Fingers, or rather between my Thumb and Forefinger, and ſoon found it would come to my Finger at the diſtance of half an Inch; and ſoon after I found that the fine Hair of a Dog's Ear was ſtrongly Electrical; for upon taking the Ear and drawing it thro' my Fingers; great numbers of them would be attracted to my Fingers at once. The next thing which I thought of, was threads of Silk of ſeveral Colours, and of ſeveral fineneſſes, which I found to be all Electrical, but ſometimes I could not ſucceed; the reaſon of which I afterwards found, as will appear in the ſequel of this Diſcourſe.

New Electrical Experiments, by Mr Stephen Gray, N° 366. p. 104.

Having ſucceeded ſo well in theſe, I proceeded to larger quantities of the ſame Materials, as pieces of Ribband both of coarſe and fine Silk of ſeveral colours, and found that by taking a piece of either of theſe of about half a yard long, and by holding the end in one hand, and drawing;

drawing it thro' my other Hand between my Thumb and Fingers, it would acquire an Electricity, ſo that if the Hand were held near the lower end of it, it would be attracted by it at the diſtance of 5 or 6 Inches; but at ſome times the Electricity would be much weaker than at others, the reaſon of which I conjectured to be, that the Ribband might have imbib'd ſome aqueous Particles from the moiſt Air, which I found to be upon trial the occaſion of it; for when I had well warmed the Ribband by the Fire, it never failed to be ſtrongly Electrical.

After this I made trial of ſeveral other Bodies, as Linnen of ſeveral ſorts, *viz.* Holland, Muſlin, *&c.* And Woollen, as of ſeveral ſorts of Cloth and other Stuffs of the ſame Materials. From theſe I proceeded to Paper, both white and brown, finding them, after they had been well heated before rubbing, to emit copiouſly their Electric Effluvia. The next Body in which I found the ſame Property, was thin Shavings of Wood; I have only as yet tried the firſt Shavings, which are ſtrongly Electrical. The three laſt ſubſtances which I found to have the ſame property, are Leather, Parchment, and thoſe thin Guts wherein Leaf-Gold is beaten.

All theſe Bodies will not only by their Electricity be drawn to the Hand, or any other ſolid Body that is near them; but they will, as other Electrick Bodies do, draw all ſmall Bodies to them, and that to the diſtance of ſometimes 8 or 10 Inches. Heating them by the Fire before rubbing very much increaſes their Force. There is another property in ſome of theſe bodies, which is common to Glaſs, that when they are rubbed in the dark, there is a Light follows the Fingers through which they are drawn, this holds both in Silk and Linnen, but is ſtrongeſt in Pieces of white preſſing Papers, which are much the ſame with Card-Paper; this not only yields a Light as above, but when the Fingers are held near it, there proceeds a Light from them with a crackling Noiſe, like that produced by a Glaſs Tube, though not at ſo great a diſtance from the Fingers; to perform this, the Paper before rubbing muſt be heated as hot as the Fingers can well bear.

A Down Feather being tied to the end of a fine Thread of raw Silk, and the other end to a ſmall ſtick, which was fixed to a Foot, that it might ſtand upright on the Table; there was taken a piece of brown Paper, which by the abovementioned Method was made to be ſtrongly Electrical, which being held near the Feather, it came to the Paper, and I carried it with the ſame till it came near the Perpendicular of the Stick; then lifting up my Hand till the Paper was got beyond the Feather, the Thread was extended and ſtood upright in the Air, as if it had been a piece of Wire, tho' the Feather was diſtant from the Paper near an Inch. If the Finger were held near the Feather in this Poſition, the greateſt part of the Fibres next the Paper would be repelled, when at the ſame time if a Finger were held to the Fibres that were more remote from the Paper, they would be drawn by it.

I then

I then repeated this Experiment without the Feather, *viz.* by a ſingle thread of Silk only of about 5 or 6 Inches long, which was made to ſtand extended upright as abovementioned, without touching the Paper; then placing my Finger near the end, it would avoid, or was repelled by it, but when I had placed my Finger at about the ſame diſtance from a part of the Thread, that was about two Inches from the end, it was then attracted by it.

An Enumeration of the ſeveral Bodies mentioned herein, that are found to be Electrical.

1. Feathers, 2. Hair, 3. Silk, 4. Linnen, 5. Woollen, 6. Paper, 7. Leather, 8. Wood, 9. Parchment, 10. Ox-guts, wherein Leaf-Gold is beaten.

More Experiments concerning Electricity; *by Mr.* Stephen Gray. N° 417. p. 18.

2. In *Febuary* 172⅘, I repeated ſome of the Experiments I had formerly made, in the firſt Diſcovery of an Electrical Attraction in many Bodies, not before known to have that Property, I made ſeveral Attempts on the Metals, to ſee whether they might not be made attractive by the ſame Method as other Bodies were, *viz.* by heating, rubbing and hammering, but without any Succeſs: I then reſolved to procure me a large Flint-Glaſs Tube, to ſee if I could make any farther Diſcovery with it, having called to Mind a Suſpicion which ſome Years ago I had, that as the Tube communicated a Light to Bodies, when it was rubbed in the Dark, whether it might not at the ſame Time communicate an Electricity to them, though I never till now tried the Experiment, not imagining the Tube could have ſo great and wonderful an Influence, as to cauſe them to attract with ſo much Force, or that the Attraction would be carried to ſuch prodigious Diſtances, as will be found in the Sequel of this Diſcourſe.

Before I proceed to the Experiments, it may be neceſſary to give a Deſcription of the Tube: It's Length is three Feet five Inches, and near one Inch two Tenths in Diameter: I give the mean Dimenſions, the Tube being larger at each End than in the Middle, the Bore about one Inch. To each End I fitted a Cork, to keep the Duſt out when the Tube was not in uſe.

The firſt Experiment I made, was to ſee if I could find any Difference in it's Attraction, when the Tube was ſtopped at both Ends by the Corks, or when left open, but could perceive no ſenſible Difference; but upon holding a Down-Feather over againſt the upper End of the Tube, I found that it would go to the Cork, being attracted and repelled by it, as by the Tube when it had been excited by rubbing. I then held the Feather over againſt the flat End of the Cork, which attracted and repelled many Times together; at which I was much ſurprized, and concluded that there was certainly an attractive Virtue communicated to the Cork by the excited Tube.

I fixed an Ivory Ball of about one Inch three Tenths Diameter, with a Hole through it, upon a Fir-Stick about four Inches long, thruſting the other End into the Cork, and upon rubbing the Tube,

found that the Ball attracted and repelled the Feather with more Vigour than the Cork had done, repeating its Attractions and Repulſions for many Times together: I then fixed the Ball on longer Sticks, firſt upon one of eight Inches, and afterwards upon one of twenty-four Inches long, and found the Effect the ſame. Then I made uſe firſt of Iron, and then Braſs Wire, to fix the Ball on, inſerting the other End of the Wire in the Cork, as before, and found that the Attraction was the ſame as when the Fir-Sticks were made uſe of, and that when the Feather was held over againſt any Part of the Wire, it was attracted by it; but though it was then nearer the Tube, yet its Attraction was not ſo ſtrong as that of the Ball. When the Wire of two or three Feet long was uſed, its Vibrations cauſed by rubbing the Tube, made it ſome what troubleſome to be managed: This put me upon thinking, whether if the Ball was hung by a Packthread, and ſuſpended by a Loop on the Tube, the Electricity would not be carried down the Line to the Ball: I found it to ſucceed accordingly; for upon ſuſpending the Ball on the Tube by a Packthread about three Feet long, when the Tube had been excited by rubbing, the Ivory Ball attracted and repelled the Leaf-Braſs, over which it was held, as freely as it had done, when it was ſuſpended on Sticks or Wire; as did alſo a Ball of Cork, and another of Lead that weighed one Pound and a quarter.

After I had found that the ſeveral Bodies abovementioned had an Electricity communicated to them, I then went on to ſee upon what other Bodies the Tube would have the ſame Effect, beginning with the Metals, ſuſpending them on the Tube by the Method abovementioned; firſt in ſmall Pieces, as with a Guinea, a Shilling, a Half-penny, a Piece of Block-Tin, a Piece of Lead; then with larger Quantities of Metal, ſuſpending them on the Tube by Packthread. Here I made uſe of a Fire-Shovel, Tongs, and Iron Poker, a Copper Tea-Kettle, which ſucceeded the ſame, whether empty, or full of either cold or hot Water; a Silver Pint Pot; all which were ſtrongly Electrical, attracting the Leaf-Braſs to the Height of ſeveral Inches. After I had found that the Metals were thus Electrical, I went on to make Trials on other Bodies, as Flint-Stone, Sand-Stone, Load-Stone, Bricks, Tiles, Chalk; and then on ſeveral Vegetable Subſtances, as well green as dry, and found that they had all of them an Electric Virtue communicated to them, either by being ſuſpended on the Tube by a Line, or fixed on the End of it by the Method abovementioned.

I next proceeded to try at what greater Diſtances the Electric Virtue might be carried, and having by me Part of a hollow walking Cane, which I ſuppoſe was Part of a Fiſhing-Rod, two Feet ſeven Inches long; I cut the great End of it, to fit it into the Bore of the Tube, into which it went about five Inches; then when the Cane was put into the End of the Tube, and this excited, the Cane drew the

Leaf

Leaf-Braſs to the Height of more than two Inches, as did alſo the Ivory Ball, when by a Cork and Stick it had been fixed to the End of the Cane. A ſolid Cane had the ſame Effect, when inſerted in the Tube after the ſame Manner as the hollow one had been. I then took the two upper Joints of a large Fiſhing-Rod, the one of *Spaniſh* Cane, the other partly Wood and the upper End Whale-bone, which, together with the Tube, made a Length of more than fourteen Feet. Upon the leſſer End of the Whale-bone was fixed a Ball of Cork of about an Inch and quarter Diameter; then the great End of the Rod being inſerted in the Tube, the Leaf-Braſs laid on the Table, and the Tube excited, the Ball attracted the Leaf-Braſs to the Height of about three Inches by Eſtimation. With ſeveral Pieces of *Spaniſh* Cane and Fir-Sticks I afterwards made a Rod, which together with the Tube, was ſomewhat more than eighteen Feet long, which was the greateſt Length I could conveniently uſe in my Chamber, and found the Attraction very nearly, if not altogether as ſtrong, as when the Ball was placed on ſhorter Rods.

May 14 1729, between ſix and ſeven o'Clock in the Evening. Having provided a Rod of about twenty four Feet, that conſiſted of a Fir-Pole, of Cane, and the Top of Reed, upon the End of which the Ball of Cork was placed, and the great End of the Rod put into the Tube about ſeven or eight Inches; then the Leaf-Braſs being laid down, and the Tube rubbed, the Ball attracted and repelled the Leaf-Braſs with Vigour; ſo that it was not at all to be doubted, but with a longer Pole the Electricity would have been carried much farther.

May the 16th, I made a Rod thirty-two Feet long, including the Tube; the bigger Part of it was a Fir-Staff about ſix Feet and a half long, the reſt was of Cane, and Reed for the top Part of it. All Things being prepared, as before, the Effect was the ſame as in the laſt Experiment, only the Pole bending ſo much, and vibrating by rubbing the Tube, made it more troubleſome to manage the Experiment. This put me upon making the following Experiments.

May the 19th, about ſix in the Morning, the Ivory Ball being ſuſpended on the Tube, by a Line of Packthread twenty-ſix Feet long, which was the Height, I ſtood at in the Balcony, from the Court where he ſtood, that held the Board with the Leaf-Braſs on it; then the Tube being rubbed, attracted the Leaf-Braſs to the Height of near two Inches, as he that aſſiſted informed me. This was repeated with the Cork Ball with the ſame Succeſs.

May the 31ſt, in the Morning, to a Pole of eighteen Feet there was tied a Line of thirty-four Feet in Length; ſo that the Pole and Line together were fifty-two Feet. With the Pole and Tube I ſtood in the Balcony, the Aſſiſtant below in the Court, where he held the Board with the Leaf-Braſs on it; then the Tube being excited as uſual, the Electric Virtue paſſed from the Tube up the Pole, and

down the Line to the Ivory Ball, which attracted the Leaf-Braſs, and as the Ball paſſed over it in it's Vibrations, the Leaf-Braſs would follow it, till it was carried off the Board: But theſe Experiments are difficult to make in the open Air, the leaſt Wind that is ſtirring, carrying away the Leaf-Braſs.

Some Time after I made ſeveral Attempts to carry the Electric Virtue in a Line horizontally, ſince I had not the Opportunity here of carrying it from greater Heights perpendicularly, but without Succeſs, for want of then making uſe of proper Materials, as will appear from what follows. The firſt Method I made Trial of, was by making a Loop at each End of a Line, and hanging it on a Nail driven into a Beam, the other End hanging downwards, through the Loop at this End the Line with the Ivory Ball was put; the other End of this Line was by a Loop hung on the Tube; ſo that that Part of the Line next the Ball hung perpendicular, the reſt of the Line Horizontal: Then the Leaf-Braſs being laid under the Ball, and the Tube rubbed, not the leaſt Sign of Attraction was perceived. Upon this I concluded, that when the Electric Virtue came to the Loop that was ſuſpended on the Beam, it went up the ſame to the Beam; ſo that none, or very little of it at leaſt, came down to the Ball, which was afterwards verified, as will appear by the Experiments that will be mentioned hereafter.

June the 30th, 1729, I went to *Otterden-Place*, to wait on Mr *Wheler*, deſigning only to give him a Specimen of my Experiments. The firſt was from the Window in the Long Gallery that opened into the Hall, the Height about ſixteen Feet; the next from the Battlements of the Houſe down into the fore Court, twenty-nine Feet; then from the Clock-Turret to the Ground, which was thirty-four Feet, this being the greateſt Height we could come at; and notwithſtanding the Smallneſs of the Cane, the Leaf-Braſs was attracted and repelled beyond what I expected. As we had no greater Heights here, Mr *Wheler* was deſirous to try whether we could not carry the Electric Virtue horizontally. I then told him of the Attempt I had made with that Deſign, but without Succeſs, telling him the Method and Materials made uſe of, as mentioned above. He then propoſed a Silk Line to ſupport the Line, by which the Electric Virtue was to paſs. I told him it might do better upon the Account of it's Smallneſs; ſo that there would be leſs Virtue carried from the Line of Communication, with which, together with the apt Method Mr *Wheler* contrived, and with the great Pains he took himſelf, and the Aſſiſtance of his Servants, we ſucceeded far beyond our Expectation.

The firſt Experiment was made in the matted Gallery *July* 2, 1729, about Ten in the Morning. About four Feet from the End of the Gallery there was a croſs Line that was fixed by it's Ends to each Side of the Gallery by two Nails; the middle Part of the Line was Silk, the reſt at each End Packthread; then the Line to which the Ivory

Ball

Ball was hung, and by which the Electric Virtue was to be conveyed to it from the Tube, being eighty Feet and a half in Length, was laid on the croſs Silk Line, ſo as that the Ball hung about nine Feet below it. Then the other End of the Line was by a Loop ſuſpended on the Glaſs Cane, and the Leaf-Braſs held under the Ball on a Piece of white Paper; when the Tube being rubbed, the Ball attracted the Leaf-Braſs, and kept it ſuſpended on it for ſome Time.

This Experiment ſucceeding ſo well, and the Gallery not permitting us to go any farther in one Length, Mr *Wheler* thought of another Expedient, by which we might encreaſe the Length of our Line, which was by putting up another croſs Line near the other End of the Gallery; and over the Silk Part of both the Lines there was laid a Line that was long enough to be returned to the other End, where the Ball hung; and though now both Ends of the Line were at the ſame End of the Gallery, yet Care was taken that the Tube was far enough off from having any Influence upon the Leaf-Braſs, except what paſſed by the Line of Communication: Then the Cane being rubbed and the Leaf-Braſs held under the Ivory Ball, the Electric Virtue paſſed by the Line of Communication to the other End of the Gallery, and returned back again to the Ivory Ball, which attracted the Leaf-Braſs, and ſuſpended it as before. The whole Length of the Line was 147 Feet.

We then thought of trying whether the Attraction would not be ſtronger without doubling or returning the Line, which we found Means of doing in the Barn, where we had a Line of 124 Feet long, fourteen Feet of which hung perpendicular from the Silk Line; and now the Attraction was, as we then concluded, ſtronger than when the Line was returned, as in the matted Gallery.

July 3, between Ten and Eleven in the Morning we went again into the Barn, and repeated the laſt mentioned Experiment with both the Tube and Cane; but the Attraction was not ſo ſtrong as in the preceding Evening, nor was there ſo great a Difference in the Attraction communicated by the ſolid Cane and Glaſs Tube, as one would have expected, conſidering the Difference of their Lengths and Diameters.

We then proceeded farther, by adding ſo much more Line as would make a Return to the other End of the Barn, the whole Length of the Line being now 293 Feet; and though the Line was ſo much lengthened, we found no perceivable Difference in the Attraction, the Ball attracting as ſtrongly as before. This encouraged us to add another Return; but upon beginning to rub the Tube, our Silk Lines broke being not ſtrong enough to bear the Weight of the Line, when ſhaken by the Motion given it by rubbing the Tube. Upon this, having brought with me both Braſs and Iron Wire, inſtead of the Silk we put up ſmall Iron Wire; but this was too weak to bear the Weight of the Line. We then took Braſs Wire of a ſomewhat larger Size than

than that of Iron. This ſupported our Line of Communication; but though the Tube was well rubbed, yet there was not the leaſt Motion or Attraction given by the Ball, neither with the great Tube, which we made uſe of when we found the ſmall ſolid Cane to be ineffectual: By which we were now convinced, that the Succeſs we had before, depended upon the Lines that ſupported the Line of Communication, being Silk, and not upon their being ſmall, as before Trial I imagined it might be; the ſame Effect happening here as it did when the Line that is to convey the Electric Virtue is ſupported by Packthread; *viz.* that when the Effluvia come to the Wire or Packthread that ſupports the Line, it paſſes by them to the Timber, to which each End of them is fixed, and ſo goes no farther forward in the Line that is to carry it to the Ivory Ball.

Finding that our Silk Threads were too weak to bear many Returns of Line, Mr *Wheler* thought of another Way of managing them, ſo that fewer Returns might be upon each Silk Line; which was by placing two other croſs Lines ſome Feet below the upper ones; ſo that every other Turn of Line was ſuſpended by the lower croſs Line. By this Means there was but half the Weight of Line upon each Silk of what there was when only two croſs Lines were made uſe of as before. By this Contrivance, we could add a much greater Length of Line, without Danger of breaking our Silk. We then put up a Line that was 666 Feet in Length, by eight Returns: Then the Leaf-Braſs being held on a Piece of white Paper under the Ivory Ball, and the Tube, with the other End of the Line ſuſpended on it, being rubbed for ſome time, the Leaf-Braſs was attracted as manifeſtly as it had been with much ſhorter Lines. We then repeated the Experiment with the little ſhort ſolid Cane, and found there was ſomewhat of an Attraction, but not near ſo great as with the large Tube.

Though the going and returning of the Electric Effluvia was very ſurpriſing, yet we were willing to try how far the attractive Virtue might be carried in a continued right Line; the Method of doing which was thus: That End of the Line where the Attraction was to be made, was ſuſpended on a Silk Line that was fixed croſs the Garret Window on the North-ſide of the Houſe, which was by Eſtimation about forty Feet high; at about an hundred Feet from hence two Rods or Poles of about ten Feet long, and at two Feet diſtance from each other, were driven into the Ground, ſo as that they ſtood nearly perpendicular. Theſe were in the great Garden, beyond theſe, in the great Field, that is ſeparated from the Garden by a deep Foſs, about the ſame Diſtance from the firſt, were another Pair of Poles fixed; then four others at a like Diſtance. Upon the Ends of theſe Poles were tied the croſs Lines of Silk, to ſupport the Line of Communication, which being laid on the Silk Lines, the Ivory Ball hanging in the Garret Window, and the other End of the Line being hung by a Loop on the Tube, the Leaf-Braſs was held under the Ball, and after the

the Tube had been rubbed for ſome Time, they called to me to let me know that there was an Attraction of the Leaf-Braſs. This was ſeveral Times repeated with Succeſs; then Mr *Wheler* came into the Field, and rubbed the Tube himſelf, that I might ſee there was an Attraction; which I ſaw, though I perceived it not to be ſo ſtrong as when the Attraction was carried by longer Line, by returning it, as in the Experiments abovementioned. The Length of the Line was 650 Feet. This was ſeveral Times repeatd, but the Experiment being made in the Evening, at length the Dew began to fall. We began about ſeven o'Clock, or ſome little Time after, but before Eight the Attraction ceaſed: But whether this was cauſed by the Dew falling, or by my being very hot, we could not poſitively ſay, but I rather impute it to the latter. This Experiment was made *July* 14, 1729.

Note, That though we call the carrying the Electric Virtue by the Lines in this Poſition Horizontal, you are not to underſtand it in a ſtrict Senſe, as may be eaſily perceived by the Deſcription of the Method; and That as the Line ſwagged down much below the Silk Lines that ſupported it, in the middle Part between thoſe Lines, it was ſome Feet longer than the Diſtance of the Poles.

Some Days after this Experiment was repeated from the Turret Cloſet Window, when the Line was 765 Feet, and the Attraction was no leſs perceivable than in the Experiment abovementioned.

More Experiments made at Mr Wheler's, *ſhewing that large Surfaces may be impregnated with Electric Effluvia.*

A large Map of the World, that had twenty-ſeven ſquare Feet in it a Table-Cloth containing fifty-nine ſquare Feet; theſe ſuſpended on the Tube by Packthreads, became Electrical. An Umbrello, ſuſpended by a Packthread tied to the Handle of it, became ſtrongly Electrical.

An Experiment propoſed by Mr Wheler, *to ſee whether the Electric Virtue would be any Way hindred by the magnetical Effluvia of a Loadſtone.*

This had a ſmall Key hung by one of its arming Irons, and the Stone, together with the Key hung to it, were ſuſpended on the Tube by a Packthread; then the Tube being rubbed, the Key and Stone both attracted the Leaf-Braſs, the Attraction being the ſame as that of other Bodies.

An

An Experiment made to ſhew that the Electric Virtue is carried ſeveral Ways at the ſame Time, and may be conveyed to conſiderable Diſtances.

There were made three Stands, each compoſed of two upright Pieces of Fir, fixed perpendicular, near the Ends of a long ſquare Board, diſtant from each other near a Foot and a half. Upon the Tops of theſe were tied Threads of Silk to ſupport the Lines of Communication with the Tube and the attracting Bodies. One of theſe Stands was placed in the great Parlour, near the farther End; another in the little Parlour, and a third in the Hall, which was between the two Parlours: As the other two were one of them to the right, the other to the left Hand, this laſt was placed near the Hall-Window forwards; the two firſt were about fifty Feet, the other about twenty Feet from the Place where the Tube was held; then there were taken three ſmall ſquare Pieces of Wood, that were tied to three Lines of Packthread: Theſe were of about the Lengths above-mentioned. They were laid on the Silk Lines, and by Loops at the other Ends were ſuſpended on the Tube; then the Leaf-Braſs being held under the Pieces of Wood, and the Tube rubbed, they all of them attracted the Leaf-Braſs at the ſame Time. Some Time after, in my Abſence, Mr *Wheler* tried a red hot Poker, and found that the Attraction was the ſame as when cold. He alſo ſuſpended a live Chick upon the Tube, by the Legs, and found that the Breaſt of the Chick was ſtrongly Electrical.

At Mr Godfrey's *I made the following Experiments; ſhewing that the* Electric Virtue *may be carried from the Tube, without touching the Line of Communication, by only being held near it.*

The firſt of theſe Experiments was made the 5th of *Auguſt*, 1729. I ſhall here mention ſome of the moſt conſiderable ones; but as I did not always ſet down the Day of the Month, ſome of them may not be related in the Order of Time they were made; nor did I always mention the Length of the Lines, theſe not being thought to be abſolutely neceſſary.

I took a Piece of a Hair-Line, ſuch as Linnen-Cloaths are dried on, of about eleven Feet in Length; which, by a Loop at the upper End of it, was ſuſpended on a Nail, that was driven into one of the Rafters in the Garret, and had at it's lower End a leaden Weight of fourteen Pounds hung to it by an Iron Ring: then the Leaf-Braſs was laid under the Weight, and the Tube rubbed, and being held near the Line without touching it, the Lead-Weight attracted and repelled the Leaf-Braſs for ſeveral times together, to the Height of at leaſt three, if not four Inches. If the Tube was held three or four Feet above the Weight, there would be an Attraction; but if it were held higher up, ſo as to be near the Raftor where the Weight was hung by the Hair-Line, there would be no Attraction.

An

An Experiment, ſhewing that the Electric Virtue *may be carried ſeveral Ways at the ſame Time, by a Line of Communication, without touching the ſaid Line.*

There were taken two Hair-Lines, of between four and five Feet long; to each of theſe was tied a ſquare Piece of Cork, by Packthread; the Lines were ſuſpended by Loops at their upper Ends, upon two Nails; near the lower Ends there was tied to the Hair-Lines a Piece of Packthread, by which there was a Communication between the two Hair-Lines; then the Leaf-Braſs being laid under the Corks, and the Tube being rubbed, and held near one of the Lines, both the Corks attracted; but that which was fartheſt, much ſtronger than that, near which the Tube was held. About the Middle of the Line of Communication they both drew with equal Force.

Some Time after, at Mr Wheler's, *we made the following Experiment, in order to try whether the* Electric Attraction *be proportional to the Quantity of Matter in Bodies.*

There were made two Cubes of Oak, of about ſix Inches ſquare, the one ſolid, the other hollow: Theſe were ſuſpended by two Hair-Lines, nearly after the ſame Manner as in the Experiment abovementioned; the Diſtance of the Cubes from each other, was by Eſtimation, about fourteen or fifteen Feet; the Line of Communication being tied to each Hair-Line and the Leaf-Braſs placed under the Cubes, the Tube was rubbed and held over the Middle of the Line, and as near as could be gueſſed, at equal Diſtances from the Cubes, when both of them attracted and repelled the Leaf-Braſs at the ſame Time, and to the ſame Height; ſo that there ſeemed to be no more, Attraction in the ſolid than in the hollow Cube; yet I am apt to think that the Electric Effluvia paſs through all the interior Parts of the ſolid Cube, though no Part but the Surface attracts; for from ſeveral Experiments it appears, that if any other Body touches that which attracts, it's Attraction ceaſes till that Body be removed, and the other be again excited by the Tube.

A Continuation of the Experiments made at Mr Godfrey's.

I next went on with an Experiment, to ſee if the Electric Virtue might not be conveyed to a Rod, without inſerting it into the Bore of the Tube, or without touching the Rod, which I found to ſucceed, by ſuſpending the Rod either by Lines of Silk, or by Pieces of Horſe-Hair Fiſhing-Lines, placing a Ball of Cork on the leſſer End of the Rod.

Auguſt 13, I took a large Pole that was twenty-ſeven Feet long, two Inches and a half Diameter at the great End, and at the leſſer

about half an Inch: It was that Sort of Wood they call Horſe-Beech, with the Rind on. This was ſuſpended by two Hair-Lines of about four Feet and a half in Length; the firſt Line was about two Feet from the great End of the Pole, the other about eight Feet from the leſſer End; ſo that the pole hung horizontal. At the little End of the Pole was hung a Ball of Cork about an Inch and a half Diameter by a Packthread about a Foot long, and a ſmall leaden Ball upon the Cork to keep the Packthread extended: Then the Leaf-Braſs being laid under the Cork, the Tube rubbed and held near the great End of the Pole, the Cork Ball drew the Leaf-Braſs ſtrongly to the Height of an Inch, if not more: Then the Leaf-Braſs being held under ſeveral Parts of the Pole, it was attracted by it, as Mr *Godfrey* obſerved, but not near ſo ſtrongly as by the Cork.

About the Beginning of September *I made the following Experiment, which ſhews that the* Electric Effluvia *will be carried in a* Circle, *and be communicated from one* Circle *to another.*

There was taken a Hoop of about two Feet two Inches Diameter; this I ſuſpended by a Hair-Line upon a Nail driven into a Beam; the Line was about four Feet long; then the Leaf-Braſs being laid under the Hoop, the Tube was rubbed, and held within the Hoop, near the upper Side of it, without touching it by ſeveral Inches: Then the lower Part of the Hoop attracted and repelled the Leaf-Braſs ſtrongly; but when held near the lower Part, there was very little, if any Attraction. If the Tube was held near the outſide of the Hoop, it attracted; but ſtrongeſt, when at the ſame Time it was held near the Knot of the Hair-Line by which the Hoop was ſuſpended. To this Hoop there was tied a leſſer Hoop of about a Foot and a half Diameter: It was tied to it by Packthread, ſo as to hang below it about two Inches. They were ſuſpended together by the Hair-Line; then the Leaf-Braſs and the Tube being prepared, as hath been mentioned before, the Tube being held near the upper Hoop, the lower Part of the lower Hoop attracted ſtrongly, and when held near the upper Part of the lower Hoop, but very weakly. But when held near the lower Part of the lower Hoop, there was no Attraction.

On the 15th of September *I made the following Experiment which ſhews, that the* Electric Effluvia *have the ſame Effect in a* Circle, *when it's Poſition is horizontal.*

I took a large Hoop, of ſomewhat more than three Feet Diameter, and Breadth of about two Inches and a half; to this was tied at near equal Diſtances, four Lines: They were what they call Twine, which is of three Threads of Packthread twiſted together each about two Feet eight Inches long. Theſe were tied with their Ends together

to

to a Hair-line of about two Feet and a half long, by which the Hoop was hung on a Nail, as in the other Experiments, ſo that the Hoop hung now in an horizontal Poſition: Then the Leaf-Braſs being laid under the Edge of the Hoop, at between two and three Inches below it, the Tube being rubbed, and held between the Cords without touching them, the Leaf-Braſs was attracted and repelled for ſeveral times together; but when held near the outſide of the Hoop, oppoſite to that Part where the Leaf-Braſs lay, the Attraction was much ſtronger.

About the latter End of Autumn, and the Beginning of the Winter in 1729, I reſumed my Enquiry after other Electric Bodies, to ſee what Addition I could make to the Catalogue of thoſe mentioned above, and found many more that have the ſame Property, and may be excited to attract by the ſame Method. As for Inſtance, the dry withered Leaves of Reeds and Flags, Graſs and Corn, both Leaves and Straw; the Leaves of Trees, as thoſe of the Laurel, the Oak, the Walnut, the Cheſnut, Hazle-nut, Apple and Pear-tree Leaves; ſo that we may conclude, that the Leaves of all Vegetables have this Attractive Virtue.

I ſhall now give an Account of the Experiments made at my Chamber in the Year 1730.

March the 23d, I diſſolved Soap in the *Thames*-Water, then I ſuſpended a Tobacco-Pipe by a Hair-line, ſo as that it hung nearly horizontal, with the Mouth of the Bowl downwards; then having dipped it in the Soap-Liquor, and blown a Bubble, the Leaf-Braſs laid on a Stand under it, the Tube being rubbed, the Braſs was attracted by the Bubble, when the Tube was held near the Hair-line. Then I repeated the Experiment with another Bubble, holding the Tube near the little End of the Pipe, and the Attraction was now much greater, the Leaf-Braſs being attracted to the Height of near two Inches.

March the 25th, I repeated this Experiment after a ſomewhat different Manner: The Pipe was now ſuſpended by two Lines of white ſewing Silk, of about five Feet and a half long; theſe were hung upon two Nails driven into the Beam of my Chamber, diſtant from each other about a Foot, by Loops at the other End of the Lines, by which the Pipe was ſuſpended; then the Bubble being blown, by holding the Tube to the little End of the Pipe, the Bubble attracted the Leaf-Braſs to the Height of near four Inches. This Experiment was made to ſee whether fluid Bodies would not have an Electricity communicated to them.

April 8, 1730, I made the following Experiment on a Boy between eight and nine Years of Age. His Weight, with his Cloaths on, was forty-ſeven Pounds ten Ounces. I ſuſpended him in a horizontal Poſition, by two Hair-Lines, ſuch as Cloaths are dried on: They were about thirteen Feet long, with Loops at each End.

There was driven into the Beam of my Chamber, which was a Fo thick, a Pair of Hooks oppoſite to each other, and two Feet fro theſe another Pair in the ſame manner. Upon theſe Hooks the Lin were hung by their Loops, ſo as to be in the Manner of two Swing the lower Parts hanging within about two Feet of the Floor of th Room: Then the Boy was laid on theſe Lines with his Face dow wards, one of the Lines being put under his Breaſt, the other und his Thighs: Then the Leaf-Braſs was laid on a Stand, which was round Board of a Foot Diameter, with white Paper paſted on it, ſu ported on a Pedeſtal of a Foot in Height, which I often made uſe in other Experiments, though not till now mentioned: Upon t Tube's being rubbed, and held near his Feet, without touching then the Leaf-Braſs was attracted by the Boy's Face with much Vigou ſo as to riſe to the Height of eight, and ſometimes ten Inches. I p a great many Pieces on the Board together, and almoſt all of the came up together at the ſame Time. Then the Boy was laid wi his Face upwards, and the hind Part of his Head, which had ſho Hair on, attracted, but not at quite ſo great a Height as his Fa did. Then the Leaf-Braſs was placed under his Feet, his Shoes an Stockings being on, and the Tube held near his Head, his Feet a tracted, but not altogether at ſo great a Height as his Head: The the Leaf-Braſs was again laid under his Head, and the Tube hel over it, but there was then no Attraction, nor was there any whe the Leaf-Braſs was laid under his Feet, and the Tube held over then

April the 16th, I repeated the Experiment with the Boy, but no the Attraction was not quite ſo ſtrong as at the firſt, the Braſs n riſing higher than to about ſix Inches. His Hands being ſtretche nearly horizontal, I placed a ſmall Stand with Leaf-Braſs under eac Hand, and under his Face the great one, furniſhed as the other when the excited Tube being held near his Feet, there was an A traction by his Hands and Face at the ſame Time. I then gave hi the Top of a Fiſhing-Rod to hold in his Hand; there was a Ball Cork ſtuck on the little End of it, under which the Leaf-Braſs bein laid, and the Tube rubbed and held near his Feet, the Ball attracte the Leaf-Braſs to the Height of two Inches, and repelled it, and a tracted for ſeveral Times together with great Vigour.

April 21, I again repeated the Experiment on the Boy; and now h attracted much ſtronger than at the firſt: The Leaf-Braſs roſe to h Face at the Height of more than twelve Inches. Then I gave t Boy to hold in each Hand the Tops of two Fiſhing-Rods, with a Ba of Cork on each of their leſſer Ends; then a ſmall Stand being ſ under each Ball, with the Leaf-Braſs on it, the Tube being rubbe and held near his Feet, both the Corks attracted and repelled togeth ſtrongly. The Length of the Poles were each of them about ſeve Feet. Then the Boy was laid on his left Side, and a Fiſhing-Rod, near twelve Feet in Length, given him to hold with both his Han

the

there was a ſmall Ball of Cork at the End of the Rod, that was an Inch and three quarters Diameter: Then all Things being prepared, the Tube held near the Boy's Feet, the Cork Ball attracted and repelled the Leaf-Braſs with Force to the Height of at leaſt two Inches.

Note, That when I ſpeak of holding the Tube near the Boy's Feet, I mean over againſt the Soles of his Feet; and when near his Head, is to be underſtood the Crown of his Head for when the Tube is held above, or over his Legs, the Attraction is not ſo ſtrongly communicated to the other Parts of his Body.

By theſe Experiments we ſee that Animals receive a greater Quantity of Electric Effluvia, and that they may be conveyed from them ſeveral Ways at the ſame Time to conſiderable Diſtances, wherever they meet with a Paſſage proper for their Conveyance, and there exert their Attracting Power.

In theſe Experiments, beſides the large Stand abovementioned, I made uſe of two ſmall ones, which, as I found them very uſeful, it may not be improper to deſcribe them. The Tops of them were three Inches Diameter; they were ſupported by a Column of about a Foot in Height, their Baſes of about four Inches and a half: They were turned of *Lignum vitæ*; their Tops and Baſes made to ſkrew on for Convenience of Carriage. Upon the Tops were paſted white Paper. When the Leaf-Braſs is laid on any of theſe Stands, I find it is attracted to a much greater Height than when laid on a Table, and at leaſt three Times higher than when laid on the Floor of a Room.

June 20, *I made the following Experiment, ſhewing that the* Attraction *and* Repulſion *is as ſtrong, if not ſtronger, and that the* Effluvia *may be carried to great Lengths, without touching the Line by the Tube.*

There was taken a Line of Packthread 231 Feet in Length; it was ſupported on two croſs Lines of blue Silk; the Diſtance of theſe Lines was near eighteen Feet. About four Feet below one of theſe Lines, was put up another Silk Line of the ſame Colour: To this was tied one End of the Packthread; at the other End the Ivory Ball hung; the Line was returned over the croſs Lines thirteen times; than the Leaf-Braſs being laid under the Ball, upon one of the ſmall Stands and the Tube excited, the Ball attracted and repelled to the Height of one of it's Diameters, which was about an Inch and a quarter.

I have, by ſeveral Trials lately made, found that rubbing the Tube and putting it up between the Returns of the Line in ſeveral Places, before I go with the Tube to the End of the Line, much facilitates, and cauſes the Attraction much ſooner than when one ſtands with the Tube and applies it to the End of the Line only.

Auguſt 1, *at Mr* Wheler's, *we made the following Experiment; being an Attempt to ſee how far the* Electric Virtue *might be carried forward in a Line, without touching the ſame.*

This

This Experiment was made by carrying the Line out of the Grea Parlour Window into the Garden, and down the great Field befor it. The Line was ſupported by fifteen Pair of Poles; each Pair ha a Line of blue Silk tied from one Pole to the other, the Length c about four Feet, equal to the Diſtance of the two Poles: About te Feet from the Window there was a Silk Line put up croſs the Roor upon which that Part of the Line hung that had the Ivory Ball upon i Below the croſs Line of the fartheſt Pair of Poles was placed anothe croſs Line, four Feet from the Ground, to which was faſtened th other End of the Communicating Line, as mentioned in the Exper ment above: Then the Leaf-Braſs and Tube being prepared as uſua the Tube being held over the Line at ſeveral Diſtances, beginnin towards that End where the Ball hung, and ſo proceeding towards th farther End of the Line, the Leaf-Braſs was attracted at the Statio not exceeding two or three hundred Feet, pretty ſtrongly; but ſti grew weaker as we came towards the farther End of the Line: Y even at the End of the Line, the Leaf-Braſs would be lifted by th Ball, when the Tube touched the Line, whoſe Length was 886 Fee

I ſhould now have given ſome Account of the Diſcovery I made th laſt Year concerning the Attraction of coloured Bodies, ſhewing th they attract more or leſs, according to what Colours they are o though the ſubſtance be the ſame, and of equal Weight and Bigneſ only I ſhall obſerve, that I find the Red, Orange or Yellow, attra at leaſt three or four times ſtronger than Green, Blue or Purple: Bu having very lately found out a new and more accurate Method c making theſe Experiments, I muſt beg Leave to proceed farther wit them, before I communicate them.

Concerning the Electricity *of* Water, *by the ſame.* N° 422. p. 227.

3. *Firſt*, In the former Account of my Experiments, I deſcribe the manner of communicating an Attraction to a Bubble of ſoape Water; but I have now found, that even *a Body of Water receives a Attractive Virtue, and alſo a Repelling one, by applying the excited Tu near it, after the ſame manner as ſolid Bodies do.* To perform this E periment, I cauſed a wooden Diſh to be turned, with a Screw-hole the Bottom, but not ſo far as to come through the Wood: This w ſcrewed on to the upper End of one of the Stands I have mentioned i the other Experiments, the other Top being taken off: The Di was about four Inches Diameter, and one Inch deep. Then th Stand was ſet on a Cake of Roſin, or a Plate of Glaſs, or the Brim of a Drinking-Glaſs, or of a Cylindric one, ſuch as are uſed fo Water Glaſſes. the Glaſs muſt be firſt warmed, then the Diſh bein filled with Water, the Tube rubbed, and moved both under the Di and over the Water three or four times, without touching them. A ter it has been excited, not only the Diſh, but the Water alſo, become Electrical; and if a ſmall Piece of Thread, or a narrow Slip of thi Paper, or a Piece of Sheet-Braſs, commonly called Tinſel, be hel over the Water in an horizontal Poſition, within about an Inch o

ſome

ſometimes more, any of the ſaid Bodies will be attracted to the Surface of the Water, and be repelled, but not ſo often as by Solids. If a pendulous Thread be held at ſome Diſtance from the outſide of the Diſh, it will be attracted and repelled by it many times together with a very quick Motion, but not at ſo great a Diſtance as when the Diſh is empty.

II. *An Experiment ſhewing, that Water is attracted by the Tube, and that the Attraction is attended with ſeveral remarkable and ſurpriſing* Phænomena.

This Experiment being to be made with ſmall Quantities of Water, I at firſt made uſe of ſome of the Braſs Concave little Diſhes in which I formerly ground Miſcroſcopes; but have ſince cauſed to be made a more convenient Apparatus, which conſiſts of a ſmall Pedeſtal of about four Inches and a half long, the Baſe of Ivory about two Inches Diameter. Upon the upper End, as in the larger Stand, there is a Screw, upon which is ſcrewed on one of the little Diſhes, which are made of Ivory: Of theſe I have ſeveral Sizes, from three Quarters to one Tenth of an Inch Diameter. When any one of theſe little Veſſels is filled with Water, ſo as that it may ſtand above the Brims of the Cup, and has acquired a Spherical Surface (as it will do in the ſmalleſt Cups) let it be ſet on the Table with the little Stand to which it had before been ſcrewed, or which is better, upon the large Stand mention'd above, the great Diſh being taken off, and the ſmall plain Top ſcrewed on; being thus prepared, let the Tube be excited, and held over the Water at the Diſtance of about an Inch or more. If it be a large Tube, there will firſt ariſe a little Mountain of Water from the Top of the Drop, of a conical Form, from the Vertex of which there proceeds a Light (very viſible when the Experiment is performed in a dark Room) and a ſnapping Noiſe, almoſt like that when the Fingers are held near the Tube, but not quite ſo loud; and of a more flat Sound: Upon this immediately the Mountain, if I may ſo call it, falls into the reſt of the Water, and puts it into a tremulous and waving Motion. I have now a few Days ſince repeated this Experiment in the Day-time, where the Sun ſhined: I perceived that there were ſmall Particles of Water thrown out of the Top of the Mount, and that ſometimes there would ariſe a very fine Stream of Water from the Vertex of the Cone, in the manner of a Fountain, from which there iſſued a fine Stream, or Vapour, whoſe Particles were ſo ſmall as not to be ſeen; yet it is certain that it muſt be ſo, ſince the under Side of the Tube was wet, as I found when I came to rub the Tube again; and I have ſince found, that though there does not always ariſe that Cylinder of Water, yet there is always a Steam of inviſible Particles thrown on the Tube, and ſometimes to that Degree as to be viſible on it. When ſome of the larger Cups are made uſe of

they

they are to be filled as high as may be without running over: The Surface will be flat about the middle Part, but when the Tube is held over it, the middle Part will be depreſſed into a Concave, and the Parts towards the Edge be raiſed; and when the Tube is held over againſt the Side of the Water, the little conical Protuberance of Water iſſues out with its Axis horizontally, and after the crackling Noiſe, returns to the reſt of the Water, and ſometimes there will be thrown out of it ſmall Particles of the ſame, as from the ſmaller Portions of Water abovementioned.

The laſt Experiment was repeated with hot Water; when the Water was attracted much ſtronger, and at a much greater Diſtance: The Steam ariſing from the Vertex was in this Caſe viſible, and the Tube was ſprinkled with large Drops of Water. I tried the Experiment in the ſame Manner upon Quickſilver, which was likewiſe raiſed up; but by reaſon of it's great Weight, not to ſo great an Height as the Water: The ſnapping Noiſe was louder, and laſted much longer than in the Water.

Farther Experiments concerning Electricity, by the ſame. N° 423. p. 285.

4. Since my laſt wherein I gave an Account of my Experiments, ſhewing Water will be attracted by Electric Bodies, and that it may have an Electric Virtue communicated to it, ſo as to attract ſolid ones, I have been upon another Enquiry; Whether there might not be a Way found to make this Property of Electrical Attraction more permanent in Bodies? How far I have ſucceeded in this Attempt, will appear by the Experiments I have made on the ſeveral Bodies mentioned in the following Catalogue; and as they were all of them prepared after the ſame manner, excepting Numb. 18 and 19, which ſhall be deſcribed afterwards, a general Deſcription of the Method of preparing and preſerving them in a State of Attraction, may ſuffice.

The Bodies on which the Experiments were made, were Roſin both black and white, Stone-Pitch, Shell or Gum-Lac, Bees-Wax, and Sulphur. I procured three Iron Ladles of ſeveral Sizes, in which I melted theſe Subſtances, making uſe of that which I thought moſt convenient for the Quantity I deſigned to melt. When any of theſe Bodies were melted, they were taken off the Fire, and ſet by in the Ladle to cool and harden; then it was returned to the Fire, where it remained till it was melted about the Bottom and Sides of the Ladle, ſo as to be moveable; ſo that by inverting the Ladle, it might be taken out; having the Form of nearly the Section of a Sphere, the Convex Surface, as alſo the Plain one, being naturally (if I may ſo ſay) poliſhed, excepting the Sulphur, which cools without retaining its Poliſh, except when caſt in Glaſs Veſſels, as ſhall be ſhewed hereafter. I ſhall now proceed to the Experiments and Obſervations made on theſe Electric Bodies.

When any of them were taken out of the Ladle, and their Convex Surface hardened, they would not at firſt attract, 'till the Heat was abated,

abated, or 'till they came to a certain Degree of Warmth, and then there was a ſmall Attraction which Warmth I eſtimated to be nearly that of a Hen's Egg when juſt laid: The Attraction encreaſing ſo, as when cold, to attract at leaſt ten times farther than at firſt.

The manner of preſerving them in a State of Attraction, was by wrapping them up in any thing that would keep them from the external Air; as at firſt for the ſmaller Bodies I uſed white Paper, but for the larger ones white Flannel; but afterwards found that black Worſted Stockings would do as well. Being thus cloathed, they were put into a large Fir Box, there to remain 'till I had Occaſion to make uſe of them.

The Cylinder of Sulphur, *Numb.* 18, was made by melting the Sulphur, and pouring it into a Cylindric Glaſs Veſſel, which had firſt been heated, to prevent it's cracking. When the Sulphur was hardened, it was ſomewhat leſs than the Glaſs; ſo that by inverting the Glaſs, it came out eaſily, and had a poliſhed Surface almoſt as ſmooth as the Glaſs in which it was caſt. The large Cone of Sulphur, *Numb.* 19, was made after the ſame manner; *viz.* by being caſt in a large Drinking-Glaſs.

I am now to give an Account of the Obſervations made on the ſeveral Bodies mentioned in the Catalogue, but muſt firſt give a Deſcription of the Catalogue. The firſt Column contains the Number, which in a ſmall Piece of Paper is fixed on each of the ſeveral Bodies; the Name of which is given in the ſecond Column, whether they are ſingle or compound Subſtances. The third Column ſhews what Weight they were of when melted, in Ounces and Drachms of *Averdupois* Weight. In the fourth Column you have the Days of the Month when the Body was melted and received it's Form, and conſequently when it firſt began to attract.

I did for thirty Days continue to obſerve every one of theſe Bodies, and found that at the End of the ſaid Time they attracted as vigorouſly as at the firſt or ſecond Day, as they do now at the writing hereof. By the Times mentioned in the Catalogue, being ſubſtracted from any Time after, will be ſhewn how long any of the Bodies have continued their Attractive Virtue; by which it will appear, that ſome of them have not loſt their Attraction for more than four Months: So that we have ſome Reaſon to believe, that we have now diſcovered that there is *a perpetual attractive Power* in all Electric Bodies, without exciting by either rubbing, heating, *&c.* or any other Attrition. But this will farther appear by the Account I am now to give of the two laſt Bodies mentioned in the Catalogue. The Cone of Sulphur, *Numb.* 19, that was caſt in a large Drinking-Glaſs, in about two Hours after it was taken out of the Glaſs, attracted, and the Glaſs attracted too, but at a ſmall Diſtance. Next Day the Sulphur was taken out of the Glaſs, and then it attracted ſtrongly, but there was now no perceivable Attraction of the Glaſs. Then the Cone of Sulphur was ſet with it's Baſe upon the Lid of the Fir Box, wherein the other Electric Bo-

dies lay, and the Glaſs whelmed over it. I examined it every Day, after, and ſtill found it to attract; but finding the Place not ſo convenient, having Occaſion to look into the Box often, I removed it to the Table that ſtands between the two Windows of my Chamber, where it has continued to this Time, and whenever the Glaſs is taken off, attracts at near as great a Diſtance as the Sulphur that is clothed and ſhut up in the Box abovementioned. And though at firſt there was no Attraction, when the Glaſs was taken off, yet I now find, that in fair Weather the Glaſs alſo attracts, but not at ſo great a Diſtance as the Sulphur, which never fails to attract, let the Wind or Weather be never ſo variable, as do all the other Bodies mentioned in the Catalogue; only in wet Weather the Attractions are not made at ſo great a Diſtance as in fair Weather.

Number 20 is a Cake of Sulphur that was melted; and as the other Bodies have taken the Form of a Convex Section of a Sphere, this when cold, was laid with it's flat Side downwards, on the ſame Table with the Cone of Sulphur: They were both placed ſo near the Wall, as to prevent the Sun ſhining on them. This was, as the Catalogue ſhews, on the 18th of *April*; and, though it had no manner of Clothing or Covering, has attracted ever ſince. And in this, as in the other Bodies, the Attraction will be according to the Weather; but when it attracts the ſtrongeſt, it is not more than the tenth Part of what the Cone of Sulphur, that is covered, attracts.

The manner of obſerving theſe Attractions is beſt performed by holding the Attracting Body in one Hand, and a fine white Thread tied to the End of a Stick, in the other; by this means far leſs Degrees of Attraction will be perceived, than by making uſe of Leaf-Braſs. When the Thread is held at the utmoſt Diſtance, it may be attracted; the Motion of it is at firſt very ſlow, but ſtill accelerating as it approaches nearer to the attracting Body.

I am now on the Subject of permanent Attraction in Glaſs, than in the other Bodies, but have not yet compleated thoſe Experiments, meeting with more Interruption by the Weather.

With a ſmall Hand Air-Pump, I have made Experiments on ſeveral Bodies, and find that they will attract *in vacuo*, and that at very nearly the ſame Diſtance as *in pleno*, provided that the Experiment be made in the ſame Receiver filled with Air; as will appear by the following Experiments.

There was taken a hollow Glaſs Sphere, of ſomewhat more than 2 ½ Inches Diameter, being firſt excited. It was ſuſpended by a Loop of Silk that went through a ſmall Cork, with which the Hole in the Glaſs Ball, by which it was blown, was ſtopped, and by the Loop ſuſpended on a ſmall Hook that was ſkrewed on to the Braſs Wire that came through the Collar of Leather in the Braſs-Plate that covered the Top of the open Receiver; as in the Experiment of letting fall the Guinea and Feather *in vacuo*. Then the Ball was drawn up to the

Top

Top of the Receiver, and the Top of the ſmall Stand, covered with Paper, was laid on the wet Leather on the Plate of the Pump, and Leaf-Braſs laid on the ſame. Then the Air was exhauſted, when the Glaſs Ball was let down to about an Inch, or ſomewhat more, towards the Pieces of Leaf-Braſs: Many of them were attracted by it. Then the Air was let into the Receiver, and the Leaf-Braſs laid on the Stand, the Ball being, as before, ſuſpended, was let down to about the ſame Diſtance from the Leaf-Braſs as before, and there ſeemed to be very little Difference in the Attraction.

I have made the ſame Experiments with Sulphur, Shell-Lac, Roſin, and white Bees-Wax. Theſe would be attracted to the Height of an Inch and a half by Eſtimation; and when the Experiment was made with the Receiver full of Air, there was very little, if any Difference in the Height of the Attraction, when there was the ſame Time ſpent before the Attraction was begun *in pleno*, as there was required to exhauſt the Receiver.

A CATALOGUE of the ſeveral Electric Bodies *mentioned in the foregoing Diſcourſe.*

N°	Names of the ſeveral Bodies.	Weight. ℥	ʒ	Months.	Days.
1	Fine black Roſin	2	0	*January*	31
2	Stone Pitch and black Roſin	2	2	*January*	31
3	Fine Roſin and Bees-Wax	2	1	*February*	1
4	Stone Pitch	1	7	*February*	1
5	Stone Sulphur	3	6	*February*	4
6	Shell-Lac	10	0	*February*	10
7	Fine black Roſin	10	4	*February*	11
8	Bees-Wax and Roſin	9	0	*February*	12
9	Roſin 4 *parts*, and Gum-Lac 1 *part*	10	0	*February*	12
10	Sulphur	18	0	*February*	15
11	Stone Pitch	10	12	*February*	16
12	Black Roſin	23	0	*February*	23
13	White Roſin	7	12	*February*	25
14	Gum-Lac	11	14	*February*	26
15	Gum-Lac and black Roſin *ana*	9	12	*February*	26
16	Gum-Lac 4 *parts*, Roſin 1 *part*	17	8	*February*	28
17	Shell-Lac, fine black Roſin *ana*	28	4	*March*	2
18	A Cylinder of Stone Sulphur	19	4	*March*	20
19	A large Cone of Stone Sulphur	30	0	*March*	29
20	A Cake of Sulphur	11	4	*April*	29

A new Barometer, by Dan. Gab. Fahrenheit. *F. R. S.* N°. 385. p. 179.

IV. Cylindro AB annectitur tubus BC, cui additur globulus oblongus CD, & huic tubulus gracillimo foramine præditus DE. Cylindrus liquore quodam, qui calorem aquæ ebullientis perferre poteſt, replebitur. In tubulo BC, gradus caloris in aëre obvii menſurabuntur ope ſcalæ affixæ *b c*. Si autem thermometrum hocce aquæ bullienti imponatur, liquor thermometri non ſolum globulum CD implebit, ſed etiam uſque ad terminos varios tubuli DE aſſurget, ſecundum gradum caloris, quem aqua tempore experimenti a gravitate atmoſphæræ acquiſitura eſt. Ita, ſi, exempli gratia, tempore experimenti altitudo mercurii in barometro ſit 28 pollicum Londinenſium, liquor in hocce thermometro attinget infimum locum in tubulo DE; Si vero gravitas atmoſphæræ æquipolleat altitudini mercurii triginta & unius pollicum, liquor a calore aquæ ebullientis uſque ad locum ſupremum tubuli DE attolletur, termini varii autem caloris aquæ ebullientis non gradibus, ſed illorum loco numeris digitorum, quibus altitudo mercurii in barometris vulgo menſuratur, ope nempe ſcalæ additæ *d e* denotabuntur.

Fig. 1.

Obſervations of an extraordinary Height of the Barometer, by Mr George Graham, *F. R. S.* N°. 369. p. 222.

V. Upon *Thurſday* the 21ſt of *December* 1721, obſerving the Barometer much higher than uſual; that Evening, between Seven and Eight a Clock, I fill'd a Tube with very clean Quick-ſilver, and found the Height a little to exceed 30,7 ½ Inches. By Eight the next Morning, a Wheel-Barometer, which hung in the ſame Room, had riſen One tenth of an Inch higher than it was the Night before, when the Experiment was made; at Ten a Clock, One fifth of an Inch more: At which Time it was at the higheſt, being a little above 30,8 ½ Inches; for about Twelve at Noon it was ſenſibly lower, and continued falling all the reſt of the Day.

When the lower End of the Tube was firſt immers'd in the Ciſtern, the Quick-ſilver for ſome Time adher'd to the Crown of the Glaſs, but upon ſhaking, it fell to the Height abovemention'd.

A Propoſal for meaſuring the Height of Places, by help of Mr Patrick's *Barometer, in which the Scale is greatly inlarged, by* Edm. Halley, *L. L. D. Aſtr. Reg. F. R. S.* N°. 366. p. 116.

VI. Since *Torricelli* firſt found the Mercury in an inverted Tube was in *æquilibrio* with the whole Column of Air that was over it; and that the Weight of the incumbent Column was various, according to the different Diſpoſitions of the Air, in reſpect of ſerene fair Weather, and of rainy, windy, or otherwiſe tempeſtuous Weather: there have been ſeveral Attempts and Contrivances to make the minute Variations thereof more ſenſible. And firſt the Wheel-Barometer was thought of, which certainly ſhews theſe Variations with great exactneſs, but is only proper for a fixt ſtation, and not eaſy to be removed; which Circumſtance is required for the principal uſe to which this Inſtrument is applicable and for which I would recommend it.

The next Thought for this purpoſe was that of Mr *Hubin*, deſcribed in *Phil. Tranſ.* N° 184, who returning the Tube of the Barometer, as an inverted Syphon, made a large dilatation in the aſcending leg thereof, wherein the *Mercury* aſcended, as it's Altitude in the other part thereof abated, and *è contra*, over this he drew out a narrow

Glaſs

Glaſs Cane, which he filled with a tinged Spirit, and which being about fifteen times lighter than *Mercury*, would aſcend about 15 times as much as the *Mercury* in the Barometer fell. This, beſides that the Spirit would dilate and contract itſelf with Heat and Cold, had the inconvenience of the former, not to be eaſily removed without great danger of diſorder and breaking, by reaſon of the ſmallneſs of the Tube in which the Spirit was to riſe and fall.

This was ſucceeded by Dr *Hook's* Marine Barometer, made of two Thermometers, the one the common ſeal'd weather Glaſs, having no communication with the outward Air, wherein the temper as to heat and cold was ſhewn by the ſwelling or ſhrinking of the included Spirit; the other the old Thermometer made with an inverted Bolt-head, in whoſe globular Part was included Air ſomewhat rarer than the ambient, ſo as to make the Liquor which was to riſe and fall in the ſhank of the Bolt-head, always to ſtand above the ſurface of the *Stagnum*, into which it's end was immerſed. This ſhew'd the heat of the Air by it's own dilatation; but at the ſame time, the different preſſure of the Atmoſphere mixed with it, ſo that the graduation of theſe two Thermometers be adjuſted to any given Height of the *Mercury*, they would at all times when the *Mercury* was at that Height, both ſhew the ſame degree of Heat: But at other times when the weight of the Air was different, that difference would ſhew itſelf by the diſagreement of the degree of Heat ſhewed by them. This will be better underſtood from N°. 269, of the *Tranſactions*, wherein I have deſcribed this Inſtrument at large. This, tho' of admirable uſe at Sea, to give timely notice of approaching bad Weather, labours under the Objection that it ſuppoſes the Concave of the Tubes of the Thermometers to be Cylinders, or of equal Diameters throughout; and alſo that on account of Heat and Cold the Air and Spirit have a proportional Dilatation and Contraction; the firſt of which I take to be very hard to be found in ordinary Glaſs-Canes, and the other I fear ſtill wants to be made out by authentic Experiments.

The laſt contrivance for this purpoſe is that of Mr *Patrick*, who ſtiles himſelf the *Torricellian Operator*, by filling a ſmall Glaſs-Cane about five foot-long, and ſomewhat, but as little as may be, tapering upwards, toward the cloſe end of the Cane; then inverting it, without a ſtagnant Ciſtern of *Mercury*, ſo much of the *Mercury* as exceeds the Length of the Column the Atmoſphere can then ſupport, will drop off, and leave it's length equal to the then preſent Height of the common Barometer: now when the Barometer riſes, this length in the Cane becomes greater by the *Mercury*'s being preſt up into the upper and narrower Part of the Tube; and when it falls, on the contrary, it ſettles down into the wider part thereof, and becomes ſhorter, being always the ſame in quantity. By this means, as the Angle of the Concave Cone of Glaſs, of which this Tube conſiſts, is ſmaller, the different Situation of the *Mercury*, will, upon

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the Alteration of the Air's preſſure be nicely ſhewn by very large an diſtinct Diviſions.

Now the Uſe to which I would apply this contrivance of the Barc meter, is to meaſure by it the different Levels of Places too remote t be come at by the ordinary Inſtruments for levelling, with the certaint one would deſire. For this purpoſe let there be provided two ſma Glaſs-Canes, as near as can be ſimilar, growing very little taper o ſmaller at the cloſed end, ſo that being inverted, the *Mercury* ma be ſuſpended in them at the Height it ought to have at the time c the Experiment. Let that Height be duly noted, and then aſcendin the Monument, or ſome ſuch Edifice where the Aſcent may be exactl meaſured, let the Scales annexed be divided into parts by the defcer of the *Mercury* at every ten feet, in both the pendent Barometer which I conceive may be ſo choſen as to make the Diviſions ver diſtinct and ſenſible. Theſe thus prepared, when it is deſired t take the Level of two diſtant places, let one of them be placed in th lower place, at the time when the *Mercury* has the ſame Height a when they were firſt inverted and graduated; and let the other b carried to the higher place, where it will be found to ſtand at that di viſion which anſwers the Elevation of that place above the other, th which had before been found by meaſure in aſcending the Monumen Thus may 90 foot Aſcent, which makes but one tenth of an Inch c *Mercury*, be repreſented by two or three Inches, or a ſpace capabl of being divided into 90 parts: whereas, if the diſtance of the tw places be 20 Miles, a Minute of a Degree is equal to above 30 foot and by the uſual Sights, whether Teleſcope or otherwiſe of your wate Levels, I fear it will be very hard to convey a true Level without greater Error than one Minute in the whole. This Propoſal I hum bly ſubmit to the Examination of this Honourable Society.

The Barometrical Method of meaſuring the Height of Mountains, with two new Tables ſhewing the Height of the Atmoſphere at given Altitudes of Mercury. By J.G. Scheuchzer, *M. D. R. S. S.* No. 405. P. 537.

VII. The Height of Mountains, and their Elevation above th Level of the Sea, hath been at all Times thought worthy the Atten tion of inquiſitive Philoſophers. We find in *Pliny* *, that *Dicæarchus* one of the old Geographers, a Diſciple of *Ariſtotle*, and, as *Plin* himſelf ſtiles him, a Man of great Learning, had by particular Or der of ſome Princes meaſured the Heights of ſeveral Mountains and that the higheſt of them, Mount *Pelius* in *Theſſalia*, was found b his Obſervations 1250 Paces high perpendicularly. *Cleomedes* alſo, *Grecian* Aſtronomer and Geographer, who lived ſome time before ou Saviour's Nativity, aſſerts †, that the higheſt Mountain cannot b above 15 Stadia, or 9375 *Roman* Feet high.

But *Plutarch* ‖ fixes the perpendicular Height of the higheſt Mour tains, as alſo the greateſt Depth of the Sea, only to 10 Stadia, 6250 *Roman* Feet. It will appear by the Sequel of this Paper, th

* Hiſt. Nat. L. xi. c. 65. † Cyclicæ Theor. Cap. x. ‖ In vita Æmilij.

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the Height of Mountains, as determined by theſe early Writers, doth not ſo very much deviate from Truth, as one would be apt to ſuſpect from the infant State of Arts and Sciences in thoſe Times. Particularly the 15 Stadia of *Cleomedes*, which make out 9375 *Roman*, or 10,214 *Paris* Feet, will be found by the following Obſervations to come very near the Height of the Mountains of *Swiſſerland*, which, although the higheſt of *Europe*, do not riſe above 10,000 *Paris* Feet above the Level of the Sea; and it may ſeem ſurprizing, that ſubſequent Writers, even ſuch as were otherwiſe deeply ſkill'd in mathematical Learning, have run them up to an extravagant, and altogether unnatural Height.

At firſt, it is not improbable, they went only upon bare Conjectures; but afterwards, when Geometry came to be more and more improved, Quadrants, Semicircles, and other Geometrical Inſtruments were call'd in Uſe, by the Means of which, and by a Trigonometrical Calculation, the Heights of Places could be determined in a more ſatisfactory Manner. And yet, however true the Principles be, upon which this Method is founded, however nice the Inſtruments, and however curious the Obſerver, the Method itſelf muſt be owned, and hath been found by undoubted Experiments, to fall far ſhort of that Accuracy, which it ſeems to promiſe; and the more conſiderable the Heights are, the more uncertain it will be. For, in the firſt Place, as the State of the Air is very different in different Seaſons and different Weather, it's Refraction alſo becomes thereby greatly altered, which occaſions the Tops of Mountains to appear higher at ſome Times than they do at others, and at all Times higher than they actually are. But beſides, there is another Inconveniency, of which whoever is acquainted with the true State of mountainous Countries, muſt needs be ſenſible, and that is the extream Difficulty of meeting at the Bottom of high Mountains with Plains large enough for a proper horizontal Stand, or Baſis, to ſuch a Triangle, as an accurate and knowing Obſerver would think ſatisfactory to determine a conſiderable Height, making even proper Allowances for the Air's Refraction.

Among the many Improvements in Natural Philoſophy, which are owing to the Torricellian Tube, one of the moſt conſiderable Inventions of the laſt Century, it hath been thereby enriched with a new Method of meaſuring the reſpective Heights of Places, and their Elevation above the Level of the Sea; a Method, which, although it muſt be owned, that it hath not as yet, and perhaps, conſidering the Inconſtancy of the Air, hardly ever will be brought to an abſolute Degree of Certainty, is yet in many Reſpects preferable to the Trigonometrical one, as it hath alſo been found by Experience to come nearer the Truth, and leads us, by a new and ſingular Scale, from the very Horizon of the Sea to the Tops of the higheſt Mountains, a Diſtance far beyond the Reach of Geometrical Inſtruments. This

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new Method is grounded upon that that eſſential Quality of the Air, it's Gravity or Preſſure. As the Column of Mercury in the Barometer is counterpoiſed by a Column of Air of equal Weight, ſo whatever Cauſes will make the Air heavier or lighter, it's Preſſure will be thereby increaſed, or leſſened, and conſequently the Mercury riſe or fall. Again the Air is more or leſs condenſed, or expanded, in Proportion to the Weight, or Force, which preſſes it: Hence it is, that in *England*, *Holland*, the maritime Provinces of *France*, and in general all thoſe Countries which border upon the Sea, the Mercury ſtands higheſt, that the higher you remove from the Sea into the midland Countries, the lower the Mercury will deſcend, becauſe the Air alſo becomes more rarified and lighter, and that upon the Tops of the higheſt Mountains it falls loweſt, and theſe Heights of the Mercury in different Places are reciprocally, as the Expanſions of the Air. From theſe Principles, ſupported by a competent Number of Obſervations, it hath been attempted by ſeveral learned Men, to derive proper Tables, whereby the Height of any Place may be determined, if the Height of the Barometer be given, or the Height of the Barometer determined from the given Altitude of the Place, and likewiſe the Expanſions of the Air ſettled, as they anſwer to every Inch, or Part of an Inch, in the Barometer.

M. Mariotte, a celebrated Member of the *Royal Academy of Sciences* at *Paris*, was one of the firſt that laid down certain Rules for the Conſtruction of ſuch Tables, as might ſerve to determine both the Elevation of Places above the Level of the Sea from given Altitudes of Mercury, and the Heights of the Air, anſwering to every Line of Mercury in the Barometer, from 28″, where the Mercury was ſuppoſed to ſtand at a Medium near the Sea. The Principles he went upon, and the Method he followed, he diſcourſed of at large, in his *Second Eſſay de la Nature de l'Air*.

Some time after, in 1686, Dr *Halley* went about another Calculation, which he derived partly from Principles agreeing with thoſe of *M. Mariotte*, partly from the ſpecifick Weight of Air and Mercury which were found by Experiments to be as 1 to 10,800; Air being to Water as 1 to 800, and Water to Mercury as 1 to 13 ½, or very near it. If ſo, as the Column of Mercury in the Barometer is counterpoiſed by a Column of Air of equal Weight, a Cylinder of Air of 10,800 Inches or 900 Feet will be equal to one Inch of Mercury, and 90 Feet to $\frac{1}{10}$ of an Inch, or 75 to $\frac{1}{12}$ Part of it. The Height of the Air, as it anſwers to one Inch of Mercury, being thus determined and the Expanſions of the Air being reciprocally as the Heights of Mercury, Dr *Halley*, by the Help of the Hyperbola and its Aſymptotes, calculated two Tables, one ſhewing the Altitude to given Heights of Mercury, the other the Heights of Mercury at given Altitudes. Theſe Tables, the firſt that ever were calculated, together with the Doctor's whole Method of proceeding, and an

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genious Attempt of his to diſcover the true Reaſon of the Riſe and Fall of Mercury upon Change of Weather, were printed in the *Philoſophical Tranſactions* *, and the Tables themſelves were very lately re-printed, with ſome Obſervations upon them, by Dr *Deſaguliers* †.

In the Year 1703, when the *Meridian* Line, firſt begun by *M. Picard* in 1669, afterwards continued in 1683, was farther purſued, ſeveral Obſervations of this Kind were made, and the Heights of ſeveral conſiderable Mountains, particularly in the Southern Parts of *France*, determined as well by Trigonometrical as Barometrical Obſervations. Monſieur *Caſſini* the Younger took that Opportunity to compare theſe Obſervations with the Rules laid down by *M. Mariotte* ‖, in order to one which, and conformable to the ſaid Rules, he calculated two Tables, ſhewing the Height of the Atmoſphere, as it anſwers to every Line of Mercury in the Barometer, the other determining the Height of the Atmoſphere above the Level of the Sea at given Altitudes of Mercury. But having afterwards, upon Compariſon, found that the Obſervations made in 1703, did not in the main agree with the Rules of *M. Mariotte*, and that the Heights of Places, as they appeared by thoſe Obſervations, exceeded, generally ſpeaking, the Numbers reſulting from the Tables made by him according to the ſaid Rules, he thought it neceſſary to calculate two new ones, wherein indeed the Reſults are conſiderably greater than in the Tables framed according to the Rules of *M. Mariotte*; inſomuch, that for Inſtance, a Place, where the Mercury falls to 22 Inches, riſes above the Level of the Sea, according to *Mariotte*, 852 Toiſes, or 5112 *Paris* Feet; and, according to *Caſſini*, 1158 Toiſes, or 6948 Feet, which makes a Difference of 1836 *Paris* Feet, or 306 Toiſes. Dr *Deſaguliers*, in his Diſſertation concerning the Figure of the Earth **, hath already ſhewn how far the Obſervations made by the Gentlemen, that drew the *Meridian* a-croſs the Kingdom of *France*, differ from each other; inſomuch, that there are not two in nine, where the Number of Toiſes, ſaid to correſpond to the Heights of the Barometer, agree together; and that conſequently the Heights of Mountains, as determined by theſe Obſervations, are little to be depended on.

My Father, Dr *J. J. Scheuchzer*, in his Journies over the Mountains of *Swiſſerland*, at they were more particularly calculated for the Improvement of Natural Philoſophy in it's ſeveral Branches, neglected no Opportunity, along with his other Obſervations, to make ſuch Experiments with the Barometer, as might ſerve to illuſtrate the Qualities of the Air, to ſettle the reſpective Heights of Places, and particularly to ſhew, how much our Mountains riſe, as well above the Level of the Sea, as above other neighbouring Mountains in *France*,

* No. 181. *pag.* 106. † Phil. Tranſact. No. 386. ‖ Memoires de l' Acad. Royale, 1705. *pag.* 61. & ſeq. ** Phil. Tranſ. No. 386. *pag.* 211.

Italy, *Spain*, &c. Many of theſe Obſervations are ſcattered up and down in his Writings, particularly his *Itinera Alpina*, and the ſeveral Parts of his *Natural Hiſtory of Swiſſerland*, which laſt Work was publiſhed in *High German*. It would be too tedious to mention all the Experiments he made at different Times, and upon different Mountains. But my Deſign in this Paper requires me to be particular in one, which for the Height meaſured both with the Line and Barometer is, I believe, the moſt conſiderable that ever was made, and which enabled him more particularly to examine the two Tables made by *Caſſini* the Younger, according to the Rules of *M. Mariotte*, and the Obſervations made by him and others, when the *Meridian* Line was perfected in 1703.

This curious Experiment was made in the Year 1709, at *Pfeffers*, a celebrated Mineral Water in the County of *Sargans*, at the Bottom and Top of a Mountain, which riſes from a ſmall Brook, called the *Taminna*, to the Height of 714 *Paris* Feet, as appeared by letting a Line drop down perpendicularly from a Tree at Top, full to the Bottom. At the Bottom of this Mountain, near the *Taminna*, the Mercury was by repeated Experiments obſerved at $25''$, $9\frac{1}{2}'''$, and at the Top it deſcended to $24''$, $11\frac{1}{2}'''$, ſo that it fell juſt 10 Lines, for 714 Feet, which gives about 71 *Paris* Feet for a Line, if the Heights anſwering to every Line were ſuppoſed to be equal.

I muſt here once for all deſire the Reader to take Notice, that I have made uſe in this Paper of *Paris* Meaſure, namely, of Toiſes (°) Feet (′) Inches (″) and Lines (‴). Every Toiſe is reckoned at ſix Foot, the Foot is divided into twelve Inches, and the Inch into twelve Lines.

The Heights of the Barometer at the Bottom and Top of the Mountain being thus given, the Height of it ſhould be, according to *M. Mariotte*, 116°, 0′, 8″, 11‴, or 696 *Paris* Feet, 8″, 11‴, which falls 17′, 3″, 1‴, ſhort of the true Height, and according to *Caſſini* 153° 3′, 8″, that is, 921 *Paris* Feet, 8″, which exceeds the true Height by 207 *Paris* Feet, 8 Inches; whereby it appears, that the Table made according to the Rules of *Mariotte* is much preferable to that of *Caſſini* the Younger. The ſame was likewiſe confirmed by another Experiment made in *June* 1715, upon the Steeple of our Cathedral at *Zurich*. At the Foot of the Steeple the Barometer ſtood at $26''$, $10'''$, and at the Top at $26''$, $7\frac{1}{2}'''$, and the Height of the Steeple was found by the Line of 241 *Paris* Feet, 4 Inches, which gives very near 69 *Paris* Feet for one Line. According to the Table of *Mariotte*, the Height of the Steeple ſhould have been of 237 *Paris* Feet, according to *Caſſini*, 265, and according to the new Calculation (of which by and by) made purſuant to the Experiments above, it comes to 243°, $16''$, $2'''$, or about two Foot more than the true Height.

It appearing by the Experiments made at *Pfeffers*, that from $25''$, $9\frac{1}{2}'''$ the Barometer deſcends to $24''$, $11\frac{1}{2}'''$, that is, juſt 10 Lines,

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for the Height of 714 Feet, and the Expanſions of the Air being reciprocally as the Heights of Mercury, my Uncle, Dr *John Scheuchzer*, undertook, purſuant to theſe Principles, and the Properties of the Hyperbola, to calculate a new Table, after the following Method.

As the Difference of the Logarithms of the two given Heights of the Barometer $25^{II}\ 9\frac{1}{3}^{III}$ and $24^{II}\ 11\frac{1}{3}^{III}$, that is $309\frac{1}{3}$ and $299\frac{1}{3}$, or	Is to Foot,	So the Difference of the Logarithms of the Height of Mercury near the Sea, $28^{II}\ 1^{III}$ to any leſſer Height, as for Inſtance $28^{II}\ 0^{III}$, that is 337 —336, or	To the Height of the Atmoſphere above the Level of the Sea, as it anſwers to one Line of Mercury, is
928 — 898		1011 — 1008	
142717	714	12906	$64^{I}, 6^{II}, 9^{III}$

Thus the Height of the Atmoſphere at 28^{II} appears to be of 10^{o}, 4^{I}, 6^{II}, 9^{III}, but, according to *Mariotte*, it is only of 10^{o}, 3^{I}, or 63 Feet, and *Caſſini* ſuppoſes it only at 10^{o}, or 60 Feet.

In like Manner the Height of the Atmoſphere, from 28^{II}, 0^{III}, to 27^{II}, 11^{III} is found to be 64^{I}, 9^{II}, 2^{III}. According to the ſame Rule half the Height of the Atmoſphere, that is, the Height of the Place, where the Mercury in the Barometer would deſcend to 14 Inches, appears to be, $1506o^{I}$, 3^{II}, o^{III}, or 2510^{o}, o^{I}, 3^{II}, o^{III}. Still upon the ſame Principle the Mercury will deſcend to one Line at the Height of 133,397 *Paris* Feet above the Level of the Sea, which makes 22,232 Toiſes, 5 Feet, or 11 *Paris* Miles (at 2000 Toiſes the Mile) 232 Toiſes, 5 Foot. But as in order to determine the whole Height of the Atmoſphere, the Logarithm of 1^{III} ought to be deducted from the Logarithm of 336^{III} or $28^{II}\ 0^{III}$, and as that Logarithm is ooooo, it follows from thence, that beyond the Place, where the Mercury would deſcend to 1^{III}, the Air is expanded into an Indefinite Space.

VIII. In a former Paper, I took Notice that *Dicæarchus* found Mount *Pelius* in *Theſſalia*, to be 1250 Paces high, which make 6250 *Roman*, or 6822 *Paris* Feet, a Height which we may well pronounce too great even for the abſolute Height of Mount *Pelius*, I mean it's Riſe above the Level of the Sea. Conformable to the Determination of *Dicæarchus*, I mentioned, that *Plutarch* fixes the Height of the higheſt Mountains, and the greateſt Depth of the Sea to 10 Stadia, and *Cleomedes* affirms, that they cannot exceed 16 Stadia. The celebrated *Galileus de Galileis* is one of the moſt modeſt among the modern

Remarks on the Height of Mountains in general, and of thoſe of Swiſſerland *in particular, by the ſame.* No. 406. p. 577.

Writers on this Head: For he ſays, * that the higheſt Mountains do not riſe above a Mile, or 8 Stadia, or 5000 old *Roman Veſpaſian* Feet, which make 5458 *Paris* Feet above the Level of the Sea, which we ſhall find by and by to agree pretty well with ſome of the higheſt Mountains in *France*, and may conjecture to do ſo with thoſe in *Italy*. *Kepler* went rather too far † when he aſſigned the Mountains of *Rhætia* (thought the higheſt in *Swiſſerland*) a Height of 26 Stadia, or 10000 old *Roman Veſpaſian* Feet, which make 10916 *Paris* Feet. The Opinions of ſome other Antient and Modern Geographers and Mathematicians, will appear better by the Table annexed.

A Table ſhewing the Height of Mountains according to ſeveral Antient and Modern Writers.

	Stadia.	Old *Rom Veſpaſian* Feet.	*Paris* Feet.
Strabo (*Lib.* II. *Geog.*) ſays, that the higheſt Mountain, called by him *Petra Sogdiana*, is of - - - - - - - - - - - - - - -	30	18750	20468
Pererius (*Lib.* XII. *in Geneſin*) determines the higheſt Mountains to - - - - - - -	32	20000	21832
Leo Bapt. Albertus (*Architect. Lib.* X. *Cap.* i.) to		22500	23661
Ath. Kircher. (*Ars magn. luc. & umbr. P.* II. *Probl.* 5.) brings them to - - - - - -	43	26875	29337
Fromond. (*Lib.* I. *Meteor. Cap.* 2. *Art.* i.) - -	64	40000	43664
Gilbertus de magnete. L. IV. *C.* i. - - - - - -	128	80000	87328
Pliny (*Lib.* III. *Cap.* lxiv.) according to the Explanation of *Fortunius Licetus* (*de Lunæ Luce ſubobſcura, Lib.* II. *p.* 306.) to - -	400	250000	272900
Ricciolus, Geophr. (*Lib.* VI.) is of Opinion, in Purſuance of what he imagines to have demonſtrated of the Mountains *Athos* and *Caucaſus*, that poſſibly there may be Mountains of - - - - - - - - - - - -	512	320000	349312

Now, in Oppoſition to this Table, wherein the Heights muſt needs, upon firſt View, appear romantic and unnatural, let us conſider the Height of ſuch Mountains, as have been meaſured, either by Trigonometrical or Barometrical Obſervations.

In *England*, the Height of *Snowdon-hill*, one of the higheſt Mountains in *Wales*, was meaſured Trigonometrically, by Mr *J. Caſwell* of *Oxford*, and found to be of 1240 Yards, or 3720 *Engliſh* Feet, which make 3488 *Paris* Feet. At the Top of this Mountain, the Mercury ſubſided to $25^{II}\ 6^{III}$, which being reduced to *Paris* Meaſure, make juſt 24^{II}. Now in the Tables above, the Height of the Place where the Mercury ſubſides to 24^{II}, is, according to *Mariotte*, of 544

* Nuntius Sidereus, p. 14. † Aſtronom. Optic. p. 129, 135. & Epitom. Aſtronom. Lib. I. pag. 26.

Toiſes,

Toiſes, two Foot, or 3266 Foot above the Level of the Sea, according to *Caſſini*, 676 Toiſes, or 4056 Feet, and according to my Uncle's Calculation 559° 2', or 3356', ſo that *Mariotte* comes 222 Feet ſhort of it's Height, as it was determined Trigonometrically, Dr *Scheuchzer* but 132', but *Caſſini* exceeds this Height by 568 Feet, which confirms again, as I have ſhewn in a former Paper, that the *Mariottian* Table is preferable to that of *Caſſini*, though pretended to have been corrected upon the former, and that that of Dr *Scheuchzer* is an Improvement upon both. According to the Obſervations made by Dr *Halley*, *May* 26, 1697, the Mercury ſtood at the Top of *Snowdon-hill*, ar 26'' 1''' *Engliſh*, which, if reduced as above, would give the Height of the Mountain ſomething leſs.

In *France*, when the Meridian Line, firſt begun in 1669, was continued in 1703, the Heights of ſeveral Mountains, particularly in the South of *France*, were determined Trigonometrically by the Members of the *Royal Academy of Sciences*: And I find up and down in their Memoirs, the Heights of the following.

	Height in Toiſes.	Feet.
Mont Clairet in *Provence*	277 or	1662
La Maſſane in *Rouſſillon*	397 —	2382
The ſame according to another Obſervation	408 —	2448
Bugarach a Mountain in *Languedoc*	648 —	3888
Mountains in *Auvergne*.		
Le Puy de Domme, near *Clermont*	810 —	4860
La Courlande	838 —	5028
La Coſte	851 —	5106
Le Puy de Violent	853 —	5118
Le Cantal	984 —	5904
Le Mont d'or	1030 —	6180
In the County of *Avignon*.		
Le Mont Ventoux	1036 —	6216
Pyrenean Mountains.		
S. Barthelemy dans le pais de foix	1185 —	7110
La Montagne du Mouſſet	1258 —	7548
Le Canigou	1440 —	8640

Before I proceed farther, I muſt beg Leave to obſerve, that the Heights of theſe Mountains, in the main, ſeem rather too great. This indeed is eaſily accounted for, as they were meaſured by Trigonometrical Obſervations, which will, as I have taken Notice above, becauſe

becauſe of the Refraction of the Air, give the Heights greater than they actually are. But what confirms it ſtill more, is, that according to the Tables above, the Numbers which anſwer to the Heights of the Mercury, as they were obſerved at the Top of ſome of thoſe Mountains, are conſiderably leſs, and that even Monſ. *Caſſini*'s own Numbers, which yet we have by ſome undoubted Experiments ſhewn to be too great, fall often ſhort. It will be enough to mention two or three Inſtances At the Tower of *Maſſane* in *Rouſſillon*, the Mercury ſtood at $25^{11}\ 5^{111}$, and the Height of that Place was determined Trigonometrically, of —— —— —— 397 Toiſes.

Now $25^{11}\ 5^{111}$ anſwer according *Mariotte*, to ——	342	0
According to *Caſſini*, —— —— —— ——	392	4
According to Dr *Scheuchzer* —— —— ——	350	0

At the Top of the Mountain called *la Coſte* in *Auvergne*, the Mercury ſtood, *Oct.* 9, 1700, at $23^{11}\ 4^{111}$, and the Height of this Mountain was determined Trigonometrically of - -851° Toiſes.

Now $23^{11}\ 4^{111}$ anſwer according to *Mariotte*, to —— ——	644°	1′	diff.	206° 5′
Caſſini —— —— —— ——	826	1		24 5
Dr *Scheuchzer* —— —— —— ——	661	5		189 1

The Difference is ſtill more conſiderable with Regard to the high Mountain *Mont d'Or* in *Auvergne*, the Height whereof was determined Trigonometrically to —— —— —— 1040 Toiſes.

At the Top of this Mountain the Mercury fell, according to an Obſervation made by *F. Sebaſtien Truchet*, *June* 8, 1705, to $22^{11}\ 11^{111}$, which anſwer according to

Mariotte, to —— —— —— ——	707°	5′	diff.	332° 1′
Caſſini to —— —— —— ——	925	1		114 5
Dr *Scheuchzer* —— —— —— ——	727	3		312 3

I come now to the Mountains of *Switzerland*. The Barometrical Obſervations made by my Father upon ſeveral of the higheſt will convince us, that they riſe aloft, above all the neighbouring ones in *France*, *Spain*, *Italy*, and *Germany*. And that it muſt be ſo appear farther, becauſe from their elevated Tops, they diſpenſe their Water to all the *European* Kingdoms and Provinces around them. Nay, doubt not, but that they may vye in Height with the moſt conſiderable Mountains in any other Part of the known Globe. *Switzerland* ſelf, I mean it's Valleys and lower Parts, as they are conſiderably remote from the Sea, riſe alſo in Proportion above the Level of it. 'Tis true, the Aſcent thither is but gradual, in Proportion to the Remotne

ness. At *Zurich*, for Inſtance, which lies towards the Northern Borders of *Swiſſerland*, the mean Height of the Barometer hath been obſerved of $26^{II}\ 5^{III}$, which give the Elevation of that Town, above the Level of the Sea, according to *Mariotte*, 205 Toiſes, 4 Foot, or 1234^{I}, according to Dr *Scheuchzer*, $210°\ 4^{I}$, or 1264^{I}, and according to *Caſſini*, $221°\ 4^{I}$, or 1330^{I}. This Town is diſtant from the Mouth of the *Rhine*, which is the neareſt Part of the Ocean, at leaſt 375 *Engliſh* Miles, or an hundred marine *French* Leagues, and from *Genoa* which is neareſt upon the Mediterranean, 225 *Engliſh* Miles, or 62 *French* marine Leagues. So that going down from *Zurich* Northwards towards the Sea, the Deſcent, or Fall, is but ſomething more than 12 Foot, for a marine League of *France*, if we ſuppoſe a ſtreight Line to be drawn from *Zurich* to the Sea-ſhore in *Holland*; but it is much greater going Southward towards the Mediterranean, where it comes at leaſt to 20 Foot for one League. Nay, if we conſider that the higheſt Mountains of *Swiſſerland* lie almoſt directly between *Zurich* and the Mediterranean Shores, we muſt allow ſo much more in Proportion, as thoſe Mountains are elevated above the Horizon of *Zurich*, and how great and ſudden this Elevation be, will appear by the following Obſervations.

At *Ennen Sewen gen Aweren* in the Aſcent of the high Mountain *Freyberg*, in the Canton of *Glarus*, which lies South Eaſt of *Zurich*, the Mercury was obſerved *Sept.* 11, 1710, at $23^{II}\ 10^{III}$, which gives the Height of that Place above the Level of the Sea, according to

Mariotte	569°	2′	or 3416′
Dr *Scheuchzer*	584	4	— 3508
Caſſini	712	3	— 4275

Upon *Scherf*, one of the Branches of the *Freyberg*, the Mercury fell *Sept.* 12, 1710, to $21^{II}\ 8^{III}$, which gives the Height of that Part of the Mountain according to

Mariotte	906°	1′	or 5437′
Dr *Scheuchzer*	931	2	or 5588
Caſſini	1247	4	or 7486

Still higher upon *Blattenſtock*, another Part of the ſame Mountain, the Mercury fell on the ſame Day to $21^{II}\ 6^{III}$, which anſwer according to

Mariotte, to	933°	2′	or 5600′
Dr *Scheuchzer*	959	2	or 5756
Caſſini	1293	3	or 7761

Hence from *Zurich* to the *Blattenſtock* near the Top of the *Freyberg*, there is, in leſs than three Days Journey, a Riſe of 4366 Feet, according to *Mariotte*, and 4492, according to Dr *Scheuchzer*, that is, more

more than three times the Elevation of *Zurich* above the Level of the Sea.

At *Guppen ob Schwanden*, in the ſame Canton of *Glarus*, the Mercury was obſerved, *Auguſt* 5, 1705, at $23^{II}\ 4^{III}$, which give, according to

Mariotte	644^{q} 1^{l}	or 3865^{l}
Dr *Scheuchzer*	661 5	or 3971

(I omit giving the Numbers according to the Tables of Mr *Caſſini*, having already ſhewn, that they are too great) The Height of this Mountain is nearly the ſame with the celebrated *Puy de Domme*, where Monſ. *Perier* obſerved the Mercury, *Sept.* 19, 1648, at $23^{II}\ 2^{III}$.

Upon *Joch*, a high Mountain in the Territory of *Engelberg*, where it confines upon the Canton of *Bern*, full South of *Zurich*, the Mercury ſtood, *June* 23, 1706, at $21^{II}\ 4^{III}$, which gives the Height of that Mountain according to

Mariotte	961^{q} 0^{l}	or 5766
Dr *Scheuchzer*	987 4	or 5926

This Mountain, though very high, is far from being the higheſt in that Neighbourhood, for next to it there riſes another called the *Titliſberg*, covered with everlaſting Snow, which we may, upon a moderate Computation, pronounce at leaſt 1000 Foot higher than the Top of the *Joch*, and conſequently one of the higheſt in the Country.

Upon the *Avicula*, by the *Italians* called *Monte del' Uccello*, and by ſome S. *Bernhard*'s Mountain, from a Chapel built in Honour of that Saint, a high Mountain in *Rhætia*, towards *Italy*, the Mercury was obſerved, *July* 30, 1707, at $22^{II}\ 11^{III}$, which give according to

Mariotte	707^{q} 5^{l}	or 4247^{l}
Dr *Scheuchzer*	727 3	4365

This Height muſt be underſtood only of that Part of the Mountain which is paſſed over by Travellers, the Mountain itſelf riſing conſiderably above it, and the *Adula*, or Ἀδουλίλλας of *Strabo*, Geog. Lib. III. of which the *Avicula* is only a Part, being ſtill higher. The *Rhenus poſterior*, or *Hinter Rhein*, and the *Moüſs*, which at laſt loſes itſelf in the *Teſin*, near *Bellenzone*, not much above the Entry of the *Teſin* into the Lake of *Locarno*, ariſe upon this Mountain.

At *Santa Maria*, upon the *Luckmannier Berg*, by ſome S. *Barnaby*'s Mountain, which is likewiſe a Branch of the *Adula*, the Mercury ſtood, *Aug.* 9, 1725, as upon the *Avicula*, at $22^{II}\ 11^{III}$, which ſhews the Height of theſe two Places to be equal.

In the Alp *San Porta*, near the Source of the *Hinter Rhein*, *Rhenus poſterior*, five Hours and a half from *Speluga*, *Splügen* in *Rhætia*, the Mercury was obſerved, *July* 29, 1707, at $21^{II}\ 4^{III}$, where it ſtood likewiſe

likewiſe upon the above-mentioned Mountain *Joch*, whither the Reader is referred for the Height of this Alp. At *Splügen* itſelf, the Mercury ſtood the ſame Morning early, at 23^{II} 4^{III}, which give the Elevation of *Splügen* according to *Mariotte* 644° 1^{I} or 3865, and according to Dr *Scheuchzer*, 661° 5^{I} or 3971^{I}. So that the Fall of the *Rhine* from the Alp aforeſaid to *Splügen*, in five Hours and a half, comes, according to *Mariotte*, to 1901, and according to Dr *Scheuchzer*, to 1955 *Paris* Feet perpendicular.

At the *Capuchins*, upon the high Mountain S. *Gothard*, a celebrated Paſſage out of *Swiſſerland* into *Italy*, the Mercury ſtood, *June* 30, 1705, at 22^{II} 0, which gives the Height of that Paſſage, which with Regard to the higheſt Tops of S. *Gothard*, lies but as it were at the Foot of a high Mountain, according to *Mariotte* 852°, or 5112^{I}, and according to Dr *Scheuchzer*, 875° 5^{I}, or 5255^{I}, above the Level of the Sea.

Upon the *Furca*, a high Mountain between the *Urſeren Thal*, *Urſaria Vallis*, and the upper *Valleſia*, and one of the Branches of the S. *Gothard*, the Height of the Mercury in the Barometer was obſerved, *July*, 31, 1707, at 21^{II} 5^{III}, which give the Height of this Mountain above the Level of the Sea, according to *Mariotte*, 947° 1^{I} or 5683^{I}, and according to Dr *Scheuchzer*, 973° 3^{I} or 5841. Near this Mountain there are others, which cannot be leſs than 800 or 900 Foot higher.

Theſe Mountains, I mean the *Avicula*, the *Luckmannier Berg*, the S. *Gothard*, and the *Furca*, together with the *Grimſila*, the *Criſpalt*, the *Sempronier*, or *Sempronius Mons*, the *Adula*, and a Chain of others, are the *Lepontiæ Alpes* of *Pliny* * and the *Summæ Alpes* of *Cæſar* †. They begin in the upper *Valleſia*, traverſe the Canton of *Uri*, and ſo run on Eaſtwards, a-croſs the Country of the *Griſons*, towards *Tirol*. Their greateſt Height above the Level of the Sea, may be fixed in round Numbers to 7500, or 8000 *Paris* Feet.

Gemmius Mons, the *Gemmi*, is a very high and ſteep Mountain in *Valleſia*, over which there is a Paſſage, but only in Summer-time, from the *Fruttinger Valley*, in the Canton of *Bern*, to the Mineral Waters at *Leük* in *Valleſia*. The Deſcent, on the South-ſide of this Mountain, is ſteep and frightful, even to the Aſpect, beyond what can be imagined, being a narrow Path, cut on the Side of almoſt perpendicular Precipices, ſometimes with trembling wooden Bridges, or Planks over the Clefts in the Mountain, and here and there ſupported with low Walls. Having been geometrically meaſured, it was found of 10110 Feet in Length, or rather Height, it's many Windings and Turnings included. At a ſmall Cottage, called *Zur Dauben*, a poor reſting Place for weary Travellers, being the higheſt

* Lib. iii. cap. xx. † De Bello Gallico, lib. iii.

Part of the Mountain which is paſſable, the Mercury ſubſided *July* 1, 1709, to $21^{II}\ 3^{III}$ which gives the Height of that Place, according to

Mariotte	974° 5′	or 5849′
And Dr *Scheuchzer*	1002 0	or 6012

Not far from this Cottage, is a ſmall mountainous Lake, called the *Dauben Sea*, or the *Pidgeons Lake*, encompaſſed on all Sides with high Mountains, the Tops whereof, for their Steepneſs, it would be impoſſible to reach. At *Kandelſteg*, the firſt Village in the *Fruttinger Valley*, in the Territory of *Bern*, going up to the *Gemmi*, the Mercury roſe on the ſame Day to $24^{II}\ 2^{III}$, which give according to

Mariotte	520° 1′	or 3121′
Dr *Scheuchzer*	534 1	or 3205

And at *Müllenen*, at the Foot of the *Gemmi*, it ſtood at $25^{I}\ 7^{III}$, which anſwer according to

Mariotte	318° 5′	or 1913′
Dr *Scheuchzer*	327 0	or 1962

On the other Side of the *Gemmi*, at *Leück*, a celebrated Place for it's Mineral Waters, the Mercury was obſerved *July* 2, and *July* 5, 1709, at $23^{II}\ 9^{III}$, which anſwers according to *Mariotte*, to 581° 4′, or 3490′, and according to Dr *Scheuchzer*, to 597° 3′, or 3585′. So that the Cottage *Zur Dauben*, riſes above *Leück*, according to

Mariotte,	2359′
Dr *Scheuchzer*	2427

Above *Müllenen*, in the *Frutinger Valley*, according to

Mariotte	3936′
Dr *Scheuchzer*	4050

And the perpendicular Height of the *Gemmi*, above the Level of the Sea, conſiderably exceeds 6000 *Paris* Feet.

But high above all the Mountains of *Swiſſerland* riſes the *Stella*, *Piz Stail*, a ſteep Mountain in the *Schamſer* Valley, in *Rhætia*, or the *Griſons*, the Height whereof was by my Uncle Dr *John Scheuchzer*, by ſome Obſervations made in the Year 1709, determined to 9585 *Paris* Feet, above the Level of the Sea, according to his own Calculation, or 9441 according to *Mariotte*, and 12196 according to *Caſſini*: A Height, which the *Rupicapræ*, or *Shamoys* themſelves ſcarce venture to aſcend. And 'tis to theſe only, and the like Heights the following Verſes of *Silius Italicus* ought to be applied:

Cuncta gelu, canâque æternùm grandine tecta,
Atque ævi glaciem cohibent: riget ardua montis
Ætherei facies, ſurgentique obvia Phœbo
Duratas neſcit flammis mollire Pruinas.
Nullum ver uſquam, nullique æſtatis honores,
Sola jugis habitat diris, ſedeſque tuetur
Perpetuas deformis hyems ——

The Mountains are much more abrupt, and ſteep, and the Precipices greater to the South, than to the North, and Weſtwards than Eaſtwards. Many Inſtances of this might be given in particular Mountains in *Swiſſerland*, as the *Gemmi*, the *Mons fractus*, and ſo forth; but it is alſo evidently true with Regard to the whole. Thoſe are the higheſt Mountains, which ſeparate *Valleſia*, the Canton of *Uri*, and the ſeveral Leagues of the *Griſons*, from *Savoy*, *Piemont*, and the *Tirol*, which lie to the South, or South-Eaſt. Thoſe very Countries are, as it were, one continued Set of high Mountains, quite to the *Mediterranean Sea*, and the like Structure ſeems to be continued farther on into that Sea itſelf. The *Pyrenean* Mountains alſo are but a Continuation of that vaſt Chain, which begins in the *Lepontiæ Alpes*, or the Mountains in the upper *Valleſia*, the Canton of *Uri* and *Rhætia*, and from thence ſpreads itſelf chiefly Weſt and South. On the contrary to the Eaſt and North they break off by Degrees into gentle Plains, which appears evidently by the vaſt Tracts of Ground, which the *Rhine* for Inſtance, and the *Danube* compaſs, before they loſe themſelves, the one into the *German* Ocean, the other into the black Sea, whereas the *Rhoſne*, on the other Side, quickly, and with proportionable Velocity, reaches the *Mediterranean*. The ſame Obſervation, with Regard to the abrupt Steepneſs of Mountains to the South and Weſt, holds true in other Parts of *Europe*, remarkably in *England* and *Norway*, more or leſs in other Countries. And ſo far as our Maps, and the Accounts of Travellers go, the ſame Thing is obſervable in other Parts of the World, but moſt evidently in the high Mountains of *Peru* and *Chili* in *South America*, which terminate very abruptly Weſtwards into the *Pacifick* Sea, but gradually decline to the Eaſt into immenſe Plains, watered by ſome of the moſt conſiderable Rivers in the known World, particularly the *River of Amazons*, and the *Rio della Plata*, which ariſe in the ſaid Mountains.

To conclude, from what hath been hitherto ſaid, it appears evidently, that the Mountains of *Swiſſerland* are the higheſt of *Europe*, they are alſo the great Store-houſe, whence all the Countries around them are ſupplied with Water; conformable to what the learned *Loritus Glareanus* hath long ſince elegantly expreſſed in the following Verſes.

Præterea caput Europes hanc eſſe probabunt:
Æternis Alpes nivibus, juga Olympica, quorum

Porgitur in cælum caput, & ſub Tartara venter:
Et quod ad Auroram, Boream, Solemque cadentem
Flumina perpetuo non deficientia curſu
Parturit, illa volant & in omnia membra redundant,
Ad Zephyrum & Libyen Rhodanus, Rhenana furentem
Unda citat Boream, gelidus rotat Iſter ad Eurum
Dirus aquas, Getico novus Hoſpes & advena Ponto.
Aſtalios ſileo quos Italia accipit amneis
Alpibus à noſtris, quæque alto à vertice montes
Agmina diſparibus fundunt latiſſima Sultis.

Obſervations concerning the Height of the Barometer, at different Elevations above the Surface of the Earth, by Dr Nettleton, N°. 388. p. 308.

IX. Being curious to learn by Obſervations, how far the Mercury will deſcend in the Tube at any given Elevation, for which there is ſufficient Opportunity hereabouts, I propoſed to take the Altitude of ſome of our higheſt Hills; but, when we attempted it, we found our Obſervations ſo diſturbed by Refractions, that we cou'd come to no Certainty. Having meaſur'd one Hill of a conſiderable Height, in a clear Day, and obſerved the Mercury at the Bottom and at the Top, we found, according to that Eſtimation, that about 90 Feet, or upwards, were required to make the Mercury fall one Tenth of an Inch; but coming afterwards to repeat the Experiment on a cloudy Day, when the Air was ſomewhat groſs and hazy, we found the ſmall Angles ſo much augmented by Refraction, as to make the Hill much higher than before, tho' they were taken carefully with very good Inſtruments, both at that Time and before. I afterwards frequently obſerved at home, by pointing the Quadrant to the Tops of ſome of our neighbouring Mountains, that they would appear higher in the Morning before Sun-riſe, and alſo late in the Evening, than at Noon, in a clear Day, by ſeveral Minutes: Particularly, one Morning in *December* laſt, when the Vapours lay condens'd in the Vallies, and the Air above was very pure, the Top of a Mountain, at ſome Diſtance from hence, appear'd more elevated, by above 30 Minutes, than it had done in the Beginning of *September* about Noon, on a very clear Day. From whence it appears, that the Refraction is at ſome times greater than at others; but probably 'tis always very conſiderable, and, as there is no certain Rule to make Allowance for it, it ſeems likely, that all Obſervations made on very high Hills, eſpecially when view'd at a Diſtance, and under ſmall Angles, as they commonly are, are uncertain, and ſcarce to be depended on, geneally erring in making the Heights greater than they really are.

I then proceeded to obſerve, as near as I was able, the Alteration of the Mercury in ſome ſmaller perpendicular Elevations, which we could meaſure with a Line, and alſo on the Tops of ſome Hills of a moderate Height, whoſe Altitude we could obſerve moſt commodiouſly, and, by taking the Angles large, avoid the Danger of any conſiderable Refraction.

At the Bottom of the Tower of *Halifax* Church, the Mercury ſtood at 29 *Inch.* 78 *Dec.* At the Top it ſubſided to 29. 66. The Height of the Place, where the Obſervation was made, was found to be 102 Feet.

At the Bottom of a Coal-Mine, near this Place, the Mercury ſtood at 29. 48. At the Top, it fell to 29. 32. The Depth of the Mine, being meaſured, was found to be 140 Feet.

At the Bottom of another Mine, the Mercury was obſerved to ſtand at 29. 50. At the Top, it fell to 29. 23. The Depth of this Mine was 236 Feet.

At the Foot of a ſmall Hill, whoſe Height we cou'd meaſure very exactly, the Mercury ſtood at 29. 81. At the Top it fell to 29. 45. The Height of the Hill was 312 Feet.

At the Bottom of *Halifax* Hill, commonly called the Bank; the Mercury was obſerved to ſtand at 30. 00. At the Top, it fell to 29. 41. The Height of this Hill was found to be 507 Feet.

Our Mathematicians demonſtrate, that the Denſity of the Air decreaſes in a Geometrical Progreſſion, as the Elevation encreaſes in an Arithmetical one, and conſequently, that the Logarithms of the Denſities are as the Elevations reciprocally. But the Weight of the Air being as its Denſity, and the Height of the Mercury in the Barometer being always proportional to the Air's Weight, it follows, that the Logarithms of the Heights of the Mercury are, reciprocally, as the Elevations: Whence having found by Obſervation, what Elevation is requir'd to make the Mercury ſtand at any given Height, it will be eaſy to determine, how much is requiſite to reduce it to any other Height propos'd. If we make 30 Inches the Standard Height of the Mercury, equal to Unity, and ſuppoſe an Elevation of 85 Feet be requir'd to make it fall one Tenth of an Inch from that Height, as by theſe Obſervations it is very nearly; then as the Logarithm of $\frac{30,0}{29,9}$ is to 85, ſo is the Log. $\frac{30,0}{29,5}$ to the Number of Feet requir'd to make it fall Half an Inch, and ſo of the reſt. When the Mercury ſtands above 30 Inches, the Numbers will be negative, and ſhew the Spaces deſcending; by which Method I computed the following Tables.

The latter, which contains the Differences of the Numbers in the former, was of very great Uſe to me, when, in theſe Experiments, the Mercury ſtood at any other Height in the Tube, beſides 30 Inches, and fell any Number of Tenths, or Parts of a Tenth, by adding the Numbers anſwering thereto, or proportionable Parts of them, to find the Elevation requir'd in the Table, to make the Mercury fall ſo much, and thereby readily to compare the Heights found by Obſervation therewith. And though ſome ſmall Errors, in

in the Obſervations, do make them vary a little from each other, yet in the main they agree as near as poſſible with the Numbers of the Table; as did alſo ſeveral other Experiments too long to mention, which makes me believe thoſe Numbers are not far from the Truth; but of that you will be beſt able to judge, by comparing theſe Experiments with others of the ſame Kind.

That the Air is colder, as well as more light and rare, in Places that are ſituated high, than it is in the Vallies and low Grounds, is generally known; and in order to learn, how much it might be ſo, I got a Friend of mine, who lives higher than we do here, to obſerve the Portable Barometer and Thermometer, at his Houſe, for ſome Days, being plac'd as near as poſſible in the ſame Circumſtances with mine; and we found his Barometer ſtood at a Medium for 20 Days, 3 Tenths lower than mine, and the Thermometer 3. *deg.* 2. lower; allowing for the Difference of the Inſtruments, which had been obſerved before.

At another Place the Barometer, at a Medium for 14 Days, ſtood lower by 4. 46. and the Thermometer was lower by 4 *deg.* 4. At another Place, which was very high upon the Moors, the Barometer, at a Medium for ten Days, ſtood lower by 0. 65. and the Thermometer fell 7°.

A TABLE

A TABLE ſhewing the Number of Feet aſcending, required to make the Mercury fall to any given Height in the Tube, from 30 to 26 Inches. As alſo the Number of Feet deſcending, requir'd to make the Mercury riſe, from 30 to 31 Inches.

In.	Dec.	Feet	Dec.	In.	Dec.	Feet	Dec.
31	0	834	79	27	9	1847	55
30	9	752	53	27	8	1938	97
30	8	670	01	27	7	2030	72
30	7	587	21	27	6	2122	80
30	6	504	15	27	5	2215	21
30	5	420	82	27	4	2307	95
30	4	337	21	27	3	2401	02
30	3	253	32	27	2	2494	44
30	2	169	10	27	1	2588	20
30	1	84	72	27	0	2682	33
30	0	00	00	26	9	2776	80
29	9	85	00	26	8	2871	62
29	8	170	29	26	7	2966	79
29	7	255	87	26	6	3062	32
29	6	341	73	26	5	3158	21
29	5	427	89	26	4	3254	46
29	4	514	34	26	3	3351	07
29	3	601	08	26	2	3448	05
29	2	688	11	26	1	3545	41
29	1	775	44	26	0	3643	14
29	0	863	08				
28	9	951	01				
28	8	1039	25				
28	7	1127	80				
28	6	1216	66				
28	5	1305	83				
28	4	1395	32				
28	3	1485	13				
28	2	1575	26				
28	1	1665	70				
28	0	1756	47				

A TABLE ſhewing the Number of Feet requir'd to make the Mercury fall one Tenth of an Inch from any given Height in the Tube, from 31 to 26 Inches.

In.	Dec.	Feet	Dec.	In.	Dec.	Feet	Dec.
31	0	82	26	27	9	91	42
30	9	82	53	27	8	91	75
30	8	82	79	27	7	92	08
30	7	83	06	27	6	92	41
30	6	83	33	27	5	92	74
30	5	83	61	27	4	93	07
30	4	83	89	27	3	93	41
30	3	84	16	27	2	93	76
30	2	84	44	27	1	94	12
30	1	84	72	27	0	94	47
30	0	85	00	26	9	94	82
29	9	85	29	26	8	95	17
29	8	85	58	26	7	95	53
29	7	85	86	26	6	95	89
29	6	86	16	26	5	96	25
29	5	86	45	26	4	96	61
29	4	86	74	26	3	96	98
29	3	87	03	26	2	97	36
29	2	87	33	26	1	97	73
29	1	87	63	26	0	98	10
29	0	87	93				
28	9	88	24				
28	8	88	55				
28	7	88	86				
28	6	89	17				
28	5	89	49				
28	4	89	81				
28	3	90	13				
28	2	90	45				
28	1	90	76				
28	0	91	09				

A Barometrical Experiment by And. Celsius, *from the* Act. Lit. Sueciæ Ann. 1724. Trimestr. IV. N°. 388. p. 313.

X. Ad variationem columnæ mercurialis obſervandam, pro diverſa altitudine regionum atmoſphæræ, fodinæ noſtræ profundiores in primis idoneæ cenſeri debent. Harum enim profunditatem non modo omni exactitudine metiri; ſed & brevi temporis ſpatio obſervationem totam abſolvere licet. Quo ſane commodo haud raro deſtituuntur, quibus circa altiores montes hæc talia experiri animus eſt. Si itaque quamplurima in variis fodinis inſtituerentur experimenta; nulli dubitamus, quin vera progreſſio, quâ denſitates aëris decreſcant, tandem ſua ſponte ſe proderet.

In *magna fodina Cuprimontana* argenti vivi aſcenſum a viro ampliſſimo *Georgio Vallerio* dudum obſervatum eſſe, ex litteris ipſius ad Cl. *De La Hire* d. 16 Julii, A. 1711. Fahlunæ datis, certiores reddimur. *

In *argenti* vero *fodina Salana*, ſeptem fere milliaribus ab Upſalia verſus occidentem diſſita, hujus rei periculum a me factum eſt die 28 Aug. currentis anni. Scilicet juxta limen *putei Reginæ Chriſtinæ*, (*Drottning Chriſtinæ Schatcht*,) hydrargyri altitudinem 30 digit. & 38 centeſ. ſeu $\frac{3038}{1200}$ pedis Suecani obſervavi. Cum Barometro deinde in tonna, quæ funi adpenſa machina hydraulica trahitur, ad profunditatem 636 pedum me demiſi; ubi mercurius ad 30 dig. 98 centeſ. aſcendiſſe deprehenſus eſt. Inde iterum evectus ad orificium putei, in eadem ac antea altitudine, nempe 30 dig. 38. cent. columnam mercurialem notavi. Adeo ut hydrargyrum 636 ped. in aëre elatum 6 lineas ſeu $\frac{6}{125}$ ped. deſcenderit; & ſic conſequenter, ſi aër æque denſus ubique ſupponeretur, unius lineæ in cylindro mercuriali variatio, 106 ped. altitudini perpendiculari correſponderet. Horæ illius intervallo, quo integra perficiebatur obſervatio, cœlum erat pluvium nonnihil & ventoſum; nulla tamen ſenſibilis mutatio, columnæ mercurialis in alio Barometro ſupra fodinam parieti affixo, iſto tempore videri potuit.

Poſtero die, aëre ſereno & tranquillo, ad baſin templi urbis *Salæ*, haud procul a fodina diſtantis, argentum vivum 30 dig. 36 cent. altum hæſit, altitudinem vero 145 ped. in turri ejuſdem templi ſcandens, mercurium ad 30 dig. 23 cent. ſubſtitiſſe deprehendi, ut unius lineæ in Barometro deſcenſui, altitudo $111\frac{1}{3}$ ped. reſpondeat. Baſis templi 60 fere pedes infra ſuperficiem fodinæ deprimitur. Ipſius autem fodinæ elevationem ſupra mare Balticum explorare nondum licuit.

Ut hæc noſtra obſervatio cum exterorum hujus generis experimentis rite conferri queat, notandum eſt inter pedem Suecanum & Pariſinum Regium eam rationem intercedere, quæ eſt inter 1000 & 1096, ſeu 125 & 137 proxime; quam ex pede Gallico orichalceo, inſignis artificis *Chapotot* manu inſculpto, cum pede *Stiernhielmiano*, qui in Bibliotheca publica Upſal. ſervatur, collato, exactiſſime obſervavi.

* *Vid.* Memoires de l'Acad. R. des Sc. l'ann. 1712. p. 105.

XI. It

An Experiment, made to aſcertain the Proportion of the Expanſion of the Liquor in the Thermometer, with Regard to the Degrees of Heat. By Brook Taylor, *LL.D. F.R.S.* No. 376. pag. 291.

XI. It has, I believe, been generally ſuppoſed, tho' not proved, that the Expanſion of the Liquor in the Thermometer, is proportional to the Increaſe of Heat. To determine this Matter with Certainty, I made the following Experiment.

I provided a good Linſeed Oil Thermometer, which I marked with ſmall Diviſions, not equal in Length, but equal according to the Capacity of the Tube in the ſeveral Parts of it, as all Thermometers ought to be graduated. I likewiſe provided two Veſſels of thin Tin, of the ſame Shape, and equal in Capacity, containing each about a Gallon. Then (obſerving in every Trial, that the Veſſels were cold, before the Water was put in them, as alſo that the Veſſel I meaſured the hot Water with, was well heated with it) I ſucceſſively filled the Veſſels with one, two, three, *&c.* Parts of hot boiling Water, and the reſt cold; and at laſt with all the Water boiling hot; and in every Caſe I immerſed the Thermometer into the Water, and obſerved to what Mark it roſe, making each Trial in both Veſſels for the greater Accuracy. And having firſt obſerved where the Thermometer ſtood in cold Water, I found that its riſing from that Mark, or the Expanſion of the Oil, was accurately proportional to the Quantity of hot Water in the Mixture, that is, to the Degree of Heat.

Experiments concerning the Heat of boiling Liquors, by D. G. Fahrenheit *F.R.S.* No. 381. pag. 1.

XII. Cum elapſis abhinc circitur decem annis in Hiſtoriâ Scientiarum Societatis Regiæ Pariſienſis legiſſem quod celeberrimus *Amontonius*, ope alicujus thermometri ab eo inventi, detexiſſet, aquam fixo caloris gradu ebullire; ſtatim magno accendebar deſiderio, thermometrum ejuſmodi mihimet ipſi præparare, ut pulchrum hocce naturæ phænomenon mihi oculis perluſtrare liceret, & de veritate experimenti convictus eſſem.

Qua propter Thermometri ſtructuram quidem tentabam, ſed ob habitudinis ſufficientis in elaboratione illius defectum, vana erant conamina, licet ſæpius iterata; & quoniam etiam alia negotia prohibebant thermometri elabarationi magis inſiſtere, opportuniori repetitionem illius dedicabam tempori. Cum defectu virium atque temporis ardor non langueſcebat, æque avidus enim experimenti exitum videndi manebam. In mentem autem mihi veniebant ea, quæ ſolertiſſimus ille rerum naturalium ſcrutator de rectificatione barometrorum ſcripſerat; obſervaverat enim altitudinem columnæ mercurialis in barometro a vario temperamento mercurii aliquantulum (ſatis ſenſibiliter tamen) turbari. Ex his rebar, quod thermometron fortaſſe e mercurio conſtrui poſſet, cujus ſtructura non adeo difficilis foret, & cujus tamen ope experimentum maxime a me deſideratum explorare liceret.

Præparato ejuſmodi thermometro (licet in multis adhuc imperfecto) voto tamen meo eventus reſpondebat magnâ enim animi voluptate rei veritatem contemplabar.

Exitus experimentorum ſequenti continetur tabula, cujus prima columna exhibet liquores adhibitos; ſecunda illorum gravitatem ſpecificam; tertia gradum caloris, ad quem unuſquiſque liquor ebulliendo pertigit.

Liquores.	Gravitas ſpecifica Liquorum ad 48 Gr. calidorum.	Gradus ebullitone acquiſiti.
Spiritus vel Alcohol vini.	8260	176
Aqua Pluvia.	10000	212
Spiritus Nitri.	12935	242
Lixivium cineris clavellati.	15634	240
Ol. Vitrioli.	18775	546

Gravitatem ſpecificam cujuſcunque liquoris addendam neceſſe judicavi, ut ſi aliorum experimenta jam inſtituta, vel adhuc inſtituenda, a memoratis differrent, colligi poſſit, an e variatione gravitatis ſpecificæ, vel ex aliis differentia petenda ſit cauſis. Experimenta præterea non eodem tempore ſunt facta, & inde etiam liquores vario temperamenti vel caloris gradu erant affecti, ſed quoniam illorum gravitas diverſimode & inæqualiter turbatur, calculo illorum gravitatem ad 48 gradum (qui in thermometris meis medium tenet locum inter terminum intenſiſſimi frigoris arte commixtione aquæ, glaciei, ſaliſque Ammoniaci, vel etiam maritimi, confecti, & inter terminum caloris, qui in ſanguine hominis ſani reperitur) revocavi.

Olea Volatilia aliquo gradu quidem incipiunt ebullire, ſed eorum calor ebulliendo ſemper augetur. Cujus rei cauſa fortaſſe erit, quod nempe volatillores particulæ avolent, dum reſinoſæ majori attractione prædictæ reſtant.

Olea fixa autem tanto calore afficiuntur, ut Mercurius in thermometro ſimul cum illis ebullire incipiat, & inde eorum calor memorato modo vix certe explorari poterit. Sed alium excogitavi modum, cujus in alia ſchedula coram Illuſtri Societate Regia meminiſſe me honorem habiturum eſſe ſpero.

Excepto ſpiritu vini & aqua, fortaſſe etiam gradus cæterorum liquorum hic commemoratorum variabit, precipue ſi magna ſatis quantitate adhibeantur & longius ebulliant.

XIII. Inter

XIII. Inter plurima admiranda Naturæ Phœnomena aquarum congelationem non minoris momenti esse semper judicavi; hinc sæpe experiundi cupidus fui, quinam effectus frigoris futuri essent, si aqua in spatio ab aëre vacuo clauderetur. Et quoniam dies secundus, tertius & quartus *Martii*, (Styli V.) Anni 1721. ejusmodi experimentis favebat, hinc sequentes observationes & experimenta a me sunt facta.

Experiments and Observations concerning the freezing of Water in vacuo, by the same N°. 382. pag. 78.

Antequam autem experimentorum recensionem aggrediar, necesse erit ut paucis quædam de thermometris, quæ a me construuntur, eorumque scalæ divisione, ut & de methodo evacuandi, qua usus sum, mentionem faciam. Duo potissimum genera thermometrorum a me conficiuntur, quorum unum spiritu vini & alterum argento vivo est repletum: Longitudo eorum varia est, pro usu, cui inservire debent: Omnia autem in eo conveniunt, quod in omnibus scalæ gradibus concordent, interque limites fixos variationes suas absolvant. Thermometrorum scala, quæ meteorologicis observationibus solummodo inserviunt, infra a Zero incipit & 96to gradu finitur. Hujus scalæ divisio tribus nititur terminis fixis, qui arte sequenti modo parari possunt; primus illorum in infima parte vel initio scalæ reperitur, & commixtione glaciei, aquæ, & salis Ammoniaci vel etiam maritimi acquiritur; huic mixturæ si thermometron imponitur, fluidum ejus usque ad gradum, qui zero notatur, descendit. Melius autem hyeme, quam æstate hoc experimentum succedit. Secundus terminus obtinetur, si aqua & glacies absque memoratis salibus commiscentur, imposito thermometro huic mixturæ, fluidum ejus tricesimum secundum occupat gradum, & terminus initii congelationis a me vocatur; aquæ enim stagnantes tenuissima jam glacie obducuntur, quando hyeme liquor thermometri huncce gradum attingit. Terminus tertius in nonagesimo sexto gradu reperitur; & spiritus usque ad hunc gradum dilatatur, dum thermometrum in ore vel sub axillis hominis in statu sano viventis tam diu tenetur donec perfectissime calorem corporis acquisivit. Si vero calor hominis febri vel alio morbo fervente laborantis investigandus est, alio thermometro utendum, cujus scala usque ad 128 vel 132 gradum prolongata est. An autem hi gradus ferventissimo calori alicujus febris sufficiant nondum expertus sum, vix tamen credendum, quod cujusdam febris fervor gradus memoratos excedere debeat. Thermometrorum scala, quorum ope ebullientium liquorum gradus caloris investigatur, etiam a zero incipit & 600 continet gradus, hoc enim circiter gradu Mercurius ipse (quo thermometron repletum est) incipit ebullire.

Ut autem quoque thermometra ab omnibus mutationibus caloris celeriter afficiantur, loco globulorum cylindris vitreis sunt prædita, eo enim modo ob majoris superficiei quantitatem citius a variatione caloris penetrantur.

Postquam breviter mentionem feci de constructione thermometrorum meorum, adhuc describendus erit modus evacuandi, quo in ex-

Fig. 2. perimentis initio memoratis uſus ſum. Globulus vitreus A tubulo B C duorum vel trium pollicum longo in extremitate C attenuato præditus ſupra ignem calefit, quo facto tubuli extremitas aquæ immergitur, & tam diu in aqua relinquitur donec refrigefactione aëris in globulo contenti, guttulis aliquibus aquæ ſit repletus, deinde iterum ſupra flammam latiorem lampadis cujuſdam, vel ſupra prunas ope forcipis parvæ tenetur, donec aqua in globo contenta incipit ebullire, & vapor aquæ impetu inſtar Æolipilæ erumpit: Hæc ebullitio aquæ aliquantulum continuatur, quo facto globulus ab igne removetur, & extremitati ejus flamma candelæ appropinquatur. Refrigereſcente globulo vapor ab igne rarefactus etiam ſucceſſive condenſatur, vaporumque egreſſus paulatim diminuitur, qui poſtquam plene ceſſavit, in ipſo etiam momento extremitas tubuli colliqueſcit, globuluſque hermetice ſigillatus & ab aëre evacuatus redditur. An vero hoc modo probe ab aëre evacuatus ſit, experiri poteſt, ſi nempe extremitas tubuli ſub Mercurio diffringitur, totus enim globulus Mercurio replebitur, ſi diffractio caute ſine introitu aëris externi fuerit peracta. Diffractio extremitatis etiam ſub aqua perfici poteſt, ſed licet ſummâ curâ peragatur, globus tamen non tam perfecte aqua replebitur; dum enim aqua globum evacuatum intrat, aër, qui ſemper in aliqua quantitate aquæ commixtus eſt, ab illa in minutiſſimis bullulis ſeparatur, quæ poſtquam coiverunt ſub ſpecie bullulæ majoris in globulo apparent. Eodem modo globus ab aëre evacuari poteſt, ſi tertia, dimidia vel major pars globi aqua repleta deſideratur; deſiderata enim quantitate aquæ prius impletur & deinde poſt ebullitionem aquæ hermetice clauditur. His explicatis ad recenſionem experimentorum pervenio.

Globulum vitreum, cujus diameter uni circiter pollici æquabat, memorato modo ab aëre evacuatum, & aqua pluviatili fere ad dimidiam partem repletum, die ſecundo *Martii* Anni 1721, frigoris rigori exponebam. Aëris temperies in thermometro appoſito quindecimo gradu notabatur. Elapſo horæ ſpatio, aquam adhuc fluidam in globulo reperiebam, cujus rei cauſam eſſe arbitrabar, quod nempe aqua nondum bene a frigore eſſet penetrata, ut autem dubii omnis tolleretur ſcrupulus, globum per totam noctem aëri expoſitum relinquebam. Sequenti die tertio *Martii* ad horam matutinam quintam aquam adhuc fluidam inveniebam & liquor thermometri eundem adhuc notabat gradum, cujus improviſi phænomeni cauſam aëris abſentiæ attribuebam. Ut autem hujus conjecturæ veritas mihi innoteſceret, diffringebam tubuli extremitatem, ut ſpatium vacuum globuli iterum aëre repleretur, quo facto tota aquæ maſſa celerrime tenuiſſimis glaciei lamellis permiſcebatur. Placebat mihi autem antequam experimenti repetitio fieret, alio experimento explorare, an hæ lamellæ glaciales aquæ innataturæ eſſent, quapropter globum diffringebam partemque aliquam glaciei aquæ vitreo poculo contentæ injiciebam, & illam aquæ innatare conſpiciebam.

Dum autem forte oculos admodum brevi temporis intervallo in alium quendam direxeram locum, aſpiciendo iterum poculum, totam aquam glacialibus lamellis permixtam cernebam, manente tamen adhuc in interſtitiis lamellarum plurimâ aquæ parte fluidâ. Thermometron huic mixturæ impoſitum, trigeſimum ſecundum notabat gradum. Attentiori autem animo & oculo hæc phænomena contemplari cupidus, experimentum duobus aliis globulis repetere reſolvebam: poſtquam igitur priori modo præparati erant, illos per horæ ſpatium aëri externo exponebam, liquor autem thermometri interea jam vigeſimum attigerat gradum. Elapſa hora aquam in ambobus globulis adhuc fluidam inveniebam, poſtquam autem ſpatium vacuum globuli aëre iterum repletum erat, citiſſime etiam aqua (ut in priori experimento) lamellis glacialibus permiſcebatur, illarumque generatio tam ſubitanea erat ut vix oculis aſſequi poterat. Et quoniam lamellarum generatio, quæ in poculo vitreo erat facta, obſervationem meam effugerat, hinc adhuc maxime curioſus eram, illarum generationem paulo attentius contemplari. Priuſquam autem globulorum alterum diffringebam, aquam memorato poculo contentam a lamellis glacialibus ſeparabam quo facto globulum diffringebam, glaciem in globo generatam aquæ injiciebam. Glacies injecta quidem aquæ innatabat, ſed lamellarum generatio in poculo fruſtra a me expectabatur. Ob negotiorum quorundam neceſſitatem, experimentorum continuationem advenienti dedicabam nocti. Quæ poſtquam advenerat, iterum hora undecima tres globulos ſævienti gelu exponebam. Horum duo ad dimidiam circiter partem, iterum aqua erant repleti, manente reſidua parte globulorum vacua, in tertio vero ſolummodo quarta circiter pars globuli erat vacua. Aëris temperies in thermometro appoſito vigeſimo ſexto notabatur gradu. Hora quarta matutina eundem ſtatum temperiei aëri adeſſe thermometro deprehendebam, & aquam in duobus globulis, qui tantum pro dimidia parte aqua modo erant repleti, adhuc fluidam inveniebam: in tertio autem aqua congelata, atque globus diffractus erat. Glacies minutiſſimis ſed admodum paucis permixta erat bullulis, pelluciditaſque ejus maxime perturbata apparebat & confuſæ cryſtallizationi alicujus ſalis ſimillima erat. Hujus experimenti contrarium ſucceſſum inviſibili cuidam fiſſuræ attribuebam, quâ aër externus introitum invenerat atque ita congelationem aquæ procreaverat.

Quoniam autem magno adhuc flagrabar deſiderio, lamellarum generationem in poculo vitreo attente contemplari, idcirco vas vitreum e cubiculo in illam afferebam cameram ubi hæc experimenti fiebant, dum autem ſcalas paucas, quæ ad illam ducebant cameram, aſcendere volebam, deficiebam ſcalam aliquam pede bene attingere, quo facto aqua vitro contenta ruditer commovebatur, atque eo ipſo momento tota ejus maſſa plurimis permixta apparebat glacialibus lamellis. Hoc autem caſu infortuito edocebar, glaciem in aqua ſatis frigida agitatione produci poſſe; curioſus inde eram experimento explorare.

plorare, an congelatio aquæ etiam in ſpatio vacuo agitatione futura eſſet. Poſtquam igitur globulum aliquantum agitaveram, magna animi voluptate eundem phœnomeni eventum cernebam, ſimulque judicii errorem agnoſcebam, quod nempe abſentiæ aëris fluiditatem aquæ attribuiſſem. Interea e thermometro agnoſcebam, gelu multum langueſcere, liquor enim jam ad vigeſimum octavum aſcenderat gradum, cito igitur manu diſſolvebam glaciem, globulumque unum iterum aëri exponebam (erat autem alter caſu infortuito diffractus). Relicto globo per dimidium circiter horæ ſpatium, gelu adhuc magis remittere obſervabam; thermometri enim liquor jam ad gradum trigeſimum ſecundum pervenerat. Et quoniam verebar, ne remiſſione frigoris experimenti repetitio vana futura eſſet, ſi diutius globulus aëri relinqueretur expoſitus: hinc ipſo tempore, agitatione globuli aquæ congelationem procreare tentabam; ſed licet fortiter agitaretur, non minima tamen congelationis apparebant indicia. Cum vero hoc modo omnis congelationis ſpes evanuerat, adhuc experiri volebam, an cogelatio ſucceſſura eſſet, ſi ſpatium vacuum globuli iterum aëre repleretur. Diffracta igitur extremitate tubuli, minutiſſimæ glaciei ſpiculæ per totam aquæ maſſam diffuſæ generabantur, quæ circumrotatione aquæ ſuperficiem petebant, amœniſſimumque ſpectaculum reflectione luminis ab earum politis ſuperficiebus præbebant. Quoniam autem hujus hyemis gelu hoc die finiebatur & cum illo experimentorum continuationi finis imponebatur, quam vero tempori opportuniori aliis excogitatis experimentis inſtituere mihi proponebam. Hyems anni 1722. ita mitis in *Hollandia* erat, ut per totam hyemem vix aquæ ſtagnantes glacie aliqua obducebantur. Et licet hyems initio anni 1723. multo leverior erat, attamen negotiorum copia, aliorumque experimentorum major neceſſitas continuationem eorum prohibebant.

An extraordinary Inſtance of the almoſt inſtantaneous freezing of Water; *by Mr* Triewald *F R. S.* No. 418. p. 79.

XIV. The 15th of *December* laſt coming into the Hall, where my *Apparatus* is placed, in the Palace of the Nobility at *Stockholm*, the Weather being very cold, I feared that the Glaſs for ſhewing the Experiment with the *Carteſian Devils* (or thoſe glaſs Figures in Water, which by the Preſſure of the Air on the Surface of the Water, are made to change their Places, and ſink to the Bottom of the Glaſs) would be in Danger, if the Water ſhould freeze in the ſame. I took it down from the Shelf, and was well pleaſed to ſee the Water in a fluid State; but before I would empty the Glaſs, as ſome Friends that were preſent had not ſeen that Experiment, I placed my Hand on the Bladder tied on the Top of this Cylindrical Glaſs, which was of a pretty large Size, ſixteen Inches high, and three Inches and a half Diameter, containing three glaſs Figures: In that very Inſtant, and in the Space of a Second of Time, I found all the Water changed into Ice; when in that Time two of the Figures had reached very near the Bottom, but the Third, as well as they, fixed in the Middle of the Glaſs, ſurrounded with Ice as tranſparent as the Water itſelf before it congealed.

D.	M.	Barom. Altitud.	Therm. Altitud.	Lat. North.		Long. West.		Variat. West.		Obſ.	Wind.	Weather.
June	4	27	25	59°	12′	4°	44	17°	00	Obſ.	SW.	Cloſe.
	5	22	25	59	38	5	11	16	00	Obſ.	SW to NW.	Rain, and ſtormy Winds.
	6	21	24	59	58	5	57	17	00		WSW.	Rain, and freſh Gales.
	7	22	23	59	22	7	06	17	20		NW to SSW.	Rain and ſqually, with Fogs.
	8	22	22	59	38	8	39	18	00	Obſ.	SW to SE.	Much Rain all Night, fair at Noon.
	9	23	22	59	54	8	47	18	00		NE.	Very cloudy.
	10	20	22	59	14	10	14	18	00		North.	Firſt Part ſqually, latter fair.
	11	22	22	58	35	11	23	18	00		NW.	Squally with Rain.
	12	22	25	57	21	12	20	18	00		NW.	Cloudy, with ſmall Rain.
	13	22	24	56	31	13	13	18	00		NW.	Squally.
	14	25	25	56	00	14	22	18	00		NW to S.	Firſt Part ſqually, latter hazy.
	15	24	25	55	53	17	02	18	00	Obſ.	E to N.	Squally, and freſh Gales.
	16	20	23	55	42	18	16	18	00		NE to SW.	Cloudy.
	17	19	23	56	21	18	47	18	00		SW to NW.	Rain and ſtormy.
	18	18	22	55	22	19	34	18	30		NW.	Squally, with Rain.
	19	20	23	55	42	21	14	19	00		NNE to WbS.	Cloudy with Rain, uncertain.
	20	21	24	56	51	21	31	19	30		NW.	Freſh Gales, and foggy.
	21	21	24	57	23	21	54	20	00		WNW to WbS.	An hard Rain, and ſtormy.
	22	21	24	57	00	22	01	20	00		NE to W.	Hard Gales for the moſt Part.
	23	21	24	57	56	23	52	21	00		WSW.	Freſh Gales, but cloudy.
	24	23	24	58	16	24	09	22	00		W to WNW.	Hard Gales, cloudy.
	25	24	23	57	40	24	38	22	00	Obſ.	WNW to SW.	Cloudy, little Wind.
	26	23	23	57	57	25	33	22	00		SW.	Little Wind, and foggy.
	27	22	22	58	47	28	25	23	00		SW to W.	Foggy, and ſqually.
	28	23	22	58	39	29	31	23	00		W to NNW.	Freſh Gales, Rain.
	29	24	21	58	28	29	45	23	20		NW to W.	Moderate and calm.
	30	25	22	58	00	30	38	24	00		W to SW.	Moderate, cloudy.
July	1	22	22	58	25	31	29	24	00	Obſ.	WSW.	Moderate and clear.
	2	20	22	59	13	32	54	25	00		SW to W.	Frequent Squalls, ſome Rain.
	3	24	21	59	03	33	14	25	00	Obſ.	WNW.	Moderate and cloudy.
	4	25	22	58	54	33	30	25	00		WNW.	Fair, ſometimes calm.
	5	20	22	58	43	35	44	26	00	Obſ.	SSE.	Sometimes calm. Fair.
	6	20	22	58	26	37	25	26	30		SSE to W.	Stormy, and Rain.
	7	21	20	58	06	39	30	27	30	Obſ.	WNW to SE.	Moderate. Little Wind.
	8	22	20	58	03	42	38	27	00		S to SW.	Foggy.
	9	24	22	57	34	43	23	27	00		NNW.	Foggy. Little Wind.
	10	24	24	57	43	45	25	27	00	Obſ.	NNW.	Freſh Gales and clear.
	11	28	28	58	11	46	47	27	00		WbS to NNW.	Cloudy, with ſmall Rain.
	12	29	26	57	34	48	17	28	00	Obſ.	NNW to SSW.	Fair.
	13	29	26	58	00	50	48	29	00		SW.	Hazy.
	14	28	26	58	53	53	20	31	00		SW to WbS.	A thick Fog.
	15	33	35	58	56	55	18	32	00		WNW to NW.	Small Rain, and ſqually.
	16	38	37	59	06	55	33	34	00		NbW to NW.	Several Iſles of Ice.
	17	40	38	58	50	56	04	35	00		NNW.	Fair and clear. Very cold.
	18	41	39	58	53	56	43	37	00	Obſ.	NW to WSW.	Very cold. Much Ice.
	19	40	38	59	45	58	03	36	00	Obſ.	NW to WSW.	Fair and clear.
	20	40	38	60	01	58	27	37	00		NNW.	Fair and moderate
	21	42	38	59	51	59	59	37	00		NNW to SEbS.	Fair.
	22	43	38	61	16	62	09	38	00		SSE.	Hazy.
	23	43	39	61	50	63	34	40	00		SE.	In *Hudſon's Streights.*
	24	42	38	62	11	72	32	42	00	Obſ.	SE.	Foggy.
	25	40	35	63	11	76	22	40	00		SE.	Rainy and cold.

XV. *Obſervations on the Weather, in a Voyage to* Hudſon's Bay *in* North-America, *in the Year* 1730. *By Capt.* Chriſtopher Middleton. No 418. *page* 76.

D. M.	Barom. Altitud.	Therm. Altitud.	Lat. North.	Long. West.	Variat. West.	Obſ.	Wind.	Weather.
July 26	41	37	63° 12	78 04	40° 00	Obſ.	SE.	Little Wind, and clear.
27	39	39	63 09	78 43	42 00		Eaſt.	Little Winds, ſometimes calm.
28	37	38	62 10	81 12	40 00		SE to WbN.	Squally, with much Rain.
29	35	37	60 49	82 21	36 00		WbN to NE.	Gentle Rain. A freſh Gale.
30	38	36	58 24	84 09	33 00		N to NNW.	Much Ice all round.
31	40	38	56 51	84 27	28 00		NW.	Fair and clear. Ice ſtill.
Aug. 1	43	39	56 15	83 46	24 00	Obſ.	NW to WSW.	Fair. Ice as before.
2	42	38	56 20	84 16	24 00	Obſ.	SbW.	Mercy. incloſed in Ice. Fair.
3	40	38	56 27	83 44	24 00		South.	Still in Ice. Freſh Gales.
4	38	36	56 20	33 01	24 00		SW.	Foggy, and much Ice.
5	38	35	56 15	83 24	24 00		ESE.	Much Rain, and foggy.
6	40	37	56 00	82 46	24 00		WSW.	Fair and moderate.
7	40	39	55 08	82 43	24 00		ENE.	Lightning with ſome Rain.
8	38	36	55 11	82 43	24 00		N to NNW.	Fog. Freſh Gales. Jambed in Ice.
9	38	36	55 16	82 43	24 00		NNW.	Froſt and calm.
10	34	31	55 22	82 40	24 00		South.	Fair and pleaſant.
11	34	32	55 11	84 20	24 00		SW to NW.	Moderate.
12	31	30	55 06	84 36	24 00		NNW to SbE.	Moderate and fair.
13	27	30	55 15	84 52	24 00		S to SSW.	A freſh Gale. Much Ice.
14	26	30	55 20	34 34	24 00		SbW.	Hard Gale. Thunder and Rain.
15	26	27	54 44	84 34	24 00		WNW to NW.	Freſh Gales. In Ice.
16	29	27	54 28	84 34	24 00		NW to N.	Moderate and fair.
17	26	27	53 54	84 56	24 00		NE to SbE.	Clear of Ice. Fair.
18	25	25	53 56	84 58	24 00		WbN to WSW.	A freſh Gale. Clear of Ice.
19	25	24	53 44	84 57	24 00		WSW to WbN.	Moderate and fair.
20	28	26	53 09	85 00	24 00		WbS to SEbS.	Moderate and fair.
21	28	25	52 31	85 30	23 00	Obſ.	E to NE.	Moderate.
				In ALBANY *Road*				
22	27	25	50° 29′	85° 20′	23° 00′		NW to SE.	Moderate and fair.
23	26	22					S. W.	Dry. Somewhat cloudy.
24	26	21					WNW.	Mercy. at a Stand.
			The Time I was on Shore not obſerved. From ALBANY.					
Sep. 2	25	20	53° 56′	0° 30′	E24° 00′		SSW.	Hazy, but ſmall Gales.
			From the BEAR Iſlands.					
Sept. 3	35	32	54° 22′	0° 7′W	24° 00′		SW to NEbN.	Mercy. ſuddenly falls to freezing.
4	40	37	55 45	0 49W	25 00		NNE to WSW.	Hard Froſt. Fair.
5	37	36	56 35	2 26W	26 00		EbN to NE.	Cold Air. Squally, and foggy.
6	37	35	56 57	3 04W	26 00		NE.	A wet Fog.
7	37	34	56 45	1 22W	26 00		NE.	Moderate Gales.
8	38	36	57 06	3 26W	26 00		NEbN.	Freſh Gales.
9	36	36	58 08	3 02W	28 00		NbE to W.	Foggy.
10	36	38	60 25	2 02W	33 00		WSW to NWbN.	Freſh Gales. Wet Fog.
11	35	38	61 49	0 42 E	38 00		NbW to NbE.	Moderate, but cold Air.
12	34	37	62 33	0 51 E	42 00	Obſ.	NbE to NNW.	Freſh Gales, ſqually, with Rain.

From Diogs.

D. M.	barom. Altitud.	Therm. Altitud.	Lat. North.	Long. West.	Variat. West.	Obſ.	Wind.	Weather.
Sep. 13	33	34	63° 20′	1° 20′E	43° 00	Obſ.	All round.	Sometimes calm.
14	32	35	63 03	2 34E	40 00		SbE to NNW.	Squalls, Showers of Snow and Hail.
15	32	36	62 09	9 19E	42 00		NW to NNW.	Stormy, frequent Showers of Snow

From Button's Iſlands.

16	33	35	61° 10′	0° 29′E	39° 00′		NbW to NNW.	Many Iſles of Ice and Snow.
17	30	34	60 35	6 09	34 oc		NW to N.	Freſh Gales, and frequent Squalls.
18	30	34	58 52	10 39	34 oo		NNW to NNE.	Squally, with Showers of Snow.
19	30	35	57 54	14 06	32 oc		NW.	Squally, with Hail.
20	30	34	57 28	16 15	30 oo		NW to Sb W.	Squally, with Hail and Rain.
21	31	33	57 38	18 24	28 oc		SbW to WSW.	Hard Squalls, ſome Rain.
22	30	35	56 19	22 27	25 oo		W SW to NW.	Stormy, with ſome Hail.
23	30	36	54 49	27 43	22 30		NW.	An hard Storm, with Hail.
24	29	36	53 28	32 28	21 oo		WNW to SSW.	High Winds, with Hail.
25	31	35	53 34	35 16	19 oo		S to W SW.	A Storm. Wind and Rain.
26	33	34	52 46	36 27	18 oo		W to SW.	More moderate. Freſh Gales, Rain.
27	33	34	52 21	39 11	17 oo		SSW to NW.	Squalls of Rain.
28	32	34	50 35	42 10	16 oo		N. to WbS.	Frequent Showers of Rain.
29	30	33	50 41	46 23	15 oo		SWbW to SSW.	Very ſqually, with Lightning.
30	32	32	50 07	49 09	14 oo		SW.	An hard Gale, with Rain.
Oct. 1	35	31	49 26	51 57	14 oo		SW to NNW.	More moderate and fair.
2	30	33	49 30	53 45	14 oo		NE.	Moderate and fair. Little Wind.
3	25	30	49 56	54 34	13 oo		SE.	Freſh Gales, with Rain.
4	25	30	49 19	54 16	13 oo		S to E.	A Storm. Wind and Rain.
5	25	29	49 47	53 50	13 oo		E b S.	An hard Storm, with Rain.
6	29	28	50 10	53 26	13 oo		ESE.	Stormy, with Thunder.
7	31	27	49 58	53 48	13 oo		Eaſt.	More moderate. Cloudy. Some Rain.
8	32	29	49 21	55 19	13 oc		E to SSW.	Foggy, with ſome Rain.
9	32	30	49 45	58 49	13 oc		WSW to SbW.	Freſh Gales, with Rain.
10	33	28	49 56	61 37	13 oc	Obſ.	S to SSW.	Fair and moderate for the moſt Part. Off *Plymouth*.

Theſe Obſervations were made by Mr *John Patrick*'s new Quickſilver Marine Barometer.

Note, The Altitude of the Barometer and Thermometer were taken at Noon. The Account of Wind and Weather at Sea is from Noon to Noon.

XVI. The weighing the Water and reducing it from Weight to Depth ſeemed pretty troubleſome, even when done in the eaſieſt Method: To remedy this Inconvenience (beſides a Funnel and proper Receptacle for the Rain) I uſe a cylindrical Meaſure and Gage. The Funnel is 30 Inches diameter, and the cylindrical Meaſure exactly 3; the Depth of the Meaſure is 10 Inches, and the Gage of the ſame Length, with each Inch divided into 10 equal parts; or, inſtead of a Gage, the Inches and Diviſions may be mark'd on the Side of the cylindrical Meaſure. The *Apparatus* is ſimple and plain, and it is eaſy to apprehend the Deſign and Reaſon of the Contrivance; for

An Account of the Depth of Rain fallen from April 1, 1722, *to* April 1, 1723. *Obſerved at* Widdrington *in* Northumberland, *by the Rev. Mr* Horſley. No. 377. P. 328.

the Diameter of the cylindrical Measure being just $\frac{1}{10}$ of that of the Funnel, and the Measure exactly 10 Inches deep, 'tis plain that 10 Measures of Rain make an Inch in Depth; one Measure, $\frac{1}{10}$; one Inch on the Gage, $\frac{1}{100}$; and $\frac{1}{10}$ of an Inch on the Gage, $\frac{1}{1000}$, *&c.* By this Means the Depth of any particular Quantity which falls, may be set down with Ease and Exactness, and the whole at the End of each Month, or every Year, may be summed up without any Trouble.

By the following Account you'll see, that some of the Summer Months, particularly *May* and *July*, were very wet, and some of the Winter ones very dry; so that, one with another, this Year's Rain, as far as can well be conjectured, may be looked upon as a *Medium*. And if so, it differs not above two or three Inches, from the mean Quantity of Rain which falls at *Upminster*, *Paris*, and *Lisle*, being less than at *Lisle*, and more than at the other two Places.

An Account of the Depth of Rain fallen from April 1, 1722, *to* April 1, 1723.

	Inch.
In *April*	1,015
In *May*	3,532
In *June*	2,570
In *July*	4,350
In *August*	2,132
In *September*	1,155
In *October*	,600
In *November*	2,205
In *December*	1,780
In *January*	1,225
In *February*	,485
In *March*	,195
In the whole Year	21,244

The Effects of a violent Shower of Rain in Yorkshire, *by* Mr Ralph Thoresby, *F. R. S.* No 372 p. 101.

XVII. The Effects of a violent Shower of Rain at *Riponden*, near *Halifax*, were so surprizing, that I wrote to a Gentleman in those Parts for an Account that might be depended upon; and particularly desired to know, whether there was not an Eruption of Waters out of the Hills, as the late ingenious Mr *Townley* of *Townley* wrote me there was out of *Pendle-hill*, in that at *Star-bottom*, mentioned in the *Philos. Trans.* N° 245. but all the Account I can learn of this is, that what they call the Dashing of two great watery Clouds upon the Hills, occasioned the Inundation; whatever was the more immediate Cause,

Cauſe, the Effects were diſmal, and ſo ſudden, that tho' it was upon the Day-time, the poor Creatures could not ſave their Lives. This Calamity happened the 18th of *May*, 1722. betwixt the Hours of 3 and 5, when by the modeſteſt Account the Beck was raiſed two Yards at leaſt in perpendicular Height above what was ever known before; which may be eaſily conceived by the Situation of the Place implied in the Termination *den*, which ſignifies a deep Valley between pretty ſteep Hills on each Side. *Fontes in convallibus*, is in the *Saxon* Verſion rendered ꝑillaꝛ on ðenum *Pſ.* ciij. 2. and *Valley of Tears*, (as this now) *Pſ.* lxxxiij. 6. ðene ðeopa. Several Houſes, four Mills (ſome ſay ſix), nine Stone-Bridges, and ten or eleven of Wood, are taken down, and the Wheels, Dams, and Sluices, (*Eboracenſibus* Goits, from the verbal Noun ȝeotan *fundere*) of moſt of the Mills that are left ſtanding, broken and damaged; and a great deal of Cloth gone. Fifteen Perſons were drowned, of whom *Jonas Longbotham* and his Servant are not yet found. Seven out of eight in one Houſe were either ſlain by the Fall of it, or drowned. A young Man eſcaped by help of a piece of Timber, was turned over and over again, in paſſing two or three Dams, but at laſt taken out alive, tho' diſtracted for the preſent; but it's hoped he may recover.

The Rapidneſs of the Torrent was ſo violent, that it took down the North-ſide of *Ripponden* Chapel, and carried off moſt of the Seats. A Man of *Dewſbury* told me, that he ſaw four of them that were driven to that Town; and the Rector of *Caſtleford*, who viſited me the Day after, informed me, that many Goods were carried down ſo far, tho' above 20 Miles off. It tore up the Dead out of their Graves; at firſt I was willing to believe it only of an old Woman that had been buried that Afternoon, and ſo the Earth not fully ſettled again; but am ſince informed, by a ſure hand, that two corrupted Corpſes were driven upon one Gentleman's Land, and as many upon another's. It ſwept away all the Corn-Land, as deep as the Plow had gone. Some Perſons ſaved themſelves by forcing a Way out of the Roofs of their Houſes, and ſitting upon the Ridges till the Floods abated.

I was that Day ſeized by a ſmart Thunder-Shower, upon the Moor, as I was coming home.

XVIII. On the 30th of *January* laſt, ſomething paſt Nine in the Morning, Weather cold, Wind Southweſterly, but not very high, Barometer above thirty Inches, I ſaw that pretty Phenomenon of the Star-like Snow, and tho', upon comparing my Obſervations afterwards with thoſe of *Deſcartes*, Dr *Grew*, and Mr *Morton*, I find I have but little to add upon the Subject; yet, as I obſerved the Progreſs of Nature in this ſort of Cryſtallization, with a great deal of Pleaſure, I hope it will not be diſagreeable to you to receive an Account of it. *Obſervations on the Figures of Snow. By the Reverend* Benj. Langwith, *D. D.* N°. 376. p. 298.

I ſhall begin with the moſt ſimple Figures A and B, of which the former is a roundiſh Pellet of Ice; the ſecond, a ſmall oblong Body, *Fig* 3. with parallel Sides, which is often as fine as a Hair. Of this latter kind the Flakes of Snow chiefly conſiſt; and tho' they look white to the Eye, yet when viewed with a ſmall Magnifier of a Microſcope, they appear like ſo many tranſparent Needles of Ice thrown together, without any Manner of Order.

The next Figure is C, in which the Pellet has ſhot out ſix of thoſe ſmall Bodies of equal Length, and ſet at equal Angels: Of this kind I ſaw a conſiderable Number.

The next Step in the Cryſtallization is D, in which thoſe Bodies are lengthened, and have ſhot out a great many more from their Sides, at equal Angles, but unequal Lengths, as growing continually ſhorter and ſhorter, till they terminate in a Point: I meaſured ſome of theſe, and found them to be about one quarter of an Inch in Breadth. I ſaw but very few of them in Perfection, for the collateral Shoots were ſo exquiſitely fine, as to be liable to be broken in their Fall, or confounded together by the leaſt Degree of Heat.

Of the next kind, E, I ſaw a very great number, which being examined by the Microſcope, plainly appeared to be nothing but the former in Diſorder. The Edges of theſe were in general very irregular, but ſome of them happened to be ſo indented, as to look like the jagged Leaves of Plants.

The next Kind, F, had twelve points regularly diſpoſed, and probably might conſiſt of two of the former ſo joined together, as to cut their Angles equally.

Perhaps alſo thoſe Mr *Morton* deſcribes, as conſiſting of *Radii*, which, inſtead of terminating in a Point, grow bigger, as they advance from the Centre, might be formed from two of the Kind, C, ſo joined at the Centre, as to cut each other's Angles unequally; for in the Progreſs of the Cryſtallization, theſe *Radii* would quickly unite.

Laſtly, that Sort, which *Deſcartes* compares to Roſes, and of which he has given a Figure in his Treatiſe of Meteors, may be nothing but the Kind E, when the Points are rounded off, by being gently thawed.

I propoſe theſe things only by way of Conjecture; becauſe, as the ſmall Drops of Water may be impregnated with very different Particles in the Air, it is not eaſy to determine, whether theſe Figures may not be the Reſult of a Cryſtallization quite different from the former

I had almoſt forgot to tell you, that I ſaw but very few Figures of twelve Points, and thoſe moſtly imperfect in one reſpect or other.

XIX. Dr

XIX. Dr *Niewentyt* and ſome others ſay —— That Particles of Fire ſeparated from the Sun-Beams, by adhering to Particles of Water, make up *Moleculæ*, or ſmall Bodies, ſpecifically lighter than Air, which therefore, by hydroſtatical Laws, muſt riſe and form Clouds that remain ſuſpended when they are riſen up to ſuch an Height that the Air about them is of the ſame ſpecifick Gravity with themſelves.—

An Attempt to ſolve the Phænomenon of the Riſe of Vapours, Formation of Clouds, and Deſcent of Rain, by J. T. Deſaguliers, *L. L. D. F. R. S.* No. 407. pag. 6.

That Rain is produced by the Separation of the Particles of Fire from thoſe of Water, which laſt being then reſtored to their former ſpecifick Gravity, can no longer be ſuſtained by the Air, but muſt fall in Drops. See *Niewentyt's Religious Philoſopher*. Contemplation 19. From Sect. xiii. to Sect. xxv.

Now this is liable to ſeveral Objections, *Firſt*, It is built upon a Suppoſition that Fire is a particular Subſtance, or diſtinct Element, which has never yet been proved by convincing Experiments and ſufficient Obſervations; and which the Reverend Mr *Hales* has in his late excellent Book of *Vegetable Statics* ſhewn to be an ill grounded Opinion, making it very plain, that in Chymical Operations thoſe Bodies which had been thought to become heavier by Particles of Fire adhering to them, were only ſo by Adheſion of Particles of Air, *&c.* which he has ſhewn to be *abſorbed* in great Quantities, by ſome Bodies, whilſt it is *generated* (or reduced from a fixt to an elaſtic State) by others; nay, that it may be *abſorbed* and *generated* ſucceſſively by the ſame Body, under different Circumſtances.

Secondly, If we ſhould allow the above-mentioned Suppoſition, the Difficulty will ſtill remain about the Production of Rain by the Separation of the Fire from the Water; For Dr *Niewentyt* aſcribes this Effect to two different Cauſes. *Firſt*, to Condenſation (*Sect.* xxiii.) ſaying, "That when contrary Winds blow againſt the ſame Cloud "and drive the watery Particles together, the Fire that adhered to "them gets looſe, and they (becoming then ſpecifically heavier) "precipitate and fall down in Rain." Then in the very next *Sect.* he aſcribes it to Rarefaction, when he ſays, "That when a Wind "blowing obliquely upwards cauſes a Cloud to riſe into a thinner Air "(*i. e.* ſpecifically lighter than it ſelf) the Fire which by ſticking to "the Particles of Water rendered them lighter, extricates itſelf from "them, and aſcending by it's Lightneſs, the Water will become too "heavy, not only to remain in this thin and light Air, but even in "a thicker and heavier near the Earth, and ſo will be turned into a "deſcending Dew, Miſt, or Rain, or Snow, or the like, according "as the watery Vapours are either rarefied or compreſſed."

The firſt of theſe Cauſes of Rain is contrary to Experience; for when two contrary Winds blow againſt each other over any Place of the Earth, the Barometer always riſes, and we have fair Weather. For then (as Dr *Halley* ſays, in *Philoſophical Tranſ.* N° 183) the Air being accumulated above, becomes ſpecifically heavier about the

Clouds, which (inſtead of falling into Rain, as Dr *Niewentyt* ſuppoſes) aſcend up into ſuch a Part of the Atmoſphere, as has the Air of the ſame ſpecifick Gravity with themſelves.

If the falling of Rain might be attributed to the ſecond of theſe Cauſes, then every time a Cloud is encompaſſed with Air ſpecifically lighter than itſelf (whether it be when by the blowing away ſome of the ſuperior Air, that which is about the Cloud becomes rarer as it is leſs compreſſed, or by the Cloud being driven upwards) Rain muſt neceſſarily follow; whereas one may often ſee the Clouds riſe and fall without Rain, even when the Barometer ſhews the Weight of the Air to be altered. For that happens only when by the great Diminution of the ſpecifick Gravity of the Air about the Cloud, it has a great Way to fall; in which Caſe, the Reſiſtance of the Air, which increaſes as the Square of the Velocity of the deſcending Cloud, cauſes the floating Particles of Water to come within the Power of each others Attraction, and form ſuch big Drops, as being ſpecifically heavier than any Air, muſt fall in Rain.

No gentle Deſcent of a Cloud, but only an accelerated Motion downwards, produces Rain.

N. B. *I don't mean that the quick Deſcent of a Cloud is the only Cauſe of Rain; becauſe the Shock from a Flaſh of Lightning, and the ſudden return of the Air, after the* Vacuum *made by the Flaſh, will condenſe the floating Vapour into Water; and alſo the ſame Cloud which in the free Air, might be carried horizontally without being turned into Rain, meeting with an high Hill in it's Way, will be condenſed and fall in Drops; eſpecially if, in the Day-time, it be driven by the Wind out of the Sun-ſhine, againſt the ſhaded Side of the Mountain.*

Beſides all this, if Particles of Fire were joined with thoſe of Water to raiſe them up, thoſe igneous Particles muſt be at leaſt 1000 Times greater in Bulk than the watery ones; ſo that a Perſon, who at the Top of a Hill, has his Hands and Face in a Cloud, muſt feel a very ſenſible Warmth, by touching a much greater Surface of Fire than Water in the Cloud, and afterwards find the Rain produced from that Vapour ſenſibly colder; whereas the contrary is proved by our Senſes; the Tops of Hills, though in the Clouds, being much colder than the Rain at Bottom.

There is another Opinion concerning the Riſe of Vapours, namely, that tho' Water be ſpecifically heavier than Air, yet if it's Surface be increaſed by very much diminiſhing the Bulk of it's Particles, when once raiſed, it cannot eaſily fall; becauſe the Weight of each Particle diminiſhes as the Cube Root of it's Diameter, and the Surface to which the Air reſiſts, only as the Square Root of the ſaid Diameter: That we ſee this in the Duſt in Summer, and in Menſtruums that ſuſtain Metals diſſolved, which are ſpecifically heavier than the Menſtruums.

But this will not explain the *Phænomenon*; becauſe though the Encreaſe of Surface (the Weight remaining the ſame) will in a great Meaſure hinder (or rather retard) the Deſcent of ſmall Bodies moving in the Air, by reaſon of it's great Reſiſtance to ſo large a Surface; it will for the ſame Reaſon alſo hinder the Aſcent. For the Riſe of Duſt is owing to the Motion of Animals Feet in it, or to the Wind: Whereas Vapours riſe in calm Weather, as well as windy; neither do they, like the Duſt, always fall to the Ground when the Wind ceaſes to blow.

The third Opinion, and which is moſt commonly received, is, that by the Action of the Sun on the Water, ſmall Particles of Water are formed into hollow Spherules filled with an *Aura*, or finer Air highly rarefied, ſo as to become ſpecifically lighter than common Air, and conſequently that they muſt riſe in it by hydroſtatical Laws. As for Example, If a Particle of Water, as it becomes a hollow Sphere, be only encreaſed ten Times in Diameter, it's Bulk will be encreaſed a thouſand Times; therefore it will then be ſpecifically lighter than common Water, whoſe ſpecifick Gravity is to that of Air, as 850 to 1; then if the Denſity of the *Aura*, or Spirit within the little Shell, be ſuppoſed 9 Times leſs than that of Air, or as 50 to 850, that ſpecifick Gravity of the Shell, and it's Contents will be to that of Air, as 900 to 1000; therefore ſuch an aqueous Bubble muſt riſe till it comes to an Æquilibrium in Air, whoſe Denſity is to the Denſity of that in which it began to riſe, as 850 to 945 nearly. But it appears by Experiments, that Air rarefied by an Heat which makes a Retort red hot, is only encreaſed in Bulk, or dilated 3 Times; by the Heat of boiling Water only $\frac{10}{14}$ or near two Thirds; and by the Heat of the Human Body (ſuch as will raiſe Vapours plentifully) only $\frac{10}{33}$ or about $\frac{1}{3}$. I own my Objection may be anſwered, by ſuppoſing the Spherule of Water to be more encreaſed in Diameter, as for Example 20 times; becauſe then if it be filled with Air only $\frac{1}{3}$ rarer than common Air, it will be ſpecifically lighter, and capable of riſing to a conſiderable Height.

To give this Solution all it's Force, let us expreſs it in Numbers. Let A and W repreſent a Particle of Air, and one of Water of equal Bulk, then will the Weight of A be to the Weight of W as 1 to 850, their Bulks being equal. If the Particle of Water be blown up into a Bubble (*w*) of 20 Times it's Diameter, then will it's Bulk be to it's Weight, as 8000 to 850, whilſt a Sphere of Air (*a*) of the ſame Bigneſs, has it's Weight as well as Bulk equal to 8000: Now if an Air or *Aura* $\frac{1}{3}$ rarer than common Air be ſuppoſed within the watery Bubble to keep it blown, it will be the ſame as if $\frac{1}{3}$ of the Air of (*a*) was carried into (*w*) and then the Weight of (*w*) would be encreaſed by the Number 6000; ſo that the Shell of Water being in Bulk 8000, would be in Weight 850+6000=6850, whilſt an equal Bulk of Air weighed 8000, and conſequently the watery Bubble would riſe *Fig.* 4.

till

till it came to an Air, whoſe Denſity is to the Denſity of the Air next to the Surface of the exhaling Water as 6850 to 8000.

This is the ſtrongeſt Way of ſtating the Hypotheſis. But to ſupport it, the following Queries muſt be anſwered.

Query 1ſt, How comes the *Aura*, or Air in the Bubbles, to be ſpecifically lighter than the Air without them, ſince the Sun's Rays, which act upon the Water, are equally denſe all over it's Surface?

Query 2d, If it could be poſſible for a rarer Air to be ſeparated from the denſer ambient Air, to blow up the Bubbles (as Bubbles of ſoaped Water are blown up by warm Air from the Lungs, whilſt the ambient Air is colder and denſer) what would hinder that cold Air by it's greater Preſſure, from reducing the Bubbles to a leſs Bulk, and greater ſpecifick Gravity than the Air, eſpecially ſince cold can be communicated through ſuch thin Shells, and the Tenacity of common Water is very ſmall when compared to that of ſoaped Water (whoſe Bubbles, notwithſtanding that Tenacity) are ſoon deſtroyed by the Preſſure of the outward Air, as the Air within them cools?

Query 3d, If we ſhould grant all the reſt of the Suppoſition, yet this Difficulty will remain. If Clouds are made up of hollow Shells of Water filled with Air, why do not thoſe Clouds always expand when the ambient Air is rarefied, and preſſes leſs than it did before, and alſo ſuffer a Condenſation, as the ambient Air is condenſed by the Accumulation of the ſuperior Air?

If this Condenſation and Rarefaction ſhould happen to the Clouds, they would always continue at the ſame Height, contrary to Obſervation; and we ſhould never have any Rain.

From all this it follows, that the Condenſation and Rarefaction of the Vapours, which make Clouds, muſt depend upon another Principle than the Condenſation and Rarefaction of the Air: And that there is ſuch a Principle, I ſhall endeavour to ſhew.

LEMMA.

The Particles of all Fluids have a repellent Force.

Fluids are elaſtic or unelaſtic; The elaſtic Fluids have their Denſity proportionable to their Compreſſion, and Sir *Iſaac Newton* has demonſtrated (*Princip. Lib.* ii. *Sect.* v.) that they conſiſt of Parts that repel each other from their reſpective Centers. Unelaſtic Fluids, like Mercury, Water, and other Liquors, are by Experiments found to be incompreſſible; for Water in the *Florentine Experiment* could not by any Force be compreſſed into leſs Room, but oozed like Dew through the Pores of the hollow golden Ball in which it was confined, when a Force was applied to preſs the Ball out of it's ſpherical, into a leſs capacious Figure. Now this Property of Water and other

other Liquors muſt be intirely owing to the centrifugal Force of it's Parts, and not it's want of Vacuity; ſince Salts may be imbibed by Water without encreaſing it's Bulk, as appears by the Encreaſe of it's ſpecific Gravity. So Metals, which (ſingly) have a certain ſpecific Gravity beyond which they cannot be condenſed, will yet receive each other in their Interſtices ſo as to make a Compound ſpecifically heavier than the heavieſt of them; as is experienced in the Mixture of Copper and Tin.

SCHOLIUM.

By encreaſing the repellent Force of the Particles, an unelaſtic or incompreſſible Fluid may become elaſtic, or a Solid (at leaſt a great Part of it) may be changed into an elaſtic Fluid; and, *vice verſâ*, by diminiſhing the repellent Force, an elaſtic Fluid may be reduced to an unelaſtic Fluid, or to a Solid. That the Particles of Quickſilver, Water, and other Liquors, are likewiſe endued with an attractive Force, is evident from thoſe Subſtances running into Drops in an exhauſted Receiver, as well as in the Air, and likewiſe their adhering to other Bodies. The Attraction and Repulſion exert their Forces differently: The Attraction only acts upon the Particles, which are in Contact, or very near it; in which Caſe it overcomes the Repulſion ſo far, as to render that Fluid unelaſtic, which otherwiſe would be elaſtic; but it does not wholly deſtroy the Repulſion of the Parts of the Fluid, becauſe it is on Account of that Repulſion that the Fluid is then incompreſſible. When by Heat or Fermentation (or any other Cauſe, if there be any) the Particles are ſeparated from their Contact, the Repulſion grows ſtronger, and the Particles exert that Force at great Diſtances, ſo that the ſame Body ſhall be expanded into a very large Space by becoming fluid, and may ſometimes take up more than a Million of Times more Room than it did in a ſolid or incompreſſible Fluid. (See the *Queries* at the End of Sir *Iſaac Newton*'s Optics.) Thus is Water by boiling, and leſs Degrees of Heat, changed into an elaſtic Vapour rare enough to riſe in Air, Oils and Quickſilver in Diſtillation made to riſe in a very rare Medium, ſuch as remains in the red-hot Retort, and ſulphureous Steams will riſe even in an exhauſted Receiver, as the Matter of the *Aurora Borealis* does in the thinner Part of our Atmoſphere. If Aqua-fortis be poured on Quickſilver, a reddiſh Fume will riſe much lighter than common Air; ſo alſo will Fumes riſe from Filings of Metals, from Vegetables when they ferment by Putrefaction; and (as the Reverend Mr *Hales* has ſhewn) ſeveral ſolid Subſtances by diſtilling, as well as Fermentation, will *generate* permanent Air.

That Heat will add Elaſticity to Fluids is evident from numberleſs Experiments, eſpecially from Diſtilling and Chymiſtry: But what is needful to conſider here is only, that it acts more powerfully on

Water than common Air; for the ſame Heat which rarefies Air only ⅓ will rarefy Water very near 14000 times, changing it into Steam or Vapour as it boils it: And in Winter, that ſmall Degree of Heat, which in Reſpect to our Bodies appears cold, will raiſe a Steam or Vapour from Water at the ſame Time that it condenſes Air.

By a great many Obſervations made by Mr *Henry Beighton*, F.R.S. and myſelf, upon the Engine to raiſe Water by Fire, according to Mr *Newcomen*'s Improvement of it; we found that the Water in boiling is expanded 14000 times to generate a Steam as ſtrong (*i. e.* as elaſtic) as common Air, which therefore muſt be near 16½ times ſpecifically lighter. And that this Steam is not made of the Air extricated out of the Water is plain, becauſe it is condenſed again into Water by a Jet of cold Water ſpouting in it; and the little Quantity of Air that comes out of the injected Water muſt be diſcharged at every Stroke, otherwiſe the Engine will not work well. There is alſo another Experiment to confirm this.

EXPERIMENT.

Fig. 5. ABCD is a pretty large Veſſel of Water, which muſt be ſet upon the Fire to boil. In this Veſſel muſt be ſuſpended the glaſs Bell E, made heavy enough to ſink in Water; but put in, in ſuch a Manner that it be filled with Water when upright, without any Bubbles of Air at it's Crown within, the Crown being all under Water. As the Water boils, the Bell will by Degrees be emptied of it's Water, being preſſed down by the Steam which riſes above the Water in the Bell; but as that Steam has the Appearance of Air, in order to know whether it be Air or not, take the Veſſel off the Fire, and draw up the Bell by a String faſtened to it's Knob at Top, till only the Mouth remains under Water; then, as the Steam condenſes by the cold Air on the outſide of the Bell, the Water will riſe up into the Bell at F quite to the Top, without any Bubble above it, which ſhews that the Steam which kept out the Water was not Air.

N. B. *This Experiment ſucceeds beſt when the Water has been firſt purged of Air by boiling, and the Air-Pump.*

We know by ſeveral Experiments made on the Fire-Engine (in Captain *Savery*'s Way, where the Steam is made to preſs immediately on the Water) that Steam will drive away Air, and that in Proportion to it's Heat; though in the open Air it floats and riſes in it like Smoak.

Now if the Particles of Water turned into Steam or Vapour repel each other ſtrongly, and repel Air more than they repel each other; Aggregates of ſuch Particles made up of Vapour and Vacuity may riſe in Air of different Denſities, according to their own Denſity dependant on their Degree of Heat, without having Recourſe to imaginary Bubbles formed in a Manner only ſuppoſed, and not proved, as

we

we have already ſhewn. *I own indeed, that if the watery Particles had no repellent Force, they muſt precipitate in the ſame Manner that Duſt will do after it has been raiſed up; but we have too many Obſervations and Experiments to leave any Doubt of the Exiſtence of the repellent Force above-mentioned. Neither can I ſhew by any Experiment, how big the* Moleculæ *of Vapour muſt be which exclude Air from their Interſtices, and whether thoſe* Moleculæ *do vary in Proportion to the Degree of Heat by an Increaſe of repellent Force in each watery Particle, or by a farther Diviſion of the Particles into other Particles ſtill leſs; but in general we may reaſonably affirm, that the Rarity of the Vapour is proportionable to the Degree of it's Heat, as it happens in other Fluids (See* Phil. Tranſact. *Numb.* 270.) *and that, though the different Degrees of the Air's Rarefaction are alſo proportionable to the Heat, the ſame Degree of Heat rarefies Vapour much more than Air.*

Now to ſhew, that what has been ſaid will account for the Riſe of Vapours and Formation of Clouds, we muſt only conſider; — whether that Degree of Heat, which is known to rarefy Water 14000 * Times, being compared with ſeveral of thoſe Degrees of Heat in Summer, Autumn, and Winter, which are capable of raiſing Exhalations from Water or Ice; the Rarity of the Vapours (eſtimated by the Degree of Heat) will appear to be ſuch, that the Vapour will riſe high enough in Winter, and not too high in Summer, to agree with the known *Phænomena.*

That the Effects are adequate to the Cauſes in this Caſe, I think I can make out in the following Manner, viz.

The Heat of boiling Water, according to Sir *Iſaac Newton*'s Table (*Phil. Tranſact.* Numb. 270) is 34, the mean Heat of Summer 5, the mean Heat of Spring or Autumn 3, and the leaſt Degree of Heat, at which Vapours riſe in Winter (*alias* the mean Heat of Winter) is 2. The Rarity of Vapour proportionable to theſe four Degrees of Heat, is 14000, 2058, 1235, and 823. The Rarity of Air is, in Summer 900, in Spring or Autumn 850, and in Winter 800, the Denſity of Water compared with the above-mentioned Denſities, being inverſely as *One* to the ſaid fore-mentioned four Numbers. The Heights above the Earth to which the Vapours will riſe, and at which they will be in *æquilibrio*, in an Air of the ſame Denſity with themſelves, will vary according to the Rarity of the Vapour depending on the Heat of the Seaſon. For the Vapour which is raiſed by the Winter's Heat, expreſſed by the Number 2, when the Air's Rarity

* As the Digreſſion would be too long to mention here thoſe Obſervations on the Fire-Engine, which ſhew that the Vapour from boiling Water is expanded 14000 Times more than cold Water; I refer the Reader to the 6th *Section* of 25th *Contemplation* of *Nieuwentyt's Religious Philoſopher*, where he proves by an Experiment made with an Æolipile, that one Inch of Water produces 13365 Inches of Vapour; which, conſidering the great Allowances made againſt the Aſſertion, may well be called 14000.

is 800, will riſe to (and ſettle at) a Height of about the Sixth of a Mile, when the Barometer is above 30 Inches high. But if the Heat be greater then, the Vapours will riſe higher, and pretty much higher if the Sun ſhines, though in froſty Weather, the Barometer being then very high. If the Barometer falls, and thereby brings the Place of *Æquilibrium* (for Vapours raiſed by the Heat 2) nearer the Earth, then alſo will the Heat be encreaſed, the Vapour more rarefied, and conſequently the new Place of *Æquilibrium* ſufficiently high. It is to be obſerved, that in Winter, when the Heat is only equal to 2, the Air is denſeſt cloſe to the Earth, which has not any Heat ſufficient to rarefy it near the Ground, as happens in warm Weather; therefore the Vapour will riſe gradually in an Air whoſe Denſity decreaſes continually from the Earth upwards; neither will the Vapour be hindered of it's full Riſe, by any Condenſation from a greater Cold of the ambient Air, the Air being then as cold next to the Ground where the Vapour begins to riſe, as it is at any Heighth from the Earth.

The Vapour which is raiſed by the Heat of Spring or Autumn expreſſed by Number 3, will riſe to the Height of 3¼ Miles, when the Barometer is at 30, and the Air's Rarity is 850. But then, as the Air is hotter nearer the Ground than at the Height of half a Mile or a Mile, the Vapour will condenſe as it riſes; and as the Air, when the Earth is heated, is rarer near the Ground than at ſome Height from it, the Place of *Æquilibrium* for Vapour will, upon theſe two Accounts, be brought much lower than otherwiſe it would be; as for Example, to the Height of about a Mile, which will agree with *Phænomena*.

In Summer, the two Cauſes above-mentioned encreaſing, the Vapour raiſed by the Heat 5 (whoſe Place of *Æquilibrium* would be 5¼ Miles high, if the Vapour after it began to riſe was not condenſed by cooling, and the Air was denſeſt cloſe to the Earth) will ſettle at the Height of about 1½ or 2 Miles, which is alſo agreeable to *Phænomena*.

Laſtly, As the Denſity and Rarity of the Vapour is chiefly owing to it's Degree of Heat, and in a ſmall Meaſure to the encreaſed or diminiſhed Preſſure of the circumambient Air, when it is not confined; and the Denſity and Rarity of the Air is chiefly owing to the increaſed or diminiſhed Preſſure, by the Accumulation or Exhauſtion of ſuperior Air, whilſt Heat and Cold alter it's Denſity in a much leſs Proportion; the Clouds made of the Vapours above-mentioned, inſtead of conforming themſelves to the altered Denſity of the ambient Air, will riſe when it is condenſed, and ſink when it is rarefied; and alſo riſe or ſink (when the Preſſure of the Air is not altered, and it's Denſity very little changed) by their own Dilatation, owing to Heat or Cold; as may be obſerved often, by ſeeing them change their Height conſiderably, whilſt the Barometer continues

exactly at the ſame Degree, and the Thermometer's Liquor riſes or falls very little, and ſometimes not at all.

As for the Manner how Clouds are changed into Rain, I have hinted it in the Beginning of this Paper; but for farther Satisfaction, I refer the Reader to Dr *Halley*'s Account of it, in the *Philoſophical Tranſactions* (Numb. 183.) in which I entirely acquieſce, having always found it agreeable to the *Phænomena*.

If by publiſhing theſe Thoughts, I have explained the Riſe of Vapours, in a more ſatisfactory Way than has been done before; or if I have only given uſeful Hints to others more capable of doing it, I have my End.

P. S. Since I have, for Brevity ſake, only mentioned at what Heights from the Surface of the Earth, Vapours of different Denſities will come to an *Æquilibrium*, without giving a Reaſon for ſettling the Place of *Æquilibrium*, at thoſe Heights; I think proper to give the Method here by which they are to be found, *viz.* As the Vapours will ſettle and riſe where the Air is of the ſame Denſity with themſelves; it is only required to find the Denſity of the Air at any Diſtance from the Earth, at ſeveral Heights of the Barometer, which may be deduced from Dr *Halley*'s two Tables, *Philoſoph. Tranſact.* Numb. 386. (the Firſt ſhewing the Altitude to given Heights of the Mercury; and the Second, the Heights of the Mercury at given Altitudes) and knowing the Degree of Heat by the Thermometer, becauſe the Denſity of the Vapour depends upon the Degree of Heat of the Seaſon; provided that proper Allowances be made for the great Rarefaction of the Air near the Earth in hot and dry Weather, and the Condenſation of the Vapours in their Riſe, by reaſon of the Air being colder at a little Height above the Earth than juſt at the Surface of it.

XX. In the *Philoſophical Tranſactions* for *November* and *December*, 1709, N. 324, I have given an Account of ſome of the moſt remarkable Froſts that I could find any Relation of; and particularly of that great and, I had almoſt ſaid, univerſal one in 1708, which the Society had very good Hiſtories of from divers Parts, and which, in that *Tranſaction*, I have given an Account of from the Original Papers, which the Society was pleaſed to do me the Honour to entruſt me with.

Concerning the FROST *in* January 173$\frac{8}{1}$. *By the Rev.* William Derham, *D. D.* No. 417. pag. 16.

In that *Tranſaction* I have made it very probable, that the greateſt Deſcent of the Spirits in the Thermometer, was on *Decem.* 30, 1708, when my Glaſs was within $\frac{1}{10}$ of an Inch as low as it is with artificial Freezing with Snow or Ice and Salt: And in the late Froſt it was almoſt, if not altogether, as low.

The *Freezing-Point* of my Thermometer is 10 Inches (which I call 100 Degrees) above the Globe of Spirits; and the moſt intenſe Freezing (according to the Methods I have mentioned in that *Tranſaction*) is juſt at, or very little within, the Ball. And on *January* 30, about

Sun-

Sun-rising, the Thermometer was but an Inch, or 10 Degrees above the Point of extreme Freezing; and on *February* 3, at only half an Inch, or 5 Degrees. And considering that the Thermometer I observed with in 1708, was less accurate, and differently graduated from that which I now have, I am apt to think, that the Frost on *February* 3 last, was altogether as intense as that on *December* 30, 1708. For although a frigorifick Mixture sunk the Spirits but one Tenth lower in the old Thermometer, and about 5 or 6 Tenths in that I now observe with, yet I take the Difference to be little, or none at all, by reason of the Tenderness of the new above the old Glass.

And this Degree of Cold I take to be as excessive as in any of the Years mentioned in the said *Transaction*; yea, any of the Years, when the *Thames* at *London* was frozen over: I am sure colder than in the Year 1716, when that River was frozen over for several Miles, and Booths and Streets were made on the Ice, an Ox roasted thereon, *&c.* For the lowest Point of Freezing in 1716, was on *January* 7, when the Spirits fell to 35 Degrees only of the Glass I now make use: But the true Cause of the freezing of the *Thames* that Year was not barely the Excess of the Cold, but the long Continuance of it: Which was also the principal Cause of those remarkable Congelations of that River in 1683, and 1708, when I saw Coaches driven over the Ice, large Fires made on it, *&c.*

Effects of Lightening, *by the Rev. Mr* Jos. Wasse, N°. 390. pag. 366.

XXI. 1. We are told by Mr *Jessop*, in the *Transactions*, that what the common People call *Fairy Circles*, are occasioned by Lightening; but I think it has not yet been observed, that they continue visible 50 Years, and that no Composition of Use in Fire-works will produce near so lasting an Effect, as I have experienced. There seems to be something here, which Sulphur and Nitre will hardly account for. Does it depend upon the great Quantity of the Matter discharged, or the Violence with which it is impelled? The Ground is no way torn up, and the Grass is only a little blasted; which would make one think it's Force well nigh spent: Whereas, when the Burst is near us, the Effect is like that of a Petard, as appears from the following Instance.

On *Saturday July* 3, at *Mixbury*, three Miles *East* of this Place, about two in the Afternoon, *William Hall*, aged above Sixty, was found dead in a hard gravelly Field, together with five Sheep, which lay round him about 30 Yards Distance: of the five, that only, which lay nearest him, had a visible Wound through the Head. The Shepherd lay partly upon his Side; the upper Part of his Head was terribly fractured, and his right Knee was out of joint. He had a Wound in the Sole of his Foot, towards the Heel; his right Ear was cut off, and beaten into his Skull, and Blood flow'd out of that Part upon the Ground. He is supposed to have been driving those Sheep.

Sheep. All his Cloaths and Shirt were torn into ſmall Pieces, and hung about him; but from the Girdle downwards were carried away intirely, and ſcattered up and down the Field: Particularly, the Soles of a new ſtrong Pair of Shoes were rent off. His Hat was driven to Pieces: I have a Hand breadth of it full of irregular Slits, and, in ſome few Places, cut as with a very ſharp Pen-knife, and a little ſinged in the upper Part. His Beard, and the Hair of his Head were, for the moſt Part, cloſe burnt off. The Iron Buckle of his Belt was thrown 40 Yards off, and a Knife in the right ſide Pocket of his Breeches was broken in Pieces, not melted, and the Haft ſplit. Near each Foot appear two round Holes about a Yard deep, and five Inches Diameter, which ſhews the Force of the Blow. I have ſeen an Iron Ball ſhot out of a Mortar almoſt perpendicular, which, upon a like gravelly Soil, made not a greater Impreſſion. About the Time this Accident happened, a Tradeſman of the ſame Town obſerved a Sort of Fire-ball, as large as a Man's Head, to burſt in four Pieces near the Church. The Storm began here at 1^h $30'$, and laſted, with intermiſſions, to 2^h $30'$, and we ſaw the Lightening towards *Aylesbury* all the Evening. Two Perſons at *Aynho* were a little hurt at the ſame Time, and one of them ſtruck down to the Ground, and ſays, he thought he was felled with a Beetle. I my ſelf heard the Hiſs of a Ball of Fire, almoſt as big as the Moon, which flew over my Garden, from *S. E.* to *N. W.*

2. I thought I had been impertinently circumſtantial in the Account of the late Storm; but there ſtill remains a Particular or two to complete it. I ordered my Nephew, a Student of *Merton*, a pretty good Philoſopher, to ſearch the Holes made by the Blaſt. Both of them at firſt, were almoſt perpendicular for half a Yard, and after that grew narrower; in both of them, the Matter divided into two Parts, and formed horizontal Cavities about three Inches Diameter: In one he found a very hard glazed Stone, of about 10 Inches long, 6 wide, and 4 in Thickneſs, crack'd in two: Others it could not pierce, but was turned here and there out of its Courſe, but left not the leaſt Blackneſs, or other Diſcolouring any where. As to the Knife, it was not the Blade, but the Haft, and the Hinge that goes into it, which was ſhivered in Pieces. Near the Sheep that was wounded, the Ground was torn up near two Yards round. It was very ſurprizing, that the Man's Body was not beaten to Pieces, or Bones broken at leaſt. *A farther account, by the ſame.* ibid. p. 368.

To make a groſs Eſtimate of the Force, I took a *Cohorn* charged with three Quarters of a Pound of very good Powder, wadded with thick Paper, and fired it againſt a Stone of the ſame Dimenſions, but not ſo hard, which it ſhattered to Pieces at half an Inch Diſtance: But, in the other Blow, we have above treble the Effect, without any diſcoverable Particles at all; and yet it ſeems to fly like ſmall Shot; pierces only here and there, and leaves a good many Places quite

quite untouched, as is evident from the Hat which I have by me. To confirm this, *James Marſhal* of this Town aſſures me, that in the Middle of the ſame Storm, he received a Blow upon his Hat, which rattled like Shot through the Branches of a Tree: It beat in the Crown a little without penetrating it: He ſtaggered, and was giddy for two Days afterwards. Two of his Sons were, at the ſame Inſtant, both knocked down to the Ground, and ſtunned a little, but preſently came to themſelves, and have no Wound: They are about 20, and 23 Years old. *Qu.* Whether this may not be accounted for, by ſuppoſing the Flame to rarify the Air, and make a Sort of *Vacuum* about one; into which when it returns again, it gives the Likeneſs of a Stroke with a Beetle, as he expreſſes it. I fancy a Wind-Gun, with compreſſed Air, would have the ſame Effect, and might eaſily be tryed upon a Dog, or ſuch like Animal.

At Worceſter, June 11, 1724. *communicated by* R. Beard, *M.D. F.R.S.* No. 394. Pag. 118.

3. We had on the 10th continued Lightening in the *Eaſt* from Eight of the Clock at Night to Twelve; the Weather for ſome time before having been very ſultry, the Wind at N. E. and the Barometer at ſettled Fair. The next Morning the Mercury ſunk, and the Sky became more cloudy and temperate, except a few hot Gleams; at Two in the Afternoon, ſeveral fierce Showers fell, attended with Flaſhes of Lightening and Claps of Thunder, that ſtill approached nearer us: Between Two and Three, a Flaſh came ſo violently upon me, ſucceeded ſo very quick by a low, unuſual, dreadful Sound, that I immediately went to the door, fearing ſome Miſchief near. I was ſoon call'd to an Officer's Lady (aged about 18, and breeding) kill'd by it in the adjoining Street. I found her yet warm, and that ſhe had ſurvived the Stroke for 6 or 7 Minutes. The Fire-Marks they ſhewed me were Streaks of a Copper-Colour branched from the Left Shoulder all-over the *Thorax*, and interſperſed here and there with irregular Spots, which gave occaſion for that Conceit publiſh'd in our News, that *curious Plants were drawn on her Boſom, as with the fineſt Pencil.* This ſad Accident happened in a Parlour-Window next the Street, that could contain about two Perſons. The Lady, it ſeems, terrified with the repeated Lightening and Thunder, (it having formerly been fatal to her Brother) deſir'd an Officer to change Places with her, that ſhe might be near her Huſband; but ſhe was no ſooner ſeated by his ſide, than ſhe inclined ſide-ways, and ſpoke ſome Words; after ſhe was carried to another Room, ſhe ſaid, ſhe was gone, and then, that ſhe was blind, and aſked for Water. The Huſband was thrown along, together with the fortunate Gentleman that had juſt reſigned his Seat; and a large Looking-Glaſs was lifted off the Hooks. The Landlord's Daughter, at work near the Lady, perceived ſuch an Impulſe on the ſide of her Head, that her Hearing was much impaired, *and upon every Peal of Thunder ſince ſhe is affected in like manner, tho' not ſo ſtrongly.* The Gentleman complained, that they were ſtupified, forced down they did not know why, unleſs it were

were for want of Breath; and of Pains and Numbneſs in their Limbs. They had likewiſe on different Parts of their Bodies ſuch reddiſh Wheals as were ſeen on the Lady's Breaſt: But theſe Symptoms vaniſhed the next Day. The other two Perſons at the further End of the Room were untouched; they were all ſenſible of a ſulphurous Smell. The Pane of Glaſs exactly behind the Lady's Waſt, was perforated by a round Hole of an Inch and half Diameter, as if done with a Diamond, or rather a Wind-Gun; but no where thereabouts could I diſcern the leaſt Traces of Fire, or Heat, nor on the Lady's Clothes (having no Stays on) the Signs of any Violence. On a more nice Examination of the Body, in the Preſence of the Friends, that Evening, I diſcovered on the left Loin, taking in part of the Spine of the *Os Ilium*, which was ſomewhat ſwoln, a deep Contuſion of the ſame Dimenſion with the Breach in the Glaſs: The Skin was neither indurated, nor pierced: The Blood in the Capillaries all round, but chiefly up the Back, ſettled, the Colour of which was eaſily diſtinguiſhed from that of the Streaks, and the circular Impreſſion.

The *Phænomenon*, that cauſed this Misfortune, roſe from the N.E. firſt ſlid off the Gabel-Beam, and the Bricks on the back part of the next Houſe, filled a little Court with Flame and Smoak, then turned a Leaden Spout contrary to it's former Direction, mounted over the Roof, and, cracking a Stack of Chimneys, dropt down at the Window where the Huſband and Wife ſate. Some credible People that ſaw it, to their great Terror, aſſure me, that it was a Ball of Fire, and that it burſt with the loudeſt Report they ever heard; and then, with a hiſſing Noiſe, paſſed about a Yard from the Ground through an adjacent Street, and rolled off to the S. W. Some Workmen there, and on a neighbouring Hill, obſerved the ſame.

In my Opinion, the Mortality of this Blow may be accounted for from the known Effects of impriſoned Air only, when ſet at liberty, as the Appearances on the Skin may, from other active Particles hurried along with it at the time of the Exploſion. The *Impetus* being firſt received on the Parts deſcribed, occaſioned her Death to be leſs ſudden than uſual in ſuch Caſes.

4. We have had more Lightening and Thunder lately in one week, than ever has been known in that ſpace of time: And what was more extraordinary, the Continuance of it for 9 or 10 Hours together, with little or no Intermiſſion, and at ſuch a Height above us. So far has this been from doing any great Damage near us, that in the Opinion of the Country-Farmers, it had very good Effects, eſpecially at the beginning during the Heat: For the little Inſects, that in ſome Places threatened the Deſtruction of the Hops and ſome other Plants, fell off like Bees by the Steam of a lighted Match.

A farther account by the ſame. N°. 394. pag. 120.

In Carmarthenſhire; *by* *Mr* Evan Davies, N°. 416. pag. 444.

5. On *December* 6, 1729, in the Afternoon, there happened terrible Thunder and Lightening, which alarmed the whole Neighbourhood; and about four of the Clock or thereabouts, as the Wife of one *William Griff. Morgan* of *Pencarreg*, was carrying a Pail of Water into the Houſe, ſhe was no ſooner come over the Threſhold into a ſmall Entry that leads towards the Fire, than there broke ſuch a violent Clap of Thunder, after its Forerunner (Lightening) that ſhe and three of her Children were inſtantly bereaved of their Senſes, and lay (they know not how long) miſerable and ghaſtly Monuments of the terrible Shock; and (if my Memory fails me not) they lay weltring in their Blood, before they recovered, and were able to creep to the Bed, 'till the next Neighbour happened to come in (the Huſband being then abroad at his Day-Labour) to aſſiſt them. The Cauſe, whatever it was, whether Thunder-Bolt, Thunder-Ball, Lightening, *&c.* ſtruck ('tis imagined) at the *Eaſt* End, near the Foundation, into the Hearth, and cleaved in two a thick Stone of about half a Yard in Breadth beyond the Fire (which we commonly call in *Welſh Pentan*) one Part whereof ſtill remains, and that cleft, but the other is ſhattered into ſmall Particles and Splinters, and thoſe ſhot into their Fleſh, which ('tis preſumed) did the moſt Hurt. About twenty-four or more of thoſe Stones were from Time to Time taken out of their Wounds; two of thoſe, being all I could get, I have ſent for an Inſtance. It appears, that afterwards it forced it's Way out through the Wall on the *South-ſide* within the Compaſs of the Hearth, when it made a terrible Breach from Top to Bottom, and removed the Stones from the Foundation, and nigh thereto made a deep Hole perpendicular in the Earth, that one might thruſt in a Staff to the Wriſt, as the Woman herſelf informed me. That part of the Wall was made up before I viewed the Spot. By the Violence of it, the Brand-Irons and Legs thereof were ſtrained, and when they endeavoured to put them to their true Poſition as before, they found them ſo burnt up, that they fell a-ſunder like ruſty Iron, or Wormeaten Timber, and ſo became of no further Uſe. The Partitions in the Houſe, which were of no ſtrong Subſtance (being watled, ſuch as they have in Country Houſes) were moved out of place, and a Cheſt full of Corn forced down towards the Door, ſome Yards from the Place where it ſtood. The Bucket the Woman had in her Hand, and other wooden Veſſels in the Houſe, were all or moſt of them ſhattered, Diſhes and Spoons, *&c.* blown off, and after ſome Days, found and gathered in the Garden, on the *North-ſide* of the Houſe, ſplit and broken, with ſome Yarn that was hanging in the Top of the Houſe, found out of Doors a while after; and many more Diſorders than I am able to account for at preſent.

The Woman has quite loſt her left Eye, ſhe was ſpeechleſs for a Week or nine Days, and could not ſwallow. She has lately had a few Stones come out of her Mouth, under the Tongue, and other

ther Parts inwardly: The Tip of her Tongue is taken off, as far as I can gueſs, for ſhe is ſtill liſping; three of the fore Teeth of the under Jaw are broken, and the lower Lip is ſlit, but is now pretty well healed; the ſecond and third Fingers of the Right-hand are quite off, and the Colour of that Hand is ſtill like a Flame of Fire, as if there were yet remaining ſome igneous Particles in it. She has ſuch a terrible Gaſh upon that Shoulder between the Joints, that once one might cover an Egg in it, very painful; beſides three or more Bruiſes upon the Arm down to the Wriſt, that ſhe is not able to heave or lift it up, without the Help of the other Hand, beſides ſeveral other Wounds and Bruiſes over great Part of her Body. A Boy (an Ideot) had his Hair all ſindged, his Face and Breaſt all ſcorched with Bliſters like Bladders running from the raw Fleſh, with ſeveral Stones taken out from his Body and Legs, and two other ſmall Children ſuffered greatly; ſo that the Wounds are reckoned by the Woman that uſed to dreſs them, to be Thirty at leaſt between the Mother and Children: only one Girl about ten Years old, or thereabouts, that ſtood at a Diſtance next the Doors eſcaped, having her Cloaths only ſindged, and no Hurt done her. I had almoſt forgot to mention the ſeveral Splinters of Bones taken out in dreſſing their Wounds, that I could not get. It is worth obſerving alſo, that they did ſmell ſo ſtrong of the Sulphur and bituminous Matter for ſome Days, that one could hardly go near them. They are now, free from any grievous Pain ſo that they go about.

This Account was ſent me by Mr *Jenkin Jenkins* a Clergyman, who lives in that Neighbourhood: About half a Year after I was that Way, and viewed the Breach made in the Houſe, and the Wounds which the Woman and her Children had received by the Stones lodged in their Bodies, ſome of which were not then healed. The Woman then gave me the little Piece of a Stone, wrapped up in the brown Paper, which ſhe ſaid ſhe had taken out of her Tongue, above five Months after this Diſaſter had happened.

XXII. 1. The 26th of *October*, being on the River coming up to *London*, about half an Hour paſt Ten, the Sun being then about twenty Degrees high, I obſerved a Circle about the Sun, which is by no means unuſual, when the Air in chilly Weather, ſuch as it is now, is replete with ſnowy Particles; which Circle was of the Size in which it always appears about 23 Degrees from the Sun, and faintly ting'd with the Colours of the *Iris*. When this Circle happens, I always look out, to ſee whether any other of the *Phenomena* that ſometimes attend it do at that Time appear, ſuch as *Parhelia*, and other coloured Circles, concentric with the Sun, and ſometimes, as once I ſaw it, excentric; as alſo a white Circle round the *Zenith*, in equal Altitude with the Sun: But this Time, the Air being thickned with a hazy Vapour, and the Smoke of the Town, I could only ſee to the *Eaſtward* a luminous white Patch, which for about

A Parhelion, *by* Edmund Halley *L. L. D. R. S. S.* No. 369. pag. 211.

twenty Minutes ſhone through the thick Air very conſpicuouſly, of about two Degrees Diameter, as near as I could eſtimate it, and about the ſame Altitude with the Sun: and from it, towards the Sun, there ſeemed to proceed a long white Tail, much narrower than the Mock-Sun, but which I took to be a Segment of the white Circle which I once ſaw entire in *London*. Had the Air been clear, I doubt not but much more of the *Phenomena* of the *Parhelia* might this Time have been obſerved: and I hope, that from our Neighbourhood ſome Member of the *Society* may furniſh us with a fuller Relation. But how to explain theſe Appearances, and account for the Magnitude of theſe Circles, is what ſeems ſtill wanting.

Two Parhelia, *and an* Arc of a Rainbow inverted, *with a* Halo, *and it's brighteſt Arc, by the Rev. Mr* William Whiſton. M. A. N°. 369. pag. 212.

2. About Ten of the Clock in the Morning, on *Sunday October* 22. 1722. being at the Houſe of *Samuel Barker*, Eſq; of *Lyndon* in the County of *Rutland*, after an *Aurora Borealis* the Night before (Wind W. S. W.) I ſaw an Attempt towards two Mock-Suns, as I had done ſometimes formerly, of which I immediately informed Mr *Barker*, though without any great Expectations of what followed. About ½ or ⅓ of an Hour after, I went to view the Heavens, and then found the Appearance compleat; and when Mr *Barker* and others of the Family were called, we all ſaw it, and all ſaw indeed what we had none of us ſeen before; I mean two plain *Parhelia*, or Mock-Suns, tolerably bright and diſtinct; and that in the uſual Places, *viz.* in the two Interſections of a ſtrong and large Portion of an *Halo*, with an imaginary Circle, parallel to the Horizon, paſſing through the true Sun. I call this Circle here *imaginary*, becauſe it was not it ſelf viſible, as it ſometimes has been at ſuch Appearances. Each *Parhelion* had it's Tail, of a white Colour, and in direct Oppoſition to the true Sun; that towards the *Eaſt* was 20 or 25 Degrees long; towards the *Weſt* about 10 or 12 Degrees; but both narroweſt at the remote Ends. The Mock-Suns were evidently red towards the Sun, but pale or whitiſh at the oppoſite Sides, as was the *Halo* alſo. Upon caſting our Eyes upward, we ſaw an Arc of a curious *inverted Rainbow*, about the Middle of the Diſtance between the Top of the *Halo* and our *Vertex*. I mean this, when Allowance is made for the uſual Inequality, that appears between the ſame Number of Degrees, nearer to and remoter from that *Vertex*. This Arc was as diſtinct in it's Colours as the common Rainbow; and, with the like Allowance as before, of the ſame Breadth. The red Colour was on the Convex, and the blue on the Concave of the Arc; which ſeemed to be about 90 Degrees long: It's Center in or near our *Vertex*. On the Top of the *Halo* was a kind of inverted bright Arc, though it's Bend was not plain. The lower Part of the *Halo* was among the Vapours of the Horizon, and not viſible. The Angles, eſpecially as more exactly meaſured on *Monday*, near Noon, when the ſame Appearance returned again, but more faintly, were as follows, Sun's Altitude 22°½; perpendicular Semidiameter of the *Halo* 23°½; Diſtance

Fig 6.

ſtance of the *Rainbow* from the Top of the *Halo* 23°½; Semidiameter of the Arc of the *Rainbow*, if our *Vertex* be ſuppoſed it's Center, 12°. The *Phænomenon* laſted each Day for an Hour and an half, or two Hours. What was moſt remarkable on *Monday* was that the Wind, which on *Sunday* had been almoſt inſenſible, was now become ſenſible, and changed to N. N. E. that the *Halo* was ſenſibly become *oval*; it's ſhorter Axis parallel to the Horizon; and the two Mock-Suns, which were then but juſt viſible, eſpecially that on the *Eaſt*, were not in the *Halo*, but a Degree or two without it, which I aſcribe to the unuſual Shortneſs of the Horizontal Diameter; which Poſition of the Mock-Suns, does not appear to have been hitherto taken Notice of by any, though it was now very ſenſible.

On *Thurſday* Morning, *Octob.* 26. as I was coming in the *Northampton* Coach towards *London*, about 9 of the Clock, the *Halo* returned larger and clearer than before; and the two Mock-Suns juſt attempted an Appearance therein, as on *Sunday*; but the Air becoming thicker and thicker towards Rain, I ſaw them no more. I add nothing to this Account, but only, that *Aug.* 30. before, I ſaw at the ſame Place (*Rutland*) a remarkable *Halo*, whoſe upper Part had it's inverted Arc reddiſh within, and pale without, but brighter and more vivid than ever I ſaw in my Life: That we had there, *Sept.* 11. in the Evening, the lighteſt and moſt remarkable *Aurora Borealis*, with it's unaccountable Motions and Removals, that ever I ſaw; excepting that original one. *March* 6, 171½: That it was ſeen in *Northamptonſhire*, at the *Bath*, and elſewhere: That the *Vertex* of the Columns which ſhot upwards, was not our *Vertex*, but evidently 15 or 20 Degrees diſtant towards the South; and that the Wind was in *Rutland* North, as I obſerved myſelf; at the *Bath*, *Weſt*, as Mr *Molyneux* obſerved; and, as I am informed by Sir *Robert Clarke*, in *Northamptonſhire* South; at all the ſame Time, which deſerves particular Reflexion.

3. *March* 22. 172½, about half an Hour after 5 in the Afternoon nearly, I ſaw a diſtinguiſhable *Parhelion*, the Sun near *Weſt*, about an Hour high, the Wind and Carry of the Clouds, about N. and by E. the Sky in ſeveral Places obſcured with light Clouds, and the Sun entring into one ſomewhat more watery, yet ſo as to diſtinguiſh it's Diſk. At firſt appeared below the Sun, breaking out of the Cloud, ſuch Rays as are uſually ſeen in an Evening, in a Sky interſperſed with Clouds. In a little Time appeared at the ſame Height with the Sun, as near as I could gueſs, having no Inſtrument, a luminous Spot, being about four Times the largeneſs of the Sun's Diſk, and about 30 Deg. diſtant from the Sun to the Southward, which was covered with the lively Shades of red and yellow on the Side next the Sun, and encreaſed in Splendor (ſo as ſcarce to be born by the naked Eye) till it exceeded the Brightneſs of the Sun, which was then under a thin Cloud, ſo as eaſily to perceive his Diſk. After this had appeared about 3 or 4 Minutes, I finding it to be a real *Parhelion*, began to look about.

—*in* Ireland, *by* Arthur Dobbs *Eſq*; N°. 372. pag. 89.

about for the *Halo* they generally appear in; and as I obſerved ſome Rays reſembling a Glory to point upwards from the Sun, I ſaw in thoſe Rays at the ſame Diſtance (being, as near as I could gueſs, about 30 Deg. perpendicularly above the Sun) the Colours of the *Halo* appearing as in the luminous Spot; but inſtead of finding it, as I expected, in a Circle ſurrounding the Sun, it was inverted, yet not circular, but making an obtuſe Angle, the point towards the Sun. I then looked to the Northward of the Sun, and as the Cloud, which was thicker on that ſide, moved ſouthwardly, a luminous Spot began to appear at the ſame Diſtance from the Sun as the other, and in the ſame Parallel of Altitude, which had the ſame Colours towards the Sun, and increaſed in Brightneſs, but did not come up to the Brightneſs of the other Spot, yet was as luminous as the Sun then appeared: this Spot was very little bigger than the Sun's Diſk. As the Cloud mov'd on, till it came to about 60 Deg. to the Southward of the Sun and 30 Deg. from the Spot, at an equal Height there appeared another Spot tinged with the Colours of the Rainbow. The whole Appearance laſted a Quarter of an Hour. The Reaſon of my not ſeeing the *Halo*'s, which generally appear with them, was, that there was a good deal of clear Sky above the Sun, and the Cloud was too thick below it.

Fig. 7.

A. The Place of the Sun, being nearly *Weſt* about 12 or 13 Deg. above the Horizon, being about an Hour before Sun-ſet.

B. The luminous Spot, being about 30 Deg. to the Southward, of the Sun, as near as I could compute, having no Inſtrument to take the Angle, and in the ſame Parallel of Altitude; the Spot was not ſo well defined as in the Scheme, being more imperceptibly ſhaded off in the Cloud, the two ſemicircular Lines next the Sun were thoſe tinged with the Colours; the neareſt the Sun being of a deep ſcarlet, the inner one a deep yellow, both the Colours being ſoftned as they fell off from the Sun, all the reſt of the Spot being an intenſe Light, ſo as the naked Eye could ſcarce bear it.

C. The other Spot to the Northward, which appeared ſome time after that marked B, being not quite ſo large, nor the Colours ſo intenſe, but the ſame way diſpoſed, thoſe next the Sun being red, the next yellow, and the reſt white.

D. A Spot in the Cloud, as it moved ſouthwardly, till it came to about 60 Deg. Diſtance from the Sun, which had the Colours as in the other Spots, that next the Sun being red, the next yellow, but much fainter than in the *Parhelia*.

E. The Appearance of two Segments of Circles, at about the ſame Diſtance from the Sun, as the *Parhelia*, being perpendicularly above it, the Colours being fainter than in the *Parhelia*, but the ſame Way diſpoſed, the lower Lines next the Sun expreſſing the red, and the upper the yellow.

The Colours at D, and E, as they were not ſo intenſe, neither were they quite ſo broad as thoſe at B and C; the two Colours being added together were about ⅓ of the Diſk at B, and the Colours in the ſame Proportion at C; the Diameter of the *Parhelion* at B, being about double the apparent Diameter of the Sun, as near as I could compute, as in the Scheme is expreſſed.

The Centres of the Segments of the *Halo*'s marked E, if not in the *Parhelia*, were very little below 'em.

Below the *Sun* and *Parhelia* the Cloud was too thick to diſcover any thing thro' it; and above them, till near the Segments marked E, the Sky was ſerene and nothing obſcured; but at E, where the Rays, which pointed upwards from the Sun, terminated, it appeared hazy, and ſo thick as to reflect the Colours.

4. On *Wedneſday*, *March* 1ſt, 17$\frac{1}{2}$$\frac{1}{9}$, walking in a Garden at *Kenſington*, about a quarter after Ten I happened to obſerve the following Appearance. *Four ſeen at* Kenſington *by Mr* G. Whiſton, N°. 398. pag. 257.

I at firſt took notice of the *Halo* about the Sun, V. M. with its uſual Circumſtances, which are pretty frequent; the upper part of it was very luminous, having a confuſed mixture of the Rainbow-Colours in it, and being touch'd at the *Vertex* with the two other Curvatures, OVR, NVT, in the Situation which the Scheme ſhews; tho' *Fig.* 8. the latter Arch NVT, did not appear till ſome time after. The Bottom part of it alſo at M, which appeared a little above the Horizon, had ſomething of the ſame nature, but not in ſo great a degree.

I perceived, preſently likewiſe, the two *Parhelia*, A, B; whoſe Diameters were pretty large, and whoſe Brightneſs and Colour was pretty much as the upper part of the *Halo*.

As the *Halo* was at that time not quite perfect, but had ſome parts interrupted, I thought that the two *Parhelia* were in the Circumference of its Circle, as uſual; but after about a quarter of an Hour, I directly obſerved the *Halo* to paſs between the *Parhelion* A, and the true Sun; and I have no reaſon to doubt the ſame of the other, B, alſo, tho' I do not remember that I directly obſerved that.

The *Parhelia* A, B, therefore, which were but a little diſtant from the Circumference of the *Halo*, began now to appear with narrow, pale, whitiſh Streaks of Light, in the nature of Tails, proceeding from them; but ſoon extended themſelves ſo far, that they met in the Point oppoſite to the Sun, and formed the Great Circle, ABCD, parallel to the Horizon, whoſe Breadth was about half that of the *Halo*.

Upon viewing it carefully all round, I ſoon diſcovered a third Mock-Sun, C, of a plain whitiſh Light, without any mixture of Colours, (which was alſo the Caſe of the great Circle,) and preſently alſo a fourth, D, both of them pretty exactly reſembling each other, (as the two firſt did themſelves likewiſe,) very much inferior to the *Parhelia* A, B, in Brightneſs, tho' not ſo much in magnitude; for I eſtimate

eſtimate their Diameters to have been to the two firſt *Parhelia*, as 4 to 5.

As I had no opportunity of meaſuring the ſeveral Angles, I have placed the Mock-Suns, C, D, in the Scheme, rather in Agreement with former Obſervations, than my own Gueſſes; for they appeared to me to be at a greater diſtance from each other, and nearer reſpectively to the two firſt *Parhelia*, which Difference M. *Huygens* attributes to the different Altitude of the Sun.

The Arch, NVT, not being very viſible while the Great Circle was, and indeed not extending itſelf at any time near ſo far as to the *Parhelia*, or the Circumference of the great Circle, I could not determine by a direct Obſervation, whether the *Parhelia* A, B, appeared in the Interſection of that Circle produced, with the great Circle; but the Curvature appeared to me ſo plainly different from that, it's Center not being, I reckon, above M, that I cannot but believe the *Parhelia*, A, B, were neither in the Interſection of NVO, with the great Circle, ABCD, nor of the *Halo* with the ſame Circle, in one of which Circumſtances they have hitherto appeared; but between thoſe two Points, and much nearer to the Circumference of the *Halo*.

I thought I ſaw plainly at one time likewiſe, a ſmall Portion of a Secondary *Halo*, if I may ſo call it, as in the Scheme at P. It ſeemed evidently to be an Arch of a Circle concentrical with the *Halo*, and tinged with the Rainbow-Colours, whoſe Diameters might perhaps be to that of the *Halo*, as 4 to 3; but as it appeared but for a little time, I would not be thought poſitive about it.

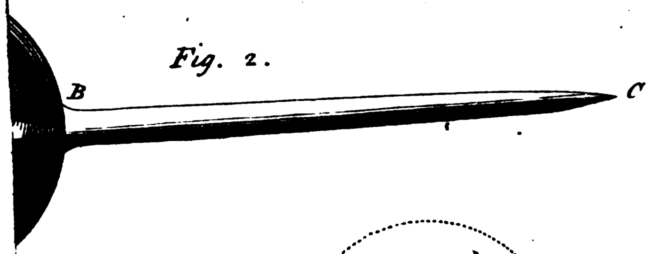
I don't at all remember, that during the time I watched it, I ever obſerved the great Circle ABCD, to be viſible within the *Halo*, between A and B, tho' all the other part of it was ſometimes very perfect.

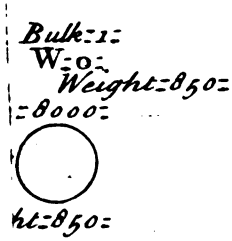
This Face of the Heavens continued, tho' with an Interruption of ſome parts now and then, till about a quarter after eleven, when I left it, and could not return till about twelve, at which time the Sky was clouded over, (which had been before only hazy, a ſure Criterion of theſe Appearances) and this *Phænomenon* no longer viſible.

A Rainbow ſeen on the Ground by the Rev. Benj. Langwith, *D. D.* No. 369. pag. 229.

XXIII. On the 7th of *September* laſt, about Nine in the Morning, I was riding with ſome Friends over *Port-Mead* near *Oxford*. The Morning had been miſty, and the Graſs was very wet with the Dew. We had not been long out, before the Air cleared up, and the Sun began to ſhine very bright. We ſoon after had the Satisfaction of ſeeing a Rainbow upon the Ground, whoſe Colours were very near as lively as thoſe of the common *Iris:* This was extended upon the Ground for ſome Hundreds of Yards, and the Colours were ſo ſtrong, that it might have been ſeen much farther, had it not been terminated by the Bank, and Hedge of the Field. It is hardly worth while to obſerve, that it continually changed it's Place as we moved along, ſince this is no more than happens in other Rainbows. The more remarkable Particulars were theſe:

Fig. 2.





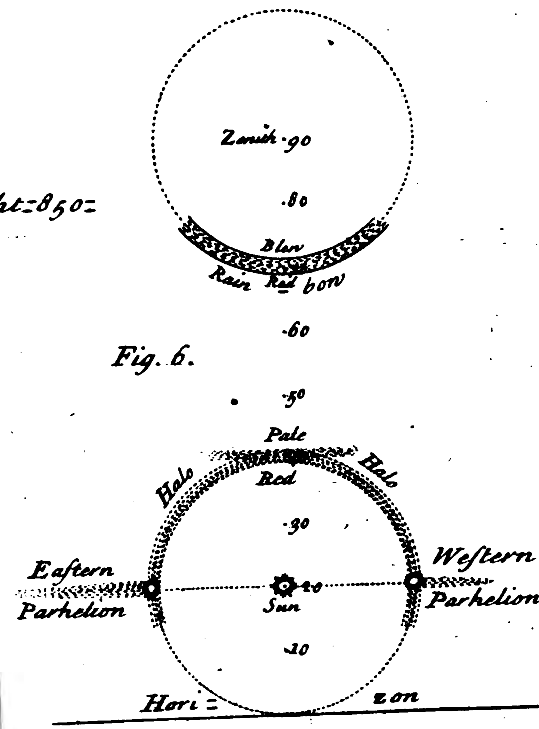


Fig. 6.

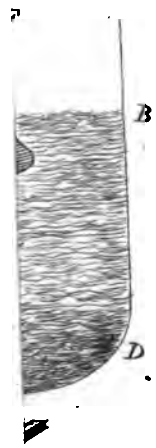
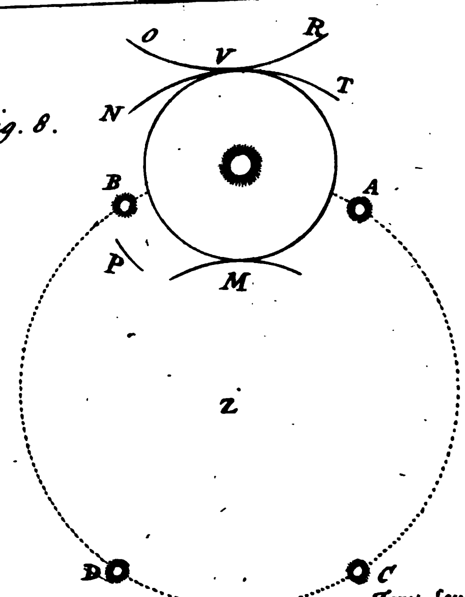


Fig. 8.



1. That the Figure of it was not round, but oblong; being as I conceive, a Portion of an *Hyperbola*.

2. That the Convex Part of it was turned towards the Eye, and the *Vertex* was at a ſmall Diſtance before us.

3. That the Colours took up leſs Space, and were much more lively in thoſe Parts of the *Iris* that were near us, than in thoſe at a Diſtance.

Theſe *Phænomena* may eaſily be accounted for, by comparing this *Iris* DCE, with the common *Iris kiEe* formed by Drops falling in the Air at a ſmall Diſtance from the Eye of the Spectator H, and touching the Ground with the lower Part of it's Arch in E, the vertical Point of the *Iris* DCE. Produce the Cone H*kiEe*: It's Interſection with the Plane of the Horizon will give the Figure of the *Iris* DCE. Hence it follows, *Fig.* 9.

1. That as the Angle *e*HG happens to be greater, equal to, or leſs, than 90 deg. the Figure will be a *Hyperbola*, *Parabola*, or *Ellipſis*.

2. That as the Sun was about 30 deg. high, when we viewed the *Phænomena*, the *Iris* was a *Hyperbola*.

3. That the Arches of the ſame *Iris*, conſiſting of Colours of different Refrangibility, may alſo in ſome Caſes be different Sections of the Cone.

4. That ſince the Angle *e*HF is always given; from the Height of the Point of View HG, and the Sun's Altitude SLA, the Dimenſions of theſe *Iris*'s are eaſily determined.

XXIV. It began about 10 a Clock on *January* 12th $17\frac{1}{10}$, but had nothing very remarkable till about half an Hour after Eleven, when I was call'd out to ſee it, by the Servants, who had been looking at it about half a quarter of an Hour, and told me it looked juſt like Fire. But it appeared firſt to me in long Streams of Light, of a round Body, as at A, and very bright, tho' ſome were coloured, as at A*a*. They came before the Wind, which was then *Weſt*, as near as I could gueſs, there not being a Cloud in the Sky, and the brighteſt Moon I have known. We had Rain about Five, but at 6 a Clock the Night was clear. The Streams of Light AA, moved very ſlow, (there being but little Wind) but as they moved they joined, and, ſwelling out in the middle, formed themſelves into the Figure *bb*B, continuing to advance ſlowly in that ſhape for about a Minute, when the two Ends *bb*, approaching near each other, as deſcribed by the pricked Lines, the advanced part B, ſuddenly, and with great Swiftneſs, ran back, and joining it ſelf with the Ends *bb*, formed it ſelf into the Figure C, quivering in the upper part, and darting down perpendicularly in ſharp Points, as at DDD; and it's Colour from a bright Light changed into the Colours of a Rainbow, but much fainter. It continued this way about a Minute, *A Luminous Appearance in the Air at* Dublin, *By* Philip Percival, *Eſq;* N°. 364. pag. 21; *Fig.* 10.

and then the ſharp points D D D, gathering themſelves up into C, it changed again into a ſquare Sheet of Light, as at E, and ſwell'd out at F, as before at B; and advancing leiſurely, repeated the ſame Scene as before, 'till it ſeemed at a great diſtance to diſperſe it ſelf into ſmall thin light Clouds; tho' 'tis probable that to thoſe who ſaw it in a like Situation, as it travelled, it might make the ſame appearance as it did to me. I was very particular in obſerving it, and the next Morning drew it, and I think very exactly. I ſhould have continued longer to look at it, (which I did for above a quarter of an Hour) but that it was exceſſive cold; the beginning of it was very like the *Aurora Borealis*, which has been very frequent this Winter here.

A great Meteor at Cambridge, *by Mr* Roger Cotes, *Plumian Profeſſor*, No. 365. p. 66.

XXV. I am told that ſome Streams were ſeen to ſhoot forth immediately after Sun-ſet, and that they did not perfectly ceaſe till about 3 or 4 in the Morning. It was after 7 before I had Notice of it. At firſt I ſaw only two or three of the Triangular Streams towards the North and North-Weſt: Theſe were not of long Duration, but were ſucceeded by others which appeared and vaniſhed again by turns, ariſing from, and aſcending up to Places in the Heavens, of very different Altitudes above the *Horizon*. From the Time I began to view them, they continued to aſcend more and more copiouſly, being propagated ſtill further and further from the North towards the Weſt and Eaſt, and directed always to the Head of *Gemini*; till at length, when they ſeemed almoſt to meet at the Point of Convergence, they began to aſcend up towards it from the Southern Parts alſo, and all around it; inſomuch, that at a quarter after Seven, we had a perfect Canopy of Rays over us: The bottom of this Canopy did no where reach down to the *Horizon*; for near the North, where it deſcended the moſt, it's Altitude was about 10 or 15 Degrees; and near the South, where it deſcended the leaſt, it's Altitude was about 40 Degrees. It remain'd in this State about 2 Minutes, during which time, we ſaw ſeveral Colours, ſome fainter, and ſome more permanent, others brighter, but quickly vaniſhing. Thus in the Weſt I obſerved the Rays to be tinged for ſome conſiderable time with an obſcure and heavy red; and in one of the brighteſt Streams at another time, there ſuddenly broke out a very vivid red, which was inſtantly and gradually ſucceeded by the other priſmatick Colours, all vaniſhing in about a ſecond of time. Theſe Colours affected the Senſe ſo ſtrongly, that I thought them to be more intenſe than thoſe of the brighteſt Rainbow I had ever ſeen. A ſmall time before the Appearance loſt it's Perfection, we were ſurprized to obſerve a ſhaking and trembling of the Streams, chiefly in their upper Parts, during which, their Convergence was confounded, and the whole Heaven ſeemed to be in a Convulſion. At the ſame time I could perceive Waves of Light towards the North, which moved upwards, and in their Motion croſſed the Streams, lying

ing parallel to the *Horizon*. Theſe Waves were different from thoſe broad ones, which you mention, and which I alſo took notice of; their breadth ſeemed to be about a Degree, their length about 90 Degrees; and I can compare them to nothing better than thoſe ſlender Waves upon the ſurface of ſtagnant Water, which are made by caſting in a ſmall Stone.

About ſeven or eight Years ago, I happened to ſee a Meteor which it will be of uſe to deſcribe to you. Along the *Horizon* in the North, there lay a white and luminous, and ſeemingly denſe Matter in the form of a Cloud, repreſented by *a b c d*; the length of it, *a b* was about 10 or 15 Degrees. From this there aroſe directly upwards, pointed Streams of the like luminous and white Matter, which yet did not appear in any part of it to be ſo denſe as the former; and grew gradually more and more rare in it's upper Parts, ſo as to vaniſh almoſt inſenſibly at the Points. There was ſome little Difference in the Height of theſe Streams; but they generally aſcended up to about 4 Degrees above the *Horizon*. They were very numerous and contiguous to each other, and ſeemed to be compoſed of very ſlender parallel Filaments or Rays. This was the common Appearance, and the only remarkable Thing that I farther obſerved was, that ſometimes a Fire or Flame would break out in the Cloud, *a b c d*, and move along it in in a direction parallel to the *Horizon*: And during this Motion, a pointed Stream directly over the Fire ſeemed to run along with it, and to paſs by the other more fixed Streams, to which it always kept itſelf parallel. *Fig.* 11.

I am perſuaded that the late Appearance was of the ſame kind with this, which I have now been deſcribing. For let A B, repreſent the Plane of the *Horizon*, C the place of the Spectator, E F a fund of Vapours, or Exhalations at a conſiderable Height above us, diffus'd every way into a large and ſpacious Plane, parallel to the *Horizon*. This fund of mixt Matter by Fermentation will emit Streams from it ſelf, ſuch as E G, F H, *&c.* which, if the Wind be perfectly ſtill, will aſcend perpendicularly; if it be boiſterous and irregular, they will be blended and confounded together; but if it be very gentle and uniform, as it was at the Time of our Appearance, they will be inclined towards the Point of the *Horizon*, which is oppoſite to that from which the Wind blows. Now if A D B repreſent the Concave of the Heavens, and a Line C D, be drawn parallel to the Columns E G, F H, *&c.* 'tis certain by the Rules of Perſpective, that theſe Columns will appear upon that Concave to converge all around towards the Point D: Thus the Column, E G, will ſeem to ariſe from the Point *e*, to aſcend up to *g*, and to take up the ſpace *e g*; and in like manner the Arch *f b* will be the Projection of the Column F H. From hence it is evident, that the Reaſon why the Triangular Streams aſcended at firſt only from the Northern Parts of the Heavens was this: The Fund of Matter; E F, was not yet

arrived by it's Motion to the Line C D, after it had paſſed that Line, it is plain they muſt appear to aſcend from all Quarters. A great number of Columns being therefore diſpoſed to emit Light at the ſame time, cauſed that perfect Conopy, which I deſcibed above. The reaſon why that Canopy deſcended lower in the North than in the South, was this: The ſhining Columns, which had not yet paſſed the Line C D, were more numerous and more remote from it than thoſe which had paſſed it; for if the Point E, be farther diſtant from C D than the Point F, the Arch A *e*, muſt needs be leſs than the Arch B *f*. An irregular Guſt of Wind blowing upon and ſhaking the Columns, was (I ſuppoſe) the Cauſe of that trembling, which appeared in the Triangular Streams, and the Cauſe alſo which deſtroyed that fine Appearance of the Canopy. The ſlender circular Waves ſeen at the ſame time might alſo be explained from the ſame Cauſe. I need not detain you any longer by endeavouring to make out ſome other particulars of this unuſual Appearance: I fear I have been already too tedious. However I will not omit to mention a very eaſy Contrivance by which the Thing may be tolerably well repreſented to view. Take a Hoop and round about it faſten ſeveral ſtreight Sticks parallel to each other, but all inclined to the Plane of the Hoop, hold this Plane parallel to the *Horizon*, and in that Poſture move it with Sticks over a Candle, the ſhadows of the Sticks upon the Ceiling of your Room, will converge to a Point not directly over the Candle, (as they would have done, had the Sticks been perpendicular to the Plane of the Hoop) but to the Point in which a Line drawn from the Candle parallel to the Sticks, ſhall interſect the Plane of the Ceiling.

An Aurora Borealis, Sept. 20, 1717. *near* Upſal, *by* E. J. Burrman; *Act. Lit. Suec. An.* 1724. *Trimeſt.* 3. N°. 385. P. 175.

Chaſmata, uti vocantur, cœli, quæ alias horizontale lumen & aurora ſeptentrionalis audiunt, Suethice *Nord-ſkjen*, *Nord-ljus*, *Nordblyſs*, *Nordbläſs*, *Låterſkjen*, *Lyſſnor*, *&c.* illæ, vulgi, judicio, acies, ſeu exercituum præliorumque ideæ, Meteoron in regionibus noſtris, aliſque Polo vicinioribus, illuſtre ſane & frequens (frequentius hodie quam olim nobis ætate provectiores perſuadere volunt) juſta eum diligentia ſæpius obſervavimus. Communicabimus unicum, quod A. 1717. d. 20. Septembris in nocturno itinere accuratius conſiderare licuit, & cujus rarior planeque ſingularis facies conjecturam de natura phænomeni paraſtatica eruditorum examini accuratiori heic ſubjiciendi anſam dedit.

Erant ſolito plures phaſmatum horuncce tractus, arcus nimirum albicantes & reliquo cœlo (ſereno utique ac tranquillo) lucidiores, quatuor ad minimum aut tres, mediocribus tenebrarum intervallis diſtincti, & unus ſupra alterum poſiti. Quod autem rariſſimum adſpectuque jucundum, dictorum arcuum diſtantiæ ſub ipſa Cynoſura maximæ (infra quam ſupremus quidem ultra viginti & ſex gradus non conſiſtebat, quippe per quem ſtella Urſæ majoris Dubbe leviter ſubinde tranſparebat) verſus horizontem utrinque ſenſim decreſcebant, donec

donec illi tandem in ipſis orientis occidentiſque cardinibus mutuo ſeſe interſecarent, haud ſecus quam in artificiali globo Meridiani ad Polos Æquatoris convergere cernuntur. Candidi iſti arcus ſeu ſemicirculi maximam partem ex ſtriis diſtinctis & ad horizontem normalibus conſtabant, præſertim in ſummitate, vel ſub ipſo ſeptentrione; ad latera lux debilior conſpiciebatur ac ſubobſcura.

Striarum geminus erat motus, horizontalis unus, alter perpendicularis: hic minor longe & tardior, ut vix circularem arcuum formam turbaret; ille varius ſimul atque celerrimus, ab oriente in occidentem, & retro. Quoties autem ſtriæ plures (quod ſæpius accidebat) a contrariis venientes plagis ſibi invicem occurrebant, ſive id in medio arcu, ſive alibi fieret; toties, quaſi ex illa radiorum mixtura ſeu multiplici interſectione proveniens colorum pulcherrima apparebat varietas, & quidem ordine prorſus eodem atque in priſmate vitreo, explicatis ſolique obverſis avium minorum pennis, aliiſve corporibus ſimilibus colores produci ſolent.

Hinc vero dari occaſio poterit adhuc de Opticis phænomeni rationibus, cum *Carteſio in de Meteoris Cap. VII. §. 18.* cogitandi; ſed neque tamen ideo ſubtiliori materiæ ſulphureæ in regione aëris inferiori accenſæ omnem denegari poſſe locum exiſtimamus. Ipſi enim alias ſæpius, præſertim in chaſmate A. 1716. d. 17. Martii hoc longe illuſtriori quam in Anglia, Gallia, Germania, alibi, per totam noctem viſo, colores multo plures, necnon ſuſurros & ſibilos, quales excitari a focali flamma ſolent, obſervavimus. Forſan autem duo diverſa ſtatuere luminis borealis genera oportet: unum meteoron igneum ab effluviis & exhalationibus; alterum mere paraſtaticum, ex diverſimoda ſolarium radiorum refractione & reflexione, ſive in glacialibus quibuſdam lamellis, ſtelluliſve atmoſphæræ regionem excelſiorem occupantibus facta, ſive etiam in maribus quibuſdam ad ſeptentrionem, indeque nobis ex nubibus communicata, ortum. Certe poſterius ſingulari experimento illuſtrari poſſe videtur, quod occaſione jam deſcripti phaſmatis (cui tamen ſimile vidimus A. 1716. in Februario hora veſpertina 9. ex duobus ejuſmodi arcubus ſemicircularibus, ſed minus ſtriatis & ſupra borealem horizontis plagam elevatioribus, conſtans) inventum factumque, huc redit.

Si lamina fumatur ſtannea longitudinis latitudiniſque arbitrariæ, eademque acuto & fortiori cultro, uno ductu ſecundum longitudinem univerſam, donec tota ſtriata facta fuerit, raſa, manu ita teneatur, ut ejus planum cum lucente candela & obſcuro pariete tabulave æquales faciat angulos; deinde autem variis modis incurvetur & torqueatur, ipſam nunc concavam nunc convexam parieti vel tabulæ obvertendo, tardius ad lubitum aut celerius: phaſmata ſupra recenſitis admodum ſimilia ſpectaculo non injucundo repræſentabuntur.

Quid ſi utriuſque generis lumen forte aliquando una exiſtere, atque unum cum altero coincidere dicamus, ut neutrum alterius cauſa ſit aut effectus, ſed ambo ad noctem illuminandam terroremque ſpectatoribus

ſpectatoribus incutien dumconcurrant? Quemadmodum enim ſæpiſſime quidem lumen horizontale, Zonas videlicet candentes, nunc nudas (imo per ipſum fere Zenith tranſeuntes, quas cum Galaxia utut non parum latrori, ob ſimilitudinem vulgus confundere ſolet) nunc columnis, pyramidibus inverſis aliiſque figuris variis ſtipatas, ſed citra omne aëris, ut ita dicam, incendium; ita nec raro hoc ſine illis vel antecedentibus vel concomitantibus, apparentiis diſtincte notatis, vidimus: quamvis etiam e regione quadam cœli, nude primum candente, tandem ferventiſſimas faces, ſive per ſolis radios in glacialibus Oceani partibus, ceu in ſpeculis quibuſdam cauſticis, reflexos, ſive alio quocunque modo accenſas, ad Zenith & ſuper totum nonnunquam hemiſphærium evolaſſe fatendum ſit.

Sed quia genuinas veraſque phænomeni hujus admirandi cauſſas vix cuiquam certo invenire prius licet, quam plurimarum in diverſis terræ locis unâ habitarum obſervationum rite inſtitui queat comparatio; unde ante omnia conſtet, num lumen iſtud in remotioribus etiam locis ſub eodem altitudinis angulo conſpiciatur; num quod heic horizonti parallelum, alibi verticale ſit, & id genus alia; verbo, utrum unus idemque ſit arcus qui in diverſis locis conſpicitur, an quemadmodum in Iride, ita quoque heic, quot in terra ſpectatores, tot arcus in cœlo: Enixe proinde omnes in univerſum atque ſingulos rogamus, quibus rerum naturalium in aliquo pretio eſt ſcientia, velint ubicunque terrarum, maxime vero in regionibus borealioribus, boreali huic lumini quoad omnes circumſtantias obſervando quam diligentiſſime invigilare, ſuaque obſervata quantocyus cum publico vel ſaltem nobiſcum communicare, gratiam ab erudito orbe ſane maximam merituri. Nos alia occaſione quaſdam regulas ſeu harum obſervationum normam & exemplar dabimus, parati interim & ipſi aliorum monita grato excipere animo, & quænam judicaverit quiſque potiora hujus negotii momenta, fieri certiores.

—*at* Dublin, Feb. 6, $17\frac{20}{21}$. *By* J. W. No. 368. pag. 180.

XXVII. 1. The Air was all that Day, as it had been for ſome time before, vey clear and ſharp; abouthalf an Hour paſt four in the Evening, ſomer flying Clouds appeared, and the Sky was tinged with a very unuſual yellowiſh Colour, which perhaps might be reflected from a great Quantity of Snow, that ſoon after fell for near a quarter of an Hour. However that might be, I'm willing to date the beginning of the enſuing *Phænomena* from the firſt appearance of this uncommon Light. About a quarter paſt ſix, a thin Vapour, which was as yet very ill defined, and in all appearance reſembled an exceeding black Cloud, had fixed itſelf in the Northern *Hemiſphere*; it's Edges were tinged with a rediſh Yellow, that by degrees, as it approached the *Vertex*, grew more dilute, till at laſt it ended in a faint Whiteneſs. That in reality it was no Cloud, but only a Vapour exceeding pure and limpid, was manifeſt, becauſe ſeveral of the fixed Stars ſhone thro' it, without having their Light in any degree effaced. In the midſt of this dark *Baſis*, about half an Hour paſt ſix, a lucid *Area* ſhewed

ſhewed itſelf due N. E. about 35 deg. above the Horizon, and in leſs than a Minute from the time I firſt diſcovered it, emitted a very large *Pyramidal* Stream of ſhining Vapour, which with an incredible Swiftneſs aſcended obliquely towards S. S. W. ſo as to leave the *Zenith* conſiderably to the Weſtward, and very ſoon after, about the ſame Place, ſix others aroſe at the ſame inſtant almoſt to the *Zenith*. From this time till 48 Minutes paſt ſix, we had repeated Projections of theſe lucid Rays, without any order as to Time, Place, or Magnitude. They did not only ariſe from behind the dark *Baſis*, but ſometimes as it were out of the pure Sky; and tho' ſome of them continued viſible more than a Minute, yet the greater part of them only juſt ſhewed themſelves and died away. I had now got to the Top of a convenient Obſervatory, where (though deſtitute of Inſtruments) I had a free Proſpect of the *Horizon*; and in company of another Gentleman, fixed myſelf with great Attention, to expect the enſuing *Phaſes* of this *Phænomenon*.

About 6 h. 55 m. between N. W. by N. and W. N. W. we found the Repreſentation of a very bright *Crepuſculum*, ſuch as that which appears about 20 Minutes after Sun-ſet; from which aroſe ſeveral very large Beams of Light, not exactly erect towards the *Vertex*, but ſomewhat declining to the South; among theſe, one which aroſe about N. W. and in three or four ſecond Minutes paſſed over 50 or 60 degrees of a great Circle, was above all others that had preceded, the moſt ſplendid: It's ſides were inclined to each other with an Angle of about 8 or 10 Degrees, and were tinged with a briſk lively Red, which by degrees, as it approached the *Axis*, became more intenſe and dirty: On the other hand, receding from the *Axis*, it's Colour was a pale Yellow, that ſoon loſt itſelf in a faint Whiteneſs.

From this time no Moment paſſed without ſuch Variety of different *Phaſes*, that it was impoſſible for the Eye of any ſingle Perſon to purſue it thro' the ſuddenneſs of it's Alteration. While ſome of the lucid Beams ſeemed to ſtand fixed, as it were, among the Stars, others moved ſlowly from *Eaſt* to *Weſt*, by which they ſeemed to meet each other, ſometimes to recede from each other, and ſometimes by a kind of appoſition, great ones were produced from others of an inferior order.

The lucid *Area*, which I firſt diſcovered in the N. E. had now formed itſelf into a *Parallellogram*, whoſe upper and lower Edges were 5 or 6 Degrees diſtant from each other, and nearly parallel to the *Horizon*: In this, as if behind a Curtain, vaſt Waves of Light, whoſe Extremities did not reach the *Periphery* of the dark *Baſis*, ſeemed to meet and pervade each other; at other times, while ſome of them, with a remarkable Velocity, moved Eaſtward; others, as if behind them, would fly towards the *Weſt*; by which variety of different Motions, as often as any Interval paſſed between the Colliſion of theſe

erect:

erect Waves, a beautiful Undulation was produced, and it's Pulſes, by the adjoyning Parts of the Fluid, were propagated to a vaſt diſtance.

While we ſtood amazed at this ſurprizing Sight, the *Axis* of the coloured *Pyramid*, which aroſe in the N. W. had moved conſiderably toward the *Weſt*, and at 7 h. 25 m. was about 23 or 25 Degrees to the *North* of *Venus*. The dark *Baſis* of this Meteor had now extended almoſt to the *Eaſt* Point of the *Horizon*, and at half an Hour paſt ſeven, between E. N. E. and E. by N. ſeveral large Columns aſcended in an inſtant to the *Zenith*; the moſt Eaſtward whereof was remarkably convex toward the *South*, and tinged with a pale Red, as were moſt of thoſe which aſcended with it. They were met by others, that aroſe at the ſame time between the *North* and *Weſt*, and in the *Zenith* formed a vaſt Collection of Vapour, that pretty much reſembled Smoke inlightned by the Sun's Beams; it's Waves reflected a briſk, lively red Colour, and in ſome places a pale Yellow; they rolled indifferently any way; and in little more than a Minute, when the firſt Efforts of their Congreſs were ſpent, and all ſeemed fixed and ſerene, the *Corona* projected ſeveral ſmall Rays, which with a ſlow uniform Velocity deſcended between W. by N. and N. W. ſoon after which it died away.

We had not much time to lament the Abſence of our *Spectrum*, for at 7 h. 40 m. ſeveral other *Striæ* were diſcharged from behind the dark *Baſis*, which interſecting with others, that at the ſame time aroſe about the *Eaſt* and *Weſt* Points, formed in the *Zenith*, or rather 6 or 8 Degrees to the *South* thereof, a ſecond much more elegant and ſurprizing than the former, and indeed than any thing that had yet appeared: it was not only tinged with different Orders of red and yellow, but alſo with blue and violet, the laſt of which, by a Mixture with the white Light, appeared faint and inclined to Purple. Tho' the Vapour, of which this and the preceding *Corona* were formed, was ſo exceeding thin and pure, that ſeveral of the fixed Stars were viſible thro' it, yet it reflected a Light ſo copious, that I could thereby perfectly diſtinguiſh the time of night by a ſmall Watch. While thus delighted, our *Phænomenon* ejected four or five large Columns toward the N. W. (beſides others toward the *South*) which appeared pointed at the Top, and their Sides inclined to each other with an Angle of 5 or 6 Degrees. When their Baſes were extended about 30 or 35 Degrees from the *Vertex*, the lower Parts of two or three of them broke, as it were, by the meer Weight of the Vapour, ſeparated from the upper, and deſcended with a ſlow Motion, in the Form of truncate Cones: they were gradually followed by their upper Parts, and in about a Minute were loſt in a large Body of Light that was ſettled between the N. W. by N. and W. N. W. The *Corona*, as if exhauſted by theſe great Diſcharges, became immediately more dilute and languid, it's lively Colours faded, and were ſucceeded by a

whitiſh vibrating Light, that in leſs than two Minutes intirely diſappeared.

The dark Vapour, which continued to poſſeſs the Polar Regions, had now extended itſelf from the *Eaſt* to the N. W. by N. point of the *Horizon*, and was formed in a large Segment of a Circle, whoſe Center was about 20 Degrees below the *Horizon*: it's upper Edge was tinged with a pale Red, which was ſoon loſt in a florid Yellow, and this again, as it approached the *Zenith*, became more effœte and languid. In this dark Segment ſeveral lucid *Areas* frequently diſcovered themſelves, with a vibrating Light, which inſtantly diſappeared, as if a Curtain were drawn over them; and from it's Rays of very different Magnitudes continued to aſcend without any Uniformity as to time and place, till 48 or 49 minutes paſt ſeven, when a third *Corona*, very little, if at all, inferior to the preceding ones, either in the Variety of it's Colours, or in the quantity of Light it emitted, was formed in the *Zenith*. As the preceding were both produced by the Northern *Striæ*, ſo this was augmented by two or three large ones, that aroſe due *South*, out of the pure Sky, and were, in all probability, part of the Vapour, which had been projected beyond the *Zenith*, or which had ſubſided from the two former: they cauſed the Vapour, of which this Image was compoſed, to move with great Violence, in different Directions, not unlike Waves of Smoke, confin'd in a reverberating Furnace; this Motion being abated, the Vapour acquired a kind of Stagnation, in which State it continued but a very ſhort time, before it projected ſeveral lucid Beams, an inevitable Fore-runner of it's approaching Diſſolution, between the *North* and *Weſt*, and ſoon after, pardon the levity of the Expreſſion, *Noctis ſe immiſcuit atræ*.

About this time, the great Beam, which aroſe in the N. W. and had preſerved it's Colours in their original Beauty, for more than three quarters of an hour, began to fade, and at 7h. 53m. was abſorbed in a vaſt body of Light, which ſeemed fixed in that part of the *Horizon*: it had moved in that time 15 or 20 degrees to the *Weſtward* of the Place from whence it aroſe. The *Impetus* of the Vapour being now pretty much abated, we had nothing extraordinary but ſucceſſive Diſcharges of pointed Rays between the N. Weſt, and E. N. Eaſt; without any order or Uniformity as to time or place; ſetting aſide theſe, there was very little difference in the general face of affairs for 20 minutes; neither had we much reaſon to hope for any, becauſe the ſeverity of the Cold was ſuch, that it obliged us to remove to a better Climate, and by that means we unfortunately loſt the enſuing *Phaſes* of our dying *Meteor*.

2. *Monday* the 6th of *Feb.* $17\frac{20}{21}$, a little before 7 in the Evening, there aroſe out of the *North*, or a little towards the *Eaſt*, a bright *Crepuſculum*, which ſoon ſpread itſelf a great way through the Northern part of the Hemiſphere. About 7 (when I firſt ſaw it) it began to leave behind

—*at* Cruwys-Morehard, *in* Devonſhire. *By* Samuel Cruwys, *Eſq;* F. R. S. No. 368. pag. 186.

behind it, at due *North*, or a few Degrees to the *Eaſt*, part of a very clear Sky (which looked like a black Cloud, but the Star ſhone in it clearly) being a Segment of a Circle, into which Figure, the *Crepuſculum* (or expanded Body of lucid Vapour) had now formed it's upper Limb alſo, making a kind of broad *Iris*, terminated at each end by the Horizon.

All this while the ſtreaming Lights appeared in great Variety as to Figure, Place, Magnitude, and Colour, but for the moſt part of a redder Colour (eſpecially towards the *Weſt*) than the *Crepuſculum* itſelf, out of which they ſeemed to be formed, and tho' for the moſt part the greateſt Appearances had been within 20 Degrees of the *North* on each ſide, yet at due N. W. there were very many conſiderable ones.

About 8, this *Crepuſculum*, (which had been conſtantly, though ſlowly, carried further from the *North*) had, with the upper part of it's outer Limb, reached to about 10 or 12 Degrees beyond the Pole-Star towards the Zenith, being now above 30 deg. broad, with a circular Segment of black clear Sky to the *North*, of about 25 deg. when the whole *Crepuſculum*, or Vapour, was all ſuddenly formed into aggregate Bodies like Vapours, and gave one of the moſt pleaſing Appearances, that perhaps has been ſeen of this kind. The *Baſes* of the Cones ſeemed to reſt on the upper Limb of the Segment of clear Sky (which was extended near 60 deg. on each ſide the N.) and the Vertices of the Cones, pointing all towards the Zenith, approached within a few Degrees of it, and terminating there, formed the greateſt part of a Semicircle incloſed, as it were, with Golden Palliſadoes, which ſhining all at once as bright almoſt as Flame, and being of a prodigious Length and Number, exhibited a moſt agreeable Spectacle.

This laſt *Phænomenon* convinced us, that theſe Cones were Collections of the very ſame Particles, whereof the *Crepuſculum* had conſiſted: becauſe when it appeared every where alike and equal, the great Stars ſhined through it but very faintly; whereas afterwards, thoſe Stars, that remained between the Cones, ſuddenly appeared very bright, whilſt thoſe, that were covered by them, could hardly be perceived: and indeed all the ſtreaming Lights this Evening ſeemed to flow from this *Crepuſculum* downwards, as from a Fountain or Store, and not to ariſe from the Horizon, few approaching it nearer than 10 Degrees, and many not within 20 or 30 deg.

After this fine Appearance had continued about 2 Minutes, the Matter ſeemed to be exhauſted, and the Scene almoſt at an end, the ſtreaming ſhining Lights being moſtly extinguiſhed, and the remaining Parts of Vapour left, like broken Clouds; when the flaſhing Lights began to appear of a moſt prodigious Swiftneſs, both from N. E. and N. W. pointing to the Zenith, or a little more to the *South*. 'Twas obſervable, that over the Tracts, where theſe flaſhing Lights paſſed, the remaining parts of Vapour (which now lay ſcatter-

ed

ed every where, like white broken Clouds) pointed, or ſeemed to have a Tendency, conformable to the ſame Motion; whereas, towards the due *North*, where no Flaſhes appeared, theſe whitiſh Clouds lay confuſed and irregular as before.

This continued about 20 or 25 Minutes, when the Wind began to ariſe a little at N. E. and the Scene was quite at an end, dark Clouds ſucceeding all over the *North*, and by nine a Clock we had a ſevere Storm of Snow.

N. B. *That all the time of theſe Appearances, many broken parts of the extinguiſhed Vapours, like white Clouds, were carried beyond the Zenith, ſome* 50 *or* 60 *deg. and others, even to the Horizon itſelf, at S. S. W.*

During the whole Continuance, there ſeemed to be a ſmall, eaſy breath of Wind, ſcarce perceivable, at N. N. E. which the Motion of the Clouds abovementioned alſo confirms, but as ſoon as it began to blow a little briſker, the remaining parts of the Vapour were all diſſipated.

An Account of the Weather both before and after this Phænomenon.

January 30. Hard Snow in the Morning, and Froſt all Night.

31. and *Feb.* 1, 2, 3, 4. Pleaſant Sun-ſhine Days, very calm, but the Snow ſtill lying, and at Nights very hard Froſts.

February 5. Very violent Snow in the Morning, and ſome Thaw in the Afternoon, hard Froſt at Night.

6. Hard Froſt in the Morning, and the Wind exceeding cold and ſharp, but not hard; the afternoon pleaſant, Sun-ſhine and calm, but it froze all Day out of the Sun, and continued to do ſo all the Evening, and the Ground was ſtill covered with Snow.

7. Very hard Froſt in the Morning, and Froſt and Storms of Snow all Day. Wind N. N. W.

8, 9, 10, 11. Pleaſant calm Days, but hard Froſt, and very hard Froſt at Night.

12. Hard Froſt. Exceeding cold Wind at S. E.
The 12th at Night theſe Lights are ſaid to have appeared again, as alſo on *Saturday* the 18th, to a very great degree, but I ſaw them not; the Weather ſtill froſty with little Snow.

22. At Night, hard Snow.

23, 27. A Thaw and ſome Rain, and but little Froſt afterwards, only dry-cold Winds, till the 27th, when the Froſt returned very ſharp, with exceeding cold Winds, at N. E. and S. E. for a Fortnight or more, without any Snow, and did a great deal of hurt.

Obſervations on the Aurora Borealis *for four Years, at* Lyn, *in a Letter to* Martin Folkes Eſq; Soc. Reg. V. Præſ. No. 376. pag. 300.

XXVIII. Mirum illud Phænomenon ſexto Martii 17$\frac{1}{3}$. non licuit mihi inſcienti videre, quod infortunium haud exiguum in me peperit ſtudium ſubſequentibus Phænomenis invigilandi. Priorem obſervationem, quam hic ſubjeci, ſummâ curâ delineavi, ſtatim atque vidi, ideoque, ni fallor, a vero parum diſcrepat. Reliquas etiam deſcriptiones pro certo habeas accuratas eſſe. Quænam ſit cauſa harum coruſcationum, nondum, ut opinor, ſatis exploratum eſt.

Die Veneris *Sept.* 5. 1718. circa hor. x. Phænomenon hoc, in tabula delinenatum obſervatum fuit Lennæ Regis, in puncto boreali.

Fig. 12. Die Saturni *Sept.* 6. circa horas VIII & x. perplures Luminis columnæ, ſimiles ſupradeſcriptis (*aa*) obſervabantur, non æque lucidæ ac pyramides nocte præcedente obſervatæ, quæ ferebantur verſus orientem, hæ vero ad occidentem.

Die Jovis *Sept.* 11. perplures iſtiuſmodi columnæ iterum conſpiciuntur cum motu occidentali.

Die Saturni *Sept.* 13. circa horam XI. Aurora Borealis lucidior ac altior fuit, longioribuſque pyramidibus adornata, quam adhuc obſervata fuerat. Adeo lucebat hâc nocte, ut characteres in libro legerentur.

Die Saturni vero *Octob.* 11. circa horas x. & XI. Aurora Borealis lucidior quam unquam fuit, ac coruſcationibus pyramidalibus interſperſis, haud multum abſimilis Phænomeno prius obſervato, *Sept.* 5. Lumine iterum ita ſplendente, ut legere liceret.

Die Veneris *Dec.* 19. circa horas VIII & IX. Hâc nocte viſi ſunt cum Aurorâ Boreali perplures lucis radii, e nube veluti nigrâ exorientes; revera autem non fuiſſe nubem exinde patet, quia ſtellæ per illam clare videbantur. Quid vero aliud fuerit, haud facile eſt dictu. Sed quod præcipue notavimus, fuit motus horum luminum ſane mirabilis. Hos radios obſervavimus in ſtatu ſemper mobili, poſitiones ſuas, ſeu loca, perpetuo mutantes; curſum ſuum modo hâc, modo illâc, rurſum, prorſum dirigebant, & interdum alii ex aliis eâdem viâ ſingulatim progreſſi ſunt, & aliquandiu ſibi invicem colliſione mutuâ impingebant cum tremulo ac vibrante motu, & celeritate fere incredibili. Radii quidam obſervati ſunt uſque ad Zenith ſe porrigentes. Viſa eſt ſæpe lux ſe in acervum collegiſſe, atque ita mirum exhibuiſſe fulgorem coloribus Iridis tinctum, & iterum viſa eſt ſe dilatâſſe. Luna hâc nocte lucide ſplendebat.

Die Jovis *Martii* 12. 17$\frac{1}{3}$. circa horas x & XI. Aurora Borealis rurſus obſervabatur.

Fig. 13. Die Veneris *Martii* 27. iterum viſa eſt Aurora Borealis cum radiationibus variis obliquis, ſecundùm hanc Figuram.

Die Lunæ *Octob.* 26. 1719. hâc nocte etiam viſa eſt circa horas VII & VIII.

Item die Lunæ *Nov.* 9. 1719.

Die Domin. *Jan.* ult. 17$\frac{1}{2}$. Hâc nocte, ab horâ ſeptimâ uſque ad decimam, Aurora Borealis viſa eſt altior, quam unquam antehac obſervata

ſervata fuit, per dimidium cœli ab oriente uſque ad occidentem, fere obducta coruſcationibus variis interſperſis, adeoque lucebat, ut characteres in libro perquam diſtincte videri poſſent.

Die Saturni *Sept.* 17. 1720.

Die Lunæ *Jan.* 6. $17\frac{2}{3}$. circa horas VII & VIII. viſa eſt iterum Aurora Borealis cum coruſcationibus pyramidalibus, undique a Zenith, veluti centro, obductis, imaginem exhibentibus pæne inſtar Umbellæ.

Die Domin. *Jan.* 12. $17\frac{2}{3}$.

Die Lunæ *Sept.* 11. 1721. circa hor. IX.

Die Mercurii *Sept.* 5. 1722. ab horâ decimâ ad ſeſquidecimam.

Die Mercurii *Octob.* 3. circa hor. IX.

Die Jovis *Octob.* 4. circa hor. X.

Die Domin. *Dec.* 23. 1722. circa hor. VIII.

XXIX. I obſerved, that the Theatre of Light forming an irregular variable Curve, was, as at moſt times formerly, from E. N. E. to W. N. W. the Horizon and whole Hemiſphere ſerene, little or no Wind, what there was, ſeemed Northerly. The ſeeming Dawn, or Stage of Light generally continued in an irregular Curve; the one Point in the two firſt Nights whilſt I obſerved it, began near the Horizon, near N. N. E. the other Point was at W. N. W. the Height of the Arch not exceeding 20 Degrees, in which there ſeemed to be a continual Dawn: Under that Field of Light ſeemed to be a dark Cloud, which, however, was a clear Sky, not filled with that luminous Vapour; becauſe all the Stars appeared diſtinctly and twinkling thro' it. Whenever that Light roſe about 10 Degrees higher, to about 30 Degrees, then Flaſhes, or Coruſcations followed alternately, and ſeemed to be Pillars or Beams of Light, which followed or ſucceeded one another, and by that means ſeemed to move and change with one another, by the Succeſſion of Light and Darkneſs, according to the Flaſhes. When the lighted Vapour roſe higher to about 40 or 45 Degrees, then the Appearance altered; and inſtead of Beams, or Pillars of Light, as when lower, there were Flaſhes like thoſe attending Exploſions, wherein faint Colours of Red, Green and Yellow appeared, but not very vivid; and upon each Exploſion it would ſpread upwards towards the Zenith, in the Appearance of thin enlightned Clouds, and immediately diſappear. On the 26th, about 9 at Night, one of theſe irregular Arches of Light had got up to the Zenith, the lower Points being near E. N. E. and W. S. W. I then ſaw it for a conſiderable time, at leaſt a quarter of an hour, and it had been there for ſome time before I ſaw it. I could diſtinctly obſerve all the different Appearances, according to it's Altitude in the Hemiſphere, *viz.* the lower part (being within 12 or 14 Degrees, as near as I could compute) was a conſtant fixed Light, equal to the Light of the Edge of a white Cloud in the Day-time, when the Sun ſhines on it. As it roſe higher, I could obſerve it ſomewhat weaker, and could perceive the Motion of the Pillars or Beams of Light after each Flaſh, which

—Sept. 24, 25, 26. *in* Ireland; 1725. *by* Arthur Dobbs, *Eſq;* N°. 395. pag. 128.

which ſeemed by that means to move. Somewhat higher again, at about 40 Degrees, the Flaſhes were like Exploſions of great Guns, with the faint Colours obſerved as before; but the Coruſcations or Flaſhes from thence to the Zenith, expanded at every Flaſh, like a broad, thin, white Cloud, of which ſome faint View could be ſeen after each Exploſion for ſome time: And after all the Exploſions were over, there remained a thin duſkiſh Vapour in and near the Zenith, and all along the Arch from *Eaſt* to *Weſt*, from 14 to 20 Degrees broad, which undulated and moved like a ſtormy Sea, the Motion coming from the S. S. E. and ſo leſſened till it appeared no brighter than the Milky Way, but more like a very thin Cloud or Miſt, thro' which I could perceive the Stars. At the ſame time I ſaw another thin Cloud, having the ſame Appearance, Arch-ways, to the Southward, at about the Height of 40 Degrees, which I ſuppoſe had been another, which had been over, and had moved thither from the Northward before I went out: And during the whole time there were leſſer Lights towards the *North*, but diſperſed here and there, and not forming any large Body of Light. During the whole time, the Hemiſphere was clear, except a few very ſmall Clouds near the Horizon; and when any moved into the enlightened Arch, they broke the Connexion, ſo that the Light was above them: At the ſame time it froze hard each Night.

Solution of this Phænomenon.

From theſe Obſervations, I ſuppoſe that the *Aurora Borealis* is a thin Nitro-ſulphureous Vapour raiſed in our Atmoſphere conſiderably higher than the Clouds, which is diſcontinued in ſeveral Places by the interſperſed Air, and which by Preſſure and Motion is kindled; and perhaps the Exploſion of one may by it's Shock and Motion contribute to kindle the next; by which means they go off one after another, till the whole Vapour within their influence is diſcharged, and then the Light diſappears, and the thin Smoak appears, and undulates, according to the Motion in that part of the Atmoſphere. And hence I think, moſt of the Appearances may be ſolved: For 1ſt, As to the continued Light near the Horizon, they being at a great diſtance from us, and nearly in a Line, all theſe Exploſions may ſeem as a continued Light: When theſe approach nearer to us, and by conſequence appear higher in our Hemiſphere, we obſerve the Motion in each Flaſh, and ſtill ſeeing them laterally, yet ſomewhat breaking the Continuity of the Light; they (by the Reflexion of the Vapour floating in the Atmoſphere, and being not reflected, where the Air betwixt them is free of thoſe Vapours) may appear as Pillars: And as the Flaſh below and beyond them moves (as it kindles and expands) ſo they ſeem to move, and perhaps are ſhocked at the ſame time by the Motion; but afterwards, when they are nearer, and raiſed to the Altitude of 40 Degrees, we get ſomewhat under them, and ſee the Expanſion of the Exploſion, which appearing ſomewhat globular, gives the faint Colours obſerved above, the Light not being intenſe

enough to make them vivid; and afterwards when they riſe to, or near, the Zenith, they are nigheſt to us, and then expand very wide at each Flaſh, like little Clouds: And, I think, the great Objection of their appearing in the Northern Part of the Hemiſphere, and ſeldom or never in the Southern is in ſome meaſure anſwered by the Appearance on the 26th; ſince at leaſt half of the Arch was in the Southern Part of the Hemiſphere; and perhaps the Reaſon why the Light is not ſeen near the Horizon, in the Southern Part of the Hemiſphere, may be this, that in clear ſerene Weather, the Wind being generally near the *North*, Objects from thence are much more diſtinctly viewed, and at a greater diſtance than from the South; and 'tis generally known, that Lands at a great diſtance are moſt diſtinctly ſeen, when the Winds blow from them.

And perhaps a cold Northerly freezing Air may be needful to kindle the Vapours, when a contrary Motion above (higher in the Atmoſphere) may carry the ſulphureous Vapour, which falling down from the Nitrous Vapour may be kindled. Which, I ſuppoſe, form the Undulations of the Smoak after the Exploſion, which ſeemed, as above, like a ſtormy Sea moving from the S. S. E. *Note*, The Barometer was low for ſome Days before and after it.

XXX. 1. The Lights began about Sun-ſet; but I heard nothing of them till between 7 and 8. When I went out, I obſerved a Stream of Light almoſt due *Weſt*, which was about ſeven or eight Degrees broad, and extended itſelf upwards about 35 or 40 Degrees. I had not a free Proſpect of the Weſtern Horizon, and ſo cannot tell what it's Appearance was below. It was not perpendicular to the Horizon, but inclined a few Degrees towards the *South*. This Stream was of a duſky red towards the *North*, but pale on the other ſide, and ſeemed to have a faint Mixture of the Priſmatic Colours in it.

—*at* Petworth *in* Suſſex. Oct. 8. 1726. *by the Rev. Dr* Langwith, N°. 395. P. 132.

At the ſame time there appear'd a pale luminous Arch, whoſe Middle was nearly N. W. by N. The Altitude of it's inner Edge was about 18 or 20 Degrees. This Edge was very diſtinct and regular all above, but a little confuſed towards the Horizon, where it extended itſelf beyond the North-Point: How it terminated to the Weſt, I cannot inform you. From the upper Side of this Arch, which was waving, and ill defined, there ſhot up continually ſuch Streams of Light as have often been ſeen and deſcrib'd, ſince the Great Meteor of *March* the 6th, 171$\frac{1}{6}$. The Sky under this Arch look'd exceeding dark, but was in reality clear; for we could ſee the ſmalleſt Stars in it.

Nearly N. E. there was another Stream of pale-coloured Light, which was about 7 or 8 Degrees diſtant from the Horizon, and was about as many in Breadth: It's Heighth was various, and ill defined. Towards the bottom of it, was an irregular black Cloud, which in ſome parts was near a Degree in breadth, in others hardly

half

half ſo much: This Cloud was almoſt parallel to the Horizon. The Stream moved with a ſlow regular Motion towards the Eaſt.

In the S. E. was another Arch, like that in the N. W. by N. but not quite ſo high, or of ſo great an Extent. Between this Arch and the North-Eaſterly Stream the Sky was of an odd pale coloured Light, with a mixture of Red in it.

From the South towards the Weſt were gloomy irregular Clouds, which now and then ſent out Flaſhes of Light.

About 8, the North-Eaſterly Stream ſuddenly expanded itſelf every way: All its Parts began to be in a violent Commotion, and its Brightneſs increaſed to ſuch a degree, that I remember nothing like it in the former great Meteor of this Kind. All above it was of a bright flame-colour; but below, it was edged with the Priſmatic Colours, which were full as ſtrong as I have ever ſeen them in the brighteſt Rainbow: They were not indeed ſo diſtinct; for, tho' I obſerved them as exactly as the ſtrange variety of their Motion would permit, I could only diſtinguſh the Red, the Yellow, and a duſky bluiſh-Green.

This ſurprizing Sight did not laſt above a Minute or two; but when the Colours vaniſhed here, they began to appear in the North-weſterly Arch, which was now become a Portion of a larger Circle than before, and was not elevated ſo high above the Horizon. The Colours extended themſelves from the North towards the Weſt for about 15 or 20 Degrees; and tho' they were not ſo bright as in the other Place, yet they were more ſteady, and ſo as eaſily obſerved. Their Order was the ſame as before, the Red lowermoſt, and ſo on: Their Duration much longer.

In the mean time the Streaming Lights began to appear in all Parts of the Heavens, and to form a *Corona* and Canopy, which were in all reſpects like thoſe of the Great Meteor of 1716. Inſtead therefore of troubling you with a long detail of the Particulars of theſe, I ſhall refer you to the curious Deſcriptions of the other by the Aſtronomer-Royal, and my late worthy Friend Mr *Cotes*. I ſhall only take notice that the Colours of the *Corona* were neither ſo ſtrong nor ſo laſting as thoſe before deſcribed, and that the Top of the Canopy was ſometimes over-ſpread with a deep ſullen red.

The Streams continued their Direction upward towards a point of Concourſe for a long time after, and formed by fits imperfect Circles of pale Light about it: This Point, however was not fixed; for at firſt it ſeemed to be in, or very near our Zenith; but when I obſerved it ſome time after, it lay between the Stars in *Andromeda*'s Right-hand, and thoſe at the end of her Chain. The ſame Obſervation was made by a curious Gentleman of this place, who alſo informed me that there was another luminous Arch which paſt quite

thro'

thro' the Pole-Star: It's Continuance was ſhort, and I had not the good Fortune to ſee it myſelf.

Theſe Appearances held on in ſome Degree till about 11, when the Air began to grow miſty, and ſo put an End to any farther Obſervations.

I cannot ſend you the exact Point of the Wind: It was ſo calm below, that I could not be certain which way it ſtood; but ſome that were making their Obſervations from a high open Place, aſſured me, that it was North-Weſterly, as it was in the Afternoon before, and the Morning after.

The Mercury was up at 30: The Weather mild and temperate.

I ſhall venture to add, the following Obſervations, *Obſervations on this Phænomenon.*

1. That it plainly appears from the Poſition of the Arches, that they could not owe their Figures to the Sun: They ſeem to have been partly Optical, and partly to have depended upon the different Heights of the luminous Vapours; but for want of ſufficient *Data*, it will be no eaſy matter to determine how far each of theſe Cauſes concurred.

2. The Priſmatic Colours, wherever they appeared, ſeem to have been cauſed by the Sun.

3. None of the Streams, as far as I could obſerve proceeded directly from the Horizon. They were neareſt it towards the North, where there were ſome weak irregular Lights in the confuſed Parts of the Arch before deſcribed.

4. I find by ſome of my Papers, that during the Meteor of $17\frac{15}{16}$. the Mercury ſtood at 30.2; ſo that the two Meteors agree, as in many other Particulars, ſo in the following, *viz.* That the Air was calm, the Wind North-Weſterly and the Mercury high.

I ſhall only add farther, that luminous Vapours in the Air are much more common than they are generally taken to be; for the Nights are very often lighter when the Sky is over-caſt, than in the brighteſt Star-light, though the *Crepuſculum* be quite gone off and there be no Moon.

2. About half an hour paſt Six, perceiving *Jupiter* ſhone very bright I was applying my Teleſcope to obſerve him, when on a ſudden ſeveral luminous Streaks appeared about 10 Degrees above the Horizon in the N. E. and the Hemiſphere ſeemed much enlightned. Imagining this to be the beginning of a *Lumen Boreale*, I caſt my Eye carefully along the Northern Horizon from E. to W. and very nearly in the W. Point I perceived, as it were, a vaſt red fiery coloured Obelisk ſhot itſelf up to the Height of 30 or 40 Degrees, which ſeemed perpendicular to the Horizon, and it's Baſe ſeemed to inſiſt on it. It's Point almoſt touched the bright Star in the Northern Crown; a ſmaller Column or two ſtood near it, of the ſame

—*at* Plymouth, *by Dr* Huxham, No. 395. pag. 137.

ſame Colour and Shape. The Light, in the mean time, to the Eaſtward increaſed conſiderably, and became more vivid; as when the Moon is behind a very bright Cloud. It alſo formed itſelf into Columns, which were projected to no great Height, and would ſoon vaniſh, then ſoon return, and appeared not only in the N. E. but alſo more Northerly.

In about a quarter of an hour from my firſt Obſervation, as from an Arch, or black Baſis (I know not better how to expreſs it) extended all over the Northern Horizon, which ſeemed to interſect it nearly in the W. and E. N. E. Points, aroſe abundance of pyramidal Columns of Light on all parts of it; now here, now there, of unequal Bigneſs, Height, and Luſtre; now ſuddenly gleaming forth, then as ſuddenly diſappearing; but thoſe Columns, that were to the Eaſtward of the N. were more bright and lucid than thoſe to the Weſtward, which were of a more fiery, rutilant Colour. The great Column in the *Weſt* ſtill remained in the ſame Poſition, Height, and Shape; as I obſerved, by applying my Eye to a Wall very near E. and W.

Between the Arch and the Horizon, appeared as it had been a black, duſky Fog, from whence the Streams of Light ſeemed every where darted forth: Yet however black this appeared, we could diſcern the Stars very clearly thro' it. This Arch at it's firſt Appearance ſeemed not to be above 15 or 20 Degrees (at it's higheſt part) above the Horizon; but it continually grew higher, and from all parts of it Cones of Light were every Moment ſhot up, which all ſeemed to tend to a Point near the Zenith (as the Vertical Circles or Arches on a Globe tend to it's Poles) tho' as yet none reached it by ſeveral Degrees.

After 7 a clock the Columns to the Weſtward appeared bright and vivid as thoſe in the E. except thoſe very near the W. Tho' the Limb of the Arch would ſeem ſometimes very regular and well defined; yet at other times it would ſeem to ſink, now in the middle, then at one part, then at another; and ſometimes it would riſe with the ſame Irregularity: But it was certain, that during the whole time of the *Phænomenon*, no Light, or flaſhes of Light did appear in the black *Area* included between the Arch and the Horizon; even when it was at it's greateſt Height, which was about 10 or 12 Minutes before 8, when I judged it to be at leaſt 40 Degrees above the Horizon. Then from all parts of the Arch, but firſt from the Northern or higheſt parts of it, were Rays, or lucid Columns of a ſurprizing Brightneſs and Luſtre, darted with incredible Velocity towards the *Vertex*, where the Cuſps of the converging Columns ſeemed nearly to centre; and ſuddenly from every Quarter of the Heaven, bright, ſhining Streams of Light were ſhot towards the Zenith; which meeting about 6 or 8 Degrees to the Southward of it, formed a ſmall Circle of two or three Degrees Diameter, whoſe Border was much more lucid

than

than near it's Centre: This Circle ſeemed formed between *Cauda Cygni* and the *Lizard*, then nearly upon the Meridian.

This beautiful *Spectrum* might be likened to the Star worn by the moſt Noble Order of the Garter, but the pyramidal *Radii* were here reverſed; and from the Southward the Rays or *Striæ* were not near ſo long as thoſe from the N. eſpecially thoſe from the due S. not reaching above 10 or 15 Degrees from the Centre or Circle; whereas thoſe from the Eaſtern and Weſtern Quarters were very long, and reached almoſt down to the Horizon; eſpecially in the E. and W. Points. The *Radii* were in a continual and exceedingly ſwift Undulation, and appeared of ſeveral very bright Colours, as white, red, green, yellow, for ſeveral Seconds; but the moſt permanent and predominant Colours were a fiery red, with an Eye of Crimſon, and a bright Pearl Colour: The red Rays came moſtly from the Weſtward, and that Colour continued till the entire Diſſipation of this radiant Canopy; the others dying away and leaving, as it had been, a thin Smoak. The Vibrations of theſe radiant Columns were as ſwift as Flaſhes of Lightening, and inceſſant.

This ſurprizing Sight remained over us in it's full Glory 3 or 4 Minutes, during which time the Rays were darted towards the Centre with prodigious Swiftneſs, and did not ſeem to be ſhot from it. Sometimes they undulated like the Vapours ariſing from a Lime-Kiln, or from the Earth in very hot Weather, and all the upper part of the Hemiſphere ſeemed to be, as it were, in a Convulſion.

In a ſhort Time this agreeable Scene vaniſhed, and was broken into ſmall flitting bright Clouds, which ſtill retained an undulating Motion; and Coruſcations would every now and then break forth from them. At this time alſo I obſerved ſeveral Star-like Meteors fall, as is frequently obſerved in a bright ſerene Night.

Tho' our glorious *Cupola* diſappeared a very few Minutes after 8, yet very vivid Coruſcations were ſhot continually from the N. E. and N. W. Parts of the Heaven, which daſhing againſt one another near the Zenith, formed by their Colliſion momentary Arches of a Circle, nearly in the ſame Place and of the ſame Diameter with that abovementioned. None now proceeded from the *South*, and very rarely from the true *North*. The Coruſcations were always more red and fiery from the Weſtward than from the *Eaſt*, which were always more bright and luminous.

We were loſt in the Contemplation of the beautiful *Phænomenon* over our Head, and did not obſerve the Formation of a lucid Arch projected over all the Northern Horizon, which ſeemed like the Arch of a Rainbow, of one vivid, bright, yellowiſh Colour, and all under was as it were, a very dark Cloud; tho' by viewing it with a Teleſcope, we could diſcern the minuteſt Stars: So that the Darkneſs only proceeded from the greatneſs of the Light juſt above it. From this, as from the former, aroſe very lucid, bright Columns on all parts of

it. No Coruſcations appeared under it. It's greateſt Height might be 20 or 30 Degrees. Some of the Columns ſeemed to radiate even to the Zenith from this Arch.

About 9, this lucid Arch vaniſhed inſenſibly, with moſt of the luminous *Radii*, or Columns; but, as it were, a very bright *Crepuſculum* ſtill remained all along the Northern Horizon, and ſeveral very bright Coruſcations would ſeem to be ſhot out of the pure Sky: This, more eſpecially, was obſerved in the N. E. About 11, I obſerved ſeveral Coruſcations ſtill breaking forth, and here and there a luminous Column; and ſeveral little bright Clouds ſeemed irregularly ſcattered up and down the Hemiſphere, which ſtill retained their darting and quivering Motion. The Northern *Crepuſculum* remained as bright as ever, and ſo continued till paſt Two in the Morning.

There were but very few, and thoſe very ſmall, Clouds to be obſerved during the whole time of this *Phænomenon*, and the Air was clear; yet all around, and between the lucid Columns, whenever, or in what part ſoever, they appeared, the Air would ſeem very thick and hazy; tho' immediately upon the diſappearing of thoſe gleaming Lights, the Sky would in the ſame Place appear very clear and ſerene. Nay, even thro' ſome of the very Columns we could plainly diſcern the Stars. Some Gentlemen thought they ſaw the bright Stars of the Swan thro' the *Corona* itſelf.

As to the Weather preceding and following this *Phænomenon*, I need not be very particular, ſeeing you will ſoon have it in my Meteorologic Obſervations. The Morning was fair, tho' the Air was thick, and we had a great Dew: The Mercury was at 30 Inch. *Hawkſbee*'s Thermometer at 50, little, or no Wind. The Day was pleaſant and warm, and the Air grew much thinner. The Evening was ſerene; a very ſoft Breeze from N. and by W. About Five the next Morning, there were ſeveral Clouds formed, and the Air was very thick and hazy, at Seven it was all Cloudy, and a few Drops fell.

Tho' I had before ſeen ſeveral faint Appearances of the *Aurora Borealis*; yet this, for Beauty, Luſtre, and Duration, vaſtly exceeded any thing of that nature I had ever ſeen. Indeed, I ſaw not that of *March* 6th, 1716, being not then in *England*.

—*at* Exeter, *by Dr* Hallet, N°. 395. p. 143.

3. *October* 3, 1726, at Nine in the Evening, I ſaw an *Aurora Borealis* (as 'tis commonly called,) in which there was nothing different from former Appearances, excepting that from the luminous Arch which appeared in the *North*, were frequently ſhot off Parts of Arches towards the Zenith, which vaniſhed there.

Octob. 8, Coming from the Country near Seven in the Evening, I obſerved a great Light in the *Eaſt* and *Weſt*, which ſoon extended itſelf over our Heads, the *North* and *South* appearing dark at the ſame time. No Cloud was ſeen all that Day. A great Dew fell on a ſudden, with which the Streets were wet, as by a ſmall Rain. Half

an

an Hour after Seven many Streams appeared in the *North*, which grew very bright, and darted frequently up to the Zenith. A Line drawn through the Baſes of them, made an Arch of a Circle, extending from the N. E. to the W. or S. W. But the Streams ſeemed to proceed from a clear Sky being diſtinct from one another at the Baſes, and not united by a luminous Arch or Cloud, as in the more uſual *Aurora*'s. The Streams at the two Extremities of the Arch were brighter, wider and longer when they did not ſhoot, than thoſe on the Top of it. There was at the ſame time a luminous Arch extending itſelf from the two Extremities of the above-mentioned *Aurora* through the *South*, at a conſiderable Altitude. *Fig.* 14. About Eight o'clock the Streams began to have a Horizontal Motion, propagating themſelves on both ſides towards the *South*; and in a Minute or two the whole Heaven was ſurrounded with them. Immediately they all extended themſelves up to a Point near the Zenith (I think, a little towards the *Eaſt*) where their Points were blended together in a confuſed manner. At the ſame time, every Stream, which before was white, appeared ſtriped with all the Colours of the Rainbow; but the moſt prevailing Colour was a deep Red. It is impoſſible to expreſs the Beauty of this glorious *Umbrella*, which covered the whole Hemiſphere with it's variegated Rays, the Colours of which ſucceeded one another in a regular Order. In the Center of theſe Rays was a confuſed Rolling, Agitation or Ebullition of a luminous Cloud, appearing like Smoak. In about ten Minutes (as I imagine) the Colours diſappeared, and the Streams began to retire from the Zenith; preſently after which, they would frequently dart and ſhoot with great Celerity up to the ſame Point. This Darting and Flaſhing, together with a tremulous Motion from all ſides of the Horizon, I obſerved till 12. And I am informed by others, that it continued till Four in the Morning. The moſt conſiderable Rays came from the *Eaſt* and *Weſt*. Next Morning we had a Fog.

The beſt Account which I can give of this *Phænomenon* is this: I imagine a thin Cloud compoſed of a Sulphureous Exhalation, hanging over us in the Air, at a conſiderable Height, parallel to the Horizon; the Length of it being very great from *Eaſt* to *Weſt* nearly; the Breadth of it (at firſt) not ſo great, but that we might ſee the Stars from under it to the *North* and *South*. The North-Side of it, I ſuppoſe, firſt took Fire, and ſhot it's Streams or Flames perpendicularly upwards, which being undiſturbed by Winds, muſt appear ſtreight and pointed at the Top. The Baſes muſt make an Arch by the Rules of Perſpective: For, I think, an Horizontal Right Line, of a vaſt Length, and at a great diſtance from us (ſuch as I take the Northern Edge of this luminous Cloud to have been,) ſeen at a conſiderable Height in the Air, muſt appear bent down into an Arch. On a ſudden the Fire propagated itſelf to all parts of this Vapour. The whole Heaven muſt then appear covered with the ſame Streams. *Cauſe of this Phænomenon.*

which tho' really parallel to one another, muſt appear bent into a *Cupola*. The ſhooting and darting of theſe Flames, and their Concourſe, together with a Smoak proceeding from them, muſt give that confuſed Cloud which was obſerved in the Center of this Canopy. The regular Diſpoſition of the Colours in every Stream, perhaps, you may account for. I think, the red appeared at the right hand in all of them. Somewhere in the *Philoſ. Tranſact.* I have met with an Obſervation of an *Aurora*, in which the Streams were coloured only where they met, or croſſed one another. Whether the Light of one Stream paſſing thro' another, may not be ſeparated into Colours by Refraction, I will not determine. You may think of a better Solution. If the Altitude of the Top of the Arch in the *North* had been taken here, and at the ſame time at another Place upon the ſame Meridian, whoſe diſtance is known, from thence I imagine, the Height of the Cloud (as I call it) might have been calculated.

—*by* John Hadley, *Eſq*; *F. R. S.* N°. 395. p. 146.

4. The *Royal Society* hath received ſo many and ſo full Accounts of the frequent Northern Lights, which of late Years have been ſeen in *Europe*, and particularly of that remarkable one of the 8th of *October* laſt, that it ſeems needleſs at preſent to give a minute Deſcription of the whole Appearance. I ſhall therefore only take notice of a few Particulars, which either have been omitted by others, or by ſome remarkable Circumſtances attending them, ſeem moſt likely to be of uſe to thoſe who employ their Thoughts in attempting to diſcover the Nature and Cauſes of theſe *Phænomena*.

The firſt Sight I had of this Appearance, was about half an Hour after Seven of the Clock; at which time it had nothing remarkable to diſtinguiſh it from thoſe others which had been obſerved almoſt every Evening for ſome time, except a duſky redneſs ariſing from the Weſtern Extremity of the luminous Arch; and that at the ſame time there was ſeen another like hazy Arch low to the Southward, fainter, but more ſteady than that to the *North*. I judged the higheſt Point of it to be ſomething more elevated than the Sun at Noon about the Winter Solſtice.

In a ſhort time after, the Northern Arch was riſen conſiderably higher from the Horizon, and continued to advance towards the Zenith, till 8; when in one part it paſſed among the uppermoſt Stars of *Caſſiopeia*, and in another cloſe below the bright Star in the *Harp*. The Heavens underneath looked clear, and of a dark Blue, having no reſemblance either of Dawn or duſky Cloud, and the Pyramids of Light ſeemed to ſpring immediately out of the pure Sky. The Arch itſelf was very irregular, being full of Notches, ſome greater, ſome leſs. The duſky red on the *Weſt* was changed to a light Crimſon, and was anſwered by the like Colour on the *Eaſt*. The Rays iſſuing from both Extremities, were thick and bright, appearing as if there were ſeveral, one behind another. They were alſo generally longer than the reſt, and pointed conſiderably to the *South*

Fig. 10.

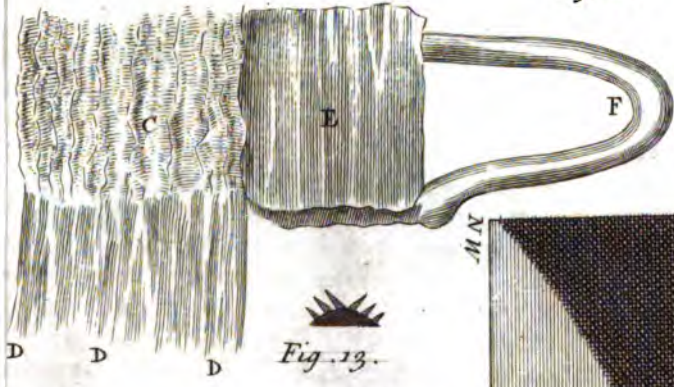
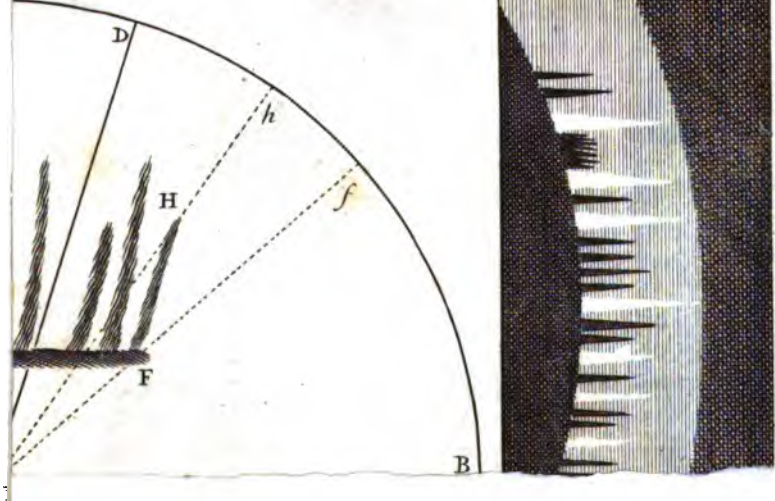


Fig. 13.



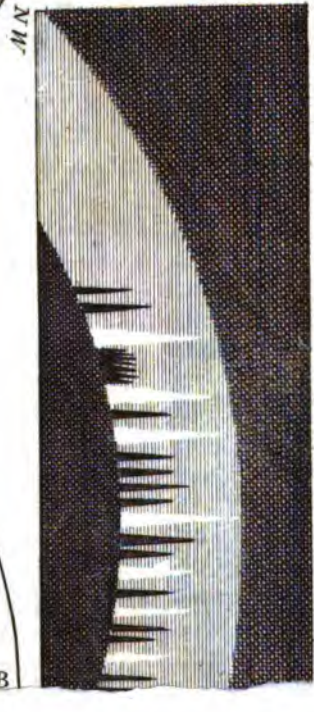


Fig. 12.

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of the Zenith. After 8, the Northern Arch retired again downwards, till it came among the Stars of the *Great Bear:* when the whole Scene was changed on a ſudden, and Rays were darted up from all ſides, and formed that Crown-like, or Star like, Figure which has been ſufficiently deſcribed.

The intermediate *Area* (left between the innermoſt Extremities of the Rays coming from different Quarters, which very rarely, if ever, joined) was of an irregular Figure, commonly inclining to an Oval, whoſe longeſt Diameter lay *Eaſt* and *Weſt*. Sometimes it appeared as clear Sky, at other times was filled with a thin white Cloud, and that Cloud was often divided into two Parts, by an uneven crooked Line, running likewiſe *Eaſt* and *Weſt*.

The Rays which immediately ſurrounded this void Space, were of no great Length, and very unſtable: Yet two or three times, when they continued ſteady enough to afford an Opportunity of conſidering them attentively, their outermoſt Extremities were ſenſibly carried Southwards, the Center itſelf remaining, to appearance, fixed.

The Southern Quarter was filled with continual Flaſhings of Light. Theſe followed one another very quick, and were propagated upwards from the afore-mentioned Arch with great Swiftneſs, each of them leaving in ſome parts of the Space it paſſed through, a faint, and very tranſient Whiteneſs, which preſently vaniſhed, and was quickly renewed, uſually in the very ſame Track, by the next ſucceeding Flaſh. Yet none of thoſe Tracks were in any degree direct and uniform; but all very irregular and broken.

The Central Figure ſometimes diſappeared for a while, and then returned again. Whether it always retained the ſame Situation with reſpect to our Horizon, I cannot depend on the Exactneſs of my Obſervations enough to determine. They were as follow:

About half an hour paſt Eight, the Center, as well as I could judge by my Eye, was very near a Star of the fifth Magnitude, placed by *Hevelius* at the End of the *Lizard*'s Tail, whoſe preſent Right Aſcenſion is about 331°, and Decl. 36° and an half N. At Nine, it was at the Northern Point of an *Iſoſceles Triangle*, whoſe Baſe was a Line joyning the Star in *Pegaſus* Shoulder, called *Scheat*, and the brighteſt of thoſe in his Knee; the Perpendicular from the Center being in proportion to the Baſe, about as 3 to 2. At 9 *h.* 15′ the *Triangle* made between that and the two forementioned Stars was become right-angled at *Scheat*, the Diſtance being not much altered. At Ten, it was directly between the Zenith and *Andromeda*'s Head at a Diſtance from this Star not ſenſibly different from what it had kept from the Northermoſt of the two forementioned.

According to the firſt of theſe Obſervations, the Central Point muſt have been very near the Meridian, and about 15° South of the Zenith of the Place where I was; which is a few Minutes directly North from *London*. The three laſt agree pretty well with one another,

another, to carry it between 2 and 3 Degrees further Southward, and to give it a perpendicular Diſtance of 3 or 4 Degrees of a great Circle from the Meridian Eaſtward.

In the remarkable Appearance of this kind which happened the 6th of *March* $17\frac{15}{16}$, I obſerved the like Center at near half an hour after 7 o'clock, to be ſomething nearer the Zenith, than the bright Star in the Northern Head of the *Twins*, and to be more Eaſterly by about half the Diſtance between that and the Star in *Pollux*'s Head. By comparing this Obſervation with the Situation of the Star at that time, the Center appears to have been about 16 or 17 Degrees from the Zenith, and about 2 or 3 diſtant from the Meridian Circle towards the *Eaſt*.

5. Die Saturni $\frac{13}{23}$ Menſis Octobris, horâ ſextâ & dimidiâ veſpertinâ, Aurora Borealis fulgere cœpit, Phænomenon vobis quidem ſatis familiare, nobis verò ex ſeniorum ſententiâ plane novum, ſed tam illuſtre, & circumſtantiis à vulgaribus in Tranſactionibus ſæpe deſcriptis tam diverſum, ut de eo audiiſſe fortaſſe non pigebit.

— *at* Geneva, *by* Joh. Lud. Calandrini, Math. Prof. Ordinar. N°. 395. pag. 150.

Primò quidem, quâ horâ dixi, Arcus lucidus viſus eſt, cujus medium ſtabat in Horizontis Septentrione, extremitates ad Arcturum in Occaſu, & ad Pleiades in Ortu, 40° altus; lucidus ſatis, ut Solem è Septentrione jamjam ortum ire diceres; ſed hic nihil eſt novi.

Poſt horam ſeptimam, quaſi violenti incendii flammæ, vel continua fulgura totum albicantis arcus locum occupaverunt. Serpebant ex Horizonte ad cœli fornicem haud abſimiles veri furni flammis, extremitates arcûs rubicundo atrove fulgore vulgum terrebant, ipſæ flammæ in atrum fumum deſinere videbantur, ita ut diem Domini inſtare mulierculæ non dubitarent. Cœleſte hoc incendium pluſquam horam duravit; Scenâque mutatâ, ex Horizonte exilire columnas, quæ ad Zenith pertingerent, viſum eſt: Ex eâdem ſupradictâ baſi, coronâ in extremitate Phænomeni tum occidente & cornu Tauri inferiore ab alterâ parte ſurgente, columnæ plus minuſve latæ, 60 aut 70° altæ, tria vel quatuor minuta durantes, paulatim evaneſcentes, vel prius in igneum colorem verſæ; poſt aliquod tempus ceſſarunt columnæ: tum Aurora Borealis ut primum fulſit, cui ante decimam ſucceſſerunt flammæ vehementiores quam prius, quibus ceſſantibus columnæ circa undecimam viſæ ſunt, magis diutinæ, & 120° plerumque altæ: Rurſus Aurora, mox flammæ, poſtea columnæ, atque ita ad tertiam uſque, quâ videbantur adhuc Phænomeni relliquiæ.

Ultra luculam, quæ ſemper Septentrionalem, quam dixi, cœli partem illuſtrabat, majoris Urſæ ſtellæ parum fulgebant. E Veſontio, quod 90 milliaribus hinc diſtat, eodem modo viſum fuiſſe Phænomenon accepimus.

Arſit interea unum ex illis Meteoris, ſtellæ cadentes dictum, quod ultra Phænomenon arſiſſe viſum eſt.

Ex reflexione Solaris luminis à partibus Atmoſphæræ Borealibus congelatis Auroras Boreales formari dictum eſt: Sed flammas adeò notabiles

notabiles quo pacto explicentur non video. Si ab exhalationum incendiis ortum hoc Phænomenon cenſeatur; Aurora Borealis Phænomeni comes, columnæ, duratio Phænomeni, & ipſius in eodem loco ſtatio, negotium faceſſent.

6. For the clearer proceeding in my Relation, I ſhall obſerve, that there are two ſorts of *Streamings*, which I have taken notice of; one, by way of *Exploſion* from the Horizon; the other, by *opening* and *ſhutting*, without Shootings up, and ſwift Dartings. —*by the Rev. Mr* Derham, F. R. S. N°. 398. *p.* 245.]

Of the latter ſort chiefly, was that of *Oct.* 8: in which, altho' the *Streams*, or *Spires*, or *Lances*, or *Cones* (or, what ſhall I call them?) were as large and remarkable as in that of the Year $17\frac{15}{16}$; yet they exhibited themſelves principally by the vaporous Matter opening and ſhutting, as if a Curtain had been drawn and withdrawn before them.

The firſt View I had of this *Phænomenon*, was preciſely at Eight o'Clock in the Evening: At which time, all I ſaw, was a long narrow *Faſcia*, like a white ragged Cloud, extended croſs the Heavens, from W. b S. to E. b N. which in a few Minutes began to emit ſome Streams, and then diſappeared; Which was ſucceeded by much Streaming in the Northerly Parts; and in a quarter of an Hour it began to reach other Points alſo; and ſoon after that, it ſtreamed all round in the Southerly, Eaſterly and Weſterly Parts as much, or nearly as much as in the *North*. Which was a thing I never had ſeen before in theſe Phænomena.

Theſe *Streams*, or *Cones*, were for the moſt part pointed, ſo as to make the Appearance of *flaming Spires*, or *Pyramids*; and ſome others were truncated, and reach'd but half way: Some alſo were longer, and ſome ſhorter; ſome of which had their Points reaching up to the Zenith, or near it, where they formed a ſort of *Canopy*, or thin Cloud, ſometimes red, ſometimes browniſh, ſometimes blazing as if fired, and ſometimes emitting Streams all round it, which at that time gave it the Appearance of ſuch a Star as our Knights of the Garter wear on their Breaſts. *Fig.* 15.

This *Canopy* was manifeſtly formed by the Matter carried up by the Streaming on all parts of the Horizon: Which Matter ſometimes ſeem'd to aſcend with ſome force, as if impell'd by the Impetus of ſome exploſive Agent below, as I have ſaid it was in the Streaming of *March* $17\frac{1}{16}$, and which I gave the Society a large and particular Account of ſoon after. This forcible Aſcent of the ſtreaming Matter, gave a Motion to the Canopy, ſometimes a Gyration, like that of a Whirlwind; which was manifeſtly cauſed by the Streams ſtriking the outſide Parts of the Canopy, as in the Figure: But when the ſtreaming Matter hit the Canopy in the Middle, all was then in Confuſion. *Solution of this* Phænomenon.

Theſe two Particulars, namely, the *Streaming all round*, in all Points of the Horizon; and the *Canopy* in and near the Zenith, are

what were taken notice of in all Parts of *England*, that I have met with any Accounts from; particularly, in *Northamptonſhire*, *Staffordſhire*, *Oxfordſhire*, *Wiltſhire*, *Berkſhire*, *Middleſex*, *Somerſetſhire*, and *Eſſex*, and in divers Parts beyond Sea.

Mr Waſſe's *Account, from* Aynho *in* Northamptonſhire.

The Reverend and Learned Mr *Waſſe* gives me this Account of it's Appearance at *Aynho* in *Northamptonſhire*, That at 7 h. 20′ p. M. he ſaw an Arch ſomewhat curved, like a Rainbow at firſt, and about half the Breadth of the Rainbow, and yellow; which in about ten Minutes began to twiſt, and make an Angle at the Zenith: That one End of it was pretty much to the Eaſt, and not directly to the North; and the Weſtern End deflected as much to the South: That it remained after the Twiſt, at the Zenith, without any great Motion, not a quarter of an Hour. After which, the Rods aroſe on all ſides, from the Horizon to the Zenith, the upper Points ſeeming to move thro' a ſort of Vortex quite out of our Atmoſphere: Which Rods, he thinks, roſe perpendicularly from the Horizon, but ſeemed to converge towards the Zenith, according to the Rules of Perſpective, by their Angle then being leſs than their Baſis at the Horizon: That a Redneſs was perceived, which, he thinks, was ſtrongeſt towards the Weſt; which Colour did not appear till the Arch brake into ſeveral Pieces, and overſpread the Heavens with a thin faintiſh Fire, thro' which they ſaw *Jupiter* very clearly.

This Account of Mr *Waſſe*'s may ſhew, how the Phænomenon was in *England*; by reaſon moſt of the Accounts I have met with concur in the main with his. But in the more Southerly Parts of *Europe*, I take it to have been ſomewhat different. The News-Papers tell us from *Schaffhauſen*, "That on the 19th of *October* there was a great "Alarm in many Parts of *Switzerland*, on Account of a great *Light* "ſeen in the Air, from 7 o'Clock till Midnight; which was ſup- "poſed to be the Reflection of ſome great Conflagration. At *Bern*, "every body thought there was a Fire in ſome part or other of "the City or Neighbourhood. At *Neufchatel*, the Alarm-Bells were "rung, and the Governour ſeveral Hours on Horſeback, to give "Orders, *&c.* as in Caſes of Diſtreſs. All which they heard after- "wards, was only an *Aurora Borealis*". And from *Florence*, my ingenious and curious Friend, Sir *Tho. Derebam*, ſent me this Account.

Account from Schaffhauſen.

— *Florence* by Sir *Thomas Derham.*

"As to the *Lumen Boreale*, which appear'd in theſe Parts on *October* "the 8th laſt, I ſaw it my ſelf in the following manner: It was one "Hour and half after Sun-ſet, when I was paſſing thro' a Piazza in "this Town, that I diſcovered the Phænomenon, that ſeem'd one "Mile long, and three quarters of a Mile broad, of an almoſt per- "fect Oval Figure, hanging North and North-Eaſt to us: The "Edges of it were of a pale light Colour, like the firſt Dawn of the "Morning; and towards the Center, it encreaſed it's fiery Colour; "ſo that in ſome Places it looked as the Fire of a Furnace; but "in the very Center, and many adjacent Parts, it was like a red-hot

"Iron

" Iron growing cold, that ſeems bloody. For a good while I could " perceive no Motion in it; but after a quarter of an Hour, I diſ- " covered a general ſlow Motion backwards and forwards, like that " one ſees of the Circulation of the Blood in the Tails of Fiſhes, " by the help of the Microſcope, but no manner of darting; in- " ſomuch that in another quarter of an Hour it vaniſhed imperceptibly, juſt as a Rainbow, and the Air grew dark again, that was " ſo luminous before, that one might read a Manuſcript by the ſame. " It is very remarkable, that at *Fieſole*, a Town within a ſhort Mile " of this, the Phænomenon ſeemed to thoſe Inhabitants, to be be- " tween them and us, and they thought our Town was burning: " Whereby it appears not to have been very deep, nor very high; " *Fieſole* ſtanding upon a Hill half a Mile high, and to the North- " North-Eaſt of this Town.

Some farther Obſervations.

To theſe Obſervations of myſelf, and ſome of my Correſpondents, I ſhall add two or three things more, before I enquire into the Cauſe of the Phænomena.

One thing that was taken notice of in moſt Places, was, That in ſome part of the greateſt Streaming, the Vapours between the Spires, or Lances, were of a Blood-red Colour. That which I obſerved, was, That about half an Hour after Eight o'Clock, the Vapours towards the South-Weſt were very denſe, and for ſome time red. And not long after, the like Redneſs aroſe in the North-Eaſt, and the other gradually went off. Both which gave thoſe Parts of the Atmoſphere the Appearance of blazing Lances, and bloody-coloured Pillars.

Another thing I took notice of, was, a ſtrange Commotion, and working among the Streams, as if ſome large Cloud, or other Body was moving behind them, and diſturbed them.

In the Northerly and Southerly Parts the Streams were perpendicular to the Horizon; but in the intermediate Points they ſeemed to decline more or leſs one way or other; or rather to incline towards the Meridian.

As for the Weather, the preceding Day was cloudy, with an Hoar-Froſt in the Morning; but it cleared up, and grew warmer afterwards; but towards the Horizon, very vaporous. And the next Morning (after the Streaming) before Sun-riſing, the Air was full of Vapours, with divers thin vaporous Clouds, ſome of a lucid brown, ſome reddiſh, which I took to be Remains of the Streaming, which, I was informed, continued all Night.

Cauſe of theſe Phænomena.

As for the Cauſe of theſe Phænomena, I take it to be from the ſame Matter, or Vapours, which produce Earthquakes: And that for theſe Reaſons: *Firſt*, Becauſe ſome of theſe Phænomena have been followed by Earthquakes. As that which *Stow* gives an Account of in his Annals. in the Year 1574, on *November* 14, in which he ſaith, *were ſeen in the Air ſtrange Impreſſions of Fire and Smoak to proceed forth of a black Cloud in the* North *towards the* South. That *the*

next Night following, the Heavens from all parts did ſeem to burn marvellous ragingly, and over our Heads the Flames from the Horizon round about riſing did meet, and there double and roll one in another, as if it had been in a clear Furnace.

And after this (he tells us) *followed on the 26th of* February, *great Earthquakes in the Cities of* York, Worceſter, Glouceſter, Briſtol, Hereford, *and in the Countries about, which cauſed the People to run out of their Houſes, for fear they ſhould have fallen on their Heads. In* Tewkſbury, Breedon, *&c. the Diſhes fell from the Cupboards, and the Books in Mens Studies from the Shelves:* With more to the ſame purpoſe.

So this laſt (in *October*) was preceded by that fatal Earthquake at *Palermo* in *Sicily*, and ſucceeded by one in *England*, on *Tueſday*, *October* 25, following. This, I hear, was perceived in *London*, and was very conſiderable at *Dorcheſter*, *Weymouth*, *Portland*, *Portſmouth*, *Purbeck*, and divers other Places in *Dorſetſhire*, that it cauſed the Doors to fly open, ſhook down Pewter off the Shelves, and was felt in ſome Ships that lay in the Harbours.

2. Another Reaſon is, That I am aſſured by an ingenious ſenſible Gentleman of my Acquaintance, that as he was viewing this Appearance, on the Top of his Houſe at *Little Chelſey*, he plainly perceived a ſulphureous Smell in the Air; and that another Perſon did the ſame, on the Top of another Houſe near him.

3. Another thing which concurs with what hath been ſaid, is, That I am aſſured from ſeveral Perſons, that an hiſſing, and in ſome Places a crackling Noiſe was heard in the time of the Streaming, like to what is reported to be often heard in Earthquakes.

And now, for a Concluſion, I ſhall remark two things upon what hath been ſaid.

1. That it may help the ſagacious Meteorologiſt to reſolve ſeveral Difficulties relating to theſe *Northern Lights*, to obſerve, that what was *Streaming* or *Darting* in our Northern Parts, was only a remarkable Light, or Blaze in *Italy*, and the Southern Parts, if I take Sir *T. Dereham*'s and the News-Papers Accounts right.

2. If thoſe Phænomena have the ſame Origin that Earthquakes have, that then they are, doubtleſs, of great uſe to the Peace and Safety of the Earth, by venting ſome of that pernicious Vapour and Ferment that is the Cauſe of thoſe terrible Convulſions, which Earthquakes are accompanied with.

I forgot (when I deſcribed the *Canopy* or *Corona*) to ſay, that it did not reſt in one place; but changed it's Poſition, ſometimes higher near the Zenith, and then towards the Eaſt, and South-Eaſt, 10 or 15 Degrees, and then back again nearer the Zenith, according as the darting Matter directed it: But I do not remember, that this Canopy was at any time directed towards the Weſtern Points.

In moſt of the *Northern Lights* that I have ſeen, there generally was a dark Bank of Vapours, circular on the Top; but whether this

of *Oct.* 8, had any ſuch Arch, I could not ſee at *Upminſter*, where I was ſurrounded with Trees.

7. *Octob.* 8, 10, Morn. { *Barom. Alt.* 29. 90. } { *Therm.* 54. } { *Wind.* W. 1. } Weather fair and clear. —*at* Southwick *in* Northamptonſhire, *by* George Lynn, *Eſq;* N°. 398. p. 253.

This Evening appeared an *Aurora Borealis*, I think, full as remarkable as that in *March* 1716, tho' varying in Form: It began about Six at Night to be light in the North, with Streaks proceeding from it, and ſpread gradually both towards the Eaſt and Weſt, the South being ſtill very clear; but before Seven it left all the Northern Parts (except towards the Zenith) and covered all the Southern. Soon after which, there appeared a white Arch proceeding from Eaſt to Weſt, paſſing near the Zenith, but more South, which ſeemed fixed for a time; but about 10 Minutes paſt Seven was diſperſed, and immediately ſucceeded by a kind of Glory of an Oval Form, the longer Axis from Eaſt to Weſt, ſomething South of the Zenith, with Rays ſhooting up from all parts, and interchanging ſwiftly, for about 15 or 20 Degrees from it; the reſt of the Heavens (except the North, which ſtill continued very clear) affording various Phænomena. In the Eaſt there was a quick Succeſſion of Columns of the *Iris* Colours, inclinable to White, the Weſt to Purple, and about the South-Weſt, for a good ſpace, appeared almoſt a blood red Coruſcation, which continued 5 or 6 Minutes.

Theſe Appearances in a quarter of an Hour became leſs remarkable; though the *Aurora* continued moſt of the Night, and afforded a Light generally equal to the Moon in it's Quadratures. Looking with my Teleſcope at *Jupiter*, I found both his Satellites and Belts appear as plain thro' the *Aurora*, as if the Sky had been perfectly clear.

8. Monſ. *Gaudin*, in a Letter from the Obſervatory at *Paris*, dated *October* 20. N. S. 1726. writes, that he ſaw it firſt at half an Hour paſt ſeven in the Evening, forming at that Time a luminous Arch (with another ſomewhat darker under it) which extended itſelf almoſt from *Sun-ſet* to *Moon-riſe*, and was raiſed above the Horizon about twenty five Degrees; from whence ſhot out from Time to Time luminous Streams about ten Degrees above it. At half an Hour paſt eight, the Number of theſe Streams vaſtly encreaſed, covering all the Heaven, excepting the Height of twenty Degrees oppoſite to it: But towards the Zenith there remained a circular Space which was never covered by them, tho' there wanted not a conſtant Succeſſion. Theſe Appearances continued very ſtrong till half an Hour after ten; when they began to decline, and diſappeared totally about two in the Morning. —*By ſeveral Perſons* N°. 402. pag. 453. —*Monſ.* Gaudin at Paris.

Monſ. *Maraldi*, in a Letter dated at *Thiers*, *Oct.* 20, 1726. N. S. two Leagues to the South of *Paris*, ſays, it began there about half an Hour paſt ſix with a conſtant uniform Light in the North; ſoon after which appeared three or four luminous Arches one over another, —*M.* Maraldi, at Thiers.

another, from whence iſſued a great Number of Rays, which ſhot up a conſiderable Height above the Horizon. At eight o'Clock theſe Rays darted quite up to the Zenith; half an Hour after which they very much encreaſed, ſpreading with ſtrong Undulations all over the Sky, and all terminating in the Zenith formed a Sort of *Cupola* there. The Concluſion he has not obſerved.

—*Sig.* Quaranbotti, *from* Treggiaia.

Sign. *Franceſco Quaranbotti* writes from *Treggiaia*, *Oct.* 20. 1726. N. S. that he firſt obſerved it a little before eight in the Evening, when it extended itſelf along the North Horizon about eighty Degrees, and reached above it about eight. After ſome time, the luminous Emiſſions began to riſe perpendicularly, and continued from time to time ſo to do, from nine till eleven. About ten it enlarged itſelf fifteen Degrees farther Eaſt, and ſtretched under the laſt Star in *Urſa major*. At eleven it vaniſhed.

—*anonymous Account, from* Florence.

An anonymous Account in *Latin* from *Florence* informs us, that it was firſt ſeen there at half an Hour paſt ſix in the Evening, with a clear expanded Light, occupying all the Space betwixt the North-Eaſt and North-Weſt. At ſeven it divided itſelf into ſeveral ſpherical Triangles near the Horizon, which half an Hour afterwards united into one large Triangle, whoſe Baſe was near the Horizon, and extended twenty Degrees to the Weſt from the North-Pole, and whoſe *Vertex* reached up to *Urſa minor*. This continued about half an Hour, and then diſappeared; but at ten o'Clock it returned much more conſpicuouſly, forming about the *Pole*, a large Column which was raiſed thirty Degrees above the Horizon. From this Time it emitted lucid Undulations till Midnight, when it entirely diſperſed. He afterwards takes Notice that the ſame was ſeen at *Milan* and *Bologna*; the Accounts from whence agree, that none of the Streams reached beyond the Zenith.

—*Sig.* Manfredi, *from* Bologna.

Sign. *Manfredi* writes from *Bologna*, *Jan.* 3. $17\frac{24}{27}$, that he did not obſerve this Phenomenon himſelf, but was informed that it was ſeen every where in the *Campagna di Roma*, as far as *Peſaro* and *Fano*.

To theſe Accounts, which were communicated to the Society by their worthy Aſſociate Sir *Thomas Dereham*, and moſt of them tranſlated from the *Italian* by the ingenious Dr *Scheuchzer*, it will not be improper to ſubjoin, that Dr *Ericus Burman* in the *Act. Literar. Suec. Trimeſt. prim.* 1727. takes Notice, that altho' this *Meteor* was ſeen in *Germany*, *Poland*, *Swifferland*, *France*, and *England*, yet at *Upſal* they could obſerve nothing but the whole Sky beſet thick with Clouds, of a Colour like that of the Moon in a total Eclipſe, and variouſly agitated as by a Wind, but this chiefly towards the South; which continued till nine o'Clock at Night, a little after which it grew quite cloudy.

—*Dr* Burman, *from* Upſal.

XXXI. *Jan.*

XXXI. *Jan.* 4. A Luminous Arch which extended itſelf from N. E. to Weſt. The Streams all moved Weſtward. Wind N. W. *Merc.* 29 ½.

An Account of the Lumen Boreale, *as ſeen at ſeveral Times, by the Rev. Dr* Langwith, N°. 399. p. 301.

Jan. 5. We had ſomething of the ſame Nature, but hardly enough for Obſervation; and yet, this very Night the Appearances were more remarkable in ſome parts of the Kingdom than thoſe of *October* the eighth. This I was informed of by a Perſon of Quality in *Lancaſhire*, who was pleaſed alſo to ſend me the annexed Deſcription and Draught, communicated to him by a curious Obſerver at *Liverpool*.

March 2d. Between 7 and 8, there was an Arch upon a black Baſis as before, extending itſelf from N. E. to W. It's height variable, pyramidal Streams of Greeniſh Light moving weſtward. About a quarter paſt 8, there ſhot up from the Weſt a Stream of pale Flame-colour about 6 or 7 Degrees broad: It paſſed over the *Pleiades*, and croſſing the Meridian about 19 Degrees to the North of our Zenith, deſcended as low as the Tail of *Urſa Major* which it left a little to the South. It continued thus for ſome Minutes and then gradually vaniſhed. Wind North, *Merc.* about 30.

March 3d. The Appearances this Night were ſo extraordinary, that they would require a long deſcription: But I ſhall chiefly take Notice of ſuch particulars as differed from thoſe of *October* 8.

1. That inſtead of one luminous Arch in the North, here were two and ſometimes three one above another. They were diſtinct enough from each other in their upper parts, but blended together towards the Horizon, which they generally cut about N. E. and N. W. but ſometimes varied conſiderably from theſe Points.

The ſame Obſervation may be applied to the Heights, for they were alſo variable; and in particular, the inner edge of the lowermoſt Arch was at ſometimes about 6 Degrees above the Horizon, at others, conſiderably more or leſs.

I ſuppoſe this extraordinary Appearance was owing to ſeveral diſtinct Collections of luminous Vapours, which were either at different Heights from the Earth, or different Diſtances from the Eye.

2dly, Several of the more permanent Streams were bent, at times, into irregular Arches of different Curvatures and Poſitions.

Some of them held pretty near the ſame ſhape till they vaniſhed, others went off moſt commonly in *Tangents* to ſome part of the former Curves.

3dly, The flaſhing Streams from the Eaſt ſometimes met with thoſe from the Weſt, and ſo formed continued Arches, of a pale Colour, which quickly broke and vaniſhed. No colouring followed upon the mixture of theſe Streams.

4thly, The Streams of this kind moved moſtly Southward, but not to any certain Point; for they were inclined to the Horizon at all Degrees between 5, or leſs, and 90. There was ſometimes ſuch a ſtrange irregularity in their Motions as can hardly be deſcribed;

for the Places from whence the Flaſhings were directed ſeemed to vary every Moment.

As to the more ſteady pyramidal Streams, they generally moved Weſtward; and tho' ſome of them, at times, ſeemed to ſtand ſtill, or even move backward; yet I am apt to believe, this irregularity was only apparent.

5thly, A little after the beginning of this *Meteor* there was a faint ruddineſs in the Sky towards N. E. and N. W. but when it was in it's greateſt perfection, towards 12 o'Clock, I ſaw none of the Priſmatic Colours, tho' the Air was then full as Light as I have ever known it upon theſe Occaſions. This helps to confirm me in the Opinion that the Priſmatic Colours in theſe Meteors were owing to the Sun.

Theſe Appearances began early in the Evening, and held, as I am informed, for a good part of the Night. Wind N. Weſterly, Merc. above 30.

I am told that theſe Meteors are much more common in the North of *England* than here, and that they go by the Name of *Streamers*, *Merry Dancers*, or *Petty Dancers*. They alſo pretend to foretel the Weather by them, and ſay, that when the Streamers are green, they betoken wet ſtormy Weather; but when they are yellow, it will be clear and dry.

P. S. I don't know whether it is worth while to acquaint you, that *Ariſtotle* has given an imperfect Account of ſome of theſe Meteors.

The Deſcription of an Aurora Borealis *mentioned in the foregoing Letter.* N°. 399. pag. 304.

XXXII. About Seven o'Clock at Night I was told that the Meteor called by our Sailors, Merry Dancers, was viſible, and very bright. Having ſeen ſeveral before, but had no opportunity of being particular in my Obſervation, I went out into the open Air, clear of Houſes, that I might have a better View all round the Horizon; from whoſe Northern part aroſe ſeveral Streams of Light, as if from behind a black Cloud. They were very many, and I believe, there was no poſſibility of numbering them, their Motion being ſo quick, ſhooting upwards to the Zenith with a Motion not to be followed by the Eye. They had alſo another Motion which ſeemed to be ſide-ways, their higher Ends terminating ſometimes in a ſharp Point, ſometimes in two or three Points; they appeared from the North-Weſt to North-Eaſt; but were brighteſt in the North. Their Colour was pale like that of *Jupiter* through a Teleſcope, but not near ſo bright. Moſt of them reached the Zenith, where mixing with one another, they whiſked round and formed an Appearance like the curling Flame of a Glaſs-Houſe-Fire; they had a very irregular Motion, ſometimes turning inwards, ſometimes outwards, like the *Pendulum-Spring* of a Watch. This circular Light was the brighteſt, and ſeemed to occupy near ten Degrees of the higheſt part of the Hemiſphere; Several Strokes of Light ſeemed to dart from it to the South; but died before they got any conſiderable diſtance. In the Weſt, I ſaw two

ſmall

ſmall long Clouds, which interpoſed betwixt me and the light Streams; which I ſaw above the Clouds, and betwixt them, which convinced me that this Light (whatever it be) is far above them. I have drawn a Scheme of the whole Horizon, as it appeared to me. That bright Star is *Jupiter*, whoſe Place then was 17° in *Aries*, and was about South-Weſt, I gueſs about 20° high. Some of the brighteſt Stars in *Taurus*, *Orion*, and *Aries*, appeared South and South-Eaſt; but I have not placed thoſe but by gueſs. In this ſtate I left it: But was told by one that ſaw it after Ten o'Clock, that the whirling Light in the Zenith appeared of ſeveral Colours, as, blue, green, yellow, and reddiſh. But that I did not ſee. *Fig.* 16.

XXXIII. Die Martis, *Feb.* 19, $17\frac{11}{12}$, hora ſeſquidecima.

Die Veneris, *Martii* 15, $17\frac{11}{12}$, ab hora octava, ad mediam uſque noctem.

Die Martis, *Aug.* 20, 1723.

Die Dominica, *Oct.* 20, 1723, ab hora ſexta, ad mediam noctem.

Die Dominica, *Sept.* 26, 1725, Aurora Borealis viſa eſt ab hora ſeptima, ad horam decimam, cum Radiationibus variis.

A Regiſter of Obſervations of the Aurora Borealis *for four Years, at* Lynn, *by Mr* W. Raſtrick, N°. 398. p. 255.

Die Lunæ, *Oct.* 3, 1726, per totam noctem.

Item Die Martis, *Oct.* 4, 1726.

Itemque Die Saturni, *Oct.* 8, 1726, per totam noctem. Mirum ſanè Phænomenon, de quo nihil dixi, qui tam accuratè deſcribitur à Dominis *Langwith*, *Huxham*, *Hallet*, *Hadley*, & *Joban. Ludov. Calandrino*, in *Actis Londinenſibus*, N°. 395.

Die Mercurii, *Oct.* 26, 1726, circa horam decimam.

Die Veneris, *Martii* 3, $17\frac{25}{26}$, ab hora octava, ad mediam noctem. Aurora hac nocte (ut mihi videbatur) longe mirabilior fuit illâ *Oct.* 8; & credo equidem, nullatenus diſcrepavit (ſecundum deſcriptiones quas habemus) ab illo memorabili Phænomeno, ſexto *Martii*, $17\frac{11}{16}$.

Item Die Domin. *Martii* 5, $17\frac{25}{27}$.

XXXIV. About 8 in the Evening of that Day, my Family and others at *Windſor*, ſaw a conſiderable *Streaming* in the North, with ſuch bright Lances and Columns as uſual. But at *Redbridge* none ſuch appeared, only in the North, I obſerved a great thick, black Bank of Vapours; the Top reaching about 20° above the Horizon, without any Convexity or Curvature, as is uſual in moſt of the *Streamings* I have ſeen; but inſtead of that, the upper Part was indented in many Parts, with long black Pyramids, ſomewhat reſembling the Streams of the *Lumen Boreale*, the Edges of which were gilded with lucid Rays, of the Streaming Colour: And all over the Clouds, or Vaporous Bank, I diſcovered a great Commotion or Diſturbance behind them, as if ſomething was rolling, or tumbling behind them. The End of all theſe Appearances I expected would have been *Streaming*: But in leſs than an Hour, the Clouds (which had been pretty ſtill) began to move to the S. W. and at laſt obſcured the whole Hemiſphere; which before was all clear enough (except towards the North)

An Aurora Borealis Oct. 13, 1728, *at* Redbridge *near* Southampton, *by the Rev. Mr* Derham, F. R. S. N°. 410. p. 137.

North) to ſhew the Stars, although beſpread with Vapours, like a thin Fog, a little inclining to red.

——Feb. 15. 1730. N. S. *at* Geneva, *by Mr* Cramer. No. 413. p. 279.

XXXV. The *Aurora* it ſelf had nothing extraordinary; it was a quiet one, that is, without any ſenſible Motion, except, perhaps, an alternative Increaſe and Diminution of apparent Altitude. Whether it was for this Reaſon, or becauſe the Light had it's Edge imperceptibly confounded with the Colour of Heaven, ſeveral People judged of that Altitude ſeverally. There are ſome that pretend to have ſeen it to the very Zenith: I was not ſo happy, and could not ſee it higher than the Girdle (β) of *Cephus*, which was about 30 Deg. high. The greateſt Part did fix it to the Polar Star, which is about 46 Deg. It's Baſe reached from the Head of *Andromeda* and further, to the Shoulder (γ) of *Bootes*, and further, and ſo it did inſiſt upon an Arch of 140 or 150 Deg. of the Horizon. This Meaſure was taken half an Hour after Eight. It's Middle declined from North to Weſt about 15 Deg. The Light was ſtill, and clear enough to read a Character no bigger than that of this Letter. The Baſe has ſeemed obſcure to ſome People.

But what was chiefly to be conſidered, was a great Meridional Zone pretty like a Rainbow in it's Figure, but broader. It was terminated by two parallel Arches. The ſuperior inſiſted with one Side upon the true Point of Eaſt, and with the other upon the Point of South-weſt, or Weſt-ſouth-weſt: Whence you ſee it's Middle declined about 15 Deg. from South to Eaſt, and was diametrically oppoſed to the Middle of the *Aurora Borealis*. It's Altitude did vary a little, but never reached higher than the Head of *Orion*, which was 54 Deg. high, and never was ſeen lower than a little under *Procyon*, which is an Altitude of 45 or 46 Deg. The inferior Arch was exactly parallel to the ſuperior, and the Breadth of the Zone varied from 14 or 15 Deg. to 18 or 20 Deg.

The Colour of this Zone was Red, Scarlet, inclined to Purple, pretty lively and changeable by Intervals. It was leſs vivid near the Horizon, and alſo to the Meridian, where it ſeemed now and then interrupted. Some Standers by did imagine two great Arches riſing, one from the Eaſt, the other from the South-Eaſt, and meeting together near the Meridian, but immediately afterwards parting one with another, and drawing back, which they repeated very often.

Under this Zone then was to be ſeen, but not conſtantly, one or two Arches lucid and interrupted, which comprehend with the Horizon a dark Segment very like a Miſt.

The Phænomenon did laſt till Four o'Clock in the Morning. The Weather was calm, ſerene, and cold, the Barometer very high; no Cloud in the Heaven.

It was remarkable, and I think extraordinary, that this *Aurora* conſiderably darkened the Light of thoſe Stars which were ſeen through it; and that was much more true of the red meridional Zone, which dyed

dyed with it's reddiſh Colour the Stars that appeared behind. When that Zone was the higheſt, it covered *Jupiter*, and ſome Gentlemen, which at that Time had not yet remarked the *Aurora*, looking at *Jupiter* through a Teleſcope, affirm they could hardly ſee it, but that it ſeemed as intercepted by ſome dark Cloud; and indeed it looked at that Time as if it had been ſeen through a red Glaſs.

This Obſervation confirms what is moreover very probable, that this Zone was produced by the Light of the oppoſite *Aurora*, either by Reflexion or Refraction. But the Manner of it's Production ſeems difficult to be accounted for. There may be ſuppoſed Icy Particles ſwimming in the Air, and of ſuch Figure as to exhibit a great Zone, by the Reflexion and Refraction of the Light of the *Aurora*, almoſt in the ſame Manner as the Drops of Rain produce the Appearance of the Rainbow. But this being meer Conjecture, I ſhall paſs it over.

The *Aurora* and Zone ſeemed a great deal nearer one another in the Horizon than in the Top. If we could ſuppoſe this Difference to be entirely Optic, and theſe two Circles really Parallels, that would be enough to compute the Diſtance of the Phænomenon from the Earth. But the Suppoſition, though it ſeemed, at firſt, pretty allowable, is by no means to be admitted; for it would follow, that the Phænomenon was at leaſt diſtant from us one twenty-fourth Part of the Diameter of the Earth, which is too great an Altitude to be believed.

XXXVI. 1. The *Aurora Borealis* has been very frequent with us of late; but none either for Brightneſs, Variety, or Duration, ſo conſiderable as what occurred on the laſt *Thurſday* Night, which was the 22d of *October*. This Meteor has been obſerved in *New-England*, at different Times, ever ſince it's firſt Plantation; but I think at much longer Intervals than of late Years, and never to ſo great a Degree as the preſent Inſtance: Nor indeed is there any recorded in the *Philoſ. Tranſact.* that I could think, by their Deſcription, equal to it; excepting only that celebrated one of the 6th of *March*, 1716, obſerved by the moſt judicious and learned Dr *Halley*, and in many Reſpects that alſo muſt give the Preference to it. And on this Account I have thought the moſt particular Deſcription of this Meteor would not be unacceptable to you; and have therefore ſent all my Notes relating thereunto, which are very numerous, almoſt to every Change and Circumſtance of the Appearance. I am perſwaded there is no better Way to arrive at the true Cauſe of this extraordinary Phænomenon, than by attending to the minuteſt Particulars and Circumſtances thereof; and if what I have done contributes thereunto, I ſhall eſteem it a ſufficient Excuſe for the Number and Particularity of my Notes.

—*Oct.* 22, 1730. *in* New-England, *by Mr* Iſaac Greenwood, Prof. Math. N°. 418. pag. 55.

Oct. 22, 1730, 6^h 30$'$ *P. M.* There lay near the Horizon an extended duſkiſh Vapour reaching from N W by N. to N E by E. The upper Edge was the Segment of a Circle, whoſe greateſt Height *Obſ.* 1. *Fig.* 1.

from the Horizon was about 15° bearing nearly N. by E. Adjoining to this was a concentric Segment of a very light Azure, of a greeniſh Caſt, ſtrongly illuminated, a few Degrees in Breadth, and then dilated more and more till it became blended with an extenſive Brightneſs, or *Aurora*, which lay every where above it for about 45 Degrees. There was in ſeveral Places a faint Caſt of Red. The Heavens were every where elſe perfectly ſerene; a ſmall Weſterly Wind, and the Moon above 80° below the Eaſtern Horizon.

Obſ. II. 6h. 35'. Two Striæ riſing perpendicularly from different Parts of the illuminated Edge of the Vapour (which I all along ſuppoſe to continue it's Figure, when there is no particular Note to the contrary). Theſe were of a faint Red, and to the Height of 45° at leaſt.

Obſ. III. 6h. 40'. The Striæ were very numerous to the Left, each about 45°; and one in the Middle (by which I ſhall always mean the Middle of the Northern duſky Vapour) roſe to a ſurpriſing Height. It was 8° or 10° in Breadth; of a light Azure tinged with Green, and in ſeveral Places ſtreaked vertically with a bright Flame-Colour. There was alſo N W by N. a large Area or Body of a very intenſe Red.

Obſ. IV. 6h. 45'. *Fig.* 18. The whole extraordinarily luminous. The Red diffuſed in all Parts above the greeniſh Light, which now bounded the duſkiſh Vapour in the North; and indeed ſeveral Parts of this were tinged therewith alſo. But the moſt intenſe Red was towards the N W. and N E. by E, between which were various pyramidical Streams of different Colours, ſome Blue, ſome Green, others Flame-coloured, *&c.* many tinctured with, and all terminated by, the diffuſive Roſineſs. One Stria was of a ſurpriſing Luſtre, of a light Azure turned upon Green, appearing N W. by N. This Scene was very beautiful, the Height of each Column about 45°, and many of them well defined.

Obſ. V. 6h. 50'. The enlightened Part of the Hemiſphere was every where tinged with Red; it's horizontal Bounds the ſame as before, but it's Altitude about 70°. Whence it appears the *Aurora* is conſiderably extended upwards. The reddiſh Caſt on the right Hand from North to Eaſt was beautifully diſtinguiſhed into perpendicular Striæ, which generally obſerved the following Order of Colours, beginning from the Eaſt; *viz.* a deep Azure, which ſucceſſively proceeded to the lighteſt Blues (though each Column was of ſuch Intenſity as to be diſtinguiſhed from the neighbouring Columns) after which followed ſeveral Degrees of Green, and then of Red, the deepeſt being an intenſe Scarlet. And this Order was repeated ſeveral times, filling up the whole Space from N E. to N by W. The Weſtern Regions were at the ſame Time of an undiſtinguiſhed Red. Many of the riſing Columns were very exactly terminated.

Obſ. VI. 6h. 55'. *Fig.* 19. The Red, which in the laſt lay towards the Zenith, became very intenſe; darting to the horizontal Vapour, throughout the intermediate Space, innumerable Striæ differently coloured. The horizontal duſkiſh Cloud was ſomewhat raiſed; an apparent Stratum of Blue

juſt under it, which towards the Horizon was of a fainter Caſt, as the Colour of the Sky is when over-charged with Vapours. I ſhould not forget that the upper Surface of Red jutted out, irregularly, in ſeveral Places, though in general well terminated; as I have obſerved the Caſe has been in ſome riſing Clouds.

The diſtinguiſhed Red towards the Zenith, approaching nearer thereunto; it is about 20° broad upon our Meridian, and thence tapering to the Eaſtern and Weſtern Horizon. The whole Appearance is of a reddiſh Hue, 'tis in ſome Places faintly ſtreaked. At this Juncture appeared ESE conſiderably removed from the other Phænomena, a remarkable Oval, the tranſverſe Diameter erect, about 30° in Length, and of a very bright Azure. The whole Scene was very beautiful. *Obſ.* VII. 7h. 0'.

The Phænomena much the ſame, excepting that the reddiſh Caſt has riſen, and is now diffuſed to the Southward of the Zenith. The other Parts of the Northern Hemiſphere much like the genuine *Aurora*, interſperſed with various ſmall Clouds. There are two diſtinguiſhed parallellogramic Areæ of an intenſe Red, nearly 30° in Diameter, the one to E by N. the other to NW. which was of the deepeſt Colour, and croſſed in the Middle with a black Bar. The bright azure Oval ſtill remains towards the ESE. *Obſ.* VIII. 7h. 2' ½. *Fig.* 20.

The whole Appearance ſeemingly vaniſhed, excepting that the Northern Regions retained the *Aurora*, which was as bright as about half an Hour after Sun-ſet. The Eaſtern Area of Red was diſtinguiſhable, though very faint, reaching from 30° to 50° high; alſo the former Area to the NW. ſomewhat more intenſe. This was the ſame as in the laſt Article; and the black Bar mentioned then, appeared now to be a Cloud moving Eaſtward, Part whereof was ſeen on this red Area, and Part to the North. And in this View the red Vapour appeared vaſtly more diſtant than the Cloud. There were ſeveral ſmall Spaces of Light interſperſed throughout the Scene. *Obſ.* IX. 7h. 5'.

The Appearance ſomewhat changed. The Area of Red NW. was the moſt intenſe. Several riſing Columns of a faint red and blue between Weſt and North. A deep Red E by N. I have all along obſerved, that ſome of the fixed Stars could be ſeen through all the Colours that have ſucceſſively laid upon them, though with conſiderable Differences as to Obſcurity and Clearneſs, according to the Intenſities of the Colours. No Clouds in the Southern Regions. *Obſ.* X. 7h. 15'.

It is now neceſſary for me to obſerve, that the Wind has been all along Weſt and W by N. and if the ſtrongeſt Winds be expreſſed by 10, this was ſometimes 2, and, I think, never leſs than Unity. I am informed that at *Boſton*, which lies about three Miles Eaſtward, it was all the while to the Eaſtward of the South. The *Aurora* ſtill of the ſame Dimenſions, but the Edge of the duſkiſh horizontal Cloud much abated of it's Brightneſs and Colour. There are four remarkable Spots, or Areæ of Red, one E by N. one NE. by N. very intenſe, *Obſ.* XI. 7h. 20'.

intenſe, as alſo was another nearly North; and the laſt bore N W by N, which, with the E by N, has been of ſome conſiderable Duration.

There were ſeveral conſiderable Striæ intermixed with red, and a Flame-colour riſing about N N W.

Obſ. XII. 7h. 28'. The Redneſs about the North increaſed in it's Dimenſions and Intenſity very much. It reaches from the North Star to about 20° upwards, and for about 12° is exceedingly bright.

It is diſtinguiſhed into ſeveral perpendicular Columns of various Degrees of Red, and many well terminated.

Obſ. XIII. 7h. 30'. The Redneſs N E by N. moves Weſtward, and is conſiderably altered in that reſpect ſince the firſt Obſervation thereof. That about the North Star is now divided in the Middle by a perpendicular Column, very broad, and of a very intenſe yellow Light. It appears now that this alſo has a ſlow Motion Weſtward: But the Weſtern Redneſs has all along advanced Eaſtward at a conſiderable Rate.

Obſ. XIV. 7h. 37'. *Fig.* 21. The three red Areæ juſt mentioned are now united, and nearly confounded with one another. The Diſtinction is only as to the Degree of Redneſs. The *Aurora* which lies partly under theſe is conſiderably abated of it's Luſtre; and the horizontal Bounds contracted to about 80°, though the Altitude is rather increaſed. The Eaſtern and Weſtern Limits ſeem ſtill to approach one another very ſlowly. There was one Stria very conſiderable, horizontally poſited, and about 5° broad, of a bright Flame-colour, reaching from the horizontal Bounds throughout the whole Meteor Arch-wiſe, whoſe greateſt Height was about 15°.

Obſ. XV. 7h. 45'. The Flame-coloured Arch much diminiſhed. The Redneſs very evident, and contiguous; though in ſome Places of different Intenſities, and viſibly increaſing about N by W. On each ſide of which there was a diſtinguiſhed Ruddineſs.

Obſ. XVI. 7h. 51'. The Diſtinction of Redneſs about N by W. changed to a more intenſe uniform Redneſs, which ſeemed to be by the Union of the aforeſaid diſtinguiſhed Areæ; and the greateſt Intenſity was in the middle Space that was between them; *viz.* N by W. At this Juncture I was not a little ſurprized with an extraordinary Flaſh of Lightening very bright, which began about the midſt of this congregated Vapour, and ran with an oblique undulatory Motion for 20° towards the Horizon.

Obſ. XVII. 8h. 1'. The Redneſs ſtill continues, but much abated.

Obſ. XVIII. 8h. 9'. The Meteor ſcarce to be diſtinguiſhed but by the *Aurora*, which reaches from N W to E, in ſuch Sort of Curve that the higheſt Part is due North about 40° of Altitude. There is ſtill a reddiſh Caſt N N W.

Obſ. XIX. 8h. 30'. The Colours not very conſiderable; but the Form entirely new. The Breadth of the Redneſs was from the Pole Star downwards about 20°; and from thence it run tapering on the left Hand to W by N.

and on the Right to the Eaſt. In which Points it was of no diſcernable Breadth. It's upper Edge was of the deepeſt Red, which dilated by Degrees to a Flame-colour, and could ſcarce be diſtinguiſhed from the neighbouring *Aurora*. However, there were two Spots, one to the Right, and the other to the Left, in the extenſive Arch of a remarkable Sadneſs.

This was an extraordinary beautiful Appearance. From the Zenith about 20° Southward, an uncommon Redneſs was formed, as it were into a Knot or Canopy, very diſtinctly terminated (eſpecially on the South Parts) about 20° in Length, which lay Eaſt and Weſt, and little leſs in it's Dimenſions North and South. From this iſſued innumerable Striæ throughout the Northern Hemiſphere and farther, the horizontal Bounds being WSW. to ESE. Theſe Striæ were diſperſed in an exact Order, proceeding from the aforeſaid Knot, as Folds equally diverging, and each of the ſame Colour and Brightneſs throughout the whole Space to the Horizon. The Order of the Colours was very agreeable, interchangeably blue, red, and then Flame-colour; each of which was alſo diſtinguiſhed into Striæ of various Intenſities, from the deepeſt blue to the lighteſt; from the Bounds of Violet, to a Tincture of Orange; and laſtly, from the Colour of the *Aurora* to the brighteſt Flames. And this Order was repeated innumerable Times throughout the whole Scene. The whole was as bright, and in many Reſpects reſembled a Series of Rainbows vertically poſited; and in this View the Generality of People will always remember it. And indeed were the Heavens to be diſpoſed into innumerable Rainbows (excepting only the greater Number of Primitive Colours) it would ſcarce exceed this Phænomenon in Beauty: And the Knot from whence it ſeemed to proceed, far ſurpaſſes any of the Redneſs of that Meteor, and even Blood itſelf. It may not be amiſs to obſerve here, that the Weſtern Breeze has been for ſome time ſince perfectly lulled; nor is there the leaſt Motion in any Part of the Heavens. *Obſ.* XX. 9h. 25'. *Fig.* 22.

The Northern Bank of Vapours has all along continued, and now reaches from W to E by S, it's greateſt Height about 8°.

The bloody Knot wholly vaniſhed; though ſeveral of the deſcending Striæ remain entire, and in many Places Parts of others, all of the ſame Direction, and a fainter Colour than before. The Sky is perfectly calm and ſerene. *Obſ.* XXI. 9h. 35'.

The Northern Regions retain a bright *Aurora*, interſperſed with a reddiſh Caſt. From the Zenith is diffuſed a very extenſive red Vapour, reaching to the Southward near 30° from the Zenith, and from thence converging towards the Eaſtern and Weſtern Horizon, where it meets, the one E by S, and the other WSW. The Southern Edge was of the deepeſt Red, and the moſt diſtinguiſhed Redneſs WSW. There appeared a falling Star SW. of a conſiderable Duration. *Obſ.* XXII. 9h. 42'.

The

Obſ. XXIII. 10h. 2'. The Meteor much advanced to the Southward, it's greateſt Height being not above 40° from the Horizon: It's horizontal Bounds E S E and W by S. It's Redneſs much abated; but the *Aurora* diffuſed every where throughout the Scene, as conſpicuous to the South as towards the North Parts of the Zenith; which was an uncommon Sight. The Sky was now remarkably hazy, and full of Vapours.

Obſ. XXIV. 10h. 18'. The *Aurora* advanced conſiderably to the Southward of the red Vapour, which now is much diluted, about 20° in Breadth, a Part of it at leaſt 50° to the Southward of the Zenith, and tapering towards the Eaſtern and Weſtern Horizon, where the Bounds are much the ſame as before.

Obſ. XXV. 10h. 25'. *Fig.* 23. *in which* Z *denotes the Zenith, and* N. E. S. W. *the Horizon.* The *Aurora* ſeparated from the reddiſh Vapour conſiderably, in the upper Parts, though joined in the horizontal, and not above 25° from the South Horizon. Not any diſtinguiſhable red to the Northward, but an Arch of the *Aurora* of much the ſame Height, though much inferior in it's horizontal Meaſure. The Southern and Northern *Aurora* each very bright. There were ſeveral temporary Flaſhes in many Parts of the red Vapour. At this Juncture the *Aurora* ſeemed to appertain as much to the Southern as Northern Horizon; and the Redneſs conſiderably more: But there was a great Difference juſt towards the Horizons; the one being covered with the duſkiſh Vapour ſo often mentioned, and the other appearing of it's natural blue.

Obſ. XXVI. 10h. 35'. The Appearance over, excepting a reddiſh Caſt to the Eaſtward, and a faint *Aurora* in the Northern Regions, of but ſmall Extent from the duſkiſh horizontal Vapour.

Obſ. XXVII. 11h. 35'. There have not been any remarkable Phænomena ſince the laſt. The Northern *Aurora*, with the duſkiſh Vapour, ſtill continue, and I think as evident as at any of the foregoing Periods.

Here I ended my Obſervations. I am informed by others, who were occaſionally on the Water, that it's beginning was juſt after Sun-ſet, in the Form of an extended darkiſh Cloud riſing Northward; a few Minutes after the Appearance of which, there was, towards the Eaſtern and Weſtern Regions, a very diſtinguiſhable Tincture of red. And the next Change was my firſt Obſervation.

Obſ. XXVIII. 11h. 45'. *Fig.* 24. It appeared in a new and very ſurprizing Form. The Edge of the horizontal Vapour was ſtrongly illuminated, as though it had been fired; and this was in Height about 8°. From hence aroſe up continually, following one another, very extenſive horizontal Columns of a bright Flame-colour, which in ſcarce a ſecond of Time reached ſome to 40°, others above 60° of Altitude, and many to the intermediate Altitudes. Each of theſe Columns were as though a horizontal Train of Gunpowder had been ſuddenly fired, and the Flaſhes regularly propagated to ſuch enormous Heights in a horizontal Poſture. And there were innumerable Succeſſions of theſe riſing Flaſhes, the Phænomenon continuing nearly a quarter of an Hour. This Compariſon will alſo illuſtrate ſeveral other Particulars

at

at this Juncture. Sometimes there were ſeveral of theſe Flaſhes aſcending together, at a little Diſtance from one another, as though there had been ſeveral horizontal Trains ſucceſſively and almoſt inſtantaneouſly kindled after one another. Sometimes the riſing Line of Light would be continued horizontally throughout the whole Scene, in other Places three quarters, an half, one third, a quarter, *&c.* of the ſame Length, as though theſe Trains had been unequally extended. Sometimes the Flaſh would begin in the Middle, and run kindling to the Extreams: Then, at one Extream, moving towards the other; and at other Times in more Places than one: But in all theſe Varieties, the horizontal Motions ceaſed, and the whole became one uniform Line before it had paſſed the enkindled Edge of the Cloud, which was not above 8°, as I obſerved before. All which may be well repreſented by the aforeſaid Trains of inflamable Matter, ſometimes enkindled in one Place, ſometimes in another, but always propagated through the whole Train, with ſo ſwift a Motion, that there could be no conſiderable Difference as to the Height of one Part above another. The greateſt Extent of theſe horizontal Flaſhes was from N W to N E. After theſe Phænomena the Meteor aſſumed it's uſual Form; *viz.* a bright *Aurora* ſettled upon a duſkiſh horizontal Vapour.

The Meteor was again formed into much the ſame Shape as was deſcribed in Obſervation the twentieth, but of fainter Colours conſiderably. It vaniſhed alſo again in the ſame manner. *Obſ.* XXIX. 2h.

The *Aurora* continued till Day-light; and the Phænomena, at different Times, and without any certain Periods, were much the ſame as I have deſcribed in one or another of the foregoing Articles. *Obſ.* XXX. 6h. 30'.

I ſhall conclude theſe Notes, by obſerving, that the Day before this Meteor was very warm for the Seaſon, though early in the Morning there was a very conſiderable Hoar-Froſt. The Morning following was remarkable for an abundant Dew. The Temper of the Air much the ſame as the preceding Day. About Eight o'Clock the Heavens fair and calm. Barom. 30.1. Therm. $\frac{38}{100}$.

You may obſerve, that in the Figures I have attempted the *Stereographic Projection* of the moſt conſiderable Scenes, which may be a conſiderable Aſſiſtance to the Imagination; though I think the Expreſſions do not abſolutely require any Schemes.

I have compared theſe Obſervations with what I could find relating to the *Aurora Borealis* in the *Philoſ. Tranſact. &c.* and think there are few Particulars mentioned there, but what occurred in this wonderful Inſtance; ſome that are rare confirmed, and a few altogether new; but the chief Advantage, I ſuppoſe, in theſe Notes, in the Proceſs, Criſis, and Decay, which is ſo obvious in many of the moſt remarkable Scenes.

—*by Mr* Rich. Lewis; No. 418. pag. 69.

2. About Six at Night the North Part of the Hemiſphere appeared of a faint red, the Horizon was very duſky, and this Redneſs was bounded above by a very dark Cloud.

As the Night advanced this Meteor reddened, till it was of as deep a Colour as Blood; and it ſpread itſelf to the North Eaſt. It continued all Night, but about Two in the Morning, I obſerved that it ſent forth two and three Streams from it's North Part, of a whitiſh Colour, which ſhot up to the Zenith. Theſe Emanations looked much like the Rays of the Sun, when they paſs through a dark Cloud, when it's ſaid to be drawing Water. I took it to be an *Aurora Borealis*, but it appeared much fainter than thoſe I have ſeen in *England.*

Dr *Samuel Chew* at *Maidſtone*, tells me, that he has for ſome Days paſt, at Morning and Evening, obſerved ſeveral Spots in the Sun, very plainly with his naked Eye, ſome of which ſeemed very large.

An Invitation to an Aſſociation in forming Meteorological Diaries, by James Jurin, M. D. R. S. Sec. No. 379. p. 422.

XXXVII. Cœli & Aëris, quem ſpiritu ducimus, conditiones varias, frigoris, puta, & caloris, ſudi, vel humidi commutationes & viciſſitudines, magnas præſertim atque ſubitaneas, ad Humani Generis valetudinem pertinere merito cenſetur. Operam itaque & laborem in iiſdem obſervandis minime contemnendum poſuerunt non Medici ſolum, ſed & alii quoque ab omni ævo Naturæ rerum contemplandæ ſtudioſi. Superiore tandem ſæculo Inſtrumenta etiam & Machinæ Philoſophorum ingenio & diligentiâ repertæ ſunt, quibus ponderis, caloris, humiditatis, & elaterii aërii momenta & mutationes ſimul oculis repræſentantur, ſimul ad menſuram ac trutinam, & quidem ſubtilem admodum illam atque accuratam, exiguntur.

Nec hic etiam ſubſiſtendum judicarunt Eximii illi Viri, ſed ſtudio & ſciendi amore incitati ad cauſas harum mutationum, quâ licuit, indagandas contenderunt. Quem in finem Obſervationes Inſtrumentorum recens inventorum ope factas de pondere, humiditate, & calore ambientis diligenter in Diariis notabant; iiſque multa alia adjiciebant ad Tempeſtatem ac Cœli faciem, Ventos, & Pluviæ copiam pertinentia, quod in Actis Philoſophicis & alibi ſparſim videre eſt.

Methodo iſtâ & obſervandi ratione meliorem facile non reperias. Quod ſi fuiſſent Obſervatores & numero idoneo, & commodis locis per magna terrarum ſpatia diſpoſiti; ac tandem unus aliquis omnium Diaria, quid inter ſe convenirent aut diſcreparent, contuliſſet; profecto jam a multis annis eam haberemus Aëris Hiſtoriam, qualem hoc temporis vix animo & votis fas eſt concipere.

Id etenim compertum habemus, ut quod maxime, ſubitas Tempeſtatum commutationes Ventis præcipue acceptas eſſe referendas; quumque ſcire liceret per talem obſervandi rationem, qualem ſupra expoſuimus, quibus in locis orti, quem curſum, quo tempore & per quanta terrarum ſpatia Venti tenerent; his cognitis, forſan ad Originem etiam & Cauſas Ventorum aſſequendas via patuiſſet. Unum hoc ſaltem, quod ipſum non leve momentum ad has diſquiſitiones attuliſſet,

tuliſſet, quodque jam, ut plurimum, pro Conjecturâ verisimili habetur, potuiſſemus certiſſimis obſervationibus ſive veri, ſive falſi arguere. Opinionem dico ſagaciſſimi Viri, *Edmondi Halleii* *, qui Hydrargyrum ideo cenſet in Barometro aſcendere, quod Venti ex contrariis regionibus utrinque eodem ſpirantes Aërem cogant & quaſi in cumulum attollant; ut contra Hydrargyri deſcenſum Ventis, ex eodem loco verſus oppoſitas partes Aërem deferentibus, & quaſi exhaurientibus, attribuit.

Rogantur itaque Eruditi, qui ad excolendam hanc partem Hiſtoriæ Naturalis operam ſuam conferre voluerint, ut quotidie ſemel minimum, vel utcunque ſæpius libuerit, notare dignentur in Diario Barometri & Thermometri altitudinem, Venti Plagam cum aliquâ virium æſtimatione, Cœli faciem, & Pluviæ vel Nivis quantitatem, quæ tempore poſt obſervationem ſuperiorem elapſo deciderit. Quod ſi quis Obſervationes Hygroſcopii cujuſlibet, ſive Acus Magneticæ ope factas adjicere voluerit, non erit ingratum.

Quoties ingruerit Procella vehementior, utile fuerit ortum ejuſdem, incrementum, ſummam violentiam, remiſſionem & exitum notatis temporibus accuratius deſignare, uti & altitudines Barometri, quæ dictis temporibus reſpondeant.

Monendum cenſemus, ut qui Barometri replendi & conficiendi modum callent, Barometro vulgari, ſive aperto, quod vocant, utantur. Sit autem Tubus quartam, ut minimum, vel etiam tertiam digiti partem latus, quum in Tubis anguſtioribus Hydrargyrus infra juſtam altitudinem ſubſidere deprehendatur †. Ciſternæ vero, ſive Vaſi Hydrargyrum excipienti tribuetur diameter octonis ſaltem, vel decem partibus major Tubi diametro, idque eum in finem, ut aſcendente, vel ſubſidente Hydrargyro in Tubo, altitudo Hydrargyri in Ciſternâ invariata permaneat, aut certe quam paululum immutata.

Qui vero Barometro clauſo, ſive portatili uti malunt, ejuſmodi Barometra magnâ diligentiâ fabricata comparare poterunt apud Laudatum Artificem *Franciſcum Hawkſbejum*, in Areâ vulgo dictâ *Crane-Court*, *Londini* degentem; qui Thermometra etiam ſubminiſtrabit ad eâm Scalam, ſive graduum notationem exacta, quæ jam per multos annos, exquiſitis ejus Thermometris inſculpta, innotuit Eruditis.

Qui Thermometro utuntur aliâ quâcunque ratione conſtructo, rogatos volumus, ut in Diario Thermometri ſitum, fabricam, diſpoſitionem graduum in Scalâ, & nomen etiam Opificis, ex cujus Officinâ prodiit, apponere ne graventur. Situm Thermometro commodiſſimum cenſemus in conclavi ad Septentriones obverſo, ubi focus aut nunquam accenditur, aut ſaltem quam rariſſime.

Quo facilius inter ſe conferri poſſint Diaria, commodum fuerit omnia in hujuſmodi formam diſponere.

Columna prima indicet diem & horam obſervationis; ſtylo autem ut omnes Juliano, ſive Vetere, in Diariis utantur, Obſervatores rogamus.

* *Vid.* Philoſ. Tranſact. N. 181. † *Vid.* Philoſ. Tranſact. N. 363

Secunda altitudinem exhibeat, ad quam attollitur Hydrargyrus in Tubo Barometri ſupra ſuperficiem Hydrargyri in Vaſe, per digitos, ſive partes duodecimas Pedis *Londinenſis*, & per partes decimales eorundem digitorum notatam. Habet autem Pes *Londinenſis* ad *Pariſienſem* eam rationem, quæ eſt inter 15 & 16 proxime.

Columna tertia gradum monſtret, & partes gradus decimales, quas Spiritus in Thermometro attingit.

Quarta Venti Plagam & ſpirandi vires repræſentet; quæ vires ſemper denotari poterunt per aliquem ex numeris ſequentibus, 1, 2, 3, 4: ex quibus 1 ſignificet leniſſimum Aëris motum vix arborum folia agitantem, 4 vero ſummam Venti violentiam; numeris 2 & 3 intermedias inter haſce Ventorum vires exponentibus, & denotante cyphrâ, ſive 0, perfectam Malaciam.

Quintam occupet Cœli facies, & ſuccincta Tempeſtatis hiſtoria.

Sexta & ultima altitudinem pluviæ, vel nivis in aquam reſolutæ, quæ poſt ſuperiorem obſervationem deciderit, per digitos *Londinenſes* & eorum partes decimales metiatur.

Hæc facile æſtimari poterit ope Infundibuli duos circiter, vel tres pedes ampli, Vaſis alterius aquam ex Infundibulo defluentem excipientis, & Menſuræ Cylindricæ cum Regulâ in digitos & partes decimales divisâ. Infundibulum ita ſitum ſit, ut, quicunque ventus flaverit, nulla tamen pluviæ pars ſive ædificii interventu, ſive quocunque alio impedimento intercipi queat. Sit autem vas aquam continens undique probe clauſum, ne quid in vapores attollatur, angusto ſolum foramine, ad aquam deſuper ex Infundibulo excipiendam, relicto. Menſuræ porro Cylindricæ Diameter decem partibus minor Diametro Infundibuli tribuetur: quo fiet, ut aqua digitum unum alta in menſuræ ad altitudinem centeſimæ partis digiti in Infundibulum, atque adeo in reliquam terram, cecidiſſe intelligatur; & ſimiliter pro partibus digiti decimalibus.

Ad finem vero Menſis & Anni cujuſque apponatur media altitudo menſtrua, vel annua, Barometri & Thermometri, uti etiam ſumma omnium altitudinum Pluviæ, quæ Menſe, vel anno integro deciderit. Habebitur autem dicta media altitudo, redigendo in unam ſummam, omnes Barometri altitudinum obſervationes mane factas, Thermometri vero ſive matutinas, ſive totius diei maximas, (quæ nempe circa horam tertiam, vel quartam pomeridianam contingunt) & ſummam iſtam per numerum dierum dividendo.

Omnes rogamus, qui ſupraſcriptas Obſervationes, vel univerſas, vel aliquâ ex parte volent inſtituere, ut Diariorum Exempla, ad finem anni cujuſque continuata, ad Secretarios Regiæ Societatis tranſmittere dignentur; uti cum Diario, quod *Londini* juſſu Societatis Regiæ conficitur, conferri poſſint. Conſilium vero eſt, ut quicquid ex Diariorum iſtorum collatione colligi poterit, ſingulis annis in Actis Philoſophicis cum Publico communicetur.

Diarii

Diarii Forma.

Dies & Hora 1723. Nov. St. V.	Barom. alt. dig. dec.	Therm. alt. gr. dec.	Vent.	Tempestas.	Pluvia. dig. dec.
1. 8 *a. m.*	29. 75	49. 6	S. W. 1	Cœlum nubibus obduct.	0.035
4 *p. m.*	29. 56	47. 3	S. W. 2	Imbres interrupti. Sol pervices intercurrens	0.043
2. 7 ½ *a. m.*	29. 24	48. 5	S. 1	Pluvia fere perpetua	0.725
3. 9 *a. m.*	29. 95	49. 7	N. 1	Cœlum sudum	0.032
5 *p. m.*	30. 4	49. 2	N. 1	Cœlum sudum	0.000
4. 7 *a. m.*	29. 9	47. 0	S. W. 1	Nubes sparsæ	0.000
10	29. 7	46. 2	S. W. 2	Imbres intercurrentes	0.103
12.	29. 4	45. 0	S. 3	Cœlum nubibus undique fere tectum	0.050
3 *p. m.*	28. 8	46. 0	S. 4	Nubes sparsæ	0.000
5	28. 6	47. 2	S. W. 4	Eadem Cœli facies	0.000
7	28. 9	48. 0	S. W. 2	Pluit	0.000
9	28. 9	48. 2	0	Pluvia fere perpetua	0.305
5. 7. *a. m.*	29. 7	53. 4	N. E. 1	Sudum. Gelu.	0.250

XXXVIII. This Method in general is, that in Addition to such Observations as should be made on Land, there might be some Account taken of those also that were made at Sea; which already are by far more numerous than what were ever made ashore, or indeed what can be expected thence for some Ages still to come. This Method occurred to me, as I was looking over various *Journals of Voyages* in my Passage from *England*, in which I was not a little surprized to find the following Particulars constantly observed.

A new Method for composing a natural History of Meteors, *by* Mr Isaac Greenwood, *Prof. Math. at* Cambridge, New-England, N°. 401. p. 390.

First, There was a general Account of the Weather for every Day, during the Passage of the Ship on the Voyage, which though not quite so exact as the Observations of the same Kind that have been made on Land, particularly what were published by the Rev. Mr *Derham*, yet for all that I know, are sufficient for the Design. However, if there is any Defect in this Article, it is abundantly made up in another Column; which is a far more exact Register of the Direction of the Winds than was ever kept ashore, being an Account thereof to every two Hours in the Day. This Article may perhaps be of very great Importance; since, as Dr. *Jurin* observes, *Compertum habemus, ut quod maximè, subitas tempestatum commutationes Ventis præsipuè acceptas esse referendas.* As for the Degree or Strength of the Wind there are also sufficient Data in all Sea Journals to determine it, as I shall particularly shew in the Sequel of this Paper. Lastly, there is a daily Account inserted of the Latitude and Longitude of the Ship, that there will be no Difficulty in computing what Part of the Globe each Observation belongs to.

And now since there is in the World a great Variety of these Marine Observations already made, (for in all Voyages whatsoever that

have been performed for many Years past, it has been customary to keep an exact Journal of the aforesaid Articles,) I thought it might be no difficult Matter to collect therefrom the History of the Winds, and Weather in most Parts of the Ocean.

In order to this, I imagined that if the Royal Societies of *London* and *Paris* should encourage such a Design, they might easily procure Extracts from most of the Journals kept in their respective Nations: For certainly such Gentlemen as would be at the Pains to keep a constant Diary of the Weather, would not fail also to communicate such Marine Observations, as they should be able to obtain.

The Seamen likewise themselves, (among whom there are a considerable Number of such as have a Taste for Physical Knowledge) as they are under a Kind of Necessity to observe exactly the Winds, *&c.* would not be backward in transmitting their Observations; especially when they were informed of what Importance and Advantage it might be to themselves, and the Cause of Navigation.

I proceeded further to think, that if the aforesaid Societies should judge it improper to be at so great an Expence as would be requisite in printing so many Extracts from such Journals as should be sent to them, that they might notwithstanding keep in Manuscript a Book of Tables of such Marine Observations, as they should think fit to collect therefrom; and that the Secretaries of the Society (who for the most Part are such Gentlemen as have in a particular Manner discovered a generous Principle of promoting Natural Knowledge) should take Care, that all such Observations were transcribed in their proper Places.

The Form of these Tables I thought might be in the following Manner.

January the First, 1726.

Longitude		20			21.			22.		
Latitude	H.	W.	D.	Weather.	W.	D.	Weather.	W.	D.	Weather.
	12.	N.	2.	Fair.						
	6.									
	12.	N b E	3.	Fair.						
30.	6.									
	12.							S b E	2.	Cloudy.
	6.								2.	Rain.
	12.							S	3.	Storm of Rain.
31.	6.							S b E	2.	Rain.

In which the *Title* shews the *Year*, *Month*, and *Day*; the *horizontal Space* just below it, the *Longitudes*; the *vertical Space* without the double Lines,

Lines, the *Latitudes*; *that within the double Lines*, the *Hour* of the Day; and the *horizontal Spaces* under the Longitudes, the *Wind*, it's *Degree*, or *Strength*, and the *Weather*, which are accordingly marked with W. D. Weather.

In this Specimen I have noted every Degree of Latitude and Longitude, that the Work might be the more perfect. I have only taken Notice of Four Hours in the Day, *viz.* 12 at Noon, 6 in the Afternnoon, 12 at Night, and 6 in the Morning. However, if there be required a greater Exactneſs in this Article, it will be eaſy enough to frame Tables accordingly. I began the Hours with 12 at Noon, becauſe all Journals are kept from that Period, the Marine Day being always counted from Noon to Noon. There may be other Columns inſerted, as I ſhall mention in the Cloſe of this Paper, though what I have already taken Notice of is ſufficient to our preſent Deſign.

Of theſe Sort of Tables there muſt be at leaſt Four Volumes; One for that Part of the Atlantic Ocean, which ſuch Ships generally paſs over, which Trade between *Great Britain* and the *Weſt Indies*; another for thoſe Parts of the Ocean, that lie in the Paſſage of ſuch Ships as are engaged in the Mediterranean, or *Turkey* Trade: to which may be added a Table for the *African*, and *India* Commerce. A third may be framed for that Part of the Ocean, that lies between the Northern Provinces in *America* and the *Weſt Indies*; and a fourth for the Ships that paſs between *New-England*, and *New-York* and *Britain*, which on the Northern Part may be made ſo wide as to take in the *Newfoundland* Trade, *&c.*

It muſt be confeſſed, that the Work will be very much protracted, and require ſome conſiderable Application and Care, in extracting ſuch Obſervations, as ſhall be of Uſe, from Journals. There will alſo be ſome Difficulty in procuring any conſiderable Number of ſuch Journals; and laſtly, there is but a very ſmall Number of Obſervations made in Compariſon to the Spaces that muſt be allow'd in the Tables for them, by which Means there muſt neceſſarily be a great Waſte.

In Anſwer to theſe Objections, it may be ſaid in general, that there will be much leſs Application and Care required than in keeping a *Diary* of the Weather, *&c.* on the Land. By this Means alſo, there may be more Obſervations collected in a few Years, than can be expected from the other Method in ſome Ages; and one Man may be able in a few Months, hereby to compile a larger Hiſtory of the Weather, than what has hitherto been done by the united Obſervation of all ſuch, as have undertaken this Province.

Though there might be ſome Difficulty as to particular Perſons in procuring a great Number of Journals, it cannot be ſuppoſed, that ſo illuſtrious a Body of Men as the *Royal Societies* at *London*, and

and *Paris*, ſhould meet with the ſame. It is obſervable alſo, that in the *Royal Navy* of *Great Britain*, the Maſters of the *Mathematics* are obliged to keep ſuch a Journal by an Act in the late Reign, on Board every Ship, which without Doubt might be eaſily obtained on this Occaſion: Nor can we imagine any in the trading Intereſt would refuſe a Thing, that tended ſo much to their own Advantage and Benefit.

It is true, there can be no Remedy for the many empty Spaces in the Tables (if that Method be followed which I have propoſed); however this will be look'd upon as a trifling Objection, by ſuch as conſult the Improvement of Natural Knowledge, rather than the Waſte of Paper.

I ſhall conclude theſe general Remarks, by obſerving, that as the Hiſtory of the Winds and Weather is capable of a more ſpeedy and expeditious Improvement from Marine Obſervations than from Diaries from the Land, ſo alſo it is capable hereby of a more large and extenſive Improvement. Without Doubt it will require many Years before Obſervatories of the Weather, *&c.* will be erected at all the *Univerſities* and *Capital Towns* of the Provinces, Shires, *&c.* in *Europe*, (if ever ſuch ſhould be) not to mention *Africa*, *Aſia*, and *America*, from which little can be expected in this Affair; and yet upon that Suppoſition, how few would the Diaries be, in Compariſon of the great Number of Journals that are annually kept at *Sea?* beſides many Thouſands that might perhaps be obtained, relating to the Courſe of the Winds and Weather, ſucceſſively for many Years laſt paſt. It is beyond my Abilities, indeed, to calculate with any Exactneſs, how many Veſſels there may be upon the Seas which I have named, in the Space of one Year, and conſequently how many diſtinct Journals there are annually kept; however, if I may judge from the Trade of the little Town, where this Letter is dated, there muſt be many Thouſands: For there are ſeldom leſs than eight or nine Hundred Voyages made to and from this Port in a Year. I ſhall only add in this Place, that the Method here propoſed ſeems to have the Advantage of the common Method heretofore uſed in compoſing the Natural Hiſtory of Meteors; inaſmuch as that requires a particular Application and Attention without any other Views and Advantages; whereas in our Caſe there is a Kind of Neceſſity of making ſuch Obſervations, in order to conduct a Ship ſafely thro' the Ocean, whether the Philoſophical Part of Mankind ſhall think fit to improve them in their Intereſt, or no: However, I would not be underſtood, by any Thing that has been ſaid upon this Head, to derogate from the Deſign of obſerving on Land, for that likewiſe has many Advantages, that we can by no Means pretend to in the New Method.

We

We may be able from this Method to define with a great deal of Exactneſs, the Bounds and Limits of all conſiderable Winds; for as there are at all Times in the Year ſome Hundreds of Veſſels at Sea, it is of the ſame Importance in our Caſe, as though there were ſo many diſtant Obſervatories there; and that the Knowledge of theſe more extenſive and general Winds would be of conſiderable Uſe, none will deny, that ſhall attentively conſider it; for hereby we may be able to judge, in what Place ſuch a Wind has it's Origin, how long a Time it continues, with what Velocity, it moves, where it's greateſt Strength is, and how great a Part of the Earth it paſſes over. Perhaps alſo, in Proceſs of Time by this Means, we may arrive to ſo much Skill, as to judge with ſome conſiderable Certainty, from the Riſe or Beginning of a Wind, what it's Effect and Iſſue ſhall be; which will be of as great Importance in Navigation, as any Thing ſtill wanting. Again, from ſuch Marine Obſervations of the more extenſive and laſting Winds, it is not impoſſible, that we ſhould be able to make a probable Judgment of the Effect and Influence of the Wind upon the Weather; which, for what Cauſe I know not, I have frequently obſerved at Sea, to change and alter, according as that doth.

From collecting all ſuch Meteorological Obſervations as are made at *Sea*, we may reaſonably expect to come to the Knowledge of ſuch Winds, as prevail moſt in particular Latitudes. Though the Wind is a very uncertain Meteor, there is no Doubt, but that in ſome Places, it has a very different Courſe from what it has in others. If I miſtake not alſo, it has been frequently obſerved, in ſome particular Places, that the Courſe of the Wind in one Year has been much the ſame as in others; and though there has been no particular Order or Exactneſs yet diſcovered, yet the prevalent Winds, or the greater Number of Winds have been in both Caſes, according to the ſame Direction: In theſe Parts of the World it is remarkably ſo. We cannot, indeed, expect to diſcover the Reigning or Prevalent Winds of ſuch Latitudes, as are very diſtant from the Tropics, by as eaſy an Obſervation, as the Trade-Winds and *Monſoons*, which are in the *Torrid Zone*, were firſt found out. However as it has been after many Obſervations, that the Courſe of thoſe Fixed Winds was determined, we may alſo hope, that Time and Induſtry may bring us to a much better Knowledge than what we have at preſent, of theſe which are more Variable. I need not ſay of how much Importance it would be to the Trading Part of the World, were we able to define the more frequent and reigning Winds of every Climate; for as the Probability of Voyages might then be calculated in the ſame Manner as that of other Chances, the Sailor might then better know

how to order his Courſe ſo, as to arrive with the moſt probable Diſpatch to his Port.

It may not be impoſſible alſo, from a protracted Series of Sea-Obſervations, not only to know the general Courſe of the Winds in every Climate in the whole Year, but alſo to make a very probable Judgment of the reigning Winds of the ſeveral Seaſons of the Year, and perhaps of every Month too: Which if it could once be obtained, we ſhould have nothing more uncertain in Navigation, than that it was a Doctrine of Chances, which might be mathematically calculated.

I ſhall mention under this Head but one thing more, which we may with all the Probability imaginable expect to arrive to, *viz.* the particular Seaſons, Signs, and Places of the *Tornados* and *Hurricanes*. The Effect of theſe are in many Caſes ſo fatal, that they call for all our Skill and Obſervation: And could the Hiſtory hereof be ſo ſucceſſively known, as that we might be able to draw any certain Conluſions from it relating hereunto, it might perhaps be a ſufficient Recompence for all the Care, that is required, in the whole Collection of Marine Obſervations.

I might add in common to the two foregoing Heads, that the Marine Obſervations have much the Advantage of ſuch as are made on Land, (which notwithſtanding are of very great Service,) inaſmuch as they are not obnoxious to any external Accidents, as theſe are; the Winds aſhore being frequently interrupted in their Courſe, and often diverted therefrom, by intervening Mountains, Vallies or Promontories.

Were I allowed to reckon among the Advantages of this New Method of obſerving on the Winds and Weather, thoſe incidental Obſervations, that might be found in Journals, of general Benefit to Mankind, they are perhaps alone ſufficient to engage us in the Work. I ſhall only hint here, that if it ſhould be thought proper to practiſe our Deſign, it may perhaps be worth the while to inſert into the Meteorological Tables, ſuch Obſervations as relate to the *Variation of the Compaſs* and *Currents*; the true Knowledge of which would be of no inconſiderable Service to *Navigation*.

If likewiſe there was a Column left for ſuch remarkable Accidents as did occur, it might not be amiſs; particularly, any uncommon Diſcoveries of Lands, Rocks, or Soundings; exceſſive Thunder and Lightening, *&c.* Luminous Appearances in the Sky; what Remarks may be found relating to the Water-Spout, which though perhaps one of the moſt curious Phænomena of Nature is as little known as any whatſoever; ſubmarine *Hiatus* or Wirlpools, if any ſuch there be; and laſtly, any extraordinary Rendezvous of Fiſh, *&c.* that are uſed in the Affairs of Life, not to mention ſuch Deſcriptions, as may relate to Matters of meer Speculation and Curioſity.

But theſe Sort of accidental Advantages, in ſuch a Collection of Journals of Voyages, as is neceſſary to our Deſign, are too numerous to be inſiſted on: I ſhall therefore only add one more, which is the great Improvement there would hereby be given to *Geography*, a Science of the greateſt Uſe and Importance in the Affairs of Life. Not only all *Hydrographical Charts* might be by this Means corrected, and brought to the Truth, which is of ſo much Concern, that the Lives of a great Part of ſuch as go to Sea depend upon it; but alſo, the Diſtances and Situation of all *Sea-Ports*, and many other Things, which are uncertain, or wanting in that Science, determined with the greateſt Exactneſs. In a Word, *Geography* may, by ſuch an Expedient, arrive, in a very expeditious Manner, to as great a Degree of Perfection, as it is capable of.

I ſhall have finiſhed my Deſign, when I have taken Notice of the Method of determining the Degree and Strength of the Wind from ſuch *Data* relating thereunto, as are to be found in Sea-Journals; which in general is, from obſerving how many *Knots* the Veſſel goes at the time of Obſervation; which is always inſerted in the *Day-Book* or *Journal*; or, in other Words, what *Velocity* ſhe then has; for the Strength of the Wind may, with Exactneſs enough in this Affair, be judged of from the Effect it produces, or the Motion it communicates to the Ship. It is true, there will be ſome conſiderable Difference in this Reſpect, ariſing from the Shape and Burthen of the Veſſel: However, as we do not expect a mathematical Exactneſs in this Article, after a little Uſe and Experience, together with comparing the greateſt Velocities of different Ships together, a Perſon may ſeldom fail of judging of the Strength of the Wind, at leaſt to a fourth Part; that is, if according to the Method propoſed in the foregoing Paper, the greateſt Winds be expreſſed by 4, and the lighteſt by *Unity*.

In *Oblique Winds*, the Strength or Degree thereof will not be directly proportional to the Velocity of the Veſſel, but muſt be corrected a little; however, there will be no Difficulty in this Matter. For ſuch as are acquainted with the Method of reſolving *Oblique Powers* into *Direct ones*, may eaſily compoſe a Table of *Proportional Parts* ſuited thereunto. I did intend to have inſerted ſuch a Table; but I am afraid I have already treſpaſſed in the Length of this Epiſtle.

XXXIX In primis animadvertam, in tempore connotando, me diei cujuſque initium a meridie, ut Aſtronomi conſuevere, ſupputaviſſe: Obſervationeſque in Ephemeridum meteorologicarum adverſaria referendas paulo poſt meridiem inſtituiſſe; niſi quidpiam me aliquando impedivit, aut tempeſtas aliqua a propoſito me illo abduxit.

Meteorological Obſervations, made for ſix years, at Padua, *by* Johannes Marchio Polenus. No. 421. pag. 201.

Veteri autem Stylo in temporibus deſignandis, & in menſuris Anglico Pede ejuſque Partibus, me uſum fuiſſe, Inſtitutum meum

ſatis declarat. Si qua erunt, enarrationum progreſſu, ad tempus conveniens Novo Stylo, atque ad Gallicam menſuram referenda; de Styli atque menſuræ mutatione admonebo.

In menſura nivis, hanc liquefieri curavi; liquatamque ratione eâdem, ac pluviam aquam metitus ſum.

Barometri mei tubulus ſatis amplus eſt, & Vaſis, quo ſtagnans mercurius continetur, diameter eſt ferme vigecupla diametri tubuli: quamobrem aſcendente intra eundem tubulum, & deſcendente mercurio, altitudo mercurij eo in vaſe tuto poteſt ceu invariata reputari.

Thermometrum meum ex genere illorum eſt, quorum inventio Gulielmo Amontonio, ornamento illuſtri Gallicæ Academiæ, adtribuitur. Tubulus eſt recurvus deſinens in phialam, cujus phialæ pars inferior vivo argento, ſuperior repletur aëre; hujuſque dilatatione vel majore, vel minore, pro varia caloris vi, mercurius in tubulo vel magis vel minus attollitur. Quoniam vero tubuli extremitas patula eſt; idcirco opportuit veram Thermometri Altitudinem ex Altitudine mercurij obſervatâ in Thermometri tubulo, Altitudineque mercurij in Barometro, collectis in unam ſummam, componere; inque Ephemerides referre Altitudinem eâdem plane ratione compoſitam. Eſt autem Thermometrum meum appenſum ad parietem cubiculi (in quo vix unquam ignis accenditur) facie unâ ad meridiem alterâ ad orientem ſolem obversâ: neque enim aptum locum ad ſeptentriones reſpicientem habeo. Thermometri mei phialâ intra glaciem immersâ ſubſidit mercurius in altitudine Dig. 47. Dec. 30. intra vero ebullientem aquam, aſcendit mercurius ad altitudinem Dig. 63. Dec. 10. Porro iiſdem ſemper Inſtrumentis, & ad eandem jugiter plagam conſtitutis uſus ſum.

Perſpicuum autem, ſi opus eſſet, ex modo relatâ & ſuperioribus obſervationibus fieri poſſet; Hyemali rigidiore tempore aërem noſtrum ad frigus aquæ glacialis quamproxime accedere (ut alias in Commentariis Regiæ Scientiarum Gallicæ Academiæ An. 1711. pag. 2. obſervatum fuit, ab aëre ſuſcipi eundem frigoris gradum, qui nivi convenit) æſtivo autem tempore, aëris noſtri teporem ab aquæ ebullientis calore diſtare plurimum: at id vel naturæ lumine notum eſt, atque manifeſtum.

Ventorum directiones ſingulis diebus adſcripſi; eorum autem vires dumtaxat cum ſatis patentes, majores, vel maximæ fuere, numeris 2, aut 3, aut 4, pro magnitudine eorum ſignavi; prætermiſſo zero, ſive malaciæ ſigno; & unitate, venti leniſſimi indicio. Ceterum, etiam me ſilente, nemo in hiſce rebus vel mediocriter verſatus non animadvertit; in infima hac prope nos aëris regione ubi Anemometrorum ſedes eſt, ſæpe unum aliquem ventum obſervari, dum in ſuperioribus aëris regionibus alii diverſique venti dominantur.

Poſt

Post hæc vero monita, attingendo rem ipsam, ut aquæ pluviæ, nec non ex fusa nive collectæ, quantitates (ut ferunt summæ ex observationibus desumtæ, singulis Mensibus convenientes) considerari queant; eas in subjectam Tabellam conjeci.

	1725.		1726.		1727.		1728.		1729.		1730.	
	Dig.	Dec.	Dig.	Dec.	Dig.	Dec	Dig.	Dec.	Dig.	Dec	Dig.	Dec.
Jan.	0	521	1	355	5	955	4	278	1	085	0	112
Feb.			1	460	1	073	1	050	1	245	2	906
Mar	0	889	3	168	1	878	4	832	2	902	4	592
Apr.	4	019	3	998	0	498	1	419	2	768	1	638
Mai.	3	625	1	368	3	530	3	403	2	634	4	467
Jun.	0	036	2	608	2	476	2	103	3	134	6	205
Jul.	2	297	2	357	2	930	4	016	4	526	2	339
Aug.	5	185	1	268	5	067	5	186	0	578	4	269
Sep.	2	647	2	900	4	164	6	948	3	267	1	090
Oct.	7	104	0	179	6	576	5	163	6	294	5	254
Nov.	3	636	2	277	5	091	6	836	4	186	0	534
Dec.	0	030	2	390	7	169	7	599	2	804	0	894
Sum. totius anni.	29	989	25	328	46	407	52	833	35	423	34	300

Si idem Menses illorum sex annorum colligantur in unam summam, comperietur ex Tabellâ minimam aquæ quantitatem decidisse Mensibus Februariis; quippe quæ non excesserit Dig. 7. Dec. 734. Maximam vero Octobribus Mensibus, quæ Dig. 30 .Dec. 570, æquaverit. Præterea ex Tabellâ eâdem facile apparet, siccioremannis aliis fuisse annum 1726, qui dedit aquæ Dig. 25. Dec. 328: aliis autem annis humidiorem fuisse Annum 1728, quo collegi aquæ Dig. 52. Dec. 833.

Numeros præterea quantitatum aquæ, singulis quæ anni Tempestatibus decidit, seorsum collegi; Tempestates ita partiens pro quocunque proposito anno; ut Hyemis initium referrem ad decimam diem Decembris anni præcedentis, & sic porro ad diem decimam Martij, Junij, atque Septembris Tempestatum reliquarum initia constituerem. Inventæ summæ, in Tabellâ, notatæ, sub oculis positæ sequuntur.

	Hyems.		Ver.		Æſtas.		Autumnus.	
	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.
1725	0	912	8	167	7	584	13	327
1726	2	815	9	6	7	355	4	999
1727	8	181	5	916	11	875	15	497
1728	11	419	10	752	12	83	20	556
1729	7	470	9	430	6	310	13	617
1730	8	693	8	817	12	818	6	562
Sum.	39	490	52	88	58	25	74	558

Ex quâ Tabellâ proclive eſt noſcere quantitatem aquæ pertinentis ad Æſtatem & Autumnum, ſingulis annis majorem fuiſſe quantitate aquæ pertinentis ad Hyemem & Ver.

Quod ſi quantitates ad quamlibet Tempeſtatem pertinentes colligantur in unam ſummam; & deinde hæ ſummæ conferantur inter ſeſe, facile liquebit, incrementa progredi eodem ordine ac Tempeſtates; ordiendo ad Hyeme; hoc eſt; Quantitatem minimam aquæ Hyemis tempore haberi, tempore autem Veris majorem, hanc vero ſuperari ab Æſtatis tempore, demum Autumnali tempore maximam reperiri.

Notum autem eſt & pervulgatum, pluviam a decreſcente Barometri altitudine, ſerenitatem vero a creſcente altitudine indicari. Ut igitur aliquo modo explorarem, quantum poſſint indicia illa, ut ex Barometro futuræ pluviæ anticipata cognitio aliqua habeatur; dies, quibus pluit ſex illis propoſitis annis collegi in varias ſummas pro Ventorum varietate, atque pro incremento aut decremento altitudinis Barometri a Meridie præcedentis Diei ad Meridiem Diei ejus quo pluit. Tabellam autem ipſam ſubjeci.

Decreſcente Barometro a Meridie Diei præcedentis ad Meridiem Diei, quo pluit.

Numerus Dierum, quibus pluit.	Ventus qualis erat Meridie Dierum, quibus pluit.
86	N.
61	NE.
33	E.
28	SE.
44	S.
42	SW.
49	W.
35	NW.
378	Summa.

Creſcente Barometro a Meridie Diei præcedentis ad Meridiem Diei, quo pluit.

Numerus Dierum, quibus pluit.	Ventus qualis erat Meridie Dierum, quibus pluit.
64	N.
41	NE.
16	E.
17	SE.
21	S.
15	SW.
20	W.
17	NW.
211	Summa.

Quâ

Quâ abſolutâ Tabellâ, miratus profecto ſum inter numeros incrementi decrementique altitudinis Barometri non majorem differentiam intereſſe quam ea, quæ inter 378 & 211 intercedit.

Fateor equidem; aliquoties creſcente Barometri altitudine a præcedente Meridie ad Meridiem Diei, quo pluit, cœpiſſe tamen altitudinem eam decreſcere poſt Meridiem Diei ejuſdem, quo pluiſſe contigit: præterea vero incrementum illud aliquoties ſumi poſſe, tanquam indicium futuræ, poſt haud longam pluviam, ſerenitatis: rationem etiam quantitatis pluviæ eſſe habendam.

Sæpe tamen nulla ex hiſce (ut ita dicam) excuſatio præſto eſſe poteſt, ut ſervetur conſtantia legis illius paulo ſupra indicatæ; qua a nonnullis ſancitur, decrementa altitudinis Barometri eſſe pluviæ indicia, incrementa vero ſerenitatis indicia eſſe reputanda. Aliquid aliud detegendum adhuc eſt ad prænoſcenda phænomena hæc. Quod ſi tamen deerit Obſervatorum induſtria, atque aſſiduitas, fortaſſis variationum hujuſcemodi leges aliquando detegentur; & *veniet tempus, quo iſta, quæ nunc latent, in lucem extrahat dies, & longioris ævi diligentia:* & fortaſſis non erunt difficilia, ac *Poſteri noſtri nos aperta neſciſſe mirabuntur.*

Nivalium poſtea Dierum, propoſitis ſex illis annis contentorum comparationem inſtitui ſuperioris illius ſimilem; atque illud animadverti, quod Nix magis, quam pluvia, Barometri decrementis reſpondeat: ut in ſubjectâ Tabellâ videre eſt.

Decreſcente Barometro a Meridie Diei præcedentis ad Meridiem Diei, quo ninxit.		Creſcente Barometro a Meridie Diei præcedents ad Meridiem Diei, quo ninxit.	
Numerus Dierum, quibus ninxit.	Ventus qualis erat Meridie Dierum, quibus ninxit.	Numerus Dierum, quibus ninxit.	Ventus qualis erat Meridie Dierum, quibus ninxit.
4	N.	4	N.
6	N E.		
1	E.		
1	S W.		
1	W.		
1	N W.		
14	Summa.	4	Summa.

Præterea vero, pro ſingulis annis ſummas altitudinum Barometri ac Thermometri confeci; ex quibus deinde altitudines medias convenientes ſingulis Diebus eorundem Annorum elicui; ut in ſubjectâ Tabellâ apparet.

	Summa Altitudinum Barometri.		Summa Altitudinum Thermometri.		Altitudo Media Barometri ad ſingulos dies.		Altitudo Media Thermometri ad ſingulos dies.	
	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.	Dig.	Dec.
1725	10854	26	18287	66	29	74	50	10
1726	10823	8	18268	93	29	65	50	5
1727	10831	17	18325	96	29	67	50	21
1728	10864	72	18419	81	29	68	50	33
1729	10842	23	18326	62	29	70	50	21
1730	10853	75	18264	18	29	74	50	4

Porro ſi Altitudines Barometri, non ſingulorum Annorum, ſed omnium ſex Annorum in unam tantum ſummam colligantur, invenietur, media Barometri Altitudo, ſingulis Diebus eorundem omnium annorum conveniens, eſſe Dig. 29. Dec. 70.

Ac ſi Thermometri Altitudines, non ſingulorum Annorum, ſed itidem ſex Annorum omnium colligantur in unam tantum ſummam, comperietur media Thermometri Altitudo ſingulis diebus eorundem omnium Annorum conveniens, eſſe Dig. 50. Dec. 16.

Quamobrem, inſpectâ Tabellâ, facile eſt intelligere, Diales Medias Altitudines tum Barometri tum Thermometri, pertinentes ad annos ſingulos, pauciſſimis partibus differre a Dialibus Mediis Altitudinibus, quæ ex ſex illis collectim ſumtis proficiſcuntur.

Maximam deinde Barometri Altitudinem Minimamque, itidem Thermometri Maximam ac Minimam Altitudinem in oppoſitam Tabellam redegi: ut uno aſpectu conferri inter ſeſe poſſent atque comparari.

Anni

Anni	Menſes.	Dies S. V	Horæ	Maxima Barometri Altit. Dig	Dec	Minima Barometri Altit. Dig.	Dec	Thermometri Altit. Dig.	Dec	Venti	Tempeſtas.
1725	Jan.	19	15	30	28			48	45	W.	Cœlum ſudum.
	Dec	8	15			28	56	47	98	SW 4	Cœlum nubibus fere obductum.
1726	Nov.	28	15	30	18			48	70	N.	Cœlum ſudum.
	Feb.	13	15			28	92	48	62	S W.	Cœlum nubibus fere obductum.
1727	Nov.	20	15	30	24			48	88	N W.	Cœlum ſudum.
	Oct.	29	3			28	80	49	6	S. 2.	Cœlum nubibus obductum.
1728	Dec.	2	15	30	20			48	98	N.	Nubes raræ.
	Dec.	12	15			29		48	60	N. W	Pluvia tenuis.
1729	Dec.	20	15	30	30			48	88	W.	Cœlum nubibus fere obductum.
	Nov.	10	15			28	90	49	30	N.	Pluvia.
1730	Dec.	20	15	30	40			48	20	N.	Cœlum ſudum.
	Feb.	27	15			28	98	48	78	S E.	Sol & nubes alternatim.

Anni	Menſes.	Dies S. V	Horæ	Barometri Altitudo. Dig.	Dec.	Maxima Ther. Altit. Dig.	Dec.	Minima Ther. Altit. Dig	Dec	Venti	Tempeſtas.
1725	Jul.	9	15	29	64	52	50			S. 2.	Cœlum ſudum.
	Dec.	23	15	29	25			47	82	N E.	Sol & nubes alternatim.
1726	Jul.	15	15	22	74	52	40			S.	Cœlum ſudum.
	Jan.	14	15	29	68			47	68	W.	Cœlum nubibus fere obductum.
1727	Jul.	13	15	29	60	52	18			E.	Sol paucæque nubes.
	Jan.	2	15	29	68			48	15	S. E.	Aër nebuloſus.
1728	Jun.	22	15	29	68	52	54			S.	Sol paucæque nubes.
	Dec.	26	15	29	30			48	8	N. 2.	Cœlum nubibus fere obductum.
1729	Jun.	25	15	29	70	52	28			N E.	Cœlum ſudum.
	Jan.	14	15	29	50			47	82	S W.	Cœlum ſudum.
1730	Aug.	4	15	29	76	52	28			N.	Sol & nubes alternatim.
	Dec.	23	15	30	30			47	58	W.	Cœlum ſudum.

Ut vero aquæ, quæ decidit, Quantitates conferri poſſent cum Quantitatibus iis, quæ in Regiæ Scientiarum Academiæ Commentariis regeruntur; Menſuras Anglicas in Gallicas tranſtuli, illas ad Regium Pariſienſem Pedem (in Pollices atque Lineas diviſum) referendo. Ac ſummas ad Annum quemlibet Novo Stilo computatum confeci, ut in ſubjectâ Tabellâ videre eſt.

Anni Stilo Novo.	Pol. Ped Pariſ.	Lin.
1725	28	$1\frac{1}{2}$
1726	23	$2\frac{1}{2}$
1727	42	11
1728	49	$9\frac{1}{2}$
1729	34	$1\frac{3}{4}$
1730	32	$1\frac{1}{8}$
Summa.	210	$3\frac{1}{4}$

Quare, si Pol. 210. & Lin. $3\frac{1}{2}$. dividantur in annos sex; Mensura Media Quantitatis aquæ, quæ decidit, conveniens singulis annis prodit Pol. 35. Lin. $\frac{7}{12}$. Mensura autem Media aquæ quæ cadit Lutetiæ Parisiorum (ut habetur in Academiæ Commentariis Ann. 1711, 1714, 1715, & alibi) Media, pro unius Anni curriculo Pollicum 19 esse computatur. Quamobrem Patavina Media Mensura Mediam Parisiensem excedit Pollicibus 16. Lin. $\frac{7}{12}$. Aut, si assumamus pro Mediâ Mensura Parisiensi Pol. 18. Lin. 8. (quemadmodum ex observationibus triennio habitis colligitur in Commentariis Ann. 1719) erit differentia Pol. 16. Lin. $4\frac{7}{12}$. Itaque plane liquet aquæ copiam hic decidere multo majorem, quam Lutetiæ Parisiorum.

Præstat etiam animadvertere, a Meridie Diei 23. (S T. Vet.) Augusti Anni 1727. (vento boreali) ad Meridiem sequentis diei, nimirum intra horas 24, decidisse pluviæ Pol. 3. Lin. $\frac{1}{2}$. hoc est Lin. $36\frac{1}{2}$. Quæ sane pluviæ copia multo major reperitur eâ, quæ intra horas 24. unquam decidat Lutetiæ Parisiorum: ut ex Commentariis Regiæ Scientiarum Academiæ colligere est.

Si maxima Barometri Altitudo Die 20 Dec. 1730. hic observata, redigatur ad Gallicam Mensuram, comperietur esse Pollicum 28. Lin. 6. minima vero Barometri Altitudo, quæ pertinuit ad Diem 8 Dec. 1725, invenietur Pollicum 26. Lin. $9\frac{1}{2}$. Quamobrem Mercurij in Barometro differentia inter Maximam Altitudinem, Minimamque colligetur Pollicum 1. Lin. $8\frac{1}{2}$.

Assumto itidem sexenio Observationum, quas in Regio Observatorio habuit Lutetiæ Parisiorum Philippus Hirius (nimirum ab Anno 1699 ad annum 1705) inveni Maximam Barometri Altitudinem extitisse Die 10 Dec. 1704. Pol. 28. Lin. $4\frac{1}{2}$. Minimam vero Die 20 Dec. 1703. Pol. 26. Lin. 5: atque ideo Mercurij in Barometro differentiam inter Maximam Altitudinem Minimamque fuisse Pol. 1. Lin. $11\frac{1}{2}$. Differentia itaque inter Maximam atque Minimam Mercurij in Barometro Altitudinem (attentis observationibus quas proposuimus) Lutetiæ Parisiorum inventa fuit major, quam Patavij Lin. $2\frac{1}{12}$. Et quidem jamdudum nonnulli fuere, qui observarent, illiusmodi differentias eo minores reperiri, quo magis loca, in quibus Observationes instituuntur, sunt Æquatori circulo vicina.

Reliquum nunc est ut ad aliud Observationum genus in Invitatione indicatum, hoc est ad Observationes Declinationum Magneticæ Acus, gradum faciam: ab hac tamen parte me paucis expediam. Notum hoc tempore est, atque inter hujusce modi rerum Peritos pervulgatum, variis unius ejusdemque Diei horis exiguas nonnullas mutationes in Acus Magneticæ Declinatione ita contingere, ut singulis integris Diebus eadem omnino constantissima Declinatio non observetur; sed paucis varietur aliquando Gradus sexagesimis: præterea vero compertum est, non ab omnibus Acubus (præsertim ad varios Magnetes affrictis) eandem prorsus penitusque exhiberi

hiberi Declinationem, ſed aliquot (pauciſſimarum tamen cum ab excellentibus Artificibus Acus ſint elaboratæ) ſexageſimarum differentias aliquando comparere. Variationes itaque perexiguas ab hiſce cauſis facile promanantes, ſi excipias, totis hiſce ſex ſolidis annis, Magnetis Declinationem verſus Occaſum Graduum tredecim obſervavi. Pyxis Magnetica, qua præſertim utor, & cujus (ut ita dicam) fidei plurimum tribuo, eſt Opus Bernardi Facini ſcientis Artificis, maxime harum rerum periti, maximeque induſtrij: cujus Pyxidis Acus longa eſt Pollices ſex, granorum triginta duorum pondo. Hoc unum adjiciam, me ſuſpicari (neque enim de tam exigua mutatione quidpiam ſecure affirmandum eſt) Declinationem Acus intra illud tempus, decreviſſe decem ſexageſimis potius, quam creviſſe.

XL. *An Abſtract of the* Meteorological Diaries *communicated to the* Royal Society, *with Remarks upon them by* W. Derham, *D. D. F. R. S.* No. 423. p. 261.

PART I. Containing METEOROLOGICAL OBSERVATIONS made at *Coventry*, *Upminſter*, 1707. | *New-England*, *Upminſter*, 1715, 1716.

A TABLE ſhewing the Height of the Mercury *in the Barometer, the Coaſt and Strength of the Winds, and the Weather, on the firſt Day of eight Months in the Years* 1707 *and* 1708. *Obſerved at* Coventry *in* Warwickſhire *by Mr* H. Beighton, *F. R. S. and at* Upminſter *in* Eſſex, *by* W. Derham, *F. R. S.*

	Coventry.			Upminſter.			
Month.	Barom. Inch. Decim.	Winds.	Weather.	Barom. Inch. Cent.	Winds.	Clouds.	Weather.
July.	29. 2	S 2	Cloudy	29. 39	S 2	SW	Showers
	25	SW 3	with Sun-	36	W 7	SWbW	and
	4	2	ſhine.	52			Stormy.
Aug.		W 1	Fair	58	WbS 8		Fair and
		NW 1	Sunſhine				ſome
	5	1	Day.	51			Clouds.
Sept.	15	SW 5	Rain.	33	SbW 3	SSW	Storms
			High	29	WbS 8		with
	25	4	Winds.	38			Showers.
Octob.	05		Much	13	WSW 6		Stormy
			Rain.	14	7		Day.
	65	SW 3		14			
Nov.	85	W 1	Cloudy.	81	NWbW 1		Cloudy.
				84			
	85	W 1		82			
Decem.	05	SW 3	Rain.	21			
			Warm.				
Jan.	05	E 1	Tempe-	01	NNE 6		Cloudy
			rate and				dark
			Miſty.	06			Day.
Febr.			Clear.	02	NNE 3		Froſt and
	65	N 2	Cold with	59			Snow with
			Snow.	52			Fair.

A TABLE shewing the Coasting and Strength of the Winds and the Weather every first Day of the Month in the Year 1715, *and the Quantity of Rain in that Month, observed at* Harvard-College *in* Cambridge *in* New-England, *by Mr* Tho. Robie; *and the Height of the* Mercury *in the Barometer, the Coasting and Strength of the Winds and Clouds, the Weather and Rain at the same Time at* Upminster, *by* W. Derham, D. D. *F. R. S.*

	Harvard-College.			Upminster.				
Month.	Winds	Rain. Lib.	Rain. Cent.	Weather.	Barom	Winds.	Clouds	Rain.	Weather.
Jan.	WNW W b N S	5.	17		30. 11 10 14	NE 3 2		4. 31	Hard Froſt and Cloudy.
Febr.	S W 1 S W 3 W 0	12.	92	Hazy. Snow. Cloudy.	29. 75 30. 10	WSW 7 10		3. 7	Stormy.
March.	W 1 S W 1 SWbW 1	5.	14	Hazy. Cloudy.	29. 40 48 40	ENE 3 4		12. 53	Cloudy. Miſling. Rain.
April.	NWbW 5	12.	71	Snow.	65 60 46	SbW 1 E 3	S.	13. 19	Fair with Cloudy.
May.	Calm. E 3 E 4	13.	14	Froſt. Serene.	32 39 30	SbE 1 SW 2		4. 66	Rain. Fairer.
June.	SW 2 WNW 0 SW 1	13.	63		69 69 72	NNW 0 NW 2	SW.	16. 34	Fair with Cloudy.
July.	NWbW 3	14.	42	Showery.	65 71 77	W 1 NW 1		20. 00	Cloudy. Thunder and Rain.
Auguſt.	NW 0	9.	64	Serene and Pleaſant.	30 28 28	NW 0	SW.	20. 49	Fog. Rain. Fairer.
Sept.	NE 0 E 1 0	*Sept. and*		Fair.	55	SSW 4		9. 17	Fair. Rain.
Octob.		*Octob.* 30.	78		75 72 50	WSW 0 1		14. 08	Hoar Froſt. Fair. Rain.
Nov.	W 0 NW 1 N 1	7.	24	Fair with Cloudy.	54 54 38	SW 0 WbN 1		8. 53	Rain. Cloudy.
Dec.	W 3 WNW 3 W 1	5.	83	Fair and Cold.				2. 55	

A TABLE

A TABLE of the like Observations in the Year 1716, *as those in the preceeding Table, except the Rain in* New-England *which Mr* Robie *omitted.*

Month	Harvard-College. Wind.		Weather.	Upminster. Barom.	Winds.	Cloud.	Rain. Lib.	Cent.	Weather.
Jan.	NW 2 NW 2		Cold and Clear.	29. 62 59 76	WbN ° NbW °		8.	61	Thaw with Misling & Cloudy.
Febr.	NW & W 1 N ° E °		Cold hard Froft.	30. 15 18 21	NNE 2 1		1.	76	Black Clouds.
March.	E ° N ° NW 1		Rain, Fairer.	29. 42	WbN °		1.	93	Fair.
April.	S E 1 NW 6		Cloudy. Fair.	85 85 80	E b S 1 E S E	S. S.	5.	04	Fair and Pleaſant.
May.	N ° E 1 S 2		Fair.	30. 00 29. 97	N 2		9.	52	Fair warm Day.
June.			Rain.	94 98 30. 01	NNW 1 NbE 4	NNW	8.	24	Cloudy. Rain. Fairer.
July.	NW 1 °		Fair and Cool.	29. 91 92 90	NW ° W 3	NbE	4.	47	Fair Pleaſant Day.
Aug.				88 88 92	WNW 1 NW 4	NW	2.	11	Cloudy. Fairer. Cloudy.
Sept.	SW 2 6 4		Fair and ſome Clouds.				9.	87	
Octob.	W 1 SW 2 S 1		Fair. Hoar-Froſt.	51 52 50	WbS ° °		15.	75	Cloſe dark Day. Rain.
Nov.	W 1 WNW 1 1		Fair and Pleaſant.				4.	41	
Dec.	N 1 NE 2		Cold and Raw. Snow.	68 87	NbW 2		7.	16	Froſt and Fair.

I. I obſerve

REMARKS on the foregoing TABLES.

In that for the Year 1707

I. I obſerve there is a great Agreement between the *Barometers* at *Coventry* and *Upminſter*, in their *Riſing* and *Falling* near the ſame Time, at leaſt not many Hours before or after one another, and for the moſt Part in the ſame Proportion. Alſo when one is *Stationary*, the other is ſo too, eſpecially if of any Continuance: But at *Coventry* the *Mercury* is lower than at *Upminſter* about a tenth of an Inch, the Situation at *Coventry* being, I ſuppoſe, higher than that of *Upminſter* about 82 Feet, according to my Experiments in *Philoſ. Tranſ.* N°. 236.

II. I obſerve alſo a greater Conformity between the Winds, than (conſidering the Cauſes of their perpetual Change) would be imagined. For although they may vary a Point or two, yet generally through all the eight Months, they tended nearly towards the ſame Point of the Compaſs, and changed in one Place as they did in the other; eſpecially when they blew ſtrongly, or were of ſome Continuance. I have obſerved, that a Storm in one Place is ſo in the other; of which the Diaries at large give many Examples; and in this Table of 1707, in the Months of *September* and *October*, where Mr *Beighton* hath noted the Wind's Strength to be three and four, it is about the ſame Strength with mine of five, ſix, ſeven and eight, I taking in more Degrees of the Strength of the Winds than he.

III. I obſerve alſo, that the Weather in each Place is for the moſt Part nearly the ſame.

IV. I have often obſerved, that the Falling of the Quickſilver in dark and cloudy Weather betokeneth Rain; but the Rain is always preceeded with Fair Weather: And when the Fair comes, the Foul is not far off. And this chiefly happens, when the Wind is in any of the Eaſterly Points.

V. In *January* 1707, many were troubled with cuticular Eruptions, which itched much. After this the Meaſles were epimedical 'till the latter end of *May*.

VI. The Beginning of this Year being very dry, and often the Weather cold (as appears by my Tables at large) Hay was ſcarce, and became very dear.

VII. *July* 8, commonly called the *Hot-Thurſday*, was the hotteſt Day that hath happened ſince I began my Meteorological Obſervations. A young Man working in Harveſt harder than ordinary, was overcome with the Heat, and died: And divers Horſes on the Road that Day, dropped down, and died alſo.

VIII. In *November* and *December* the Air being moiſt, and frequently cold, Coughs were epidemical with us.

IX. I hope I ſhall be excuſed if I go out of the Bounds of this Table, and obſerve that the unſeaſonable Froſts in *April* 1708 (particularly *April* 25th and 26th) blaſted the tender young Leaves and *Catkins* of the Oak, Wallnut-Tree, *&c.* which I take to be the Reaſon that few Acorns and Wallnuts were that Year. From whence

it

It is a juſt Concluſion, That the *Catkins* are of greateſt uſe to the Fertility of ſuch Trees that bear them; but whether as a Male-Sperm I ſhall not determine. *Catkins of uſe to the Fertility of Trees.*

X. This Month of *April* alſo Horſes were every where ſeized with dangerous Coughs; of which many died in *London*, and other Places, eſpecially ſuch as laboured on the Roads. I have great Reaſon to think theſe Colds were catching, becauſe my Horſes that went well to *London*, returned with great and ſudden Colds.

XI. *June* 11 (although it was the Day of the Summer Solſtice) was enſued with a very cold Night, my Thermometer deſcending nearly to the Point of an Hoar-Froſt.

The late ingenious Mr *Robie*, at my Requeſt, was pleaſed to make, in *New-England*, *Meteorological Obſervations*, Morning, Noon, and Night, to correſpond with mine at the ſame Time at *Upminſter*. *REMARKS on the TABLES of* 1715 *and* 1716.

Theſe Obſervations he made in 1715 *&c.* to the End of 1722, and ordered them to be ſent to our *Royal Society*; and accordingly I received them, not long ſince, from his ingenious Succeſſor at *Harvard-College*, Mr *Iſ. Greenwood*, and now preſent them, with my own, to the *Society*.

But by reaſon they are too long to be read at the *Society's* Meetings, or to be inſerted in the *Tranſactions*, I have therefore made the foregoing Extract from them, together with ſome Obſervations of my own, which tally with them.

But I am ſorry that Mr *Robie's* Obſervations want thoſe of the Barometer and Thermometer: Neither of which Inſtruments was to be gotten in *New-England*. Could we have had thoſe Obſervations, they would have been of great uſe in ſeveral Phænomena of thoſe diſtant Places, which now I can only gueſs at: And,

I. I gueſs, that notwithſtanding *Harvard-College* is ten Degrees more South than *Upminſter* (it being, as Mr *Robie* ſays, *in Lat.* 42 *Deg.* 25′ *North*, and *Longitude from* London 4ʰ 44′ *as corrected by the beſt Obſervations*, that I ſay) they have as *cold*, if not colder Seaſons than we have here.

II. Although the ordinary Agreement or Diſagreement of the Winds, deſerves no Remark, yet it may deſerve Obſervation, That when the Winds have continued long in one Point, they have nearly agreed in both Places, and eſpecially when they have been high, and ſtrong for ſome time. In which Caſe I have obſerved, that there have been ſome Days Difference in the coming of thoſe Winds, as if they were ſo many Days in their Paſſage from Place to Place.

And this Agreement of the Winds, together with that of the Aſcent and Deſcent of the Quickſilver before-mentioned, divers curious Obſervers have taken Notice of, as well as my ſelf, between diſtant Places, though not ſo far as *New-England*; as *Zurich*, *Paris*, *Lancaſhire* and *Upminſter*; as may be ſeen in the *Philoſ. Tranſact.* particularly Numb. 208, 286, 297, and 321.

III. I obſerve, that they have in *New-England* many more *Parhelia*, *Halo's*, *Lunar Rainbows*, and ſuch like Appearances: Alſo more *Earthquakes*, *unuſual Meteors*, *Thunder and Lightening*, than we have.

IV. The *Rain* in 1715 (which was the only Year in which Mr *Robie* obſerved it) in the different Months, amounted to different Quantities; but in the whole Year, it was nearly the ſame as at *Upminſter*; that at *Harvard-College* being 130,64 ℔, that at *Upminſter* 128,92 ℔. But conſidering that Mr *Robie's Tunnel* that received his Rain, was but 11 ½ Inches in Diameter, and mine exactly 12, therefore the Proportion of the *New-England* Rain may be accounted ſomewhat the greater.

V. I obſerved at *Upminſter*, that in *January* the Contagion which was very fatal among the *Black Cattle* about *London* the latter End of the laſt Year, came amongſt us, and deſtroyed many.

In *March* many were afflicted with *Head-aches*; and the *Small-Pox* was epidemical: And the Earth being very dry, the Ponds empty, and the Springs low, in that and the next Month there fell good Store of ſeaſonable Rain, as the Table for that Year ſhews, but not ſufficient to fill the Ponds. But in *June*, *July* and *Auguſt*, more Rain fell than was welcome; which filled the Ponds, but hurt the Hay, and Corn, and made the Ways as dirty as in Winter.

In the Summer this Year I had many Confirmations of ſome former Obſervations in my *Phyſico-Theology Lib.* I. *Ch.* 3. *viz. That a cold Summer is commonly a wet one.* Which this Summer was, the Spirits in the Thermometer being often low, particularly near the Point of *Hoar-Froſt* on *Auguſt* 12.

In *January*, the following Year 1716, the River of *Thames* was frozen for ſeveral Miles, and particularly ſo intenſely at *London*, that whole Streets of Booths were erected on the Ice, Oxen roaſted, Coaches driven, and many Diverſions, exerciſed above Bridge. And ſo ſtrong was the Ice below Bridge, as to allow People to walk and ſkate at their Pleaſure thereon. But yet the Spirits in the Thermometer deſcended not all the while near ſo low, as on *December* 30, 1708.

In *Scotland* alſo (which in 1708 felt but little of that Year's ſevere Froſt) the Ice was ſtrong enough to bear the Horſe and Foot of the Armies.

And beyond Sea they ſuffered much; particularly in *Spain*, much Miſchief was done by the wild Beaſts, which were forced by the Froſt out of the Woods.

Among *Birds* I find the *Goldfinches* to have ſuffered much, having ſcarce ſeen one of them all the following Part of the Year; they being killed by the hard Weather, or driven to ſeek Food in other Parts.

On the —— Day of ——, the Wind was ſo violent, that the *Thames* was emptied from *London-Bridge* as far as ——, ſo that only a ſmall Rivulet of Water, no bigger than a Brook of 10

or

or 12 Foot over, remained; insomuch, that People walked on the Bottom, and found Treasure there.

In *November* and *December* Pleurisies were frequent, and mortal in our Parts of *Essex*. The Weather was mild, open, dark, and damp for the most Part, with now and then a cold Day or two.

On *February* 12, 171$\frac{1}{8}$, he notes an *Earthquake* to have been at *Salem Village*; and on *Octob.* 21 following the *Day was so dark, that People were forced to light Candles to eat their Dinners by.* Which could not be from an Eclipse, the Solar Eclipse being the 4th of that Month. *Farther Remarks from Mr Robie's Papers.*

On *Feb.* 13, 171$\frac{4}{7}$, he observed an Immersion of the first Satellite of *Jupiter*, at $10^h\ 48'\ 17''$; and on *Feb.* 8. I observed an Emersion at $8^h\ 7'\ 30''$; according to which the Difference of *Longitude* between *Harvard-College* and *Upminster* is $4^h\ 45'$, and Mr. *Robie* says, that it is $4^h\ 44'$ from *London*, by the latest and best Observations.

Sept. 23, 1717, Mr. *Robie* observed the Solar Eclipse.

The Beginning at $12^h\ 23'$
The Middle at $1^h\ 47$ or thereabout.
The End at $3^h\ 5'\ 10''$ *p. M.*
About 9 Digits were eclipsed.

Octob. 5, following he observed the *Southing* of the Moon, at $9^h\ 32'$ *p. M.*

On *Feb.* 25, 171$\frac{7}{8}$, Mr. *Robie* saw the *Moon* cover *Aldebaran* at about $9^h\ 18'$ *p. M.* and the Star to emerge at $10^h\ 20'$ *p. M.* then by his Meridian Instrument (such as I have described in *Philos. Transf.* Numb. 291) being 2′ too slow, so that 2′ are to be added to the Time mentioned.

March 10, 171$\frac{7}{8}$, Mr *Robie* observed an Emersion of the first Circumjovial at $10^h\ 45'\ 35''$.

Sept. 24, 1718, Mr *Robie* observed the *Moon* to *South* at $9^h\ 38'$, or thereabout: On the 25th at $10^h\ 22'\ 32''$ *p. M.* On the 26th at $11^h\ 26'$ *p. M.*

Decemb. 5, a great *fiery Meteor* was seen in the Morning about Break of Day. And on the 9th, about half an Hour after Ten, in the S S W, he saw another which made a Light like the Moon.

Dec. 19, the *Moon southed* at $6^h\ 45'\ 45''$ *p. M.* On the 20th at $7^h\ 30'\ 56''$. On the 23d at $9^h\ 54'\ 5''$. On the 25th at $11^h\ 47'\ 33''$.

On *Jan.* 13, 171$\frac{8}{9}$, the first *Circumjovial* immerged at $10^h\ 35'$ *p. M.*

Jan. 17, The *Moon southed* at $5^h\ 52'\ 1''$. On the 19th at $7^h\ 33'\ 1''$. On the 22d at $10^h\ 21'\ 40''$ *p. M.*

Feb. 16, *Moon southed* at $6^h\ 15'\ 15''$: On the 19th at $8^h\ 59'\ 40''$: On the 21st at $10^h\ 54'\ 30''$ *p. M.*

On *Dec.* 11, 1719, a very unusual *Meteor* was seen in the Evening

On *Jan.* 8, 17$\frac{19}{20}$, Mr *Robie* says there was an *Earthquake.*

On *Nov.* 24, 1720, Mr *Robie* obſerved a *Streaming* from the Northern Horizon; as I did on *Nov.* 22, before.

On *Dec.* 10, 1720, about 8^h *p. M.* Mr *Robie* firſt ſaw the Light that ſtrikes up toward the *Pleiades*; and on *Jan.* 6, following, he found it was increaſed, and almoſt reached to the *Pleiades.* And *Dec.* 7, 1721, he obſerved the ſame; and on the 25th he hath given this Figure of it: *b o* is the Part next the Horizon; V the Point toward the *Pleiades.*

Fig. 25.

This *Glade of Light* is the ſame that Dr *Childrey* mentions in his *Briton. Bacon.* under the Name of *Semita luminoſa*; and which I ſaw, and gave a Figure of in *Philoſ. Tranſ.* Numb. 305.

Obſervations of the Eclipſe *of the* Moon *on* June 28, 1721.

About Two in the Morning Mr *Robie* viewed the Moon with his eight Foot Teleſcope, and ſhe was untouched.

Time Correct. H.	′	″	
2	10	00	A thin Penumbra.
2	12	00	Shadow is plainly entered.
2	18	10	*Palus Mæotis* covered.
2	31	40	*Mons Porphyritis* touched.
2	34	20	—— —— —— covered.
2	47	10	Moon eclipſed about ſix Digits.
2	49	05	*Beſbicus* juſt touched.
2	50	30	——— —— covered wholly.
2	53	40	*Byzantium* touched.
2	54	10	—— —— covered.
3	05	40	*Palus Mæotis* touched.
3	18	30	Moon wholly covered.

There remained a Light on the Weſtern Side of the Moon for ſome Time.

About 3^h $50'$ in the Morning the Moon was wholly hid by the Haze, and coming on of Day-Light, that nothing could be ſeen of her; although from the Immerſion 'till now ſhe was viſible.

The Obſervations Mr Robie *made on the* Solar Eclipſe, Nov. 27, 1722, *were as follows.*

H.	′	″	
7	27	00	He ſaw the Sun riſe eclipſed about four Digits on his ſupreme Vertex; to the S W the greateſt Part of the Shade lay. Then we could obſerve no more 'till
8	30	00	The Sun began to appear, and ſix Digits, or thereabouts, were eclipſed.
8	55	15	The Sun was eclipſed $4\frac{1}{4}$ neareſt; and then the Sun's Diameter was to the Moon's, as 1000 to 972.

9 00 15

9 00 15 Were hid 4½ nearly; and the Sun's Diameter was to the Moon's as 1000 to 975.
9 19 45 A little Spot on the Sun emerged.
9 25 45 I ſaw the Moon go off the Sun, and Mr *Danforth* at the ſame Time: And Mr *Appleton* at
9 25 20

XLI. It being the Opinion of divers ſkillful Naturaliſts (particularly Mr *Fr. Willughby* and Mr *Ray*) that the *Ignes Fatui* are only the Shining of a great Number of the *Male-Gloworms* in *England*, or of the *Pyrauſtæ* in *Italy*, flying together, I was minded to conſult my curious and ingenious Friend, Sir *Tho. Dereham*, about the *Phænomenon*, being informed, that thoſe *Ignes Fatui* are common in all the *Italian* Parts. But of the *Pyrauſtæ*, or *Fire-flies*, he ſaith, *He never obſerved any ſuch Effects, although there is an immenſe Number of them in* June *and* July. He ſaith moreover, that theſe *Pyrauſtæ* are called *Lucciole*, i. e. *Small Lights*, and that they are not the *Farfalls* (as Mr *Ray* thought) which are *Butter-flies*.

Of the Meteor *called the* Ignis Fatuus, *from Obſervations made in* England, *by the Rev. Mr* W. Derham, *F. R. S. and others in* Italy, *communicated by Sir* Tho. Dereham, *Bart. F. R. S.* N°. 411. pag. 204.

But I have good reaſon to think, that Inſects are not concerned in the *Ignes Fatui*, from the following Obſervations; the Firſt of which I made my ſelf, and the others I received from *Italy*, by the Favour of Sir *Tho. Dereham*.

My own Obſervation I made at a Place that lay in a Valley between Rocky Hills, which I ſuſpect might contain Minerals, in ſome boggy Ground near the Bottom of thoſe Hills. Where, ſeeing one in a calm, dark Night, with gentle Approaches I got up by Degrees within two or three Yards of it, and viewed it with all the Care I poſſibly could. I found it friſking about a dead Thiſtle growing in the Field, until a ſmall Motion of the Air (even ſuch as was cauſed only by the Approximation of my ſelf) made it ſkip to another Place, and thence to another, and another.

It is now about fifty-five Years ſince I ſaw this Phænomenon, but I have as freſh and perfect an Idea of it, as if it was but of a few Days. And as I took it then, ſo I am of the ſame Opinion now, that it was a *fired Vapour*.

The *Male-Gloworms* I know emit their ſhining Light, as they fly; by which Means they diſcover and woo the Females: but I never obſerved them to fly together in ſo great Numbers, as to make a Light equal to an *Ignis Fatuus*. And I was ſo near, that had it been the Shining of Gloworms, I muſt have ſeen it in little diſtinct Spots of Light; but it was one continuous Body of Light.

Having thus related my own Obſervations of the *Ignes Fatui*, I ſhall next give an Account of the Obſervations which Sir *Tho. Dereham* procured for me in *Italy*, in the following Letter of Dr *Giacomo Bartholomeo Beccari*, F. R. S. to Sir *Tho. Dereham*, F. R. S. dated at *Bologna*, *Octob.* 23, 1728.

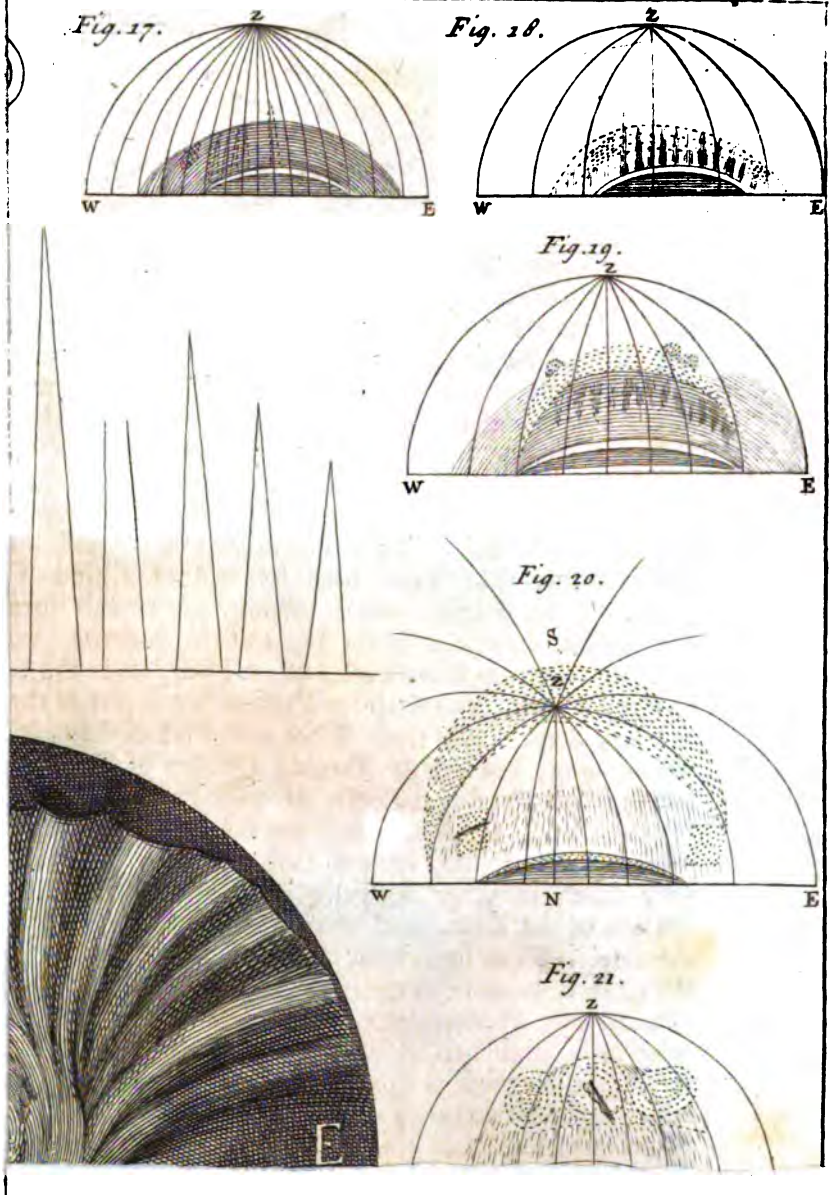
IT is purely in Obedience to your Commands, by Dr *Euſtachio Manfredi*, I ſend you the following Obſervations on the *Ignes Fatui*. What I am now going to offer to you concerning theſe fiery Appearances, is the Reſult of ſeveral Converſations I had upon this Subject with ſeveral experienced Travellers, Men of Learning and Reputation, whoſe Sincerity I had no Reaſon to miſtruſt. For my own farther Satisfaction, ever ſince I received your Commands, I have made it my Buſineſs to ſpeak with as many as I could light of, with ſuch as travelled much in the Mountains, and with others that obſerved them in Plains, on Purpoſe to ſee whether or no the Difference of the Place made any ſenſible Difference in the Appearance. I find upon the Whole, that they are pretty common in all the Territory of *Bologna*. To begin with the Plains, they are very frequently obſerved there; the Country People call them *Cularſi*, perhaps from ſome fancied Similitude to thoſe Birds, and becauſe they look upon them as Birds, the Belly and other Parts of which are reſplendent like our ſhining Flies. They are moſt frequent in watery and moraſſy Ground, and there are ſome ſuch Places, where one may be almoſt ſure of ſeeing them every Night, if it be dark. In the Fields near the Bridge *Della Calcarata*, in a Common belonging to the Pariſh of *S. Maria in dono*, North of *Bologna*, one of theſe fiery Appearances is very often obſerved to move a-croſs the Fields, coming from another Bridge, called *Della Foſſa quadra*. There is another of them in the Fields of *Bagnara*, almoſt Eaſt of *Bologna*, which ſcarce ever fails to appear in dark Nights, particularly when it rains, or ſnows, as alſo in cold and froſty Weather. Both theſe, I mean that near the Bridge of *Calcarata*, and that in the Fields of *Bagnara*, are very large; and I am aſſured, that ſometimes their Light is equal to that of one of our ordinary Faggots or Bundles made of Branches of Vines, and that it is ſcarce ever leſs than that of the Links which our Country People make of Hemp-ſtalks, and which they light themſelves withal, when they travel at Night. That at *Bagnara* appeared, not long ſince, to a Gentleman of my Acquaintance, as he was travelling that Way; it kept him Company for a Mile or better, conſtantly moving before him, and caſting a ſtronger Light on the Road, than the Link he had with him.

I believe there may be many more in other Plains as large as theſe two, though at preſent I have not been able to get certain Information of any others. Leſſer ones there appear a good many, ſome of them giving as much Light as a lighted Torch, and ſome there are no bigger than the Flame of a common Candle. Of theſe, I have been aſſured, a good many were ſeen in the Fields of *Bariſella*. All of them have the ſame Property in reſembling both in Colour and Light, a Flame ſtrong enough to reflect a Luſtre upon Neighbouring Ob-

lects all round. They are continually in Motion, but this Motion is various and uncertain. Sometimes they riſe up, at others they ſink. Sometimes they diſappear of a ſudden, and appear again in an Inſtant in ſome other Place. Commonly they keep hovering about ſix Foot from the Ground. As they differ in Largeneſs, ſo they do in Figure, ſpreading ſometimes pretty wide, and then again contracting themſelves. Sometimes breaking to all Appearance into two, and a very little while after meeting again into one Body; ſometimes floating like Waves, and letting drop ſome Parts like Sparks out of a Fire. I have been aſſured, that there is no dark Night all the Year round, when they do not appear. And in the very Middle of the Winter, when the Weather is very cold, and the Ground covered with Snow, they are obſerved more frequently than in the hotteſt Summer. The Gentleman who obliged me with an Account of that at *Bagnara*, told me, that if I had a Mind to ſee it my ſelf, I might be ſure of finding it if I went thither in very cold Weather, and in a ſharp Froſt. Nor doth either Rain or Snow in any wiſe prevent or hinder their Appearance; on the contrary, they are more frequently obſerved, and caſt a ſtronger Light in rainy and wet Weather. This laſt Circumſtance indeed hath been taken Notice of by ſome Writers, and among the reſt, if I remember right, by the learned *Gaſſendi*. Neither doth the Wind much hurt them, though one ſhould think, that if it was a burning Subſtance, like common Fire, it ſhould either be diſſipated in windy Weather, or extinguiſhed by Rain. But ſince they do not receive any Damage from wet Weather, and ſince, on the other Hand, it hath never been obſerved, that any thing was thereby ſet on Fire, though they muſt needs in their moving to and fro, meet with a good many combuſtible Subſtances, it may from thence be very reaſonably inferred, that they have ſome Reſemblance to that Sort of Phoſphorus which doth indeed ſhine in the dark, but doth not burn any thing as common Fire doth. Nor is there any thing extraordinary in this, any more than in other fiery Appearances, which I am informed are likewiſe pretty common, and agree with the *Ignes Fatui*, in having only the Splendor and Appearance of Fire, without the Quality of Burning, but differ from them in a good many other Particulars. Such a Phænomenon was obſerved by a noted Clergyman of this City, one Summer's Evening, near ſome Country Peoples Houſes. The Flame ſeemed to him ſo ſtrong, that he called to them to put it out, for fear it ſhould reach a Hay-loft, and a Heap of Hemp that lay not far from it; but when he came to the very place where he had firſt ſeen the Flame, he perceived that it was only an Appearance, obſerving not the leaſt Footſtep of Fire, though he aſſured me there lay a good deal of combuſtible Stuff all thereabouts, which would have eaſily took Fire, if there had been any thing of an actual Flame upon the Spot. The ſame Gentleman told me, that in a very dry Summer (I do not know whether

the

the ſame with the foregoing) he obſerved, in the Middle of ſome other Fields of his own, for ſeveral Evenings together, a pretty conſiderable Flame on the Ground, nearly in the ſame Place, and that having reſolved to go and take a nearer View of it the next Evening, it did not appear for that Time; that, however, he went to the Place were he had before ſeen it, and ſat himſelf down on the Ground, but could not obſerve the leaſt Mark of any Fire or Flame having been in that Spot, nor feel any Heat in the Ground any more than in other Places; only he ſaw ſome ſlight Flames ariſing out of the Ground hard by, which diſappeared as ſoon as they came into the open Air. It is well known to People that travel on Horſeback at the Beginning of the Night, in the Heat of the Summer, when they traverſe the dry Beds of Rivers, and break with their Horſes Feet thoſe ſandy Grounds that have been all Day long ſtrongly heated by the Sun, there riſe up ſome bluiſh Flames, which very often fright the Horſes. This Phænomenon is moſt common in thoſe Places where the Water hath left behind a kind of a chalky Sediment, or fat Earth, which drying, afterwards forms a thick hard Cruſt. So likewiſe if in the Heat of the Summer you travel in dark Nights, either on Horſeback, or on Foot, over the burnt-up Ground of ſome Fields, you ſhall ſee Flames break out of the Ground almoſt at every Step. All theſe Fires and Flames have indeed the Light and Shining, but not the Burning Quality of Fire, whether from the extream Smallneſs and Rarity of their Parts, as ſome apprehend, or for ſome other Reaſon, I will not attempt to determine. And this is the only thing they have in common with the *Ignes Fatui*, differing very much in other Reſpects, particularly in not appearing at all Seaſons of the Year, and moſt frequently in the Winter, as the others do. Thus far, what I could learn concerning the *Will with a Wiſp*, as it hath been obſerved in the Plains. As to the Appearance of this Phænomenon in mountainous Parts, by what I have hitherto been able to learn, they differ in nothing elſe but in Largeneſs; and all thoſe I converſed with, that ſaw them in the Mountains, agree in that they never obſerved any larger than the Flame of an ordinary Candle. Nor do thoſe that live in the Mountains call them *Cularſi*, which Name is perhaps uſed only by the Country People in the Plains for thoſe large ones above deſcribed. I will make it my Buſineſs to enquire a little farther into this Matter, if perhaps the large ones are ſeen in the Plains only, and thoſe in the Mountains are always ſmall. The Difference of the Air, and that of the Soil may, for ought I know, contribute a great deal towards the different Size of theſe Appearances; at leaſt all that I can offer material at preſent towards ſolving this particular Circumſtance, with Regard to their Largeneſs, is, that thoſe Grounds, where we obſerve the largeſt Fires, as at *Bagnara*, are what they here call *ſtrong Ground (terreni forti)* being a hard chalky and clayey Soil, which will harbour the



by
her

Water a long while, and is afterwards, in hot Weather, very apt to break into large Cracks and Fiſſures; whereas on the contrary, thoſe Soils in the Mountains, where they obſerve the ſmall Fires, are what they call ſoft, or *ſweet Ground* (*terreni dolci*) being generally ſandy, and of a more looſe Contexture, which do not keep the Water ſo long as the others. Of that Sort, alſo is the Soil in the above-mentioned Plains of *Bariſella*, where, about ſeven or eight Years ſince, they obſerved a good Number of the ſmalleſt *Ignes Fatui* in the Fields, within the Compaſs of about three Miles. One Thing I will beg Leave to add, that according to the beſt Informations I have hitherto been able to procure, theſe Lights are great Friends to Brooks and Rivers, being frequently obſerved along the Banks of them, perhaps becauſe the Air carries them thither more eaſily than any where elſe. In all other Particulars, as in their Motion, the Manner of their Appearance, their diſappearing ſometimes very ſuddenly, their Light, the Height they riſe to, and their not being effected either by rainy or cold Weather, they are the very ſame with the *Culariſi* above deſcribed, or the large *Will with a Whiſp*, as obſerved in the Plains.

I intended here to have cloſed this Account, but I cannot forbear adding the following Obſervation, which in my Opinion is very curious and ſingular. I am indebted for it to a young Gentleman, a very accurate and knowing Obſerver of natural Appearances. Travelling ſome time in *March* laſt, between eight and nine in the Evening, in a mountainous Road not far from our Lady *del Sarſo*, about ten Miles South of *Bologna*, as he approached a certain River called *Rioverde*, he perceived a Light, which ſhone very ſtrongly upon ſome Stones that lay upon the Banks. It ſeemed to be about two Foot above the Stones, and not far from the Water of the River: In Figure and Largeneſs it had the Appearance of a *Parallelopiped*, ſomewhat above a *Bologneſe* Foot in Length, and about half a Foot high, it's longeſt Side lying parallel to the Horizon; It's Light was very ſtrong, inſomuch that he could very plainly diſtinguiſh by it Part of a neighbouring Hedge, and the Water in the River; only in the Eaſt Corner of it the Light was pretty faint, and the ſquare Figure leſs perfect, as if cut off, or darkened by the Segment of a Circle. The Gentleman's Curioſity tempted him to examine it a little nearer; in order to which he advanced gently towards the Place, but was ſurprized to find, that inſenſibly it changed from a bright Red to a yellowiſh, and then to a pale Colour, in Proportion as he drew nearer, and that when he came to the Place itſelf, it was quite vaniſhed. Upon this he ſtepped back, and not only ſaw it again, but found that the farther he went from it, the ſtronger and brighter it grew; nor could he upon narrowly viewing the Place where this fiery Appearance was, perceive the leaſt Blackneſs, or Smell, or any Mark of an actual Fire. The ſame Obſervation was confirmed to me by another

another Gentleman, who frequently travels that Way, and who aſſured me, that he had ſeen the very ſame Light five or ſix different Times, in *Spring* and *Autumn*, and that he had always obſerved it in the very ſame Shape and the ſame Place, which to me ſeems very difficult to be accounted for. He told me farther, that once he took particular Notice of it's coming out of a neighbouring Place, and then ſettling itſelf into the Figure above deſcribed. How it comes to paſs, that the nearer one approaches to theſe, or the like fiery Appearances, the fainter they grow, till at laſt they diſappear totally, I very freely own my ſelf at a Loſs, but yet I cannot help thinking, that there is ſomething in it analogous to what we obſerve in Fogs and Clouds, which at a Diſtance have indeed the Appearance of very thick Bodies, but are found more rare as one gets into them. Nor is it improbable, as they muſt be ſomething very thin and ſubtle, that upon the Approach of groſſer Bodies with their Atmoſpheres, they are actually driven away.

This is the Subſtance of what I have been able to gather from ſeveveral Accounts relating to the *Ignes Fatui*; but as to the Cauſes of them I will not pretend to aſſign any: I will only add, that all that ever ſaw any of theſe fiery Appearances agree, and you may aſſure Mr *Derham* of it, that they caſt a Light quite different from that of the *ſhining Flies*; and if you pleaſe to reflect on the ſeveral Circumſtances above related, I believe you will find, that they are not eaſily, if at all, to be ſolved by that Hypotheſis. I intend in another Letter to trouble you with ſome Queſtions, and likewiſe ſome Obſervations of my own on *theſe Flies*.

BAROMETRUM.

BAROMETRUM.	THERMOM.	HYGROMETRUM.	
Hic pono *Pondus* Athmosphæræ incumbentis, in planum pedis quadrati *Rhenolandici*, cujus Athmosf. pondus 1947 libras Amstelædamenses pendet, quando ☿ii in barometro altitudo est 27 *poll.* 7 *lin.* pendet 2094 ℔. Amst. quando altitudo fuit ☿ in barometro 29 *poll.* 8 *lin.* hæc enim fuit maxima & minima ☿ii in barometro observata altitudo intra plures jam annos.	Hic calorem Athmosphæræ in loco observationis destinavi ex rarescente Aëre ita ut summum frigus observatum sit ubi notabatur gradus 1000, aqua pura gelascceret ad grad. 1070, ebulliret vero ad grad. 1510.	Mensuravi hic aquæ copiam in Athmosphærâ in loco observationis; juxta accrescens decrescensve pondus spongiæ ad bilancem appensæ, quam spongiam prius Muria Salis Ammoniaci humectaveram.	Quantitas aquæ, quæ totius hujus anni decursu mense quolibet exhalaverat, in Aëre aperto, & ventis perflato. *Rhenoburgi.*

	℔.	*grad.*	*pond.*	*lin.*
Januar.	2051	1076	81	7
Februar.	46	85	80	14
Martio	35	102	80	33
Aprili	46	109	60	36
Maio	57	126	57	58
Junio	53	140	57	57
Julio	2044	1129	58	37
Augusto	46	141	60	39
Septemb.	54	132	61	24
Octobri	55	121	71	15
Novemb.	53	104	77	15
Decemb.	35	96	79	12
Summa	5715	1361	821	347
12				
Medium	2048	1113	68	toto anno. 28 *pol.* 11 *lin.*

XLII. *Observations on the middle Height of the Barometer, the middle Elevation of the Thermometer, the middle Variation of the Hygrometer, the quantity of Rain, Dew, Snow, and Hail, the quantity of Water that has exhaled, the Height of the Water in a Well, out of which none was drawn for a whole Year, and the monthly Variation of a Watch, by* Nicholaus Cruquius, F. R. S. N°. 381. pag. 4.

Aquæ Cœlo delapsæ, nimirum Pluviæ, Roris, Nivis, Grandinisque Altitudo;

Cum cauta cura, ne exhalatione, aut alio modo vel minimum perierit.

Delphis.	*Rhenoburgi.*
lin. dec.	*lin. dec.*
— 17.9	— 21.2
— 25.1	— 23.8
— 18.8	— 28.-
— 5.5	— 7.5
— 4.2	— 2.7
— 3.1	— 4.8
— 38.6	— 28.-
— 41.9	— 40.2
— 15.1	— 14.8
— 8.2	— 11.3
— 30.7	— 29.7
— 30.6	— 40.-
239.8	— 252

poll. 20 (in toto anno) 21 *poll.*

Aquæ altitudo putealis, in puteo, mensurata a summo ejus margine, ad aquæ superficiem, in fine cujusque mensis. Fuit vero putei profunditas ima usque ad fabulum scaturiens vel currens, nihilque aquæ inde eductum toto observationis tempore.

ped.	*poll.*
— 5 :	4
— 4 :	11
— 5 :	7
— 6 :	10
— 8 :	1
— 9 :	3
— 9 :	7
— 9 :	7
— 9 :	9
— 9 :	8
— 9 :	3
— 8 :	2
— 96 :	—

Med. 8 *ped.*

Observatio accelerati, vel retardati Cursus, in Horologio portatili ac curatissimo.

Ut pateat quot minuta, in quoque Mense, plura vel pauciora, absolverit. Hic (+) augmenti, (÷) decrementi nota est.

Ratio relata ad Solis decursum.

Minuta.	
+ 151	Jan.
+ 21	Febr.
÷ 168	Mar.
÷ 120	Apr.
÷ 123	Maii.
÷ 130	Jun.
÷ 90	Jul.
+ 153	Aug.
+ 24	Sept.
+ 49	Oct.
+ 266	Nov.
+ 252	Dec.
+ 866, & ÷ 631	
five + 235	

in quoque mens. 20′ accelerat.

Observationes per aliquot annos factæ.

Ann.	Jan.	Feb.	Martio.	Ap.	Mai.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Sum. Med. Ann.
	℔.					BAROMETRUM.							12 ℔.
1720	2034	34	38	36	38	42	45	36	50	40	38	23	474 2038 1720
1721	52	42	36	29	29	43	51	46	43	42	32	29	474 39 1721
1722	76	41	32	41	42	45	36	39	50	59	37	30	528 44 1722
1723	51	46	35	46	57	53	44	46	54	55	53	35	575 48 1723
	213	163	141	152	166	183	176	167	197	196	162	117	169
4	2053	41	35	38	41	46	44	42	49	49	40	29	2042
	grad.					THERMOMETRUM.							Grad.
1720	1087	89	86	102	126	126	145	138	121	107	91	91	1305 109 1720
1721	90	74	75	112	116	137	136	142	133	110	100	84	1305 109 1721
1722	79	90	97	109	122	134	139	140	135	117	101	90	1353 113 1722
1723	76	85	102	109	126	140	129	141	132	121	104	96	1361 113 1723
	332	338	360	432	490	537	549	561	521	455	396	361	444
4	83	85	90	108	122	134	137	140	130	114	99	90	111
	pond.					HYGROMETRUM.							pond.
1721	89	82	73	80	69	64	63	68	76	76	89	88	917 76 1721
1722	88	85	76	63	62	62	63	68	70	76	81	88	882 74 1722
1723	81	80	80	60	57	57	58	60	61	71	77	79	821 69 1723
	258	247	229	203	188	183	184	196	207	223	247	255	219
3	86	82	76	68	63	61	61	65	69	74	82	85	73
	lineæ.					Pluvia, &c. Delphis.							poll. lin.
1715	11	20	36	8	15	18	95	62	36	37	47	15	400 33:4 1715
1716	19	20	14	7	17	4	48	19	55	57	21	32	313 26:1 1716
1717	31	15	29	29	31	28	29	28	24	32	29	28	333 27:9 1717
1718	21	18	6	30	17	17	35	27	14	46	21	25	277 23:1 1718
1719	33	20	10	11	17	4	12	34	23	25	24	22	235 19:7 1719
1720	36	24	21	21	15	20	23	55	47	56	25	20	363 30:3 1720
1721	20	31	27	59	30	34	15	41	27	57	30	48	419 34:11 1721
1722	2	20	25	23	15	22	49	53	25	7	21	53	314 26:3 1722
1723	18	25	19	5	4	3	39	42	15	8	31	31	240 20: 1723
	191	193	187	193	161	150	345	361	266	325	248	274	241:3
9	21	21	21	21	18	17	38	40	30	36	28	30	26:10

lin.

1720	35	16	13
1721	21	29	28
1722	3	20	27
1723	21	24	28
	80	89	96
4	20	22	24

lin.

1720	10	10	10
1721	8	9	15
1722	5	7	20
1723	7	14	33
	30	40	78
4	8	10	20

ped. pol.

1720	6:	6: 3	6: 5
1721	5:6	5: 6	4: 6
1722	6:	5: 7	5:11
1723	5:4	4:11	5: 7
	22:10	22:3	22:5
4	5:8	5:7	5:7

Minuta

1722	÷ 34	÷ 9	÷ 7
1723	+ 131	+ 1	÷ 187
	+ 97	÷ 8	÷ 194
2	+ 48	÷ 4	÷ 97

Jan. Feb. Mar.

Pluvia &c. Rhenoburgi

24	29	14	20	48	54	50	39	25
59	35	28	14	47	27	51	32	46
29	28	27	60	64	26	10	21	61
7	3	5	28	40	15	11	30	40
119	84	74	122	199	122	122	122	172
30	24	19	30	50	30	30	30	43

Aqua quæ exhalavit Rhenoburgi.

25	44	55	59	56	50	30	10	12
54	47	60	48	42	27	20	22	10
28	54	54	65	59	34	14	13	13
36	58	57	37	39	24	15	15	12
143	203	226	209	196	135	79	60	47
36	51	56	52	49	34	20	15	12

Putealis Aquæ Altitudo.

6: 7	6: 6	8:	8:11	9:	8:3	6:11	5:8	5:5
4: 2	5: 7	7:	8: 1	7: 9	7:7	6: 3	4:6	4:4
6: 1	6:10	7:11	8:	7:10	7:4	7: 9	7:3	4:6
6:10	8: 1	9: 3	9: 7	9: 7	9:9	9: 8	9:3	8:2
23:8	27:	32: 2	34:7	34:2	32:11	30: 7	26:8	22:5
5:11	6: 9	8·	8:8	8:6	8:3	7:8	6:8	5:7

Horologii portatilis Cursus.

+ 5	÷ 38	÷ 55	÷ 89	÷ 78	÷ 84	÷ 8	+ 151	+ 246
÷ 139	÷ 142	÷ 149	÷ 109	+ 113	+ 4	÷ 1	+ 246	+ 232
÷ 134	÷ 180	÷ 204	÷ 198	+ 35	÷ 80	÷ 9	+ 397	+ 478
÷ 67	÷ 90	÷ 102	÷ 99	+ 17	÷ 40	÷ 4	+ 199	+ 239

Apr. Maii. Jun. | *Jul. Aug. Sept.* | *Oct. Nov. Dec.*

pol. lin.

367	30: 7	1720
417	34: 9	1721
376	31: 4	1722
252	21:	1723
	117:8	
	29:5	

pol. lin.

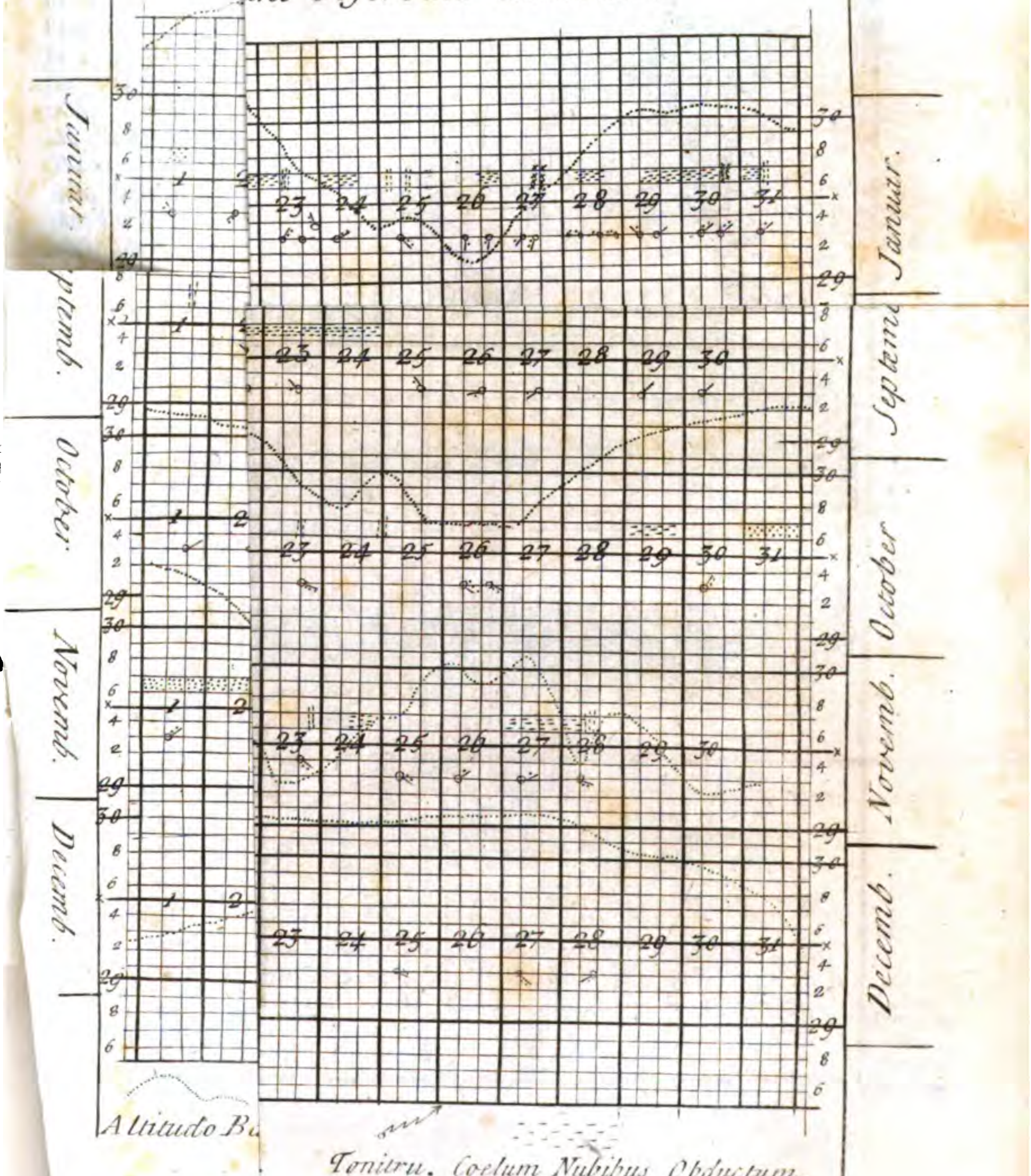
371	30:11	1720
362	30: 2	1721
366	30: 6	1722
347	28:11	1723
	120:6	
	30:2	

ped. pol.

84:	7:	1720
70:	5:11	1721
81:	6: 9	1722
96:	8:	1723
	27:8	
	6:11	

+ &	÷ 402	1722
+ &	÷ 727	1723
+ &	÷ 1129	
+ &	÷ 564	

Tabula ... i decursu 1723 Stylo Veteri digitis
Londini ... uni Observata exhibens.



XLIII. I took three pound of *Mercury*, which by meaſure filled three times a ſmall glaſs Jar exactly full, and poured it into a thin Florence Flaſk: then having poured the ſame quantity of Water (that is, three of the ſame Jars full) into another ſuch Flaſk, I ſet both the Flaſks in a Pail, and poured boiling Water about them, keeping the Flaſk that had the Water down by Force that it might be as low in the hot Water as the *Mercury*. After the Fluids in the Flaſks had received a ſufficient degree of Heat from the Water, which was round the Flaſks, for the Space of five Minutes, I took the Flaſks out of the hot Water, and putting that which held the Water into a Cylindric Veſſel, that had three Pints of cold Water in it, I did at the ſame time plunge the Flaſk with *Mercury* into another Cylindric Veſſel containing alſo three pints of cold Water, and obſerved which of the cold Waters was moſt heated in the following manner.

An Experiment made before the R. Society, *June* 30, 1720, *to prove that Bodies of the ſame Bulk do not contain equal quantities of Matter, and therefore that there is an interſperſed* Vacuum, *by the Rev.* J. T. Deſaguliers *F. R. S.* N°. 365. p. 81.

A little Thermometer being held in the firſt Veſſel of cold Water, ſo as to have it's Ball covered with the Waters, upon the putting in the Flaſk of warm Water, the ſpirit roſe two degrees; then putting the Thermometer into the Water where the Flaſk that had the *Mercury* was, the Spirit roſe three degrees higher. The Thermometer being again put into the firſt Veſſel fell four degrees, and afterwards again into the laſt it aroſe almoſt three degrees.

This ſhews that more heat is communicated by warm *Mercury* than by an equal Bulk of Water equally warmed; and therefore that there is more Matter in the *Mercury*; but how much more Matter there is in the *Mercury* is not determined by this Experiment alone.

N. B. The warm *Mercury* and the warm Water were not poured into the cold; but only communicated their Heat through the Flaſks.

XLIV. 1. The incomparable Sir *Iſaac Newton* has not only ſhortened the Geometrician's Work, by his wonderful Diſcoveries in abſtract Mathematics; but has alſo taught us, by his own Practice, how to make, and judge of, Experiments and Obſervations with the utmoſt Accuracy: And as he avoided making Hypotheſes; he was ſo cautious as to deliver only by way of Queries, ſeveral Truths which he was convinced of; becauſe he wanted a ſufficient Number of Experiments to make them as evident as thoſe others, whereby he has ſo far improved and advanced Natural Knowledge. Our Author has followed his ſteps, aſſerting nothing but what is evidently deduced from thoſe Experiments, which he has carefully made, and faithfully related; given an exact Account of the Weights, Meaſures, Powers and Velocities, and other Circumſtances of the Things he obſerved; with ſo plain a Deſcription of his *Apparatus*, and manner of making every Experiment and Obſervation, that as his Conſequences are juſtly and eaſily drawn, ſo his Premiſes or Facts may be judged

An Account of a Book entituled Vegetable Staticks: *Or an Account of ſome* Statical Experiments *on the* Sap *in* Vegetables; *being an* Eſſay *towards a* Natural Hiſtory of Vegetation. *Alſo, a Specimen of an* Attempt *to analyſe the* Air, *by a great Variety of* Chymico-Statical Expe-

riments; *which were read at ſeveral Meetings before the* Royal Society, *&c. By* Stephen Hales, *B. D. F. R. S. &c. The Account by the Rev.* J. T. Deſaguliers, L. L. D. *R. S. S.* N°. 398. pag. 264. *and* N°. 399. pag. 323.

judged of by any Body that will be at the Pains to make Experiments, which are moſt of them very eaſy and ſimple.

His Account of every Thing is written in ſuch an intelligible manner, that the inquiſitive Reader is capable of underſtanding it, without being puzzled with perplexed Calculations and complex Experiments; which Authors have ſometimes contrived, in order to be admired for thoſe Things, which they themſelves found out either by mere chance, or with very little Labour. He has illuſtrated, and put paſt all Doubt, ſeveral Truths mentioned in Sir *Iſaac Newton*'s Queries; which though believed by ſome of our Eminent Philoſophers, were called in queſtion by others of an inferior Claſs, who were not acquainted with thoſe Facts and Experiments upon which Sir *Iſaac Newton* had built thoſe Queries.

Chap. I. *Experiments, ſhewing the Quantity of Moiſture imbibed and perſpired by Plants and Trees.*

II. *Experiments whereby to find the Force with which Trees imbibe Moiſture.*

III. *Experiments, ſhewing the Force of the Riſe of the Sap in the Vine, in the Bleeding Seaſon.*

IV. *Experiments, ſhewing the ready lateral Motion of the Sap, and conſequently the lateral Communication of the Sap-Veſſels: The free Paſſage of it from the ſmall Branches towards the Stem, as well as from the Stem to the Branches. With an Account of ſome Experiments relating to the Circulation, or Non-Circulation of the Sap.*

V. *Experiments, whereby to prove, that a great Quantity of Air is inſpired by Plants.*

VI. *A Specimen of an Attempt to analyze the Air, by a great Variety of Chymio-Statical Experiments, which ſhew, in how great a proportion Air is wrought into the Compoſition of Animal, Vegetable, and Mineral Subſtances; and withal how readily it reſumes it's former elaſtic State, when in the Diſſolution of thoſe Subſtances it is diſengaged from them.*

VII. *Of Vegetation.* Our Author in this Chapter applies his ſeveral Experiments, and Concluſions drawn from them, to Vegetation; and ſhews chiefly the following Things, *viz.* That Vegetables are compoſed of Sulphur, volatile Salt, Water, Earth and Air.

That in Nutrition, the Sum of the attracting Powers of thoſe Subſtances is ſuperior to the Sum of the repellent; and as the watery Vehicle flies off, the Parts harden.

That Oil, which is made up of Sulphur and Air, abounds in Seeds for their better preſervation.

That in cold Countries, where thoſe Principles are not ſo firmly united, ſmall Wines, ſuch as *Rhenish*, moſt eaſily yield their Tartar (which by Experiments appears to contain Oil and Air;) but generous

rous Wines, ſuch as *Madera*, having thoſe Principles more firmly united, will bear a great degree of Heat before they part with them.

That the uſe of the Leaves of Trees is to bring up Nouriſhment within reach of the Attraction of the Fruit, to carry off the redundant watery Fluid; to imbibe Rains and Dews which are impregnated with Salt and Sulphur; as likewiſe to imbibe Air, and to be of the ſame uſe to Plants as the Lungs are to Animals.

That Plants which are overſhaded, or too replete with Moiſture, cannot ſo well imbibe Air: Therefore, though they will ſhoot out faſt, and have much Wood, they will be more barren in proportion.

Mr *Hales*, by a very ingenious Contrivance, found the Degrees of growing in every part of young Shoots, which in their growing extend themſelves moſt in the middle, and leaſt towards the top and the bottom; the ductile Matter for their growth being drawn out in length like melted Glaſs-Tubes, which retain a Hollowneſs, though drawn out to the ſmalleſt Thread. N. B. *In ſome Animals there is ſuch a tough ductile Subſtance, which hardens when expoſed to the Air in ſmall Threads, as in Spiders and Silk-Worms.*

He ſhews, that the Pith ſerves to ſupply the dilating Moiſture for the tender Shoots, but that their Figure may be oblong, and not round, as the Fruit commonly is, there are tough Diaphragms in the Pith at ſmall diſtance from each other, which check the lateral Expanſion; as alſo horizontal Fibres, which ſerve for the ſame purpoſe: And of the ſame ſort is the Pith in the large growing Feathers of Birds; which is made up of Veſicles that can be diſtended lengthwiſe, but have Sphincters at the ends, to prevent too large a lateral Dilatation. —— That the Bones of Animals do not grow at the Joints (which would prevent their free Motions) but at the *Symphyſis*, viz. where the Heads join to the Shanks of the Bones. —— That there are particular Veſſels in Vegetables, as well as Animals, appropriated for conveying different ſorts of Nutriment; and that where a viſcid Subſtance is to be furniſhed, the Veſſels are lengthened, and often fetch a compaſs to retard the Velocity of the Fluid, which is to be inſpiſſated into an hard Subſtance. Thus in hard Stone-Fruits the Umbilical Veſſel goes round the Concave of the Stone, and then enters the Kernel near it's Cone.

At laſt, our Author traces the Vegetation of a Plant, from a Seed to a Tree again producing Seed; for which Account, as it cannot well be contracted, we muſt refer to the Author's own Words.

2. The Author, after dedicating his Tracts to the Royal Society, gives a Deſcription of the particular Sort of Barometer, Thermometer, Hygrometer, and Hyetometer, which he made uſe of in the ſubſequent Obſervations. The firſt of theſe is a Diary of the Weather, from the Vernal Equinox of the Year 1728, to that of the Year 1729; containing the daily State of the Barometer, Thermometer, Wind.

An Account of a Book entituled, J. Frider. Weidleri Obſervationes Meteorologicæ

& Aſtronomicæ, Annorum 1728 & 1729, *&c.* Wittembergæ, Anno 1729. N°. 412. pag. 250.

Wind and Weather, together with the Quantity of Rain during that Time. To this he annexes ſome ſelect Meteorological and Aſtronomical Obſervations, which he deſcribes more at large.

The firſt he takes Notice of is a remarkable *Halo* round the Moon, on *February* 20, 1728, at forty-five Minutes paſt Seven in the Evening, when the Moon was not far diſtant from the Meridian, and about her firſt Quarter. The Diameter of the *Halo* occupied about 47 Degrees, being extended from ς in *Procyon* to *Capella* towards the Weſt. It's Arch was 4 ½ Deg. broad, as far, for Inſtance, as α and ς in *Procyon* are from each other. Within it was red, and towards the Extremity was pale; exhibiting entire a beautiful Spectacle for about four Minutes, but he did not know when it began. Before it diſperſed, ſome thin white Clouds began to paſs over it tranſverſly, and then it was broke towards the Weſt, the Redneſs of the diſperſing Vapours greatly encreaſing: After which the Sky became clear again. The ſame Day at Noon, he obſerved thirteen Spots on the Sun, the largeſt equalling $\frac{3}{4}$ of the Sun's Diameter; and the Spirit fell to 90 Degrees of the *Engliſh* Thermometer.

April 4, 1728, he obſerved an *Aurora Borealis.*

On *June* 20, another, which is deſcribed in the *Act. Erudit. Lipſ. Ann.* 1728. *p.* 375.

October 7, a very remarkable one appeared in the N. E. A *White Arch*, extended between the W. and N. E. quickly aſſumed a black Colour, and then divided into three other concentrical Arches equally black. From theſe ſome Radiations aroſe as uſual, but ſhorter. A little afterwards theſe likewiſe ceaſed and the black Arches were converted into luminous Tracts, only one remained till eleven o'Clock: And whereas at firſt the lowermoſt Arch was raiſed ſeven Degrees above the Horizon, it was now depreſſed towards it, being ſcarcely two Degrees above it.

The Author next proceeds, and gives fourteen Aſtronomical Obſervations, ten of which are of the Eclipſes of *Jupiter's Satellites* at different Times. In making theſe he was guided by *Caſſini*'s Tables for the Meridian of *Paris*, and by comparing the Time when they ſhould happen, as therein ſpecified, with the Time he obſerved them at *Wittemberg*, he collects the Difference of Meridians of that City and *Paris* to be 41 Minutes.

The eighth Obſervation contains his *Calculus* for the total Eclipſe of the Moon which happened *February* 13, 1729, N. S. but the Heavens being very cloudy, he could not obſerve the Eclipſe itſelf.

The ninth is an Obſervation of *Mercury*, *March* 4, 1729; at which Time the Planet was fartheſt from the Sun, and remained ſome Time above the Horizon. Making uſe therfore of a twenty-two Foot Teleſcope, he obſerved it's Phaſe almoſt biſſected, and it's Diameter appeared equal to a third part of the Diameter of *Venus*, this Planet being above the Horizon, and ſeen at the ſame Time.

The

The thirteenth is a Conjunction of *Venus* and the Moon, *viz. April* 2, 1729. At 7 h. 13′ he obſerved *Venus* placed in ſuch manner near the Moon, that the Horns of the Moon were in the ſame right Line with *Venus*, which was then diſtant from the Southern Cuſp of the Moon 1 Deg. 10′. At 7 h. 30′. he meaſured the Diſtance of *Venus* from the Eaſtern Cuſp of the *Pleiades* to be 2 Deg. 15′, and the Horn of the Moon at the ſame Time was diſtant from the ſame Cuſp 1 Deg. 53′, 45″; the intermediate Diſtance of the Horns of the Moon was 29′ 30″.

His laſt Obſervation is on the Declination of the Magnetical Needle in this and the former Year, which he defines to be 12 Deg. 01 55″ Weſt at *Wittemberg*, at this Time.

Theſe Obſervations are followed by the Author's Account of the laſt hard Winter, This ſet in ſooner than uſual, the Rivers being frozen the 19th of *September*, though they uſed not to be ſo till the Winter Solſtice, and the Spirit of Wine in the *Engliſh* Thermometer, on *September* 21, fell to the 66th Degree: At which Time a N. E. Wind blew very ſtrong. Afterwards, on *October* 3, the Spirit fell to 72 Deg. and the Ice was half an Inch thick on ſtanding Waters in the Fields, ſo that even then it might be judged, that the Cold would be more ſevere than is uſual in their Parts. From this Time the Froſt did not at all abate, but contiuued much in the ſame State the Month of *October*, except on the 20th Day, after a S. W. Wind had blowed pretty hard for ſome Days, the Cold was obſerved to encreaſe remarkably. The Beginning of *November* a ſtrong Eaſt Wind continuing to blow for ſix Days, the Spirit ſunk to 86 Deg. on the 5th, and the Ice was much thicker. On the 28th it fell to 96 Deg. after which they had no Rain, but all Vapours were congealed into Ice and Hoar. On *December* the 2d, the Spirit of Wine ſtood at 96 Deg. but on the 4th at 99 Deg. ſo that it not a little exceeded the Limit of intenſe Cold. Hence a S. W. Wind intervening now and then, the Cold ſeemed to abate a little; but that, and ſometimes a N. E. Wind blowing ſtronger on the 21ſt, 22d, and 23d Days, it ſo prepared the Air, that on *Chriſtmas* Day the Spirit in the Thermometer ſtood at 96 Deg. and the Cold was intenſe. Hence the Winter grew immediately more ſevere. The Wind almoſt always blew from the E. or N. ſo that on *January* 20, the Cold was almoſt intolerable, on which Day the Spirit deſcended to the 126th Deg. very little remaining above the Ball of the Tube; and this was the greateſt Degree of Cold at *Wittemberg*. After this the Winter ſomewhat declined. A S. W. Wind blew freſh ſometimes; but afterwards a N. and E. Wind reſtored the Cold on *February* 3, when the Spirit ſtood again at 86 Deg. On the 4th it fell to 95 Deg. and from this Time, barring a few Days, always in a Morning it reciprocated between 80 Deg. and 100 Deg. to *March* the 8th, on which it exceeded 106 Deg. and on the 9th it was forced down by a

N. E. Wind to 110 Deg. But although the Spring was at Hand, yet the Severity of the Weather did not ceaſe, as appears in that the Spirit of Wine, in the *Engliſh* Thermometer, in a Morning always ſtood at, or under the 80th Deg. of the Thermoſcopic Scale; nay, even on *March* the 21ſt, on which Day the Equinox preciſely fell, it was at 81 Deg. At length, on the laſt Day of *March*, the Weather grew milder, from whence may be taken the true Beginning of the Spring; not but that all *April* was much colder than uſual.

Thus far from Thermoſcopical Obſervations. After this, the curious Obſerver proceeds to ſhew it's Severity from ſome of the more remarkable Effects the Cold had on the Rivers, Plants, and Animals. As to the firſt, he ſays, that the *Elbe*, both at *Wittemberg* and other Places, was covered on *December* 29, with a perfect Bridge of Ice, which bore both Men and all Sorts of Carriages. This remained till *February* 28, when it grew thinner, and broke conſiderably; but the Cold returning on *March* 8, it re-united, and was as firm as before, till *March* 29. The Water within the Houſes, and in the Bed-chambers, where were good Fires, was wholly congealed and the Rind within on the Windows ſtuck for many Days, when the Wind was either E. or N. though the Room was well warmed. Examples of the other Kinds were ſeveral. Many Perſons periſhed in their Journies, and more loſt their Limbs in a very ſhort Time: So that near the *Elbe* they could not work abroad. It killed alſo many Animals immediately. The Crows, which can bear intenſe Cold, fell dead from the Trees: Stags, Goats, and Hares, periſhed in great Numbers. The Plants likewiſe felt it's Violence, and the more tender Trees were damaged. The Limes were every where injured. The greater Branches of the Plumb-trees, Apricocks, and Peaches, were dried up; but the Vines ſuffered moſt, the more robuſt being ſhriveled to the very loweſt part of their Trunk, unleſs guarded by a Wall, or ſome other Covering.

From theſe Obſervations the Author compares this Winter with the memorable one of 1709, and proves both from Thermoſcopical Obſervations; from it's Effects upon the Earth and Animals; from it's longer Continuance, and from the greater Extent of the Cold into the more Southern Parts, that this laſt much exceeded the former, at leaſt in *Germany*.

Having thus finiſhed the Hiſtory, he laſtly enquires into the probable Cauſes of it. He takes Notice, that the Winter foregoing was moderately cold and dry; and as a cold Summer ſucceeded, and alike dry, in which the North Winds blew moſt frequently, and during the hotteſt Months of *July* and *Auguſt* the Sky was covered with dark and black Clouds, the Earth was prepared for Froſt; to which the remarkable Drineſs of the Seaſon did not contribute a little, as Barometrical Experiments ſhew, that a dry Air cools ſooner than a moiſt, and is both heavier, and retains Cold longer.

Neither does he think it altogether foreign to Truth, to reckon the remarkable Frequency of the *Aurora Borealis* to be a Preſage of a colder Winter than ordinary, which has been obſerved to be followed by cool and ſerene Weather: As alſo the unuſual Number and Largeneſs of the Spots on the Sun's Diſk, for almoſt two Years together; by which Means, in ſuch a Length of Time, the Force of it's Rays might be obſtructed in ſome Degree, and the colder Winds thereby have Liberty to prevail. The Air by theſe concurrent Cauſes being rendered very cold, the Encreaſe, and extreme Degree of it proceeded from the great Cloudineſs of the Sky; and the blowing of the N. E. or E. Wind ſo remarkably obſervable for the moſt part of the Froſt.

CHAP. II.

HYDROLOGY.

I. THere have been ſeveral Machines contrived for meaſuring the different Depths of the Sea, eſpecially ſuch as could not be determined by the Lead and Line; but as thoſe Machines conſiſted of two Bodies (the one ſpecifically lighter, and the other ſpecifically heavier than Water) ſo joined together, that as ſoon as the heavy one came to the Bottom, the lighter ſhould get looſe from it, and emerge; and the Depth was to be eſtimated by the Time of the Fall of the compound Body from the Top to the Bottom of the Water, together with the Time of the Emerſion of the lighter Body, reckoned from the diſappearing of the Machine, till the emergent Body was ſeen again, no certain Conſequence could be drawn from ſo precarious and complex an Experiment.

An Account of a Machine for meaſuring any Depth in the Sea, with great Expedition and Certainty; ſhewn to the Royal Society, by J. T. Deſaguliers, *L. L. D. and R. S. S. contrived by the Rev. Mr* Stephen Hales, *F. R. S. and Himſelf.* No. 405. pag. 559.

For even in ſtill Water, and in the ſame Place, the Time will hardly be the ſame in two Experiments: Much leſs will this Machine anſwer in the Sea, on Account of Waves and Currents, and many other Hindrances.

But as the Preſſure of Fluids in all Directions is always the ſame at the ſame Depth, a Gage which exactly diſcovers what the Preſſure is at the Bottom of the Sea, will ſhew what is the true Depth of the Sea in that Place, whether the Time of the Deſcent of the Machine be but a Minute or two, or twenty Times as long.

The Reverend Mr *Hales*, in his *Vegetable Statics*, deſcribes his Gage for eſtimating the Preſſure made in opake Veſſels; where Honey being poured over the Surface of Mercury in an open Veſſel, riſes upon the Surface of the Mercury as it is preſſed up into a Tube

whoſe lower Orifice is immerſed into the Honey and Mercury, and whoſe Top is hermetically ſealed. Now as, by the Preſſure, the Air in the Tube is condenſed, and the Mercury riſes, ſo the Mercury comes down again when the Preſſure is taken off, and would leave no Mark of the Height to which it had riſen; but the Honey (or Treacle, which does better) which is upon the Mercury, ſticking to the Inſide of the Tube, leaves a Mark, which ſhews the Height to which the Mercury had riſen, and conſequently makes appear what was the greateſt Preſſure.

My Contrivance therefore is a Machine which will carry down *Fig.* 26. Mr *Hale*'s Gage to the Bottom of the Sea, and immediately bring it up again.

A B, is the Gage Bottle.

F *f*, the Gage Tube cemented to the Braſs Cap of the Bottle at G, with it's open End *f* immerſed in the Mercury C, which by the Preſſure of 32 Foot of Water is carried up to *d* with a little Treacle or Honey *d* upon it, raiſed up from D, a ſmall Thickneſs of Treacle poured on upon the Mercury.

When the Preſſure of Water is from a Depth of 64 Foot, the Mercury and Treacle riſe up to E, ½ of the Height of the Tube; and ſo higher proportionably to the Depth.

N. B. *A Scale may be marked on the Tube with a Diamond.*

K, is a Weight hanging by it's Shank I, in a Socket *m*, fixed to the Ring M B cemented at the Bottom of the Bottle. When the Hole L of the Shank is ſhoved up to *m*, the Catch *l* of the Spring S holds it from falling out of the Socket, whilſt the Machine is deſcending. But as ſoon as K touches the Ground at the Bottom of the Sea, the Hole L riſing, the Catch flies back and lets go the Weight, as it is ſeen in the Figure. Then the empty Glaſs Ball I (which at Sea may be a Hog's Bladder) riſes up to the Surface of the Water with the Machine, in which obſerving how high the Inſide of the Tube is daubed, the Preſſure, and conſequently the Depth of the Sea, is known.

H G, is a Braſs Tube to guard the Top of the Gage Tube.

There are Holes at F, G and E, to admit the Water to paſs freely every where.

To confirm the Uſe of this Sea-Gage, ſhewn before to the Society, I made another Experiment in the following Manner. Having poured ſome Quickſilver into the Bottle of the Gage, I poured upon it Treacle to the Depth of half an Inch, then ſcrewed on the Braſs Cap of the Bottle to which the Glaſs Gage-Tube was cemented; by which Means the open End of the Tube was brought under the Surface of the Mercury, the ſealed End being upwards. The Machine, thus fitted, was immerſed in a cylindric Veſſel of Water, which with a Plate at Top was preſſed between two Pillars, in ſuch Manner that Air might be condenſed over the Water without eſcaping

ping. Then having forced in ſo much Air with a Syringe, as to lay on a Preſſure equal to what would be in a Depth of 40 Foot of Water, I opened the Cock of the upper Plate, let out the Air, and, upon taking out the Machine, it appeared how high the Quickſilver had riſen in the Gage-Tube, by the greaſy Mark which the Treacle left within.

An Attempt to account for the riſing and falling of the Water of ſome Ponds near the Sea, or ebbing and flowing Rivers; where the Water is loweſt in the Pond, at the Time of high Water in the Sea or River; and higheſt in the Pond, at the Time of low Water in the Sea or River. As alſo for the increaſing or decreaſing of the Water of ſuch Pools and Brooks as are higheſt in the dry Seaſons, and loweſt in the rainy Seaſons: With an Experiment to illuſtrate the Solution of the Phænomena. By the Rev. J. T. Deſaguliers, L. L. D. and R. S. S. N°. 384. p. 132.

II. *Hero Alexandrinus*, and other Hydraulic Writers, have deſcribed a Cup (called a *Tantalus*, from it's Effect) which will hold any Liquor very well, when it is not filled above a certain Height marked in the Cup; but if it be filled higher, not only the Liquor above the Mark will run out, but the whole Liquor that was in the Cup. This is performed by a Syphon in the Cup, which is ſometimes concealed to make the Effect the more ſurprizing.

The Cup, A B (*Fig.* 27.) has a viſible Syphon C E D in it; the Cup, (*Fig.* 28.) has the ſame, concealed by the Figure of a Man, to repreſent *Tantalus* in the Fable; and the Cup of (*Fig.* 29.) has it's Syphon more concealed, as it is carried up into the Handle. Any of theſe Cups will hold Water very well, provided they are not filled up above the Line F G; for then not only the Liquor that is above F G will run out, but all the Liquor in the Cup as low as D, the Orifice of the ſhort Leg of the Syphon.

Experim. I.] (*Fig.* 30.) In the Veſſel *a b c d* is placed an open wooden Box A B C D filled with Water as high as the Line L M Another Box or Plug E F G H made tight, and containing Weights to ſink it, is made to let down into the Water between the Partition I K and the End A B of the Box above mentioned; but when it is not to preſs the Water up to I O, (as it does when let down) it is drawn out of the Water by the Weight *m*, which pulls it up by the Bar *i k* faſtened to a Leaver moving round the Center *l*.

When, by means of the Plug, the Water in the Space A B K I is puſhed up to I O, by paſſing under K; it runs out thro' the Spout P Q (whoſe Paſſage is gaged by a little Sluce P *p*) and falls into the Veſſel R S made of an oblong Figure like a Fiſh-Pond, and having a Syphon at S, ſo as to make it a *Tantalus*, or in the Nature of the Cups above-mentioned.

Let the Weight *m* pull up the Plug E F G H, and the Water, having filled R S, will run down below the Orifice P to M.

The *Tantalus* R S, beginning to run out as ſoon as full, will for the Reaſons above given, continue to run till it is all emptied; and as it diſcharges itſelf into another *Tantalus* T V (whoſe Syphon is at V); this laſt *Tantalus* will alſo, when full, begin to run out, and it's Water go down to *x Y o*.

If the Plug be let down gradually, as ſoon as the Water begins to run out of the laſt *Tantalus* T V, (and the firſt *Tantalus* R S be covered ſo as to be concealed from Sight) it will appear to the Lookers on, That the Cavity T V, repreſenting a Pond near an ebbing and

flowing River (as I am credibly informed there is ſuch an one at *Greenhith* in *Kent*, between *London* and *Graveſend*) always riſes, whilſt the Water at NO (or the Tide) falls to LM; and always ſinks whilſt the Water at LM (or the Tide) riſes to OL.

Experim. II. Let the Water in the Box ABCD not be made uſe of; only the Veſſel Z be filled every half Hour: It will empty itſelf in the Space of a Quarter of an Hour, falling like Rain, and dropping alſo thro' the Leaden Platform *ef* into the hidden *Tantalus* RS, which will not begin to run till this artificial Rain is over: Then in a Quarter of an Hour more, the *Tantalus* RS will have emptied it ſelf into the viſible *Tantalus* TV, which will be filling all the Time after Z has done running; (or in the dry Seaſon) and as ſoon as TV is full, it will begin to run out thro' it's Syphon V, at the End of the half Hour, when the Veſſel Z or Sieve runs again; that is, at the Return of the rainy Seaſon.

This laſt Experiment may eaſily be applied to thoſe Ponds, or thoſe Brooks, that are high in dry Weather, and low in wet Weather; of which Kind, I am told, there is a Brook at *Lambourn* in *Berkſhire*.

If it be objected, that ſuch Ponds are full for ſome time, which a *Tantalus* cannotbe, becauſe it begins to run out as ſoon as full; that may be eaſily ſolved, by ſuppoſing the hidden *Tantalus*, (or intermediate Cavity between the River and Pond) to contain more Water than the viſible one, provided it does not contain ſo much as not to be emptied, before the Return of the Tide.

The ſame Solution will ſerve for wet and dry Seaſons, only ſuppoſing the Cavities larger.

If it be aſked, where the Water of the viſible *Tantalus*, near a River, can run; it may be anſwered, that all this may happen, tho' the ſecond, or loweſt *Tantalus* ſhould have it's Bottom higher than low Water-Mark in the River. And for the Syphons, which are of a particular Make in the Cup; tho' ſuch be not ſuppoſed in the Earth, yet any long Paſſage, riſing in the Middle, will anſwer the End. *Fig.* 31. ABCD repreſents the Channel of a River, AD high Water-Mark, and GH low Water-Mark; ZI a Paſſage from the River to the Cavity IKLMN, or firſt, or hidden *Tantalus*; LMQ the Syphon of the firſt *Tantalus*, running into the ſecond *Tantalus*, or viſible Pond OQRP, which by it's Syphon RSV runs out into low Grounds that may be above the low Water-Mark GH; and the Bottom KL of the firſt *Tantalus* may be above the Top of the laſt, whoſe Level is the Line WW.

ABCDYOQRPVH is the Section of the Surface of the Earth.

III. *March*

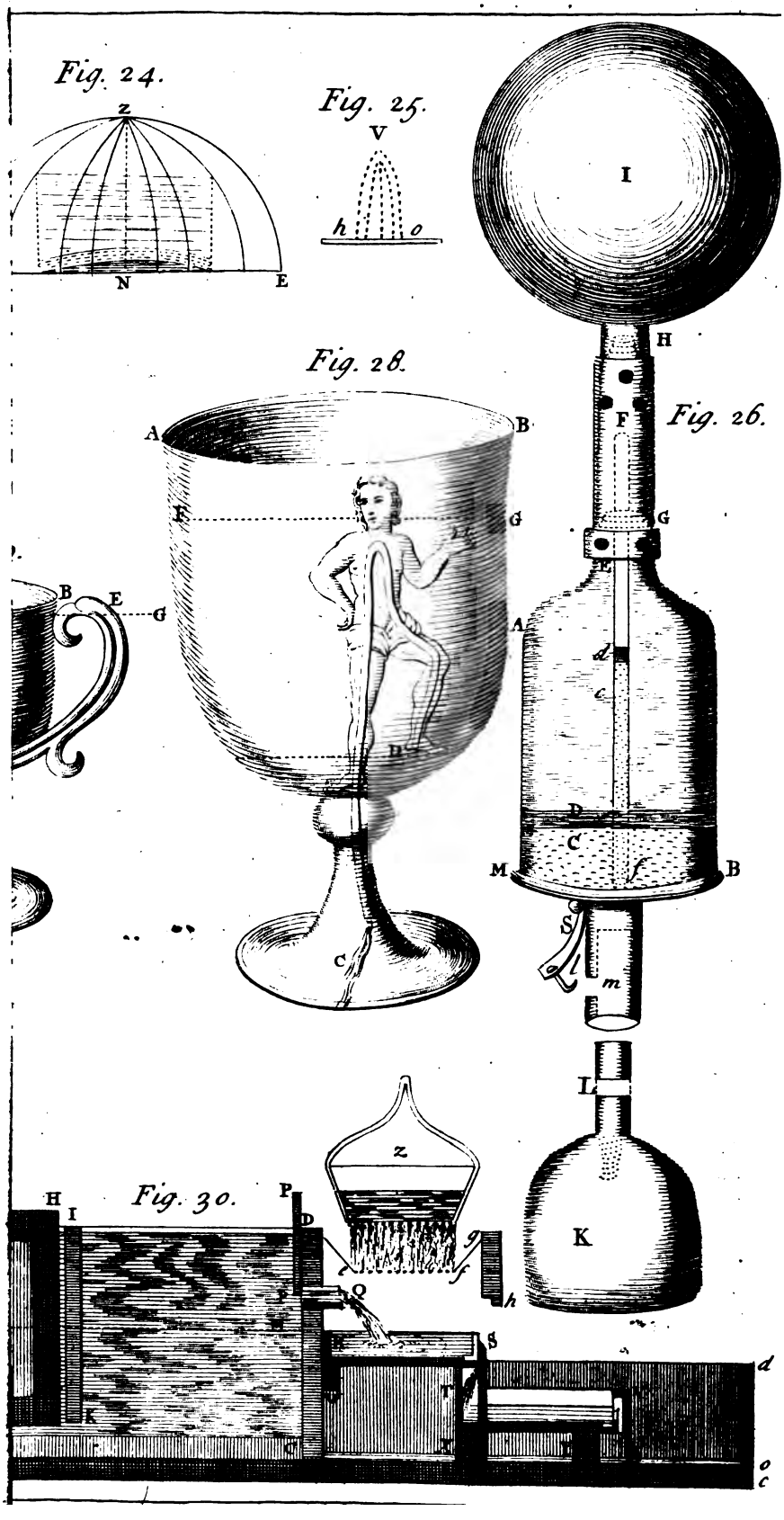


Fig. 24.
Z
N
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Fig. 25.
V
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Fig. 26.
F
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Fig. 28.
A
B
E
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D
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Fig. 30.
H
I
P
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Z
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c

III. *March* the 8th, 1725-6, The *Tide* in the *River Thames*, at *New Crane* in *Shadwell*, flowed twenty Foot, five Inches and a half, taken by a Level, from that High-water Mark, to Low-water the next Morning, and was four Inches higher than has been known these forty Years.

An Extraordinary high Tide in the River Thames *observed by Capt.* Tho. Jones. No. 393. p. 68.

IV. That the Use of my Instrument called the * *Marine Surveyor* may yet farther appear, I shall here give some Experiments I made with it on the River *Thames*, in order to determine the Strength of the Tides of *Flood* and *Ebb*. Were the same to be done in the Channel, and on the Sea Coast of *Great Britain*, and marked in our Charts, I am humbly of Opinion, it would be of no small advantage to our Commerce, and of consequence a sufficient Recommendation of the *Marine Surveyor*, if that alone were the Use of it.

Observations upon the Tides in the River Thames, *by Mr* Henry de Saumarez. No. 393. pag. 68.

I am induced the rather to be of this Opinion, in regard I am not insensible of the Dangers on the *Casquets*, in the *Race* of *Alderney*, &c. where rapid Tides and Currents have occasioned but too many to mourn the Loss of Friends and Fortunes: As I dwell in the Neighbourhood of these Dangers, I have (in manifest hazard of my Life) surveyed and taken correct Draughts not only of them, but of the Islands of *Guernsey*, *Sarck*, &c. And as I persuade my self they are as correct, as any thing that has hitherto appeared of this kind, it is my intent to publish them for the Good of the Public.

* *Vid.* Philos. Transact. No. 391.

A TABULAR

A TABULAR Account, shewing the Strength and gradual Increase and Decrease of the Tides of Flood and Ebb in the River Thames, *as observed in* Lambeth *Reach, off of* Mancheſter *Stairs, and in the Middle of the River, with a new Inſtrument called the* Marine Surveyor, *on the* 9th *of* June, 1720; *It being then Full Moon, and conſequently a Spring Tide. The Movement of the* Machine 14 *Inches under Water.*

FLOOD.

The Time of Flood.		The Depth of the River.		The Run of the Current in every 15 Min.	The whole Run of the Current to the Times expreſſed in the firſt Column.	The ſame reduced to Statute Miles of 5280 Feet, or 528 Revolutions of the Machine.		The Reduction into Engliſh maritime Miles of 6000 feet, or 600 Revolutions.	
H.	M	Feet	Inch.	Feet.	Feet.	M.	Pts Rev	M.	Pts. Rev.
	15	5		110	110		11		11
	30	6		590	700		70		70
	45	6	9	1100	1800		¼ 48		¼ 30
1		7		1400	3290		¼ 55		⅛ 29
1	15	8		1870	5160		¼ 120		¼ 66
	30	9		2230	7390	1	¼ 79	1	139
	45	10		2500	9890	1	¼ 65	1	⅛ 89
2		11	6	2660	12550	2	¼ 67	2	55
2	15	13		2730	15280	2	¼ 76	2	½ 28
	30	14		2740	18020	3	¼ 86	3	2
	45	14	9	2720	20740	3	¼ 94	3	¼ 124
3		14	9	2570	23310	4	¼ 87	3	½ 81
3	15	14	10	2220	25530	4	¼ 45	4	¼ 3
	30	14	9	1820	27350	5	66	4	⅛ 35
	45	14		990	28340	5	¼ 62	4	⅛ 134
	50	13	9	130	28470	5	¼ 75	4	⅛ 147

The

E B B.

The time of Ebb.	The Depth of the River.	The Run of the Current in every 15 Min.	The whole Run of the Current to the Times expressed in the first Column.	The same reduced to Statute Miles of 5280 feet, or 528 Revolutions of the *Machine*.	The Reduction into English maritime Miles of 6000 feet, or 600 Revolutions.
H. M.	Ft. In.	Feet.	Feet.	M. Pts Rev.	M. Pts Rev.
15	12 9	280	280	28	28
30	12 3	1140	1420	¼ 10	142
45	11 10	1900	3320	½ 68	½ 32
1	11 4	2080	5400	1 12	¾ 92
1 15	11 2	2120	7520	1 ¼ 92	1 ¼ 2
30	10 9	2120	9640	1 ½ 40	1 ½ 64
45	10 4	2170	11810	2 125	1 ¾ 131
2	10	2130	13940	2 ½ 74	2 ¼ 44
2 15	9 6	2060	16000	3 16	2 ½ 100
30	9 4	2040	18040	3 ¼ 88	3 4
45	9	2020	20060	3 ½ 26	3 ¼ 56
3	8 9	1910	21970	4 85	3 ½ 97
3 15	8 6	1900	23870	4 2 11	3 ¼ 137
30	8 3	1910	25780	4 ¼ 70	4 ¼ 28
45	8	1860	27640	5 124	4 ½ 64
4	7 9	1810	29450	5 ½ 41	4 ¾ 95
4 15	7 3	1780	31230	5 ¼ 87	5 123
30	7	1690	32920	6 124	5 ¼ 142
45	6 6	1620	34540	6 ½ 22	5 ¾ 4
5	6 3	1570	36110	6 ¾ 47	6 11
5 15	6 3	1570	37680	7 72	6 ¼ 18
30	6	1570	39250	7 ¼ 97	6 ½ 25
45	6	1560	40810	7 ½ 121	6 ¾ 31
6	5 9	1550	42360	8 12	7 36
6 15	5 6	1500	43860	8 ¼ 30	7 ¼ 36
30	5 3	1460	45320	8 ½ 44	7 ½ 32
45	5	1450	46770	8 ¾ 57	7 ¾ 27
7	4 9	1430	48200	9 68	8 20
7 15	4 6	1400	49600	9 ¼ 76	8 ¼ 10
30	4 3	1380	50980	9 ½ 82	8 ¼ 148
45	4 3	1340	52320	9 ¾ 84	8 ½ 232
8	4	1270	53590	10 79	8 ¾ 109
8 5	3 10	420	54010	10 121	9 1
10	3 11	410	54420	10 ¼ 30	9 42
15	4	400	54820	10 ½ 70	9 82
20	4	380	55200	10 ¾ 108	9 120
25	4 2	300	55500	10 ½ 6	9 ¼
30	4 2	270	55770	10 ½ 33	9 ½ 27
35	4 3	130	55900	10 ½ 46	9 ¾ 40
40		Stagnt.	Stagnant.		

A TABULAR Account, ſhewing the Strength and gradual Increaſe of the Tides of Flood and Ebb in the River Thames, *as obſerved in* Lambeth *Reach, off of* Mancheſter *Stairs, and in the Middle of the River, with a new Inſtrument called the* Marine Surveyor, *on the* 18th *of* June, 1720; *It being then the laſt Quarter of the Moon, and conſequently a Neap Tide. The Movement of the* Machine 14 *Inches under Water.*

FLOOD.

The Time of Flood.		The Depth of the River.		The Run of the Current in every 15 Min.	The whole Run of the Current to the Times expreſſed in the firſt Column.	The ſame reduced to Statute Miles of 5280 feet, or 528 Revolutions of the *Machine.*	The Reduction into Engliſh, maritime Miles of 6000 feet, or 600 Revolutions.
H.	M.	Ft.	In.	Feet.	Feet.	M. Pts Rev.	M. Pts Rev.
	15	4		220	220	22	22
	30	4	3	520	740	74	74
	45	4	9	900	1640	32	14
1		5	3	1030	2670	3	117
1	15	5	9	1020	3690	105	69
	30	6	1	1160	4850	89	35
	45	7		1450	6300	102	30
2		7	9	1640	7940	2	44
2	15	8	1	1830	9770	93	77
	30	9		1920	11690	113	119
	45	9	6	2070	13760	96	26
3		10		2170	15930	9	
3	15	10	4	2070	18000	84	
	30	11	3	1960	19960	16	46
	45	11	4	1890	21850	73	85
4		11	9	1700	23550	111	105
4	15	11	6	1300	24850	109	85
	30	11		730	25580	50	8
	35	11		70	25650	57	15
	40			Stagnt.	Stagnt.		
	45	10	10	dit.	dit.		
	50	10	9	dit.	dit.		

E B B.

The Time of Ebb. H	M.	The Depth of the River. Ft.	In.	The Run of the Current in every 15 Min. Feet.	The whole Run of the Current to the Times expressed in the first Column. Feet.	The same reduced to Statute Miles of 5280 feet, or 528 Revolutions of the *Machine*. M.	Pts	Rev.	The Reduction into English maritime Miles of 6000 feet, or 600 Revolutions. M.	Pts	Rev.
	15	10	6	610	610			61			61
	30	10		1340	1950		¼	63		¼	45
	45	9	9	1520	3470		½	83		½	47
1		9	3	1650	5120		¾	116		1	62
1	15	9		1750	6870	1	¼	27	1		87
	30	8	6	1730	8600	1	½	68	1	¼	110
	45	8		1700	10300	1	¾	106	1	½	130
2		7	9	1710	12010	2	¼	13	2		1
2	15	7	5	1710	13720	2	½	52	2	¼	22
	30	7	1	1710	15430	2	¾	91	2	½	45
	45	6	9	1710	17140	3		130	2	¾	64
3		6	7	1680	18820	3	¼	34	3		82
3	15	6	4	1670	20490	3	½	69	3	¼	99
	30	6		1570	22060	4		94	3	½	106
	45	5	9	1500	23560	4	¼	112	3	¾	106
4		5	8	1480	25040	4	½	128	4		104
4	15	5	3	1440	26480	5		8	4	¼	98
	30	5	2	1430	27910	5	¼	19	4	½	91
	45	5		1420	29330	5	½	29	4	¾	83
5		5		1430	30760	5	¾	40	5		76
5	15	4	10	1420	32180	6		50	5	¼	68
	30	4	6	1430	33610	6	¼	61	5	½	61
	45	4	4	1420	35030	6	½	71	5	¾	53
6		4	1	1380	35410	6	¾	77	6		41
6	15	3	11	1360	37770	7		81	6	¼	27
	30	3	11	1340	39110	7	¼	83	6	½	11
	45	3	10	1230	40340	7	½	74	6	¾	134
7		3	10	1070	41410	7	¾	49	6		91
7	15	3	11	530	41940	7	¼	102	6	¼	144
	20	4		20	41960	7	¾	104	6	½	146
	25			Stagnant.	Stagnant.						
	35	4	3	dit.							

Of the Currents at the Streights Mouth. By Capt --- Communicated by Dr. Hudson. No. 385. pag. 191.

V. Cape *Spartel*, and Cape *Trafalgar*, from the western Ocean, are known to make the *Streights* Mouth, from whence a Current, in the middle of the Channel (which is about five Leagues broad) betwixt the *Barbary* and *Spanish* Land, runs, at least, two Miles each Hour, as far as *Ceuta* Point; and there the two Coasts opening about eight een

eighteen Leagues diſtant from each other, the Current does not run above one Mile an Hour, and ſo continues as far as Cape *de Gat*, which is ſeventy Leagues up the *Mediterranean*. Our Mariners obſerve a Current to ſet to the weſtern Sea, or the great Ocean from *Ceuta*, along the *Barbary* Shore; and from *Gibraltar* along the *Spaniſh* Shore; but that on the *Barbary* Shore is generallytheir common Rout, not only as being the freeſt from Rocks and leſs dangerous, but by reaſon that the Tide is much ſtronger, than it is on the other Side, which the ſooner helps the Ships out of the *Streights*, which are the narroweſt betwixt the Points of *Gibraltar* and *Ceuta*; at which laſt Place, a Neck of Land extends itſelf a conſiderable Way into the Sea; and it's my Opinion, and that of others, that whereas the Current runs, as aboveſaid, two Miles an Hour againſt this Neck of Land, the Water there meets with ſo violent an Oppoſition in it's Courſe, as occaſions it to rebound with ſo much Force, that Part of it returns back along the ſame Coaſt, and ſo out of the *Streights* Mouth; which, with the ſmall Tide that ſets out on the *Spaniſh* Shore, 'tis believed, may exhauſt a conſiderable Part of that Current, which continually ſets in, to the Eaſtward, at the Rate I have already mentioned. What I look upon to be very remarkable, is that in the Year 1712, Monſieur *du L'Aigle*, that fortunate and generous Commander of the Privateer called the *Phœnix* of *Marſeilles*, giving Chaſe, near *Ceuta* Point, to a *Dutch* Ship bound for *Holland*, he came up with her in the middle of the Gut, or *Streights*, betwixt *Tariffa* and *Tangier*, and there gave her one Broad-ſide, which directly ſunk her, all her Men being ſaved by the Means of Monſ. *du L'Aigle*; and a few Days after, the ſunk Ship, with her Cargo of Brandy and Oil, aroſe on the Shore near *Tangier*, which is, at leaſt, four Leagues to the Weſtward of the Place were ſhe ſunk, and directly againſt the Strength of the Current; which has perſuaded many Men, that there is a Recurrency in the deep Water in the middle of the Gut, that ſets outwards to the grand Ocean, which, I think, this Accident very much demonſtrates; and poſſibly, a great Part of the Water, which runs into the *Streights*, does return that Way, and along the two Coaſts which I have already mentioned; otherwiſe, this Ship of Courſe, muſt have been drove towards *Ceuta*, and ſo upwards. I was at *Gibraltar* when this happened, where I ſaw above 100 of the Butts of that Cargo of Brandy, which were ſent thither from *Tangier*; I likewiſe ſpoke with the Captain of the *Dutch* Ship, who told the Governor, myſelf, and many others, where his Veſſel ſunk; and her riſing afterwards at *Tangier*, appeared very unaccountable to us, as it does to me to this Day; for there's no Doubt but the Ship ſunk where the *Dutchman* told us, ſince the *Spaniards* from the Land, who ſaw it, confirmed it to us. The Water in the Gut muſt be very deep, ſeveral of the Commanders of our Ships of War having attempted to ſound it with the longeſt Lines they could contrive, but could never find any Bottom.

VI. The

VI. The Falls of *Niagara* are a mighty Ledge or Precipice of ſolid Rock, that lies acroſs the whole breadth of the River (a little before it empties it ſelf into or forms the Lake *Ontario*) and very ſteep.

An Account of the Falls of the River Niagara *taken at* Albany, Octob. 10. 1721. *from Monſieur* Boraſſaw, *a* French *Native of* Canada. *By the Hon.* Paul Dudley, *Eſq*; F. R. S. N°. 371. pag. 69.

Monſieur *Boraſſaw* never meaſured the Falls himſelf, though he has been there at ſeven different Times: But what he ſays is, That,

This laſt Spring the Governour of *Canada*, Monſieur *Vaudreil*, ordered his own Son, with three other Officers, *viz.* Meſſieurs *Longue Iſle*, St *Ville*, and *Laubineau*, to ſurvey *Niagara*, and take the exact height of the Cataract, which they accordingly did with a Stone of half an hundred Weight, and a large Cod-line, and found it upon a Perpendicular no more than twenty ſix Fathom; his Words were *Vingt & Six Bras.*

This differs very much from the Account Father *Hennepin* has given the World of that Cataract, for he makes it an hundred Fathom; and our Modern Maps from him, as I ſuppoſe, mark it at ſix hundred Feet; but I believe *Heunepin* never meaſured it, and there is no gueſſing at ſuch Things.

When I objected *Hennepin*'s Account of thoſe Falls, to Monſieur *Boraſſaw*, he replied; That accordingly every Body had depended upon it as right until the late Survey. Upon further Diſcourſe he acknowledged, That below the Cataract for a great way, there were numbers of ſmall Ledges, or Stairs croſs the River, that lowered it ſtill more and more, till you come to a Level; ſo that if all the Deſcents be put together, he does not know but the Difference of the Water above the Falls, and the Level below, may come up to Father *Hennepin*, but the ſtrict and proper Cataract upon a perpendicular, is no more than twenty ſix Fathom, or an hundred and fifty ſix Foot, which yet is a prodigious Thing, and what the World I ſuppoſe cannot parallel, conſidering the greatneſs of the River, for it is near a Quarter of an *Engliſh* Mile broad, and very deep Water.

Several other Things Monſieur *Boraſſaw* ſet me right in, as to the Falls of *Niagara*. Particularly it has been ſaid, That the Cataract makes ſuch a prodigious noiſe, that People cannot hear one another ſpeak, at ſome Miles diſtance whereas he affirms, you may converſe together cloſe by.

I have alſo heard it poſitively aſſerted, That the Shoot of the River when it comes to the Precipice, was with ſuch a mighty force, that Men and Horſe might march under the Body of the River without being wet. This alſo he utterly denies, and ſays the Water falls in a manner right down. What he obſerved farther to me was,

That the Miſt or Shower (his Word was *La Brume*) which the Falls make, is ſo extraordinary, as to be ſeen at five Leagues diſtance, and riſes as high as the common Clouds. In this *Brume* or Cloud, when the Sun ſhines, you have always a glorious Rainbow.

Of

Of the River it ſelf, which is there called the River *Niagara*, he tells me it is much narrower at the Falls, than either above or below, and that from below there is no coming nearer the Falls by Water, than about ſix *Engliſh* Miles, the Torrent is ſo rapid, and withal ſuch terrible Whirl-pools.

He confirms Father *Hennepin*'s and Mr *Kellog*'s Account of the large Trouts of thoſe Lakes, and ſolemnly affirmed there was one taken lately, that weighed eighty ſix Pounds; which I am the rather inclined to believe upon the general Rule that Fiſh are according to their Waters. To confirm which, a very worthy Miniſter, now alive in *New England*, affirmed to me; That while he was a Priſoner at *Mon-real*, in *Canada* River, he ſaw a Pike brought up one Day from the River to the Governour's Houſe, and carried upon a Pole between two Men, that meaſured Five Foot, and Ten Inches long, and proportionably large.

I my ſelf this laſt Summer, ſaw a Cataract, three Leagues above *Albana*, in the Province of *New York*, upon *Schenectada* River called the *Coboes*, which they count much of there; and yet that is not above 40 or 50 Foot perpendicular. From theſe Falls alſo there riſes a miſty Cloud, which deſcends like ſmall Rain, that when the Sun ſhines, gives a handſome ſmall Rainbow that moves as you move, according to the Angle of Viſion. The River at the *Coboes* is to 40 or 50 Rods broad, but then it is very ſhallow Water, for I was told that in a dry Time, the whole River runs in a Channel of not more than fifteen Foot wide.

In my Journey to *Albany*, 20 Miles to the Eaſtward of *Hudſon*'s River, near the middle of a long riſing Hill, I met with a briſk noiſy Brook ſufficient to ſerve a Water-Mill, and having obſerved nothing of it at the beginning of the Hill, I turned about and followed the Courſe of the Brook, till at length I found it come to an End, being abſorbed, and ſinking into the Ground, either paſſing through Subterraneous Paſſages, or ſoaked up with the Sand; and though it be common in other Parts of the World for Brooks and even Rivers thus to be loſt; yet this is the firſt of the Sort, I have heard of, or met with in this Country.

An Account of the Riſe of ſeveral of the moſt conſiderable Rivers in Europe, *by* J. G. Scheuchzer, *M. D.* F. R. S. No. 406. p. 587.

VII. The *Rhoſne*, *Rhodanus*, by *Marcellinus* called, *maximi nominis flumen*, and by *Varro*, *Fluvius inter tres Europæ maximus*, ariſes from two *Gletchers*, as we call them, or *Montes glaciales*, *huge Mountains of Ice*, near the *Furca*, whoſe Height hath been above determined, and thence runs with great Impetuoſity down *Valleſia*, the *Walliſſerland*, forming a long Valley, ſurrounded on both Sides with huge Mountains, till it loſes it's Waters and Name in the *Lacus Lemannus*, or *Lake* of *Geneva*, but reſumes it again near the Town of *Geneva*, whence it flows with a more gentle Deſcent through ſome Provinces of *France* into the *Mediterranean Sea*.

The Rhoſne.

The

The *Thesin*, *Ticinus*, by *Claudian*, in his Panegyric upon the Consulat of the Emperor *Honorius*, called *Pulcher*, *the handsom*, takes it's first Rise from two small Lakes upon the *S. Gothard*, and some lateral Sources from the *Lago sopra la Cima di Pettine*, upon a Mountain called *Pettine*, the *Lago della Sella*, the Lake of *Rottom* upon the *Luckmannier Berg*, the Lake of *Tom*, and the *Lake of Bedretto*, upon a Mountain of this Name. It descends the *Lavinia Vallis*, or *Liviner Valley*, and in it's way to the Lake of *Locarno*, receives many Brooks and Rivulets from the adjoining Mountains: It unites it's Waters with the *Po*, near *Pavia*, and loses itself jointly with that River into the Adriatic Gulf. *The Thesin.*

The Rhine, *Rhenus*, by *Cæsar de Bello Gallico* termed, *latissimus atque altissimus*, arises in three several Branches, which are called *Rhenus anterior*, *posterior*, & *medius*, the *further*, the *hinder*, and *middle Rhine*. The *hinder Rhine* takes it's Rise upon the high Mountain *Avicula*, *Colmen del Occello*, Part of the *Adula*, in the Alp *San Porta*, from a *Glatsher*, or Ice-Mountain, which extends in Length full two Hours. The *middle Rhine*, *Rhenus medius*, arises upon the *Luckmannier Berg*, which is likewise Part of the *Adula*, in the upper Part of a Valley, called *San Maria*, opposite to one of the Sources of the *Thesin*. The *farthermost Rhine*, *Rhenus anterior*, arises upon that Branch of the *Crispalt*, which is called *Cima del Badut*, *Badus*, and soon receives several lateral Branches from the *Alps Mugels* and *Cornera*. Near the Monastery of *Disentis*, the *further* and *middle Rhine* join together, and the united Stream falls into the *hinder Rhine*, near *Reichenau*. Below *Rheineck*, the *Rhine* falls into the *Lacus Bodamicus*, or *Boden Sea*, and comes out of it near *Stein*, whence washing for some time the Borders of *Switzerland*, it then traverses great Part of *Germany* in a very irregular Course, till at last, in *Holland*, it loses itself in the great Ocean. *The Rhine.*

The *Reüss*, *Rusa*, arises from a small Lake called *Lago di Luzendro*, upon the *S. Gothard*, but soon receives a considerable Inforcement from the *Furca*, and near *Urselen*, another from a mountainous Lake in *Oberalp*. Near *Flüelen*, not far from *Uri*, it enters the IV. *Waldstetter Sea*, *Lacus quatuor Civitatum Sylvestrium*, but resumes it's Course and Name at *Lucern*, and at last falls into the *Aar* below *Windisch*, *Vindonissa*. *The Reüss.*

The *Aar*, *Arola*, *Arula*, arises upon the high Mountain *Grimsula*, in the upper *Vallesia*. About three Hours below that, it falls into the Lake of *Brientz*, and out of that, not far from the Monastery *Interlacken*, into the Lake of *Thun*, which it leaves near the Town of *Thun*, and thence running by *Bern*, *Solothurn*, and so down, falls at last, after many Windings and Turnings into the *Rhine* near *Coblentz*, *Confluentia*, probably so called from the uniting of these two considerable Rivers. *The Aar.*

The Aſcent of the Mountains of *Swiſſerland* being ſo very ſudden and quick, that as I have ſhewn, the Elevation of the Mountains in the Canton of *Glarus* above the Horizon of *Zurich*, though not quite three Days diſtant, is more than three Times as great, as the Elevation of *Zurich* itſelf above the Level of the Ocean, of which it is upwards of 375 *Engliſh* Miles diſtant in a ſtreight Line; and ſo in Proportion of others; and the Rivers, which ariſe in theſe Mountains, ruſhing down, in Conſequence of ſo quick a Deſcent, with great Force and Impetuoſity, it was to be feared, they would often overflow their Banks, and cauſe frequent Inundations in the flat Countries, (of which there are too many Inſtances in our own Vallies and Plains,) if this Force and Impetuoſity was not in great Meaſure broke, and their Waters diſpoſed to a more gentle Deſcent. And this is effectually done by thoſe great Receptacles of Water, the Lakes, which are beſides of infinite Uſe to the Inhabitants around them, ſupplying them with Plenty of Fiſh for their Suſtenance, and enriching them by the Facility with which Commerce may be carried on over them. Thus the *Rhine* falls into the *Lacus Bodamicus*, *Boden-Sea*, the *Rhoſne* into the *Lacus Lemannus*, or *Lake of Geneva*, the *Mueſa* and *Theſin* into the *Lake of Locarno*, the *Reüs* into the *Lake of Lucern*, the *Adda* and *Maira* into the *Lake* of *Como*, the *Lint*, or *Limat*, into the *Lake* of *Zurich*, the *Aar*, into the Lakes of *Brientz* and *Thun*. And it ſeems, that the more conſiderable the Rivers are, and the more impetuous their Courſe, ſo much the greater muſt the Receptacles be, wherein they are to loſe their Force and Rapidity. The *Lake of Geneva*, and the *Boden-Sea*, the two largeſt in *Swiſſerland*, evidently evince what I here aſſert, and the others above-named gradually decreaſe in Largeneſs, in proportion as the Rivers, which fall into them, are leſs and leſs rapid.

An Account of the Nature and Virtues of the Holt-Waters, *by the Rev. Mr* J. Lewis, *Vicar of the Place.* No. 408. pag. 43.

VIII. Experience has proved them of admirable Efficacy in Scorbutic and Scrophulous Caſes: wherein they have done ſuch Wonders, that a ſhort Account which was publiſhed of their Cures in that Kind, above five Years ago, was looked upon by ſome, rather as a romantic Tale, than a true Narrative of real Facts.

They are of an attenuating, aſtringent, and drying Nature: And by theſe Qualities, I imagine, they perform their Cures. The firſt is the known Property of all Water, to dilute the Blood, and thin the Juices, and thereby to fit them to paſs the fine Strainers, and be carried out of the Body by their proper Drains. In the Second conſiſts the great Excellence of *Holt-Water*, which, by it's notable Aſtringency, braces the Solids, ſtimulates the Fibres, and quickens their contractile Power, and thereby enables them to ſhake off, protrude and ſqueeze out ſuch Feculencies, as may adhere to, clog and ſtuff them up. And this Quality, it is probable, they derive from the Allom and Iron that are ſuppoſed to impregnate them. The Ingredients, which give them their drying, abſorbing and healing Quality,

Quality, are the Sulphur and Ochre; by which they imbibe the peccant Humours, and ſheath the ſharp Salts, that lance and tear the finer Glands, and cauſe Blotches, and Ulcerations. As they attenuate and aſtringe, they are a noble Diuretic, removing Obſtructions from the Kidnies, and cauſing the Renal Glands to make their due Secretions, and at the ſame Time diſſolving the groſſer Salts, and fitting them to be carried off through the Urinary Paſſages.

Theſe Waters have been found of excellent Avail in many other Illneſſes, beſides the Scurvy and Evil.

IX. The following Conjectures upon the Subject of intermitting and reciprocating Springs, were ſuggeſted to me by the Phænomena of a particular Fountain, ſeen by my ſelf this laſt Winter. I am ſenſible that my Obſervations made on it are very imperfect, in Compariſon of what the *Society* may expect, and I my ſelf hope hereafter to give them: And as the Conjectures were framed chiefly for my own uſe, againſt another Opportunity of obſerving this Fountain more carefully; ſo they are now communicated only for the uſe of others, who may perchance find ſuch an Opportunity before me. Theſe Obſervations will however diſcover ſomething of the Nature of this Spring not yet imparted to the *Society*, nor taken notice of by the Naturaliſts, ſo far as I know, in any other Spring whatſoever. But ſince they are few, and imperfect, I ſhall be more particular in my Relation of them, that no greater Streſs may be laid on them than they deſerve. *Conjectures upon the Nature of* Intermitting *and* Reciprocating Springs. *By Mr* Joſeph Atwell, *F.R.S.* No. 424. pag. 301.

The Spring is ſituated at one End of the Town of *Brixam* near *Torbay* in *Devonſhire*, and is known by the Name of *Laywell*. It is a long Mile diſtant from the Sea, upon the North and North-Eaſt Side of a Ridge of Hills lying between it and the Sea, and making a Turn or Angle near this Spring. It is ſituated in the Side of thoſe Hills, near the Bottom, and ſeems to have it's Courſe from the South-Weſt towards the North-Eaſt. There is a conſtantly running Stream which diſcharges itſelf near one Corner into a Baſon about eight Foot in Length, and four Foot and a half in Breadth; the Outlet of which is at the fartheſt End from the Entrance of the Stream, about three Foot wide, and of a ſufficient Height. This I mention, that a better Judgment may be made of the perpendicular Riſe of the Water in the Baſon, at the time of the Flux or Increaſe of the Stream. Upon the outſide of the Baſon are three other Springs, which always run, but with Streams ſubject to a like regular Increaſe and Decreaſe with the former. They ſeem indeed only Branches of the former, or rather Channels diſcharging ſome Parts of the conſtantly running Water, which could not empty itſelf all into the Baſon; and therefore when by means of the Seaſon, or Weather, Springs are large and high, upon the Flux or Increaſe of this Fountain ſeveral other little Springs are ſaid to break forth, both in the Bottom of the Baſon,

and without it, which diſappear again upon the Ebb or Decreaſe of the Fountain. All the conſtantly running Streams put together, at the time that I ſaw them, were, I believe, more than ſufficient to drive an Over-ſhut Mill; and the Stream running into the Baſon, might be about one half of the whole.

I had made a Journey purpoſely to ſee it, in Company with a Friend. When we came to the Fountain, we were informed by a Man, working juſt by the Baſon, that the Spring had flowed and ebbed about twenty times that Morning; but had ceaſed doing ſo, about half an Hour before we came. I obſerved the Stream running into the Baſon, for more than an Hour by my Watch, without perceiving the leaſt Variation in it, or the leaſt Alteration in the Height of the Surface of the Water in the Baſon; which we could obſerve with great Nicety, by means of a broad Stone laid in a ſhelving Poſition in the Water. Thus diſappointed, we were obliged to go and take ſome little Refreſhment at our Inn; after which we intended to come back and ſpend the reſt of our Time by the Fountain, before we returned Home. They told us in the Town, that many had been diſappointed in this manner; and the common People ſuperſtitiouſly imputed it to I know not what Influence which the Preſence of ſome People had over the Fountain; for which reaſon they adviſed, that in caſe it did not flow and ebb when we were both preſent, one of us ſhould abſent himſelf, to try whether it would do ſo in the Preſence of the other.

Upon our Return to it, the Man, who was ſtill at work, told us, that it began to flow and ebb about half an Hour after we went away, and had done ſo ten or twelve times. In leſs than a Minute, we ſaw the Stream coming into the Baſon, and likewiſe the others on the outſide of the Baſon, begin to encreaſe and to flow with great Violence; upon which the Surface of the Water in the Baſon roſe an Inch and a quarter perpendicularly, in near the Space of two Minutes: Immediatly after which, the Stream began to abate again to it's ordinary Courſe; and in near two Minutes time the Surface was ſunk down to it's uſual Height, where it remained near two Minutes more. Then it began to flow again as before; and in the Space of twenty-ſix Minutes flowed and ebbed five times: So that an Increaſe, Decreaſe, and Pauſe, taken together, were made in about five Minutes, or a little more.

I could obſerve by the Mark upon the Stones, that the Surface of the Water in the Baſon had riſen before we came at leaſt three Quarters of an Inch perpendicularly higher than when we ſaw it; and I thought that I could perceive ſome very little Abatement each Turn, both in the Height, and in the Time of the riſing of the Surface, and conſequently in the Time of it's ſinking; but the Time of the Pauſe, or ſtanding of the Surface at it's uſual Height, or equable running of the Stream, was lengthened; yet ſo, as to leave

ſome

ſome Abatement in the time of the riſing, ſinking, and pauſe taken together. This is all which my ſhort Time would allow me to obſerve; many more things ſhould have been taken notice of, as will appear from the Hypotheſis propoſed to explain theſe Phænomena.

But before I enter upon explaining that Hypotheſis, I muſt remark what Difference or Agreement is to be found between this Account of the Fountain, and another publiſhed in the *Philoſ. Tranſ.* Numb. 204. p. 909, 910, in two Letters from Dr *Oliver* to *Walter Moyle*, Eſq; The Doctor places it a Mile and half from *Brixam:* I ſuppoſe he means *Brixam-Quay*, which is more than a Mile off from the Town. He gives the Dimenſions of the Baſon a little different from mine, making the Surface of it thirty Foot ſquare, whereas I make it thirty-ſix Foot. He ſays, that it ebbs and flows very often every Hour; which is certainly falſe, as appears both by common Report, and by my own Obſervation. When it once begins indeed to flow and ebb, it continues to do ſo ſeveral times in an Hour; but then there is after this again a certain Space of Time, perhaps two Hours or more, when it runs with an equable Stream, without any the leaſt Variation: And this is a particular Circumſtance not obſerved in any Spring whatſoever that I have heard of. When the Doctor firſt ſaw it, *viz.* in *July* 1693, he ſays that he judged the Flux and Reflux, as he calls them, to be performed in about two Minutes: If he means two Minutes each, it agrees very well with my own Obſervations; but as he had neither Glaſs nor Minute-Watch with him, this Obſervation cannot be depended on. When he ſaw it again, *viz.* in *Auguſt* the ſame Year, he judged it to flow ſlower than before; which he explains by ſaying, that though it performed it's Flux and Reflux in little more than a Minute (which by the way is quicker than before) yet it would ſtand at the Low-Water Mark two or three Minutes; which I ſuppoſe he calls flowing ſlower than before, becauſe the Space of Time between the End of the Ebb and the Beginning of the ſucceeding Flux was longer. I had never read this Account 'till lately; long ſince my own Obſervations were made; but, if we ſuppoſe the Doctor to have made his Obſervations ſomewhat nearer the Time when the Fountain was to ceaſe ebbing and flowing, than I made mine, our Obſervations will perhaps exactly agree: The Time of the Flux and Reflux being ſhorter, the Time of the Pauſe longer, but the whole Time of the Flux, Reflux, and Pauſe taken together, being ſhorter by his Account than by my own. He ſays, that he found it by his Watch to flow and ebb ſixteen Times in an Hour: I do not ſuppoſe that he made a whole Hour's Obſervations, which muſt have ſhewn him a Difference in the Times of the Reciprocations that he did not perceive; but having obſerved, that one Reciprocation, or a Flux, Reflux, and Pauſe, took up about the Space of four Minutes, he from thence computed,

as I imagine, that there would be ſixteen in an Hour, preſuming that there was no Alteration in the Times. In this ſenſe I would underſtand him, when he adds, that he was informed it ſometimes flowed twenty Times in an Hour. For, according to his Obſervation, it flowed at the rate of ſixteen Times in an Hour, according to my own Obſervations, at the rate of twelve Times in an Hour; perhaps before my Obſervations at a leſs Rate, and after his at a greater: So that in the whole Hour, according to the ſeveral Rates taken together, it may flow and ebb about nine or ten Times, according to another Account which I have received; but of this I can aſſert nothing certain, or upon my own Obſervations. The Doctor adds, that when the Water in the Baſon began to riſe, he obſerved a Bubbling in the Bottom of the Baſon, which ceaſed when the Water began to ſink. This I did not ſee, becauſe the Springs were ſmall and low, by means of a dry Seaſon; but it was confirmed to me by the Report of Eye-witneſſes, as is before obſerved.

Having thus compared the two Accounts given of this Fountain, I come now to my Hypotheſis, for explaining the Phænomena obſerved by me; and I imagine them to be occaſioned by two Streams or Springs, one of which paſſing through two Caverns or natural Reſervoirs with Syphons, meets with the other Stream in a third Reſervoir without a Syphon; where being joined, they come out of the Earth together. This complicated Piece of Machinery will be beſt underſtood by beginning with an Explanation of the more ſimple Parts firſt; in doing of which, we ſhall have an Opportunity of conſidering ſome other Sorts of Fountains, which have already been obſerved, or may hereafter be found to be in Nature.

The *Petitio Principii*, or Suppoſition of Reſervoirs and Syphons in the Bowels of the Earth, has been made by others: *Père Regnault*, in his *Phil. Converſations*, Vol. 2. Conv. 6. *p.* 125, &c. *Eng. Edit.* has mentioned it in general, and Dr *Deſaguliers*, in *Phil. Tranſ.* Numb. 384, has attempted to apply it to two Caſes in particular; as *Dechales*, Tract. xvii. *de Fontibus Naturalibus*, &c. Prop. xv. had done in two other Caſes before him. Nor is it unnatural or hard to be granted. Whoſoever has ſeen the *Peak* of *Derbyſhire*, the Hilly Parts of *Wales*, or other Countries, muſt be ſatisfied that they abound with Caverns of many ſorts. Some of them are dry, others ſerve only for Paſſages, or Channels to Streams, which run through them; and a third Sort collect and hold Water, 'till they are full. They muſt likwiſe have obſerved, that there are ſometimes narrow Paſſages running between the Rocks which compoſe the Sides, and going from one Cavern to another. Such a Paſſage, of whatſoever Shape or Dimenſions, how crooked and winding ſoever in it's Courſe, if it be but tight, and runs from the lower Part of the Cavern firſt upwards to a leſs Height than of the Cavern, and then downwards below the Mouth of the ſaid Paſſage, will be a natural Syphon.

A natural

A natural Reſervoir then, A B C D, with ſuch a natural Syphon, M N P may be ſuppoſed. Let a Stream, which I ſhall call the Feeding-Stream, enter it, near the Top at O. The ſaid Cavern muſt contain all the Water which comes in at O, 'till it is filled to the Top of the Syphon at N. Then the Syphon beginning to play, and being ſuppoſed always to diſcharge more Water than comes in by the Feeding-Stream at O, will empty the Cavern, 'till the Water is ſunk in it below the Mouth of the Syphon at M, when it muſt ſtop, 'till the Cavern is filled, and the Syphon runs again as before. If the Water diſcharged by ſuch a Syphon, M P be brought out of the Earth by a Channel P Q, the Water will flow out of the Earth, and ſtop alternately, making an intermitting Fountain at Q. *Fig.* 32.

By this plain and eaſy Contrivance, ſeveral of the flowing and ebbing Springs obſerved by the Naturaliſts, may probably be explained; and even a much greater Variety of them than is hitherto known. For if the Feeding-Stream at O ſhould ariſe only from the Rains in Winter, or from the melting of the Snow in Summer, the intermitting Fountain would become a temporary Spring, as Dr *Plot* calls ſuch Springs which are confined to a Seaſon. Or if the Feeding-Stream at O ſhould be conſtant, but yet liable with other Springs to an Encreaſe and Decreaſe ariſing from the Seaſons, Weather, or other Cauſes, the Conſtruction of the Syphon would make a great Alteration. For when the Syphon is ſo made that it's Diſcharge (which is continually decreaſing, as the Surface of the Water ſubſides in the Cavern) ſhall at any Time be equal to the Feeding-Stream entering at O, in ſuch a Caſe, the Syphon muſt continually run, and yet not empty the Cavern, 'till the Feeding-Stream at O is ſufficiently diminiſhed. But, when the Diameter of the Syphon at N, according to the Height of the Cavern, is ſo great, and the Feeding-Stream at O ſo ſmall, that the Syphon can carry off (in the Manner of a Waſte-Pipe) all the Water which comes in, and yet not run with a full Stream; the Syphon muſt then continue to run without emptying the Cavern, 'till the Feeding-Stream at O is ſufficiently enlarged. So that by theſe different Conſtructions of the Syphon, there may be ſome Fountains which ſhall flow conſtantly in the Winter, or a wet Seaſon, and intermit in the Summer, or a dry Seaſon; and on the contrary, others which ſhall flow continually in the Summer, or a dry Seaſon, and intermit in the Winter, or a wet Seaſon. There is a third Variety, which may ariſe from the Make of the Syphon, and will occaſion ſuch Irregularities as admit of no certain Explanation. This happens when the Diſcharge of the Syphon at the very laſt is juſt equal to the Feeding-Stream, and the Cavity of the Syphon at N is large; for in this Caſe, the Air-Bubbles, made by the Fall of the Feeding-Stream from O to the Bottom of the Cavern, will ſometimes accidently get into the Mouth of the Syphon at M, and lodging at N, will ſo choak it as to render it's running and ſtopping, as well as

the Quantity of its Diſcharge, entirely uncertain; ſo that theſe ſort of Fountains will admit of no farther Conſideration.

But before I leave the Conſideration of Fountains explicable by one Reſervoir and Syphon, it may not be amiſs to obſerve, that thoſe which intermit regularly will have their Flux always longer, and their Pauſe or Intermiſſion ſhorter in Winter and in wet Weather, than in Summer or in a dry Seaſon; which is a Conſequence of this Hypotheſis, by which it may be examined, whether it be applicable to any particular intermitting Fountain, or not.

Fig. 33. If the ſingle Reſervoir and Syphon has another Out-let at R, ſituated between the Bottom C D of the Cavern, and the Top of the Syphon N, we ſhall have another kind of Fountains. For if the Feeding-Stream at O, is capable of being diſcharged by the Out-let at R, a Fountain derived from R will continually run, whilſt the Feeding-Stream can be diſcharged that Way, and will encreaſe and decreaſe with any little Alteration happening to the Feeding-Stream at O, provided that the ſaid Stream does not grow too large for the Out-let at R. But in that Caſe the Cavern muſt be filled up to N, and the Syphon may begin to play; which, together with the Out-let at R, may diſcharge ſo much as to make the Surface of the Water in the Cavern ſink below R, and conſequently the Fountain proceeding from R muſt ſtop. If the Diſcharge of the Syphon is ſo great as to empty the Cavern, then the Fountain derived from R will, after ſome time, begin to run again, and encreaſe 'till the Water riſes in the Cavern to N; after which it will decreaſe, and at length ſtop. But if the Diſcharge of the Syphon only keeps the Surface of the Water below R, without emptying the Cavern, then the Fountain derived from R ſhall be dried up, ſo long as the Stream at O continues encreaſed; and ſhall run again when the ſaid Feeding-Stream is leſſened. Thus we may have a Spring which ſhall run all Summer, and be dry all Winter: Such a Spring will encreaſe juſt before it begins to fail, *i. e.* whilſt the Water in the Cavern is riſing to N, will be dried up ſooner in a wet Summer, and break out later in a wet Winter, contrary to the Nature of other Springs. Which Particulars are worthy of Obſervation in ſuch ſort of Springs (of which it is ſaid we have ſome in *England*) and will ſerve to diſcover, whether they are occaſioned by this kind of Machinery, or not.

Fig. 34. If the Syphon M N P, of the Reſervoir A B C D, having no Out-let at R, ſhould diſcharge itſelf into a ſecond Reſervoir E F G H of a ſmaller Capacity, but furniſhed with a Syphon S T V, which diſcharges the Water more plentifully than it comes in; a Fountain derived from this ſecond Syphon S T V would flow and intermit, whilſt the firſt Syphon M N P continued running; *i. e.* 'till the great Reſervoir A B C D ſhould be emptied. After which it would entirely ſtop, 'till the ſaid Reſervoir A B C D was filled again by the

Feeding-Stream at O, and then it would flow and intermit as before.

Such a Sort of compound Fountain would be liable to all the Variations of the former Fountains derived from a ſingle Reſervoir, if we take the Fits of flowing and intermitting of this for the Flux of the Former, and the long Stop in this, whilſt the great Reſervoir is filling, for the Pauſe or Intermiſſion of the former. Beſides which, we muſt remark, that as the Flux in the former Fountains may be changed, and be made longer or ſhorter; ſo in this the Number of Intermiſſions during one Fit of flowing and intermitting may not always be the ſame, becauſe of the different Capacities of the two Reſervoirs, and a Difference or Change occaſioned in the Feeding-Stream at O. For if, whilſt the great Reſervoir A B C D is emptying, the little Reſervoir E F G H ſhould empty itſelf nine times, for Inſtance, and be half full again, the Fountain derived from it's Syphon S T V muſt have nine Intermiſſions in one Fit, and ten in another, alternately, whilſt the Feeding-Stream at O remains the ſame. But the Feeding-Stream at O being leſſened or enlarged, without making the Syphon M N P run continually, the Number of Intermiſſions in each Fit will be diminiſhed or augmented accordingly. But 'tis peculiar to this laſt Sort of Fountains, that in each Fit of flowing and intermitting the firſt Flux will be larger and longer than the ſecond, and the ſecond than the third; but the firſt Intermiſſion will be ſhorter than the ſecond, and the ſecond than the third: becauſe the Syphon M N P running faſter at firſt than at laſt, the Reſervoir E F G H muſt be a ſhorter Time in being filled, and a longer Time in being emptied the firſt Time than the ſecond; the ſecond than the third, and ſo on. As to the whole Time of the firſt Flux and Intermiſſion, in Compariſon of the whole Time of the ſecond Flux and Intermiſſion, it is a Particular, requiring ſo many Things to be taken into Conſideration for determining it in each Caſe, that I ſhall wave it here, and content myſelf with ſhewing that it may be longer, by an Experiment that will preſently be made. Another Variety in this Sort of Fountains might be made by a ſecond Feeding-Stream Z, coming into the ſecond Reſervoir E F G H; but the bare mentioning of that will at preſent be ſufficient.

If in the Contrivance of a ſingle Reſervoir and Syphon, the Stream derived from the Syphon ſhould fall into another Reſervoir I K K L, *Fig.* 35 having no Syphon, but only a common Out-let X, and ſhould in this Reſervoir meet and join with another Stream conſtantly running, a Fountain derived from the ſaid Out-let X would be a Reciprocating Spring; by which Name I call thoſe Springs which flow conſtantly, but with a Stream ſubject to encreaſe and decreaſe, to diſtinguiſh them from Intermitting-Springs, which flow and ſtop alternately. And if the Out let X be too ſmall to carry off all the Water brought into the Reſervoir I K K L, by the Syphon, over and above what is brought in by the conſtantly running Stream W; then the Surface

of

of the Water in the ſaid Reſervoir IKKL muſt continually riſe, 'till the Velocity of the Stream going out at X, is ſufficiently encreaſed to carry off the Water coming in: Upon which, the Diſcharge of the Syphon being continually leſſened, the ſaid Surface will again ſubſide, and the Velocity of the Stream at X will diminiſh; ſo that both the Encreaſe and Decreaſe in this Reciprocating Fountain will be gradual. Beſides, if the Reſervoir IKKL, or the Channel derived from it, ſhould have any Leaks, Crevices, or other Out-lets, the Water will iſſue through them upon the Riſing of the Surface in the ſaid Reſervoir, and occaſion Springs, which will ceaſe again when the Surface ſubſides.

Fig. 36. Let us now ſuppoſe ſuch a Reſervoir IKKL, with a conſtantly running Stream W, and an Out-let X, to receive the Water of a Syphon STV, coming through two Reſervoirs ABCD and EFGH, as before deſcribed. A Fountain derived from X in this Caſe, would be an intermitting Reciprocating Spring, whoſe Stream would reciprocate, but whoſe Reciprocations would ſometimes ſtop, and have Fits of Intermiſſion.

Such, in all probability, is the Fountain called *Laywell*, before deſcribed, whoſe Phænomena gave occaſion to theſe Thoughts, and ſeem capable of being accounted for by ſuch a Contrivance. And for the better Diſcovery of the Nature of this Fountain, whether it is owing to ſuch a Piece of Natural Machinery, or otherwiſe, it would be proper to obſerve the length of Time of each Increaſe, Decreaſe, and Pauſe in every Reciprocation, together with the Number of Reciprocations in every Reciprocating-Fit, and likewiſe the length of the Intermiſſions of the ſaid Fits. Theſe Obſervations ſhould be continued for ſome Time, both in a ſettled Seaſon, when the Feeding-Stream at O cannot change, and in Variety of Seaſons, when the ſaid Stream may be altered.

Having now brought theſe Thoughts to the End propoſed, *viz.* an Explanation of ſuch a Fountain as *Laywell*, I ſhall carry them no farther; but conclude, by preſenting to the View, an artificial Fountain of this kind, which being very eaſily made, may be buried in the Bottom or Slope of a Terraſs, where a conſtant Stream of Water can be brought, and will furniſh us with a new ſort of Water-Works in Gardens. The two Reſervoirs ABCD, EFGH, with their Syphons MNP, STV, and the third Reſervoir IKKL, with it's *Fig.* 36. Out-let X, are included in a Box YYYY. Into this Box at λ enters a Funnel ΓλΓ divided within the Box into two Pipes, *viz.* λO, which ſerves for a Feeding-Stream to the great Reſervoir, and λW, which ſerves for a conſtant Stream to the third Reſervoir. A Stream of Water being let into the Funnel ΓλΓ, will diſcharge itſelf like ſuch an intermitting Reciprocating-Fountain at X, where there is a Baſon YZZZ without the Box to receive it; with an Out-let *a*, and a Diagonal Gage ZY, to mark the Riſe and Fall of the Water in the Baſon.

CHAP.

CHAP. III.

MINERALOGY.

I. 1. THE following Obſervations are the Particulars of what I obſerved during a Year's Stay in the Weſtern Part of *Cornwall*, concerning *Mines*, &c.

Some Obervations towards compoſing a Natural Hiſtory of Mines and Metals, by Dr Fr. Nicholls, N°. 401. pag. 402.

Mines in general are Veins or Cavities within the Earth, whoſe Sides receding from, or approaching nearer to, each other, make them of unequal Breadths in different Places; ſometimes forming large Spaces, which are called *Holes*. They are filled with Subſtances, which, whether metallic, or of any other Nature, are termed the *Loads*. When the Subſtances forming theſe Loads are reducible to Metal, the Loads are by the Miners ſaid to be alive; otherwiſe they are termed dead Loads.

In *Cornwall* and *Devon* the Loads always hold their Courſe from Eaſtward to Weſtward; tho' in other Parts of *England* they frequently run from North to South. The Miners report, that the Sides of the Load never bear in a Perpendicular, but conſtantly underlay either to the North or South.

The Mines ſeem to be, or to have been, the Channels thro' which the Waters paſs within the Earth; and, like Rivers, have their ſmall Branches opening into them in all Directions; which are by the Miners termed, the Feeders of the Load.

Moſt Mines have Streams of Water running thro' them, and when they are found dry, it ſeems to be owing to the Waters having changed their Courſe, as compelled to it, either becauſe the Load had ſtopped up the ancient Paſſages, or that ſome new and more eaſy ones are made.

The Load is frequently intercepted by the croſſing of a Vein of Earth, or Stone, or ſome different metallick Subſtance. In which Caſe it generally happens, that one Part of the Load is moved a conſiderable Diſtance to one Side. This tranſient Load is by the Miners termed a Flooking; and the Part of the Load which is moved, is, in their Terms, ſaid to be heaved. This heaving the Load would be an inexpreſſible Loſs to the Miner, did not Experience teach him, that, as the Loads always run on the Sides of the Hills, ſo the Part heaved is always moved towards the Deſcent of the Hill. So that the Miner working towards the Aſcent of the Hill, and meeting a Flooking, conſiders himſelf as working in the Part heaved; wherefore cutting thro' the Flooking, he works upon

it's Back towards the Aſcent of the Hill, till he recovers the Load, and *vice verſâ*.

Fig. 37. A D ſhews a Load running in the Side of a Hill, B the Feeders, C the Flooking, D is the Part heaved.

Sometimes, tho' not conſtantly, the Mine is lined with an intermediate Subſtance between the Load and itſelf. This is (properly ſpeaking) the Wall of the Load: Though, in the common Acceptation of that Term, it ſignifies either ſuch intermediate Subſtance, or the Side of the Mine, where the Load immediately unites itſelf to it.

Fig. 38. A is the Side of the Mine, B the intermediate Wall of white Mun-
Fig. 39. dic, C the Load of Copper. D E two Walls of Spar-Stone, F a ſmall Vein of Tin Ore.

The Springs in theſe Parts are always hard, as abounding very much, either in ſtony, or ſulphureo-ſaline Particles.

From this Water thus ſaturated with ſtony Particles, we frequently find the Paſſages of the Water under Ground, either partly, or totally ſtopped up; the ſtony Matter gradually concreting round the Sides of the Mine, and forming thereby a confuſed Load of Spar-Stone.

At other Times this ſtony Matter concretes more diſtinctly: In which Caſe the ſtony Matter ſeems to be governed in it's Concretion by a Plaſtic Power.

N. B. When I ſpeak of a plaſtic Power, I would be underſtood as meaning only a Modus of Attraction, by which the attracted Particles are ranged in this or that determined Form. This Power then ſo exerts it's Action, as to range the concreting Matter into the Form of a hexagonal Priſm, whoſe Head goes off in a hexagonal Pyramid. Where this plaſtic Power happens to be ſingle and uncontrouled, it preſerves the Form of the Cryſtal to very conſiderable Magnitudes.

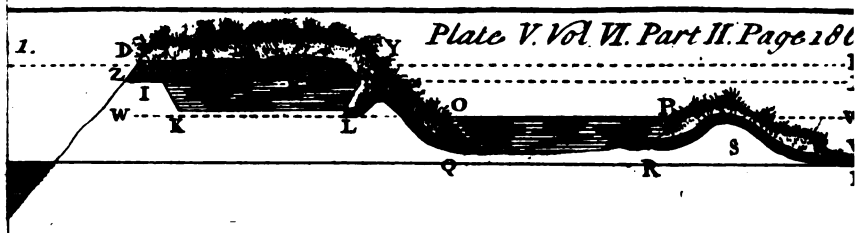
In theſe ſingle Cryſtals we may obſerve, that they are of different Tranſparencies and Colours, as the ſtony Matter is more or leſs diſengaged from other Subſtances, or as thoſe other Subſtances are capable of imparting different Tinctures to them. And that they ſeem formed *laminatim*; tho' the *Laminæ* are only diſtinguiſhable, when the Matters from whence the Cryſtal is ſucceſſively formed,

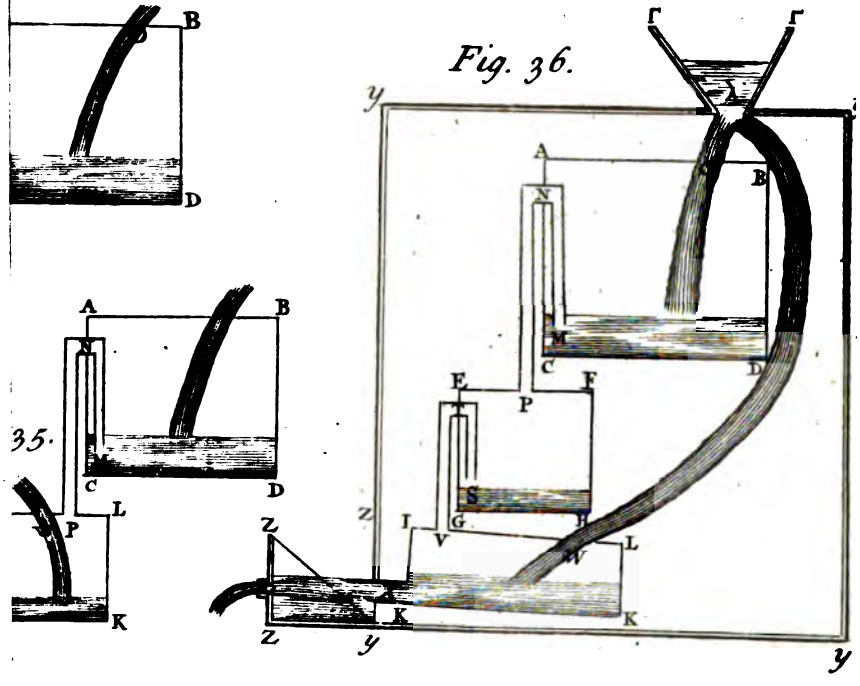
Fig. 40. happen to differ in Purity. The Cryſtal A was at firſt formed from Matter intangled with a foul yellow Subſtance; after which, a pure Matter advening, the Cryſtal was in it's future Lamination formed more pure and tranſparent.

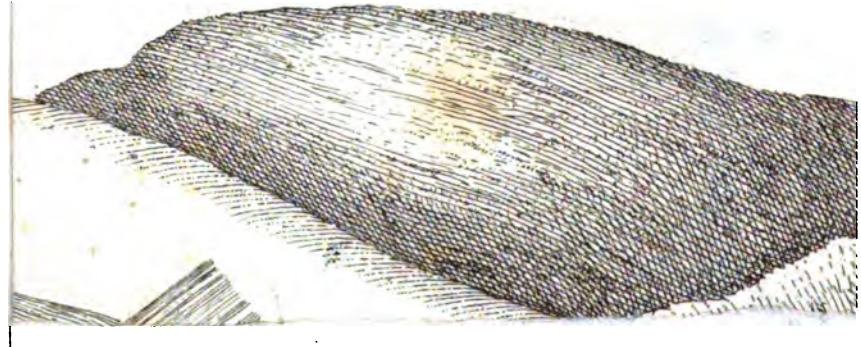
But where the plaſtic Particles are more numerous, there ſeems Reaſon to believe, that theſe very plaſtic Particles, before they are fixed, are ſubject to the Controul and Direction of any fixed plaſtic Particle, within the Verge of whoſe Activity they happen to move: notwithſtanding which, after they are once fixed, they exert their own plaſtic Powers, and, in Conjunction with the firſt plaſtic Particle, govern the future Concretion, in ſuch Manner as to form a

ſeemingly

1.







de *and* Metals,
of

ſeemingly irregular Cryſtal, tho' compoſed of two or more regular Cryſtals. Thus A and C ſeem to have attracted amongſt the ſtony Particles, two plaſtic Particles, which afterwards exerting their own Powers, form the additional Cryſtals B and D. *Fig.* 41, and 42.

There are many Phænomena obſervable in theſe Cryſtals, which, at preſent, I may paſs over, as leſs relating to the Affair of Metals; wherefore I ſhall only add, that theſe cryſtalline Concretions exert a ſtrong Attraction on many metallic Subſtances. As the Spar A has attracted the three Portions of Lead B. and the Cryſtals C have attracted the Copper D, and are attracted by the Lead E. *Fig.* 43. *Fig.* 44.

The ſulphureo-ſaline Particles, with which, as I obſerved, the Waters are frequently ſaturated, are found to be either of a vitriolic or an arſenical Nature: The firſt conſtantly, if pure, concreting into white Cubes reſembling Grains of Silver, while the arſenical Sulphur concretes into yellow Cubes like Grains of pure Gold. Both theſe are by the Miners termed Mundic.

Theſe ſulphureo-ſaline Subſtances ſeem directed in their Concretions by a plaſtic Particle, in the ſame Manner as the Cryſtals abovementioned; and, like them, upon the ſame Principles, are found ſimple or compound. In their Sides you may obſerve the Concretion forms itſelf like Threads, which in three Sides run in different Directions, but are always ſimilar in the oppoſite Sides.

Fig. 45. ſhews one of theſe Cubes, A the parallel Threads. *Fig.* 45.

Fig. 46. ſhews another of theſe Cubes, from whoſe Sides ariſe ſmall Segments of Cubes C. *Fig.* 46.

But this plaſtic Power ſeems to be weakened or deſtroyed, in Proportion, as this ſulphureous Matter is more or leſs intangled with metallic Subſtances.

Thus in *Fig.* 47. the plaſtic Particle ſeems for a while to have exerted it's Power in the uſual Manner, till the advening Matter grew intangled with a ſmall Quantity of Copper, after which it ſeems only to have exerted it's attractive but not it's plaſtic Power. *Fig.* 47.

And in *Fig.* 48. the white Mundic being infected with Iron, ſeems ſo far from being affected by a plaſtic Power, that it concreted in the Form of Icicles from the Fluid which tranſuded thro' the Top of the Mine. *Fig.* 48.

Fig. 49. repreſents ſome ſmall Cubes of white or vitriolic Mundic. *Fig.* 49.

But to return to the Mines: They are found to contain Iron, Tin, Lead, Copper, and a pſeudometallic Subſtance, by the Miners termed Gliſt.

2. Of all the Subſtances concurring to form the terreſtrial Globe, Iron probably bears the greateſt Share; as it not only abounds in moſt Kinds of Stone, ſhewing it ſelf in Varieties of Crocus, all which gain a more intenſe Colour by Fire; but enters likewiſe greatly into the Compoſition of common Clay; as may be judged from the Similitude

Some farther Obſervations towards compoſing a Nat. Hiſt. of Mines *and* Metals.

by the ſame No. 403. pag. 480.

of Colour between Clay and dry Iron Ore; from the eaſy Vitrification of Clay; from the Reſemblance between Clay ſo vitrifyed and the Clinkers of Iron; from it's deep red Colour after Calcination; and laſtly, from it's yielding pure Iron, by being burned with Oil.

Of IRON.

But while Iron is thus entangled with other Bodies, it rarely employs the Care of the Miner; who finds the Expence of reducing it to Metal too ſeldom ballanced by the Price it yields: For which Reaſon though we frequently meet with large and rich Loads of Iron, yet (the Woods having been applied to more advantageous Uſes) they are there entirely neglected.

When it is moſt pure, I find the Ore under three different Appearances.

Paper the firſt contains a Piece of rich dry Iron Ore, whoſe Scrapings exactly reſemble an *Alkohol Martis*: This Kind of Iron Ore has very nearly the Colour of common Clay.

Paper the ſecond contains a Piece of rich Iron Ore, with Part of the Wall of the Load formed by a Concretion of yellow Cryſtals. In this Stone the Iron radiates from Points forming Segments of Spheres, and where theſe Spheres leave any Interſtices, you will find a Crocus, or Oker.

Paper the third contains a Stone of Iron of the Kind uſed for burniſhing Plate; it is of the Species of the *Hæmatites*.

Both theſe laſt Stones ſcrape into a deep Crocus.

From the ſecond Inſtance we may conjecture, that the yellow Colour in Cryſtals ariſes from a Crocus entangled with the ſtony Salts.

Though the Want of Wood in *Cornwall* deprives it of the Advantages it might otherways reap from Iron as a Metal, we ſhall nevertheleſs find it far from being an uſeleſs Ore, when we conſider it as ſometimes impregnating the Waters with vitriolic Salts, thereby making them a proper Menſtruum for diſſolving the diſſeminated Particles of Metals; ſometimes deſtroying the ſulphureous Menſtrua, which (though they diſſolve the diſſeminated Metals) do nevertheleſs obſtruct their new Concretions; and ſometimes as being itſelf the Magnet by which the metallic Particles are attracted into new Concretions.

Of TIN.

The next metallick Subſtance found in *Cornwal*, and from which theſe Iſlands are ſuppoſed to take their Name, is *Tin*. It is never found but as an Ore; whereas Gold is never found but as a Metal, at leaſt it's Ore is unknown, and all other Metals are found ſometimes as a Metal, and ſometimes as an Ore.

Tin always ſhoots into Cryſtals which are of different Magnitudes from two Ounces in a ſingle Cryſtal to ſuch as eſcape our Sight. Theſe Cryſtals are for the moſt Part interſperſed in Loads of other Subſtances

Paper the fourth contains Tin Cryſtals interſperſed in a Load of a Kind of Clay, in which is obſervable a conſiderable Quantity of Red-oker.

Paper the fifth contains a Stone of hard Iron Stone, in which are exceeding ſmall Cryſtals of Tin.

Paper the ſixth contains ſomewhat larger Cryſtals, interſperſed in a dry Red-oker.

Paper the ſeventh contains Tin Cryſtals, interſperſed with Spar-ſtone and a Sort of Marl.

Paper the eighth contains larger Cryſtals, interſperſed in a kind of Clay and Red-oker, as in Paper the fourth.

When a hundred Sacks of the Load (each containing more than a *Winchester* Buſhel) yield one Gallon of clean Ore, the Load is eſteemed very well worth working.

Sometimes theſe Cryſtals are ſo collected into one Maſs, as to form Loads of pure Tin Ore, and ſo large as to yield to the Value of 100lb. every twenty-four Hours.

Paper the ninth contains two Stones of ſuch pure Loads, in which obſerve the one is black, and the other nearly white.

Theſe Cryſtals concrete ſometimes into the Form of a Parallelopipedon, whoſe Summit is covered by a Pyramid; ſomtimes the Angles formed by the Sides of the Pyramid, and ſometimes the Summit of the Pyramid are as it were plained away.

Paper the tenth contains ſeveral of theſe Cryſtals, of which Number the firſt contains a whole Cryſtal; which has none of it's Angles off. *Fig.* 50. The ſecond contains a Cryſtal which has only two of it's Angles plained away. *Fig.* 51. The third contains a Cryſtal which has all it's Angles plained away. *Fig.* 52. The fourth contains a Cryſtal which has all it's Angles and it's Summit plained away. *Fig.* 53.

Sometimes the Cryſtals repreſent two equal pentelateral Pyramids joined at their Baſe.

As in Paper the eleventh, which contains two Cluſters of Cryſtals, which conſidered ſeparately are of that Form.

Under whatſoever Form theſe Cryſtals ſhoot, they always carry an exceeding fine Surface; which, when rubbed off, can be renewed by no Art. In Paper the fourth one Side of the Parallelopipedon is rubbed away to ſhew it's Appearance after loſing it's natural Surface.

Theſe Cryſtals are of different Colours from the White (like white Sugar candyed) to the deep Black. Thus Paper the twelfth contains a group of ſmall white Tin Cryſtals, which are very uncommon. Theſe white Cryſtals ſeem to me to carry a finer Luſtre than any other I ever ſaw, and are perfectly tranſparent; ſo that were they found of equal Size with the black Cryſtals, and of a white Water (which I imagine may be) their Hardneſs and Weight (in both which they exceed any other Foſſil) would probably make them preferable

to

to the Diamond. However, as the deeper Colours of theſe Cryſtals ſeem to ariſe from a greater Proportion of Iron in their Compoſition, which they throw off in an Iron Slag upon Fuſion, and which changes by proper Degrees of Heat into a Crocus, thereby changing the Colour of the Cryſtal to a brighter Red; ſo the white Tin Ore is certainly to be eſteemed both richeſt and beſt, as moſt free from Iron.

Paper the thirteenth contains a Piece of the Load contained in Paper the ſeventh, in which the Cryſtals are of a brighter red, from it's being heated red-hot. (*Theſe Specimens were all produced before the Society, and are ſince preſented to* Sir Hans Sloane, *Preſident.*)

Theſe Cryſtals ſeem to be the heavieſt Bodies the Earth produces, except Quickſilver and actual Metals. Their ſpecific Gravity is to Water as 90 ½ to 10; to Rock Cryſtal in Water as 90 ½ to 26; to Diamond as 90 ½ to 34; and to pure malleable Tin, as found by repeated Trials, as 90 ½ to 78; from whence appears the Poſſibility of what ſome Miners affirm, *viz.* That a cubical Inch of ſome Tin Ores will yield more than a cubical Inch of Metal.

Having already taken Notice that the Cryſtals of Tin are ſometimes ſo ſmall as to eſcape the Eye, and ſo diſſeminated in the Load as not to make above $\frac{1}{800}$th, or $\frac{1}{1000}$ Part of the Load, one would naturally imagine it an endleſs Labour to cleanſe the Ore from ſuch a vaſt Diſproportion of Rubbiſh. But the great ſpecific Gravity of theſe Cryſtals renders the cleaning it leſs troubleſome, and leſs expenſive, than in any other Ore whatever. It requires no more, than that the whole Stuff be ſtamped to a fine Powder, after which it is waſhed by a Water, whoſe Force is ſo moderated as to waſh away only the lighteſt Parts. This Stamping and Waſhing is repeated till the Ore is left exceedingly clean, and yields in Metal from $\frac{1}{18}$ to $\frac{1}{15}$, according as it is cleanſed from the Load, and as it is in it's own Nature more or leſs free from Iron.

I Beg Leave to defer the Account of Lead and Copper.

Some Obſervations on the Peak *in* Derbyſhire, *by* John Martyn, *F. R. S.* No. 407. p. 22.

II. The *Peak* is famous for ſeven Places, which have been dignified by our Anceſtors, with the Name of Wonders: 1. *Chatſworth*, a magnificent Seat of his Grace the Duke of *Devonſhire*; 2. *Mam-tor*; 3. *Elden-hole*; 4. *The ebbing and flowing Well*; 5. *Buxton-Well*; 6. *Peak's Hole*, and 7. *Pool's Hole*. The Firſt being a Work, not of Nature, but Art, does not come within the Deſign of this Account.

Mam-tor.

Mam-tor is a huge Precipice facing the Eaſt, or South-Eaſt; which is ſaid to be perpetually ſhivering and throwing down great Stones on a ſmaller Mountain below it; and that nevertheleſs, neither the one increaſes, nor the other decreaſes in Bigneſs. This Mountain is compoſed chiefly of a Sort of Slate-Stone (called in that Country *Black Shale*) and great Stone. The Nature of the *Black Shale* is known to be, that notwithſtanding it is very hard before it is expoſed to the Air, yet it is afterwards very eaſily crumbled to Duſt. Thus on any

any Storm, or melting of Snow, this Shale is conſiderably waſted; and as the great Stones are gradually diſengaged, they muſt neceſſarily fall down. That it is only at theſe Times that the Mountain waſtes, is affirmed by the moſt intelligent of the neighbouring Inhabitants: And that this Decay is not perpetual, I can affirm myſelf; having not only taken a cloſe Survey of it, but alſo climbed up the very Precipice, without ſeeing any other ſhivering in the Mountain, than what the treading of my own Feet in the looſe crumbled Earth occaſioned. That the Mountain does not decreaſe in the mean Time, is a Tale too frivolous to need any Conſideration.

Elden-hole, is a huge perpendicular Chaſm. The Depth of it is not known. Mr *Cotton* tells us, that he ſounded 884 Yards, and yet the Plummet drew. But he might eaſily be deceived, unleſs his Plummet was of a very great Weight; for otherwiſe, I imagine the Weight of a Rope of that Length, would be ſo great as to make the Landing of the Plummet ſcarce perceivable. Be that as it will, the Depth of it is to be ſure very conſiderable; and ſince have nowhere in *England* ſo good an Opportunity of ſearching the Bowels of the Earth to ſo great a Depth; I wonder no curious Perſon has ever had the Courage to venter down. It is ſaid indeed, that a poor Fellow was hired to be let down with a Rope about his Middle, two hundred Yards; and that he was drawn up again, out of his Senſes, and died a few Days after: And no Wonder, for the poor Wretch having nothing elſe to reflect on in that diſmal Place, but the Danger he had put himſelf into for the Sake of a little Money, might probably be frightened out of his Senſes. Or indeed the very Fatigue itſelf might put him into that Condition; as any one will eaſily imagine, who has been let down but a quarter of the Way, and drawn up again in that Manner. But I conceive, that if any intelligent and prudent Perſon was to be let down in a proper Machine; he would not be much in Danger, and his Fatigue would be very inconſiderable. *Elden-hole.*

The *ebbing and flowing Well* is far from being regular, as ſome have pretended. It is very ſeldom ſeen by the Neighbours themſelves; and, for my Part, I waited a good while at it to no Purpoſe. *Ebbing and flowing Well.*

Buxton-Well has been eſteemed a Wonder on account of two Springs, one warm and the other cold, riſing near each other. But the Wonder is now loſt, both being blended together. The Spring which is now uſed for bathing, appears to be 32½ Degrees of one of Mr *Hawkſbee*'s Thermometers warmer than the common Spring-Water there *. *Buxton-Well.*

Peak's Hole and *Pool's Hole* are two remarkable horizontal Openings under Mountains, the one near *Caſtleton*, the other juſt by *Buxton*. They ſeem to me to have owed their Original to the Springs which *Peak's-hole.* *Pool's-hole.*

* The Spring-Water kept the Spirit of Wine at 41, the *Bath* Water raiſed it to 81½.

have

have their Current through them. It is eaſy to imagine that when the Water had forced it's Way through the horizontal Fiſſures of the *Strata*, and had carried the looſe Earth away with it, the looſe Stones muſt of Courſe fall down; and that where the *Strata* had few or no Fiſſures, they remained entire, and ſo formed thoſe very irregular Arches which are ſo much wondered at in theſe Places. Whether this be the true Origin of theſe Caves or not, I ſubmit to thoſe who ſhall hereafter have the Curioſity to examine. It ſeems more probable to me, than what others have hitherto propoſed. The three Rivers, as they are commonly called, in *Peak's Hole* are only ſome Parts of the Cave deeper than the reſt, and receiving all their Water from the Spring which comes from the farther End of the Cave. The Water which paſſes through *Pool's-hole* is impregnated with Particles of Limeſtone, and ſo has incruſted almoſt the whole Cave in ſuch a Manner, that it appears like one ſolid Rock.

Lead-mines. The *Lead-mines* in *Derbyſhire* are very various with regard to their Courſes. One into which I went down had two Branches; one running to the N. E. the other to the N. W. and as I was informed, one of the beſt they ever diſcovered ran due North. Their Breadth and Depth are full as irregular. The Bodies through which they dig to come at the Vein are generally *Limeſtone* and *Black Shale*. But it is uncertain which of the two is uppemoſt. Of two Mines into which I went down, in one they had digged firſt through 26 Yards of *Limeſtone*, then through one of *Black Shale*: In the other firſt through 42 Yards of *Shale*, and then through 28 of *Limeſtone*. The Subſtances which they find mixt with the *Ore*, are.

Chert. 1. *Chert*. This is a kind of *Flint*, which Dr. *Woodward* * ſays is called ſo, when it is found in thin *Strata*. But in the *Peak* the *Strata* of *Chert* are often four Yards thick, or thicker. They are found in *Limeſtone*, and not always diſpoſed in *Strata*. Thoſe which I took notice of were generally either black, or of ſuch a Colour as the inſpiſſated Juice of the *Buckthorn* Berries, which the Painters call by the Name of *Sap-green*: Whence they are called *Green Cherts* and *Black Cherts*.

Spar. 2. *Spar*. This is compoſed of *Cryſtal* mixt with other Bodies. Thoſe which they call *Sugar-Spars*, are thoſe whoſe Cryſtallizations are very ſmall, and ſo on crumbling to Pieces have the Appearance of powdered Sugar. I have two ſorts of theſe; white and blue. *Dog-tooth Spar* is a white pointed Spar, in Form and Colour ſomething reſembling Teeth.

Cauk. 3. *Cauk*. This Dr. *Woodward* † ſays is a coarſe talky Spar. But in that Subſtance which I met with in this Country under the name of *Cauk*; I could not diſcover any Flexibility or Elaſticity, which that learned Writer has ſet down as Characteriſticks of *Talk* and *Talky*

* Method of Foſſils, pag. 21. † Ibid. pag. 18.

Bodies.

Bodies. * It ſeems to me to be nothing but *Spar* incorporated with a coarſe earthy Matter. When this *Cauk* is mixt with pellucid Cryſtallizations of *Spar*, it is called Baſtard Cauk.

There are ſeveral other Bodies mixt in the Mines with *Lead-ore:* But as they did not occur in thoſe Mines which I examined, I ſhall omit the Mention of them.

When the *Ore* is brought up from the Mine it is broken to Pieces that the *Spar*, *Cauk*, or other Bodies which adhered to it, may be the more eaſily ſeparated. It is then thrown into a large Sieve and waſhed, and ſo farther purified from extraneous Bodies. After this, it is carried to the Furnace in order to be ſmelted. The Furnace, which I ſaw near *Workſworth*, was very rude and ſimple, conſiſting only of ſome large rough Stones, placed in ſuch a Manner as to form a ſquare Cavity, into which the Ore and Coals are thrown *ſtratum ſuper ſtratum*; two great Bellows continually blowing the Fire, being moved alternately by Water. I ſaw no other Fuel uſed on this Occaſion but dried Sticks, which they call white Coal. † Mr *Ray* informs us, that they uſe both white and black Coal or Charcoal in *Cardiganſhire*. I ſuppoſe becauſe that Ore is harder to flux; the Charcoal making a more vehement Fire. They generally throw in ſome Spar along with the Ore, which is thought by imbibing the Sulphur to make it flux more eaſily. They frequently throw in alſo ſome Cowke (or Cinders of Pit-coal) becauſe they think it attracts the Droſs, and ſo makes an eaſier Separation of it from the Lead. When the Ore is melted, it runs out at an Opening in the Bottom Part of the Front of the Furnace, through a ſmall Channel made for that Purpoſe, into a cylindrical Veſſel, out of which it is laded into the Mould. The Droſs of the *Ore* on ſmelting is called *Slag*. This *Slag* is afterwards ſmelted again with Cowke only, and the Lead obtained from it is called *Slag-lead*. Their Way of making *Red-lead* is the ſame with ‖ Mr *Ray*'s Account; only they uſe three Parts of Lead, and one of *Slag-lead*; and think that the *Red-lead* made thus is better than if made without *Slag-lead*.

Working of Lead Ore.

Red-Lead.

An Attempt made before the Royal Society, *to ſhew how Damps, & foul Air, may be drawn out of any Sort of* Mines, &c. *by an* Engine *contrived by the Rev.* J. T. Deſaguliers, LL D. *and* F. R. S. No. 400. pag. 353.

III. The *Engine* conſiſts of a Triple *Crank* working three *Pumps*, which both ſuck and force Air, by Means of three *Regulators*, and are alternately applied to drive Air into, or draw it from any Place aſſigned, thro' ſquare wooden Trunks; which being made of ſlit Deal, and 10 Inches wide in the Inſide, are eaſily portable, and joined to one another without any Trouble.

Experim. I.] I filled a tall cylindric Glaſs with the Steams of a burning Candle and burning Brimſtone Matches, in ſuch Manner that a lighted Candle would go out almoſt as ſoon as it was let down into that foul Air. Then fixing the Trunks (or ſquare Pipes) to the

* Catalogue of Foſſils, Vol. i. part i. p. 57. Ed. 2. p. 174. ‖ Ibid. p. 200. † Collections of *Engliſh* Words,

forcing Hole of the Engine, I drove freſh Air into the Bottom of the above-mentioned Receiver; ſo that the foul Steam came out at the Top of the Receiver, which was open.

Experim. II. Having filled another Receiver (cloſe at Top) with foul Steams, as before, I placed it in a Poſition almoſt horizontal, only with the cloſe End ſomething above the open End, that the foul Steam might not go out of itſelf, when ſpecifically lighter than common Air. I fixed the Trunks to the Sucking-hole of the Engine; and by working the Engine, drew out the foul Steams from every Part of the Receiver, as the Trunks were applied to them ſucceſſively.

Experim. III. Having filled with foul Steams, and ſet upright (as in the firſt Experiment) the cylindric open Receiver, I applied the Trunks to the ſucking Part of the Engine, with their open End near the Bottom of the Receiver Then, by pumping, the Steams were all drawn downwards, and ſo out at the Top of the Trunks at the Engine; whereas, in the firſt Experiment, they were driven out at the Top of the Receiver.

Experim. IV. Having ſet a Candle in the cylindric Receiver above-mentioned, without having filled it with Steams, and let down the Trunks into the Receiver, below the Flame of the Candle, I laid the wet Leather over the Mouth of the Receiver, leaving about Half an Inch open, for the Air to come in, notwithſtanding which the Candle began to dwindle, and be ready to go out; but working the Engine with the Trunks joined to the forcing Part, the Candle revived, and burned, at laſt, as well as in the open Air. When I had left off Pumping, the Flame of the Candle diminiſhed again; but when it was ready to go out, it revived again, upon forcing in more Air with the Engine.

Remarks upon the Experiments. When Damps in Mines are ſpecifically lighter than common Air, they will be driven out of the Mine by the firſt Experiment.

When Damps are ſpecifically heavier than common Air, they may be ſucked out by the Second or Third Experiment.

When a *Sough*, or *Adit*, is carried from a Mine to any diſtant Valley, to diſcharge the Water, or ſave the Trouble of raiſing it quite to the Top of the Pit, *Shafts*, or perpendicular Pits are generally ſunk from the Surface of the Earth to the ſaid Sough, to prevent the Workmen from being ſuffocated as they dig the Sough, and that at a great Expence; but, by the fourth Experiment, freſh Air may be driven down to the Workmen, to continue their breathing free and ſafe, and to keep in their Candles; by which Means the Expence of perpendicular Shafts will be ſaved.

It has been found by ſeveral Experiments, that a Man may breath a Gallon of Air in One Minute, and a Candle of Six in the Pound will burn nearly as long in the ſame Quantity of Air; therefore the Model only is capable of ſupplying freſh Air to One Man; and conſequently,

ſequently, a large Engine will abundantly ſupply Air for the burning of Candles, and the Working of a great Number of Men in a Mine.

One Man may work an Engine like the Model, and bigger every way in the Proportion of a Foot to an Inch.

As at every Stroke, 14 *cylindric* (or 11 *cubic*) Feet of Air are driven in, or as many cubic Feet of Damp ſucked out, if the Axis of the Cranks be turned round 60 Times in a Minute, one Man, in that Time, may change the whole Air in a cubic Space, whoſe Side is 8 Feet; and one Horſe, by working 24 Pumps with Half the Velocity, will eaſily do four Times the Work of one Man.

The Engines work with a great deal of Eaſe, becauſe no Preſſure of Atmoſphere is to be removed; only a Velocity to be given to one Sort of Air, to change it for another.

Fire will not do in all Caſes, though in ſome, it will draw foul Air out of Mines with ſucceſs; becauſe ſeveral Sorts of Damps extinguiſh Fire, and ſome fulminate, and are dangerous, when Fire comes near them; and even in common ſtagnant Air, Fire will not keep in long.

I am ſenſible, that large *Bellows* have ſometimes been made Uſe of for this Purpoſe; but they require a much greater Power to produce the ſame Effect, and cannot have the Advantage of being immediately changed from *Forcing* to *Sucking*; neither are they ſo cheap as the propoſed Engine, which may be all made of Wood except the *Crank*, which muſt be of Iron, and the *Barrels* of very thin Copper.

Boſton, July 19. 1729.

An Account of ſome of the Effects and Properties of Damps, by Mr Iſaac Greenwood, *Prof. Math. at* Cambridge, New-England. N°. 411. p. 184.

IV. MR *Adams* and his Servant being employed to repair a Pump in this Place, about ſix o'Clock this Afternoon uncovered the Well; upon which he immediately attempted to go down, by Means only of a ſingle Rope; but had not deſcended above five or ſix Feet, before he was rendered incapable of ſuſtaining his Weight, and without ſpeaking, or any Signals of Diſtreſs ſlipped down ſuddenly to the upper Part of the Joint of the Pump; where being ſupported about a Minute, fetching his Breath in a very diſtreſſed Manner, he fell to the Bottom, which was about eight or ten Feet lower, and covered with but a very few Inches of Water, without diſcovering any Signs of Life. Hereupon his Servant (*Thomas Reardon*) with great Precipitation took the Rope in his Hand, in order to deſcend to the Relief of his Maſter; but at the ſame Diſtance from the Top, met with the ſame fatal Interruption; and without diſcovering any Signs of Diſtreſs, was heard to fall to the Bottom.

The Workmen above prepared a *Third* with a Tackle about his Waſte. Upon his Deſcent he was rendered Speechleſs, and made no

Signs at all, though he had agreed to it; whereupon being raiſed from the Well, he was thought to have the Image of Death impreſſed upon him; but upon the Uſe of proper Means was ſoon recovered without remembring any thing particularly that had paſſed.

Some Hours after this the other Bodies were taken up; but, as we had before been well aſſured it would be, with all the Marks of a violent Death upon them.

There was nothing particular relating to this Well, excepting that it was nearly ſituated to the Town-Dock, the *Reſervoir* of all the Dregs of the Neighbouring Streets; and is about 30 Feet deep, which in this Place is ſo conſiderable, that it is lower than the Surface of the Water at the greateſt Ebb. There had not been an *Air-Tube*, or Paſſage for the external Air to communicate with it for ſome conſiderable Time.

This Evening ſeveral Trials were made on *deſcending Lights*; particularly, by letting down *lighted Candles* uncovered, others incloſed in Lanthorns, and others with the Lanthorn placed in a Pail; but in all theſe Endeavours it was obſerved, that whatſoever the Circumſtances of the deſcending Light were, it never reached above ſix Feet.

July 20. I repeated this Evening ſuch Experiments in the *Damp* as related to *Flame*, and found the Effect much the ſame as before; *viz.* in about 6 Feet below the Top of the Well, the Flame would grow dim, and if not immediately raiſed, would change to a bluiſh Colour, and become more and more contracted or diminiſhed, till in about a Minute's Time it would be totally extinguiſhed, without any Remains or Stench accompanying the Wick. In theſe Experiments I particularly obſerved, that the *Flame* in all it's Changes ſtill continued it's pyramidical Figure; nor did a quicker or ſlower Deſcent make any Alteration in theſe Circumſtances. One Experiment was very particular, relating to the Flame of a Candle. We took a common Pail, and having fixed a Candle to the Bottom thereof, erect about 8 Inches long, we poured as much hot Water into the Pail as reached within a quarter of an Inch of the Blaze of the Candle. Then having carefully lowered the Pail down the Well, the Flame, notwithſtanding it was defended by the reeking Steams of the hot Water, went out at the ſame Depth, and in the ſame Time as it did before. After this we immerſed burning Coals, flaming Brimſtone, and lighted Matches, all which were extinguiſhed with very little Difference as to the Time, or other Circumſtance.

Two Experiments were made relating to *Animal Life*. A large *Kitling* was very much affected in about a Minute's Time; and after three Minutes was rendered ſo weak, that after ſhe was taken out, ſhe could not ſuſtain her Weight on her Legs. Being at length pretty well recovered, we carefully bound her up in a Silk Handkerchief, that ſhe might be the more eaſily ſuſpended; and having let her down

down about 16 or 18 Feet, in three Minutes ſhe was affected in the like Manner as before, making a very diſtreſſed Noiſe, and in about five Minutes was in ſuch extraordinary Convulſions as rendered the Sight not a little diſagreeable; but in theſe Throws ſhe diſengaged herſelf from the Handkerchief, falling to the Bottom, without making any Efforts to ſwim; whence we concluded they were the laſt Struggles for Life, in which ſhe broke looſe.

We tried the ſame fatal Experiment upon a ſmall Bird, which being ſuſpended in the *Damp* about three Minutes, was found entirely ſenſeleſs, and according to all Appearance paſt Recovery. Upon taking it in my Hand, I found it was very cold, nor had it the leaſt Motion that I could diſcover; however, keeping of it cloſe between my Hands, which were pretty warm, in about a Minute I felt a ſmall Palpitation, which preſently increaſed to a ſtronger Pulſe, till in about ſix or ſeven Minutes the Bird was reſtored to a perfect and uninterrupted Reſpiration. About half and Hour after this, we again put the Bird into the *Damp*, and continued it there about five Minutes, after which we found it paſt Recovery.

July 21. I repeated ſeveral of the Experiments relating to Lights and Flame, which ſucceeded with very little, if any Alteration, as before; which we looked upon as an undoubted Confirmation of the Continuance of the Damp. Whereupon we proceeded; firſt, to examine the Elaſticity of the Air in the Well, by letting down a ſmall Bell, the Sound of which was as diſtinct and loud, as in any ordinary Well of the ſame Depth

Then to diſcover the Degree of Moiſture, we took a large Spunge a little wet, which with the *Silk String*, whereby we let it down, weighed 278 Grains. This being ſuſpended in the *Damp*, upwards of five Minutes, and then raiſed, was carefully weighed, and found to be of the ſame Weight preciſely. After this we dried the *Spunge*, which then weighed but 261 Grains, and having applied it to the *Damp* for the Space of ten Minutes, we found alſo, that it had not gained the leaſt Part that could be perceived in it's Weight. Alſo, a large Bundle of *Catgut*, weighing two Ounces fifteen Penny-weight ten Grains, acquired not the leaſt Augmentation thereto, by being ſuſpended for a very conſiderable Time.

To theſe Experiments we added one upon the *Hydroſtatical Balance*, in order to determine whether there was any extraordinary Difference as to the Denſity, or Specific Gravity of common, and this *vitiated Air*. The *Balance* we made uſe of was very large, and accurately poized, and the *Solid*, which was a Globe, was four Inches eight tenths in Diameter. This with its String weighed in the Air ſeven Ounces ſix Penny-weight. And after we had immerſed it in the *Damp*, it loſt nothing of it's Weight, being then in *Æquilibrio* to ſo great a Degree of Exactneſs that half a Grain would over-ponderate on either Side.

This

This *Damp* abated more and more by being expoſed to the Air, till on *July* the 25th, Perſons were let down to the Bottom without any Inconvenience.

The other Inſtance is of a very ſudden Subterraneous Vapour, on *May* 9, 1729, in a Well in *School-houſe-Street*, *Boſton*.

This Well had been opened for ſome conſiderable Time; and not only enlarged in it's Diameter, but ſunk fourteen or fifteen Feet deeper. Hereupon Mr *Rennief*, and a young Man whoſe Name was *Ruſſel*, undertook to lay the Stones. They had been employed all the Day, till about ſix o'Clock in the Afternoon, when *Rennief* perceived a very unuſual Stench, of which he firſt upbraided his Partner as an Act of Indecency, till by the extraordinary Increaſe thereof, he was apprehenſive of ſome greater Danger. *Ruſſel* was hitherto unſenſible thereof, but perceiving his Partner's Viſage to change to a very uncommon Degree, called up for Relief; at which Inſtant, as he afterwards expreſſed himſelf, *He firſt perceived a very ſtrong noiſome Smell, reſembling rotten Fiſh, which on a ſudden ſeized his Senſes, and rendered him unable to ſuſtain his Weight.* *Rennief* had immediately cloſed his Mouth and Noſtrils with his Hand; and when the Bucket was lowered with a third Perſon for their Relief, aſſiſted in getting *Ruſſel* into it. As the Bucket was raiſing, *Ruſſel* was taken with very unuſual and extraordinary Fits; and when he was laid upon the Ground, till *Rennief* was taken out, could ſcarce be kept ſtill by the united Strength of three or four Perſons; but bounding and writhing his Body, like a Fiſh newly taken from the Water. *Rennief* was affected only with fainting Fits. After three Hours *Ruſſel* recovered of theſe extraordinary Convulſions, but was diſordered in his Brain during the whole Night; and though *Rennief* was ſooner relieved of his Fits, he continued extreamly diſordered for a longer Time. It was thought remarkable, that neither of them was affected with either Vomiting or Purging.

This Accident happened on *Friday*, and on the *Monday* they were both reſtored to perfect Health. The Well continued infected for a very little while, and when on the *Monday* following ſome other Workmen renewed the Work, there was nothing Noiſome that could be perceived.

I cannot call to Mind, that there is any Inſtance of ſuch a tranſient Vapour or Damp recorded in the *Philoſophical Tranſactions*; and muſt confeſs I am at a Loſs how to account for it. Should there be Subterraneous Exhalations which, like the Clouds or Wind in the Atmoſphere, ſhifted from one Place to another, it might be of great Importance to obſerve the Particulars thereof, eſpecially ſuch as are *Malignant*, as this was. The Paſſage of this Vapour was about 25 Feet below the Surface; a Depth too great for it to affect Cellars or Vaults.

I had

I had forgot to note, that this Part of the Town lies very high; and the Ground for about ten Feet, hard Clay, and the reſt a coarſe Sand and Gravel.

V. It was firſt taken notice of on the ſecond of *Auguſt* laſt, in a *Marſhy-Field* ſituated in the Pariſh of *Flinx-Hill*, about ten or twelve Miles South Weſt of *Canterbury*.

A Subterraneous Fire, obſerved in Kent, *by* Robert Nesbitt, M. D. No. 399. pag. 307.

It began on the ſide of a little Brook near the Water, and continued to burn along it's Bank, without ſpreading much for ſome Days. Afterwards it appeared on the other ſide, and extended itſelf the ſpace of ſome Acres over the Field, conſuming all the Earth, where it burnt, into red Aſhes quite down to the Springs; which in moſt places lay four Feet or more deep. On the Twenty fourth of *September* I went to ſee it, and found it had conſumed, as well as I could gueſs by my Eye, about three Acres of Ground.

It then burnt in many Places, and ſent forth a great Smoak and ſtrong Smell, very like to that of a Brick Kiln. It never flamed but when the Earth was turned and ſtirred. For ſome ſpace round where it was burning, the Ground felt hot, tho' the Graſs ſeemed no more parched than might reaſonably be expected from the Dryneſs and Heat of the Seaſon. I cauſed it to be turned up in ſeveral Places, and found the Earth hot and wet near four Feet deep, and much hotter about two Feet than near the Surface.

When this Earth was expoſed to the Air, tho' it was very moiſt and not hotter than you might eaſily bear with your Hand, the Heat increaſed ſo faſt, that in a few Minutes it was all over on Fire, like *Phoſphorus* made with *Alom* and *Flower*.

The Soil of the Field is of the ſame nature with that they make the *Turf* of in *Holland*; the Surface of it is always wet, except in extream dry Seaſons. This Year it was ſomewhat more parched and hard than uſual.

I believe, from what has been related, it is not more difficult to account for this Fire, than for thoſe which often happen in *Hay-ricks* when Hay is ſtacked before it is thoroughly made.

VI. The Thermometer uſed in this *Diary*, was made by Mr *Hauksbee*, in which the Freezing-Point is marked at 65 Degrees under the Point extreme Hot; but the Doctor obſerves, that, at *Naples*, Water will freeze when this Thermometer ſtands at 55 Degrees only: Which, he is of Opinion, ſeems to argue, that there is ſomething elſe beſides an intenſe Degree of Cold required for freezing Water; that the Air of *Naples* abounds in it, more than the Air of *London*; and that this may probably be of a ſaline Nature; becauſe when we turn Water into Ice by the Help of Snow, it is neceſſary to mix Salt with it.

An Eruption of Mount Veſuvius, extracted from the Meteorological Diary at Naples, communicated by Nichol. Cyrillus, *M. D. R. S. S.* No. 424. pag. 336.

March

March	Ther.	Winds.	
8. 1730.	40 : 0.	S. 3	Cloudy Weather; ſtrong South Wind. *Veſuvius* ſent forth a great Smoak and Stream of Fire with hollow Rumbling.
9.	38 : 0.	W. 1	The Weather cloudy. The following Night *Veſuvius* thundred as it were twice. In the Day the Windows trembled a little.
10, 11, 12.	39 : 0.	S. 1	Cloudy; Rain now and then: The Clouds hide the Smoak and Fire.
13.	41 : 1.	NW. 1	Weather rather clear. The Smoak is leſſened.
14.	47 : 0.	N. 2	A little Rain in the Night, in the Morning Snow in the Mountains. In the Forenoon the Snow increaſed again. In the Evening after Eight o'Clock the Fire aroſe to a vaſt Height, and threw huge Stones to almoſt half the perpendicular Height of the Mountain. Pumice Stones red hot of two or more Ounces Weight, were driven ſeveral Miles like a Shower of Hail, and frightned away the Birds. In about an Hour's time the Height of the Flame was ſomewhat leſſened; and through the middle of the thick Smoak Flaſhes of Lightning were often ſee.

March	Ther.	Winds.	
15.	30. 0	NE. 1	Clear Weather. Thick Smoak ſcattered the Aſhes many Miles over the Sea.
16.	48 : 0.	S. 1	Clear in the Morning; about noon cloudy, ſmall Rain and cold. By Change of the Winds the Smoak and Aſhes were carried towards the N. Clouds hide the Mountain.
17.	40 : 1.	S. 1	A few thin Clouds. The Smoak turned with the Wind.
18.	40. S.	SW. 1	Clear. The City was ſprinkled over with ſmall Aſhes, like Kitchen Aſhes, which were attracted by the Loadſtone.
19.	42. 0	W. 1	A few thin Clouds.
20.	37. 0	0	Almoſt clear. *Veſuvius* became entirely quiet.

A Shock of an Earthquake felt near Dartford *in* Kent, *by the Rev. Mr* Edmund Barrel, *Rector of* Sutton. N°. 399. p. 305.

VII. I had an Information brought to me yeſterday, that the Earthquake was felt very ſenſibly at a Farm on a Hill called *Skeat-Hill*, which is at the Weſt End of *Lullingſtone-Park*, belonging to *Percival Hart*, Eſq; about 8 Miles South-Weſt from *Dartford*: And the ſame Morning a Piece of Ground, in a Meadow in *Farningham*, about five Miles South of *Dartford*, fell in, ſo as to leave a Pit about 8 or 10 Feet over and near as deep; and being on the ſame level with the River, it was (when ſeen that Morning) filled with Water, within 3 or 4 Feet of the Top; though that Spot of Ground, was ſuppoſed to

to have been as ſound as any about it, Carts having many times gone over that very Place.

VIII. The Earthquake came ſuddenly upon us in the Night after the Lord's-Day, *Octob.* 29, 1727, between ten and eleven, in a very ſtill and fair Evening; the Stars ſo bright and glittering, that many had taken great Notice of them, and one or two Perſons that had been in Places ſubject to Earthquakes, had ſaid tranſiently, that if we had been uſed to have them, they ſhould expect one. This only general Symptom of it's Approach I have heard of, namely, the moſt ſerene Sky and calm Air that was ever known, not a Cloud in the Sky, nor ſcarce a Breath of Wind. And though this is not univerſally a Symptom when Earthquakes are coming on Places, yet ſo far as I can inform my ſelf, it has often and for the moſt Part been obſerved. It was ſo in the dreadful Shake at *Jamaica* thirty odd Years ago; and a moſt ingenious and obſerving Friend of mine who had his Leg broke on the Point when it ſunk, and is ſtill living, tells me, That after that Shock, which was followed with many Tremblings and leſſer Shakes while his Leg was healing, he could from Day to Day judge by the Face of the Sky and Air, whether there would be any Tremor or Jar of the Earth. If there was any Cloud hanging over the mountainous Part of the Iſland, there was no Shake that Day; but if all was ſerene and fair, he expected one, and it ſeldom failed. Yet it has not been found ſo with us, in our After-rumbles and Tremblings, which returned often for ſome Months after the great Shake, and at Times for nine Months after it.

An Account of the late Earthquake which happened at Boſton *in* New-England *by the Rev. Mr* Benjamin Colman. N°. 409. p. 124.

The Town of *Newbury*, at the Mouth of *Merrimack* River, about forty Miles *North Eaſt* from *Boſton*, is the Place that ſeems to have been the Center of the Shock and Shakes felt by us. There the Earth opened and threw up many Cart-loads of a fine Sand and Aſhes, mixed with ſome ſmall Remains of Sulphur; but ſo ſmall, that taking up ſome of it in my Fingers, and dropping it into a Chafing-diſh of bright Coals, in a dark Place, once in three Times the blue Flame of the Sulphur would plainly ariſe, and give a ſmall Scent, and but a ſmall one. By this it ſeems evident that it was a ſulphureous Blaſt which burſt open the Ground, and threw up the calcined bituminous Earth. The Family neareſt to this Eruption, it being in that Part of the Town where the Houſes lie at a Diſtance from each other, were in the Terrors of Death; the Roar and Shock being much more terrible upon them than upon others: And yet upon us at forty Miles Diſtance, and upon others at forty and forty more, it was very terrifying and aſtoniſhing.

Five or ſeven ſmall Shakes were felt by us, after the firſt and great one, that Night and in the Morning following; but theſe and other following Rumbles and Tremblings, were louder and greater at *Newbury* and the adjacent Places than with us; and they felt and heard many Times when our Parts did not; but yet from Week to Week,

we and the Places about us felt and heard ſome of the greater Tremors, both by Day and Night.

I have received from a Reverend Miniſter in *Newbury* * the following Account.

As to any previous Notices of the Approach of the Earthquake, I cannot find any thing to be depended on. The Prognoſtications that have been among us have all failed; ſuch as the Brightneſs of the Sky beyond what was common; the twinkling of the Stars, and the like. I certainly know that we have heard the Rumbles in all Weathers, cloudy, foggy, rainy, ſnowy, clear, cold, hot, moderate, windy, calm, *&c.* indifferently; and at all Hours of Day and Night; (though by the way, we heard theſe Rumbles oftner in the Night during *Winter*, as I think, and ſince more uſually in the Day) Alſo when the Wind has been at any Point of the Compaſs, and at all Times of Tide; and as to the Moon equally when ſhe was nearer or further from her Change or Full: Neither in any particular Weather, nor on any obſervable Occaſion were the Shocks greater, or Rumbles louder.

As to any Alterations in the Air or Water after a Shock, I could never diſcern any thing; particularly as to the Wind being raiſed after a Shock, when it was calm before, which ſome reported, I could never perceive the leaſt Difference.

One Thing I may add here, very remarkable, and which may be depended on. About the Middle of *April*, that fine Sand which was thrown up in ſeveral Places in this Pariſh at the firſt great Shock, *Octob.* 29, did actually ſtink to a very great Degree, even ſo as to be more nauſeous than a putrefying Corpſe; yet in a very little while after it did not ſmell at all. How long it was before it began to ſtink I am not certain; I know it did not at firſt, and I believe it was covered with Snow till a little while before: There is nothing of Smell now. There has been no Opening of the Ground, throwing up Sand, ſtopping or breaking out of Springs, *&c.* as at firſt. If there had continued any ſenſible Evacuating of Air, or other Matter pent up in the Earth, from the Surface of the Sea or Land adjacent to us, at the Times of our many Rumbles and Tremblings, we ſhould have diſcerned it before now. *Newbury* is a Spot of Ground, and ſo the adjacent Towns, very much inhabited and continually travelled over; and as to the Sea contiguous to theſe Parts, it is full of our Coaſters by Day and Night; but neither on Land or Water have any ſenſible Eruptions or Evacuations been obſerved that I hear of.

P. S. *Boſton Weekly News Letter, Sept.* 5, 1728. We hear from *Newbury* and *Rawley*, That they felt the Shake of the Earth on *Thurſday* laſt about Four in the Morning, the Noiſe much like Thunder.

* Mr *Lowell*.

IX. It

IX. It was the Conſequence of a very wet Seaſon, when the Waters, that had fallen on the Up-lands, and were not carried off by Drains, ſoaked into the Ground in ſuch Quantities as to form a quick Sand at ſome conſiderable Depth in the Earth (at leaſt this is what we look on to have cauſed the Phænomenon) which not being able to bear the Weight upon it, broke out at the Side of the Hill, and raiſed the lower Parts of it; letting the Brow ſink 40 or 50 Foot, as I gueſs. I am but a rude Deſigner, but can truſt you ſo far as to give ſuch a Sketch as I can draw; for, perhaps, you may underſtand me the better for it. *An uncommon Sinking of the Ground at* Lymne *in* Kent. *Communicated in a Letter to Mr* Peter Collinſon, No. 405. p. 551.

The Ground ſunk in a Night, and was not perceived by the Farmer's Family till they found the Change in the Morning, by their Door-caſes not ſuffering the Doors to open. The Houſe is ſtrangely rent by this Accident, and, had it not been Timber built, muſt have fell, (as a mighty ſtrong Barn near it did, which was built of Stone) for one great Crack of the Earth went through the Middle of it, and ſplit a large Kitchen Chimney from Top to Bottom.

a b c d the Profile of the Land. *Fig.* 54.

a the flat Land at Bottom 3 or 4 Miles from the Sea.

d the flat Land at Top, ſtiff Ground and rocky.

* The Place of the Farm at preſent, which not only ſunk down from *d* 40 or 50 Foot, but was alſo moved ſomewhat towards *a*.

b the lower Part raiſed to *c*.

X. *John Robinſon*, being Maſter of a ſmall Pink-Snow, called the *Richard and Elizabeth* from *Piſcataqua* in *New-England*, arrived at *Tercera*, *Decemb.* 10. 1720. near which Iſland he ſaw a Fire break out of the Sea. The Governor hired him to go with the ſaid Veſſel to view it, and ſent on Board ſixteen Sailors, and two Prieſts. On *Sunday*, the 18th of *Decemb.* we got under Sail at 12 o'Clock at Night, and ſtood from *Angras*, S. E. The next Day at two o'Clock in the Afternoon, we made an Iſland all Fire and Smoak: we continued our Courſe till the Aſhes fell on our Deck like Hail or Snow all Night. We bore from it, the Fire and Smoak roared like Thunder, or great Guns. At Break of Day we ſtood towards it again: at 12 o'Clock we had a good Obſervation, two Leagues South from it. We ſailed round it, and ſo near, that the Fire and Matter it threw out, had like to have done us Damage: In which Conſternation we all betook ourſelves to Prayers, being in danger of driving a ſhoar: then a ſmall Gale, at S. E. ſprung up, and carried us clear to our great Joy. The Breeze was accompanied with a ſmall Shower of Rain, which cauſed a great Duſt to fall on our Deck; with the ſaid Breeze we ſtood away for *Tercera*. The Governor informed us that the Fire broke out the 20th of *Nov.* 1720. in the Night, and that the prodigious Noiſe it made, cauſed an Earthquake, which ſhattered down many Houſes in the Town of *Angra*, and Places adjacent, to *An account of a new Iſland lately raiſed out of the Sea near* Tercera, *by* Thomas Forſter, *Eſq;* No. 372. p. 100.

Fig. 55, 56, 57, 58, 59, 60. the great Terror of the Inhabitants. We took ſeveral Draughts of the Iſland at ſeveral Bearings in our ſailing round. Prodigious Quantities of Pumice-Stones and half broiled Fiſh were found floating on the Sea, for many Leagues round the Iſland, and abundance of Sea-Birds hovering about it. So far the Captain.

An Acquaintance of mine informed me, that in his Paſſage from *Cadiz* to *London* (the latter end of *April* was 12 Months) he obſerved the Sea from Cape *Finiſterre*, almoſt to the Chops of the Channel, to be covered with Pumice-Stones, ſome of which he gave me.

An Account of the Body of a Man, found in a Copper-Mine by Adam Leyel, Reg. Colleg. Metall. Aſſeſſor. *extracted from the* Acta Literaria Sueciæ, Ann. 1722. Trimeſt. I. No. 384. p. 136.

XI. Anni 1719. menſe Decembri, in Wrediano puteo 82 orgyias profundo, in rupis ipſius confinio, ſub aqua & 5 orgyiarum ruina, defuncti hominis corpus in conſpectum venit. Utrumque crus, cum brachio dextro & capite, avulſa petræ moles contuderat: facies vero, corpuſque reliquum cum veſte, integra plane & intacta cernebantur; habituſque totus viri, collariæ faſciæ orâ extremâ, ſiniſtræ manus ope, os obturantis, is erat, quem Lit. A. exhibet ac demonſtrat. Crumenâ, quam gerebat, pyxis ex orichalco oblonga, pyxide vero tabaci condebatur fruſtulum, utroque illæſo & integro; ductitium autem ferrum, quo ad pyxidem annecti operculum volvique ſolet, aqua tincta edaci vitriolo totum abſumſerat. Caro hominis cutiſque, aſperæ licet & duræ palpantibus viderentur, non tamen lapidis ea erat durities, ſed corneæ aut ungulinæ, etiam ſpecie, ſuppar, quippe quæ cultro cederet ſcindique poſſet.

Fig. 61.

Poſt extractum tumulo, fodinaque corpus, diligenti examinatione quæſitum eſt, ecquis eſſet, qui agnoſcere poſſet defunctum, aut quando periiſſet, ſcire? cum *Magnus Johannis*, metallicus in *Korſgård-den*, probe illum a ſe de facie, quippe quæ lineamenta omnia illibata ſervet, agnoſci, idque coram confeſſu Metallico, profiteretur; ſubjungens etiam nomen, vocatum eum aiebat *Matthiam Iſraëlis*, alias, ob proceriorem paulo ſtaturam, *Matthiam Magnum* ſeu *Procerum*, qui in Boda Swerdſiöenſis parœciæ pago editus, operam *Jonæ Petri* in *Dijkarebacken* locaſſet. Succurrit porro *Matthiam* hunc *Iſraëlis*, poſtquam anno 1670, & tempore quidem autumnali, ſolus capſula vectus deſcendiſſet in fodinam, deſideratum, dubioque procul ruina ſuffocatum fuiſſe. Dictis fidem fecere idem affirmantes *Ericus Michaëlis* Prætor Metallicus, & *Ericus Petri* Reſtiarius. His accedebat vetula, quacum vivus adhuc *Matthias* ſponſalia contraxerat, quæ, veteris & jam reviviſcentis amoris jure, exanime corpus ſibi concedendum, aut terræ ſaltem mandandum poſtulabat. Aderant & alii plures, illum qui agnoſcerent, & narrationis hujus veritatem confirmarent.

Quadraginta novem adeo annorum ſpatio, ab anno videlicet 1670. ad annum 1719. ſub terra delituerat *Matthias* hicce *Procerus*, e qua in lucem protractum, in perpetuam rei memoriam, vetus ædes fodinæ publica excepit: in qua hodieque integer, & tam quod ad veſtimentum & lintea, quam carnem, cutem, capillum, & ungues, incorruptus, fœtoriſque omnis expers, oculis intuentium ſiſtitur; ſolo

Fig. 43.

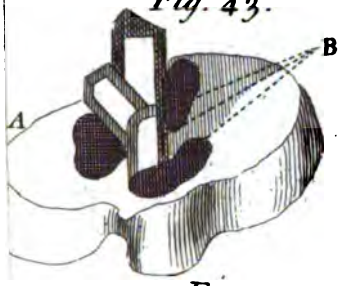


Fig. 44.

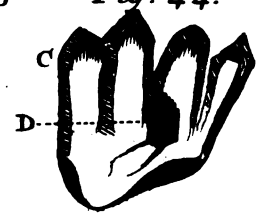


Fig. 45.

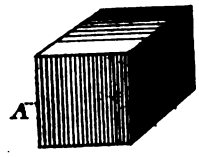


Fig. 49.

Fig. 50.

Fig. 51. Fig 52

Fig. 53.

Fig. 55.

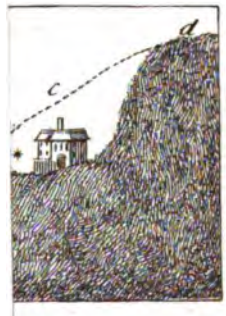


Fig. 56.

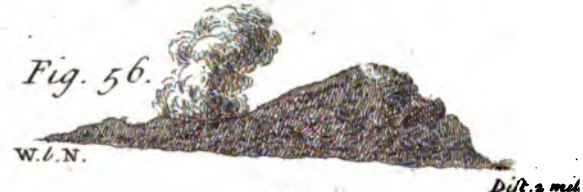


Fig. 58.

Fig. 60.

d and ſuppoſed to be about 2. leagues in Dia-
its Latitude is 38. 29. it's Longitude. 26. 33. The Bea.
ng round is expreſſed in the Draught above.

aquæ vitriolo abundantis miniſterio exſiccatus, & contra putredinis vim munitus.

Ex fideli hac certaque, quantum quidem ex loci ipſius incolis hauriri potuit, notitia haudquaquam petrificatum cadaver hoc, aut in lapidem mutatum, ſed aquæ tantum vitriolo ſcatentis beneficio induratum eſſe liquet. Quid quod vitrioli naturæ & ingenio magis nil, quam ejuſmodi petrificandi vis repugnat: quippe quod nil unquam in ſaxum convertat; tenuiſſimi vero vaporis vegeto motu omnia perrumpat, ſtringat, ac a putredine interituque tueatur.

XII. Ex hominum diluvio ſubmerſorum genere paucæ ſuperſunt reliquiæ. Neque ego hactenus in numeroſa ſatis collectione plures habui quam binas dorſi vertebras, atronitentis ſplendoris, petrefactas. Nunc autem, Muſeolo meo illatum, lapidi fiſſili *Oeningenſi* immerſum λείψανον, omni attentione digniſſimum, in quo diſtincte cernere licet, non vagæ imaginationis ſimulacra, ſed capitis humani à quovis alio animantium genere diſtinctivi partes benè multas, reapſe reſiduas, cranii ambitum, os frontis, oſſa ſincipitis, occipitis, orbitam oculi, baſeos cerebri & medullæ oblongatæ λείψανα, prominentiam interiorem oſſis occipitalis, quæ cerebelli lobos ſeparat, colli vertebras numero 7, partim denudatas, partim lapideo cortice tectas, & eſt hæc veluti orthographica ſectio poſterioris capitis partis.

An Account of part of two Human Skeletons petrefied, by Joh. Jac. Scheuczer, *M. D. F. R. S.* N°. 392. pag. 38.

Sed inde ex quo Monumenti hujus fui potitus, novum ex dicta lapicidina adfertur prius vincens & magnitudine, & ætate, & curioſitate. Adſunt nempe in dicto fiſſili lapide demerſa, ex hominis adulti ſceleto, ejuſve ſtructura anteriore, peripheria oſſis frontalis, os jugale, orbitæ oculorum, cranii tabulæ cum diplôe, veſtigia foraminis infraorbitalis deſtinati pro tranſitu nervorum quinti paris, reliquiæ vel ipſius cerebri, vel duræ matris, oſſa cribroſa & ſpongioſa, os vomeris naſum diſterminans, oſſis quarti maxillaris portio, quæ genas conſtituit naſi reliquiæ, maſſeteris portio, ſectio orthographica tranſiens per apophyſin condyloidem maxillæ inferioris ad angulum uſque hujuſdem maxillæ, vertebræ in continua ſerie numero 16, pleræque cum proceſſibus tranſverſis, claviculæ dextræ extrema portio, quæ ſcapulæ nectitur, ſiniſtræ media portio lapide tecta. Ex qua ſceleti proportione judico, integram hominis ſtaturam fuiſſe eandem, quæ incirca mea eſt, 58½. pollicum Pariſienſium.

XIII. 1. It is obſerved, that among the vaſt Variety of extraneous Subſtances lodged and found in ſeveral Layers of the Earth, at conſiderable Depths, where it is impoſſible that they ſhould have been bred, there are not ſo many Productions of the Earth, as of the Sea. And again, among thoſe which muſt have originally belonged to the Earth, there are many more remains of Vegetables, than of Land Animals. It appears, however, by the Hiſtories of paſt Times, and the Accounts of many, both antient and modern Authors, that Bones, Teeth, nay ſometimes very near entire Skeletons of Men and Animals have been dug up in all Ages of which we have

An Account of Elephants Teeth *and* Bones *found under Ground. By Sir* Hans Sloane, *Bart.* N°. 403. pag. 457.

Hiſtories

Hiſtories, and almoſt in all Parts of the World, whereof thoſe, which were the moſt remarkable for their unuſal Size, have been alſo the moſt taken Notice of. Thus, for Inſtance, they have found in *Ireland*, the Horns, Bones, and almoſt entire Skeletons of a very large Sort of Deer, which is commonly believed to have been the Mouſe-Deer, an Animal of an uncommon Size, ſome of which Kind are thought to be ſtill alive in ſome remote and unfrequented Parts of the Continent of *America*. I ſhall in this Paper confine my ſelf chiefly to the Elephant, and ſuch Bones, *dentes exerti*, Tuſks and Teeth of this Animal, as are either in my own Poſſeſſion, or have been mentioned by Authors I have met with, to have been found under Ground. And firſt, as to thoſe Foſſile Teeth in my own Collection, which unqueſtionably once belonged to Elephants, I ſhall here produce the following.

N° 116 of my Catalogue of Quadrupeds and their Parts, is the *dens exertus* of an Elephant, which was taken up, 12 Foot deep, from among Sand, or Loom, as they were digging for Gravel by the End of *Gray's-Inn-Lane*, near *London*.

As the greateſt Part of this Tooth was fallen to Pieces, nothing could be determined about it's Length, when entire. The largeſt Piece, and alſo the moſt entire, hath five Inches and $\frac{8}{10}$ in Length, and 9 Inches and $\frac{6}{10}$ in Circumference, conſequently ſomething more than 3 Inches in Diameter. This Piece belonged to the Baſis, or Bottom of the Tooth; I mean, that Part by which it is articulated with the Head, as appears by a Cavity in form of a Cone, which all theſe Tuſks have at Bottom, and which was filled, in this, with the Sand of the Gravel-pit wherein it was found.

The Condition this Tooth was found in, ſuggeſts the two following Remarks. It ſhews in the firſt Place, how far the ſubterraneous Steams are apt to calcine Subſtances of this Kind, which was done in this Tooth to ſuch a Degree, that it was grown extream brittle, and ready to fall to Pieces, and had moreover acquired an aſtringent Quality common to calcined Subſtances of this Kind, which makes them ſtick pretty cloſe, when held to the Tongue. They had altogether the ſame effect on the very large Skeleton, found near *Drapani* in *Sicily*, and mentioned by *Boccatius*, on that remarkable one found near *Tonna*, which hath been deſcribed by *Tentzelius*; as alſo on two Teeth found in *Northamptonſhire*, which I ſhall next take into conſideration. However it doth by no means follow them thence, that all Teeth and Subſtances of this Kind undergo the like Calcination by lying long under Ground, foraſmuch as there are others, as thoſe found in *Iſland*, and ſent to *Thomas Bartholin*, which were turned to a perfect hard, flinty Subſtance. It ſerves, in the ſecond Place, to aſcertain the Structure of theſe Teeth, and conſequently of Ivory in general, to be Coat upon Coat, like the Skins in an Onion, or rather the annual Circles, or Rings in Trunks of Trees. That this Tooth

is compoſed of different Coats, ſurrounding and placed upon each other, is very apparent by the largeſt Piece remaining. I have already obſerved that this Piece belonged to the Baſis of the Tooth, and there appear in it very viſible marks of nine Coats, ſome whereof have about one Tenth of an Inch in thickneſs. Towards the further End of the Tooth, where it tapers almoſt into a Point, theſe ſeveral Coats alſo join together into two or three, and thoſe pretty conſiderably thick. With ſome Care theſe Coats might be further ſub-divided into a conſiderable Number of other ſmaller ones, perhaps no thicker than a common Parchment. Farther, the very manner of it's falling to pieces is an evident Proof of it's Structure, all the Fragments being concave within, and convex without, and the Lines of Convexity and Concavity, Fragments of concentric Circles, which the ſeveral Coats compoſed, when entire. *Thomas Bartholin*, in his Treatiſe *De Unicornu* *, takes Notice, that Part of a foſſil *Unicorn's Horn* having been calcined by Order of *Chriſtian* IV. King of *Denmark*, it was found to be compoſed, after the ſame manner, of thin Layers upon Layers; whence he infers, that it was not the Horn of an Animal, as was commonly pretended, but a Tooth, and namely the Tooth of a Sort of Whale in the Northern Seas, called *Narwhal*, as he had afterwards an excellent Opportunity to verify by one of theſe Unicorn's Horns ſtill ſticking in the Skull of the Creature, which was ſent to *Wormius* by *Thorlacus Scutonius*, Biſhop of *Iſland*. Now is this Structure by any means to be looked upon as an Effect of the Calcination, whether brought about by the ſubterranean Steams, or by a chymical Trial, but is natural to the Tooth, as appears in ſome meaſure by a Piece of Ivory, marked 1181; but ſtill more plain in another marked 731, where ſeveral of theſe Coats are by ſome Diſeaſe in the Tooth actually ſeparated from each other, like the Leaves of a Parchment Book, the Ivory on the other Side being ſtill firm and cloſe. This Structure appears likewiſe from the Teeth of the very young Elephant which died at *London*, where the uppermoſt Coat, being very moiſt, cracked upon drying, and broke at the Top. *Fig.* 62. *Fig.* 63. *Fig.* 64. *Fig.* 65. *Fig.* 66.

N° 750, is Part of another *dens exertus*, which I had from the Reverend Mr *Morton*, who in his Natural Hiſtory of *Northamptonſhire* †, gives an Account of it: That Part of this Tooth, which is now in my Hands, bears again very viſible Marks both of the Calcination it underwent by lying in the Earth, and of it's laminated Structure. *Fig.* 67.

N° 1185, is the *dens exertus*, or Tuſk of an Elephant, remarkable for it's large Size, and for it's being ſo very entire. It was found under Ground in *Siberia*. It is very entire, of a browniſh Colour, and hollow at Bottom like other Elephants Teeth, one of which it plainly appears to be. From the Baſis, meaſuring along the outward Circumference to the ſmall End, *Fig.* 68.

* De Unicornu obſervationes novæ, *pag.* 102. † *Pag.* 252.

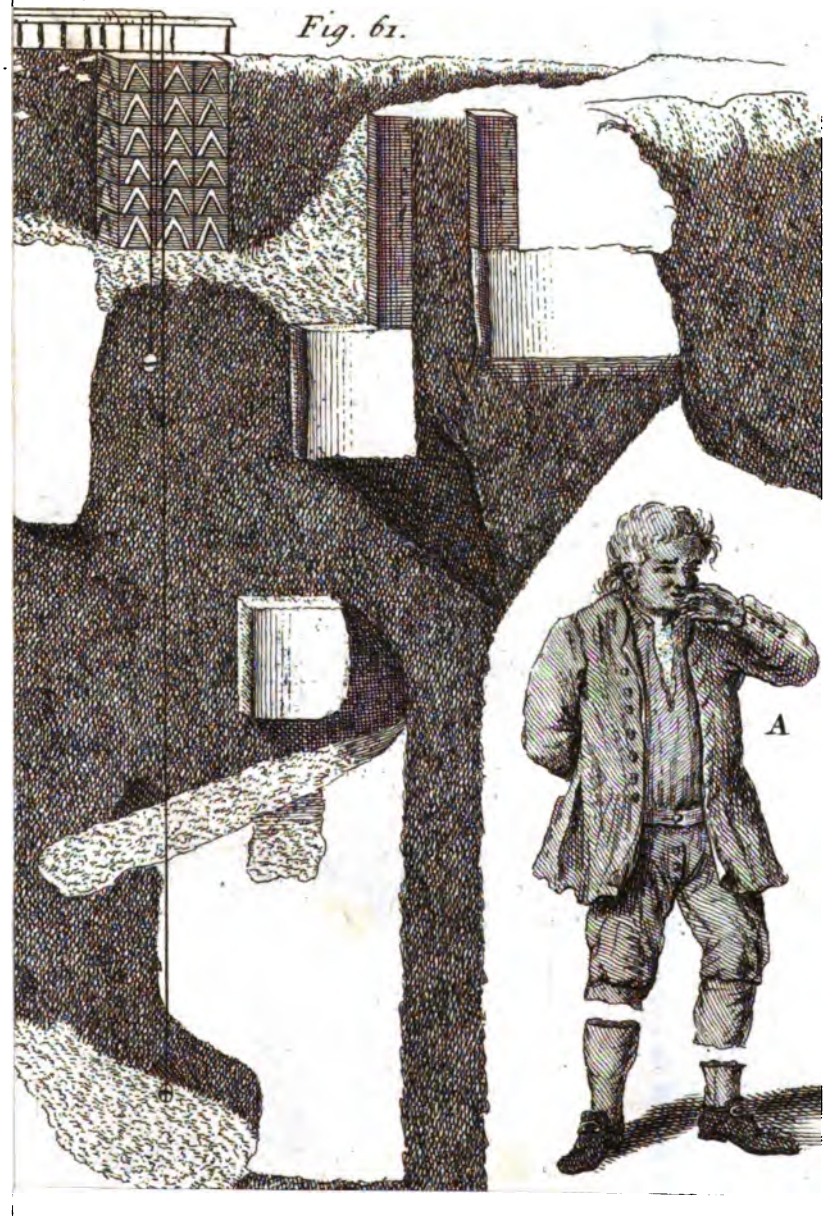
it

it is 5 Foot 7 Inches long, and along the inward Circumference 4 Foot 10 Inches. Meaſuring from the Inſide of the Baſis to the ſmall End in a ſtreight Line, the Diſtance is of 3 Foot 10 Inches and a Half. At the Baſis, where thickeſt, it meaſures one Foot ſix Inches round, and is there ſix Inches in Diameter: It weighs 42 Pound. The like Tuſks, and other Bones of the ſame Animal, that is, of the Elephant, are found in ſundry Parts of *Siberia* to a conſiderable Quantity, and the Tuſks and Teeth in particular, when leſs corrupted, are uſed all over *Ruſſia* for Ivory, *Henricus Wilhelmus Ludolfus*, in the Appendix to his *Ruſſian Grammar* *, mentions them among the Minerals of *Ruſſia*, by the Name *Mammotovoikoſt*, and takes Notice, that the *Ruſſians* believe them to be the Teeth and Bones of an Animal living under Ground, larger than any one of thoſe above Ground. They uſe it in Phyſick in Lieu of, and for the ſame Purpoſes with, the Unicorn's Horn; and *Ludolfus* himſelf having been preſented with a Piece by one of his Friends, who ſaid, He had it from a *Ruſſian*, of great Quality, lately returned from *Siberia*, found it to be true Ivory. He adds, That the moſt ſenſible among the *Ruſſians* affirm them to be Elephants Teeth brought thither at the Time of the Deluge. The Deſcription of theſe Teeth and Bones given by *E. Yſbrants Ides* †, is ſtill more extenſive. What he obſerves of thoſe Teeth that are black and broken, may ſerve as a Comment to the following Paſſage of *Pliny* ‖: *Theophraſtus autor eſt, & ebur foſſile candido & nigro colore inveniri, & oſſa è terra naſci, invenirique lapides oſſeos. Lawrence Lang*, in the Journal of his Travels to *China*, whither he went with Diſpatches from His *Czariſh* Majeſty in 1715, takes Notice of theſe Bones **, as being found about the River *Jeniſei*, and towards *Mangaſea*, along the Banks, and in the Hollows occaſioned by the Fall of the Earth. He calls them *Maman-bones*, and informs us, that ſome of the Inhabitants are of Opinion, that they are no real Bones, Teeth, *&c.* but a Sort of *Cornu Foſſile*, that grows in the Earth, and that others will have them to be the Bones of the *Behemoth* mentioned in the fortieth Chapter of *Job*, the Deſcription whereof they pretend fits the Nature of the Beaſt, whoſe Bones and Teeth they are imagined to be, thoſe ſuppoſed Words, in particular, that he *is caught with his own Eyes*, agreeing with the *Siberian* Tradition, that the *Maman* Beaſt dies upon coming to Light. The ſame Author affirms, from the Report, as he ſays, of credible People, That there have been ſometimes found Horns, Jaw-bones and Ribs, with freſh Fleſh and Blood ſticking to them. The ſame is confirmed by *John Bernard Muller*, in his Account of the *Oſtiacks* ††, who adds, That the Horns in particular have been found ſometimes *all bloody at*

* *Pag.* 92. † In his Travels from *Moſco* to *China*. ‖ Lib. xxxvi. cap. 18.
** Preſent State of *Ruſſia*, Vol. II. pag. 14. †† Ibid. pag. 52.

the

Fig. 61.



the broken End, which is generally hollow, and filled with a Matter like concreted Blood; that they find, together with theſe Teeth, or Horns, as he calls them, the Skull and Jaw-bones with the Grinders ſtill ſticking in them, all of a monſtrous Size; and that he himſelf, with ſome of his Friends, hath ſeen a Grinder weighing four and twenty Pounds, and better; that the Inhabitants make divers Sort of Works of theſe Teeth, and that they are moſtly to be met with in the coldeſt Places of *Siberia*, as for Inſtance, *Jakutſky*, *Bereſowa*, *Mangaſea*, and *Obder*. He likewiſe gives the Deſcription of one of theſe Animals, from the Accounts of ſeveral Perſons, who aſſured him, That they had ſeen them in the Caverns of the high Mountains beyond *Bereſowa*: But as this Deſcription hath very much the Face of a Fable, I forbear inſerting it here. The Author of the *Preſent State of* Ruſſia * obſerves, that ſome of the *Swediſh* Priſoners baniſhed into *Siberia*, got their Livelihood by turning Snuff-boxes out of theſe Teeth; and in another Place † he mentions them among the *Siberian* Commodities, of which the Czar hath the Monopoly.

The Accounts which I have hitherto given of theſe *Maman*-bones and Teeth, or at leaſt their moſt eſſential Parts, are confirmed by a Letter of *Baſilius Tatiſchow*, Director General of the Mines in *Siberia*, and Counſellor of the Czar's Metallic Council, written to the Learned *Ericus Benzelius*, now Biſhop of *Gothenburg*, and printed in the *Acta Literaria Sueciæ* (M. DCC. XXV. *Trimeſtre ſecundum*, pag. 36.) wherein he mentions the following Pieces he had in his own Poſſeſſion: A large Horn, as he calls it, or Tooth, weighing 183 Pounds, which he had the Honour to preſent to his *Czariſh* Majeſty, and is now kept in the Czar's Collection of Curioſities at *Peterſburg*; another large Horn, which he preſented to the Imperial Academy at *Peterſburg*; another ſtill larger than either of theſe two, which he cauſed to be cut, and carved himſelf ſeveral Things of it, the Ivory being very good; Part of the Skull, corrupted by having lain in the Ground, and ſo large, that it ſeemed to him to be of the ſame Size with the Skull of a great Elephant; the Forehead in particular was very thick, and had an Excreſcence on each Side, where the Horns uſually ſtick to it, which Excreſcence however, as the Author obſerves, was ſo ſmall, as to make him doubtful, whether or no there was ever any Horns ſtuck to them. The Cavity, wherein the Brain was lodged, was exceedingly ſmall in Proportion to the Bulk of the Skull. He had found alſo a ſpungy Bone of a Foot and a Half in Length, and three Inches in Breadth, ſticking to the Skull, and of a conical Figure, whence he conjectured, that it ſerved to ſupport one of the Horns, which is obſerved alſo in other Animals that bear Horns: Laſtly a Grinder, which had ten Inches in Length, and ſix in Breadth, beſides ſeveral of the Ribs, Shank-bones, and other Bones found from Time to Time, which the Author forbore mentioning. The ſame

* Vol. I. pag. 12. † *Pag.* 78.

Author hath taken no small Pains to inquire into the true State of those Pits and Hollows which the Pagan Inhabitants of *Siberia* say these Animals make when they walk under Ground, and found that they were nothing but Cavorns, such as are common in other mountainous Countries, and are owing to the Force of subterranean Rivers and Cataracts, which at last eat through and undermine the Places where they pass, so as to make the Ground above them give Way and sink in. This is what I found remarkable in this Letter of Mr *Tatischow*. I cannot forbear adding, that although the Author hath left the grand Question about the Origin of these Bones undetermined, yet his Observations seem to me to contribute very much to establish the Opinion above related, that these Bones are the Bones, and the Horns, as he calls them, the Tusks of Elephants drowned in the universal Deluge. It is to be hoped, that this Matter will one Time or other be set into a still clearer Light, particularly after the Order his late *Czarish* Majesty was pleased to give to the Governor General of *Siberia*, to spare no Care nor Cost to find a whole Skeleton of this Animal, and to send it to *Tatischow*.

Before I proceed farther, I will beg Leave to add one Observation of *Cornelius le Brun*, who in his Travels through *Russia* to the *East-Indies*, tells us, That in the Neighbourhood of *Veronitz* they had found several Elphants Teeth on the Surface of the Ground, which no Body could tell how they came thither, and that the Czar's Opinion about them was, that *Alexander* the Great, when he passed the *Tanais*, or *Don*, advanced as far as *Kostinka*, a small Town, eight Wersts from thence, and that probably some of his Elephants died there, of which those Teeth were the Remains.

N° 764 of my Collection, is one of the Grinders of an Elephant, which was likewise found in *Northamptonshire*, and described by Mr *Morton**. It is very visible, that this Grinder also, by lying in the Earth, hath undergone the same Alteration with the Tusk above described found in *Bowdon parva* Field.

N° 119, and 120, of my Catalogue, are two Pieces of another large Grinder, very probably of an Elephant too, turned to a very hard, stony and almost metallic Substance.

N° 121 is a Piece of the *Molaris*, or Grinder of an Elephant, where the undulated Lamellæ are set very close to each other.

N° 122 is a Piece of another Grinder, perhaps of an Elephant. It hath very apparent Marks of being fossile, as well as the preceeding, and is farther remarkable, for that a petrifying Substance being got between the Lamellæ hath very considerably separated and divided them from each other, in such a Manner, that they appear to have been set very loose.

N° 427, of my Collection of Quadrupeds and their Parts, is Part of an Elephant's Skull, which was found at *Glocester* after the

* Nat. Hist. of Northampt. C. iii. §. cxxxv. pag. 252.

Year

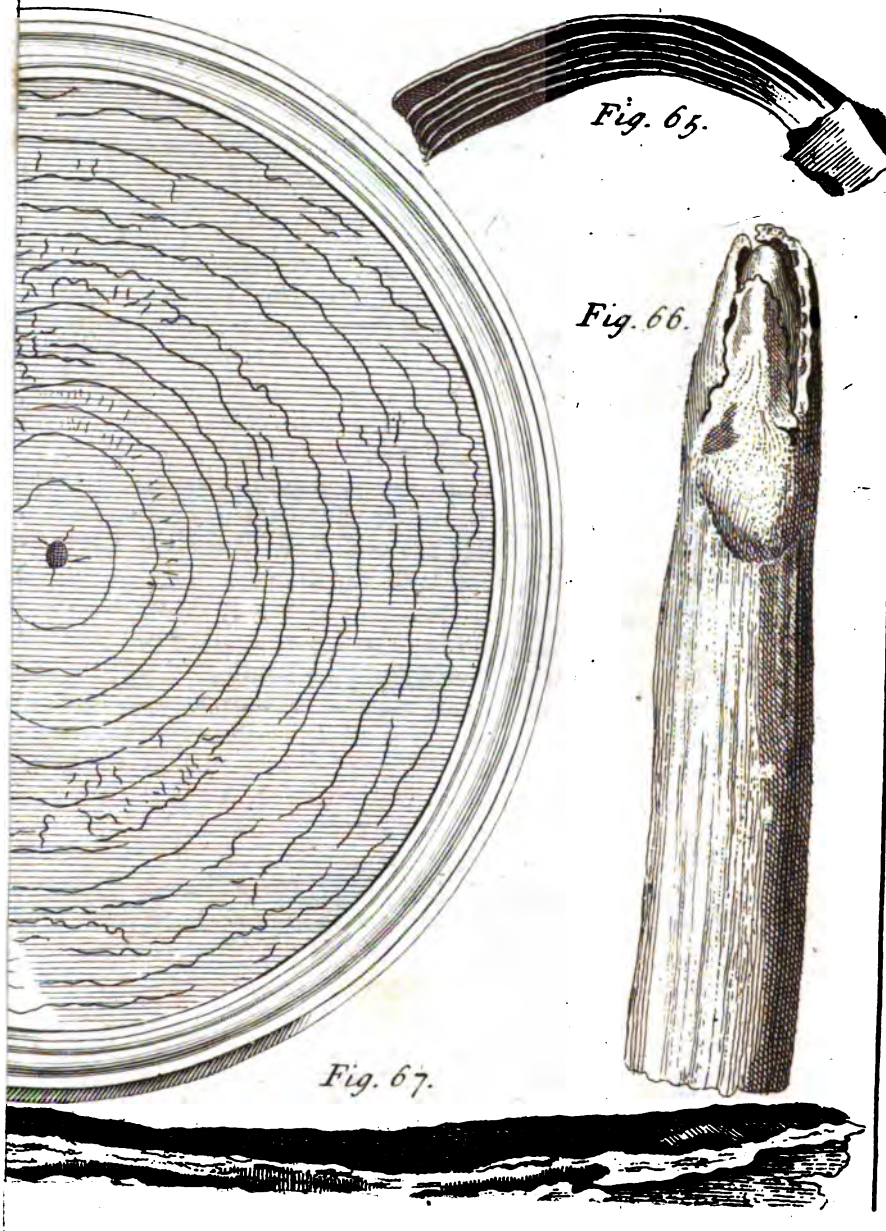


Fig. 65.
Fig. 66.
Fig. 67.

Year 1630, together with ſome large Teeth, ſome five, others ſeven Inches in Compaſs, according to a ſhort Inſcription written upon this very Piece.

2. I proceed now to the Second Part of this Diſcourſe, wherein I propoſe to offer ſome Remarks on divers Accounts of Bones and Teeth found under Ground, which I met with in ſeveral antient and modern Authors, and which will give me an Opportunity of examining into the Skeletons, and Parts of Skeletons, which are ſhewn up and down as undeniable Monuments of the Exiſtence of Giants. *Of* Foſſile Teeth *and* Bones *of* Elephants. *Part the Second. By the ſame,* N°. 404. p. 497.

And firſt, as many of thoſe Bones and Teeth, which are kept and ſhewn about for Bones and Teeth of Giants, have been found, upon a more accurate Inſpection, to be only the Bones and Teeth of Elephants or Whales, it may from thence very probably be inferred, that others alſo, which for want of a ſufficient Deſcription cannot be accurately enough accounted for, muſt have belonged either to theſe, or elſe ſome other large Animal. Thus the Fore fin of a Whale, ſtripped of it's Webb and Skin, was not long ago publickly ſhewn for the Bones of a Giant's Hand; and I have in my own Poſſeſſion (N^b^ 1027) the Vertebra of the Loin of a large Whale, which was brought me from *Oxfordſhire*, where I was aſſured it was found under Ground, and afterwards made Uſe of for a Stool to ſit on. Now if a Computation had been made from the Proportion of this Vertebra to that of the other Parts of the Skeleton, and all had been ſuppoſed to have belonged to a Man, ſuch a Skeleton would have exceeded in Meaſure, all thoſe fabulous Skeletons of Giants mentioned by Authors. *Fig.* 69.

I cannot forbear on this Occaſion to obſerve, that it would be an Object well worthy the Inquiries of ingenious Anatomiſts, to examine, with more Accuracy than hath been hitherto done, what Proportions the Skeletons and Parts of Skeletons of Men and Animals bear to each other, with Regard either to the Size, or Figure, or Structure, or any other Quality. This would doubtleſs lead us into many Diſcoveries, and is beſides one of thoſe Things, which ſeem to be wanting to make Anatomy a Science ſtill more perfect and compleat. The very Vertebra I ſpeak of may ſerve to ſhew the Uſefulneſs of ſuch Obſervations. It differs in many Things from the Vertebræ of Men and Land-animals, as do the Vertebræ of Whales and the Fiſhes of the cetaceous Kind in general; and it is a very eaſy Matter to diſtinguiſh them from each other. The Body of the Vertebra is conſiderably larger in Proportion, and alſo lighter and more porous. The tranſverſe Proceſſes ariſe from the Middle of it on each Side. The oblique deſcending Proceſſes are altogether wanting; and the Arch, or Foramen, which the ſpinal Marrow paſſes through, is made up by the ſpinal Proceſs and the oblique aſcending ones only: The Body of the Vertebra is very rough and uneven on each End, full of ſmall Holes and Eminences, which receive the Holes and

Eminences of a round Bone, or Plate, which anſwers to the Epiphyſis in a human Vertebra, whereof there are two between each Vertebra, joined together by an intermediate ſtrong and pretty thick Cartilage, probably to facilitate the Motion, and particularly the Flexion of theſe Animals in the Sea. But to return from this ſhort Digreſſion. *Fig.* 70, 71.

There are many Skeletons, that were from Time to Time found under Ground, and are mentioned by the Authors, who ſpeak of them, as Skeletons of Giants, and undeniable Monuments of their Exiſtence, which, as I have already obſerved, I ſhould rather take to be the Skeletons of Elephants, Whales, or ſome other huge Land or Sea-Animal. Of this Kind ſeem to be the pretended Skeletons of Giants of twelve, twenty, and thirty Cubits in Height mentioned by *Philoſtratus* *: The Skeleton of ſix and forty Cubits in Height, which according to *Pliny* † was found in the Cavity of a Mountain in *Creta*, upon the overthrowing of that Mountain by an Earthquake: The Skeleton ſixty Cubits high, which *Strabo* ‖ ſays, was found near *Tingis* (now *Tangier*) in *Mauritania*, and was ſuppoſed to have been the Skeleton of *Anteus*: The Skeleton of *Pallas*, as pretended, found at *Rome* in the Year 1500, which was higher than the Walls of that City: And likewiſe that, which *Simon Majolus* ſays was found in *England* in the Year 1171: *Longè ante Fulgoſi ſæculum* (are his Words **) *annis plus trecentis, anno ſcilicet* 1171. *in Anglia, illuvione fluminis, retecta ſunt humati olim Hominis oſſa adhuc ordine compoſita: Longitudo totius Corporis inventa eſt longa ad pedes quinquaginta.*

There are others, the Deſcription whereof concludes more clearly for their having once belonged to Elephants, though it could not be poſitively aſſerted, that they did. *S. Auſtin* ††, diſcourſing of the Exiſtence and great Feats of the Giants before the Deluge, mentions in Proof of what he advances, That he himſelf, with ſeveral others, ſaw at *Utica*, upon the Sea ſhore, the Grinder of a Man ſo large, that if it had been cut into Teeth of an ordinary Size, at leaſt an Hundred might have been made of it. *Hieronymus Magius* ‖‖, although himſelf very much prejudiced in Favour of the Exiſtence of Giants, yet ſuſpects this Tooth, mentioned by *S. Auſtin*, to have been rather the Tooth of an Elephant, or elſe ſome huge Creature of the Sea, than that of a Man. But *Ludovicus Vives*, in his Commentaries upon that Paſſage of *S. Auſtin*, takes Notice, that in the Church of *S. Chriſtopher* at *Hiſpella*, he was ſhewn a Tooth bigger than his Fiſt, which they pretended was one of the Teeth of that huge Saint, no Doubt, upon as good Ground, as that very large Shoulder-bone,

* In ſuis Heroicis. † Hiſt. Nat. Lib. vii. cap. xvi. ‖ Lib. xvii. ** Dierum Canicularium Colloq. 11. pag. 36. †† De Civit. Dei. Lib. xv. cap. ix. citatus per Caſſanionem & Lambecium. ‖‖ Miſcellaneorum Lib. i. cap. ii. pag. 17.

which

which *Hieronymus Magius* says *, was shewn in a Church at *Venice*, was the Shoulder-bone of *S. Chriſtopher.*

The pretended Skeleton of a Giant, which was found near *Drapani* a Caſtle in *Sicily*, upon digging the Foundation of a Houſe, and is deſcribed by *Joh. Boccatius* †, is again not unlikely to have been the Skeleton of a large Elephant. For although the greateſt Part of the Bones, through the Length of Time, and the Force of the ſubterraneal Steams, were ſo rotten, that after their being expoſed to the Air, they fell to Pieces almoſt upon touching, yet three of the Teeth were found entire, which weighed an hundred Ounces, and were by the Inhabitants of *Drapani* hung up in one of their Churches, to perpetuate the Memory of this Fact. They likewiſe found Part of the Skull capacious enough to hold ſome Buſhels of Corn, and one of the Shank-bones, which was ſo large, that upon comparing it with the Shank-bone of an ordinary Man, it was judged, that this Giant, whom ſome took to be *Erick*, others *Ethellus*, others one of the *Cyclops*, and again others the renowned *Polyphemus* himſelf, muſt have been 200 Cubits high; according to which Calculation, he is figured and repreſented by *F. Kircher* ‖ as by far the largeſt of a whole Gradation of Giants, whom, after this, he Places in the following Order:

	Cubits.
The Giant of *Strabo*, whoſe Skeleton was dug up near *Tingis* in *Mauritania*, and was found to be. — —	60 high.
Pliny's Giant, found in a Mountain in *Creta*: — — —	46.
The Skeleton of *Aſterius*, Son of *Anactes* — — —	10.
The Skeleton of *Oreſtes*, dug up by ſpecial Command of the Oracle — — — — — —	7.
The Giant, whoſe Bones were found under a large Oak, not far from the Convent of *Reyden* in the Canton of *Lucern* in *Switzerland*. — — — — —	9.
Goliath, as deſcribed in Sacred Writs — — — —	6½.

The Caſe is ſtill leſs doubtful with regard to thoſe Bones, which were found in *France* in 1456, in the Reign of *Charles* VII, by the Side of a River in the Barony of *Cruſſole* (afterwards erected into a County not far from *Valence*. *Johannes Marius in Libris de Galliarum Illuſtrationibus*, *Calamæus in ſuis de Biturigibus Commentarijs*, *Fulgoſus* in *his Annals*, & *Joh. Caſſanio* of *Monſtroeuil*, in his Treatiſe of Giants **, ſeverally take Notice of theſe Bones which were ſo large, that the whole Height of the Giant, to whom it was thought they belonged, and who was ſuppoſed to have being the Giant *Briatus*, was conjectured to have been of 15 Cubits. The Skull alone was two Cubits

* L. C. *pag.* 20. 6. † Genealogia degli Dei. L. iv. ad fin. ‖ Mund. Subterran. L. viii. Sect. 2. ** *Pag.* 57. & ſeq.

thick

thick, and the Shoulder-bone six Cubits broad. Some time after, other Bones of this Kind were found in the same Barony near the same Place, Part of which *Cassanio* saw himself, and gives such a particular Description of one of the Teeth, as leaves little Room to doubt, but that it was the Grinder, and consequently the other Bones the Bones of an Elephant. His Words are * *Miræ magnitudinis dentem multa ibidem conspeximus, longitudine unius pedis, pondere librarum octo; multo autem oblongior quam crassus visus est, radicesque aliquot habere quibus gingivæ inhærebat. Visa est insuper ea pars, qua ibus terebatur, aliquantulum concava, latitudine digitorum quatuor.* He adds farther, That such another Tooth was kept at *Gharmes*, a neighbouring Castle, that he measured the Length of the Place, whence these Bones were dug, and found it to be nine Paces; that some Time after more Bones were discovered at the same Place, and that the Country all thereabouts was very mountainous, and such, as the Giants in all Probability delighted to dwell and command in. I have seen some of these Bones brought by a very curious *French* Merchant from this last mentioned Place, which I took to have belonged to an Elephant, by some large Cells between the Tables of the Skull, which are in the Skull of that Animal.

Hieronymus Magius † gives an Account of a very large Skull, eleven Spans in Circumference, and some other Bones, probably belonging to that Skull, which were dug up near *Tunis* in *Africa* by two *Spanish* Slaves, as they were ploughing in a Field. He was informed of this Matter by *Melchior Guilandinus*, who saw the Skull himself, when he had the Misfortune to be taken by the *Rovers*, and carried into Slavery to that Place in the Year 1559. I am the more inclined to believe, that this Skull and Bones was Part of the Skeleton of an Elephant, because, as I shall shew hereafter, a like large Skeleton was dug up near the same Place some Time after, which by one of the Teeth sent to *Peiresk* was made out to have been the Skeleton of an Elephant.

I now come to those Bones, Teeth and Tusks, (or Horns, as some call them) which are mentioned by Authors to have been dug up in divers Parts of the World, and have been made out by them, or do otherwise appear by their Description and Figures, indisputably to belong to the Elephant.

Johannes Goropius Becanus ‖, notwithstanding he lived in an Age, when the Stories of Giants were very much credited, and had found their Advocates, even among Persons eminent for their Learning and Judgment, yet ventured to assert, that the Tooth, which was kept and shewn at *Antwerp*, as the Tooth of that unmerciful Giant, whose Defeat, brought about as they pretended, by *Brabo* a Son of

* *Pag.* 62. † Miscellan. Lib. i. Cap. ii. *pag.* 19. 6. ‖ Originum Antverpianarum Libro. ii. quem Gigantomachiam appellavit, *pag.* 178.

Julius Cæsar, and King of the *Ardaliens*, was fabulously reputed to have given Occasion to the building of that Castle and City, was nothing but the Grinder of an Elephant. However displeasing this Assertion might be, as *Goropius* farther adds, to those who are delighted with such idle and ridiculous Stories; yet to the Judicious it will appear the less surprizing, on Account of what passed not long before he wrote this Book, when the almost entire Skeletons of two Elephants with the Grinders, and likewise the *dentes eburni*, or Tusks, were found near *Wielvorda*, *Vilvorden*, as they were digging a Canal from *Brussels* to the River *Rupel*, to defend that Town and Country from the Incursions of those of *Mechlen*. *Goropius* conjectures, that these Elephants had been brought thither by the *Romans*, at the Time either of the Emperor *Gallien*, or *Posthumus*.

A very large Skeleton, likewise of a Giant, as pretended, was dug up near *Tunis* in *Africa* about the Year 1630, whereof one *Thomas d'Arcos*, who was then at that Place, sent an Account, together with one of the Teeth, to the learned *Peiresk*. The Skull was so large, that it contained eight *Meillerolles* (a Measure of Wine in *Provence*) or one *Modius*; as *Gassendus* calls it *, or a Pint and a Half *Paris* Measure. Some time after a live Elephant having been shewn at *Toulon Peiresk*, ordered that he should be brought to his Country Seat, on Purpose to take that Opportunity to examine the Teeth of the Creature, the Impressions whereof he caused to be taken in Wax, and thereby found, that the pretended Giant's Tooth sent him from *Tunis*, was only the Grinder of an Elephant. This is the Second large Skeleton dug up near *Tunis* in *Africa*, and it appearing plainly by the Tooth sent to *Peiresk*, that it was the Skeleton of an Elephant, it may from thence very probably be conjectured, some other Circumstances concuring, that the other also, which *Guilandinus* saw there, must have been rather of an Elephant, than of a Giant.

Thomas Bartholin † mentions the Grinder, or Maxillar-tooth of an Elephant, which was dug up in *Island*, and sent to him by *Petrus Resenius*. It was turned to a perfect stony Substance, like Flint, as was also the Tusk of a *Rosmarus* dug up in the same Island.

A large Tooth, which by it's Shape appears plainly to be the Grinder of an Elephant, is described and figured by *Lambecius* ‖, who had it out of the Emperor's Library, though he could not be informed where it was found, or how it got thither. It weighed 28 Ounces, and was commonly taken to be the Tooth of a Giant. *Antonius de Pozzis*, chief Physician to the Emperor, in a Letter to *Lambecius* **, affirms it to be an Elephant's Tooth, and conjectures, that it was dug up at *Baden*, about four Miles from *Vienna*, where, but a few

* Gassendus in vita Peiresk. Lib. iv. Anno 1632. † Act. Medic. & Philosoph. Hafn. Tom. I. Obs. xlvi. *pag.* 83. ‖ Biblioth. Cæsar. Vindob. L. VI. *pag.* 311.
** Ib. Lib. vi. *pag.* 325.

Years

Years before he wrote this Letter, they had found alſo the *Os Tibiæ & femoris* of an Elephant.

Another Tooth, probably of an Elephant too, is deſcribed and figured by *Lambecius* *, who had it out of the Emperor's Library. It weighed 23 Ounces, and was found in the Year 1644 at *Krembs*, in the lower *Auſtria*, as they were increaſing the Fortifications of that Place.

The Year following, when the *Swedes* came to beſiege the Town of *Krembs*, a whole Skeleton of a Giant, as was pretended, was found at the Top of a neighbouring Mountain, near an old Tower. The Beſiegers, in their Intrenchments there, being very much incommoded by the Water that came down from Mountains, dug a Ditch three or four Fathoms deep, to lead it another Way. It was in digging this Ditch they found the Skelton aforeſaid, which was very much admired for it's unuſual Size. Many of the Bones, chiefly thoſe of the Head, fell to Pieces upon being expoſed to the Air, others were broke by the Careleſſneſs of the Workmen; ſome eſcaped entire, and were ſent to learned Men in *Poland* and *Sweden*. Among theſe was a Shoulder-bone, with an Acetabulum in it large enough to hold a Cannon-ball. The Head, with Regard to it's Bulk, was compared to a round Table, and the Bones of the Arms (or Forelegs) as thick as a Man of an ordinary Size. One of the Grinders, weighing five Pounds, was given to the *Jeſuits* at *Krembs*: Another is figured by *Happelius* (in his *Relationes Curioſæ*, *Tom.* iv. *pag.* 47, 48.) to whom I am indebted for this Account, and it appears plainly by the Figure of it, that it is an Elephant's Tooth. It weighed four Pounds three Ounces *Nuremburg* Weight.

Again, in *Lambecius* his *Bibliotheca Cæſarea Vindobonenſis* †, are two Figures, and the Deſcription of a very large Elephant's Tooth which weighed 4 ½ Pounds. It was ſent from *Conſtantinople* to *Vienna* in 1678, and offered to be ſold to the Emperor for 2000 *Rixdollars*, having been before, for it's unuſual Size, and pretended great Antiquity, valued at 10,000 *Rixdollars*. They pretended that it was found near *Jeruſalem*, in a ſatious ſubterranean Cavern, in the Grave of a Giant, which had the following Inſcription upon it in the *Chaldaick* Language and Characters; *Here lies the Giant* OG; whence it was conjectured to have been the Tooth of *Og*, King of *Baſan*, who was defeated by *Moſes*, and who *only remained of the Remnants of Giants; whoſe Bed-ſtead was of Iron, nine Cubits was the Length thereof, and four Cubits the Breadth of it, after the Cubit of a Man* ‖. As the whole Story looked very like an Impoſition, the Emperor ordered, that the Tooth ſhould be ſent back again to *Conſtantinople*.

Hieronymus Ambroſius Langenmantel, a Member of the Imperial Academy of Sciences, inſerted into the *Ephemerides* of that Academy

* Ib. Lib. vi. *pag.* 313. † Lib. viii. *pag.* 652. ‖ Deuteronom. Ch. iii. v. 2.

† an

an Abſtract of a Letter to himſelf *, from *Johannes Ciampina* in *Rome* concerning ſome very large Bones, to wit, the Shank-bone, the Shoulder-bone, and five Vertebræ, of the Number whereof was one of the Vertebræ of the Neck, which were dug up near *Vitorchiany*, in the Biſhoprick of *Viterbo*, in the Year 1687. They weighed altogether upwards of 180 *Roman* Pounds, and having been compared with other the like Bones in ſeveral Collections at *Rome*, particularly the *Chiſian* one, they appeared to be by far the largeſt. Moſt People took them to be the Bones of a Giant, but *Ciampina*, and ſome others, taking them, with more Probability, for the Bones of an Elephant, or ſome other large Animal, and knowing that there was in the Medicean Collection at *Florence* a compleat Skeleton of an Elephant, they procured a Copy of it, and found upon Compariſon, the abovementioned Bones ſo exactly to correſpond with it, as to leave no Room to doubt, but that they had been Part of an Elephant's Skeleton.

The Skeleton of an Elephant which was dug up in a Sand-pit near *Tonna* in *Thurengen*, in 1695, is one of the moſt curious and alſo the moſt compleat in it's Kind, foraſmuch as they found the whole Head, with four Grinders, and the two *dentes exerti*, or Tuſks, the Bones of the fore and Hind-legs, one of the Shoulder-bones, the Back-bones, with the Ribs, and ſeveral of the Vertebræ of the Neck. But the whole hath been ſo accurately deſcribed by *Wilhelmus Earneſtus Tentzelius* Hiſtoriographer to the Dukes of *Saxony*, in a Letter to the learned *Magliabechi*, printed in the *Philoſophical Tranſactions* †, that it is needleſs to add any thing, the rather, as that Gentleman was pleaſed to oblige the *Royal Society* with ſome Pieces of the Bones of this Elephant, with Part of the Skull, wherein appeared it's Cells, ſome of the Grinders, and Part of the *dentes exerti*; all which being produced at a Meeting of the *Royal Society*, were found exactly agreeable to his Deſcription, and ordered to be carefully preſerved in their Repoſitory. From the Surface of the Ground down to the Place where theſe Bones were found, the Diſpoſition of the *Strata*, or Layers, was as follows: A black Soil four Foot deep, Gravel two Foot and a Half, the Middle whereof was made up of Oſteocolla, and Stones to the Depth of two Foot, Oſteocolla and Stones half a Foot, a ſandy Clay ſix Foot, with about two Inches of Oſteocolla in the Middle, Oſteocolla and Pebbles one Foot, Gravel ſix Foot, a white and fine Sand, the Depth whereof was unknown, and in this the Bones were found.

In the Second Volume of Count *Marſili*'s *Danubius*, where he treats of the Antiquities he obſerved along this River, there is Mention made of ſeveral Bones and Teeth of Elephants, which that inquiſitive Nobleman met with in *Hungary* and *Tranſylvania*, and which are now

* Decur. ii. Annus vii. 8, 1688. Obſ. cexxxiv. *pag.* 446. † N° 234. *pag.* 737.

in his valuable Collection of Natural and Artificial Curiosities at *Bologna*. According to the best Information, the People of whom he had them could give him, they were found in Rivers, Lakes, and Pools. One of the Vertebræ, a Grinder, and a considerable Part of the *dens exertus*, or Tusk, were found in the Lake, or Pool of *Hiulca*. Two Fragments of the *Os Tibiæ*, a little corroded on the Inside, were taken out of a Pool near *Fogheras* in *Transylvania*, once the Seat of the Princes of that Country; and the whole lower Jaw, with two Grinders as yet sticking in it, he had from some Fishermen, who found it in the standing Waters by the River *Tibiscus*, a little above *Die Romerskantz*, or the *Roman Fort*. All these the Author caused to be figured as big as the Life. I have above related the Opinion of *Goropius* about the Antiquity of those two Elephants, the Skeletons whereof were found near *Vilvorden*, which he traces no higher than the Time of the *Romans*, and their Expeditions into those Countries, particularly under *Galian* and *Posthumus*. Count *Marsili* is of the same Opinion with Regard to those Bones and Teeth found by him in *Transylvania*. He takes Notice, that whosoever is acquainted with the vast Use the *Romans* made of Elephants in their military Expeditions, ought not to be surprized that there are Bones and Teeth found of them in those Northern Countries, where otherwise there cannot have been any; and he urges, as a farther Proof of this Assertion, That they are found in Pools and Lakes, it having been the Custom of the *Romans*, to throw the Carcasses of dead Elephants into the Water, as it is still practised to this Day with the Carcasses of Horses and other beasts, to prevent the Distempers and other Inconveniences, which their Putrefaction might otherwise occasion. On the other Hand, there are many Arguments, taken from the Largeness of the Beasts, the Skeletons whereof are thus found under Ground, which sometimes far exceeds any that was, or could have been brought alive into *Europe*, from the Condition they are found in, and from the particular Disposition of the Strata above the Places where they are found, whereby it appears, almost to a Demonstration, that they must be of much greater Antiquity, and that they cannot have been buried at the Places where they are found or brought thither any otherwise, but by the Force of the Waters of an universal Deluge. To insist only upon one of these Arguments: If the Skeletons of Elephants, which are thus found under Ground, and at considerable Depths too, had been buried there either by the *Romans*, or any other Nation, the Strata above them must necessarily have been broken through and altered; whereas on the contrary, several Observations inform us, that they were found entire, whence it evidently appears, that what is found underneath, must have been lodged there, if not before, at least at the very Time when those Strata were formed; consequently long before the *Romans*. But there is another Argument, which seems to me to bear very hard

againſt the Conjectures of *Goropius* and Count *Marſili*. *Tentzelius* hath already mentioned it, and it is urged from the great Value of Ivory at all Times, and particularly among the *Romans*, which appears by many Paſſages in antient Authors; as for Inſtance, by a very remarkable one in *Pliny* *, who takes Notice, That among the valuable Preſents, which the *Ethiopians* were obliged to make to the Kings of *Perſia*, by Way of a Tribute, there were twenty large Teeth (unqueſtionably the *dentes exerti*) of Elephants, and then adds, *Tanta ebori auctoritas erat*. Now it is to be preſumed, that the *Romans* would not have neglected to take away the Teeth, and particularly the *dentes exerti* of dead Elephants, before they flung their Carcaſſes into the Water, whereas there hath ſcarce been any Skeleton, or any Part of the Skeleton of an Elephant dug up any where, but the Teeth were found along with them, and even among thoſe figured by Count *Marſili*, there are three Grinders, and a conſiderable Part of one of the *dentes exerti*.

Dr *Robert Plott* in his *Natural Hiſtory of* Staffordſhire †, ſays, That he was preſented by *William Leveſon Gower* of *Trentham*, Eſq; with the lower Jaw of ſome Animal, with large Teeth ſticking in it, dug up in a Marle-pit in his Ground, and which upon Compariſon he found exactly agreeable to the lower Jaw of the Elephant's Skull in Mr *Aſhmole's Muſeum* at *Oxford*.

In the *Muſeum* of the *Royal Society* there are two Foſſil-bones of Elephants: One was given by Sir *Thomas Brown* of *Norwich*, the other was brought from *Syria* for the *Os Tibiæ* of a Giant, but Dr *Grew* ‖ proves by an exact Computation, that it can never have been the *Os Tibiæ* of a human Skeleton, by being full twenty times as thick, and but three times as long. It is an *Engliſh* Yard and half a Foot long, and hath a Foot in Circumference, where it is thinneſt. Dr *Grew* obſerves, that by the Figure it appears to have belonged to the Leg, and not to the Thigh, and he conjectures the whole Elephant to have been about five Yards high.

Before I diſmiſs this Subject, I muſt beg Leave to mention a few more. *Geſner* ** takes Notice, that he was preſented by a *Poliſh* Nobleman with a Tooth four times as large as that, which he figured under the Title of *Hippopotamus* in his Book *de Aquatilibus*. It was found under Ground, as they were digging for the Foundation of a Houſe, together with a very large Horn, as they called it, which many took to be an Unicorns's Horn, but wrongly, as he, *Geſner*, thought, becauſe of it's being too thick and too crooked. It is very probable, that this pretended Horn was the *dens exertus* of an Elephant. The ſame Author mentions a ſubterraneous Cavern near *Elbingeroda*, wherein were found the Bones and Teeth of Men and

* Lib. xii. cap. 4. † Ch. vii. §. 78. pag. 78. ‖ Muſæum Reg. Soc. p. 32.
** De Figuris Lapidum, pag. 157.

Animals ſo large, that it was ſcarce credible, that ever any of that bulky Size ſhould have exiſted.

The Grinder of an Elephant, petrified, is kept in the King of *Denmark*'s Cabinet at *Copenhagen*, as appears by the Catalogue *, but there is no Mention made how it came thither, or where it was found.

They ſhew in the ſame Collection a large Thigh-bone, which weighs about twenty *Daniſh* Pounds, and is above three Foot in Length †. It is ſo old, according to the Author of the Catalogue, that it is almoſt become ſtony. The ſame Author takes Notice of another large Bone, then in the Collection of *Otho Sperling*, which weighed 25 Pounds, and was four Foot long. It was, as *Sperling* told him, found in the Year 1643 at *Bruges* in *Flanders*, near the public Priſon, in Preſence of *Bernard de Arauda*, and *Sperling*'s Father, who ſaw the whole Skeleton there, which was of twenty Yards of *Brabant* in Length.

A Piece of Ivory was dug up in a Field on the River *Viſtula*, about ſix Miles from *Warſaw*, which having been ſhewn at *Dantzic* to *Gabriel Rzaczynſki*, Author of the *Natural Hiſtory of* Poland, it ſeemed to him to be the *dens exertus* of an Elephant ‖.

In the Notes upon the laſt Edition of Dr *Herman's Cynoſura Medica*, publiſhed by Dr *Boëcler* of *Straſburg* **, under the Title of *Unicornu Foſſile*, there is Mention made of a remarkable Piece of Foſſil Ivory, or rather of an Elephant's Tooth, in the Hands of *Jaques Samſon de Rathſamhauſen de Ehenweyer*, an *Alſatian* Nobleman. It was found in the *Rhine* upon one of his Eſtates near *Nonneville*, and was three *Paris* Foot, three Inches and a Half long: It had near a Foot at the Baſis in Circumference, where thickeſt, and about eight Inches and a Half at the other Extremity. It was filled within with a Sort of Marle, but the outward Surface was ſtony in ſome Places, and bony in others. The bony Part ſcraped, or burnt, ſmelled like Ivory. The Scrapings boiled made a Sort of Gelly. The Author of the Notes adds, That they find Foſſil Ivory in ſeveral Parts of *Europe*, particularly in the *Schwartzwald* (*Sylva Hercynia*) in *Moravia*, in *Saxony*, and near *Canſtad* in the Dutchy of *Wirtemberg*.

An Account of the Pits for Fullers-Earth *in* Bedfordſhire; *by the Rev. Mr* B. Holloway, *F. R. S.* No. 379. p. 419.

XIV. I went to the *Fullers-Earth* Pits at *Wavendon* near *Wobern*, where there are ſeveral Pits now open; but, as Men were then at work only in one, and I underſtood the Earth was diſpoſed in much the ſame Manner in all, I did not trouble my ſelf to go down into more than that wherein they were then digging; in which I found Things diſpoſed thus.

From the Surface, for about ſix Yards Depth, there are ſeveral Layers of Sands, all reddiſh, but ſome lighter coloured than others,

* Muſ. Regium. Part I. §. vii. No. 109.
† Ibid. Part I. §. i. No. 73.
‖ Rzaczynski Hiſt. Nat. Reg. Polon. pag. 2.
** 1726. 4to. P. iii. pag. 133.

under which there is a thin *Stratum* of red Sand-ſtone, which they break through; and then for the Depth of about ſeven or eight Yards more, you have Sand again, and after that come to the *Fullers-Earth*; the upper Layer of which, being about a Foot deep, they call the *Cledge*; and this is by the Diggers thrown by as uſeleſs, by reaſon of it's too great Mixture with the neighbouring Sand, which covers, and has inſinuated itſelf among it: After which they dig up Earth for Uſe, to the Depth of about eight Feet more, the Matter whereof is diſtinguiſhed into ſeveral Layers, there being commonly about a Foot and an half between one horizontal Fiſſure and another. Of theſe Layers of *Fullers-Earth*, the upper Half, where the Earth breaks itſelf, is tinged red, as it ſeems by the running of Water from the ſandy *Strata* above; and this Part they call the *Crop*; betwixt which and the *Cledge* above mentioned, is a thin Layer of Matter not an Inch in Depth, in Taſte, Colour, and Conſiſtency, not unlike to *Terra Japonica*. The lower half of the Layers of *Fullers-Earth*, they call the *Wall-Earth*; this is untinged with that red above-mentioned, and ſeems to be the more pure and fitter for *Fulling*; and underneath all is a *Stratum* of white rough Stone, of about two Foot thick, which, if they dig through, as they very ſeldom do, they find Sand again, and then is an End of their Works.

One Thing is obſervable in the Site of this Earth, which is, that it ſeems to have every where a pretty equal horizontal Level; becauſe they ſay, that when the Sand-Ridges at the Surface are higher, the *Fullers-Earth* lies proportionably deeper.

In theſe Works they ſeldom undermine the Ground, but as they dig away the Earth below, others are employed to dig and carry off the Surface, otherwiſe, the Matter above, being of ſo light and flitting a Nature, would fall in and endanger the Workmen: For, as was obſerved before, that *Stratum* of Sand-Stone, which occurs before they come to the *Fullers-Earth*, does not lie, as in Coal-Pits, immediately over the Matter they dig for, like a Cieling, but even in the midſt of the ſuperjacent *Strata* of Sand, and therefore can be no Security to them if they undermine.

The perpendicular Fiſſures are frequent, and the Earth in the *Strata*, beſides it's apparent Diſtinction into Layers, like all other Kinds of Matter, by reaſon of it's peculiar Unctuouſneſs, or the running of the adjacent Sand imperceptibly among it, breaks itſelf into Pieces of all Angles and Sizes.

For the Geographical Situation of theſe Pits, they are digged in that Ridge of Sand-Hills by *Woburn*; which near *Oxford* is called *Shotover*; on which lies *Newmarket-Heath* by *Cambridge*, and which extends itſelf from Eaſt to Weſt, every where, at about the Diſtance of eight or ten Miles from the *Chiltern* Hills, which in *Cambridgeſhire* are called *Gog-Magog*; in *Bucks*, and *Oxon*, the *Chiltern* Hills, from the chalky Matter, of which they chiefly conſiſt: which two Ridges

you

you always paſs, in going from *London* into the North, North-Eaſt, or North-Weſt Counties in the Manner I before-mentioned: After which you come into that vaſt Vale, which makes the greater Part of the Midland Counties of *Cambridge*, *Bedford*, *Bucks*, *Northampton*, *Oxford*, and *Glouceſter*, and in which are the Rivers *Cam*, *Ouſe*, *Nen*, *Avon*, *Iſis*, and others; which I take Notice of, becauſe it confirms what you ſay of the regular Diſpoſition of the Earth into like *Strata*, or Layers of Matter, commonly through vaſt Tracts, and from whence I make a Queſtion, whether *Fullers-Earth* may not probably be found in other Parts of the ſame Ridge of Sand-Hills, among other like Matter.

An Account of the Strata *in Coal-Mines*, &c. *By* John Strachey, *Eſq*; *R. R. S.* No. 391. P. 395.

XV. It was ſome Time ſince, that in a Letter to one of the Members of this Society, I gave an Account of the ſeveral *Strata* of Earths and Minerals, found in ſome of the Coal-Works in *Somerſetſhire*, which was printed in *Philoſ. Tranſactions*, N° 360. But there is one great Error in the Print; for whereas I ſaid, that in thoſe Parts they never meet with *Freeſtone* over the Coal; the Printer, by miſtake, calls it *Fireſtone*; whereas *Fireſtone* is always found in thoſe Mines, contrary to the Works in *Staffordſhire*, *Newcaſtle*, and *Scotland*, where *Freeſtone* does, indeed, lie over the Coal. I have farther obſerved the *Strata* of Stone, Clay, and Marle, of the interjacent Hills, where, under the black Marle, lies a ſpongy yellowiſh Earth; all this lies above the red Soil, which I have ſaid is generally the Surface of the Vallies, where the Coal is found. And as this red Mould on the Surface degenerates into Marle or Loom, ſo, towards the North-Weſt, beyond or without the Veins of Coal, about *Winford*, in the ſame County, it turns to Ruddle, or Red-Okre, uſed chiefly for marking of Sheep, and for ground Colours or Priming, inſtead of *Spaniſh* Brown; and often counterfeits Bole Armoniac.

But as I never heard any Coal was found to the Weſt or South of *Mendip-hills*; ſo *Cotſwold*, to the North-Eaſt, and the Chalk-Hills of *Marlborough-Downs* and *Saliſbury Plains*, ſeem to ſet Bounds to the Coal Country, to the Eaſt and South-Eaſt of which *Fig.* 72. may be ſuppoſed a Section from South-Eaſt to North-Weſt, *viz.* from the Dip to the Riſe; and *Fig.* 73. at right Angles, from South-Weſt to North-Eaſt, on the Drift or Level.

Fig. 72.

Fig. 73.

I mention this by way of Correction and Addition to my former Obſervations of the Coal-Works in *Somerſetſhire*. I have ſince had Opportunities to be underground, and view ſeveral Coal-Works in *Scotland* and *Northumberland*, and to obſerve the ſeveral *Strata* there. At *Widdrington* they have four Fathom Clay, then a Seam of Coal, about ſix Inches thick, not worth working; then a white Freeſtone; then an hard Stone, which they call a Whin; then two Fathom of Clay; then a white ſoft Stone; and under that a Vein of Coal three Feet nine Inches thick. This is a ſmall Coal of the ſame Nature, but not ſo good as the *Newcaſtle-Coal* which comes to *London* Market.

Theſe

Theſe Veins dip to the South-Eaſt, one Yard in twenty. Near *Tranent*, in *Eaſt-Lothian* in *Scotland*, the Coal dips alſo to the South-Eaſt, in the ſame Proportion; but at *Baldoe*, in the Pariſh of *Campſy*, three Miles from *Kylſith*, it dips to the North-Eaſt; and at *Madeſtone*, near *Falkirk*, to the ſame Point, and in the ſame Proportion. The *Strata* of Earths and Minerals, at theſe Places, agree very near: They have, as the Ground riſes or falls, one, two, or three, Fathom of Clay; then eleven Fathom of Slate, or Coal-Clives; one Fathom of Limeſtone; under that two Fathom of Slate, Earth and Stone; and then Coal. And all theſe agree in this; that the Pits generally need no Timber, and have a good Roof, which is ſupported by Pillars of Coal, which they leave in the working. At *Baldoe*, the Coal is commonly forty-five Inches thick; and all along for ſome Miles Eaſtward thence, on the Sides of the Hills, are Crops of Coal and Limeſtone; and oftentimes the Tenants ſpit up as much as will ſerve their Turn for a Winter's burning, juſt under the Surface; for there wants a Market, and it is ſcarce worth working for Sale. And to the North-Weſt and North, in the Drift of the Coal in higher Ground, and, conſequently, lying over it, there appear, in the Sides of the Hills, Seams of Spar and Lead, the Drift of which is North-Eaſt, and lies almoſt perpendicular; but what Obliquity there is, pitches to the South-Eaſt: At *Auchenclaugh*, ſix Miles Eaſt from *Kylſith*, there is a Coal eighteen Feet thick; this dips one Foot in three, and is not purſued by reaſon of Water; and for want of a Market, will not quit the Coſt of draining. At *Madeſtone*, the Coal is four Feet and a half thick, above three Fathom and a half deep: They land it (as at many Coalhews in the Country) on Girls Backs. Near *Tranent* are three different Veins wrought: the undermoſt is about eighteen Fathom from the Surface, called the *Splenty Coal*, four Feet and a Half thick; it is a hard but not large Coal, makes a clear and ſtrong Fire; lies ten Fathom under the *main Coal*, which is nine or ten Feet thick, and comes out very large. It's Roof is of Freeſtone under which I walked backward and forward two Hours; but had no Opportunity to make any other Obſervation on the upper Vein, than that it is about four Feet thick, and neither ſo hard or large as the other.

As I have, in *Fig.* 72 and 73. drawn the different *Strata* (which have come to my Obſervation) on a ſuppoſed Plane, as they there lie; in *Fig.* 74 and 75. I protract the ſame in a globular Projection, ſuppoſing the Maſs of the Terraqueous Globe to conſiſt of the foregoing, or perhaps, of ten thouſand other different Minerals, all originally, whilſt in a ſoft and fluid State, tending towards the Center. It muſt mechanically, and almoſt neceſſarily, follow, by the continual Revolution of the crude Maſs from Weſt to Eaſt, like the winding up of a Jack, or rolling up the Leaves of a Paper-Book, that every one of theſe *Strata*, though they each reach the Center, muſt, in ſome

Fig. 72 & 73.

Fig. 74 & 75.

Place

Place or other, appear to the Day; in which Caſe there needs no ſpecific Gravitation to cauſe the lighteſt to be uppermoſt, *&c.* for every one in it's Turn, in ſome Place of the Globe or other, will be uppermoſt; and, were it practicable to ſink to the Center of the Earth, all the *Strata*, that are, would be found in every Part, and according to the Poet, *Ponderibus librata ſuis.* Add to this, that in all Places within my Knowledge, the Obſervation of * another Member of the Society has held good, that the Precipices of all Hills are to the Weſtward, whereas the Aſcent to the Eaſt is more gradual. The farther Enquiry into which I offer to the Curious, who have better Opportunity.

An Account of the Strata *met with in digging for Marle, and of* Horns *found under Ground in* Ireland; *by Mr* James Kelly. No. 394. p. 122.

XVI. Our Marle is found no where but in the Bottoms of low Boggs, where we ſearch for it with Augres, and find it at the depth of ſeven, eight, or nine Foot: This in many Places occaſion great Expence in draining off the Water. When we think to dig for it we chuſe out ſix able Labourers and a Supernumerary; then we cut up a Hole twelve Foot ſquare; becauſe we judge that this Number of Men will manage that Pit in one Day, *viz.* two Men to dig, two Men to throw it up, and two Men to throw it by. The Supernumerary ſupplies Defects in every part, as will be found neceſſary. For the firſt three Foot, we meet with a fuzzy ſort of Earth, that we call *Moſs*, proper to make Turf for Fuel; then we find a *Stratum* of Gravel about half a Foot; under which, for about three Foot more, we find a more kindly Moſs, that would make a more excellent Fuel: This is altogether mixt with Timber, but ſo rotten, that the Spade cuts it as eaſily as it doth the Earth: Under this, for the depth of three Inches, we find Leaves, for the moſt part Oaken, that appear fair to the Eye, but will not bear a Touch. This *Stratum* we find ſometimes interrupted with Heaps of Seed, that ſeem to be Broom or Furze-Seed: Nay, in one Place I ſaw, what appeared to me to be Gooſeberries and Currants: In other Places in the ſame *Stratum* we find Sea-weed, and other things as odd to be at that depth: Under this appears a *Stratum* of blue Clay, of half a Foot thick, fully mixt with Shells; this we look upon to be good Marle, and throw it it up as ſuch: Then appears the right Marle, commonly 2, 3, or 4 Foot deep, and in ſome Places much deeper, which looks like buried Lime, or the Lime that Tanners throw out of their Lime-Pits, only that it is full mixt with Shells: Theſe are ſmall Perriwinkles, ſuch as the *Scots* call *Freſh Water-Wilks*; though there are among them abundance of round red Perriwinkles, ſuch as I have often ſeen thrown out on the Sea-Shore. Among this Marle, and often at the bottom of it, we find very great Horns, which we for want of another Name, call *Elk-Horns* Where they join the Head, they are thick and round; and at that Joining there grows out a

* Dr. *Stukely*

Branch

Branch of about a Foot long, that ſeems to have hung juſt over the Beaſt's Eyes: It grows round above this for about a Foot and ſome odds; then ſpreads broad, which ends in Branches, long and round turning with a ſmall Bend. The Labourers are commonly ſo buſy, that they rarely bring them up whole; yet I have one pretty well, of which I ſend you an *Icon*, done as well as I could, but not ſo nice as I could wiſh. We have alſo found Shanks and other Bones of theſe Beaſts in the ſame Place. *Fig.* 76.

An Account of the ſeveral Strata of Earths and Foſſils found in ſinking the Mineral Wells at Holt. *By the Rev. Mr* Lewis, *Vicar of the Place.* N°. 403. P. 489.

XVII. After they had paſſed the upper Turf, they came to a blue Clay, which held about 3 Foot; then they met with a yellow, brittle Clay, very much like Ochre, uſed by Painters, about two Foot in Thickneſs; and next with a Loam of a looſer Texture, which ſparkled with a kind of Talc, called by the Naturaliſts Selenites, and was intermixed with yellow Ochre. Theſe Selenites, which were plentifully found ſhot in the Clay, were Cryſtals conſiſting of tranſparent, ſhining, brittle Flakes, ſome of a Rhomboidal, others of a Conical Figure, but all Hexaedra or Columns of 6 Sides. They had no ſenſible Taſte of Salt, and the Clay in which they were found was interſperſed with Veins of coloured Earth, of the Colour of Sulphur and Iron Ruſt.

Below this, at about 10 Foot deep, they came to a Bed of Stones, of a large Size and very hard Texture, coated with Flakes of Gypſum of a white and yellowiſh Colour, which run through and divide them as it were by various Membranes into different Cells, all filled with hardened Loam of a grey Colour. Theſe Stones, which were all of an oval Figure, in Shape reſembling Pebbles, weighed from 10 to 60 Pound Weight, and lay all on a Level one by another in the Bed of Clay. Here the Springs come in, and below this the Clay was darker coloured, and interlaid with Small Shells of the Oyſter, Eſcallop, and Muſcle, Kind, and with a few Belemnites curiouſly ſhaped. Here they met with Stones of a very cloſe Texture, which when waſhed ſeemed to be nothing but a Maſs of Shells jumbled and embodied together. And a little lower the Clay produced ſome Lumps of a black, bituminous Sulphur, interlaid with ſome ſmall thin Laminæ, ſeeming to be metalline and bright like the pureſt Silver: Upon firing this ſulphuerous Bitumen on a red-hot Iron, it emitted a blue Flame, and ſtrong Smell like Brimſtone, but the Metal was loſt. From this Account of the different Strata found in ſinking theſe Wells, their Impregnation ſeems to be from Alum, Vitriol of Steel, Ochre and Sulphur, and from an accurate Mixture of all theſe, which no Art can imitate, it ſeems to derive thoſe admirable Qualities with which it is endued.

Some Conjecture may be made of it's Nature and Qualities from the Tinctures it gives upon chymical Experiments: With aſtringent Drugs, as Galls, Oak-Leaves and Balauſtines, it ſometimes tinges Red, inclining to Purple, and ſometimes will not tinge at all: With

volatile Alkalies, as Spirit of Urine, and Sal Ammon. it turns milky, with lixiviate Salts, as Oil of Tartar, per Deliq. *&c.* it riſes in a white Curdle: But acid ſaline Liquors, as Spirit of Salt, Nitre, *&c.* cauſe no Alteration.

A Gallon and Half of this Water being evaporated *ad Siccitatem*, the Reliquiæ weighed 3 Drams, 1 Scruple and 19 Grains, ſome Part of which were white, and ſhot into Striæ like Needles, and others into Priſms.

The neighbouring Country is chiefly a ſtrong Clay; the Quarries produce a very hard Stone, which ſeems to be a Compoſition of Shells cloſely cemented and embodied together, and ſome Marchaſites which abound with Sulphur: In ſinking deep Pits they throw up Stones like Iron Oar, and covered with a ſhining metallic Subſtance and ſerpentine Stones, *&c.* and the ploughed Fields abound with Stones reſembling Shells of the Eſcallop and Cockle Kind, ſtriated with ſome Aſtroites, which are all ſtrong Alkalies, and with Aqua-fortis, or Spirit of Nitre, raiſe a violent Ebullition.

A Deſcription of ſome rare Cryſtals newly diſcovered, by John James Scheuchzer *M. D. F. R. S.* N°. 398. p. 260.

XVIII. In ſummis *Grimſulæ* jugis paucis abhinc annis detecta eſt, nunc exhauſta, in ſaxo medio, cryſtallorum vena, quibus nec majores nec puriores, vidit fortè orbis. Maxima earum pars, ad 60 circiter centenareos, in manibus eſt *D. Friſching* paſtoris *Haſleani*, venales omnes, ſed pretio, quod ex ſequentibus patebit, haud vulgari, quod fortè, præter puritatem, excuſat rara magnitudo. Præcipuarum en, quam nuper ab ipſo expetii poſſeſſore ſeriem!

Num. 1. Duorum vel 2½ centenariorum, longa 2 ped. 9½ dig. Peripheria 3 ped 7½ dig. limpidiſſima, hexagona. Pretium libræ 1½ Ludov. aur.

N. 2 Pondus 136 ℔, longit. 2 ped. 3 dig Peripheria 2 ped. 9 dig. Purpuras quaſdem habet ad marginem, puriſſima cæterùm. Pretium libræ 1 Ludov. aur.

N. 3. Pondus 135 ℔, longit. 2 ped. 4 dig. Peripheria 3 ped. 2 dig. limpidiſſima, excepto apice; pretium libræ 4 Floren.

N. 4. Pondus 96 ℔, longit. 2 ped. Peripheria 2 ped. 9 dig. pretium idem.

Ita deſcendendo pergit ad 10 librarum pondus, qualitatis, proportionis, pretii varii.

Of the Particles and Structure of Diamonds, by Mr Leeuwenhoek *F. R. S.* N°. 374. p. 199.

XIX. Poſtquam inveſtigando compereram Metalla quædam, & ipſas etiam Arenas ex perexiguis ejuſdem materiæ particulis compoſitas eſſe, meditationem meam converti ad Adamantem; ſcilicet num ille etiam ex iſtiuſmodi conſtet particulis, quæ quidem ope microſcopii conſpici poſſint.

Igitur exiguum quendam Adamantem per microſcopium contemplatus, in eâ Adamantis parte quæ polita non erat, & ſplendore carebat, complures particulas oculis obſervavi; & Adamantem ex parvis particulis compoſitum eſſe comperi. Verum cum hæc nondum mihi

mihi ſatisfacerent; Adamantem in fruſta confringere decrevi, ut illum in fragmentis ſuis conſiderarem.

Ergo Adamantem, malleo impoſitum, alio malleo ſemel iterumque percuſſi, qui ſic percuſſus in quatuor aut quinque fruſta diſſiliebat. Quod cum nondum mihi ſatisfaceret, & Adamantem in exiguiſſimas miculas comminuere vellem; fruſtum, quod cæteris majus erat, duplici chartâ circumvolvi, ne quæ Adamantis miculæ diſſiliendo perirent.

Hic ego duritiem Adamantis admiratus ſum: qui multâ vi aliquoties ictus, in quatuor tantum aut quinque fruſta ſine ullis miculis diſſiliebat——

Poſteriora iſta Adamantis fruſtula microſcopio etiam admovi: quæ cum perſpecularer, pene omnia ex minutiſſimis particulis compoſita eſſe comperi. Cum autem fruſtula illa radiis ſolaribus objicerem: quandam quaſi flammulam ex iis emicare videbam, & quidem majorem, quam unquam vidiſſem.

Fruſtulum unum oculis notabam, quod locum fracturæ ſuæ, planæ quidem ac quadratæ, ſoli directe oppoſitum habebat: qui locus, quantum viſu dijudicabam, tribus aut quatuor pilis menti virilis latitudine reſpondebat.

Ex hoc Adamantis fruſtulo tanta aſcendebat copia ardeſcentium flammularum, ut plures eſſe numero quam quadringentas judicarem Flammularum iſtarum nonnullæ, ſed numero paucæ, ſibi erant vicinius junctæ, & reliquis majoris: unde concludebam, ipſas Adamantis particulas illic etiam aliis particulis majores eſſe, vel ordinatius eſſe diſpoſitas.

Exinde oculos converti ad aliud Adamantis fruſtulum, paris circiter magnitudinis cum priori, quod radios ſolares itidem directe excipiebat; & haud paucioribus exiguiſſimæ molis particulis conſtare comperiebam. Ex unâ fruſtuli illius parte eâque circiter dimidiatâ, ſpecies illæ ardeſcentium flammularum etiam exoriebantur, ſed mole minores: in altera medietate flammula quædam cernebatur, aſſidue ſe mobilitans, cum continuâ quadam coruſcatione, quæ ſpeciem habebat debilioris fulgetri.

Cæterum, poſtquam iſta Adamantis fruſtula radiis ſolaribus ſubduxeram, adhuc multiformes rerum ſpecies oculis meis objiciebantur. Inter alia ex ſingulis Adamantis particulis flammula quædam in altum emicare videbatur.

Porro, novem præterea Adamantis fruſtula microſcopio applicata habebam: & in eorum ſeptem particulas illas agnovi, quas ſpeciem flammularum ejaculari dixi. In duobus aliis etiam particulas illas agnoſcere poteram, ex quibus Adamantem compoſitum eſſe ſtatui: ſed illæ planitiem ſuam ita ſoli obverſam habebant, ut plures eodem tempore particulas dignoſcerem.

Mihi autem peramænum erat ſpectaculum, tot intueri imagines flammularum, quæ omnes colorem præferebant coruſcum, & pleræ-

que viridentem. Iſtud autem inſolens mihi viſum eſt, quod ad flammularum quarundam extremitatem talis perciperetur in aëre motus ac vibratio; tanquam ſi flammula adeo illic debilitata foret, ut conſpicua eſſe deſineret. Præ cæteris autem admirabar, quod ex tali Adamantis particulâ circumquaque ignis exiret, debiliter rutilans, ſicuti cum fulmen e longinquo coruſcare videmus. Quod quidem tam crebro intuente me accidebat, ut oculos avertere non poſſem, niſi jam fatigatos.

Verum tam jucundo ſpectaculo ſæpius frui decrevi, & fruſtulum iſtud Adamantis, donec ſponte a vitro: decidat, microſcopio applicatum relinquere. Neque enim ope glutinoſæ alicujus materiæ affixum eſt vitro: niſi quod vitrum, antequam illi fruſtum Adamantis affigerem, humore anhelitus mei irroraſſem.

Cum tam grato ſpectaculo ſolus frui non vellem; quæ modo relata ſunt, legenda tradidi cuidam N cui & microſcopium in manus tradidi. Cumque poſt aliquantum moræ requirerem; nonne omnia deſcriptioni meæ convenire comperirent; ille prorſus convenire reſpondit, & admirationem ſuam ſuper ſpectaculi inſolentiâ confeſſus eſt.

Porro, cum fruſtulum quoddam Adamantis adhuc microſcopio applicatum eſſet, cujus particulas, lamellarum modo ſibi incumbentes, viſu dignoſcere poteram; haud abs re me facturum putavi, ſi lamellas iſtas delineari curarem, quæ denotantur per A B C.

Fig. 77

Deinde & aliud Adamantis fragmentum microſcopio applicaveram, cujus lamellæ, invicem ſuperſtratæ, ſeſe oculis meis diſtinctiſſime

Fig. 78. offerebant; quæ deſignantur per DEFGHIKLM. In hac autem figurâ particulæ illæ ſive lamellæ, per FG, FH, FI, FK, & L denotatæ ſunt, reliquis aliquanto craſſiores eſſe videntur: verum iſtæ particulæ ex pluribus lamellis, invicem ſuperſtratis, ſunt compoſitæ. In iſtâ vero fragmenti parte, quam inter DEFM exprimendam curavi, diſtinctiſſime apparent tenuiſſimæ lamellæ, ex quarum congerie totum Adamantem concretum eſſe pro certo habendum eſt.

Priuſquam ſecundam iconem in chartâ exprimendam curaveram forte celebris Gemmarius, *N. Verbrugge*, ædes meas præteribat; quem ego ad conviſendum Adamantis fragmen, ſicut microſcopio applicatum erat, invitavi. Ille fragmen iſtud non ſine admiratione contemplatus, quaſdam ſe Adamantum glebulas, quæ ſibi inutiles eſſent, mihi miſſuram recepit.

Nec multo poſt bina mihi mittit Adamantum fragmenta: item exiguum Adamantem, ex arte quidem politum, ſed ſordidum, uti vocant, ſeu vitioſum.

Cum ſingula ſingulis microſcopiis applicaſſem, primo fragmentum iſtud, quod per N O P Q R denotatum eſt, delineandum curavi.

Fig. 79. Lineolæ, quæ per totum hoc fragmentum excurrent, revera non ſunt niſi lamellæ, ex quibus Adamantes conſtare modo dixi: & apertius conſpiciendas ſe præbent ad PQ.

Cæterum ut eorum, quæ de hâc Adamantis glebulâ, ſive fruſtulo» jam dixi, clarior atque diſtinctior ſit perceptio; fruſtulum iſtud eâdem prorſus magnitudine exprimi juſſi, quam nudo delineatoris oculo, ſine microſcopii ope, offerebat: quæ vera fruſtuli magnitudo, exhibetur inter S T. Iſtud autem tantillum fruſtulum ex tam multis tamque exiguis particulis compoſitum eſt; ut qui non viderit, capere haud poſſit. *Fig.* 80.

In altero Adamantis fragmento, quod ejuſdem propemodum magnitudinis erat, lamellæ dignoſci poterant: & pars illius circiter quinta conſtabat quinquangulo tam polito, tamquam ſi ex arte lævigatum fuiſſet, niſi quod illi affixus eſſet perexiguus Adamas, qui circiter quartam quinquanguli partem obtegebat; & uti clare viſu agnoſcebam, etiam ex lamellis, ſive particulis lamellarum formam habentibus, concretus erat.

Quantum ad perexiguum iſtum Adamantem; illum quidem ex arte politum, ſed ſordidum ſeu vitioſum eſſe dixi: ſordidos enim vocamus, dum vel ſubflavi ſunt, vel rimis aut lineolis deformes: quamvis nonnullæ hujus Adamantis rimæ atque lineolæ nudis oculis conſpici non poſſent; imo, adhibito etiam microſcopio, viſum pene effugerent.

Exiguus hic Adamas erat quadrangulus: prope unum iſtorum angulorum, intra ipſum Adamantem, varias vidi particulas ab invicem ſejunctas; niſi quod aliquantulum ſeſe attingere viderentur, quod initio inſolens mihi viſum eſt. Particularum iſtarum maxima coloris erat ſubflavi, & altero circiter latior quam craſſior: nec ſplendore cedebat vitro. Reliquis particulis variæ erant figuræ; nonnullis etiam par ſplendor ac primæ: nec pauciores eſſe judicabam quam viginti: licet delineator tantum numerum non expreſſerit.

Iſte conſpectus hanc mihi perſuaſionem induxit; quo tempore materia, Adamantum productrix, vagabatur in aëre; exiguas illas particulas, quæ itidem Adamantes erant, priori quem dixi Adamanti adjacuiſſe: materiam autem adamantinam, quamdiu talis materia aëri inſedit, iſtam Adamantum congeriem paulatim circumveſtiiſſe, & minores Adamantes incluſiſſe majori.

Qua occaſione recordor complures me habuiſſe Cryſtallos montanas figuræ ſexangulæ: in quarum nonnullis quaſi incluſæ jacebant figuræ quædam perexiguæ & oblongæ, coloris ſubcœrulei; ſed tam exiles ut, adhibito etiam optimæ notæ microſcopio, vix agnoſci poſſent.

Porro iſtius Adamantis, quem vitioſum appellavi, veram magnitudinem delineari curavi: quam expreſſam habes inter V & W. *Fig.* 81.

Deinde & perexiguos iſtos Adamantes, qui in majorem Adamantem incluſi exhibentur in icone 81 ſeorſum delineandos curavi; quos deſignatos vides per X Y Z A B C. Ubi per X Y Z denotatur exterius Adamantis latus, quod licet ex arte politum, ope tamen microſcopii conſpectum, colorem tam fuſcum præferebat. *Fig.* 82.

Per

Per ZABCDE isti denotantur exiliſſimi Adamantes; quos in majuſculo Adamante velut incluſos latuiſſe præmonui.

Cum poſtea latus Adamantis in icone 81 expreſſi, cui longe minores Adamantes incluſos fuiſſe mox dicebam, ad microſcopium admoviſſem, Adamantem iſtum variis foraminibus pertuſum eſſe comperi; quæ ego foramina tunc facta eſſe cenſui, quando latus illud poliebatur. Ita nimirum ut exiguiſſimi, quos dixi, Adamantes loca illa prius inſederint, ſed poliendo delapſi foramina illa ſive puteolos produxerint, quæ foramina conſpicua ſunt inter FGH. *Fig.* 83.

Porro exiguum illum Adamantem, inter VW in icone 81 expreſſum, in latus ſuum verteram; & ubi craſſiuſculus erat, novaculum illi aptaveram, ut Adamantem ipſum ictu mallei diffinderem: quod tamen, licet iterato tentanti, non ſucceſſit.

Quare Adamantem chartâ mundâ circumvolutum, imponebam malleo; & alio malleo, crebrius tamen feriendo, diffregi. Poſtquam omnes diffracti Adamantis glebulas diverſis microſcopiis applicaveram; unam, quæ plures quam reliquæ lamellas oculis exhibere videbatur, delineatori effingendam tradidi, quæ denotatur per IKLM. Haud tamen poſſibile delineatori fuit eâdem perfectione glebulam illam exprimere, quâ ſeſe oculis conſpiciendam offerebat. *Fig.* 84.

Cum autem microſcopium, cui fruſtulum illud iconis 84 applicatum erat, diverſum eſſet ab iis microſcopiis, quorum ope alia Adamantis fruſta delineari curaveram; Delineator poſtremum hoc fruſtulum eâ magnitudine expreſſit, quam ſine microſcopio conſpectum oculis offerebat: quæ vero fruſtuli illius magnitudo exhibetur inter NO. *Fig.* 85.

Quædam ex his Adamintum fragmentis, ope microſcopia conſiderata, jucundos præbebant conſpectus: quos etiam nonnullis, talium rerum ſtudioſis, exhibui. Illis autem jucundiſſimum erat, in uno Adamantis fruſtulo tam multiplices agnoſcere partes: imprimis etiam quod lamellæ, ex quibus Adamantes concreti ſunt, in duobus Adamantum fruſtulis valde diſtincte poſſent internoſci; nempe dum lamellæ iſtæ juxta ductum longitudinis oculis objiciebantur.

Exinde ſtudium meum converti ad examen Cryſtalli cujuſdam montanæ, ſex lateribus præditæ, cujus longitudo circiter reſpondebat latitudini duorum digitorum, craſſitudo vero minori digito.

Cryſtallum iſtam in complura fruſta confregi, & fruſta microſcopiis applicavi; diſquirere volens num & illa ex ſuperſtratis ſibi lamellis compoſita eſſent: quâ ratione Adamantes magnitudinem ſuam adeptos eſſe dixi. Sed, tametſi perquiſitionem iſtam ſæpius iteraverim, ne tantillam quidem lamellam in iis deprehendi. Iſtud autem in Cryſtallis, quas quidem præ manibus habebam, plerumque animadverti, in omnibus earum lateribus, quæ numero ſena erant, tranſverſas protendi lineolas, alias aliis ſitu aliquantulum ſuperiores; tamquam ſi illic, increſcentibus Cryſtallis, ortæ productæque fuiſſent: quâ ſu-

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per re, quantumcumque Cryſtallorum numerum ante conſideraverim, atque confregerim, numquam ipſe mihi ſatisfacere potui.

Concerning Diamonds *lately found in* Brazil, *by* Jacob de Caſtro Sarmento, *M. D. and F. R. S.* No. 421. pag. 199

XX. Having an Opportunity of diſcourſing with a Gentleman recommended to me, that came from the Gold Mines in *Brazil* belonging to the King of *Portugal*, and brought many Diamonds of conſiderable Value, lately found in thoſe Places, I thought proper to deſire of him an Account of the ſame, being the fitteſt Perſon to deſcribe every minute Circumſtance of it, as one that has lived, and digged Gold there for theſe fifteen Years laſt paſt; and he having obliged me with the ſaid Acount, in the *Portugueze* Tongue I think it will not be unacceptable to the Society, to offer the Tranſlation of it, which is as follows:

In the Prince's Town, Capital of the County *do Serro do Frio*, belonging to the Government of the Gold Mines, there is a Place near the ſaid Town called by the Natives *Cay the Merin*, where they uſed to dig Gold for many Years, as alſo from a ſmall River called *do Milho Verde*. The Miners that digged Gold in thoſe Places did turn up the Ground and Sands of the Banks of the ſaid River, to extract the Gold therefrom, and by ſo doing found ſeveral Diamonds, which then they did not prize as ſuch; for ſome of the Miners kept ſeveral Stones for their Figure and Curioſity, which Stones (though ſo valuable) by Length of Time they neglected and loſt, and did the ſame till the Year 1728, at which Time one of the Miners lately coming to work there, and better acquainted, deemed them to be Diamonds, made Experiments upon them, and finding them really ſo, began to ſeek for them in the ſame Ground and Sand, where the former Miners had ignorantly left them, ſo did the reſt of the People follow his Example.

After they had thoroughly examined the Places aforeſaid, they began to ſearch for them in the River itſelf, and do actually find Diamonds there, but with more Trouble and Difficulty; for in the former Places they found them together among the Earth and Sand, as they lay; but in the River, as the Sand is more diſperſed, they lie farther from one another.

Experience and common Reaſon teaches the People there, that theſe Diamonds came from another Place by the Current of the Waters, and are not the natural Product of the Situation where they now are found.

They are uſing all poſſible Diligence to find out the Place where they grow. They have not yet diſcovered it; but their great Hopes are very much encouraged upon the Account of having near the ſaid Situation ſeveral Mountains, where nothing is to be ſeen but fine ſolid Cryſtal Rocks.

The Diamonds that have been found, are commonly from one Grain to ſix Carrats, ſome larger, and among theſe one of forty-five Carrats. The Colour, Solidity, and reſt of their Properties are the

ſame

ſame as the Oriental ones; only it was obſerved, that thoſe Diamonds that lay more ſuperficially, and expoſed to the Air and Sun were more ſcurfy, and by Conſequence loſt more by poliſhing than the other.

An Account of a Leaf of a Plant impreſſed in a piece of Amber, *by* Joh. Philip Breynius, *M. D. F. R. S.* N°. 395. p. 154.

XXI. Inter Corpora Naturalia Succinis à Natura incluſa, illa longe rariſſima eſſe, quæ Vegetabili Regno ſuam debent originem, conſitebitur mecum, opinor, quicunque Naturæ Curioſorum Pinacothecas, inque iis Succineas Gazas, non levem ipſis conciliantes ſplendorem, accuratius inſpexerit, Authoreſque de his rebus tractantes diligentius excuſſerit. Hæc inter autem cæteris Plantarum perfectiorum partes, ut folia, ſeminum receptacula, flores, ſi qui inveniuntur, &c. raritatis palmam præripiunt.

Hujus rei ratio proculdubio eſt, quod ex recentiorum mente, Succinorum officina naturalis, loca ſint ſubterranea, quorſum partes Vegetabilium, utpote terræ ſuperficiem inhabitantium, ægre & non niſi caſu, eoque rariſſimo pertingere poſſunt; cum Inſecta, quamvis etiam in aëre viventia, tamen, ut ſe à frigore, aliiſque aëris injuriis defendant vel alia etiam de cauſa, ſponte ſæpius rimas, hiatus & cryptas quærant & ſubeant ſubterraneas, & ad ſepulchrum properent, ubi à Succino adhuc liquido irretiuntur, involvuntur, ſuffocantur, cumque eodem in ævum duratura rigeſcunt.

Ejuſmodi glebam, quæ folium hujus notæ in ſinu ſuo fovebat, nuper Menſe Octobri præterito mihi exhibuit & examini ſubjecit meo hic *Gedani* Mercator quidam natione *Brittannus*, *Philippus Benlows*, qui eandem, inter alia Succina nactus, maximi, imo pluris quam triginta aureorum æſtimabat.

Fig. 86. Hæc ovalis ferme, ſed compreſſæ erat figuræ & magnitudinis quæ in Icone exprimitur, quartam Unciæ partem craſſitie æquans, illius generis, quod ſalernum, à ſimilitudine vini, ſalutatur Succinum, & quidem ſatis perſpicua & pura, neque vel leviſſima fraudis macula conſpurcata. Includebat per totam ejus mediam longitudinem exporrectum Folium aliquod Botanicis pennatum, quibuſdam etiam alatum quamvis minus recte, dictum; quod eleganti ſane ſpectaculo, obſcurum quidem, ſed aureo colore coruſcans, à reflectione & refractione radiorum luminis, oculis ſpectantium clare ſeſe offerebat. Folium hoc non integrum, ſed utraque extremitate mutilatum erat, ut ipſa indicat figura, quinque conſtans foliolorum oblongorum, utrinque non nihil acuminatorum paribus ſ. conjugationibus, quorum quædam erant ex parte exeſa & mutila, in coſta communi æque fere à ſe invicem diſtantibus. Situm erat in plano horizontali, quod in eo foliorum genere familiare eſt, præterquam, quod foliola obliquitate aliquantulum ab eo deflecterent; nequaquam vero conjugationes foliolorum decuſſatim poſitæ vel ullo modo videbantur, quod in foliis, quæ conjugata Botanicis dicuntur, ſemper obtinent; ut adeo folium hoc ex compoſitorum pennatorum genere eſſe, nullum mihi amplius reſtet dubium. Cujus autem exacte Plantæ ſpeciei ſit determinare

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vix licet; quia multæ ſpecies hujus familiæ, foliis veſtiuntur ſibi adeo ſimilibus, ut etiamſi recentia, difficile ſit à ſe invicem diſtinguere; accedit, quod nec venulæ foliolorum, vel oculis Microſcopio armatis appareant, utpote quæ à Succino olim liquido obliteratæ & quaſi incruſtatæ erant. Quam proxime autem accedit ad Securidacæ ſecundæ, *Cluſii*, ſ. Coronillæ herbaceæ, &c. *Tournefortii*, quæ in dumetis *Pruſſiæ* ſatis familiaris eſt. Ab altera parte, inter bina foliola, aranea ſatis clare conſpicitur; ab altera vero parvula muſca, ſed hæc non niſi oculo lente armato.

Non memini me apud ullum Authorem folii hujuſmodi in Succino pennati inveniſſe mentionem, præterquam apud *Michaëlem Mercatum* in nobili iſto opere Metallothecæ Vaticanæ titulo inſcripto, & immortalibus Archiatri Pontificii *Johannis Mariæ Lanciſii* meritis à ſitu, oblivione & interitu liberato. Ubi, pag. 89. inter alias elegantium glebarum Ranam, Piſciculum, Lacertulam variaque Inſecta continentium Icones, una etiam reperitur, quæ folium ejuſmodi pennatum paulo minus, ſed ob integritatem rarius & elegantius, octo conjugationum, foliolo extremo impari coſtam claudente, includit; quod parvum & tenellum Coronillæ herbaceæ, flore vario, *Tournefortii*, folium egregie exprimit, quamvis etiam non male ad Onobrychidem ſecundam, *Cluſii*, quæ pariter *Pruſſiæ* indigena eſt, referri poſſet.

Idem *Mercatus* aliam ibidem delineat glebam parvo in tenui ſegmenta diſſecto folio, plantæ cujuſdam, forte umbelliferæ, impregnatam.

Interim tamen cum glebas memoratas, in laudato *Mercati* libro ſaltem, ſummo licet ſtudio delineatas, non vero ipſas viderim, præterea figuræ Ranæ majoris, Lacertulæ & Piſciculi, non levem mihi artificioſæ fraudis excitent ſuſpicionem, ego equidem pro genuitate earum vadium in me ſuſcipere nollem; quia notum eſt affatim, Artifices, ejuſmodi res adeo artificioſe Succinis poſſe includere, iiſque non nimium Curioſis imponere, ut non niſi ab expertiſſimis & oculatiſſimis poſſit detegi fucus.

An Account of the Imperial Salt works of Sóowár *in* Upper Hungary; *tranſlated from the* High-dutch *of* Erneſt Bruckman, *of the Academy of* Brunſwick, *M. D. communicated by Sir* Hans Sloane, *Bar. Pref. R. S.* No. 413. pag. 260.

XXII. *Sóowár* is an *Hungarian* Word (which ſignifies in *German* Salt-Burg) compoſed of *So*, which is to ſay Salt, and *Wa*, which ſignifieth Burg or Town. It is a large Village, about a Quarter of a Mile from *Eper*, a City of the County of *Saár* entirely peopled with Officers of the Exciſe, and Miners or Wood-cutters, and is ſituated on the Summit of a little Hill, with an agreeable Proſpect.

The 16th of *July* 1724, we came from *Roſenaw* to *Sóowár* with Dr *Poëkin*, Phyſician to the City and County, to view this celebrated Salt-work, which furniſhes the fineſt and moſt pure Salt of the whole Kingdom. We communicated our Intention to an Officer of the Salt-works, and having aſked his Leave to go into the Cuts, he gave us two Guards for Guides. We firſt deſcended with them into the Well by a Rope, ſeated on *Leathern Dogs* (as they term it) about forty Fathom deep; after which we again deſcended one hundred Fathom

Animals ſo large, that it was ſcarce credible, that ever any of that bulky Size ſhould have exiſted.

The Grinder of an Elephant, petrified, is kept in the King of *Denmark*'s Cabinet at *Copenhagen*, as appears by the Catalogue *, but there is no Mention made how it came thither, or where it was found.

They ſhew in the ſame Collection a large Thigh-bone, which weighs about twenty *Daniſh* Pounds, and is above three Foot in Length †. It is ſo old, according to the Author of the Catalogue, that it is almoſt become ſtony. The ſame Author takes Notice of another large Bone, then in the Collection of *Otho Sperling*, which weighed 25 Pounds, and was four Foot long. It was, as *Sperling* told him, found in the Year 1643 at *Bruges* in *Flanders*, near the public Priſon, in Preſence of *Bernard de Arauda*, and *Sperling*'s Father, who ſaw the whole Skeleton there, which was of twenty Yards of *Brabant* in Length.

A Piece of Ivory was dug up in a Field on the River *Viſtula*, about ſix Miles from *Warſaw*, which having been ſhewn at *Dantzic* to *Gabriel Rzaczynſki*, Author of the *Natural Hiſtory of* Poland, it ſeemed to him to be the *dens exertus* of an Elephant ‖.

In the Notes upon the laſt Edition of Dr *Herman's Cynoſura Medica*, publiſhed by Dr *Boëcler* of *Straſburg* **, under the Title of *Unicornu Foſſile*, there is Mention made of a remarkable Piece of Foſſil Ivory, or rather of an Elephant's Tooth, in the Hands of *Jaques Samſon de Rathſambauſen de Ehenweyer*, an *Alſatian* Nobleman. It was found in the *Rhine* upon one of his Eſtates near *Nonneville*, and was three *Paris* Foot, three Inches and a Half long: It had near a Foot at the Baſis in Circumference, where thickeſt, and about eight Inches and a Half at the other Extremity. It was filled within with a Sort of Marle, but the outward Surface was ſtony in ſome Places, and bony in others. The bony Part ſcraped, or burnt, ſmelled like Ivory. The Scrapings boiled made a Sort of Gelly. The Author of the Notes adds, That they find Foſſil Ivory in ſeveral Parts of *Europe*, particularly in the *Schwartzwald* (*Sylva Hercynia*) in *Moravia*, in *Saxony*, and near *Canſtad* in the Dutchy of *Wirtemberg*.

An Account of the Pits for Fullers-Earth *in* Bedfordſhire; *by the Rev. Mr* B. Holloway, *F. R. S.* No. 379. p. 419.

XIV. I went to the *Fullers-Earth* Pits at *Wavendon* near *Wobern*, where there are ſeveral Pits now open; but, as Men were then at work only in one, and I underſtood the Earth was diſpoſed in much the ſame Manner in all, I did not trouble my ſelf to go down into more than that wherein they were then digging; in which I found Things diſpoſed thus.

From the Surface, for about ſix Yards Depth, there are ſeveral Layers of Sands, all reddiſh, but ſome lighter coloured than others,

* Muſ. Regium. Part I. §. vii. No. 109.
† Ibid. Part I. §. i. No. 73.
‖ Rzaczynski Hiſt. Nat. Reg. Polon. pag. 2.
** 1726. 4to. P. iii. pag. 133.

under which there is a thin *Stratum* of red Sand-ſtone, which they break through; and then for the Depth of about ſeven or eight Yards more, you have Sand again, and after that come to the *Fullers-Earth*; the upper Layer of which, being about a Foot deep, they call the *Cledge*; and this is by the Diggers thrown by as uſeleſs, by reaſon of it's too great Mixture with the neighbouring Sand, which covers, and has inſinuated itſelf among it: After which they dig up Earth for Uſe, to the Depth of about eight Feet more, the Matter whereof is diſtinguiſhed into ſeveral Layers, there being commonly about a Foot and an half between one horizontal Fiſſure and another. Of theſe Layers of *Fullers-Earth*, the upper Half, where the Earth breaks itſelf, is tinged red, as it ſeems by the running of Water from the ſandy *Strata* above; and this Part they call the *Crop*; betwixt which and the *Cledge* above mentioned, is a thin Layer of Matter not an Inch in Depth, in Taſte, Colour, and Conſiſtency, not unlike to *Terra Japonica*. The lower half of the Layers of *Fullers-Earth*, they call the *Wall-Earth*; this is untinged with that red above-mentioned, and ſeems to be the more pure and fitter for *Fulling*; and underneath all is a *Stratum* of white rough Stone, of about two Foot thick, which, if they dig through, as they very ſeldom do, they find Sand again, and then is an End of their Works.

One Thing is obſervable in the Site of this Earth, which is, that it ſeems to have every where a pretty equal horizontal Level; becauſe they ſay, that when the Sand-Ridges at the Surface are higher, the *Fullers-Earth* lies proportionably deeper.

In theſe Works they ſeldom undermine the Ground, but as they dig away the Earth below, others are employed to dig and carry off the Surface, otherwiſe, the Matter above, being of ſo light and flitting a Nature, would fall in and endanger the Workmen: For, as was obſerved before, that *Stratum* of Sand-Stone, which occurs before they come to the *Fullers-Earth*, does not lie, as in Coal-Pits, immediately over the Matter they dig for, like a Cieling, but even in the midſt of the ſuperjacent *Strata* of Sand, and therefore can be no Security to them if they undermine.

The perpendicular Fiſſures are frequent, and the Earth in the *Strata*, beſides it's apparent Diſtinction into Layers, like all other Kinds of Matter, by reaſon of it's peculiar Unctuouſneſs, or the running of the adjacent Sand imperceptibly among it, breaks itſelf into Pieces of all Angles and Sizes.

For the Geographical Situation of theſe Pits, they are digged in that Ridge of Sand-Hills by *Woburn*; which near *Oxford* is called *Shotover*; on which lies *Newmarket-Heath* by *Cambridge*, and which extends itſelf from Eaſt to Weſt, every where, at about the Diſtance of eight or ten Miles from the *Chiltern* Hills, which in *Cambridgeſhire* are called *Gog-Magog*; in *Bucks*, and *Oxon*, the *Chiltern* Hills, from the chalky Matter, of which they chiefly conſiſt: which two Ridges

you

you always paſs, in going from *London* into the North, North-Eaſt, or North-Weſt Counties in the Manner I before-mentioned: After which you come into that vaſt Vale, which makes the greater Part of the Midland Counties of *Cambridge*, *Bedford*, *Bucks*, *Northampton*, *Oxford*, and *Glouceſter*, and in which are the Rivers *Cam*, *Ouſe*, *Nen*, *Avon*, *Iſis*, and others; which I take Notice of, becauſe it confirms what you ſay of the regular Diſpoſition of the Earth into like *Strata*, or Layers of Matter, commonly through vaſt Tracts, and from whence I make a Queſtion, whether *Fullers-Earth* may not probably be found in other Parts of the ſame Ridge of Sand-Hills, among other like Matter.

An Account of the Strata *in Coal-Mines*, &c. *By* John Strachey, *Eſq*; *F. R. S.* No. 391. p. 395.

XV. It was ſome Time ſince, that in a Letter to one of the Members of this Society, I gave an Account of the ſeveral *Strata* of Earths and Minerals, found in ſome of the Coal-Works in *Somerſetſhire*, which was printed in *Philoſ. Tranſactions*, N° 360. But there is one great Error in the Print; for whereas I ſaid, that in thoſe Parts they never meet with *Freeſtone* over the Coal; the Printer, by miſtake, calls it *Fireſtone*; whereas *Fireſtone* is always found in thoſe Mines, contrary to the Works in *Staffordſhire*, *Newcaſtle*, and *Scotland*, where *Freeſtone* does, indeed, lie over the Coal. I have farther obſerved the *Strata* of Stone, Clay, and Marle, of the interjacent Hills, where, under the black Marle, lies a ſpongy yellowiſh Earth; all this lies above the red Soil, which I have ſaid is generally the Surface of the Vallies, where the Coal is found. And as this red Mould on the Surface degenerates into Marle or Loom, ſo, towards the North-Weſt, beyond or without the Veins of Coal, about *Winford*, in the ſame County, it turns to Ruddle, or Red-Okre, uſed chiefly for marking of Sheep, and for ground Colours or Priming, inſtead of *Spaniſh* Brown; and often counterfeits Bole Armoniac.

But as I never heard any Coal was found to the Weſt or South of *Mendip-hills*; ſo *Cotſwold*, to the North-Eaſt, and the Chalk-Hills of *Marlborough-Downs* and *Saliſbury Plains*, ſeem to ſet Bounds to the Coal Country, to the Eaſt and South-Eaſt of which *Fig.* 72. may be ſuppoſed a Section from South-Eaſt to North-Weſt, *viz.* from the Dip to the Riſe; and *Fig.* 73. at right Angles, from South-Weſt to North-Eaſt, on the Drift or Level.

Fig. 72.

Fig. 73.

I mention this by way of Correction and Addition to my former Obſervations of the Coal-Works in *Somerſetſhire*. I have ſince had Opportunities to be underground, and view ſeveral Coal-Works in *Scotland* and *Northumberland*, and to obſerve the ſeveral *Strata* there. At *Widdrington* they have four Fathom Clay, then a Seam of Coal, about ſix Inches thick, not worth working; then a white Freeſtone; then an hard Stone, which they call a Whin; then two Fathom of Clay; then a white ſoft Stone; and under that a Vein of Coal three Feet nine Inches thick. This is a ſmall Coal of the ſame Nature, but not ſo good as the *Newcaſtle-Coal* which comes to *London* Market.

Theſe

Theſe Veins dip to the South-Eaſt, one Yard in twenty. Near *Tranent*, in *Eaſt-Lothian* in *Scotland*, the Coal dips alſo to the South-Eaſt, in the ſame Proportion; but at *Baldoe*, in the Pariſh of *Campſy*, three Miles from *Kylſith*, it dips to the North-Eaſt; and at *Madeſtone*, near *Falkirk*, to the ſame Point, and in the ſame Proportion. The *Strata* of Earths and Minerals, at theſe Places, agree very near: They have, as the Ground riſes or falls, one, two, or three, Fathom of Clay; then eleven Fathom of Slate, or Coal-Clives; one Fathom of Limeſtone; under that two Fathom of Slate, Earth and Stone; and then Coal. And all theſe agree in this; that the Pits generally need no Timber, and have a good Roof, which is ſupported by Pillars of Coal, which they leave in the working. At *Baldoe*, the Coal is commonly forty-five Inches thick; and all along for ſome Miles Eaſtward thence, on the Sides of the Hills, are Crops of Coal and Limeſtone; and oftentimes the Tenants ſpit up as much as will ſerve their Turn for a Winter's burning, juſt under the Surface; for there wants a Market, and it is ſcarce worth working for Sale. And to the North-Weſt and North, in the Drift of the Coal in higher Ground, and, conſequently, lying over it, there appear, in the Sides of the Hills, Seams of Spar and Lead, the Drift of which is North-Eaſt, and lies almoſt perpendicular; but what Obliquity there is, pitches to the South-Eaſt: At *Auchenclaugh*, ſix Miles Eaſt from *Kylſith*, there is a Coal eighteen Feet thick; this dips one Foot in three, and is not purſued by reaſon of Water; and, for want of a Market, will not quit the Coſt of draining. At *Madeſtone*, the Coal is four Feet and a half thick, above three Fathom and a half deep: They land it (as at many Coalhews in the Country) on Girls Backs. Near *Tranent* are three different Veins wrought: the undermoſt is about eighteen Fathom from the Surface, called the *Splenty Coal*, four Feet and a Half thick; it is a hard but not large Coal, makes a clear and ſtrong Fire; lies ten Fathom under the *main Coal*, which is nine or ten Feet thick, and comes out very large. It's Roof is of Freeſtone under which I walked backward and forward two Hours; but had no Opportunity to make any other Obſervation on the upper Vein, than that it is about four Feet thick, and neither ſo hard or large as the other.

As I have, in *Fig.* 72 and 73. drawn the different *Strata* (which have come to my Obſervation) on a ſuppoſed Plane, as they there lie; in *Fig.* 74 and 75. I protract the ſame in a globular Projection, ſuppoſing the Maſs of the Terraqueous Globe to conſiſt of the foregoing, or perhaps, of ten thouſand other different Minerals, all originally, whilſt in a ſoft and fluid State, tending towards the Center. It muſt mechanically, and almoſt neceſſarily, follow, by the continual Revolution of the crude Maſs from Weſt to Eaſt, like the winding up of a Jack, or rolling up the Leaves of a Paper-Book, that every one of theſe *Strata*, though they each reach the Center, muſt, in ſome Place

Fig. 72 & 73.

Fig. 74 & 75.

Place or other, appear to the Day; in which Caſe there needs no ſpecific Gravitation to cauſe the lighteſt to be uppermoſt, *&c.* for every one in it's Turn, in ſome Place of the Globe or other, will be uppermoſt; and, were it practicable to ſink to the Center of the Earth, all the *Strata*, that are, would be found in every Part, and according to the Poet, *Ponderibus librata ſuis.* Add to this, that in all Places within my Knowledge, the Obſervation of * another Member of the Society has held good, that the Precipices of all Hills are to the Weſtward, whereas the Aſcent to the Eaſt is more gradual. The farther Enquiry into which I offer to the Curious, who have better Opportunity.

An Account of the Strata *met with in digging for Marle, and of* Horns *found under Ground in* Ireland; *by Mr* James Kelly. No. 394. p. 122.

XVI. Our Marle is found no where but in the Bottoms of low Boggs, where we ſearch for it with Augres, and find it at the depth of ſeven, eight, or nine Foot: This in many Places occaſion great Expence in draining off the Water. When we think to dig for it we chuſe out ſix able Labourers and a Supernumerary; then we cut up a Hole twelve Foot ſquare; becauſe we judge that this Number of Men will manage that Pit in one Day, *viz.* two Men to dig, two Men to throw it up, and two Men to throw it by. The Supernumerary ſupplies Defects in every part, as will be found neceſſary. For the firſt three Foot, we meet with a fuzzy ſort of Earth, that we call *Moſs*, proper to make Turf for Fuel; then we find a *Stratum* of Gravel about half a Foot; under which, for about three Foot more, we find a more kindly Moſs, that would make a more excellent Fuel: This is altogether mixt with Timber, but ſo rotten, that the Spade cuts it as eaſily as it doth the Earth: Under this, for the depth of three Inches, we find Leaves, for the moſt part Oaken, that appear fair to the Eye, but will not bear a Touch. This *Stratum* we find ſometimes interrupted with Heaps of Seed, that ſeem to be Broom or Furze-Seed: Nay, in one Place I ſaw, what appeared to me to be Gooſeberries and Currants: In other Places in the ſame *Stratum* we find Sea-weed, and other things as odd to be at that depth: Under this appears a *Stratum* of blue Clay, of half a Foot thick, fully mixt with Shells; this we look upon to be good Marle, and throw it it up as ſuch: Then appears the right Marle, commonly 2, 3, or 4 Foot deep, and in ſome Places much deeper, which looks like buried Lime, or the Lime that Tanners throw out of their Lime-Pits, only that it is full mixt with Shells: Theſe are ſmall Perriwinkles, ſuch as the *Scots* call *Freſh Water-Wilks*; though there are among them abundance of round red Perriwinkles, ſuch as I have often ſeen thrown out on the Sea-Shore. Among this Marle, and often at the bottom of it, we find very great Horns, which we for want of another Name, call *Elk-Horns* Where they join the Head, they are thick and round; and at that Joining there grows out a

* Dr. *Stukely*

Branch

Branch of about a Foot long, that ſeems to have hung juſt over the Beaſt's Eyes: It grows round above this for about a Foot and ſome odds; then ſpreads broad, which ends in Branches, long and round turning with a ſmall Bend. The Labourers are commonly ſo buſy, that they rarely bring them up whole; yet I have one pretty well, of which I ſend you an *Icon*, done as well as I could, but not ſo nice as I could wiſh. We have alſo found Shanks and other Bones of theſe Beaſts in the ſame Place. *Fig.* 76.

An Account of the ſeveral Strata of Earths and Foſſils found in ſinking the Mineral Wells at Holt. *By the Rev. Mr* Lewis, *Vicar of the Place.* N°. 403. p. 489.

XVII. After they had paſſed the upper Turf, they came to a blue Clay, which held about 3 Foot; then they met with a yellow, brittle Clay, very much like Ochre, uſed by Painters, about two Foot in Thickneſs; and next with a Loam of a looſer Texture, which ſparkled with a kind of Talc, called by the Naturaliſts Selenites, and was intermixed with yellow Ochre. Theſe Selenites, which were plentifully found ſhot in the Clay, were Cryſtals conſiſting of tranſparent, ſhining, brittle Flakes, ſome of a Rhomboidal, others of a Conical Figure, but all Hexaedra or Columns of 6 Sides. They had no ſenſible Taſte of Salt, and the Clay in which they were found was interſperſed with Veins of coloured Earth, of the Colour of Sulphur and Iron Ruſt.

Below this, at about 10 Foot deep, they came to a Bed of Stones, of a large Size and very hard Texture, coated with Flakes of Gypſum of a white and yellowiſh Colour, which run through and divide them as it were by various Membranes into different Cells, all filled with hardened Loam of a grey Colour. Theſe Stones, which were all of an oval Figure, in Shape reſembling Pebbles, weighed from 10 to 60 Pound Weight, and lay all on a Level one by another in the Bed of Clay. Here the Springs come in, and below this the Clay was darker coloured, and interlaid with Small Shells of the Oyſter, Eſcallop, and Muſcle, Kind, and with a few Belemnites curiouſly ſhaped. Here they met with Stones of a very cloſe Texture, which when waſhed ſeemed to be nothing but a Maſs of Shells jumbled and embodied together. And a little lower the Clay produced ſome Lumps of a black, bituminous Sulphur, interlaid with ſome ſmall thin Laminæ, ſeeming to be metalline and bright like the pureſt Silver: Upon firing this ſulphuerous Bitumen on a red-hot Iron, it emitted a blue Flame, and ſtrong Smell like Brimſtone, but the Metal was loſt. From this Account of the different Strata found in ſinking theſe Wells, their Impregnation ſeems to be from Alum, Vitriol of Steel, Ochre and Sulphur, and from an accurate Mixture of all theſe, which no Art can imitate, it ſeems to derive thoſe admirable Qualities with which it is endued.

Some Conjecture may be made of it's Nature and Qualities from the Tinctures it gives upon chymical Experiments: With aſtringent Drugs, as Galls, Oak-Leaves and Balauſtines, it ſometimes tinges Red, inclining to Purple, and ſometimes will not tinge at all: With

XX. Hoc non obſtante, argentum nativum ſuper Cobaltum non rarò reperitur, quod verò non aliud, quam hoc arguit, mineram illam argenti non incongruam eſſe matricem.

The Method of making Tin-Plates, *extracted from the Memoirs of the Academy of Sciences, for the Year* 1725, *by* William Rutty, *M. D. R. S. Secr.* No. 406. p. 630.

XXIV. The making of Tin-plates or Latten, as it is called, being not commonly practiſed in *England*, though there is ſo great a Conſumption of it, either becauſe the Method is not ſufficiently known, or becauſe that in Uſe to make ſmall Quantities for particular Purpoſes is much too dear to anſwer the Artificer's Expectation in making larger, whereby we are obliged to export our own Tin to *Germany*, to receive it back again *manufactured*; I thought it not improper to lay before the Society the Method the *Germans* themſelves make uſe of, as I have extracted it from a Diſſertation of Mr *De Reaumur*, printed in the laſt Volume of the Memoirs of the Academy of Sciences of *Paris*, in which alſo he lays down ſome Improvements, as he thinks, of his own.

He takes notice then that the making of Tin-plates, (which is called in *France*, *white Iron*) does not properly begin, till they go about to prepare the Leaves or Plates of Iron that are to be tinned, which are ſuppoſed to be ſufficiently thin and flat, and cut into Squares; But there are only certain Sorts of Iron which can be reduced into theſe Leaves, of which thoſe are the moſt proper, that when heated are eaſieſt extendible, and yet can be forged with a Hammer when cold; the more ſoft and extremely flexible, as well as the more brittle being to be rejected. Theſe Leaves are drawn from Bars of Iron, about an Inch ſquare; which being made a little flat, they cut into thin Pieces or Soles (*ſemelles*) which they fold together, and having made them into Parcels containing forty Leaves each, beat them all at once with a Hammer that weights from 600 to 700 ℔. After this, the principal Part of the whole Art is to prepare theſe Leaves; for the lighteſt Duſt, or the leaſt Ruſt upon their Surface will prevent the Tin from uniting with them. This may indeed be taken off by filling, but that being much too expenſive, the ſame may be brought about by ſteeping the Plates in acid Waters, for a certain Time, to what Number they pleaſe, and when they are taken out, ſcouring them with Sand, in order to fetch off any Thing that may remain upon the Surface: And by this Method a Woman may clean more Plates in an Hour, than the moſt expeditious Workman can file in many Days. Of theſe Waters the Author mentions ſeveral; but what the *Germans* themſelves uſed, and which they make a mighty Secret of, he found to be only common Water made eager with Rye, which requires very little Pains. For after they have ground the Grain groſly, and pounded it, they leave it to ferment in common Water for a certain Time, and with a little Patience they are ſure to have an eager Menſtruum. With this Menſtruum they fill Troughs or Tuns, into which they put Piles of Iron Plates; and to make it grow eager the better, and to have more

more Activity, they keep theſe Veſſels in Vaults or Stoves which have little Air, and in which they keep lighted Charcoal. The Workmen go into theſe Vaults once or twice in a Day, either to turn the Plates that they may be equally expoſed to the Action of the acid Liquor, or to take out thoſe that are ſufficiently cleanſed, or to put others in their room: And as the Liquor is more acid, or the Heat of the Vault or Stove is more intenſe, the Plates are ſooner cleanſed; but it requires at leaſt two Days, and ſometimes a great deal more. This is the Method which the *Germans* employed in the Tin-works in *France*, conſtantly made uſe of to prepare the Iron-Plates to receive the Coat of Tin: But as the Author obſerved, that the conſtant Attendance upon them in the Stoves was very laborious, the Heat therein being almoſt inſupportable to thoſe who are not uſed to it, he propoſes ſome other Methods which are attended with very little Trouble, and as ſmall, if not a leſs, Expence; and which upon Trial ſucceeded full as well. Having therefore obſerved that the Iron-Leaves or Plates are covered with a Scale or Layer, half vitrified by the Fire, on which Acids have none or very little Effect, he imagined that inſtead of *diſſolving* the Iron in theſe acid Waters, it would be better to make it *ruſt*, and thereby put it in a Condition to be eaſier cleanſed from theſe Scales; as Ruſt is accompanied with a ſort of Fermentation and Rarefaction, and the Matter which ruſts takes up a greater Space, and raiſes up whatever oppoſes it. To this Purpoſe he ſteeped Iron Plates in different eager Menſtruums, as in Water in which Alum, common Salt and Sal-ammoniac were ſeparately diſſolved; and others of the ſame Iron he only dipped into the ſame Waters, and inſtantly taking them out expoſed them to the Air. Theſe latter were ruſted by all of them, but ſooner by that in which the Sal-ammoniac was diſſolved. After two Days, during which every Plate had been dipped into the Menſtruum but twice or thrice, he ſcoured them, and likewiſe thoſe he had left to ſteep for that Time; and comparing them together, found that thoſe, which had been only wetted at different Times, cleanſed better than thoſe which were ſteeped; the Ruſt covering all the Surface of the latter without raiſing the Scale; whereas in the former, as ſoon as one Part of the Metal is detached, it is attracted by the Menſtruum, and the Surface is raiſed into Bliſters of Ruſt. Theſe Diſſolvents, the Author takes notice, tho' weak in themſelves, yet produce the Effect as well as the ſtronger, which are much dearer: But amongſt the latter he prefers Vinegar, which being very plentiful in *France*, may be uſed with little Coſt. For you need only dip each Leaf into it, and take it out again immediately, leaving it afterwards in ſome moiſt Place, and it will be ſcaled in eight and forty Hours, if you take care to repeat this 3 or 4 Times in a Day. The ſcaling will ſtill be more expeditious, if you diſſolve a little Sal-ammoniac in the Vinegar, a Pound or two to a Puncheon; for as the Vinegar diſſolves Iron well,

ſo Sal-ammoniac, as juſt obſerved, ruſts it ſooner than any other Salt: But this muſt be uſed very moderately, and the Leaf muſt be left to ſteep in clean Water to diſſolve any Particles of it that may ſtick to it's Surface, which may otherwiſe make it ruſt after it is tinned. If you ſcale with Vinegar, and want to do it at a leſs Expence, you need only plunge the Leaves once or twice at fartheſt, and when the Vinegar is dried upon the Surface, ſprinkle it with Water; or dip them into it, and take them out immediately. There are ſeveral other Ways of making Iron ruſt, as keeping it in a moiſt Cellar, expoſing it to the Dew, ſprinkling it with ſimple Water, ſeveral Times in a Day, which will ſtill act quicker by diſſolving Sal-ammoniac in it. In thoſe Countries where the Pyrites is common, the Vitriolic Waters will ſcale them ſoon enough, which are almoſt as cheap as common Water: You need only heap the Pyrites together, and leaving them to moulder in the Air, make afterwards a Lixivium with them and common Water, which Lie will have the deſired Effect: But as the Leaves of Iron are ſenſibly much eaſier cleanſed on one Side than the other, the bad Side rarely taking the brilliant Poliſh in the tinning, but having always ſome Spots, which proceeds in that in the beating one Side is more expoſed to the Action of the Hammer, and is therefore better plained, the Author again adviſes not to ſteep them, but only to moiſten them, in order to make them ruſt, whereby you need moiſten that Side only that wants it moſt: Whereas if you ſteep them, as the bad Side will take double or tripple the Time of the other, the acid Menſtruum will diſſolve the Surface, and occaſion a Loſs of Iron. He next gives two Cautions neceſſary to be followed: the firſt is in the Management of the Plates before they come to be prepared; which is in the beating of them, to change the Place of each in it's Turn, that every one may receive the immediate Action of the Hammer, otherwiſe they will not extend equally: the ſecond is to ſteep them in Clay or Fuller's-Earth tempered with Water before you heat them, to prevent their ſoldering with one another. He then cloſes this Part of the Operation with remarking that whatſoever of theſe Methods are pitched upon, whether the old one, of which he has learnt the Secret, or any of the new, which he has here ſhewn, it is abſolutely neceſſary after the Plates are ſufficiently ſcaled, to ſcour them with Sand, and when there remains no more black Spots upon their Surface, to throw them into Water to prevent their ruſting again, and leave them in it till the Inſtant you would tin them, or in the Term of Art, blanch them. This he obſerves is the very Object of the whole Art, and is kept as much a Secret by the *Blancher*, as the acid eroding Menſtruum is by the *Scaler:* But the Manner of doing it is thus. They flux the Tin in a large iron Crucible, which has the Figure of a broken Pyramid with four Faces, of which the two oppoſite ones are leſs than the two others. This Crucible they heat

only from below, it's upper Border being luted in the Furnace quite round. The Crucible is always deeper than the Plates which are to be tinned are long, which they always put in downright, and the Tin ought to ſwim over them. For this Purpoſe Artificers of different Trades prepare the Plates in different Manners, which are all exceptionable: But the *Germans* he perceived made uſe of no Preparation whatſoever, except putting the ſcoured Plates into clean Water, as juſt remarked; but when the Tin is melted in the Crucible, they cover it with a Layer of a Sort of Suet, an Inch or two thick, through which the Plate muſt paſs before it comes to the Tin: The firſt Uſe of which is to keep the Tin from burning, and if any Part ſhould take Fire, as the Suet will ſoon moiſten it, to reduce it to it's natural State again. This Suet is compounded, as the Blanchers ſay, and is of a black Colour, which the Author thought might be given it with Soot or the Smoak of a Chimney, only to ſpread a Myſtery over their Work; but he found it true ſo far, that common unprepared Suet was not ſufficient: For after ſeveral Attempts, there was always ſomething wanting to render the Succeſs of the Operation certain. The whole Secret then of Blanching lies entirely in the Preparation of this Suet; And this he at laſt diſcovered to conſiſt only in firſt frying and burning it; which not only gives it the Colour, but puts it into a Condition to give the Iron a Diſpoſition to be tinned, which it does ſurprizingly. The Tin itſelf ought to have a certain Degree of Heat; for if it is not hot enough it will not ſtick to the Iron; if it is too hot, it will cover it with too thin a Coat, and the Plates will have ſeveral Colours, as a Mixture of red, blue, and yellow, and the whole appear of a villainous yellow Caſt. To prevent this, by knowing when the Tin has a proper Degree of Heat, they might firſt make an Eſſay with ſmall Pieces of the ſcaled Plates, and they would learn from them when the Tin is in proper Order: But generally ſpeaking, they dip the Plates into Tin that is more or leſs hot, according to the Thickneſs they would have the Coat to be of. Some Plates they only give one Layer to, and theſe they plunge into Tin, that has a leſſer Degree of Heat than that into which they plunge thoſe Plates which they would have take two Layers; as alſo when they give theſe the ſecond Layer, they put them into Tin that has not ſo great a Degree of Heat, as that into which they were put the firſt Time: Beſides which, it is to be obſerved, that the Tin, which is to give the ſecond Coat, ought to be freſh covered with Suet, but only with the common Sort without Preparation; for melted Tin is ſufficiently diſpoſed to attach it ſelf to ſolid Tin; and in this Caſe it is to Tin itſelf, to which the new Tin is to be joined. As to the Choice of the Tin, the Manner of making it is as bright as poſſible, with a Number of little Articles neceſſary to the Practice, the Author refers them to another Time,

as more properly belonging to the Deſcription of the whole Art, than to a Memoir in which he only gives the Principles of it.

Chatham-Dock, Octob. 9. 1723.

Right Honourable,

A Letter from the King's Officers at Sherneſs *and* Chatham, *to the Hon. the Commiſſioners of the* Navy, *giving an Account of what they met with in opening an antient Well near* Queenborough *in* Kent, *communicated by Mr* Peter Colliſon, *F. R. S. on* January 8, 1729. No. 411. p. 191.

XXV. IN Obedience to your Honours Warrant of the 16th of *September* laſt, we met at the Well near *Queenborough*, where the Caſtle formerly ſtood, on *Tueſday* the 24th *ditto*, and finding but very little Water at the Bottom on our Sounding, and it having a new Curb, lately fixed on the Top, we provided our ſelves with Buckets and Ropes, and lowered down a Man, who acquainted us, that it was cleaned, and the Ground ſunk four Feet deeper than the Curb at the Bottom. We then meaſured the Depth of it, and found it 200 Foot, and artificially ſteened the whole Depth with circular *Portland* Stone, which is all entire, and ſtands fair, the mean Diameter is four Foot eight Inches; but obſerving, that not one Drop of Water came into it, we reſolved to try whether we could find any by Boring; in order thereunto, we applied ourſelves to make the neceſſary Preparations, by getting a Piece of Timber of about ſeven Foot long, and boring it through with a three Inch and a half Auger, which Trunk we fixed at the Bottom of the Well, and faſtened it by Quarters to the Curb at the Bottom, to prevent it's raiſing, and filled it all round three Foot deep with Clay, and on that laid four Courſe of Bricks for a Platform for the Men to ſtand on in their boring, and got alſo an Auger of two Inches and a half to bore through the Clay, but could not get all the neceſſary Appurtenances till *Thurſday* the 26th of *September*, when three Men at a Time began to bore, whom we ſhifted every three Hours; the Boring which they ſent us up, was a very cloſe bluiſh Clay, which continuing the ſame after three Days and a half boring, we began to deſpair meeting with Water; but on *Monday* the 30th of *September*, in the Evening, as they were boring, the Auger ſlipt down at once, and up came Water, to our great Satisfaction; and in an Hour's Time there was upward of four Foot Water which roſe ſo faſt, that at twelve o'Clock at Noon,

	Feet.	Inch.
On the firſt of *October*, we found --	55	10
On the 2d, at 5 in the Afternoon, --	109	08
On the 3d, at 3 in the Afternoon, --	132	06
On the 4th, at 3 in the Afternoon, --	149	06
On the 5th, at 4 in the Afternoon, --	161	03
On the 6th, at 10½ in the Morning, -	167	08
On the 7th, at 4 in the Afternoon, --	174	00
On the 8th, at 7 in the Morning, ---	176	07

and ſtill increaſes, though ſlowly. The Reaſon of it's not riſing ſo much now as at firſt, we apprehended proceeded from the Weight of

Water which the Spring through the Hole of the Trunk muſt force up, and the Well being wider aloft than below. What we think very extraordinary is, that we bored 81 Feet below the Foot of the Trunk before we met with this Body of Water, which by Computation is 166 Feet below the deepeſt Place in the adjacent Seas. The Water proves excellent good, ſoft, ſweet and fine; we compared it with the beſt Spring Water brought from *Milton*, and in every Body's Opinion that taſted both, they declared the Well-Water the beſt. We put ſome Soap to it, and it lathered finely; we boil'd old Peaſe in it, which performed very well, and we have great Reaſon to believe, that the Spring will ſufficiently ſupply his Majeſty's Ships, as propoſed.

Signed by

Richard Froſt, *James Young*, *Edmond Oxley*, *Benj. Roſwell*, *Richard Stacey*, *J. Hayward*, *John Ward*, *William Hogg*, *J. Dod*, *Charles Finch*, *D. Devert*, *William Jones*,

King's Officers at *Sherneſs* and *Chatham*.

XXVI. This Treatiſe contains an accurate hiſtorical Account of the ſeveral violent Earthquakes, which happened in the Kingdom of *Sicily*, in the Years 1693, 1694, and 1717. interſperſed with ſome Philoſophical Digreſſions concerning the Cauſes and Effects of Earthquakes in general.

An Account of a Book entitul'ed, Dominici Bottoni, de immani Trinacriæ Terræ Motu Idea Hiſtorico-Phyſica, in qua non ſolum Telluris concuſſiones tranſactæ recenſentur, ſed noviſſimæ Anni 1717. Meſſanæ 1718. 8°. *By* J. G. Scheuchzer, *M. D. R. S. S.* N°. 384. p. 151.

The Summer Seaſon, in 1692. was exceedingly hot and tempeſtuous, with frequent Thunders, Lightnings and Rains. About the middle of *September* fell ſuch profuſe Showers, that all the Rivers and Torrents increaſed to ſuch a Degree, as to overflow their Banks in ſeveral Places, and cover large Pieces of Ground with Water. This joined to the continual blowing of Southerly Winds, during the *Autumn*, put the Inhabitants under great Apprehenſion of future Miſchiefs. And indeed, the diſaſtrous Fate, which befel *Sicily* about the Beginning of 1693, too manifeſtly proved, that this ominous Fear was no way groundleſs. For on the 9th of *January*, about the 5th Hour (according to the *Italian* Way of counting) after a warm, ſerene and calm Day, the Earth began trembling all of a ſudden, chiefly about *Catania*, and in ſome neighbouring Places, for the Time required to ſay the Lord's Prayer. This firſt Shake was accompanied, as generally happens in Earthquakes, by a hollow, thundering Noiſe, and ſucceeded by another ſmall Trembling, obſerved only by ſome few People the next Day early in the Morning. Theſe two Succuſſions, though violent enough, where but a Prelude of the third, which happened the 11th of the ſame Month, by 4 of the Clock in the Afternoon, of which the Apprehenſion was ſo much the greater, becauſe all the 10th and 11th, between the firſt and third Shake, the Air was more than uſual dark and cloudy. It would be a Taſk too difficult even for the ableſt Pen, to deſcribe all the dreadful Effects of this laſt; the violent toſſing and dancing of the Earth; the hol-

low

low, thundering Noiſe threatening the whole Iſland with it's entire Diſſolution; the fiery Eruption of the burning *Ætna* throwing out a prodigious Quantity of Flames, Stones and Aſhes; the Terror and Confuſion of the diſtracted Inhabitants running up and down the Streets, uncertain where to provide for their Safety, or how to eſcape the Fury of all the raging Elements, which ſeemed to have conſpired their Ruin. There was ſcarce one Place all over the Kingdom left without ſome particular Misfortune, *Catania*, *Syracuſa*, *Agoſta*, *Meſſina*, *Noto*, *Raguſa*, *Leontini*, *Ibla*, *Chiarumonte*, *Carleontino*, *Caltagirone*, *Soctino*, *Francofonte*, *Bontello*, *Militello*, *Occhiali*, *Aydono*, *Motica*, *Maſcali*, were all, if not entirely deſtroyed, at leaſt miſerably ſhattered, many Churches and ſtately Buildings, up and down the Country, violently thrown down, and above 60000 Inhabitants buried under the Ruins, of which about 16000 periſhed only at *Catania*.

In many Places the Earth gap'd prodigiouſly. Such an Opening was obſerved near *Meſſina*, in the very Bottom of the Sea; another near a Village called *Botto d'Aceto*, 250 Paces long, and near 8 Palms broad; another at *Caltaniſeta*, near the Jeſuits-College, 2000 Paces long and 2 Palms broad; another, at the Top of a Hill near *Leontini*, full wide enough to hold a Man; another upon the Road between *Catania* and *Leontini*, which ſwallowed up ſome Mule-keepers, then, to their great Misfortune, happening to travel that way, along with their Mules and whole Baggage, that not the leaſt Foot-ſtep of them remained. Silently to paſs over a great many more, but of leſs Conſideration.

Out of all theſe Openings ſprung forth a great Quantity of Water, which drown'd the neighbouring Places. This Water was in ſome Places hot, with a ſtrong ſulphureous Smell, which laſted, even after the Earthquakes were over, and induced ſome of the Inhabitants, not without Succeſs, to make uſe of it in curing of Ulcers, and other cutaneous Diſeaſes, for which chiefly a hot Well near *Lazaretto* became very famous. Out of ſome of theſe Gapings of the Earth iſſued a thick Stench and Smoke, very troubleſome to all the Neighbourhood. This happened, amongſt other Places, upon a Mountain called *S. Theodor*, as alſo near *Mena*. Near *Agoſta* it was preceeded by a ſulphureous red Flame.

Juſt at the Time of the ſecond Shock, the Sea retired from the Land all along the Coaſts, leaving it's Bottom dry'd up for a conſiderable Diſtance, and within few Minutes returned again with great Fury, and overflowed the Shores. By this Accident the *Malteſe* Gallies, lying at Anchor in the Harbour of *Agoſta*, were in danger of being loſt; for the Sea ſunk down all of a ſudden, ſo that they came to ſit almoſt upon the Ground, and immediately after bubbled and ſwelled up again with ſo great an Emotion, that they run the Hazard of having their Cables broke, and being driven away.

And

And it ſeemed that the Earth itſelf was in ſome Places conſiderably lower'd, and the Tops of the Mountains depreſſed. Of this they had a remarkable Inſtance at *Paternione*. The Hills, between this City and the Shore, hindered it from having any View of the Sea, which ſince the Earthquake diſcovers itſelf towards the Eaſt very plainly.

In other Places the Earth actually ſunk down, and inſtead of it appeared great Lakes, ſome of which were large enough to become navigable. By the breaking forth of ſuch a Lake between *Noto* and *Syracuſa*, a large Piece of Ground was tranſported for about 50 Paces, where it now ſtands as firm, as if it had always ſtood there

The Looſening and Fall of two great Rocks between *Terula* and *Caſſero* is already ſufficiently deſcribed in Signor *Bonajuti's* * Account: Such Looſenings and throwing down of great Rocks happened every where up and down in the Country, to the great Terror of the neighbouring People. The ſame was alſo obſerved, according to *Kircher* and ſeveral other Authors, in ſome Earthquakes in the Kingdom of *Naples*. Two very high Rocks near *Ibla*, with all the Trees growing thereon, were by the Violence of the Fall quite inverted, that the Top came to ſtand upon the Ground.

About two Miles off from the City of *Mena*, lies a Lake full of a bituminous, ſulphureous and combuſtible Matter, formerly famous under the Title of *Lacus Palicorum*. Upon this Lake there was obſerved, the very Day of the Earthquake, about a Quarter of an Hour before the ſecond Shock, a great red Flame, like a fiery Column of above three Yards perpendicular Height, which, during the Earthquake itſelf, on a ſudden diſappeared.

At *Agoſta*, the Misfortune was ſo much the greater, becauſe beſides all the dreadful Effects of the Earthquake itſelf, the Powder-Magazine, in the Caſtle, by ſome ill Accident, and perhaps by the violent Fall over one another of the Stones of ſome ruined Buildings, (or by the breaking out of ſome ſubterraneous Flame) unluckily took Fire, by which the whole Caſtle was blown up with ſuch a Fury, that ſome of the Stones were carried as far as the Iſlands *Thapſus*, which is near 8 *Italian* Miles diſtant from *Agoſta*. By this Accident periſhed 1840 Inhabitants.

There remains ſtill one thing worth obſerving, and that is the very Riſe and Progreſs of this terrible Succuſſion. It aroſe in the South, and proceeded from thence towards the North. For it was firſt obſerved in the Iſland of *Malta*; then in the Southern Parts of *Sicily*; and laſt, always with ſome Difference as to the Time, in the Northern Parts of the ſame Kingdom. But the Shakes were leſs violent the more it approached to the North. For the reſt, it extended it-

* *Phil. Tranſ.* N°. 207. pag. 2.

ſelf

ſelf ſo far, that not only the Iſland of *Malta*, but alſo *Calabria*, and ſome Parts in the Kingdom of *Naples* participated of it's Fury.

Nor was this the End of all the Miſeries which befel this noble Kingdom: for the Earth continued trembling for ſeveral Months after, during the whole Year of 1693. In the remaining Part of *January*, and from that Time to the Beginning of the Summer, the Shakes came ſtrong and thick, with hollow terrible Noiſes, and frequent Eruptions of *Ætna*. The moſt conſiderable were obſerv'd *February* the 15th in the Morning; *March* the 1ſt; *March* the 18th, by one of the Clock; *May* the 10th; *May* the 26th in the Morning. Towards the End of the Summer, the Shakes were obſerved to loſe a great deal of their Force, and *Ætna* to throw out Flames and Aſhes in leſs Quantity, when on the fourth of *September*, this ignivomous Mountain, having been ſome Days before very quiet, trembled and cracked all of a ſudden, with ſo loud and thundering a Noiſe, as if ſome Thouſands of Guns were fired all at once. This was ſucceeded by a new Opening, about 1000 Paces diſtant from the old Mouth, out of which immediately iſſued a thick Stench and Smoke, followed by a great Flame. The ſame Mountain opened itſelf in two other Places, with the like Noiſe, and Eruption of Smoke and Fire, the 25th of *September*, 1693, and the firſt of *April*, 1694. Since that Time the Shakes became viſibly weaker and weaker, and at laſt entirely waſted.

As to the Earthquake which happened *April* the 22d, 1717. early in the Morning, and of which the Author hath given a ſhort Account by way of Appendix; I ſhall not inſiſt upon it's Effect, being much the ſame with the former, though far inferior as to the Degree of Violence.

Thus far, what I could gather out of this Treatiſe, relating to the Hiſtory of the *Sicilian* Earthquakes in 1693 and 1717. I proceed now, with all poſſible Brevity, to run over the ſeveral Obſervations, which our Author maketh about the Cauſes and Effects of Earthquakes in general: He obſerveth,

That ſuch Countries as abound much with Foſſil-coals, as *England*, ſome Parts of *Germany*, and even *Sicily* itſelf, are more ſubject to Tremblings of the Earth, than any other.

That peſtilential and other Diſeaſes, which frequently follow great Earthquakes, are rather to be aſcribed to noxious and infected mineral *Effluvia*, which upon ſuch an Occaſion iſſue out of the Earth through the ſeveral Openings, than to the Putrefaction of dead Bodies, which periſh'd in the Earthquake, and were buried under the Ruins of deſtroyed Buildings.

That amongſt the Minerals hidden in the Entrails of the Earth, ſome are combuſtible, ſome not; that of the combuſtible Ones, as Sulphur, Bitumen, Alum, Vitriol, Salt-Petre, *&c.* ſome take Fire quicker than others; that others, as Coals, are with greater Difficulty

culty to be inflamed, but keep the Fire ſo much the longer; that the Heat and ſulphureous Smell of the Waters, which broke firſt through the Openings of the Earth, probably depends upon the Mixture and Fermentation of ſome of theſe Minerals.

That *Baccius*, *Kircher*, and others, which draw the Origin of the above-mentioned ſulphureous Lake near *Mena*, and of ſeveral others in other Places from the ſubterraneous Cavities of the Mountain *Ætna*, are much in the wrong, there being not the leaſt Neceſſity of it's being derived ſo far, ſince the Country every where abounds with combuſtible Minerals, which rather ſeem to entertain and nouriſh the fiery Eruptions of *Ætna*, than to be occaſioned by them.

That the Sea's retiring from the Shore, and ſinking down, is the leſs to be wondered at, ſince there are many Examples in Hiſtories of whole Towns and Iſlands ſwallowed up by it. This Misfortune befel, according to *Pliny*, *Tyndarida*, formerly a famous City in *Sicily*.

That in all probability *Sicily* itſelf, which, by the Teſtimonies of *Diodorus Siculus*, *Strabo*, *Pomponius Mela*, *Plinius*, *Solinus*, *Juſtinus*, *Seneca*, and ſeveral others, both antient and modern Authors, appears to have been formerly annexed to the Continent of *Italy*, by a ſmall Neck of Land between the Cape of *Meſſina* and the lower Parts of *Calabria*, was ſeparated from it by ſome violent Succuſſion of the Earth.

That the ignivomous *Ætna*, far from being the Cauſe, as ſome imagine, of the Earthquakes, which ſo often deſolate the Kingdom of *Sicily*, ſeems rather to have been created by the allwiſe Providence, in order to ſecure this Iſland by it's fiery Eruptions from more frequent Misfortunes.

That contrary to what *Ariſtotle* and ſome others aſſert, ſolid and rocky Places receive infinitely more Damage by Earthquakes, than looſe, ſandy Grounds. This appears by the Ruins of *Catania*, *Leontini*, *Agoſta*, *Syracuſa*, and *Noto*, which were all built upon a ſolid ſtony Ground, whereas *Meſſina*, though every where undermined by ſubterranean Cavities, was abundantly leſs ſhaken.

The remaining Part of the Book is employed about examining the Opinions of all the antient and modern Philoſophers about the Cauſes of Earthquakes, and eſtabliſhing the Author's own, which is, that the Earth is ſhaken by the Violence of ſubterraneous Fires, occaſioned by the Fermentation of the combuſtible Minerals hid in it's Entrails, and that the Effects of the Earthquakes may in all Regards be compared to the Effects of Mines. By the way, he obſerveth, that the Cauſes of Thunder, Lightening, and Winds may be derived from the ſame Principle.

An Account of a Book intituled, Prodromus Cryſtallographiæ. De Cryſtallis impropriè ſic dictis Commentarium; à Mauritio Antonio Cappeler, M. D. & Centumviro Lucernenſi. Lucernæ 1723. 4to. *By* J. G. Scheuchzer, *M. D. R. S. S.* No. 387. p. 272.

XXVII. The Author of this Treatiſe takes notice in the Preface, that it is only a ſmall Part of a larger Work, which he promiſed the Public ſome Years ago, under the Title of *Cryſtallographia*, and hath now almoſt ready for the Preſs. This greater Work, as he intimates at the Cloſe of this Diſcourſe, is to conſiſt of three Parts, the firſt of which contains the Definition of Cryſtal, with the Synonyms given it by ſeveral Authors both ancient and modern, and an Account of it's Properties, Figure, Pellucidity, ſpecific Gravity, and Bigneſs; as alſo the Place of it's Growth, chiefly in regard to *Swiſſerland*, the moſt plentiful Country in *Europe*, as to this Sort of natural Productions; the Signs, whereby hidden Cryſtal Mines may be diſcovered, and the Way of working them. In the ſecond Part will be examined the Opinions of ſeveral Natural Hiſtorians, about the Origin of Cryſtal, and the Author's own eſtabliſhed and proved. In the third Part will be ſhewn the Uſes of Cryſtal, both Phyſical and Mechanical, and ſome few Hints given, relating to the juſt Value the World has at all Times put upon this beautiful Production of Nature.

The Author divides this preſent Eſſay into two Parts, *viz.* a ſhort Commentary upon the *Cryſtallos*, as he calls them, *impropiè ſic dictos*, in the firſt; and an Account of ſuch as he found mentioned in ſeveral Authors, with a Reduction of them under certain Heads, in the ſecond. *Cryſtalli impropriè ſic dicti*, according to the Author's Definition, are ſuch Bodies, either Stones, Metals, or Salts, as have any Reſemblance with the true Cryſtal; either, as to their multangular, regular, or irregular Figure, or as to their Pellucidity, or any other of it's eſſential Properties. As the Number of theſe Bodies is very extenſive, ſo an exact Enquiry into them cannot but be both uſeful and agreeable. I juſt now obſerved, that the *Cryſtalli impropriè ſic dicti* are taken out of Stones, Metals, and Salts. To the firſt belong amongſt other Things ſuch precious Stones, as, in all Probability, have their certain, determined Cryſtal like Figures, as Diamonds, Amethyſts, *&c.* To the ſecond belong all Sorts of *Pyritæ*, as alſo the Growth of Silver, and other Metals, in Form of Trees, or other Things. By the third are underſtood all Chymical Preparations of Salts, and ſaline Bodies, the Figure of which is, generally ſpeaking, more accurate, than in any of the two former. Several Authors of Note have endeavoured to explain how, Cryſtallization is performed; or how it comes, that certain Subſtances ſhoot into Cryſtals. Dr *Cappeler* mentions the Hypotheſis of the learned *Guilielmus*, and that of a late *Swediſh* Author, *Swedenbergh*; and though he ſeems more to favour the latter, than he doth the former; yet he thinks, that they are both liable to Exceptions. But whatever the Cauſe or Method of Cryſtallization be, our Author takes it for granted, that three Things are abſolutely required for it, *viz.* *Salt*, which muſt always be an Acid, as is evident by Chymical Experiments, and the

very Taſte of ſaline Cryſtals, Water and *Earth*. Cryſtallization, as far as can be gueſſed by Chymical Obſervations, is performed thus: Particles of certain determined Shapes, ſwimming in a Fluid of a certain Conſiſtence, are, either by the inteſtine Motion of this Fluid, or by the Motion of the Air, ſuppoſed to circulate perpetually through it's Pores, or by ſome other Cauſe, brought together, ſo as to form larger Bodies of a Figure proportionable both to the Degree of Impulſion, and the primitive Shape of the conſtituent Parts, or determined by theſe two Things. This Act of Cryſtallization, though uniform, as to the Union of Particles conſidered in itſelf, is yet obſerved to be very different, and to have different Effects, with reſpect to the different Nature of the Fluid, in which Cryſtals are formed, and the Degree of Perfection, to which they are brought. Our Author mentions ſix different Kinds of Cryſtallization, each of which, he intends to explain more fully in his larger Work. The firſt Sort of Cryſtallization, which hath been examined with a great deal of Accuracy by *Gulielminus*, is performed in an aqueous Fluid, wherein ſaline Particles have been diſſolved, boiled to a certain Degree of Conſiſtence, commonly that of a thin *Pellicula* covering it's Surface. This aqueous Fluid muſt be afterwards repoſed in a cool Place, that the ſaline Particles contained in it, may form themſelves into Cryſtals, which is done in more or leſs Time, acording to the different Nature both of the Fluid and Salts. All Chymical Preparations of Salts, the Origin of precious Stones, and of the Cryſtal itſelf, belong to this firſt Kind. Our Author obſerved, that in the *Spiritus aperitivus Glauberi*, (which is a Preparation of *Ciner. Clavell.* p. ii. *& Sal Ammon.* p. i.) after a Year's ſtanding, formed themſelves artificial Cryſtals, in Figure and Pellucidity exactly like the true ſexangular Cryſtal, and pointed on both Sides. The ſecond Kind of Cryſtallization differs from the firſt only in this, that it is performed not in a thin, pellucid, aqueous Fluid, but between thick, mineral or metallical Mixtures, corroded by acid Salts in the Bowels of the Earth. The third Sort is of a middle Kind between the firſt, and a Coagulation, *viz.* when the Fluid, in which Salts have been diſſolved, is by degrees, entirely evaporated. This Way of Cryſtallization is more proper for diſcovering the primitive Shapes of ſaline Particles. Our Author hath examined ſeveral Salts, both Mineral and Vegetable, and ſeveral Chymical Preparations after this Manner, and hath given us their Figures as they appeared to him under a good Microſcope, in two Tables annexed to this Treatiſe. The fourth Sort of Cryſtallization is performed in a ſtill thinner Fluid than Water is, or in the Air; the Sublimations of the Chymiſts, the Diſtillation of volatile Salts; Snow, whoſe wonderful Figures hath been thought worthy the Amuſement of ſeveral eminent Men; Hail, which is again of very different Shapes; Froſt and that admirable Variety of Trees, Landſkips, and other inimitable Figures, which, in very froſty Weather, appear

upon Glaſs-Windows, or other pellucid Bodies, muſt be all reduced to this fourth Sort. The fifth Sort of Cryſtallization is performed upon the Surface of a thicker Fluid, as Water, between that and a thinner one, as Air; of this Kind is chiefly Ice. The ſixth and laſt Sort of Cryſtallization, mentioned by our Author, differs from all the former, in that it is performed neither by the Riſe of Vapours, nor by the repoſing of any Fluid, but on the contrary in a Fluid, which is in a perpetual Motion. That Sort of icy Concretions, which is obſerved near ſwift running Waters, and is commonly very porous, not unlike the Tophus, and the ſtony Concretions in ſubterranean Cavities, called *Stalactitæ*, belong to this laſt Sort. Thus far what is contained in the firſt Part,

The ſecond gives an Account of ſuch *Cryſtalli improprie ſic dicti*, or Cryſtalline Bodies, which are not properly Cryſtals, as have been mentioned by ſeveral Natural Hiſtorians both ancient and modern. The Author diſtributed them into the following Claſſes, each of which comprehends Stones, Metals, and Salts.

Corpora Cryſtallifata, quæ improprie Cryſtalli vocantur.

Claſſ. I. Globoſa, rotundata & ſphæroidea.
—— II. Conica, Conoidea & fuſiformia.
—— III. Cylindrica, ſolida aut tubulata.
—— IV. Pyramidalia & cuneiformia.
—— V. Priſmatica, Parallelepipeda, Rhomboidea, Trapezoidea.
—— VI. Polyedrica, & Polygona, regularia & minus regularia.
—— VII. Racemoſa, Arbuſculorum in modum, & filamentoſa, filorum, aut capillorum inſtar naſcentia & ſtriatim contexta.
—— VIII. Cruſtis, ſquamis, lamelliſque contexta, ſine, vel cum figura propria.
—— IX. Corpora, quorum cum Cryſtallo affinitas in pellucidi-tate potiſſimum conſiſtit, figurâ eorum nativâ, vel incertâ vel nondum perſpectâ.

CHAP.

CHAP. IV.

MAGNETICS.

I. AFter having given an Account of an Experiment made with the large Magnet in the Repoſitory of the *Royal Society*, (which Experiment is deſcribed in *Philoſoph. Tranſact.* N°. 344. Article 4.) the Letter goes on with the ſame Subject as follows. —— If it were known what point within the Stone, and what point in the Needle are the Centers of the Magnetical power, it would be eaſy to find the true powers of the Magnet at all the diſtances obſerved. For want of that Knowledge, I have computed the Forces from the Center of the Needle, and the Extremity of the Loadſtone, and find that at the diſtance of nine Feet, the Power alters faſter, than as the Cubes of the diſtances, whereas at the diſtances of one and two Feet, the Power alters nearly as their Squares. To try whether the Law, by which the Magnetiſm alters, could be reduced at all diſtances to any one certain power of thoſe diſtances, I ſought thoſe points in the Needle and Stone, which being uſed as the Centers of the power might have that property. But in that caſe, I found the Center of the Stone muſt be carried quite out of it's Figure, to make the diſtances large enough for this purpoſe. From whence it ſeems to appear, that the power of Magnetiſm does not alter according to any particular power of the diſtances, but decreaſes much faſter in the greater diſtances, than it does in the near ones.

An Account of ſome Experiments relating to Magnetiſm, by Dr Brook Taylor, N°. 368. p. 204.

This ſeems to be confirmed by other Experiments I made. The firſt Experiment was thus; I made a Needle $\frac{1}{4}$ of an Inch long, of very fine Steel-wire (a Foot length of which weighed but a Grain) which I lengthen'd by ſticking a light piece of Ruſh to it, ſo that I could obſerve the Direction of the Needle in all the trials with a *Radius* of two Inches. Inſtead of a Magnet I uſed a touched Needle of Steel-wire, which I ſet on a perpendicular to the Horizontal Plane I made the Obſervations on, by means of a Frame I made to tranſport it from one place to another; the North end of the Needle being placed downwards, and made a little ſharp, that it might mark the Paper it was ſet upon in every poſition, by preſſing the top of the Needle gently with the Finger. The Obſervations were made in this manner; after having taking notice of the natural direction of the ſmall Compaſs Needle, I brought the perpendicular Needle as near to it as I conveniently could, ſetting it in ſuch a manner, that a Line from the upright Needle to the Center of the Compaſs might be perpendicular to the Compaſs Needle. Then obſerving the ſame caution

(which was convenient to make the Center of the Compaſs ſerve ſufficiently well to be eſteem'd it's Center of Power) I placed the upright Needle at ſeveral greater diſtances, every time marking the place in the manner already deſcribed, and obſerving the Variation of the Compaſs. By this means I got a Curve pretty regularly and fairly drawn by points on the paper. And by examining this Curve, compared with the Variations of the Compaſs correſponding to it's reſpective points, I found that the Magnetical power decreaſed faſter at the greater diſtances than at the nearer. It is of little uſe to be very particular in the account of the ſeveral Obſervations. I ſhall only take notice, that at about two Inches and a quarter diſtance the Force did not alter ſo faſt as the Squares, and at ten Inches diſtance (where the Variation was one degree only) it altered faſter than the Cubes, the Index of the Power being about $3\frac{1}{4}$. The Needle of the Compaſs was ſo ſhort, that to ſuppoſe it's Center of Force to be either in the middle or at the extremity of it, would not alter the Index of the Powers of the diſtances $\frac{1}{10}$ of an Unit.

I made another Experiment to the ſame purpoſe, with a Compaſs Needle made of a ſlight piece of Straw, with a ſmall piece of Steel-wire faſtened to one end of it, which was always kept in the ſame poſition, being balanced between two perpendicular Needles, one of which was moveable, and the other fixed. The Event was much the ſame as in the former Experiment.

Endeavouring to find the true Poles, or Centers of the magnetical Power in touched Needles, I made a Needle of two Inches long, of the fine Steel-wire, which I touched with the South point of a ſmall capt Loadſtone, applying the point of the Cap only to the Extremity of the Needle, without drawing it along. The Needle ſo touch'd being laid gently on the Surface of a ſtagnant Water, floated. I then applied to it ſucceſſively the two ends of a touched Needle, as near as I could, without letting the Needles touch. The reſult was, that the floating Needle reſted under the reſpective Poles of the other Needle marked with the ſmall Letters *s*, *n*, *s*. So that by one Touch with the Loadſtone, which gave the Needle a North-pole at *N*, where it was touched, it acquired three other Poles, *s*, *n*, *s*, which we may not therefore improperly call it's conſequential Poles. Having diſcovered theſe conſequential Poles, I made ſome other Experiments to diſcover more of the Nature of them, as they are deſcribed in the Scheme. The Needles were all of them two Inches long, made of the ſame fine Steel-wire, and the Letters *N*, or *n*, and *S*, or *s*, denote Character, of North or South belonging to the points marked; the great Letters ſignifying the points the Loadſtone was applied to, and the ſmall Letters ſhewing the conſequential Poles.

Fig. 87.

There

There are two other Experiments deſcribed in the ſame Letter, relating to the Attraction of Fluids, one of which (*viz.* that of the *Hyperbola*, made by the Surface of the Water between two Glaſs-planes) being already deſcribed in the *Tranſactions* (N°. 336.) we ſhall only tranſcribe the Account given of the other.

I took ſeveral very thin pieces of Fir-board, and having hung them ſucceſſively in a convenient manner to a nice pair of Scales, I I tried what Weight was neceſſary, (over and above their own, after they had been well ſoaked in Water) to ſeparate them at once from the Surface of ſtagnating Water. I found 50 Grains to ſeparate a Surface of one Inch ſquare; and the Weight in every trial being exactly proportional to the Surface, I was encouraged to think the Experiment well made. The diſtance of the under Surface of the Board from the Surface of the ſtagnating Water, at the time they ſeparated I found to be $\frac{16}{100}$ of an Inch; though I believe it would be found greater, if it could be meaſured at a greater diſtance from the Edge of the Board, than I could do it, the Water riſing a little before it came quite under the Edge of the Board.

II. *Primum* volui experiri an magnetes in ſe operarentur juxta certam proportionem in diverſis diſtantiis, vidique in Actis Britannicis, N°. 335. pag. 506. ſimile veniſſe in mentem experientiſſimo *Hauksbejo*, ſed ipſum inſtituiſſe experimenta cum magnete & acu modo tali, qui omnibus non ſatisfaceret accuratis rerum ſcrutatoribus unde concludit tamen his verbis. *I ſee no Reaſon to doubt, but the Proportions of this Power will be regular, and agreeable to the ſeveral Diſtances.* Quæ verba non adeo placuiſſe omnibus Eruditis colligo, cum Nobiliſſimus *Taylor* eadem experimenta repetiit, N° 344. pag. 294. & alia reliquit obſervata. *Of Magnetical Powers, by* P. Muſchenbroek, *M. D.* N°. 390. pag. 370.

Rem eandem aggreſſus fui methodo prorſus diverſa, ſic meditatus, ſi ſumerem duos magnetes, & unum Suſpenderem ex filo ſupra alium, ad diverſas diſtantias à ſe invicem, ſique fili extremum annecterem bilanci, me ponderare poſſe quantitatem virium, quibus magnetes in ſe agebant; neque ſucceſſu caruit meditatio. Sumpſi accuratiſſimam bilancem, qua melior nullibi forte exſtitit, & uni brachio annexui lancem, alteri filum longiſſimum plurimorum pedum, cujus parti inferiori adhærebat magnes nudus; filum longiſſimum feci, ne actio magnetis ulla in ferream libram turbaret experimentum; ideoq; ſelegi locum in quo ferri tam parum, ac in ædibus unquam ſeligi poteſt. Sumpſi præſtantiſſimos magnetes perfecte ſphæricos, terrellas veſter *Gilbertus* vocavit, horum poli erant accurate in extremo utroq; axeos ſphæræ, ita accuratiſſime diſtantias amborum polorum menſurare poteram. Gravitatem magnetis primo reduxi ope ponderis in altera lance in æquilibrium; dein ambos magnetes poſui infra ſe, & quia libra erat, ope funis, mobilis ſupra trochleam, eam demittebam ad diverſas diſtantias pro lubitu, & cum magnes ſuſpenſus ageretur deorſum attractus vi magnetis inferioris, ſemper imponebam tantundem

dem ponderis alteri lanci, donec vis magnetis cum pondere faceret æquilibrium: hæ tamen diſtantiæ menſurari non poſſunt, niſi interponendo corpus cupreum tantæ longitudinis ac eſt diſtantia inter ambos magnetes, ob oſcillationes libræ, & quia in majoribus diſtantiis magnetes minus operantur, quam in minoribus diſtantiis, æquilibrium libræ obtineri non poteſt, niſi eo artificio. Ecce nunc tabulam continentem experimenta in diverſis diſtantiis pollicum & linearum, columna remotior continet grana quæ æquiponderant cum attractionibus in iis diſtantiis.

Diſtantia Poll.	Lin.	Grana attractionis.		Lin.	Gran.
13 —	6 —	0		8 —	106.
12 —	0 —	0 $\frac{1}{10}$.		7 —	114.
11 —	0 —	0 $\frac{1}{8}$.		6 —	131.
10 —	0 —	0 $\frac{1}{4}$.		5 —	146.
9 —	0 —	0 $\frac{1}{2}$.		4 —	172.
7 —	6 —	1 $\frac{1}{2}$.		3 —	190.
7 —	0 —	2 $\frac{1}{2}$.		2 —	215.
	12 —	70 $\frac{1}{2}$.		1 —	250.
	11 —	78 $\frac{1}{2}$.		$\frac{1}{2}$ —	290.
	10 —	87.	In ipſo contactu,	0 —	340.
	9 —	94.	ſive		

Pollices ſumſi Rhenolandicos, & grana ſunt pondera noſtra medica, quæ etiam ſumma acribeia prius examinavi, ut eſſent vera & æque gravia.

Hæc experimenta inſtitueram die 24 *Decemb.* 1724. & animo adeo ad omnia attento ne hallucinarer, ut vix ſperaverim melius fieri poſſe.

Sed an ex his colligere poſſumus ullo modo dari proportionem inter vires & diſtantias? ego non video.

Poſtquam eo uſque perrexeram, ſuſpicabar an non forte ſuſpenſus magnes eſſet heterogeneus utcunque, & an alius ejus ſubſtitutus loco eventum quoq; non daret magis proſperum, ſaltem ex quo plus lucis caperem, tædioſa enim nimis fuerant hæc experimenta quam ut inde tam parum emolumenti colligerem; ſed ecce quid cum alio magnete parvo, admodum præſtanti, obſervare datum fuit, dum magnes rotundus alius inferior idem maneret, firmiter in menſa poſitus: eodem autem modo experimenta inſtituta fuerunt.

Distantia Poll.	Lin.	Grana attractionis.	Lin.	Gran.
5 —	10 —	1 $\frac{1}{4}$.	7 —	33.
4 —	6 —	2 $\frac{1}{4}$.	6 —	38 $\frac{1}{2}$.
3 —	9 —	3.	5 —	43 $\frac{1}{2}$.
2 —	4 —	9.	4 —	50 $\frac{1}{2}$.
1 —	9 —	12.	3 —	62.
1 —	0 —	23.	2 —	79.
	11 —	23 $\frac{1}{2}$.	1 —	140.
	10 —	26 $\frac{1}{4}$.	$\frac{1}{2}$ —	186.
	9 —	29.	0 —	340.
	8 —	30 $\frac{1}{4}$.		

Sed irregularitates hic iterum adsunt maximæ, ex quibus concludi potest nihil: id solum est mirandum, quod dum magnes pro hoc secundo experimento fuerat minor, quam qui primo inserviverat, tamen in mutuo contactu viribus æqualibus attrahebatur, nempe 340 granorum; dum in aliis distantiis longe minus tamen attracta fuit, uti ex comparatis ambabus tabulis patet: sed præterea hic minor magnes secundi experimenti multo generosior fuit & præstantior ad elevandum ferrum, quam magnes primi experimenti.

Hæc experimenta repetii cum aliis magnetibus & imprimis cum aliquo, cujus tanta vis ut acum magneticam inflectat, quæ distat ab ipso 14 pedibus Rhenolandicis; nescio an similis descriptus ullibi habeatur: sed ex omnibus id modo concludere possum experimentis, proportionem inter vires & distantias dari nullam.

Quum tam declinatio, quam inclinatio acus magneticæ variat singulis annis fere, subiit quoque desiderium videndi, an vis magnetis omni die esset eadem, an minor vel major æstate quam hyeme; sed vim esse minorem æstate quam hyeme, me docuerunt experimenta multa saltem de hac æstate loquor, an futuro anno idem obtinebit, explorandum erit.

Sumsi igitur magnetes binos, qui primo experimento inservierant, & eodem prorsus modo institui experimenta cum iis, ac ante, dies vero fuit 11 *Julii* 1725. cum Baroscopium esset elevatum ad 29 $\frac{1}{24}$ pollic. Thermoscopium *Fabrenheytii* ad 62 grad. & Ventus *Noordten Westen* sive Septentrionalis versus Occasum, cœlum siccum, serenum & in eodem loco mearum ædium.

Diſtantia Poll.	Lin.	Grana æqualia attractioni.
12 —	0 —	0
9 —	0 —	1 $\frac{1}{2}$.
8 —	0 —	1 $\frac{1}{2}$.
7 —	6 —	2.
7 —	0 —	2 $\frac{1}{2}$.
	12 —	70 $\frac{1}{2}$.
	11 —	75 $\frac{1}{2}$.
	10 —	85.
	9 —	92.
	8 —	100.
	7 —	106
	6 —	111.
	5 —	132.
	4 —	149.
	3 —	173.
	2 —	205.
	1 —	240.
	$\frac{1}{2}$ —	270.
	0 —	300.

Conſtat quidem inter Philoſophos, magnetis utriuſque polos non agere æque fortiter, ſed polos boreales eſſe fortiores viribus quam auſtrales, ſed hoc aſſertum quidem, demonſtratum accurate fuit nullibi; quia vero noſtra methodus ponderandi vires magnetis ſatis facilis erat, at accurate ejus ope hoc determinari poſſe videbam, converti modo ambos polos amborum magnetum ita, ut iterum duo poli amici ſibi eſſent obverſi, & in magnetibus hujus ultimi experimenti hæc obſervavi.

Ad diſtant. Lin.	Grana æqual. attractioni.
12 —	57.
11 —	63.
10 —	66.
9 —	70.
8 —	79.
7 —	83.
6 —	90.
5 —	101.
4 —	113.
3 —	124.
2 —	148.
1 —	168.
0 —	228.

Ex his patet manifeſto non ambos polos magnetis agere viribus iiſdem, quanta autem intercedat differentia, ex comparatione ambarum tabularum videre poteris.

Quum ab ineunte ætate, qua primum operam Philoſophiæ dare inceperam, in hunc uſque annum mihi perſuaſeram actionem magnetum ab effluviis, vel aliquo ſaltem fluido pellente extus magnetem, pendere; neque videram præſtantiſſimos viros aliter ſenſiſſe; experiri volui an ullo experimento hanc meam opinionem confirmare poſſem, affirmare enim effluvia vel aliquod fluidum premens extus, & non demonſtrare, mihi viſum fuit nimis temere conjecturis dare operam. Dum igitur experimenta priora cum magnetibus inſtituebam ad varias diſtantias à ſe mutuo, interpoſui fruſta craſſiſſima plumbi, ſtanni, argenti, cupri, mercurii maſſam inſignem, viſurus an hæc

effluvia magnetica non impedirentur, & ſi non omnino, ſaltem aliquo modo; vitrum pellucidum eſt, lucem tranſmittit, tamen non adeo copioſam, quam ſi nullum vitrum adfuiſſet; eodem credidi modo effluvia magnetica, ſi non prohiberentur omnino, ſaltem impediri aliquo modo ne magnetes tam fortiter ad ſe traherent, ſi plumbi fruſtum 1 pedis cubici interpoſitum foret, vel ſi plumbum craſſitiei 2 digitorum, & ſtannum ejuſdem craſſitiei, tum cuprum, tum maſſam magnam mercurii interponerem; ſed vidi, quæcunque interpoſueram corpora, ſemper vires magneticas eſſe eaſdem, ac ſi nullum corpus interlocaretur hoc profecto mirandum exiſtimo, neque intellectum credo ab ullo mortalium: non enim fingere licet hæc corpora eſſe adeo poroſa ut nihil ſolidi in ſe habeant; quod ſi igitur ſolidum habent, ut habent plurimum, an hæ partes non impedient quominus fluidum extraneum adveniat, vel ex magnete exeat; non dico quod omne fluidum impedient, ſed ſaltem aliquid, experimenta tamen omnia docent, vires magneticas impediri nullo modo: vel an hæc effluvia erunt multo ſubtiliora luce? præterquam quod hæc eſſet iterum hypotheſis, difficultas ſuperior non tollitur; Ignis impeditur à corporibus, lux non penetrat illico per omnia corpora, & ita ſe habent fluida omnia ut à ſolidis reſiſtentiam experiantur, ſed effluvia magnetica ita ſe non habebunt, immunia erunt reſiſtentiæ à ſolido corporeo; hoc eſt, ad quod mens noſtra plane hebeſcit.

Sed argumentum fortiſſimum ex viribus repellentibus magnetum depromam, ſunt hæ longe debiliores, quam vires attrahentes uti mox experimentis confirmabo, adeoque oportebit ut fluidum accedat ab exterioribus verſus magnetem, quod dum occurrit alteri magneti, unum pellit ad aliud, quodque magnetem ingreditur, & quia attractio magnetum eſt longe fortior quam repulſio, copioſius fluidum ingredietur magnetem, quam egreditur: unde fieri non poteſt quin brevi magnes adimpleatur hoc fluido, ut non amplius poroſus maneat; nec ſtatui poteſt quaſi undequaque ex magnete fluidum hoc exiret, nam fit attractio in omni puncto magnetis, & fit tantum repulſio in locis polorum. Ut vero demonſtrem repulſionem magnetum eſſe minorem attractione eorundem, ecce tabulam continentem experimenta cum memoratis ultimis magnetibus facta.

An Account of a Book intituled, Prodromus Cryſtallographiæ. De Cryſtallis impropriè ſic dictis Commentarium; à Mauritio Antonio Cappeler, M. D. & Centumviro Lucernenſi. Lucernæ 1723. 4to. *By* J. G. Scheuchzer, *M.D. R.S.S.* No. 387. p. 272.

XXVII. The Author of this Treatiſe takes notice in the Preface, that it is only a ſmall Part of a larger Work, which he promiſed the Public ſome Years ago, under the Title of *Cryſtallographia*, and hath now almoſt ready for the Preſs. This greater Work, as he intimates at the Cloſe of this Diſcourſe, is to conſiſt of three Parts, the firſt of which contains the Definition of Cryſtal, with the Synonyms given it by ſeveral Authors both ancient and modern, and an Account of it's Properties, Figure, Pellucidity, ſpecific Gravity, and Bigneſs; as alſo the Place of it's Growth, chiefly in regard to *Swiſſerland*, the moſt plentiful Country in *Europe*, as to this Sort of natural Productions; the Signs, whereby hidden Cryſtal Mines may be diſcovered, and the Way of working them. In the ſecond Part will be examined the Opinions of ſeveral Natural Hiſtorians, about the Origin of Cryſtal, and the Author's own eſtabliſhed and proved. In the third Part will be ſhewn the Uſes of Cryſtal, both Phyſical and Mechanical, and ſome few Hints given, relating to the juſt Value the World has at all Times put upon this beautiful Production of Nature.

The Author divides this preſent Eſſay into two Parts, *viz.* a ſhort Commentary upon the *Cryſtallos*, as he calls them, *impropiè ſic dictos*, in the firſt; and an Account of ſuch as he found mentioned in ſeveral Authors, with a Reduction of them under certain Heads, in the ſecond. *Cryſtalli impropriè ſic dicti*, according to the Author's Definition, are ſuch Bodies, either Stones, Metals, or Salts, as have any Reſemblance with the true Cryſtal; either, as to their multangular, regular, or irregular Figure, or as to their Pellucidity, or any other of it's eſſential Properties. As the Number of theſe Bodies is very extenſive, ſo an exact Enquiry into them cannot but be both uſeful and agreeable. I juſt now obſerved, that the *Cryſtalli impropriè ſic dicti* are taken out of Stones, Metals, and Salts. To the firſt belong amongſt other Things ſuch precious Stones, as, in all Probability, have their certain, determined Cryſtal like Figures, as Diamonds, Amethyſts, *&c.* To the ſecond belong all Sorts of *Pyritæ*, as alſo the Growth of Silver, and other Metals, in Form of Trees, or other Things. By the third are underſtood all Chymical Preparations of Salts, and ſaline Bodies, the Figure of which is, generally ſpeaking, more accurate, than in any of the two former. Several Authors of Note have endeavoured to explain how, Cryſtallization is performed; or how it comes, that certain Subſtances ſhoot into Cryſtals. Dr *Cappeler* mentions the Hypotheſis of the learned *Gulielmini*, and that of a late *Swediſh* Author, *Swedenbergh*; and though he ſeems more to favour the latter, than he doth the former; yet he thinks, that they are both liable to Exceptions. But whatever the Cauſe or Method of Cryſtallization be, our Author takes it for granted, that three Things are abſolutely required for it, *viz. Salt*, which muſt always be an Acid, as is evident by Chymical Experiments, and the

very Taſte of ſaline Cryſtals, Water and *Earth*. Cryſtallization, as far as can be gueſſed by Chymical Obſervations, is performed thus: Particles of certain determined Shapes, ſwimming in a Fluid of a certain Conſiſtence, are, either by the inteſtine Motion of this Fluid, or by the Motion of the Air, ſuppoſed to circulate perpetually through it's Pores, or by ſome other Cauſe, brought together, ſo as to form larger Bodies of a Figure proportionable both to the Degree of Impulſion, and the primitive Shape of the conſtituent Parts, or determined by theſe two Things. This Act of Cryſtallization, though uniform, as to the Union of Particles conſidered in itſelf, is yet obſerved to be very different, and to have different Effects, with reſpect to the different Nature of the Fluid, in which Cryſtals are formed, and the Degree of Perfection, to which they are brought. Our Author mentions ſix different Kinds of Cryſtallization, each of which, he intends to explain more fully in his larger Work. The firſt Sort of Cryſtallization, which hath been examined with a great deal of Accuracy by *Gulielminus*, is performed in an aqueous Fluid, wherein ſaline Particles have been diſſolved, boiled to a certain Degree of Conſiſtence, commonly that of a thin *Pellicula* covering it's Surface. This aqueous Fluid muſt be afterwards repoſed in a cool Place, that the ſaline Particles contained in it, may form themſelves into Cryſtals, which is done in more or leſs Time, acording to the different Nature both of the Fluid and Salts. All Chymical Preparations of Salts, the Origin of precious Stones, and of the Cryſtal itſelf, belong to this firſt Kind. Our Author obſerved, that in the *Spiritus aperitivus Glauberi*, (which is a Preparation of *Ciner. Clavell.* p. ii. *& Sal Ammon.* p. i.) after a Year's ſtanding, formed themſelves artificial Cryſtals, in Figure and Pellucidity exactly like the true ſexangular Cryſtal, and pointed on both Sides. The ſecond Kind of Cryſtallization differs from the firſt only in this, that it is performed not in a thin, pellucid, aqueous Fluid, but between thick, mineral or metallical Mixtures, corroded by acid Salts in the Bowels of the Earth. The third Sort is of a middle Kind between the firſt, and a Coagulation, *viz.* when the Fluid, in which Salts have been diſſolved, is by degrees, entirely evaporated. This Way of Cryſtallization is more proper for diſcovering the primitive Shapes of ſaline Particles. Our Author hath examined ſeveral Salts, both Mineral and Vegetable, and ſeveral Chymical Preparations after this Manner, and hath given us their Figures as they appeared to him under a good Microſcope, in two Tables annexed to this Treatiſe. The fourth Sort of Cryſtallization is performed in a ſtill thinner Fluid than Water is, or in the Air; the Sublimations of the Chymiſts, the Diſtillation of volatile Salts; Snow, whoſe wonderful Figures hath been thought worthy the Amuſement of ſeveral eminent Men; Hail, which is again of very different Shapes; Froſt and that admirable Variety of Trees, Landſkips, and other inimitable Figures, which, in very froſty Weather, appear

An Account of a Book intituled, Prodromus Cryſtallographiæ. De Cryſtallis impropriè ſic dictis Commentarium; à Mauritio Antonio Cappeler, M. D. & Centumviro Lucernenſi. Lucernæ 1723. 4to. *By* J. G. Scheuchzer, *M. D. R. S. S.* No. 387. p. 272.

XXVII. The Author of this Treatiſe takes notice in the Preface, that it is only a ſmall Part of a larger Work, which he promiſed the Public ſome Years ago, under the Title of *Cryſtallographia*, and hath now almoſt ready for the Preſs. This greater Work, as he intimates at the Cloſe of this Diſcourſe, is to conſiſt of three Parts, the firſt of which contains the Definition of Cryſtal, with the Synonyms given it by ſeveral Authors both ancient and modern, and an Account of it's Properties, Figure, Pellucidity, ſpecific Gravity, and Bigneſs; as alſo the Place of it's Growth, chiefly in regard to *Swiſſerland*, the moſt plentiful Country in *Europe*, as to this Sort of natural Productions; the Signs, whereby hidden Cryſtal Mines may be diſcovered, and the Way of working them. In the ſecond Part will be examined the Opinions of ſeveral Natural Hiſtorians, about the Origin of Cryſtal, and the Author's own eſtabliſhed and proved. In the third Part will be ſhewn the Uſes of Cryſtal, both Phyſical and Mechanical, and ſome few Hints given, relating to the juſt Value the World has at all Times put upon this beautiful Production of Nature.

The Author divides this preſent Eſſay into two Parts, *viz.* a ſhort Commentary upon the *Cryſtallos*, as he calls them, *impropiè ſic dictos*, in the firſt; and an Account of ſuch as he found mentioned in ſeveral Authors, with a Reduction of them under certain Heads, in the ſecond. *Cryſtalli impropriè ſic dicti*, according to the Author's Definition, are ſuch Bodies, either Stones, Metals, or Salts, as have any Reſemblance with the true Cryſtal; either, as to their multangular, regular, or irregular Figure, or as to their Pellucidity, or any other of it's eſſential Properties. As the Number of theſe Bodies is very extenſive, ſo an exact Enquiry into them cannot but be both uſeful and agreeable. I juſt now obſerved, that the *Cryſtalli impropriè ſic dicti* are taken out of Stones, Metals, and Salts. To the firſt belong amongſt other Things ſuch precious Stones, as, in all Probability, have their certain, determined Cryſtal like Figures, as Diamonds, Amethyſts, *&c.* To the ſecond belong all Sorts of *Pyritæ*, as alſo the Growth of Silver, and other Metals, in Form of Trees, or other Things. By the third are underſtood all Chymical Preparations of Salts, and ſaline Bodies, the Figure of which is, generally ſpeaking, more accurate, than in any of the two former. Several Authors of Note have endeavoured to explain how, Cryſtallization is performed; or how it comes, that certain Subſtances ſhoot into Cryſtals. Dr *Cappeler* mentions the Hypotheſis of the learned *Guilielminus*, and that of a late *Swediſh* Author, *Swedenbergh*; and though he ſeems more to favour the latter, than he doth the former; yet he thinks, that they are both liable to Exceptions. But whatever the Cauſe or Method of Cryſtallization be, our Author takes it for granted, that three Things are abſolutely required for it, *viz.* *Salt*, which muſt always be an Acid, as is evident by Chymical Experiments, and the

CHAP. IV.

MAGNETICS.

I. AFter having given an Account of an Experiment made with the large Magnet in the Repoſitory of the *Royal Society*, (which Experiment is deſcribed in *Philoſoph. Tranſact.* N°. 344. Article 4.) the Letter goes on with the ſame Subject as follows. —— If it were known what point within the Stone, and what point in the Needle are the Centers of the Magnetical power, it would be eaſy to find the true powers of the Magnet at all the diſtances obſerved. For want of that Knowledge, I have computed the Forces from the Center of the Needle, and the Extremity of the Loadſtone, and find that at the diſtance of nine Feet, the Power alters faſter, than as the Cubes of the diſtances, whereas at the diſtances of one and two Feet, the Power alters nearly as their Squares. To try whether the Law, by which the Magnetiſm alters, could be reduced at all diſtances to any one certain power of thoſe diſtances, I ſought thoſe points in the Needle and Stone, which being uſed as the Centers of the power might have that property. But in that caſe, I found the Center of the Stone muſt be carried quite out of it's Figure, to make the diſtances large enough for this purpoſe. From whence it ſeems to appear, that the power of Magnetiſm does not alter according to any particular power of the diſtances, but decreaſes much faſter in the greater diſtances, than it does in the near ones.

An Account of ſome Experiments relating to Magnetiſm, by Dr Brook Taylor, N°. 368. p. 204.

This ſeems to be confirmed by other Experiments I made. The firſt Experiment was thus; I made a Needle $\frac{1}{4}$ of an Inch long, of very fine Steel-wire (a Foot length of which weighed but a Grain); which I lengthen'd by ſticking a light piece of Ruſh to it, ſo that I could obſerve the Direction of the Needle in all the trials with a *Radius* of two Inches. Inſtead of a Magnet I uſed a touched Needle of Steel-wire, which I ſet on a perpendicular to the Horizontal Plane I made the Obſervations on, by means of a Frame I made to tranſport it from one place to another; the North end of the Needle being placed downwards, and made a little ſharp, that it might mark the Paper it was ſet upon in every poſition, by preſſing the top of the Needle gently with the Finger. The Obſervations were made in this manner; after having taking notice of the natural direction of the ſmall Compaſs Needle, I brought the perpendicular Needle as near to it as I conveniently could, ſetting it in ſuch a manner, that a Line from the upright Needle to the Center of the Compaſs might be perpendicular to the Compaſs Needle. Then obſerving the ſame caution

(which was convenient to make the Center of the Compaſs ſerve ſufficiently well to be eſteem'd it's Center of Power) I placed the upright Needle at ſeveral greater diſtances, every time marking the place in the manner already deſcribed, and obſerving the Variation of the Compaſs. By this means I got a Curve pretty regularly and fairly drawn by points on the paper. And by examining this Curve, compared with the Variations of the Compaſs correſponding to it's reſpective points, I found that the Magnetical power decreaſed faſter at the greater diſtances than at the nearer. It is of little uſe to be very particular in the account of the ſeveral Obſervations. I ſhall only take notice, that at about two Inches and a quarter diſtance the Force did not alter ſo faſt as the Squares, and at ten Inches diſtance (where the Variation was one degree only) it altered faſter than the Cubes, the Index of the Power being about $3\frac{1}{4}$. The Needle of the Compaſs was ſo ſhort, that to ſuppoſe it's Center of Force to be either in the middle or at the extremity of it, would not alter the Index of the Powers of the diſtances $\frac{1}{10}$ of an Unit.

I made another Experiment to the ſame purpoſe, with a Compaſs Needle made of a ſlight piece of Straw, with a ſmall piece of Steel-wire faſtened to one end of it, which was always kept in the ſame poſition, being balanced between two perpendicular Needles, one of which was moveable, and the other fixed. The Event was much the ſame as in the former Experiment.

Endeavouring to find the true Poles, or Centers of the magnetical Power in touched Needles, I made a Needle of two Inches long, of the fine Steel-wire, which I touched with the South point of a ſmall capt Loadſtone, applying the point of the Cap only to the Extremity of the Needle, without drawing it along. The Needle ſo touch'd being laid gently on the Surface of a ſtagnant Water, floated. I then applied to it ſucceſſively the two ends of a touched Needle, as near as I could, without letting the Needles touch. The reſult was, that the floating Needle reſted under the reſpective Poles of the other Needle marked with the ſmall Letters *s*, *n*, *s*. So that by one Touch with the Loadſtone, which gave the Needle a North-pole at *N*, where it was touched, it acquired three other Poles, *s*, *n*, *s*, which we may not therefore improperly call it's conſequential Poles. Having diſcovered theſe conſequential Poles, I made ſome other Experiments to diſcover more of the Nature of them, as they are deſcribed in the Scheme. The Needles were all of them two Inches long, made of the ſame fine Steel-wire, and the Letters *N*, or *n*, and *S*, or *s*, denote Character, of North or South belonging to the points marked; the great Letters ſignifying the points the Loadſtone was applied to, and the ſmall Letters ſhewing the conſequential Poles.

Fig. 87.

There

There are two other Experiments deſcribed in the ſame Letter, relating to the Attraction of Fluids, one of which (*viz.* that of the *Hyperbola*, made by the Surface of the Water between two Glaſs-planes) being already deſcribed in the *Tranſactions* (N°. 336.) we ſhall only tranſcribe the Account given of the other.

I took ſeveral very thin pieces of Fir-board, and having hung them ſucceſſively in a convenient manner to a nice pair of Scales, I I tried what Weight was neceſſary, (over and above their own, after they had been well ſoaked in Water) to ſeparate them at once from the Surface of ſtagnating Water. I found 50 Grains to ſeparate a Surface of one Inch ſquare; and the Weight in every trial being exactly proportional to the Surface, I was encouraged to think the Experiment well made. The diſtance of the under Surface of the Board from the Surface of the ſtagnating Water, at the time they ſeparated I found to be $\frac{14}{100}$ of an Inch; though I believe it would be found greater, if it could be meaſured at a greater diſtance from the Edge of the Board, than I could do it, the Water riſing a little before it came quite under the Edge of the Board.

II. *Primum* volui experiri an magnetes in ſe operarentur juxta certam proportionem in diverſis diſtantiis, vidique in Actis Britannicis, N°. 335. pag. 506. ſimile veniſſe in mentem experientiſſimo *Hauksbejo*, ſed ipſum inſtituiſſe experimenta cum magnete & acu modo tali, qui omnibus non ſatisfaceret accuratis rerum ſcrutatoribus unde concludit tamen his verbis. *I ſee no Reaſon to doubt, but the Proportions of this Power will be regular, and agreeable to the ſeveral Diſtances.* Quæ verba non adeo placuiſſe omnibus Eruditis colligo, cum Nobiliſſimus *Taylor* eadem experimenta repetiit, N° 344. pag. 294. & alia reliquit obſervata. *Of Magnetical Powers, by* P. Muſchenbroek, *M. D.* N°. 390. pag. 370.

Rem eandem aggreſſus fui methodo prorſus diverſa, ſic meditatus, ſi ſumerem duos magnetes, & unum Suſpenderem ex filo ſupra alium, ad diverſas diſtantias à ſe invicem, ſique fili extremum annecterem bilanci, me ponderare poſſe quantitatem virium, quibus magnetes in ſe agebant; neque ſucceſſu caruit meditatio. Sumpſi accuratiſſimam bilancem, qua melior nullibi forte exſtitit, & uni brachio annexui lancem, alteri filum longiſſimum plurimorum pedum, cujus parti inferiori adhærebat magnes nudus; filum longiſſimum feci, ne actio magnetis ulla in ferream libram turbaret experimentum; ideoq; ſelegi locum in quo ferri tam parum, ac in ædibus unquam ſeligi poteſt. Sumpſi præſtantiſſimos magnetes perfecte ſphæricos, terrellas veſter *Gilbertus* vocavit, horum poli erant accurate in extremo utroq; axeos ſphæræ, ita accuratiſſime diſtantias amborum polorum menſurare poteram. Gravitatem magnetis primo reduxi ope ponderis in altera lance in æquilibrium; dein ambos magnetes poſui infra ſe, & quia libra erat, ope funis, mobilis ſupra trochleam, eam demittebam ad diverſas diſtantias pro lubitu, & cum magnes ſuſpenſus ageretur deorſum attractus vi magnetis inferioris, ſemper imponebam tantundem

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enough to affect it at a conſiderable Diſtance) will perform all that any Loadſtone can, though not with the ſame Degree of Power: For either of them will attract, keep one Piece of Iron ſuſpended to another, and communicate ſome Degree of permanent Polarity to Steel well hardened, as I have experienced, and alſo to an Iron Wire.

The Earth's central Loadſtone, or Magnet, has all the ſame Virtues which others have, and no diſcovered ones beſides; and though we cannot approach it, yet it acts as others do at a proportionable Diſtance. I have experienced, that it will keep a prepared Sixpenny (or with more Difficulty a Ten-penny) Nail ſuſpended to a prepared Iron Bar about $\frac{7}{8}$ of an Inch ſquare, and 5 or 6 Feet long, in an erect Poſture with either of it's Ends downwards. I hung up the Bar in a Room by a Loop of ſmall Cord faſtened at the End which was upwards; I then carefully wiped the lower End of the Bar, and the Point of the Nail, that there might be no Duſt, or Moiſture, to prevent a good Contact, taking Care not to touch either of them with my Finger, leſt Perſpiration ſhould ſully them. Then holding the Nail under the Bar very erect, with it's Point upwards, I kept it cloſe to the Bar, by only one Finger held under the Head of it, for the Space of 30 or 40 Seconds or more. Then I withdrew my Finger very gently, and directly downwards, that the Nail might not oſcillate; and if it fell off, I wiped it's Point as before, and tried it again at ſome other Part, of the Plain at the Bottom of the Bar; for I always found it would more readily hang at one Place than another and uſually the Middle was not ſo well as towards one of the Edges or Corners, and the Succeſs better nigh one Edge or Corner than another. If both Ends of the Bar are equal in Bigneſs, and the Preparation of their Ends ſimilar, it is indifferent which End is downward, if it has no permanent Virtue: But if it has no more than an inchoate or imperfect Degree of fixed Polarity, one End will anſwer better, and the other worſe, in Proportion to the Degree of imperfect Polarity which it has.

Of a ſoft Iron Bar void of fixed Polarity, ſo ſoon as it is in an erect Poſition, the higher Part from the Middle upward becomes a North Pole in North, or a South Pole in South magnetic Latitude. And, *e contra*, the lower Part from the Middle downward becomes a South Pole in North, and a North Pole in South Latitude: But ſo ſoon as ever the Bar is inverted, the Polarity will be ſhifted in it, and in North Latitude the End newly placed upward becomes the North Pole, though it was a South one immediately before, and the other End the South Pole, though it was it's North one juſt before The Caſe is the ſame, if ſuch a Bar is placed horizontally in or near the magnetical Meridian; for the End directed toward the North will conſtantly be a South Pole, and that which is directed toward the South, a North one; and ſo ſoon as ever the Ends of the Bar are ſhifted, the Polarity, in reſpect of the Bar, is ſhifted alſo (but not in

reſpect of the Earth) for which Reaſon this Virtue is called Tranſient, and is communicated by the Earth's central Magnet in ſuch Manner as other Loadſtones are ſaid to do.

Since in North Latitude the North Pole of the Earth's central Magnet not only gives the Virtue of a South Pole to that End of a Bar which is neareſt to it, but alſo helps it to lift Iron when neither the Bar nor Iron lifted has any permanent Virtue; the ſaid Magnet muſt therefore neceſſarily help the South Pole of any Loadſtone or Touched Steel in lifting Iron, but hinder it's North Pole. This agrees with common Experience, the North Pole of a Magnet being unable to lift ſo much as it's South one in North Latitude, but more in South Latitude.

This plainly ſhews the Reaſon why an armed Magnet, when both of it's Poles are applied to a Piece of Iron, will lift ſeveral times as much as with either Pole ſingle. For the North Pole of the Magnet by ſending it's Virtue through the attracted Iron, powerfully helps the South Pole of the ſaid Magnet in attracting. Again, the ſtrengthened South Pole muſt more powerfully increaſe the Attraction of the North Pole: And ſince the Poles mutually aſſiſt one another's Attraction, with a Power much greater than if they themſelves are not aſſiſted, the conjunct Poles muſt neceſſarily lift at leaſt twice as much as both of them can lift ſeparately. I once tried, and found the South Pole armed to lift 1125 Grains, and both Poles united 5769 with a little more Difficulty. The Ratio is about 1 to a little more than 5.

If a Bar of Iron or Steel (not having the leaſt Degree of fixed Virtue) is placed in any Poſture (except at, or near to a right Angle with the magnetical Line) it will not only for the preſent receive a tranſient Polarity thereby, but if it ſo remains long enough, the ſaid Polarity will gradually become fixed or permanent, more or leſs, according to the Hardneſs or Softneſs of the Bar, Time it has remained in that Poſition, Angle it's Length makes with the magnetical Line, and Proportion of the Lengh thereof to it's Bigneſs, the longeſt (*cæteris paribus*) uſually receiving moſt Virtue: And ſometimes when all theſe Advantages concur, the Polarity will be ſenſibly permanent in a little Time, and not require a very long Time to be rendered pretty ſtrong.

By placing the ſaid Bar afterwards in the ſame Poſition, only with it's Ends ſhifted, it will gradually loſe it's gained Magnetiſm, and at length have it's Polarity changed.

Mr *Boyle* found one of his Loadſtones much impaired by lying long in a wrong Poſture; I ſuppoſe he meant a repelling one, with it's North Pole towards the North Pole of the Earth. Alſo by applying one Pole of a very ſmall Piece of Loadſtone to the ſame Pole of a large one, he ſoon changed the Polarity of the former, but could not effect it on a Piece of any conſiderable Bigneſs, though

he tried ſome Hours. I have changed the Polarity of a ſmall Fruſtum of Load-ſtone ſuddenly, and without a Contact, by holding one of it's Poles nigh the ſame Pole of a Piece of Touched Steel much leſs than a common Caſe-Knife, at above ⅛ of an Inch diſtant, which would make the Fruſtum leap to it. I repeated theſe Changes frequently with the ſame Fruſtum.

From this, and ſome of the preceding Experiments, I conclude, that if two parallelopiped Load-ſtones equal in Magnitude and ſimilar in Subſtance, Figure, and Virtue, are placed cloſe together as in *Fig.* 95 with the North Pole of the one directed againſt the ſame Pole of the other, or with the South Pole of the one againſt the South Pole of the other, and the Direction of their Polarities magnetically Eaſt and Weſt, they will, by Repulſion, (as it were in a Duel) reciprocally deſtroy one another in an equal, though long Time: But if they are placed (in the ſame Situation in reſpect of one another, *viz.* North Pole againſt North Pole, or South Pole againſt South Pole) with the Direction of their Polarities in or near to the magnetical Line, that Stone (in North Latitude) whoſe South Pole ſtands directed to, or pretty much towards the attractive Point of the Earth's central Magnet receiving Aſſiſtance therefrom, will not loſe Virtue ſo faſt as the other, and conſequently never loſe all it's Virtue till it has perfectly deſtroyed the Polarity of it's Antagoniſt, which it will do in leſs Time, and afterward give it ſome Polarity again contrary to what it had at firſt.

Though Fire deſtroys fixed Magnetiſm in Steel or Iron, yet if they are ſet to cool in an erect Poſture, or rather in the Direction of the magnetical Line, they will gain more or leſs fixed Virtue by the Time they are cold; but eſpecially Steel heated to a ſeaſoning Height, and in that Poſition cooled ſuddenly under Water, which I have found to fix it's Polarity ſo thoroughly, as that with it's North Pole held downward, it would attract the North End of a Dial Needle.

While a Piece of Iron of ſome Magnitude is held at one Pole of a Load-ſtone, it will increaſe the Attraction of the other Pole thereof, and enable it to lift ſomewhat more.

If either Pole of a Magnet large enough, toucheth one End of an oblong Piece of Steel (not too big and long for the Magnet eaſily to act on) it will tranſmit it's own Virtue to the other End of the Steel which is fartheſt off, and make it a Pole of it's own Kind, whilſt the End which touches the Stone has Virtue of the contrary Pole: But the Virtue uſually is not ſo ſtrong in the End which is untouched, as in that which is; though I do not know but in ſome Time it may gain more, and the other loſe ſome, until the Virtue in each End is nearly equal.

Not only a touched horizontal Needle, which has permanent Polarity, will endeavour to conform itſelf to the magnetical Meridian,

but alſo one that has no other than tranſient Virtue, and is with the greateſt Care freed from fixed Magnetiſm (if made and uſed as in the *Præcogn.*) will do ſo too, though with this Difference, that which End ſoever happens to be placed neareſt towards the magnetical North will faintly turn thither; and if that End is not ſuffered to remain ſo too long, then the other End, placed neareſt to the North, will turn thither as the firſt did. In trying this Experiment, I ſometimes found, that when the Needle had reſted in the Meridian only a few Minutes, it gained a perceptible permanent Virtue, ſo that it's other End would not be attracted to the magnetical North, unleſs it was placed conſiderably nearer thereto than I had placed the firſt End; and having ſo ſtood ſome Time, loſt again the ſaid inchoate Permanency, and received Polarity, the contrary Way. Once, while I dined, and ſat but a little Time after, I could not make the End which I left towards the South, to ſtand towards the North, unleſs I placed it very true in the Meridian; ſo that I was forced to free it again from Magnetiſm before I could uſe it to repeat the ſame, or try the following Experiment; for the leaſt Fixedneſs of Polarity in the Needle would more or leſs obſtruct both.

At the magnetical Eaſt or Weſt of the Needle's Pin, ſo nice as I could gueſs it, I held at a great Diſtance, either the South Pole of a Loadſtone, or lower End (which is the South Pole) of an erected Bar (both of them anſwered alike) and gradually approached it nearer, in a direct Line, toward the Pin, until it began to attract the Needle, which I obſerved was as I expected at the South End: I then changed the Ends of the Needle, and gradually approached the South Pole of a Magnet as before, and conſtantly found it to attract that End which was toward the South; and the North Pole of the Magnet, after the ſame manner, would attract the North End of the Needle when it had only tranſient Virtue.

I remember, that in my younger Days I once diverted myſelf with making a horizontal Needle, and a Dial-Box for it, one of my School-fellows having a Load-ſtone. Before I could have the Uſe of the Stone, I often held my Needle within it's Box, ſometimes with it's intended South End towards the Bottom of a Window Bar, (having lately ſeen one of my Companions try it with his Pocket Needle, which was touched) and at other Times I would hold the Needle's North End at the Top of the Bar. I obſerved the Needle, which was hung very tender, to make Vibrations at either End of the Bar. I happened to ſet it down in the Window at a good Diſtance therefrom, and found the South End more inclined to vibrate to the Bar's Bottom than the North End, and ſeeing it to have ſome Virtue, I thought of encreaſing it by taking the Needle out of the Box, and applying it to touch the Bar with it's proper Ends. By this Method alone it gained ſuch a Degree of Polarity as would conſtantly

ſtantly turn it's proper End to the North, if it was kept trembling; but if I placed it's contrary End to the Bar, the Polarity would be changed preſently. By this Way of Management I could give it but a faint Verticity, which was ſoon more vigorous when I got the Uſe of the Stone, though it was ſmall, and not of the beſt, and the Needle ſoft Iron. And this was all, at that Time, I knew of Magnetiſm, having never read the particular Properties of the Stone, nor ſeen one before, nor heard of the untouched Needle's Verticity, or it's vibrating to a Bar.

Having within the Space of a few Years paſt had a freſh Inclination to make ſome magnetical Experiments, amongſt other Thoughts the above-mentioned came into my Mind, That Iron, not having any fixed Polarity at all, might (if it moved tenderly enough) conform it's Ends to the magnetical Meridian; which at length put me on making ſuch Needles as are deſcribed in the Beginning, of which either Sort anſwered my Expectations above-mentioned. Afterwards I touched one of the firſt Sort of Needles (deſcribed *Præcogn. 7th*, whoſe Length was 2 $\frac{1}{8}$ Inches, and Weight ℈ß and Gr. ij) on a Piece of tranſient Iron (made for Armour of a Magnet) which meaſured in Inches each Side of the broad plated Part about 1 $\frac{1}{8}$, the parallelopiped Part in Length 2, and in Breadth (equal to it's Thickneſs) $\frac{1}{8}$. So it's whole Length was full three Inches and $\frac{1}{8}$. It's Weight *Troy* was ℥iij ℈ij. This held with it's Length directed in the magnetical Line, gave the ſaid Needle Virtue enough to vibrate about four times in one Minute. I held the Needle, while touching, in a horizontal Situation, with it's North End directed towards the North, and placing it's Middle about the Top of the Iron, drew it along Southward. Likewiſe placing it's Middle about the Bottom of the ſaid Iron, I drew it Northward, that the South End might be touched as well as the North. I afterwards touched it my new Way (hereafter mentioned) with the ſaid Piece of Armour, and a ſmall Piece of tranſient Iron, which made it vibrate about ſix times, and I believe it would have made more Vibrations, had the Needle been hardened Steel.

Having no other than a ſmall Load-ſtone of a very irregular Shape, I was loth to diminiſh it enough to bring it into a tolerable Figure to receive Armour, but did only grind a little Place plain at each Pole, where I bound it on with Thread when I had ground it. The Weight thereof naked was but ℥vij ℈ij Gr. vj; it's armed South Pole would only lift ℥vij ℈ß Gr. iij, which was a Key. They not knowing where to get a better, made me think of improving what I had. I conſidered, that ſince a larger Stone of the ſame ſpecific Virtue would lift more, it might poſſibly communicate more Virtue than mine could to the ſame Piece of Steel, but could not fail of ſo doing to a much greater Piece; and having obſerved that touched Steel would communicate ſome Virtue as well as attract, I got ſome Steel Wire

Wire (the largeſt in the Shop where I could meet with any) which having cut into equal Pieces, and filed their Ends ſo tranſverſly as I could, and very plain, I made a Standard with a Plate of Iron, into which I could but juſt thruſt the ſhorteſt; and filing all the reſt till they would but juſt enter the ſaid Standard, I reduced them nicely to the ſame Length. Then having marked one End of each of them with the Edge of a File, I ſeaſoned them very hard, and made them, Ends and all, very bright. Each of them meaſured in Length about 2. 74 Inches, and weighed 36 Grains or more. I weighed one of them, and they were all of the ſame Piece of Wire, therefore could not differ much in Weight. With my Loadſtone I touched 37 of them, one by one, making their marked Ends their South Poles. I laid them Side by Side at about half an Inch Diſtance from one another on a Board, with their marked Ends toward the ſame Edge thereof, and took Care that they ſhould not touch one another after they came from the Stone, before they were all of them touched thereon. Then having Thread and Armour made as in the Figure (one Piece marked, which I applied to the *Fig.* 98. marked Ends of the Wires) in a readineſs, I ſpeedily thruſt them together into a Bundle, and caſting the Thread 2 or 3 times round them with my Fingers I formed the Bundle into a regular Hexagon as ſoon as I could, and then bound them faſt from End to End, and bound faſt the Armour. I took the Number 37, becauſe that would form a regular Hexagon at each End, and ſo will alſo 19 or 7. Finding this artificial Magnet exceed my natural one, I held the Artificial in one Hand, and the Natural in the other, the North Pole of the one againſt the South Pole of the other, and placing their Armour on the Middle of one of my Wires, drew the Magnets aſunder, and ſo touched both Ends of the Wire at the ſame Inſtant. In that manner I touched one by one a ſecond Set of Wires, which I managed like the firſt, and bound on the Armour of the firſt Set to the ſecond. The South Pole lifted a Key, Weight *Troy* ℥ij ℥ij ℥ij *Gr.* v. Both Poles united would, with Difficulty, lift the ſaid Key with Weights faſtened to it, the whole ℔j *Troy*. I next tried with 19 Wires, for which I made Armour of a proportionable Size; but that did not anſwer ſo well, I thought, as 37, though I repeated the Touch. Afterwards I took 7, which I thought performed according to it's Quantity as well as the 37. Therefore I ever after uſed the Number 7.

In the next Place I thought of mending this Way of Touching, by placing all the 7, or more of them, with their marked Ends toward the North in a long ſmall Trench, whoſe Depth was juſt fit for one of them, to keep it from rolling away while I was touching it and it's Fellows. The North End of one touching the South End of the other, and adhering by their magnetic Virtue, I placed the two Magnets, as before, at their conjunct Middle (not letting them remain

main there a Moment) and then inſtantly and ſpeedily drew one Magnet to one End of the Wires, and the other Magnet to the other End of them; by which Method I touched them, as it were all at once, and as if they had been but one entire long Wire. I found this Way not only more expeditious, but more advantageous, giving all of them a ſtronger Touch: But the Wire at each End was not ſo ſtrongly touched as the reſt; therefore I placed more Wires in the Trench than I had Occaſion for, and laid aſide thoſe at each End, whoſe Virtue was weaker. One of theſe Wires, when it was thus newly touched, would lift a prepared Nail 4. 75 Inches long, in Weight *Troy* 3vij *Gr.* vj or vij (*i. e.*) more than 426 Grains, The Weight of the Wire can be had in that of the Nail 11. 83⅓ times. I placed all the 7 ſeparately in the magnetical Line for about two Days; in which Time all of them had loſt ſome Virtue, yet one of them would with Difficully lift the Nail aforeſaid, which it lifted ſomewhat eaſier juſt after the Touch; and that which had loſt moſt Virtue, would eaſily lift a Nail of 4½ Inches long, in Weight 306 Grains.

Having ſuch Succeſs, I got ſeven round Bars of Steel to be made, from End to End of one Size, ſo that they would but juſt go through a Hole made on Purpoſe in a Plate of Iron, and tried their Lengths in a Standard as I did the others, and marked one End of each of them with the Corner of a File in this Manner, that I might be able to ſee the Mark when they were bound together, leſt either of them ſhould be placed with it's End the wrong Way. Their Diameters were about ⅛ of an Inch, and their Lengths about 12¼ Inches good Meaſure. I hardened and cleanſed them as I did the Wires, but one of them happening to break by a Fall in touching, I got it ſupplied, and, for Fear of ſuch another Accident, reduced them to almoſt a blue Colour. I laid them one after another in a Trench planed for them, in a long Piece of Wood about the Depth of half their Diameter, putting their marked Ends all one Way: I made a Hole in the Trench a few Inches from one End of the Piece of Wood, and put a Pin in it to keep the Bars from ſliding to the Ground, and elevated the other End till it was, as I gueſſed, in the magnetical Line. I then touched them with two of my Magnets as before, and this I found the beſt Way of all. When they were finiſhed, and armed with proper Armour, the North Pole lifted above half a Year after lb j *Troy*, and the South Pole conſiderably more. In making one of theſe, I met with an odd Accident; for after I had begun to touch it apprehending it was a ſmall Matter bigger than the reſt, I attemted to mend it on a Grinding-ſtone, whoſe Axes were directed about 14 or 15 Degrees from Eaſt towards North, and from Weſt towards South. I was not careful to keep it's Poles the proper Way in grinding, but held the Bar ſometimes a-croſs to the Stone, which would make it jar, at other times, with the North Pole toward the North

Fig. 99.

North. Afterwards I touched it again with the reſt, but could not give it an Attraction equal to that of the others. I happened to try with my Dial-Needle whether the Change of Polarity was in the very Middle of the Bars, or nearer to one End than the other, and in this Bar found ſeveral Polarities contrary to my Expectation, but how many I am not certain, being ſeveral Years ſince, and I not heeding it nicely. As I held it erect, the Bottom was a South Pole, further up no Attraction, the Pole changing a little higher (I think one third Part of the Bar's Length) a ſtrong North Pole, and about $\frac{2}{3}$ up a ſtrong South Pole, and at the Top a ſtrong North Pole, the Middle between each Pole not attracting. Whether the jarring on the Grinding-ſtone while held in a wrong Poſture was, as I ſuppoſe the Cauſe of this irregular Virtue, or whether I might at firſt, by Miſtake touch it the contrary Way, I durſt not poſitively aſſert; but all my Care and Labour would not help it by touching: For, as the Virtue became ſtronger in the Ends, ſo did alſo the Polarities in the other Parts of the Bar. I was ſomewhat concerned at this Diſappointment, doubting it muſt have been new ſeaſoned, which would have created the Trouble of cleanſing and poliſhing it the ſecond Time. I thought firſt that I would try to cure it by puting it over freſh Wood-Coals in a horizontal Poſture, with it's intended South Pole directed towards the magnetical North, which I did, and ſo kept it until it was blue. Then I took it out of the Fire, and cooled it in almoſt the ſame Poſture, for I think the North Pole thereof was elevated. I tried it without retouching, and found it perfectly cured, the Polarity regular throughout, and (which I was ſurprized at) attracted full as ſtrongly as either of the reſt.

I next endeavoured to procure Magnetiſm in Steel, without the Aſſiſtance of any Magnet (except the Earth's central one.)

Finding my artificial Magnets, rightly uſed, would communicate more Virtue to other Steel than they themſelves had, and obſerving that erect Bars had ſome Virtue from the Earth's Magnet, and having alſo experienced that Iron, which had only tranſient Virtue, would, when in an erect Poſture, or in the magnetical Line, give a ſmall Degree of fixed Polarity, I ordered nine Steel Bars 0.75 of an Inch ſquare, and 16 Inches long, to be made. Some of them through the Smith's Fault were a little leſs; the Weight of the heavieſt was, after it was finiſhed, 3 ℔ *Avoirdupois*. I made them moderately bright by grinding, and filed their Ends as plain as I could, and tranſverſe to their Lengths, by help of a Carpenter's Square; then marked one End of them, and, when hardened, I ſcowered them bright, and poliſhed their Ends very well. I fitted a Piece of Armour for each End of one Bar, and marked the Piece which was for the marked End of the Bar, and bound faſt both Pieces of Armour to the ſame Bar, one at each End: Then ſtanding with my Face toward the Weſt, and holding the Palm of my Left Hand up-

ward, I placed therein one of the Bars without Armour with it's marked End Northward, and graſped it faſt at it's Middle, with my Fingers on the Weſt Side, and the Ball of my Thumb on the Eaſt Side, where I alſo laid along my whole Thumb to keep it ſteady: So the upper Part of the Bar was open from End to End. Thus holding it, I elevated the South End thereof until I gueſſed it was in the magnetical Line; and holding with my Right Hand the armed Bar, with the Poles of the Armour downward, and the marked End toward the North depreſſed to the magnetical Line, I placed the Pole of the upper Armour about 4 or 5 Inches from the Top of the unarmed Bar, and as ſoon as ever it touched the Bar, I began with the greateſt Speed I could make, to draw it downward until I was paſt the Middle, and from thence to the Bottom gradually ſlower When it was at the Bottom I permitted it to reſt there about 1 or 2 Seconds. After the ſame Manner applying the Pole of the lower Armour to the unarmed Bar about 4 or 5 Inches from it's Bottom, I drew it upward, ſpeedily at firſt, ſlower when above the Middle letting it reſt a little at the Top. Having upwards and downwards alternately repeated the Touch on the ſame Side of the Bar, I touched the oppoſite Side thereof, which was next my Hand, in the ſame Manner and afterwards the two other Sides. Then holding the unarmed Bar erect, I uſed to ſee if it had gained any fixed Polarity by holding my ſmall Needle at the Top and at the Bottom of the Bar; for if it had gained any Virtue by the Touch, it would attract the Needle ſtronger, at the ſame Diſtance, when the marked End of the Bar was held downward, than when it was held upward. If I found it had gained any ſenſible Virtue I took off the Armour from the firſt Bar, and bound it to the ſecond which I had touched, and after the ſame Manner touched the firſt Bar with the ſecond, as I had touched the ſecond with the firſt. And when by Trial with the Compaſs-Needle I found the armed Bar had communicated to the other more Virtue than was in itſelf, I took off the Armour and bound it to that which was newly touched, and therewith retouched that which I had diſarmed. In a few Repetitions of changing the Armour from Bar to Bar, and touching the weakeſt, I procured in both of them (without the Aſſiſtance of either of the other ſeven) a fixed Polarity to ſuch a Degree as that the Noth Pole, or unmarked End of either of them held downward, would attract the North End of the Needle, though much fainter than if the North Pole of the Bar had been upward, and Poſition did not now change their Polarities, but only weaken them: Therefore I now call their Virtue perfectly permanent. Four or five Repetitions more encreaſed their Virtue to ſuch a Degree as that the South Pole of one of them would lift a Ten-penny Nail prepared, and after 2 or 3 Repetitions more a common Door Key of an Iron Box-Lock, Weight *Troy* ℥j and above ℈ij, not by the Bow but by it's lower End, which was

wrought ſomewhat globular and poliſhed. In the laſt Place I got a Piece of Inch Deal above three Inches broad and 7 or 8 Feet long, in the Middle whereof, at about 5 or 6 Inches from one End, I made a Hole through with a large Gimlet, into which I drove an Iron or Steel Pin, whoſe Length (beſides what went into the Wood) was a little leſs than the Thickneſs of one of the Bars. Then I placed the biggeſt Bar on the ſaid Board with it's marked End cloſe to the Pin, and it's Length parallel to that of the Board, and with an Awl made four ſmall Holes in the Board, one of them on each Side of the Bar about an Inch from the Bottom, and about the Thickneſs of a Six-pence, from it's Sides, and the other two after the ſame Manner, about an Inch from the Top. I drove into them Pins of large Wire half an Inch long, beſides what was in the Board. The Pins were to keep the Bars from ſliding out of their Places in touching. Then removing that, and placing any other Bar between the ſaid Pins, with it's marked End cloſe againſt the great Pin, I placed the marked End of the ſaid biggeſt Bar cloſe againſt the unmarked End of the other, and made four Holes on it's Sides, and drove Pins in them as before, and ſo continued to do, until the Board was full: It held half a Dozen Bars. I took Care to place the marked End of every Bar directed towards the great Iron Pin which was to keep them from ſliding down to the Ground, when the other End of the Board was elevated, to ſtand in the magnetical Line. The Board ſtanding with one End on the Ground, and the other leaning againſt the Wall, at the South End of the Room, I took the armed Bar, which had Virtue, and placed it's North Pole's Armour about the Middle of the higheſt Bar, whoſe Middle I could reach to (keeping the Armour of the South Pole a little upon one Side of the Bars, juſt ſo far as I might be ſure not to touch them with that End) and then immediately drew it from thence downward to the Bottom of the loweſt Bar: After the ſame Manner placing the Armour of the South Pole on the Middle of the loweſt Bar (and holding the armed North Pole on one Side, that it might not touch) I drew it upward to the Top of the higheſt Bar, whoſe Top I could reach. And if the End of any Bar was a little under that which it reſted againſt, I uſed to put a ſizeable Chip under it, that the Armour might not hitch in drawing it over the Places of their Contacts. I uſually touched the Bars on all four of their Sides, then took out the loweſt, and (letting the reſt gently ſlide down to the Iron Pin) placed it at the Top, that thoſe which were firſt at the Top might in their Turns take their Places in the Middle, and be well touched. I commonly reſted at the End of each Bar in drawing (as in the ſingle Bar before-mentioned,) When I found thoſe on the Board conſiderably ſtronger than my armed one, I took out that which I thought attracted beſt, and bound the Armour to it, putting the other in it's Room. After ſeveral repeated Touchings,

the biggeſt of them being ℔iij *Avoirdupois*, would be ſuſpended by it's North Pole to the South Pole of one of the beſt of the others. They did not lift one another, or attract ſo well when their Ends were applied centrally, as when applied to one another (as is expreſſed in the Figure) near to their oppoſite Corners. The Line *m* in the End of each Bar repreſents the Manner I uſed to mark their intended South Poles. With one of theſe armed, I touched a ſmall ſquare Bar of Steel (placed betwixt two of the great ones) the Length whereof was 2.156 Inches, the Breadth of each Side 0.27 or ſomewhat more than $\frac{1}{4}$ of an Inch) the Weight ℥v Gr. iv (*i. e.* 304 Grains) it would lift afterwards an Iron $5\frac{1}{4}$ Inches long, weighing ℥iv ℥j ℈j or, 2000 Gr. 304 can be had 6.578 times in 2000. So it lifted above $6\frac{1}{2}$ times it's own Weight. With this little Bar naked I touched a ſmall Dial-Needle made of Steel (the Socket in the Middle was alſo Steel, and not Braſs, as uſual) I ſeaſoned it very hard, and cleanſed it well, and with much Care, not to break it, becauſe ſo hard. It weighs not full 4 Grains, has lifted two prepared Six-penny Nails, one at each End, while it was held in an horizontal Poſture with it's South Pole towards the North. It alſo lifted a Key by the Bow, as it was held perpendicularly with it's South Pole downwards, the Weight whereof was ℥j ℈ij Gr. xv good Weight (*i. e.* 115 Grains or better). Wherefore ſince the Needle weighed leſs than 4 Gr. which is the 29th Part of 116, we may reckon it lifted full 29 times it's own Weight by the Force of one Pole, the Key having no permanent Virtue before.

Fig. 100.

I never ſaw this Communication of Magnetiſm outdone by the Load-ſtone itſelf, as it is commonly uſed; but what a good one would do, uſed as I did the Steel, I know not for want thereof, but doubt, unleſs Steel could be made better than it uſually is, a ſtronger Degree of Attraction therein is ſcarce to be hoped for from the Uſe of the beſt of Load-ſtones.

I uſually find the attractive Power in ſquare Bars cut plain over tranſverſe to their Lengths, to be ſtrongeſt, not in the Middle of their Ends, but much nearer to their Corners or Sides, and to be greater at one Corner or Side than another; and this not only in ſuch as are of touched Steel, but in Iron ones having no Polarity, but from their Poſition. The ſame I obſerved in round Bars, if their Ends are not convex.

In ſome of my large Steel Bars (as alſo in ſome of the round Bars) I found the North Pole ſtrongeſt, in others the South. I know not the Cauſe thereof; for though I touched the weaker End twice as often as the ſtronger, it would ſtill continue to be ſo, when the ſtrongeſt had been well touched before. I imagine it muſt be owing to ſome Inequality of the Steel occaſioned by the different Degree of Heat taken at the Forging; different Degree of Heat when the Smith deſiſted hammering; different Degree of Heat

in making the Iron into Steel, or Quantity of what is uſed in doing it; Fineneſs of the Iron whereof the Steel was made, ſome ſmall Difference in Magnitude, or Difference in ſeaſoning, it being almoſt impoſſible to make both Ends equally hard; but that both Ends of mine might be ſo, I had a Fire made long enough to heat their whole Length at one and the ſame Time.

I left ſeveral of the Bars on the Board whereon they were touched, and in the ſame Poſition to one another, as well as to the Earth, for ſome Months, to ſee whether they would loſe any of their Virtue; but if they did, it was ſo little, that I could not be ſure thereof.

I alſo tried whether what I mentioned above concerning Loadſtones would hold in 5 or 6 Bars regularly touched and placed to one another in the ſame Manner; and found that at ſome of the Joinings it anſwered pretty well, but not ſo well at others, uſually beſt at the two extream Joints, and worſe at the middle ones. When I held the Dial-Needle at a good Diſtance from the Bars (perhaps 6 or 8 Inches) the Attraction was more regular, and the different Poles of the two Bars at their Contact was not ſo eaſily diſcernible; but when I held it within 2 or 3 Inches Diſtance, both the Poles diſcovered themſelves more or leſs at every Joint. Perhaps the Cauſe may be the Want of a better Contact, the Ends of the Bars not being true Planes; or it may be partly owing to their Conjunct Length (though I cannot ſee how that ſhould cauſe it) or ſome Irregularity in the Virtue of each particular Bar. For it has been obſerved, that very oblong Iron, as Wire, is capable of having a North Pole in both Ends, and a South one in it's Middle; or, as my round Bar beforementioned, ſeveral Polarities in no greater Length than about one Foot. My Bars were not made of *German*, but more ordinary Steel, of about 4 *d. per* ℔.

Of the Magnetic Quality acquired by Iron, upon ſtanding for a long time in the ſame Poſture, by Mr Anthony van Leuwenhoek F. R. S. No. 371. pag. 74.

IV. 1. I take this Opportunity of informing you, that the Iron-Croſs, which is ſuppoſed to have ſtood upon the Steeple of the New-Church here about two hundred Years, having been lately taken down to be repaired, I was informed by a certain Foreign Gentleman, that a piece of Iron, that has ſtood for a long time in one Situation, would thereby acquire a Magnetic Quality. Upon which I deſired a Workman to procure me a piece of that Croſs, who accordingly brought me a bit of it, of about a Span long, and a quarter of an Inch thick, which I applyed both to a working Needle, and the Needle of the Compaſs, but without any Effect upon one or the other.

Some time after, the ſame Workman brought me ſome other pieces, looking like ruſty Iron, which he had broken off from the bottom of the Croſs, where it had been faſtened by four croſs pieces bound down with Iron, to an erect piece of Timber nine Inches ſquare, and covered with Lead in ſuch a manner, that no wet could get to it.

This

This ſeeming ruſty Iron would take up ſeveral Needles hanging by one another, and appeared to have a ſtronger Magnetic Virtue than two Loadſtones, which I had then in the Houſe; and was ſo hard, that no File would touch it. I gave one of the greateſt pieces to a Knifegrinder, to grind it for me, who was a long time about it, and complained that it was harder than Steel.

A way to communicate the Magnetical Virtue to Iron and Steel, without the help of a Load-ſtone, by Arnold Marcel (*Nephew to the late Mr* Anthony van Leuwenhoek, *F.R.S.*) No. 423. pag. 294.

2. In the Year 1722, I obſerved that a long heavy Bar of Iron being ſet upright, and ſome Filings of Iron, or a Bit of Iron Wire, laid upon it's upper End, thoſe Filings or Wire would ſtick to another Piece of bright pointed Iron, and ſuffer itſelf to be lifted up from the ſtanding Bar even to the Height of five Inches.

In the Year 1726, making ſeveral further Obſervations about the magnetical Force, which I found in great Pieces of Iron, I made uſe of a large Iron Vice, about 90 ℔ Weight, in which I fixed a ſmall Anvil of about 12 ℔. Upon the bright Surface of this Anvil I laid the Steel, to which I would give the Virtue, in a Poſition of North and South, which happened to be in a Diagonal of the ſquare Surface of the Anvil; then I took a Piece of Iron, 1 Inch Square, and 33 Inches long, of about 8 ℔ Weight, having at one End the Figure here repreſented brightly poliſhed at *a*, and taper at the other End: Then I held faſt down the Piece of Steel upon the Anvil with one Hand, and with the other I held the Iron Bar aforeſaid perpendicular with it's Point *a* upon the Steel, and preſſing hard, I rubbed the Steel with the Iron Bar towards me, from North to South, ſeveral Strokes, always carrying the Bar far enough round about, to begin again at the North, to prevent the drawing back of the magnetical Force: Having thus given 10 or 12 Strokes, I turned the Steel upſide down, leaving it in the ſame Poſition as to North and South and after rubbing it and turning it, 'till I rubbed it about 400 times, it received by degrees more and more Strength, and at laſt had as much as if it had been touched by a ſtrong Load-ſtone. The Place where I began to rub was always that which pointed to the North, when the Needle was hung, the End where I had ended the Stroke turning to the South. Sometimes it has happened, that in a few Strokes I gave the Steel it's Virtue; nay even in the very firſt Stroke one may give a great deal to a ſmall Needle. This Way I have given the magnetical Virtue to Needles of Sea-Compaſſes made of one Piece of Steel, as the Figure 101, ſo ſtrongly, that one of the Poles would take up ½, and the other a whole Ounce of Iron, although theſe Needles were anointed with Linſeed Oil, which made a hard Coat, to keep them from ruſting, yet they kept the Virtue; but in Strengthning theſe Sort of Needles, I rubbed by turns firſt to the right and then to the left Side.

Fig. 101.

Fig. 102.

The ſame Way I brought the Virtue into the Point of a Knife, ſo that it would ſuſtain 1 ¼ Ounce.

I brought

I brought the ſaid Virtue into four ſmall Pieces of Steel, each 1 Inch long and $\frac{1}{4}$ Inch broad, as thin as the Spring of a Watch. Theſe four Pieces I joined together, as into an artificial Loadſtone weighing them 18 Grains *Troy*, and then it did draw up and ſuſtain an Iron Nail, which weighed 144 Grains *Troy*: This artificial Loadſtone has now theſe ſix Years been tumbled about, and been lying among Iron and Steel, and in any Poſition, and yet it has rather got more than loſt any of it's Virtue.

The magnetical Virtue being thus brought into Iron or Steel, I have farther obſerved, that that End where the Stroke was begun, would draw to the North, and where the Stroke ended to the South in whatever Situation the Steel had been laid upon the Anvil to give it the Virtue. I took a Piece of Steel and rubbed it from one End to the Middle, and then from the other End to the Middle, and found it had two North Poles, one at each End, and the Middle a South Pole.

Further beginning to rub from the Middle towards each End of another Piece of Steel, I found it to have at each End a South Pole, and in the Middle a North Pole.

I have put a pretty heavy Compaſs-Needle after I had given it it's Virtue, into the Fire, and made red hot three times one after another letting it grow cold every time: It loſt ſome Virtue every Heat, but at the third it had a great deal ſtill left, and making it for the fourth time white hot, it loſt it all.

When I covered the Anvil with a Piece of Woollen Cloth, and the End of the Iron Bar with a Piece of Shamoy Leather, it gave no Virtue to the Steel; then covering only the Bar, and leaving the Anvil uncovered, it gave not any Virtue that way neither: But covering the Anvil, and leaving the Bar uncovered, it gave the full Virtue.

I have tried whether my Vice had any fixed Pole by ſtanding long in one Poſition, but I found it had not.

I have tried to do this with an Anvil of about 30 ℔ Weight, being fixed in Wood; but could not come up to the other Proofs.

I believe if one took an Iron Bar of three Inches ſquare, and 10 or more Feet long, or ſeveral of them upon each other, and a ſuitable Piece or Bar of Iron to rub withal, and giving the under Part of the ſtanding Bar the Figure aforeſaid, repreſented by B, it might be brought to a vaſt Strength. *N. B.* The Steel for the Needles is always of a Spring Temper.

I have made two Pieces of Iron, at one End $\frac{1}{4}$ of an Inch, and ſo Taper to $\frac{1}{4}$ of an Inch ſquare each [*the Length was not mentioned*] and fixed theſe two Pieces of Iron to a Piece of Wood in the Shape of an armed Loadſtone, at about 8 Inches one from the other, applying to the under Part of theſe Irons, or Legs, a Piece of Iron with a Hook to it, as to an armed Loadſtone. I hung this armed Piece of

of Wood with each Leg over an Iron Bar (at a Diſtance that ſomething might hang between them) then placed the Piece of Iron with the Hook to it to the two Feet, and I found it to draw very ſtrongly; but my Trial was but with ſmall Tools. I ſuppoſe if one did this in a larger Proportion, I doubt not but it would have a great Effect.

Having ground ſome Loadſtones with Emmery, I have ſaved the Grinders, and mixing them with Water, ſo that they might eaſily be moved, I put them into a Bottle to ſink, placing on each Side a Loadſtone, one with it's North, and the other with it's South Pole towards the Bottle, and found, after the Matter was ſettled and dried it formed itſelf into a Sort of Loadſtone, which had a moderate Strength, and two regular Poles.

Explanation of the Figures.

Fig. 101. The End of the Iron Bar, with which the Virtue is rubbed into the Steel or Iron.

Fig. 102. The Needle of a Sea Compaſs.

Fig. 103. The Figure of the Point, on one Side.

Fig. 104. The Figure on the Point, of the other Side.

Fig. 105. A, The Needle of a Compaſs. BB, The End or Edge of the Bar, with which the Needle is rubbed beginning at CC, and proceeding to DD.

Obſervations of the Dipping *Needle, made at* London, *in the Beginning of the Year* 1723. *By Mr* George Graham, Watchmaker, *F. R. S.* No. 389. p. 332.

V. About the Time I was obſerving the Variation of the Horizontal Needle, I made likewiſe ſome Experiments with the Dipping Needle, to try, if the Dip and Vibrations were conſtant and regular. The Needle I made for this Purpoſe was 12 Inches and one Tenth long, half an Inch broad in the Middle, but not above one Tenth near the Ends; the Ends themſelves being filed to fine Edges; and in Thickneſs it was about one Third of a Tenth. The Ends of the Axis, upon which the Needle turned, were very ſmooth, and not bigger than was neceſſary for the Support of the Needle, which weighed nine Pennyweights twenty one Grains, or about half an Ounce *Troy*. The Ends of the Axis were placed upon the Edges of two thin Plates of Steel, that were hard and well poliſhed, and parallel to the Horizon, that the Needle, when vibrating, might roll, and not ſlide upon the Edges of the Plates, to avoid the Friction they would have been ſubject to, by moving in Holes. A Braſs Semicircle was provided, and from the loweſt Point graduated each Way and a few of the Degrees, about that Part of it which anſwered to the Dip, were divided into ſix equal Parts. By the Help of Screws, the Semicircle could be brought to a due Situation; and by two ſpirit Levels, placed at right Angles to each other, any Change of Situation was eaſily perceived, and by the Screws it could be readily reſtored to it's former Poſition; all was incloſed with Glaſs to

ſecure

ſecure the Needle from being diſturbed by the the Motion of the Air. I muſt here take Notice of the great Difficulty there is of poiſing the Needle ſo exactly, before it is touched with the Loadſtone as to take any Poſition indifferently: for, when it is pretty near the Truth, it is extremely troubleſome to place it at reſt in the Poſition deſired, in order to try which Way it is inclined to move. It cannot be done in the open Air; for the leaſt Motion of it will diſturb the Needle, and when it is ſhut up, it is no eaſy Matter to ſettle it in the Place intended. And that there will be a ſenſible Difference of the Dip, upon ſhifting the Sides of the Needle, whatever Pains be taken to prevent it, I am fully ſatisfied from the following Experiments.

I touched both Sides of that End of the Needle, which I deſigned to point South, upon the North Pole of a ſmall *Terrella*; after which I cauſed it to vibrate in an Arch of ten Degrees, and counted the Time by a Pendulum Clock, ſhewing Seconds, till the Needle had performed 50 Vibrations. *March* 20, 1722. *Experiment* I.

	I	II
It performed the firſt 25 Vibrations in	2	58
The next 25 Vibrations in	2	27
The 50 in	5	25
Which gives for each Vibration at a Medium		6, 5
The Needle dipped	73°	15′

Then I ſhifted the Needle ſo that the Side, which before reſpected the Eaſt, was now turned Weſt, and cauſing it to vibrate in the ſame Arch, as before, it performed *Experiment* II

	I	II
The firſt 25 Vibrations in	2	49
The next 25 in	2	39
The 50 Vibrations in	5	28
That is, each Vibration in		6, 56
The Dip	73°	50′

I now touched the ſame End of the Needle, a ſecond Time, on both Sides, upon the ſame Stone, and ſuffering it to vibrate as before, *Experim.* III.

	I	II
It performed 25 Vibrations in	2	49
That is, one Vibration in		6, 76
The Dip	73°	20′

The Needle was now ſhifted, and ſtood as in the ſecond Experiment. *Experim.* IV.

	′	″
It performed 25 Vibrations in	2	41
That is, one Vibration in		6, 44
Dip	7 3°	45′

Experim. V. The ſame End of the Needle being now touched twice on each Side, with the Loadſtone preſented by the Lord *Paiſley* to the Royal Society, in the Armour,

	′	″
It performed the firſt 25 Vibrations in	1	58
The next 25 in	1	46
The 50 Vibrations in	3	44
That is, each Vibration in		4, 48
The Dip	73°	55′

Experim. VI. The Needle being turned, and ſtanding as in the ſecond and fourth Experiments, it performed

	′	″
The firſt 25 Vibrations in	2	00
The next 25 in	1	57
The 50 Vibrations in	3	57
That is, each Vibration in		4, 74
The Dip	74°	10′

Experim. VII. I now touched the Needle at both Ends with the ſame Stone, with which it was touched in the fifth Experiment, after which it performed

	′	″
The firſt 25 Vibrations in	1	35
The next 25 in	1	34
The 50 in	3	9
That is, each Vibration in		3, 78
The Dip	74°	20′
The Dip repeated with the Needle taken off and replaced	74	20

Experim VIII. Upon ſhifting the Needle, it performed

	′	″
The firſt 25 Vibrations in	1	33
The next 25 in	1	34
The 50 in	3	7
The Dip	74°	25′
The Dip repeated	74	03

N.B. The

N B. *The Needle had the same Side to the East in the first, third, fifth, and seventh Experiments; and had that Side turned Westward in the second, fourth, sixth, and eighth; and I began to count the Vibrations, when I observed it to vibrate just* 10 *Degrees, as near as I could guess. All these Experiments were made with sufficient Care in every Particular excepting the Quantity of the Dip, which requires the Divisions of the Semicircle to be very equal, and the* 90*th Degree to be perpendicular under the Axis of the Needle; this last I found was a little faulty, the Dip being in Reality greater than the Semicircle shewed it. After I had rectified this Error, and new touched the Needle, upon that Part of the Armour to which Iron is applied, when it is to be lifted by the Stone, it performed the same Number of Vibrations in less Time than in any of the former Trials. I now determined to observe, for some Space of Time, both the Dip and Vibrations, without fresh touching the Needle.*

The Observations follow, by which it appears there is a very considerable Difference, both in the Quantity of the Dip, and in the Quickness of the Vibrations.

N B. *In all these Experiments, the Needle was placed, so as to vibrate exactly in the Plane of the Magnetic Meridian; and sufficiently distant from all Iron that could affect it, as far as I could perceive, till I had Occasion to put up a very large Iron Rod in the Rome above it, which immediately altered the Dip of the Needle, and thereby put an End to these Trials.*

1723.	Dip	Time of the Day.
	o ′	h ′
Mar. 29.	75=00 at	10=00.
	74=53	4=15
30.	74=55+	1=00
	74=50—	4=00
31.	74=50—	10=00
	74=50—	12=30
	74=50—	2=15
April 1.	74=25	6=45
	74=25—	7=15
	74=20+	9=00
2.	74=20+	7=30.A.M.
	74=20+	7=30.P.M.
3.	74=20+	9=30
	74=20+	12=30
	74=50	4=15
Apr 4.	74=55+	10=00
	74=50+	11=15
	74=40	12=45
	74=35	7=30
5.	74=40	9=15
	74=40	1=45
	74=40+	5=30
	74=30+	8=15
6.	74=35	10=00
	74=35	12=00
7.	74=35+	10=20
	74=35+	12=30
	74=35	4=00
	74=35	6=30
8.	74=40—	12=15
	74=40—	3=30

	Dip	Time of the Day.
	o ′	h ′
April 9.	74=40—	10=00
	74=40—	4=15
10.	74=40—	10=00
	74—30+	8=00
11.	74=35+	10=00. A.M.
13.	74=40—	
14.	74=40—	10=45
	74=40—	11=15
	74=35	5=10
	74=35	8—17
15.	74=35	9=10. A.M.
16.	74=35	11=00
	74=30+	8=45
17.	74=45	12=25
18.	74=40+	9=15
	74=45	5=00
19.	74=45	9=00. A.M.
20.	74=45	
21.	74=50	10=30

	Dip	Time of the Day
	o ′	h ′
April 23.	74=50	12=00
26.	74=50+	2=30
27.	74=55	
28.	75=00	1=00. P.M.
	75=00	3=15
	74=58	5=15
30.	74=40	3=15
May 1.	74=45	1=30
2.	74=45	12=00
	74=45+	1=00
	74=40+	3=50

The Weight of the dipping Needle 9pt. 21gr. *Troy.*

N. B. *The Mark* + *ſignifies ſomething more than is here ſet down, and* — *ſignifies ſomething leſs, but the Difference could ſcarce amount to more than two Minutes.*

Experiments of the Vibrations of the Dipping-Needle, *beginning with an Arch of* 10 *Degrees, with the Times in which* 100 *Vibrations were performed:*

172 h ′
April 1. about 7=15 Afternoon.
First 50 in 3=11
Laſt 50 in 2=45
The 100 in 5=47. Dip 74°=25′—

April 2. in the Evening
First 50 in 3= 3
Laſt 50 in 2=43
The 100 in 5=46. Dip 74=20+

h ′
April 3. about 4 in the Afternoon.
First 50 in 2=52
Laſt 50 in 2=39
The 100 in 5=31. Dip 74=50.

Repeated about an Hour after.
First 50 in 2=53
Laſt 50 in 2=35
The 100 in 5=28. Dip 74=50+

1723 h
April 4. about 11=15 in the Morn.

First 50 in 2=54
Last 50 in 2=30

The 100 in 5=24. Dip 74=50+

April 28. about 5=15 Afternoon.
First 50 in 2=48
Last 50 in 2=16

The 100 in 5= 4. Dip 74=58

Repeated

First 50 in 2=47
Last 50 in 2=16

The 100 in 5= 3. Dip 74=58

May 20.
First 50 in 3=11
Last 50 in 3= 1

The 100 in 6=12

Repeated the Needle being new touched.

First 50 in 2=38
Last 50 in 2=23

The 100 in 5= 1. Dip 74=35

Repeated again about an Hour after.

First 50 in 2=38
Last 50 in 2=20

The 100 in 4=58. Dip 74=30+

May 21. about Noon.
First 50 in 2=41
Last 50 in 2=28

The 100 in 5= 9. Dip 74=30

May 23. about 12h=45'
First 50 in 2=40
Last 50 in 2=27

The 100 in 5= 7. Dip 74=40

May 25. about 3=30
First 50 in 2=41
Last 50 in 2=30

The 100 in 5=11. Dip 74=40+

May 27. about 6=30 Afternoon.
First 50 in 2=41
Last 50 in 2=28

The 100 in 5= 9. Dip 74=50

VI. 1. *Wednesday, June* the first 1720, being at Anchor near *Revel*, in the Latitude of 58° 58' North, the Magnetical Amplitude at Sun-set was

West ——— 64° 30' North
And the true was West ——— 49 37 North

Variation North ——— 14 53 West.

Magnetical Variations, in the Baltick, *by Mr* William Sanderson, N°. 366. pag. 120.

Saturday July 23, at the Isle *Gottsand* in the Latitude of 58° 21' North, at Sun-set, the Magnetical Amplitude was West ——— ——— ——— 49° 50' North, and the true Amplitude, West ——— ——— 35 00 North, which gives the Variation North ——— ——— 14 50 West.

The Difference of Longitudes of the two aforesaid Places by *Dead Reck.* is 1° 50'.

October 24 at *Bornholme*, in the Latitude of 56° 00', at Sun-rising, the Magnetical Amplitude was

East

East 43° 15′ South, and the true was
East 28 31 which gives the Variation

North 14 44 West.

The Variation of the Magnetical Compaſs, obſerved by Capt. Rogers, *Commander of the Ship* Duke, *in his Paſſage from* Cape St Lucar *in* Calefornia *to the Iſle of* Guam *or* Guana, *one of the* Ladrones, *with ſome Remarks thereon. Communicated by Dr* Halley, No. 368. p. 173.

2. Having lately had the Opportunity of peruſing Capt. *Woods Rogers*'s original Journal, who in $17\frac{0}{0}$, in eight Weeks time traverſed the great *South-Sea*, or *Pacific Ocean*, I was highly pleaſed to find the Care he had taken to ſet down the Variations of the *Magnetical Compaſs* in his Paſſage from the South Cape of *Calefornia* to the Iſland of *Guana*, being about ſeven Hours or 105 Degrees of Longitude. This might have been long ſince expected from Capt. *Dampier*, who had three times made the *Tour* of the *World*, and thrice gone this very ſame Track.

It were to be wiſhed that the *French*, who have had frequent Opportunities to do it, would beſtow upon us an Account of the Variations they have lately found in their Voyages from *Peru* and *Chili* to *China*; and that the *Spaniards* would tell us how the Needle varies at this time in the North Part of that great Sea, through which they return from the *Manilla*'s to *New Spain*. With theſe helps, having three Points in each Curve, we might be enabled with a tolerable certainty to complete the Syſtem of the Magnetic Variations, which I was forced to leave unfiniſhed, as to this part of the Ocean, in my General Chart thereof, for want of the Obſervations requiſite.

In the mean time, pleaſe to take the following Account extracted from Capt. *Rogers*'s Journal; wherein the firſt Column gives the correct Latitude of the Place; the ſecond, the Longitude Weſt from *London*, as eſtimated by Reckoning; and the third the Variation, which in this whole Track is *Eaſterly*.

Variations obſerved in the Great South-Sea, from the South Cape of Calefornia *to the Iſland of* Guana *or* Guam, ~~*one of the*~~ Ladrones.

January $17\frac{09}{10}$.	Lat. N. correct. every Day.		Long. Weſt. from *London*.		Variation Eaſterly.	
12	22	16	114	09	03	00
	21	18	114	42	02	50
	20	24	115	15	02	50
15	19	25	115	45	02	50
	18	56	116	24	02	45
	18	00	117	06	02	45
	17	11	117	30	02	15
	16	32	118	05	02	00
20	15	44	118	54	01	50
	15	00	120	15	01	30

Variations observed in the SOUTH-SEA.

1709-10.	Lat. N.		Long. West		Variation	
January	correct.	daily	from *London*.		Eaſterly.	
22	14	49	122	05	01	10
	14	36	124	25	00	50
	14	24	126	45	00	40
25	14	14	129	05	00	45
	13	50	131	23	00	50
	13	29	132	58	01	00
	13	29	134	41	01	10
	13	22	136	48	01	15
30	13	27	139	21	01	25
	13	32	142	07	01	30
Feb. 1	13	32	144	37	01	40
	13	36	147	32	01	50
	13	26	150	18	02	00
5	13	26	153	02	02	10
	13	26	155	19	02	25
	13	26	157	43	02	30
	13	25	160	31	02	50
	13	41	163	00	03	00
	13	41	165	18	03	20
10	13	44	167	26	03	30
	13	36	169	56	03	45
	13	33	172	27	04	00
	13	36	175	00	04	30
	13	32	177	21	05	20
15	13	40	179	28	06	30
	13	47	181	24	07	00
	13	54	183	22	07	30
	13	52	185	37	09	00
	13	40	187	42	10	15
20	13	28	189	49	11	00
	13	21	191	30	11	30
	13	12	193	25	12	00
	13	07	194	37	11	50
	13	10	195	51	11	00
25	13	03	197	51	10	00
	13	00	199	03	09	50
	12	57	200	16	09	30
	12	54	202	20	09	00
March. 1	12	58	204	12	08	40
	13	04	206	06	08	20

Variations

Variations obſerved in the SOUTH-SEA.

1709-10.	Lat. N. correct. daily	Long. Weſt from *London.*	Variation Eaſterly.
March 3	13 05	207 33	08 00
	13 05	209 04	07 50
5	13 02	211 54	07 30
	13 07	212 42	07 10
	13 07	214 07	07 00
	13 03	215 28	06 50
	13 08	217 11	06 30
10	13 16	218 27	05 40
	Iſland of *Guana* in Sight.		

By this it appears, that at about 250 or 300 Leagues Weſt from the South-head of *Calefornia*, the *Eaſt Variation* diminiſhes to about $\frac{1}{4}$ of a Degree; That for 1300 Leagues from thence, the ſame *Eaſterly Variation* gradually increaſes to about 12 Degrees, where it becomes greateſt. And that at the Iſle of *Guam*, five hundred Leagues ſtill more *Weſterly*, it is again decreaſed to 5 Degrees 40 Minutes.

As far as this ſingle Inſtance can direct us, I am inclinable to think that in all that ſpace of Sea which lies to the Northwards of our Track, between *Japon* and *Calefornia*, there reigns an *Eaſterly Variation*, which is ſtill greater and greater as the North Latitude increaſes. But that to the Southward of our Track, and eſpecially to the Southward of the Equinoctial, a *Weſterly Variation* ariſes, of no great extent or quantity, but which is greateſt about 1000 Leagues Weſt from the Coaſts of *Peru* and *Chili*, about the ſame Meridians where Capt. *Rogers* found the *Eaſt Variation* ſmalleſt. This is agreeable to the *Theory* of the *Variation* I laid down in N°. 148. of theſe *Tranſactions*, about 40 Years ſince; and I then expreſly mentioned, in my ſeventh Remark on the Obſervations there cited, that there was undoubtedly ſuch a Tract of *Weſt Variation* in the Southern Parts of the *South-Sea*, it being the neceſſary Conſequence of the Site of the four Magnetical Poles there ſuppoſed, though at that time I wanted Experiments to prove it.

3 Obſer-

3. Observations of the Variation on board the *Royal African* Pacquet, in 1721. By Capt. *Cornwall.*

N. B. *The Meridional Distance is reckoned from St* Jago.

Observations of the Variation on board the Royal African *Pacquet, in* 1721. *By Capt* Cornwall. N°. 371. p. 55.

Month and Year.	Latitudes.			Meridional Distance.			Longitud.			Variation.		
August 24th 1721	9°	8′	Sou.	9°	23′	W	9°	25′	W	2°	13′	E
Ditto 26	11	12	S	10	46	W	10	50	W	4	30	E
Ditto 27	11	34	S	11	28	W	11	41	W	4	29	E
Ditto 28	12	32	S	11	31	W	11	43	W	4	27	E
Ditto 31	15	46	S	10	53	W	11	6	W	6	10	E
Septemb. 2*d.*	16	26	S	8	25	W	8	30	W	7	16	E
Ditto 5th	18	45	S	9	31	W	9	39	W	6	17	E
Ditto 6th	19	47	S	9	10	W	10	0	W	8	6	E
Ditto 17	28	43	S	1	7	W	1	9	E	5	53	E
Ditto 22	31	33	S	3	41	E	3	56	E	4	10	E
Ditto 27	33	30	S	11	29	E	12	57	E	0	11	W
Ditto 30	32	40	S	19	6	E	12	1	E	3	0	W
October 1*st,*	32	53	S	21	18	E	24	59	E	5	41	W
Ditto 3	32	30	S	25	33	E	30	0	E	7	47	W
Ditto 5	32	28	S	30	37	E	35	52	E	8	44	W
Ditto 6	31	22	S	31	40	E	37	7	E	10	57	W
Ditto 7	31	11	S	32	4	E	37	47	E	11	20	W

Observations on the Coast of Africa.

Month and Year	Latitudes.			Meridional Distance.			Longitud.			Variation.		
October 13*th,* 1721.	26°	17′	S	35°	35′	E	41°	41′	E	14°	30′	W
Ditto 19	19	41	S							12	22	W
Ditto 21	17	4	S							14	29	W
Ditto 25	13	56	S							14	48	W
Novem. 4*th,*	10	57	S							13	11	W
Ditto 7	8	19	S							15	14	W
Ditto 29	5	0	S	in *Cabenda-Bay*						14	33	W
From *Cabenda* to *London*, Meridional Distance from thence.												
Decemb. 9*th,*	3	25	S	11	38	W	11	43	W	11	32	W
Ditto 14	3	30	S	21	18	W	21	24	W			
Ditto 20	0	30	S	30	41	W	30	46	W	1	5	W
Jan. 1*st* 172½	10	50	N	39	8	W	39	16	W	1	1	E
Ditto 6	17	15	N	43	21	W	43	29	W	1	41	E

Variation of the Horizontal Needle at London, *in the latter Part of the Year* 1722, *and beginning of* 1723. *By Mr* George Graham, *Watchmaker, F. R. S.* No. 383. p. 96.

4 The Figure of the three Needles, with which the Experiments were made, was prismatic; their Lengths were nearly 12,2 Inches; their Ends, which pointed to the Divisions, being filed to an Edge, which made a fine Line perpendicular to the Horizon. The Caps of two were of Crystal, the other of Glass; they were well polished on the Inside, in that Part which touched the Pin they moved upon. The Box was Brass, and of a Breadth sufficient to admit of 20° on each Side the middle Line, and covered with a piece of ground Glass. The circular Arches at the Ends were raised so much above the Bottom of the Box, as to have their upper Surfaces, upon which the Divisions were cut, lie in the same Plane with the Needle, and at such a Distance from each other, that the Needle might play freely between them. A few of the Degrees at the North End were divided into six equal Parts, each Division being 10′. It was easy, by the help of a Convex Glass, to determine the pointing of the Needle to less than a Quarter of these Divisions, or to about 2′ of a Degree. The Pin, upon which the Needle moved, was of Steel hardened, and ground to a fine Point; and by a Spring placed in the Box, the Needle might be raised from off the Point, and let down again at Pleasure, without removing the Glass, or disturbing the Box. By this means both the sharpness of the Point, and polish of the Cap were better preserved from injury, when there was occasion to move the Box. A small piece of Brass was made to slide upon that End of the Needle which pointed to the South, for readily bringing it to an horizontal Position; for according to the different strength of the Touch, the North End of the Needle will dip more or less. The bottom Plate of Brass was a little broader and longer than the Box and it's Edges made Lines exactly parallel to the middle Line of the Divisions; and for the greater security of placing the Box in a right Situation, there was a Brass Ruler of thirty Inches long, having it's Edges even and parallel, except part of that Edge which was applied to the Side of the Box which was a little filed away on the middle, that the Side of the Box near it's Ends only might touch the Ruler. By this Contrivance the two Points of Contact were as far asunder as the length of the Box would admit of, and the other Edge of the Ruler making a longer Line than the Side of the Box, afforded a better Direction for giving it the same Situation.

For determining the Quantity of the Variation, I got a Meridian Line stretched upon the top of the House, between the Rails of the Leads, which were above fifteen Foot asunder, and the Line was a little more than thirty-nine Inches above the Leads. As this Line was fastned to two Pieces of Brass that were fixed in the Rails, and was above fifteen Foot long, no sensible Error could arise in putting it up at any Time. The Compass-Box was placed upon a Wooden-Stool, with three Feet, that had nothing of Iron about it, and it's Top set level by a Plumb-Rule. But finding that in the

open Air the Wind gave ſome Diſturbance, I put up another Line, after the ſame manner, in a Room two pair of Stairs high; this Line was about the ſame length with the other, and thirty-nine Inches above the Floor. Some time after I put up a third Line, of the ſame Length, in the Room over this. By the Method made uſe of in fixing theſe Lines they could not differ above 2′ of a Degree from the Meridian, or from one another. Before I had made any Trials, I imagined no other Difference would ariſe than what might be occaſioned by the Friction of the Needle upon the Point it was to move upon, and having found that conſiderable in all the Needles that I had taken notice of, I took more than ordinary Care to provide againſt it, and ſucceeded beyond my Expectation. For I have ſeveral times obſerved all the three Needles return ſo exactly to the ſame Place, that I could not perceive the leaſt Difference; as likewiſe all three to agree very nearly about the ſame Time, when they have been placed in the ſame Box immediately one after another, the Box remaining unmoved. The firſt Needle I made, was a little above three tenths of an Inch broad, about ,06 in thickneſs, and weighed about an Ounce Troy, the Cap of Cryſtal. After ſome Trials with this Needle, it was made narrower, not to exceed half a tenth of an Inch, and it then weighed five Penny Weight and five Grains. The ſecond Needle was at firſt about three tenths of an Inch broad, and ,04 thick, the Cap of Glaſs; and after ſeveral Trials, it was made ſo much narrower, that it's Breadth was a little leſs than it's Thickneſs, and it weighed two Penny Weight and five Grains. The third was nearly of the ſame Dimentions with the ſecond, and weighed two Penny Weight and three Grains. When the two firſt Needles were made narrower care was taken that the Files made uſe of for filing the North Ends, touched not the South Ends; and after they were made lighter, I tried them both, before they were freſh touched upon the Stone, and found no ſenſible Difference in their Direction. The reaſon of making the two firſt Needles ſo heavy, was to try whether, they would return more conſtantly to the ſame Situation than lighter ones. But notwithſtanding each of them would ſettle very exactly in the ſame Place, for a great Number of Trials made immediately one after another, yet I found them at different Times to differ conſiderably from their former Directions.

This occaſioned my making them narrower, fearing their Breadth had been ſome way concerned in this Irregularity. But after the Alteration, I found the ſame thing happened, though I could find nothing of it to proceed from any Friction upon the Point. This made me prefer the lighter Needles, as leſs apt to injure the Point they moved upon, and as exact in returning to the ſame Situation. After many Trials, I found all the Needles I made uſe of, would not only vary in their Direction upon different Days, but frequently at different times of the ſame Day; and this Difference would ſome-

times amount to upwards of half a Degree in the ſame Day, ſometimes in a few Hours. And this Alteration I obſerved, whether the Needles were drawn aſide immediately before the Obſervation, or ſuffered to remain undiſturbed. For I have left the Box ſtanding for ſeveral Days together, without ever diſturbing the Needle, only have taken notice what it pointed at, and the Time of the Day, and I could ſometimes perceive in a few Minutes a very ſenſible Alteration. But whether it ſtood near it's greateſt or leaſt Variation, or whether I drew the Needle to one Side with a Key a few Degrees or a greater Number, it would conſtantly return to the ſame Place it ſtood at immediately before. Sometimes I have taken the Needle out of the Box, and put it in again, and this I have repeated ſeveral times in the ſpace of an Hour. At other times I have taken down the Box from off the Stool, and put it up again, but have found no Alteration in it's Direction; ſo that I found it of no Conſequence, whether the Needle was drawn aſide or let alone, the ſhaking of the Floor by walking upon it, or the trembling of the Houſe by the Coaches in the Street, was ſufficient to overcome the ſmall Friction upon the Point. When I made the Obſervations, I was very careful to have no Keys, nor Iron about me, that could affect the Needle.

The Box was placed in the Room above the Diſtance of ſix Foot from the neareſt Wall, and above thirteen Foot from the Grate in the Chimney, and no Iron could at any time be brought near it without my Knowledge. Yet, after all, I am not ſatisfied that it was out of the reach of Iron, and that the Variation ſhewn by it is the true Quantity; but I am very ſure there was no Change of Circumſtances in the Room that could affect it, for if there were any ſuch Materials in the Wall, or Floor, their Diſtances and Situations continued the ſame. But for a farther Confirmation of this Irregularity, I put one of the Needles into a Wooden Box, with a few Degrees divided as the other, and placed it at the ſame Meridian Line, at the Diſtance of three Foot and a half from the other, and found both Needles nearly agreed in their Alterations. The Needles were all touched by that excellent Load-ſtone preſented to the Society by the Lord *Paiſley*. It may not be improper to take Notice, that the Needles were not touched upon the naked Stone, but with it's Armour on, generally upon that Part of the Capping neareſt the Poles; but I could not find a Difference in the Direction, by touching upon another Part. I may add, that when I have obſerved the Needle increaſing, or decreaſing in it's Variation, I have very frequently, with a Key, drawn it the contrary Way ſeveral Degrees, and then, letting it return very gently, till it has been within a Degree, or leſs, of the Place it ſtood at immediately before, I have there ſtopt it for ſome time, by holding the Key at a proper Diſtance; and withdrawing my Hand gradually, have tried

to make it ſtand ſhort of it's former Place, but could never ſucceed. By this Method, and ſeveral others made uſe of, I am well aſſured theſe Changes in the Direction are owing to ſome other Cauſe than the Friction of the Needle upon the Pin; but what that Cauſe is I cannot ſay, for it ſeems to depend neither upon Heat nor Cold, a dry or moiſt Air, clear or cloudy, windy or calm Weather, nor the Height of the Barometer. The only thing that has any appearance of Regularity, is, that the Variation has been generally greateſt, for the ſame Day, between the Hours of Twelve and Four in the Afternoon, and the leaſt about ſix or ſeven in the Evening.

March 8. 1722.

This Day a piece of Braſs was fixed to a Wooden Box, and a few Degrees were divided into 10′ each, as in the Braſs Box, to try if both Needles would be alike affected in the ſeveral Alterations. This Wooden Box was placed at the ſame Meridian Line, and about the Diſtance of 3 ½ Feet from the other.

Braſs Box. Needle 2=5.		h.	Needle 5=5
March 8.	14° = 30′ —	3 = 00′	14° = 25′ +
	14 = 20	3 = 15	14 = 20
	14 = 15 +	4 = 00	14 = 10
	14 = 20	4 = 15	14 = 15
	14 = 25	5 = 00	14 = 20
	14 = 25	5 = 30	14 = 20
	14 = 15	5 = 45	14 = 10
	14 = 00	5 = 57	14 —
	14 —	6 = 8	13 = 55
	13 = 50	6 = 15	13 = 40
	14 = 20	6 = 38	14 = 15 +
	14 +	6 = 48	14 = 00
	14 = 00	6 = 54	14 —
	14 = 5	7 = 5	14 +
	14 = 10	7 = 15	14 = 5
	14 +	12 = 00	14 +

Braſs

Braſs Box.	Needle 2=5.		Needle 5=5.
March 9.	14° = 10′	9ʰ = 30′	14° = 10′
	14 = 10 +	10 = 00	14 = 10 +
	14 = 10	10 = 15	14 = 10
	14 = 10 +	10 = 30	14 = 10 +
	14 = 15	11 = 00	14 = 15 —
	14 = 00	8 = 15	14 = 00
	14 = 00	11 = 50	14 = 00
March 10.	14° = 10′ +	10ʰ = 00′	14° = 10′
	14 = 15	11 = 00	14 = 10 +
	14 = 15	12 = 00	14 = 10 +
	14 = 15 +	12 = 45	14 = 10 +
	14 = 15 +	1 = 00	14 = 10 +
	14 = 15 +	1 = 30	14 = 10 +
	14 = 15 +	1 = 45	14 = 10 +
	14 = 15 +	2 = 00	14 = 10 +
	14 = 15	3 = 30	14 = 10
	14 = 15 +	4 = 00	14 = 10 +
	14 = 15 —	5 = 30	14 = 10 —
	14 = 10	6 = 00	14 = 5
	14 = 00	6 = 15	14 = 00
	14 —	6 = 30	14 —
	14 +	7 = 30	14 +
	14 = 5	7 = 45	14 +
	14 +	12 = 00	14 +

March 30.

The Needle 2=5 which was in the Braſs Box, was this Day put into the Wooden Box, and a new Needle put into the Braſs Box, Weight 2=3.

No remarkable Change happened to either Needle till *April* the 5th.

Needle

Needle 2=3 in the Braſs Box.				Needle 2=5.
April 5.	14° = 5′	9h = 00′	14° + 00′	
	14 = 10	1 = 30	14 = 5	
	14 = 10 —	5 = 30	14 +	
	14 —	8 = 15	14 —	
	13 = 50 +	8 = 37	13 = 45	
	13 = 55 +	9 = 45	13 = 45 +	
	14 —	10 = 25	13 = 50	
	14 = 00	10 = 45	13 = 55	
	14 +	11 = 00	14 = 00	

The firſt Column ſhews the Variation of the Needle in the Braſs Box. The third the Variation of that in the Wooden Box. The ſecond Column ſhews the Time, by the Clock, when the Obſervations were made.

April 15. 1723.		*April* 16.	
14° = 30′ —	9h = 00′	14° = 30′ —	9h = 30′
14 = 30 —	10 = 00	14 = 30	11 = 00
14 = 30	11 = 30	14 = 30	12 = 00
14 = 30 +	12 = 30	14 = 30 +	1 = 10
14 = 30 +	1 = 30	14 = 30 +	1 = 40
14 = 30	3 = 30	14 = 30	2 = 45
14 = 30	4 = 10	14 = 30	5 = 90
14 = 30 —	5 = 30	14 = 30 —	6 = 90
14 = 20	6 = 18	14 = 25	6 = 20
14 +	7 = 8	14 = 20	6 = 30
14 = 00	7 = 50	14 = 15	6 = 35
14 = 00	8 = 15	14 = 10	6 = 40
14 = 15 +	8 = 20	14 = 10 —	6 = 45
14 = 15 +	8 = 40	14 = 5	6 = 49
14 = 15 +	12 = 15	14 = 00	6 = 57
14 = 00	12 = 27	14 = 00	7 = 10
14 = 00	12 = 32	14 +	7 = 20
14 = 00	12 = 35	14 = 5 +	7 = 30
14 = 00	12 = 43	14 = 10	7 = 45
Wind at S. W.		14 = 15	8 = 00

14 =

14° = 15′ +	8h = 20′
14 = 20 —	8 = 30
14 = 25 +	9 = 00
14 = 25	12 = 12
14 = 25	12 = 21

Day warm, cloudy in the Morning, Evening clear.

April 19.

14° = 30′ —	8h = 35′
14 = 30 —	9 = 00
14 = 30 —	1 = 30
14 = 30 —	2 = 00
14 = 30	3 = 30
14 = 30	4 = 00
14 = 20	5 = 00
14 = 25	5 = 38
14 = 25 +	5 = 45
14 = 30 —	6 = 00
14 = 30 —	6 = 45
14 = 25	7 = 00
14 = 20 —	8 = 00
14 = 20	9 = 00
14 = 20 +	10 = 00
14 = 25	11 = 00
14 = 25	11 = 15

Day warm, Wind at Eaſt, ſome Thunder in the Afternoon.

May 2.

14° = 25′	9h = 30′
14 = 30 +	10 = 30
14 = 35 —	11 = 30
14 = 35 +	1 = 00
14° = 35′ +	1h = 52
14 = 40 +	2 = 30
14 = 20	3 = 30
14 = 25	3 = 45
14 = 30 —	4 = 00
14 = 25 +	6 = 45
14 = 20	7 = 00
14 = 30 —	7 = 35
14 = 20 +	12 = 50

Day cold, Wind at Eaſt.

May 3.

14° = 10′	9h = 30′
14 = 15	11 = 10
14 = 15 +	12 = 40
14 = 15 +	2 = 20
14 = 10 —	5 = 20
14 = 10	6 = 5
14 = 10	6 = 45
14 = 10 —	7 = 5
14 = 5	7 = 15
14 +	7 = 30
14 = 00	7 = 42
14 +	8 = 00
14 +	9 = 38
14 +	10 = 15
14 +	11 = 00

Day cold, Wind Eaſterly.

May 4.

14° = 5′	9h = 15′
14 = 5	9 = 30
14 = 10 +	1 = 35
14 = 10 +	3 = 17
14 = 10 +	3 = 50

14 =

14°= 10′	4h= 55′
14 = 10	6 = 00
14 = 00	8 = 15
14 +	1 = 00

Windy at Eaſt.

May 5.

14°= 10′+	9h= 30′
14 = 15	10 = 45
14°= 15 +	12h= 30′
14 = 20	1 = 57
14 = 20	2 = 45
14 = 20	3 = 25
14 = 20 —	4 = 35
14 = 15 +	5 = 30
14 = 15 +	6 = 10
14 = 15 —	12 = 7

Day clear, Wind at Eaſt.

All theſe Obſervations are of the lighteſt of the three Needles, the Compaſs Box remaining unmoved the whole time. From *February* 6. 1722. to the 10th of *May* following, I made above a thouſand Obſervations in the ſame Place; and the greateſt Variation Weſtward, was 14°=45′, and the leaſt —— 13°=50′. It was ſeldom leſs than 14°, or greater than 14°=35′.

5. A New and Exact TABLE, collected from ſeveral Obſervations, taken in four Voyages to *Hudſon's Bay* in North *America*, from *London:* Shewing the Variation of the *Magnetical Needle*, or Sea *Compaſs*, in the Path-way to the ſaid *Bay*, according to the ſeveral *Latitudes* and *Longitudes*, from the Year 1721, to 1725.

A TABLE collected from ſeveral Obſervations, taken in four Voyages to Hudſon's Bay *in North* America, *from* London, *By Capt.* Chriſtopher Middleton, No. 393. pag. 73.

Lat.		Long.		Vari.		Lat.		Long.		Vari.	
D.	M	D.	M.	D.	M.	D.	M.	D.	M.	D.	M.
50	00	12	00	14	00	50	00	18	45	17	00
51	00	12	00	14	15	51	00	18	45	17	15
52	00	12	00	14	30	52	00	18	45	17	30
53	00	12	00	14	45	53	00	18	45	17	45
54	00	12	00	15	00	54	00	18	45	18	00
55	00	12	00	15	15	55	00	18	45	18	15
56	00	12	00	15	30	56	00	18	45	18	30
57	00	12	00	15	45	57	00	18	45	18	45
58	00	12	00	16	00	58	00	18	45	19	00
59	00	12	00	16	15	59	00	18	45	19	15
50	00	14	15	15	00	50	00	21	00	18	00
51	00	14	15	15	15	51	00	21	00	18	15
52	00	14	15	15	30	52	00	21	00	18	30
53	00	14	15	15	45	53	00	21	00	18	45
54	00	14	15	16	00	54	00	21	00	19	00
55	00	14	15	16	15	55	00	21	00	19	15
56	00	14	15	16	30	56	00	21	00	19	30
57	00	14	15	16	45	57	00	21	00	19	45
58	00	14	15	17	00	58	00	21	00	20	00
59	00	14	15	17	15	59	00	21	00	20	15

Lat.		Long.		Vari.	
D.	M.	D.	M.	D	M.
50	00	16	30	16	00
51	00	16	30	16	15
52	00	16	30	16	30
53	00	16	30	16	45
54	00	16	30	17	05
55	00	16	30	17	10
56	00	16	30	17	30
57	00	16	30	17	45
58	00	16	30	18	00
59	00	16	30	18	15
50	00	25	30	20	00
51	00	25	30	20	15
52	00	25	30	20	30
53	00	25	30	20	45
54	00	25	30	21	00
55	00	25	30	21	15
56	00	25	30	21	30
57	00	25	30	21	45
58	00	25	30	22	00
59	00	25	30	22	15
50	00	27	45	21	00
51	00	27	45	21	15
52	00	27	45	21	30
53	00	27	45	21	45
54	00	27	45	22	00
55	00	27	45	22	15
56	00	27	45	22	30
57	00	27	45	22	45
58	00	27	45	23	00
59	00	27	45	23	15
50	00	30	00	22	00
51	00	30	00	22	15
52	00	30	00	22	30
53	00	30	00	22	45
54	00	30	00	23	00
55	00	30	00	23	15
56	00	30	00	23	30
57	00	30	00	23	45
58	00	30	00	24	00
59	00	30	00	24	15
50	00	32	15	23	00
51	00	32	15	23	15
52	00	32	15	23	30
53	00	32	15	23	45
54	00	32	15	24	00
55	00	32	15	24	15
56	00	32	15	24	30
57	00	32	15	24	45
58	00	32	15	25	00
59	00	32	15	25	15

Lat.		Long.		Vari.	
D.	M.	D.	M	D	M.
50	00	23	15	19	00
51	00	23	15	19	15
52	00	23	15	19	30
53	00	23	15	19	45
54	00	23	15	20	00
55	00	23	15	20	15
56	00	23	15	20	30
57	00	23	15	20	45
58	00	23	15	21	00
59	00	23	15	21	15
50	00	34	30	24	00
51	00	34	30	24	15
52	00	34	30	24	30
53	00	34	30	24	45
54	00	34	30	25	00
55	00	34	30	25	15
56	00	34	30	25	30
57	00	34	30	25	45
58	00	34	30	26	00
59	00	34	30	26	15
50	00	36	45	25	00
51	00	36	45	25	15
52	00	36	45	25	30
53	00	36	45	25	45
54	00	36	45	26	00
55	00	36	45	26	15
56	00	36	45	26	30
57	00	36	45	26	45
58	00	36	45	27	00
59	00	36	45	27	15
50	00	39	00	26	00
51	00	39	00	26	15
52	00	39	00	26	30
53	00	39	00	26	45
54	00	39	00	27	00
55	00	39	00	27	15
56	00	39	00	27	30
57	00	39	00	27	45
58	00	39	00	28	00
59	00	39	00	28	15
50	00	41	15	27	00
51	00	41	15	27	15
52	00	41	15	27	30
53	00	41	15	27	45
54	00	41	15	28	00
56	00	41	15	28	15
57	00	41	15	28	30
58	00	41	15	28	45
59	00	41	15	29	09

Lat.		Long.		Vari.	
D.	M.	D.	M.	D.	M.
50	00	43	30	28	00
51	00	43	30	28	15
52	00	43	30	28	30
53	00	43	30	28	45
54	00	43	30	29	00
55	00	43	30	29	15
56	00	43	30	29	30
57	00	43	30	29	45
58	00	43	30	30	00
59	00	43	30	30	15
51	00	46	00	29	00
52	00	46	00	29	15
53	00	46	00	29	30
54	00	46	00	29	45
55	00	46	00	30	00
56	00	46	00	30	15
57	00	46	00	30	30
58	00	46	00	30	45
59	00	46	00	31	00
52	00	48	30	30	00
53	00	48	30	30	15
54	00	48	30	30	30
55	00	48	30	30	45
56	00	48	30	31	00
57	00	48	30	31	15
58	00	48	30	31	30
59	00	48	30	31	45
53	00	51	00	31	00
54	00	51	00	31	15
55	00	51	00	31	30
56	00	51	00	31	45
57	00	51	00	32	00
58	00	51	00	32	15
59	00	51	00	32	30
60	00	51	00	32	45
54	00	54	00	32	00
55	00	54	00	32	15
56	00	54	00	32	30
57	00	54	00	32	45
58	00	54	00	33	00
59	00	54	00	33	15
60	00	54	00	33	30
61	00	54	00	33	45
54	00	57	00	33	00
55	00	57	00	33	15
56	00	57	00	33	30
57	00	57	00	33	45
58	00	57	00	34	00
59	00	57	00	34	30
60	00	57	00	35	00
61	00	57	00	35	30
55	00	60	00	34	00
56	00	60	00	34	30
57	00	60	00	35	00
58	00	60	00	35	30
59	00	60	00	36	00
60	00	60	00	36	30
61	00	60	00	37	00
57	00	63	00	35	00
58	00	63	00	35	30
59	00	63	00	36	00
60	00	63	00	36	30
61	00	63	00	37	00
62	00	63	00	37	30
59	00	66	00	37	00
60	00	66	00	37	40
61	00	66	00	38	20
62	00	66	00	39	00
63	00	66	00	39	40
60	00	69	00	41	00
61	00	69	00	41	40
62	00	69	00	42	20
60	00	72	00	40	00
61	00	72	00	42	00
61	40	72	00	42	40
62	00	78	00	43	00
63	00	78	00	44	00
63	50	78	00	46	00

Lat. D.	Lat. M.	Long. D.	Long. M.	Vari. D.	Vari. M.
61	00	75	00	38	00
62	00	75	00	43	00
62	50	75	00	45	00
63	00	81	00	43	00
64	00	81	00	46	00
62	00	82	00	39	00
63	00	82	00	44	00
61	00	84	00	33	45
62	00	84	00	40	00
63	00	84	00	42	00
60	00	86	00	30	00
61	00	86	00	33	00
62	00	86	00	35	00
59	00	88	00	28	00
60	00	88	00	28	40
61	00	88	00	29	20
57	00	90	00	24	00
58	00	90	00	24	30
59	00	90	00	25	00
57	00	94	00	23	00
58	00	95	00	22	30
59	00	95	00	21	00

From Long 68 Degrees *to* 81. *is in* Hudſon's *Straits, where is the greateſt Variation, and the Compaſs will hardly Traverſe.*

6. *A TABLE collected from ſeveral Obſervations taken from the Year* 1721 *to* 1729, *in nine Voyages to* Hudſon's Bay *in* North-America, *by Capt.* Chr. Middleton; *ſhewing the* Variation of the Compaſs *according to the Latitudes and Longitudes under-mentioned, accounting the Longitude from the Meridian of* London.

Continued by the ſame, N°. 418. p. 71.

Lat. D.	Lat. M.	Long. D.	Long. M.	Variat. D.	Variat. M.	
50	00	2	East	12	00	
49	30	0	00	12	00	
50	00	2	West	13	00	Obſ.
50	00	4	00	13	00	ditto
50	00	6	00	13	00	ditto
51	00	8	00	14	00	ditto
51	00	14	00	14	00	ditto
52	00	12	00	15	00	Ac.
53	00	12	00	ditto.		ditto
54	00	12	00	ditto.		ditto
55	00	12	00	16	00	ditto
56	00	12	00	16	00	Obſ.
57	00	12	00	17	00	ditto
58	00	12	00	17	00	ditto
59	00	12	00	18	00	ditto

Lat. D.	Lat. M.	Long. D.	Long. M.	Variat. D.	Variat. M.	
50	00	14	00	14	00	Obſ.
51	00	ditto		14		
52		ditto		15		
53		ditto		15		Ac.
54		ditto		16		Obſ.
55		ditto		16		Obſ.
56		ditto		17		Obſ.
57		ditto		17		Obſ.
58		ditto		18		Obſ.
59		ditto		18		Ac.

Lat. D.	Lat. M.	Long. D.	Long. M.	Variat. D.	Variat. M.	
50	00	16	00	15	00	Obſ.
51		ditto		15		Obſ.
52		ditto		16		Ac.
53		ditto		16		
54		ditto		17		Obſ.
55		ditto		18		Ac.
56		ditto		18		
57		ditto		19		
58		ditto		19		Obſ.
50	00	18	00	17	00	Obſ.
51		ditto		17		
52		ditto		17		
53		ditto		17		
54		ditto		18		
55		ditto		18		Ac.
56		ditto		18		
57		ditto		19		
58		ditto		19		Obſ.
59		ditto		19		
50	00	20	00	18	00	Ac.
51		ditto		18		
52		ditto		18		Obſ.
53		ditto		19		
54		ditto		19		
55		ditto		19		
56		ditto		19		Ac.
57		ditto		19		
58		ditto		20		
59		ditto		21		Obſ.
50	00	22	00	19	00	Obſ.
51		ditto		19		Ac.
52		ditto		19		
53		ditto		20		Obſ.
54		ditto		20		Ac.
55		ditto		20		
56		ditto		20		
57		ditto		20		
58		ditto		21		Obſ.
59		ditto		21		

Lat. D.	Lat. M.	Long. D.	Long. M.	Variat. D.	Variat. M.	
50	00	24	00	20	00	Ac.
51		ditto		20		
52		ditto		20		
53		ditto		21		Obſ.
54		ditto		21		
55		ditto		21		Ac.
56		ditto		21		
57		ditto		21		Obſ.
58		ditto		22		
59		ditto		22		
50	00	26	00	21	00	Obſ.
51		ditto		21		
52		ditto		21		Ac.
53		ditto		21		
54		ditto		22		Obſ.
55		ditto		22		
56		ditto		22		Ac.
57		ditto		23		Obſ.
58		ditto		23		
59		ditto		23		
50	00	28	00	22	00	Ac.
51		ditto		22		
52		ditto		22		
53		ditto		23		Obſ.
54		ditto		23		
55		ditto		23		Ac.
56		ditto		23		
57		ditto		24		Obſ.
58		ditto		24		
59		ditto		24		
50	00	30	00	23	00	Ac.
51		ditto		23		
52		ditto		23		
53		ditto		24		Obſ.
54		ditto		24		Ac.
55		ditto		24		
56		ditto		24		
57		ditto		25		Obſ.
58		ditto		25		
59		ditto		25		Ac.

Lat. D.	M.	Long. D.	M.	Variat. D.	M.	
50	00	32	00	24	00	Ac.
51		ditto		24		
52		ditto		24		Obſ.
53		ditto		24		
54		ditto		25		
55		ditto		25		Ac.
56		ditto		25		
57		ditto		26		Obſ.
58		ditto		26		Ac.
59		ditto		26		Obſ.
50	00	34	00	25	00	Obſ.
51		ditto		25		Ac.
52		djtto		25		
53		ditto		25		
54		ditto		26		Obſ.
55		ditto		26		Obſ.
57		ditto		26		
58		ditto		27		Ac.
59		ditto		27		
50	00	38	00	27	00	
51		ditto		27		Obſ.
52		ditto		27		Ac.
53		ditto		28		Obſ.
54		ditto		28		
55		ditto		28		Ac.
56		ditto		28		
57		ditto		29		Obſ.
58		ditto		29		
59		ditto		30		Obſ
50	00	40	00	28	00	Ac.
51		ditto		28		Obſ.
52		ditto		28		
53		ditto		29		
54		ditto		29		Ac.
55		ditto		29		
56		ditto		29		
57		ditto		30		Obſ.
58		ditto		30		
59		ditto		30		

Lat. D.	M.	Long. D.	M.	Variat. D.	M.	
51	00	42	00	29	00	Obſ.
52		ditto		29		
53		ditto		30		
54		ditto		30		
55		ditto		30		Ac.
56		ditto		30		Obſ.
57		ditto		31		
58		ditto		31		
59		ditto		31		
52	00	44	00	30	00	Obſ.
53		ditto		31		
54		ditto		31		Ac.
55		ditto		31		
56		ditto		31		
57		ditto		32		Obſ.
58		ditto		32		
59		ditto		32		Ac.
53	00	46	00	31	00	Ac.
54		ditto		32		Obſ.
55		ditto		32		
56		ditto		32		Ac.
57		ditto		33		Obſ.
58		ditto		33		
59		ditto		33		
56	00	48	00	32	00	Obſ.
57		ditto		32		
58		ditto		32		
59		ditto		34		
60		ditto		34		
61		ditto		34		
57	00	50	00	33	00	Obſ.
58		ditto		33		
59		ditto		33		
60		ditto		34		
61		ditto		35		

Lat. D.	M.	Long. D.	M.	Variat. D.	M.	
58	00	52	00	34	00	Obſ.
59		ditto		34		
60		ditto		34		
61		ditto		35		
62		ditto		35		
58	00	54	00	34	00	Obſ.
59		ditto		35		
60		ditto		36		
61		ditto		36		
62		ditto		36		
58	00	56	00	36	00	Obſ.
59		ditto		36		
60		ditto		36		
61		ditto		37		
62		ditto		37		
58	00	58	00	36	00	Obſ.
59		ditto		37		
60		ditto		37		
61		ditto		37		
62		ditto		38		
63		ditto		38		
58	00	60	00	37	00	Obſ.
59		ditto		38		
60		ditto		38		
62		ditto		38		
63		ditto		39		
58	00	62	00	38	00	Obſ.
59		ditto		39		
60		ditto		39		
61		ditto		39		
62		ditto		40		
59	00	64	00	39	00	Obſ.
60		ditto		39		
61		ditto		39		
62		ditto		40		
60	00	66	00	40	00	Obſ.
61		ditto		41		
62		ditto		43		

Hud-

Lat. D.	M.	Long D.	M.	Variat. D.	M.	
59	00	68	00	40	00	Obſ.
60		ditto		43		
61		ditto		44		
62		ditto		47		
60	00	70	00	43	00	
61		ditto		44		
62		ditto		47		
61	00	72	00	42	00	Obſ.
62		ditto		43		
63		ditto		48		
62	00	74	00	41	00	
63		ditto		48		
62	00	76	00	41	00	
63		ditto		47		
64		ditto		49		
62	00	78	00	40	00	
63		ditto		42		
64		ditto		49		
63	00	80	00	40	00	
64		ditto		49		
60	00	82	00	38	00	Obſ.
61		ditto		39		
62		ditto		40		
63		ditto		42		
64		ditto		44		
50	00	84	00	19	00	
51		ditto		20		
51		ditto		21		
52		ditto		22		
53		ditto		23		
54		ditto		24		
55		ditto		25		
56		ditto		26		
57		ditto		27		
58		ditto		27		
59		ditto		28		
60		ditto		29		
61		ditto		30		
62		ditto		40		

son's Straights.

Hudson's Straights.

In Hudson's Bay.

Lat.

Lat. D.	Lat. M.	Long. D.	Long. M.	Variat. D.	Variat. M.	
55	00	86	00	22	00	Obſ.
56		ditto		23		
57		ditto		24		
58		ditto		25		
59		ditto		26		
60		ditto		27		
56	00	88	00	22	00	In *Hudſon's Bay.*
57		ditto		23		
58		ditto		24		
59		ditto		25		
60		ditto		26		

Lat. D.	Lat. M.	Long. D.	Long. M.	Variat. D.	Variat. M.	
57	00	90	00	21	00	Obſ. In *Hudſon's Bay.*
58		ditto		22		
59		ditto		23		
60		ditto		24		

Note, *The Letters* Obſ. *are the Obſervations, and the Letters* Ac. *are by Eſtimation.*

An Unuſual Agitation in the Magnetical Needle, *obſerved to laſt for ſome Time, in a Voyage from* Maryland, *by Capt.* Walter Hoxton No. 417. p. 53.

VII. On the ſecond of *September*, 1724, a little after Noon, being in Latitude 41° 10′ N. and Difference of Longitude from Cape *Henry* in *Virginia* about 28° 00′ E. the Weather fair, a moderate Gale, and ſmooth Sea, my Mate, who was on the Deck, came and told me, that the Compaſs traverſed ſo much that he could not poſſibly ſteer by it: Whereupon I went up, and after trying it in ſeveral Parts of the Ship, found what he ſaid to be true. I then had all my Compaſſes brought up, and placed in different Parts of the Ship, and in Places moſt remote from Iron, and, to my great Surprize found them all in the ſame Condition; ſo that we could not ſteer by any of them. I then new touched ſome of them with a Loadſtone, which I always carry with me; and leſt that ſhould affect them, ſent it out to the End of the Bowſpreet; but I did not perceive that the new touching was of any Service, for they all continued traverſing very ſwiftly, for about an Hour after I came on the Deck, and then on a ſudden every one of them ſtood as well as uſual. During the whole Time, the Ship had very little Motion; and I had an Azimuth Compaſs, and four or five others.

An Account of a Treatiſe intituled, Calculations and Tables relating to the attractive Virtue of Loadſtones, *&c. Printed* Anno 1729. No. 412. pag. 245.

VIII. The Author, (the Hon. Lord *Paiſley*) by ſeveral Experiments very carefully made, has obſerved, that if two Loadſtones are perfectly homogeneous, that is, if their Matter be of the ſame ſpecific Gravity, and of the ſame Virtue in all Parts of one Stone, as in the other, and that like Parts of their Surfaces are capped or armed with Iron, then the Weights they ſuſtain will be as the Squares of the Cube Roots of the Weights of the Loadſtones; that is, as their Surfaces. Upon this Principle the Tables are formed. The firſt Column of theſe Tables is in common to the four following, and helps to ſhew how many times it's Weight any Loadſtone ſuſtains.

In

In the ſecond, third, fourth and fifth Columns, are the Weights of Load-ſtones in different Denominations. The ſecond, intituled Grains, reaches Grain by Grain to 480 Grains, or one Ounce, and will ſerve for any Load-ſtone, whoſe Weight does not exceed one Ounce. The third reaches, by Penny-weights, up to two Pounds, or 480 Penny-weights, and therefore ſerves for any Stone that weighs not leſs than one Penny-weight, nor more than two Pound. The fourth Column reaches, by Ounces, up to forty Pounds, or 480 Ounces, and therefore will ſerve for any Stone not exceeding that Weight. The fifth ſerves from one to 480 Pounds, The ſixth Column intituled, Weight ſuſtained, is in common to the four preceeding; and the Numbers in this Table, if they were divided by 10, would be the Squares of the Cube Roots of the Numbers in natural Order, from 1 to 480, as they are found in the Column of Pounds. But theſe Squares of the Cube Roots are here multiplied by ten, becauſe a Load-ſtone of the very worſt Sort, if it weighs but one Grain, will ſuſtain ten Grains; and ſo theſe Tables, by ſimple Inſpection, ſhew what Number of Grains any Load-ſtone of that worſt Character would ſuſtain, if the Stone weigh not more than 480 Grains, or one Ounce. The Numbers in the firſt Column intituled, How often it's Weight, are proportional to the Reciprocals of the Cube Roots of the natural Numbers, and are formed by dividing the Numbers of the ſixth Column, by the correſponding natural Numbers, as they are found in the Column of Pounds.

For the greater Convenience of Calculation, his Lordſhip has added Tables; firſt of Decimal Parts for Penny-weights, Ounces, and Pounds, in order to loſe as little as poſſible of the Fractions, in the ſeveral Calculations. The next are Tables of Grains, Penny-weights, Ounces, and Pounds, which readily ſhew how many of each Denomination are contained in the others. The Tables intituled, From Grains to Penny-weights, *&c.* and the others from the ſeveral Denominations to others, are of Uſe for carrying the Computation readily from any one Denomination to another: And laſtly, the Tables at the Bottom of theſe laſt mentioned are of the like Uſe, for the ready finding the Value in Money of any Load-ſtone, from the Numbers proper to Grains, to Penny-weights, to Ounces, and to Pounds.

The Honourable Author then proceeds to explain the Uſe of theſe Tables, by Inſtances under each Denomination. Thus, if a Load-ſtone does not exceed one Ounce, or 480 Grains, the particular Weight of the Stone, with the Weight it ſuſtains, being known, he reduces the Weight ſuſtained to Grains, by the Help of the Table of Grains. Then looking into the Column of Grains for the Weight of the Stone, againſt it, in the Column of Weight ſuſtained,

not laſt long; the inſide of the Wood is yellow and very full of Juice, as glutinous as Honey or Turpentine; the Wood itſelf has a very ſtrong unſavory Smell, but the Juice ſtinks as bad as Carrion. Having thus deſcribed the Tree, we ſhall now proceed to give an account of it's Poiſonous Quality, *&c.*

1. And firſt, it muſt be obſerved, that it poyſons two ways, either by touching or handling of it, or by the Smell; for the Scent of it, when cut down in the Woods, or on the Fire, has poiſoned Perſons to a very great degree. One of my Neighbours was blind for above a Week together, with only handling it. And a Gentleman in the Country, ſitting by his Fire-ſide in the Winter, was ſwelled for ſeveral Days with the Smoak or Flame of ſome Poyſon-Wood that was in the Fire.

2. A ſecond thing to be remarked of the Poyſon-Wood is, that it has this effect only on ſome particular Perſons and Conſtitutions; for I have ſeen my own Brother not only handle, but chew it without any harm at all. And ſo by the ſame Fire one ſhall be poiſoned and another not at all affected.

3. But then Thirdly, this ſort of Poyſon is never Mortal, and will go off in a few Days of it ſelf, like the Sting of a Bee; but generally the Perſon applies Plantain Water, or Sallet-Oyl and Cream.

4. As to it's Operation, within a few Hours after the Perſon is poyſoned, he feels an itching Pain that provokes a Scratching, which is followed by an Inflammation and Swelling; ſometime a Man's Legs only have been poyſoned, and have run with Water.

My Neighbour that was ſo ſadly poyſoned with handling it, told me one thing very remarkable of the Wood, and that is, that when he touched it, he plainly perceived it to differ from the other Wood, that he was throwing up into his Cart; for it was as cold as a piece of Ice; and withal aſſured me, he could diſtinguiſh it blindfold, or in the dark, from any other Wood in the World, by it's Coldneſs; but the poor Man is as much afraid of it, when he goes into the Woods, as of a Rattle-Snake. He further tells me, that he felt an itching in a few Hours after he had handled the Wood, but the ſwelling did not come on till in about three Days.

A Farther Account of the ſame Tree. By William Sherard, *L L. D. R. S. S.* No. 367. p. 147.

2. The Account I had of the Poyſon-Tree from Mr *More* (which probably he had from Mr *Dudley)* is as follows.

The Poyſon-Tree grows to the bigneſs of Elder; I never ſaw the Leaf; the Wood is as cold as Ice. When laid on the Fire, of 5 or 6 Perſons ſitting by it, ſome will fall a ſwooning, fainting, or yawning, continuing ſo for ſome Days, others but a few Hours, and others of the Company not at all. I handle, cut and burn it with impunity; and ſo it is with ſeveral others, I ſuppoſe, according to their ſeveral Conſtitutions. It was never known to kill any Body, but

only to do hurt to ſome Perſons. I have ſent you all the Seeds of it, I can get.

The Seeds he ſent were but few, but I had a good quantity from Mr. *Cateſby* in *Carolina*. He calls it a Water Shrub, of which he never ſaw Leaf or Flower. 'Tis a ſpecies of *Toxicodendron*, tho' not nam'd by Dr *Tournefort* in his Inſtitutions, p. 610. but I believe it to be *Arbor Americana alatis foliis, ſucco lacteo, venenata. Pluknet. Almag.* 45. Tab. 145. Fig. 1. which is a Species of *Toxicodendron* that grew formerly at *Chelſey* Garden. What makes me think it to be this, is Mr *Dudley*'s writing 'tis like a *Sumach*, and that it is by ſome called the *Swamp Sumach*; this in its manner of growing and alated Leaves, very much reſembles the *Sumach* or *Rhus*; the Fruit is a white roundiſh dry Berry, growing in Cluſters, ſo like that of *Toxicodendron triphyllon folio ſinuato, pubeſcente, Inſt. R. Herb.* 611. *Hederæ trifoliæ Canadenſi affinis planta: Arbor venenata quorundam H. R.* Paris. as ſcarce to be diſtinguiſhed from it.

II. 1. The Flower is of the Lilly Kind, monopetalous *infundibuliformis*, without any *Calyx* or *Perianthium*, it's long fiſtulous Beginning being afterwards expanded into ſix beautiful oblong Segments. A.A.

A Deſcription of the Flower and Seed-Veſſel of the Plant, called Crocus Autumnalis Sativus, *that produces the true* Engliſh Saffron *of the Shops: By* James Douglas, *M. D. F. R. S.* No. 380. p. 441.

The *Petalum* is diſtinguiſhed into a long, hollow or fiſtulous Part, which lies incloſed within the common and proper *Involucra* of the Plant, ariſing from the Top of the *Ovarium*, or *Seed-Veſſel*, and ſix Segments. *a. a.*

While this narrow, tubulous Part runs between the Leaves and Integuments that ſurround them, it is of a white Colour; but, as ſoon as it is diſenaged from theſe, it inſenſibly acquires a Purple Colour, which, a little before it's Diviſion, as it begins to be enlarged, and grow more open, inclines to a Red.

This narrow fiſtulous Part of the Flower, about 1 or 2 Inches above the *Theca Communis*, forms ſix foliaceous Segments, or divides into ſo many oblong Purple-coloured *Petala. b. c.*

Fig. 106. *Petalon.*

Three of theſe Flower-Leaves are larger than the other three, but in all other Reſpects, are much alike. *c. c. c.*

The Length of the largeſt is from 1 ¼, to 2 Inches; the Breadth ſeldom above ½ Inch: The ſhorter Leaves are from 1, to 1 ¼ Inch in Length, their Breadth being ſomething leſs in Proportion.

The Inſide of each *Petalum* is of a Violet Purple-Colour, vein'd with a few ſmall Lines of a deeper Dye, running length-ways, intermixed with White, or the whole is beautifully checquered with Blue; and White Colours.

The Outſide is of a whiter Blue, with ſeveral whitiſh Riſings or Ridges, and juſt at the Bottom of the Leaf it is of a deeper Blue; the three ſmall Leaves *b. b. b.* are much of the ſame Colour, only the Purple ſeems to be ſomething deeper.

The

The Number of the *Petala* is, for the moſt Part, 6; yet, in ſome Flowers we may obſerve 7, or 8; but then they are not ſo large as when they are fewer.

mina. In every Flower there are three *Stamina*, or Chives, *d. d. d.* properly ſo called, ariſing from the inner Surface of the tubular Part of the Flower, juſt before it's Diviſion into the *Petala*, where they make, for ſome Space, an apparent Ridge, and then they ſtand upright, oppoſite to the three large Leaves; they are of a whitiſh Colour, inclining to a light Purple, being but little above ½ of an Inch in Length

In thoſe Plants that have 7 or more *Petala*, the Number of the *Stamina* is likewiſe encreaſed to 5, or more.

ices. Each of theſe *Stamina* has it's propor *Apex*, *e. e. e.* which is a peculiar longiſh Subſtance, ſtanding upright, oppoſite to the larger Flower-Leaves, of a Yellow Colour, forked, not unlike the Tongue of a ſmall Bird, at the lower End, where it is fixed to the *Stamen*; here likewiſe it is broadeſt, but as it aſcends it becomes narrower, and it's upper Extremity is a little crooked, or turned to one Side: It ſeldom exceeds ⅛ Inch in Length.

It appears as if it was double, with a longitudinal Furrow in the middle, in which Hollow the *Stamen* ſeems to be faintly continued for ſome Space.

When the Plant is full grown, they are all loaded with that Kind of ſmall Duſt called *Farina fœcundans.*

arium. *Ovarium*, called likewiſe the *Vaſculum Seminale*, and *Piſtillum* by ſome, *f f*,

Is a particular Body, which ariſes from the Top of the *Pedunculus*, *g.* about ½ of an Inch long, or a little more, of a deep White Colour, three cornered, and divided into three *Loculamenta*, or *Capſulæ*, in which the Seeds (which however ſeldom come to Perfection with us) are formed, growing bigger and bigger after the Flower falls off; nay, even in this blooming State, if you cut this Veſſel acroſs the middle, you may perceive the whitiſh Rudiments of the Seeds.

lus From the upper Part, or *Apex*, of the *Ovarium*, ariſes the *Stylus*, *h.* which is a long ſlender Tube, that lies encloſed within the tubulous or fiſtular Portion of the Flower, being there of a whitiſh Colour, but changing into a Yellow before it's Diviſion.

This Style ordinarily ſplits into 3 Parts, juſt oppoſite to the Top of the *Stamina*, where the *Apices* take their Riſe, *i. i. i.* and thus far it ſtands upright in the Middle of the *Stamina*; for the ſake of which only, this Plant is cultivated, and being prepared, (as ſhall hereafter be deſcribed) makes the true Saffron of the Shops, which we ſo frequently uſe in Phyſic.

I call theſe Parts of the *Stylus*, from their Figure and Shape, *Capillamenta Tubiformia*, or, *Appendices Styli Salpingoeides*, in as much as they very exactly repreſent a Trumpet, and are not unlike the *Fallopian*

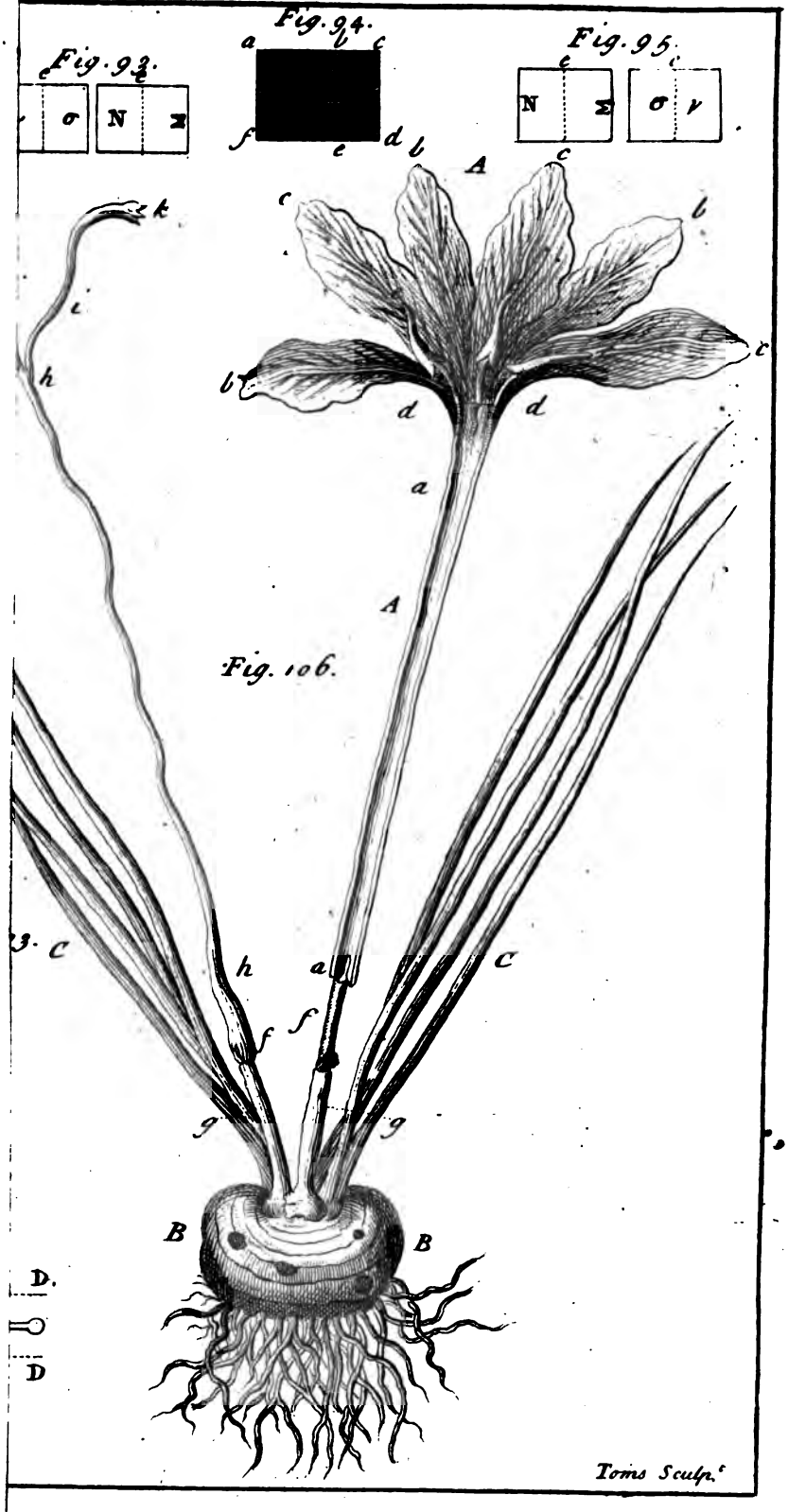
Fig. 92.
Fig. 94.
Fig. 95.
Fig. 106.
Toms Sculp.

lopian Tube in Women, being narrow at their Origin, and growing gradually larger towards their other Extremity; which like the common Trumpet, is open and expanded; and, like the *Tubæ Falloppii*, is jagged, or fringed at the Edge. *Vid. Lit. k, k, k.*

It may alſo be very fitly named *Crocus officinarum*, becauſe that is the Part only that is uſed in the Shops.

They are of a Yellow Colour, juſt at their Beginning, continued from the upper Part of the *Stylus*, but afterward they are all of a deep Red Colour, only their jagged Extremities are tipt with White inclining to a Yellow.

Theſe *Tubæ*, or *Capillamenta*, are from 1, to 1 ½ Inch in Length.

The *Stylus*, while undivided, is ſtrong enough to ſupport itſelf, being encloſed within the tubular Part of the Flower; but the *Capillamenta* being very weak and ſlender at their Beginning, this occaſions them to hang down between the *Petala*.

The Figure repreſents a Root of the Saffron-Plant, that has two Stalks encloſed in one common *Vagina*, the whole Flower with the *Stamina* and *Apices* in one, and the *Stylus* only in the other; with the Leaves, *Pedunculi*, and *Ovarium* in both, being fairly delineated from the Life.

A. A. The Flower expanded into ſix beautiful Segments. a. a. The Fiſtulous Part of the Flower. b. c. The ſix Petala. *c. c. c. The three larger* Petala. *b. b. b. The three ſmaller ones. d. d. The three* Stamina, *or Chives. e. e. e. The three* Apices. *f. f. The* Vaſculum Seminale. *g. g. The* Pedunculi. *h. h. The* Stylus. *i. i. i. The three* Capillamenta Tubiformia. *k. k. k. The jagged Extremity of the* Capillamenta. *B. B. The Root. C. C. The Graſſy Leaves.*

2. As Saffron grows at preſent moſt plentifully in *Cambridgeſhire*, and has grown formerly in ſeveral other Counties of *England*, the Method of Culture does not I believe, vary much in any of them, and therefore I have judged it ſufficient to ſet down here the Obſervations which I employed proper Perſons, in different Seaſons, to make in the Years 1723, 24, 25, and 28, up and down all that large Tract of Ground that lies between *Saffron-Walden* and *Cambridge*, in a Circle of about ten Miles Diameter. In that Country Saffron has been longeſt cultivated, and therefore it may reaſonably be expected that the Inhabitants thereof are more throughly acquainted with it than they are any where elſe.

The Culture and Management of Saffron in England, *by the ſame* No. 405. P. 566.

I ſhall begin with the Choice and Preparation of the Ground. The greateſt Part of the Tract already mentioned is an open level Country with few Incloſures; and the Cuſtom there is, as in moſt other Places, to crop two Years, and let the Land lie fallow the third. Saffron is always planted upon fallow Ground, and all other Things being alike, they prefer that which has born Barley the Year before.

The

The Saffron grounds are ſeldom above three Acres, or leſs than one, and in chooſing them, the principal Thing they have Regard to is, that they be well expoſed, the Soil not poor, nor a very ſtiff Clay, but a temperate dry Mold, ſuch as commonly lies upon Chalk, and is of a hazel Colour; though if every Thing elſe anſwers, the Colour of the Mold is pretty much neglected.

The Ground being made choice of, about Lady-day, or the Beginning of *April*, it muſt be carefully ploughed, the Furrows being drawn much cloſer together and deeper, if the Soil will allow it, than is done for any Kind of Corn, and accordingly the Charge is greater.

About five Weeks after, or during any Time in the Month of *May*, they lay between twenty and thirty Loads of Dung upon each Acre, and having ſpread it with great Care, they plough it in as before. The ſhorteſt rotten Dung is the beſt; and the Farmers who have the Conveniencies of making it, ſpare no Pains to make it good, being ſure of a proportionable Price for it. About Midſummer, they plough a third Time, and between every ſixteen Foot and an half, or Pole in Breadth, they leave a broad Furrow or Trench, which ſerves both for a Boundary to the ſeveral Parcels, (when there are ſeveral Proprietors to one Encloſure) and to throw the Weeds in at the Proper Seaſon.

To this Head likewiſe belongs the Fencing of the Grounds, becauſe moſt commonly, though not always, that is done before they plant. The Fences conſiſt of what they call dead Hedges, or Hurdles to keep out not only Cattle of all Sorts, but eſpecially Hares, which would otherwiſe feed on the Saffron Leaves during the Winter.

About the Weather we need only obſerve, that the hotteſt Summers are certainly the beſt, and if therewith there be gentle Showers from time to time, they can hardly miſs of a plentiful rich Crop, if the extream Cold, Snow, or Rain of the foregoing Winter have not prejudiced the Heads.

The next general Part of the Culture of Saffron, is planting or ſetting the Roots; the only Inſtrument uſed for which, is a narrow Spade, commonly termed a *Spit-ſhovel*.

The Time of Planting is commonly in the Month of *July*, a little ſooner or later, according as the Weather anſwers. The Method is this. One Man with his Spit-ſhovel raiſe, between three and four Inches of Earth, and throws it before him about ſix, or more Inches; two Perſons, generally Women, following him with Saffron-heads, place them in the fartheſt Edge of the Trench he makes at three Inches diſtance from one another, or thereabouts. As ſoon as the Digger or Spitter has gone once the Breadth of the Ridge, he begins again at the other Side, and digging as before, covers the Roots laſt ſet, and makes the ſame Room for the Setters to place a new Row, at the

ſame

ſame Diſtance from the firſt, that they are from one another. Thus they go on till a whole Ridge, containing commonly one Rod, is planted, and the only Nicety in digging is to leave ſome Part of the firſt *Stratum* of Earth untouched to lie under the Roots; and in ſetting, to place the Roots directly upon their Bottoms. What Sort of Roots are to be preferred, ſhall be ſhown under the fourth Head; but it muſt be obſerved in this Place, that formerly when Roots were very dear, they did not plant them ſo thick as they do now; and that they have always ſome Regard to the Size of the Roots, placing the largeſt at a greater Diſtance than the ſmall ones.

The Quantity of Roots planted in an Acre is generally about ſixteen Quarters, or 128 Buſhels, which according to the Diſtances left between them, as before aſſigned, and ſuppoſing them all to be an Inch in Diameter one with another, ought to amount to 392040 in Number.

From the Time that the Roots are planted, till about the Beginning of *September*, or ſometimes later, there is no more Labour about them; but as they then begin to ſpire, and are ready to ſhew themſelves above Ground, which is known by digging a few out of the Earth, the Ground muſt be carefully pared with a ſharp Hough, and the Weeds, *&c.* raked into the Furrows, becauſe otherwiſe they would hinder the Growth of the Plants.

In ſome Time after appear the Saffron Flowers, and this leads us to the third Branch of our preſent Method. The Flowers are gathered as well before, as after they are full blown, and the moſt proper Time for this, is early in the Morning. The Owners of the Saffron get together a ſufficient Number of Hands, who place themſelves in different Parts of the Field, pull off the whole Flowers, and throw them Handful by Handful into a Baſket; and ſo continue till all the Flowers are gathered, which happens commonly about ten or eleven o'Clock.

Having then carried home all they have got, they immediately ſpread them upon a large Table, and placing themſelves round it, they fall to picking out the Filamenta, Styli, or Chives, and together with them, a pretty long Portion of the Stylus itſelf, or *String* to which they are joined. The reſt of the Flower they throw away as uſeleſs. The next Morning they return into the Field again, whether it be wet or dry Weather, and ſo on daily, even on *Sundays*, till the whole Crop be gathered.

The Chives being all picked out of the Flowers, the next Labour about them is to dry them on the Kiln. The Kiln is built upon a thick Plank (that it may be moveable from Place to Place) ſupported by four ſhort Legs. The Outſide conſiſts of eight Pieces of Wood, about three Inches thick, joined in Form of a quadrangular Frame, about twelve Inches ſquare at Bottom on the Inſide, and twenty-two Inches at Top, which is likewiſe equal to the perpendicu-

lar Height of it. On the Foreſide is left a Hole about eight Inches ſquare, and four Inches above the Plank, through which the Fire is put in. Over all the reſt, Laths are laid pretty cloſe to one another, and nailed to the Frame already mentioned, and then are plaiſtered over on both Sides, as is alſo the Plank at Bottom very thick, to ſerve for a Hearth. Over the Mouth, or wideſt Part, goes a Hair-Cloth fixed to two Sides of the Kiln, and likewiſe to two Rollers, or moveable Pieces of Wood, which are turned by Wedges or Screws, in order to ſtretch the Cloth. Inſtead of the Hair-Cloth many People now uſe a Net-work of Iron-wire, with which it is obſerved, that the Saffron dries ſooner, and with a leſs Quantity of Fewel; but the Difficulty of preſerving the Saffron from burning, makes the Hair-Cloth be preferred by the niceſt Judges in drying.

The Kiln is placed in a light part of the Houſe, and they begin by laying five or ſix Sheets of white Paper on the Hair-Cloth, upon which they ſpread the wet Saffron, between two and three Inches thick. This they cover with other Sheets of Paper, and over theſe lay a coarſe Blanket five or ſix times doubled, or inſtead thereof, a Canvas Pillow filled with Straw, and after the Fire has been lighted for ſome time, the whole is covered with a Board, having a large Weight upon it.

At firſt they give it a pretty ſtrong Heat, to make the Chives ſweat, as their Expreſſion is; and in this, if they do not uſe a great deal of Care, they are in danger of ſcorching, and ſo of ſpoiling all that is on the Kiln.

When it has been thus dryed for about an Hour, they take off the Board, Blanket, and upper Papers, and take the Saffron off from that which lies next it, raiſing at the ſame time the Edges of the Cake with a Knife. Then laying on the Papers again, they ſlide in another Board between the Hair-Cloth and under-Papers, and turn both Papers and Saffron upſide down, afterwards covering them as above.

This ſame Heat is continued for an Hour longer; then they look to the Cake again, free it from the Papers and turn it; then they cover it, and lay on the Weight as before. If nothing happens amiſs, during theſe firſt two Hours, they reckon the Danger to be over; for they have nothing more to do, but to keep a gentle Fire, and turn their Cake every half Hour, 'till it be thoroughly dry; for doing which as it ought, there are required full twenty-four Hours.

In drying the large plump Chives they uſe nothing; but towards the latter End of the Crop, when theſe come to be ſmaller, they ſprinkle the Cake with a little ſmall Beer, to make it ſweat as it ought; and they begin now to think, that uſing two linnen Cloths next the Cake, inſtead of the two innermoſt Papers, may be of

ſome Advantage in drying; but this Practice is followed as yet but by few.

Their Fire may be made of any kind of Fewel; but that which ſmoaks the leaſt is beſt, and Charcoal for that Reaſon is preferred to any other.

What Quantity of Saffron a firſt Crop will produce is very uncertain. Sometimes five or ſix Pounds of wet Chives are got from one Rod; ſometimes not above one or two, and ſometimes not enough to make it worth while to gather and dry it. But this is always to be obſerved, that about five Pounds of wet Saffron go to make one Pound of dry, for the firſt three Weeks of the Crop, and ſix Pounds during the laſt Week; and now the Heads are planted very thick, two Pounds of dryed Saffron may, at a Medium, be allowed to an Acre for a firſt Crop, and four and twenty Pounds for the two remaining, the third being conſiderably larger than the ſecond.

In order to obtain theſe, there is only a Repetition to be made every Year of the Labour of houghing, gathering, picking and drying, in the ſame manner as before ſet down, without the Addition of any thing new; except that they let Cattle into the Fields, after the Leaves are decayed, to feed upon the Weeds; or perhaps mow them for the ſame Uſe.

About the *Midſummer* after the third Crop is gathered, the Roots muſt all be taken up and tranſplanted: The Management requiſite for which is the fourth Thing to be treated of. To take up the Saffron Heads, or break up the Ground, as their Term is, they ſometimes plough it, ſometimes uſe a forked Kind of Hough called a Pattock, and then the Ground is harrowed once or twice over; during all which Time of ploughing, or digging and harrowing, fifteen or more People will find Work enough to follow and gather the Heads as they are turned up.

They are next to be carried to the Houſe in Sacks, and there to be cleaned or raiſed. This Labour conſiſts in clearing the Roots thoroughly from Earth, and from the Remains of old Roots, old Involucra, and Excreſcencies; and thus they become fit to be planted in new Ground immediately, or to be kept for ſome Time without Danger of ſpoiling.

The Quantity of Roots taken up, in Proportion to thoſe that were planted, is uncertain; but at a Medium it may be ſaid, that allowing for all the Accidents that happen to them in the Ground, and in breaking up, from each Acre may be had twenty-four Quarters of clean Roots, all fit to be re-planted. The Owners are ſure to chooſe for their own Uſe the largeſt, plumpeſt, and fatteſt Roots, but above all, they reject the longiſh pointed ones, which they call *Spickets* or *Spickards*; for very ſmall round or flat Roots are ſometimes obſerved to flower.

This is the whole Culture of Saffron in the Country above-mentioned; and we have only now to conſider the Charges and Profits which may be ſuppoſed, one Year with another, to attend this Branch of Agriculture; and of theſe I have drawn up the following Computation for one Acre of Ground, according to the Price of Labour in this County.

	l.	*s.*	*d.*
Rent for three Years	3	0	0
Ploughing three Times	0	18	0
Dunging	3	12	0
Hedging	1	16	0
Spitting and ſetting the Heads	1	12	0
Weeding, or paring the Ground	1	4	0
Gathering and picking the Flowers	6	10	0
Drying the Flowers	1	6	0
Inſtruments of Labour for three Years with the Kiln, about	0	10	0
Ploughing the Ground once and harrowing twice	0	12	0
Gathering the Saffron Heads	1	00	0
Raiſing the Heads	1	12	0
Total Charge	23	12	0

This Calculation is made upon the Suppoſition, that an Acre of Ground yields twenty ſix Pounds of neat Saffron in three Years, which I ſtated only as a mean Quantity between the greateſt and the leaſt; and therefore the Price of Saffron muſt be adjuſted accordingly, which I think cannot be done better than by fixing it at thirty Shillings *per* Pound; ſince in very plentiful Years it is ſold for twenty, and is ſometimes worth between three and four Pounds. At this Rate, twenty-ſix Pounds of Saffron are worth thirty-nine Pounds, and the neat Profits of an Acre of Ground producing Saffron, will in three Years amount to fifteen Pounds thirteen Shillings, or to about five Pounds four Shillings yearly. This, I ſay, may be reckoned the neat Profit of an Acre of Saffron, ſuppoſing that all the Labour were to be hired for ready Money; but as the Planter and his Family do a conſiderable Part of the Work themſelves, ſome of this Expence is ſaved: That is, by planting Saffron, he not only may reaſonably expect to clear about five Pounds yearly *per* Acre, but alſo to maintain himſelf and Family for ſome Part of each Year; and it is upon this Suppoſition only, that the Reſult of other Computations which have been made of the Profits of Saffron, can be ſaid to have any tolerable Degree of Exactneſs; but the Calculations themſelves are undoubtedly very unaccurate.

I have ſaid nothing here concerning the Charge in buying, or Profits in ſelling the Saffron Heads, becauſe in any large Tract of Ground

these must at length always ballance one another, while the Quantity of Ground planted yearly continues the same, which has been pretty much the Case for several Years past.

III. Agnus dictus Vegetabilis Scythicus, Barbaro nomine *Barametz Borometz* vel *Boranetz* inter Historiæ Nat. Scriptores est notus.

A Dissertation on the Scythian Lamb, *by* Joh. Phil. Breynius, *M. D.* Dantisc. *F. R. S.* No. 390. pag. 353.

De hoc imprimis egerunt Athanasius Kircherus in Opere de Arte Magnetica, (*a*) qui citat Sigismundum L. B. ab Herberstein, Haytonem Armenum, Surium & Jul. Cæs. Scaligerum, Franciscus Baco de Verulamio, (*b*) Fortunius Licetus, (*c*) Andreas Libavius, (*d*) Eusebius Nierenbergius, (*e*) Adamus Olearius (*f*) & Olaus Wormius, (*g*) ut cæteros, quos inter multi Botanici, qui eandem fere canunt cantilenam, nunc taceam.

Hunc Julius Cæs. Scaliger (*b*) titulo Agni Scythici, Borametz, sequentem in modum describit: " Superiora ludum putes, prout est " admirabilis Tartaricus frutex. Tartarorum horda primaria Zau- " olha est, vetustissimæ nobilitatis commendatione. In eo agro se- " runt semen seminis Melonis simillimum, sed minus oblongum. " Ex eo satu plantam exire, quam Borametz, id est, agnum vocant. " Crescit enim agni figura ad pedum fere ternum altitudinem: quem " pedibus, ungulis, auribus, toto capite, præterquam cornibus, re- " præsentat. Pro cornibus pilos gerit, singularis cornu specie. Ob- " ducitur corio tenuissimo: cujus detracti usus ad capitum tegmina " incolis. Ferunt internam pulpam Gammari referre carnes. Cæ- " terum è vulnere quoque sanguinem manare. Dulcore esse admi- " rabili. Radicem humo exertam surrigere ad umbilicum usque illud " miraculi fovet magnitudinem. Quandiu vicinis obsidetur herbu- " lis, tamdiu vivere, quasi agnum in læto pascuo. Absumptis illis, " tabescere, atque interire. Idque non solum vel casu, vel tractu " temporis, sed etiam experiundi gratia, subtractis, atque ablatis " evenire. Quin illud auget admirationem: appeti à Lupis eam, " non item ab aliis bestiis, quæ carne vescantur. Hoc quasi con- " dimentum, atque intritum, ad fabulæ, & agni allusionem. Illud " scire velim: Ab uno stirpite, quatuor dissita crura cum suis pedi- " bus qui possint provenire, atque produci.

" Hæc, quod non ignorarem haud ingrata fore tibi, cæterisque " Philologiæ studiosis, enarravi partim à nobilissimis, partim ab ex- " ercitatissimis in rerum Natura viris non solum lecta, sed etiam " audita: quibus ingenii tui ampliſſima spatia implere aliqua ex par- " te posses."

Pari ratione cæteri eum describunt, vel potius ex Scaligero exscribunt Authores, quorum tamen nonnulli in quibusdam circumstantiis

(*a*) *Pag.* 504, & 505. (*b*) Histor. Natur. Cent. 7. No. 609. (*c*) De Spontaneo Viventium Ortu. C. 45, (*d*) Historia Agni Scythiæ. (*e*) Histor. Natural. *p.* 34. (*f*) De Itinere Perfico. *p. m.* 155. (*g*) Mus. *p.* 190. (*b*) De Subtilitate contra Cardanum Exerc. 181. §. 29, & 30.

variant,

variant, & Athanaſius Kircherus ejuſdem addit, vel ut rectius dicam fingit figuram. Imo in nonnullis Rerum Nat. Muſæis, ut in Wormiano, Swammerdammiano, *&c.* ejus, uti volunt, quondam demonſtrabatur detracta pellis.

Antonius Deuſingius (*i*) rem accuratiori rationis trutina examinans, fabuloſa eſſe, quæ de Agno hoc traduntur, ſubolfecit, & ipſum Julium Cæſ. Scaligerum, qui inter primos Authores, ut ſupra dictum, ejus meminit, eum ut fabulam tractâſſe evincere conatur. Quemadmodum & alii, minus creduli, eundem in dubium vocârunt.

Et revera totam hanc de hoc Agno Hiſtoriam, ſi ab animo præjudiciis vacuo accurate examinetur, fabulam ſapere, imo eſſe, & Deuſingium recte judicâſſe, ſequentes evincunt rationes.

1°. Quia à nullo fide digno Authore Agnus ejuſmodi Vegetabilis unquam viſus. Quæ enim Olaus Wormius (*k*) narrat ex relatione D. Eovaldi de Kleiſs, Electoris Brandenburgici Legati, (ipſi ſcilicet in confinibus Tartariæ degenti à Tartaro quodam fuiſſe oblatam ejuſmodi plantam exſiccatam, foliis Tabaci, cujus cauli adhærebat fructus, agnellum figura plane referens, magnitudine pedali, vellere criſpo tectus) ſuſpecta ſunt, cum Vir ille Nobiliſſimus, ab aſtuto quodam Tartaro, ipſi fucum faciente facile ſeduci potuit. Quid verode pellibus, quæ hoc nomine in Muſæis demonſtrantur, ſentiendum ſit, ex infra dicendis apparebit.

2°. Quia à Doctiſſ. & Rerum Nat. Scientiſſimo Engelberto Kæmpfero, M. D. (*l*) in ſuppoſita hujus Agni patria anxie licet quæſitus, tamen nihil huic ſimile inventum; hæc enim ejus ſunt verba: "Quia "de exiſtentia Zoophyti gramina paſcentis, nullibi Tartariæ apud "vulgum, vel Botanicæ peritos extat notitia & memoria, prout ipſe "ad riſum & nauſeam exploravi, neque ulla res Borometz dicta, "præterquam ovinum pecus ibidem poteſt reperiri, meram eſſe, "quicquid de hac planta proditur, fictionem & fabulam aſſeri-"mus."

3°. Denique quia tota de hoc Agno relatio fabulæ adeo videtur ſimilis, ac ovum ovo.

Fabulæ autem hujus originem optime detexit diligentiſſimus Naturæ in Orientalibus Regionibus Scrutator, jam jam laudatus Kæmpferus loc. cit. ubi (præmiſſis de Etymologia vocis Borometz, quod corruptum ait ex Moſcovitico Boranetz, Polonicè Baranek, quod diminutivum eſt vocus Baran Sclavonicæ originis, Polonis Ruſſiſque ovem ſignificantis) ait, in quibuſdam Provinciis circa Caſpium Mare eſſe quoddam ovium genus, præter vulgare nobis cognitum, quod ab eo in multis diſcrepat, imprimis commendabile pellium

(*i*) De Agno Vegetabili, quod extat in Faſciculo ejus Diſſertationum ſelectarum, p. 598. & ſeq. (*k*) *l. c.* (*l*) Obſervat. de Agno Scythico ſ. fructa Borometz quæ extat in Diſſert. ſua inaugurali, nec non in Amoenitatum Exoticarum Faſciculo III. Obſ. 1.

elegantia

elegantia, quas describit, & qua ratione ad usus pro vestimentis adornandis Tartaris Persisque familiares præparentur, docet, & addit: " Magnatum divitumque fastum supra vulgi sortem amiciri cupien- " tem, pullorum pelliculas expetere, qui annosis multo teneriores " & eo quidem cariores, quo juniores fuerunt agnelli, quibus de- " tractæ sunt; horum enim pili à pellionibus cogi patiuntur in sub- " tiliores & densiores cirros, qui toti pelliculæ pretium & venustatem " tribuunt. Inde fit, ut teneritatis & lucri insidiatores non vereantur " ipsam anticipare, crudeli laniena, nativitatem, & matribus uterum " gerentibus, dissecto ventre partum ante partum eximere, solius " gratia pelliculæ obtinendæ. Hæc rite elaborata, tam dubiam " prorsus & delicatissimam teneritatem exhibet, ut resectis extremi- " tatibus, vix agninæ cutis retineat similitudinem, sed ignaram cre- " dulitatem, specie quadam membranæ cucurbitinæ lanuginosæ pos- " sit decipere. His subjungit: Pretium pelliculæ, pro bonitatis " opinione, exsurgit ad aureos tres, vel amplius; servit ea pro dupli- " catione mitrarum, nec rarò, ornatus gratia, togarum & amicu- " lorum limbum constituit. Tandem concludit: Sive fabula hæc " natales debeat conjecturæ alicujus contemplatoris Philosophi, sive " insciticæ tribuenda sit primi relatoris, qui per linguæ ignorantiam, " vel incuriam, in parergo rem auditam perperam intellexisse potuit, " sive cuicunque acceptam referamus occasioni alii, qua per longe " dissitas regiones passim provecta, ambiguæ teneritatis pellicula, " integritatem historiæ ac nominis sui amiserit: donec tandem appul- " sa nobis cum prodigii lepore, in Virum illustrem, curiosum & hu- " jus peregrinæ lanuginis admiratorem incidens, vegetabili vultu " suo fidem prodigii, ut solent mirabilia omnia, nullo negotio " fecerit. Sic authoritate illustratus error, mox scriptis quoque " firmatus, sapientissimorum ingenia & vulgi opinionem ita occu- " pavit, ut hodie pro Zoophyti specie inter rariora Musæorum osten- " tari soleat, quæ verissima Cæsarei fœtus pellicula est". Hactenus ille.

Ex citatis patet pelles illas agninas Persicas quæ à Pellionibus nostris **Persianische Baranken** salutantur, hujus esse generis, quamvis non optimæ notæ, illorum scilicet agnorum, qui Cæsarea sectione ex Matrum uteris exscinduntur, cum earum pretium, teste Kæmpfero ad aureos tres, vel amplius in ipsa eorum patria exsurgat, nostræ verò pretio longe minori apud nos, unico scilicet aureo, ad summum veneant.

Interim ante triennium circiter Vir quidam eruditus & curiosus ex Moscovia iter faciens & urbem nostram transiens, Musæolum meum, inter alia quædam Naturalia, Agno ejusmodi, ut vocabat, Scythico, quod pro genuino Borometz, ceu magnum Κειμήλιον venditabat, ditavit. Hic sex pollicum præter propter erat longitudinis, capite cum auribus & quatuor cruribus instructus, coloris ferruginei & totus lanugine quadam instar panni holoserici villosi **Gammet**

vulgo

vulgo dicti, tectus, auribus & cruribus, quæ glabra erant, coloris ad fuſcum magis vergentis, exceptis. (*) ad examen vocatum cognovi non eſſe animalis naturæ, neque fructum alicujus plantæ, ſed radicem cujuſdam vegetabilis craſſam, reptantem & villoſam, vel potius caulem ſcandentem plantæ alicujus qui arte obſtetricante figuram aliqualem animalis quadrupedis acquiſiverat. Crura enim quatuor erant tot reliquiæ caulium, vel ſi mavis pediculorum abſciſſorum, qui folia ſuſtentaverant, quemadmodum & aures, qui tamen cornibus ſimiliores; præterea hinc inde emergentes fibræ, per quas more cæterarum nutrimentum radix craſſa, vel potius caulis & per hunc planta ceperat, nullum amplius relinquebant dubium. Quartum quoque crus anterius, non ut cætera corpori continua, ſed arte erat intruſum, quemadmodum & ipſum cum collo caput ſubtili modo annexum, accuratiori examine deprehendi. Ut adeò hic Agnus eodem artificio ex radice hac vel caule formatus fuerit, quo Homunciones ex Mandragoræ & Bryoniæ radicibus qui **Alraunen** vulgo dicuntur ab Agyrtis. Remanſit mihi tamen dubium, ex qua planta hoc ludibrium artis & naturæ efformatum ſit, quanquam mox ſubiit cogitatio illud plantæ cuidam ex capillarium genere vulgo dicto adſcribendum eſſe, cujus varia habebam indicia, ab analogia mihi cognitarum quarundam exoticarum ſpecierum, nonnullarumque ab Illuſtri D° Hans Sloane & Rev. P. Carolo Plumier in ſplendidiſſimis ſuis Operibus deſcriptarum & delineatarum; utpote, quarum diverſæ caules ſcandentes ejuſmodi lanugine ferruginea *ſ.* rufeſcente muſco, ut vocant, tectos emittunt. Interim tamen, ex qua ſpecie præciſe, determinare non volui, Peculiarem itaque forte nondum deſcriptam ſpeciem eſſe, quæ in Tartaria reperitur, arbitror, donec cum tempore certiora edoctus fuero.

Hanc meam ſententiam confirmant, quæ poſtmodum legi in Tranſactionibus Philoſophicis Anglicanis *(m)* ubi Illuſtris Ds. Hans Sloane, ſimilem Agnum Scythicum fictum ex India Orientali nactus deſcripſit & delineavit, qui tamen longe minus Agni figuram refert, quàm meus memoratus.

Credo autem ejuſmodi Agnos ex certis radicibus vel caulibus in Moſcovia & Tartaria effingi, ut aliquo modo Hiſtoriæ Agni Scythici Vegetabilis adſtruatur Veritas. Quis autem non videt hunc ab eo, qui a ſupra citatis Authoribus deſcribitur, plane diverſum, nec tanta admiratione dignum eſſe, cum etiam hic ex variis radicibus varia portenta, quæ rerum naturalium quarundam ſimilitudinem aliqualem habeant, effingi poſſint; quemadmodum ſupra de Mandragoræ radicibus retuli dum interim hic non magis agnus dicendus, ſed

(*). *Vid* Figuram natura dimenſione expreſſam. (*m*) N° 287. *p* 861. quod etiam reperitur *in the Philoſophical Tranſactions abridged by* John Lowthorp, *Vol.* 2. *p.* 646. *f.* 160.

radix

radix vel caulis revera eſt & manet plantæ cujuſdam, ac Homunciones **Alraunen**, Belgice PISSE DIEFJES (*n*) dicti, radices Mandragoræ.

An Account of the Cinnamon Tree in Ceylon, *and it's ſeveral Sorts. Communicated by the Chief Inſpector of the Cinnamon Trade and Manufacture in that Iſland to Mr* Albertus Seba, *at* Amſterdam. *Tranſlated by the late Dr* Scheuchzer, *F. R. S.* No. 409. p. 97.

IV. 1. The firſt and beſt Sort of Cinnamon, which grows in great Plenty in *Ceylon*, and is peculiar to that Iſland, is called by the Natives *Raſſe Coronde*, that is, ſharp, ſweet Cinnamon. 'Tis this choice Sort, which is exported yearly by the *Dutch Eaſt-India-Company*, by whom it hath been prohibited under ſevere Penalties, that no other Sort ſhould be mixed with it.

The ſecond Sort is called *Canatte Coronde*, that is, bitter and adſtringent Cinnamon; for the *Ceyloneſe*, in their Language, call Cinnamon in general *Coronde*, and *Canatte* ſignifies bitter and adſtringent. The Bark of this Tree comes off very eaſily, and ſmells very agreeably when freſh, but hath a bitter Taſte. It is an Advantage to us, that it doth not grow in great Plenty hereabouts, becauſe one might eaſily miſtake it for a better; as indeed, in general, it requires a good deal of Skill and Attention ſo to diſtinguiſh the Cinnamon Trees from each other, as not to chooſe now and then a worſe Sort for the beſt. The Root of this ſecond Tree yields a very good ſort of Camphire.

The third Sort is called *Capperoe Coronde*, that is Camphorated Cinnamon, becauſe it hath a very ſtrong Smell and Taſte of Camphire. It grows plentifully enough in the Iſland, but not in the Eaſtern Parts of it: However, they find Means now and then to ſend it over privately, and ſell it to the *Danes* and *Engliſh*, who come to Trade upon the Coaſts of *Cormandel*; for as long as there is but one Port in the Iſland left open, abundance of this ſort of bad Merchandize may be exported. Beſides, there is ſort of a *Canella*, on the Continent of *India*, about *Goa*, which is very like this ſort of Cinnamon Tree, though it hath nothing of the true Cinnamon. The ſame ſort of *Canella* agrees in many Things with the *Canella Malabarica Sylveſtris*, a wild Cinnamon Tree, growing upon the Coaſts of *Malabar*. And although with regard to the Shape of the Tree, and the outward Appearance of the Bark and Leaves, there is very little Difference to be obſerved between theſe two ſorts of *Canella*, and the beſt ſort of Cinnamon, yet the latter is vaſtly ſuperior in Richneſs, Virtue, and Sweetneſs.

The fourth Sort, called *Welle Coronde*, that is, the *Sandy Cinnamon*, becauſe upon chewing it, one feels as it were, Bits of Sand between the Teeth, though in Fact there is nothing ſandy in it. The Bark of this Tree comes off eaſily enough, but is not ſo eaſily rolled up into a fibular Form, as other ſorts of Cinnamon are, being apt to

(*n*) De quibus vid. Deuſingius de Mandragoræ Mangoniis, quod extat in ejuſdam Faſciculo Diſſertationum, *p.* 586. nec non Miſcellan. Natur. Curioſ. D. 1. A 1. Obſ. 48.

burſt open and unfold itſelf. It is of a ſharp and bitteriſh Taſte and the Root of it yields but a ſmall Quantity of Camphire.

The fifth Sort is called *Sewel-Coronde*, *Sewel* in the *Ceyloneſe* Language ſignifies mucilaginous, or glutinous. This ſort acquires, in drying, a very conſiderable Degree of Hardneſs, which upon chewing of it ſufficiently ſhews itſelf. It hath otherwiſe but little Taſte, and an ungrateful Smell; but the Colour of it is very fine, and it is not many Years ſince I firſt took Notice, that the Natives, who are all Blacks, mix a good deal of this mucilaginous Cinnamon with the beſt Sort, the Colour of both being very much alike, excepting only, that in the good Sort there appear a few yellowiſh Spots towards the Extremities.

The ſixth Sort is called *Nieke Coronde*, the Tree which bears it, having a good deal of Reſemblance to another Tree, which is by them called *Nieke Gas*, and the Fruit it bears *Nieke*. The Bark of this ſort, hath no manner of Taſte or Smell, when taken off, and is uſed by the Natives only in Phyſic. For by roaſting of it they obtain a Water and Oil, which they anoint themſelves withal, thinking thereby to keep off all ſorts of noxious Fumes, and Infections in the Air. They likewiſe expreſs a Juice out of the Leaves of it, which they ſay cools and ſtrengthens the Brain, if the Head be rubbed with it.

The ſeventh Sort is called *Dawel-Coronde*, that is, Drum-Cinnamon, in *Low Dutch Trommel-Caneel:* The Reaſon of this Appellation is, becauſe the Wood of this Tree, when it is grown hard enough, is light and tough, and that Sort, of which the Natives make ſome of their Veſſels and Drums, which they call *Dawel*. The Bark is taken off, when the Tree is yet growing, and is of a pale Colour: The Natives uſe it in the ſame Manner with the ſixth Sort.

The eighth Sort is called *Catte-Coronde*, that is, the thorny or prickly Cinnamon; *Catte*, in the *Ceyloneſe* Language, ſignifying a Thorn, or Prickle; for this Tree is very prickly. The Bark is in ſome Meaſure like Cinnamon, but the Leaves differ very much, and the Bark itſelf hath nothing either of the Taſte or Smell of Cinnamon. The Natives uſe the Root, Bark and Leaves of this Tree in Phyſic, applying them in Form of Cataplaſms, to Tumours and Swellings from a thick corrupt Blood, which they ſay it cures in a ſhort Time.

The ninth Sort is called *Mael Coronde*, or the Flowering Cinnamon, becauſe this Tree is always in Bloſſom. The Flowers come neareſt to thoſe of the firſt Sort, but they bear no Fruit, which the other doth. The Subſtance of the Wood becomes never ſo ſolid and weighty in this, as in the other Cinnamon Trees above-mentioned, which have ſometimes eight, nine, or ten Feet in Circumference. If this everflowering Cinnamon Tree be cut, or bored, a limpid

Water will iſſue out of the Wound, as it doth out of the *European Birch-Tree*, but it is of no Uſe, any more than the Leaves and Bark.

The Inhabitants of *Ceylon* ſay, there is ſtill another Sort of Cinnamon, which they call *Toupat Coronde*, or the three Leaved Cinnamon. It doth not grow in that Part of the Country which the *Dutch Eaſt India* Company is poſſeſſed of, but higher up towards *Candia*. Having never ſeen it myſelf, I will alſo, out of regard to Truth, ſay nothing farther of it.

All the ſeveral ſorts of Cinnamon Trees, the beſt as well as the reſt, muſt grow a certain Number of Years, before the Bark is fit to be taken off: With this Difference however, that ſome of the Trees of the ſame ſort, as for Inſtance of the firſt and beſt, will ripen two or three Years ſooner than others, which is owing to the Difference of the Soil they grow in; thoſe for Inſtance, which grow in Vallies, where the Ground is a fine whitiſh Sand (and there are many ſuch Vallies in the Iſland of *Ceylon*) will in five Years Time be ready, whereas thoſe, which ſtand in a wet ſlimy Soil, muſt have ſeven or eight Years Time to grow, before they are ripe enough. Again, thoſe Trees are later, which grow in the Shade of other larger Trees, whereby the Sun is kept from their Roots: And hence alſo it is, that the Bark of ſuch Trees hath not that Sweetneſs and agreeable Taſte obſervable in the Bark of thoſe Trees which grow in a white Sandy Ground, where with little Wet they ſtand full expoſed to the Sun, but is rather of a bitteriſh Taſte, ſomething adſtringent, and ſmells like Camphire.

For by the Heat of the Sun's Rays the Camphire is made ſo thin and volatile, that it riſes up and mixes with the Juices of the Tree, where it undergoes a ſmall Fermentation, and then riſing ſtill higher between the Subſtance of the Wood, and the thin inner Membrane of the Bark, it is at laſt ſo effectually diffuſed through the Branches and Leaves, that there is not the leaſt Footſtep of it to be perceived any where. Mean while that thin and glutinous Membrane, which lines the Bark on the Inſide between it and the Subſtance of the Wood, attracts and ſucks in all the pureſt, ſweeteſt, and moſt agreeable Particles of the Juice, leaving the thick and groſs ones, which are puſhed forward, and ſerve to nouriſh the Branches, Leaves, and Fruit.

What I here mention, is from my own Obſervations, and I have often had Occaſion to prove this Fact to curious Perſons by the Things themſelves. For if the Bark be freſh taken off, that Juice which remains in the Tree hath a bitteriſh Taſte, not unlike that of Cloves. On the contrary, if you taſte the inner Membrane of the Bark, when freſh taken off, you will find it moſt exquiſitely ſweet, and extreamly agreeable to the Taſte; whereas the outward Part of

the Bark differs but very little in Taſte from the common Trees; which ſhews plainly that all the Sweetneſs of it is owing only to the inner Membrane. But when the Bark is laid in the Sun in order to be dried and wound up, this oily and agreeable Sweetneſs of the inner Membrane diffuſes itſelf throughout the whole outward Part of it (which however hath been firſt ſtripped, whilſt yet upon the Tree, of it's outermoſt greeniſh Coat) and imbues it ſo ſtrongly, as to make the Bark a Commodity, which for the Fragrancy of it's Smell, and the Sweetneſs of it's Taſte, is coveted all over the World.

The Bark may be taken off from Trees which have ſtood fourteen, fifteen, or ſixteen Years, after they are come to Maturity, according to the Quality of the Soil they ſtand in: But after that Time they loſe, by Degrees, their Taſte and agreeable Sweetneſs, which makes the Bark have more of the Taſte of Camphire: Beſides, the Bark is then grown ſo thick, that if it be laid in the Sun, it will no longer ſhrink and wind it ſelf up, but remain flat.

And here it may be thought a fit Subject of Enquiry, how it comes to paſs, that, conſidering what vaſt Quantities of Cinnamon have been exported from this Iſland, and ſold all over the World, there are yet ſuch Numbers of good Trees fit to be barked, remaining in the Iſland and growing there every Year? Now in order to ſolve this Queſtion, ſeveral Authors, who deſcribed the Iſland of *Ceylon*, committed a conſiderable Miſtake, when they aſſured their Readers, that when the Bark hath been ſtripped off the Tree, it grows again in four or five Years, and becomes fit to be ſtripped a ſecond Time. But this Aſſertion is entirely contrary to the Courſe of Nature and Obſervation: Nor do I believe that there is any one Tree whatever in any Part of the World, which, if it was entirely ſtripped of it's Bark, could ſubſiſt and grow any longer: That Part at leaſt, where the Bark hath been taken off, will quickly grow dry, and ſo die away; but the Root in the mean while remains entire and in good Condition; and this ſhews the Reaſon why there is ſuch a Number of Trees fit to be barked every Year. For although the Cinnamon Trees, after the Bark hath been once taken off, is cut down to the very Root, as they do in *Europe* Oaks, Birch-Trees, Alders and Willows, yet the Root will quickly puſh forth new Shoots, which will ripen in a ſhort Time, I mean in five, ſix, ſeven or eight Years, ſome ſooner, ſome later, and then yield their Quantity of the Bark. Hence it appears, how far the old Roots are inſtrumental to the Growth and Plenty of Cinnamon Trees, but the Fruit which falls from the Trees, contributes very much towards the ſame End: And it is particularly owing to a certain kind of wild Doves, which from their feeding on the Fruit of the Cinnamon-Tree, they call *Cinnamon-eaters*, that theſe Trees grow ſo plentifully

in this Iſland; for the Doves, when they fetch Food for their young ones, flying here and there, diſperſe vaſt Quantities of the Fruit all over the Fields, which occaſions the Riſe of many thouſand young Trees, which may be ſeen along the Roads in ſuch Quantities together, that they look like a little Wood.

The Oil drawn out of it by Fire is reckoned one of the ſtrongeſt Cordial Medicines: The Camphire which comes out of the Root, is likewiſe of great Uſe in ſeveral Diſtempers, as are alſo the Oil of Camphire, a very coſtly Thing, the Leaves of the Tree, and the Oil diſtilled out of them; and laſtly, the Fruits with their Oil. In ſhort, there is no Part of the Cinnamon Tree, but what is of ſome ſingular Uſe in Phyſic. I purpoſely avoid ſpeaking of the large Gains the Company makes by the yearly Export of this precious Commodity.

2. Having ſome Years ago bought out of the *Eaſt-India* Company's Warehouſes at *Amſterdam*, a conſiderable Quantity of Cinnamon Leaves, or *Folia Malabathri*, packed up in ſeveral large Cheſts, I happened to find in one of them the Flowers of the Cinnamon, as big as the *Italian* Bean-flowers, and of a blue Colour; I chanced likewiſe to meet with the Fruit. But I could not find either in any of the other Cheſts.

Additions to the foregoing Account, by the ſame. No. 419. p. 106.

In 1722 and 1723, I bought of the ſame Company the Oil, which is expreſſed out of the Fruit of the Cinnamon Tree, as alſo that which is boiled out of them, which is of a very good Conſiſtence and white, and is by the *Eaſt-India* Company called Cinnamon Wax, becauſe the King of *Candia* cauſes Candles to be made out of it, which for their agreeable Scent, are burnt only by himſelf and at his Court. However he permits his Subjects to expreſs the Juice out of another Fruit, not unlike the Fruit of the Cinnamon Tree; but this being only a thin fat Subſtance, like Oil of Olives, they cannot burn it any otherwiſe than in Lamps.

The *Indians* uſe this Cinnamon Wax alſo in Phyſic, and give it inwardly in Luxations, Fractures, Falls, Contuſions and Bruiſes, that in caſe any inward Part be touched or bruiſed, it may by it's Balſamic Virtues heal them. They give it alſo in Bloody Fluxes to one Dram or a Dram and a half. Outwardly applied, it makes the Skin more beautiful, ſmoother and ſofter, than any one known ſort of Pomade.

The Leaves of the Cinnamon Tree yield alſo an Oil, which is of a bitteriſh Taſte, reſembling Oil of Cloves mixed with a little good Oil of Cinnamon. It is called *Oleum Malabathri*, or Oil of Cinnamon Leaves. It is an Aromatic, and is reckoned an excellent Remedy in Headaches, Pains of the Stomach, and other Diſtempers.

The Oil of the Root of the Cinnamon Tree is, properly ſpeaking, an Oil of Camphire, the Roots affording a good Quantity of Camphire. About two Years ago, I bought a Bottle of it of our *Eaſt-India* Company. There were ſeveral Bottles together in a Box, upon which was written

written in Low Dutch *Deſe Oliteyten ſyn tot een geſchenk nyt Candia geſchikt*; that is, *theſe Oils were ſent as a Preſent out of* Candia, which ſhews that they are genuine, without any Adulteration; If this Oil be diſtilled in Glaſs Veſſels, there comes over along with it, that ſort of Camphire which the *Indians* call *Camphire Baros*, or Camphire of *Borneo*, which ſhoots in thin tranſparent Cryſtals, forming a beautiful Variety of Trees on the Recipient, not unlike thoſe, which in very froſty Weather are to be ſeen upon Windows. This ſort of Camphire is of very great Efficacy in Phyſic, and is gathered and kept for the King of *Candia's* own Uſe, who eſteems it an excellent Cordial. But not only the Camphire of *Baros*, but alſo the Oil of Camphire, which is drawn out of the Roots of the Cinnamon Tree, is a very great Cordial, if taken inwardly: It ſtrengthens the Stomach, expels Wind, and hath been found of great Uſe in arthritic and gouty Diſorders; It is alſo a Diuretic. The Doſe is ten or twelve Drops upon a bit of Sugar, or in a proper Vehicle. Outwardly it is applied in all arthritic Pains from Cold and Obſtructions, being rubbed on the affected Part with a warm Hand, and it will preſently leſſen the Pain, and by Degrees take it off. About ſix and thirty Years ago Mr *Nicolas Dumbſtdorff* at *Amſterdam*, was ſo cruelly afflicted with arthritic Pains, that hecould have no Reſt neither Night nor Day; and although he called in the Aſſiſtance of ſeveral noted Phyſicians, and tried abundance of Medicines, yet he could find no Relief, till he was adviſed to cauſe himſelf to be anointed with the Oil of the Root of the Cinnamon Tree; of which he then happened to have a good Quantity by him. I anointed him myſelf, rubbing the Oil on all the affected Parts with my Hand warmed by holding it to an Oven, and this I did twice every Day for an Hour together. And though, when this Cure was firſt begun with him, his Hands and Feet were by the Convulſions and the Violence of his Pain, ſo contracted, that they grew quite crooked, and were full of Nodes, yet in a Fortnight's Time he grew ſo much better, that he could ſleep well at Nights, feeling neither Pains nor Cramps. In about ſix Weeks Time he could walk about his Room, whereas before the Anointing he was not able to ſtir either Hand or Foot. This Anointing was continued for about three Months, when the Patient not only recovered of that violent Indiſpoſition, but continued free from the Gout ever after, and lived about fifteen Years in very good State of Health. And I can not only affirm this to be true of my own certain Knowledge; but alſo, that ſince that Time I have adviſed ſeveral People in his Condition to do the ſame with as good Succeſs. Several Phyſicians have written largely of the Virtues of common Camphire, but there are as yet many hidden Qualities in this excellent Medicine. Thus, for Inſtance, I can affirm, that in all Burnings, by Fire or otherwiſe, and the Pains occaſioned thereby,

I have

I have not yet met with any better and surer Medicine than this following:

℞. *Spir. Lumbricor. terrestr. cum Spir. Vini rectificat.* ℥xij. *Camphor.* ℥ji. M.

No sooner is a Bandage, or Compress, dipped into this Spirit applied to the affected Part, but it will give instant Relief, and so effectually check the Inflammation, that it will creep no farther. But the Application of it must be continued till the Pain is quite gone, and the *Ulcus*, if there hath been any, is dried up. If the Exulceration is got deeper, and the Wound must be kept open, two Ounces of Camphire dissolved in *Oleum Hyperici*, mixed with a Pound of the common *Unguentum Cerussæ*, applied according to Art, will quickly and effectually heal it, as I have often experienced.

V. The first general Division of these Roots must be, into true and false; and each of these may be again subdivided into several Species, the distinctive Note of which is principally taken from their Colour.

Of the different Kinds of Ipecacuanha, *by* James Douglas. *M. D. F. R. S.* No. 410. pag. 152.

Of the true *Ipecacuanha* I have four Kinds, Black, Brown, Grey, and White; but I cannot pretend to determine whether they belong to different Plants, or are only Varieties of the same Plant owing to the Soil in which they grow, as is affirmed by Sir *Hans Sloane*. And as these Roots are never imported to us entire, it is impossible to give any certain Description of them in that State.

However, by comparing the several dried Pieces as we have them, we may very probably conjecture that a short radical Trunk descends from a *Caulis*, and is afterwards divided into several large Branches, and these again into smaller ones, in different Series, with minute Filaments, or Fibrillæ, going out from them.

Each Piece is made up of an Outer or Cortical part, and an Inner or Fibrous one, which like a white Nerve, or smooth compact Fasciculus of woody Filaments runs through the Center or Axis of the Roots, and perhaps encloses within it a small Pith, which however is hardly discernible by the naked Eye.

The Cortical Part is corrugated by two Sorts of Wrinkles, one superficial, consisting either in circular Rings or little Knots which do not go quite round; the other penetrating into it's Substance, being deep Incisures or Fissures reaching all the Way to the Nerve.

What Lengths these Roots are of when taken out of the Ground, cannot be determined: I have met with some Pieces above nine Inches, many above six, but the greatest Number are still shorter.

We

We find them bent, wreathed, and contorted into all Manner of Figures; and indeed few Pieces are altogether ſtraight for any conſiderable Length.

What has been hitherto ſaid, agrees to all the true *Ipecacuanha-roots*; but ſeveral other Things are ſtill to be taken Notice of, in which they differ.

The Black Sort is the ſmalleſt of the four, very hard, and the Fiſſures wide and numerous. The outward Colour of the Cortex is not equally black in all the Pieces of this Kind, and it's inner Subſtance, as well as the Nerve, is moſtly white, tho' not always in the ſame Degree.

The Brown Sort is larger than the Black, the Fiſſures at larger Diſtances, the inner Subſtance of the Cortex darker, and the external Colour has ſeveral Degrees of Redneſs in the ſeveral Pieces.

The Third or Grey Sort is ſometimes found of a darker, ſometimes of a lighter Colour, and the Inner Subſtance of the Cortex is Brown ſtreaked with White. It is much larger than the black Sort, many Pieces being above ¼ of an Inch in Diameter, but the Nerve is ſmaller in Proportion to the Cortical Part. I have met with few Pieces of this Species above five Inches in Length; but, as I already obſerved, nothing can be concluded from thence as to the Length of the whole Roots. The Fiſſures are here ſtill fewer than in the brown Sort, and in ſome Pieces ſcarce any are to be met with. The ſuperficial Corrugations are various in different Roots, ſome being almoſt wholly ſmooth, and in others the Wrinkles rather longitudinal than circular.

The white Kind, as far as I can judge by the ſmall Sample which I have of it, is of very different Sizes, ſome Pieces of it being larger than any of the grey Sort, and the reſt much leſs. The whitiſh Colour of the Cortex has a yellowiſh Caſt, and the nervous Part is very large in Proportion to the reſt. Very few Fiſſures are to be obſerved therein, and hardly any reach ſo deep as the Nerve. The other Corrugations are likewiſe very ſhallow, and moſt of them longitudinal; but it ſeems to be more knotty than the other Kinds, and theſe Knots I take to be owing chiefly to the *Fibrillæ* which go out from the larger Branches of the Roots.

The Places of Growth of theſe different Species of *Ipecacuanha* have not as yet been fully ſettled.

The Black Sort is hitherto known to come only from *Braſil*, by the Way of *Liſbon*, and ſome of our Druggiſts for that Reaſon diſtinguiſh it by the Name of the *Braſil* Root.

About the Brown Sort, I am informed by Dr *James Houſton*, who reſided for ſeveral Years in *New-Spain*, that it grows plentifully at ſome Diſtance from the City of *Cartagena* in the Kingdom of *New Granada*; from whence it is frequently ſent in Saroons or Skins, containing

containing 100 Weight, to *Jamaica*, and ſo to *England*; where it is certain we have had it of late Years in great Abundance.

The Grey *Ipecacuanha* is with us preferred to all the reſt, and by far the moſt generally uſed when it can be had. It is ſaid by Authors to grow in *Peru*, from whence, it is brought to *Porto-Bello*, and from thence into *Europe*, by the *Spaniſh Galleons*. Some Parcels thereof are likewiſe probably ſent from *Porto-Bello* to *Jamaica*; for we are certain that it has ſometimes been imported hither from that Iſland. By ſome Specimens that were brought me, from St *Thomé*, a *Portugueſe* Iſland under the Equinoctial, whither they were ſent directly from *Braſil*; it is evident that this Species is likewiſe a Native of that Country, and therefore muſt either have been included by *Piſo* under one of the two Species mentioned by him, or elſe diſcovered ſince his Time. According to Father *La Bat*, in his late Voyage to the Iſlands of *America*, this Species grows alſo plentifully in *Martinico*, where for many Years paſt it has been uſed by the Inhabitants.

The White Sort, called by the *Portugueſe*, *Ipecacuanha Blanca*, is ſaid by *Piſo* to grow in *Braſil*, and if we may believe Father *La Bat*, it is likewiſe found in *Martinico*.

Theſe are the four Kinds of true *Ipecacuanha* which have hitherto come to my Knowledge; but I have met with two other Roots to which that Name has been falſely aſcribed, which from their outward Colour I ſhall call White and Reddiſh Brown.

The White Sort agrees pretty much both in Colour and Surface with the true White, but it is not near ſo knotty. It is likewiſe conſiderably larger in Size, ſtraighter and ſofter to the Touch.

The Brown Sort is of a deeper Colour than the true Brown, and many Pieces thereof have ſome Mixture of Red (from whence it has been ſometimes called Red *Ipecacuanha*) and the inner Subſtance of the Cortex inclines to a reddiſh Yellow. The Pieces thereof are much longer than any of the former Sorts, ſome of them meaſuring ſixteen Inches, and they are of a Size between the Black and Grey. The Fiſſures are at greater Diſtances from one another than in the true Brown, and the Spaces between them much ſmoother. In a Word, though this Root when mixed with the true Brown, to which it bears the greateſt Reſemblance, may eaſily be confounded therewith; yet when they are attentively compared, their whole Appearance ſufficiently diſtinguiſhes them.

Both theſe falſe Kinds were brought me from *Maryland* in 1725, by a Surgeon, who informed me that they grow there in great Plenty, being called *Ipecacuanha* by the Inhabitants, and uſed as a Vomit by thoſe of inferior Rank. I have ſince that Time received a Sample of the Brown Sort, taken from a Parcel which lay in the Cuſtom-houſe, above twelve Years ago, and called by the Name of wild *Ipecacuanha*.

Sir *Hans Sloane* informed me that this falſe Brown Kind was the ſame that was formerly ſent to him from *Virginia* for the true *Ipecacuanha*, and which he afterwards diſcovered to be the Root of a poiſonous Apocynum deſcribed by him in his *Natural Hiſtory of Jamaica*; in which Iſland it is very common, and likewiſe in *New-Spain*, as appeared by the Specimens ſent him by Dr *Burnet*.

A Deſcription of the Cereus Peruvianus, *which flowered at* Norimberg *in* 1730, *by Dr* Chriſtopher James Trew. *F. R. S. Tranſlated from the* Latin *by* T. Stack, *M. D.* No. 416. p. 462.

VI. This *Cereus*, is ſix Foot three Inches high, and thirteen Inches thick. It has ſeven Angles at it's Baſis, eight about the Middle, and nine near the Top. It's upper Part is of a Sea-Green, from the Powder with which it is covered; it's lower of a Graſs Green. The Down of it's Prickles is between Pale and White about the Top, every where elſe it is Brown. *Sept.* 5, at the Height of ſix Foot two Inches from the Ground, it ſhot a round Knot from it's Trunk, which ſo encreaſed and extended almoſt horizontally, that on the fourteenth of the ſame Month, it was eight Inches long, and plainly ſhewed a Flower, though as yet cloſed, embelliſhed with a beautiful Mixture of Green, Purple, and White. The ſame Evening the Flower began to open, and continued till Midnight; when being entirely ſpread, it was ſix Inches in Diameter. It was of a pretty ſtrong, but not very pleaſant, Smell. After Midnight it gradually contracted about half an Inch, and remained thus till next Day at Noon. Then it began to contract faſter, to half the Diameter of the expanded Flower; and the next Morning it was quite cloſed and withered, but hung on the Trunk till *Sept.* 30. The Beginning of the Flower was a Tube three Inches long, not quite an Inch thick, between a yellow and a pale Green. It's Surface was channelled with ſmall narrow Furrows, between which, blunt Protuberances were ſeen to run, in a parallel Order, along the Ridges. Where the Tube expanded itſelf, it divided into more than forty petaloid Segments, ranked in ſix ſeparate Series, the three inferior and exterior whereof here and there confounded their order, while the three ſuperior and interior remained regular and unmixed. Theſe Series were diſtinguiſhed by their Size and Colour. The firſt, or exterior, was of the ſame Colour with the Tube, *viz.* of a pale Green; but it's upper Part gradually inclined to a Purple. The ſecond and third had half the inner Part greeniſh, the Edges of a more intenſe Purple. The fourth was between yellow and white, terminating in purple Tops. The Tops of the fifth were likewiſe purpliſh. The petaloid Segments of the ſixth were very tender and white. The Segments are of an oblong Figure, and in the firſt Series were terminated with blunt, in the others, with more and more pointed Tops. The inner or ſixth Series, which contained thirteen of theſe Segments, exhibited all the Edges finely and lightly, but irregularly cut and divided. The *Piſtillum* of equal Height with the Surface of the Flower, and hollow like a ſmall Tube, ran, at it's upper End, into as many fine pale Filaments, ſpread in the Form of a Crown, as there were Segments in the

the inmoſt Row, the Day before the Flower dropped from the *Ovarium*, the Place were it was to ſeparate was marked by a blackiſh Circle, at which the Tube ſeparated ſpontaneouſly from the *Ovarium* or *Matrix*, that is, the Rudiments of the Fruit; the *Piſtillum* ſtill firmly adhering to the *Ovarium*. The Flower now fallen, being diſſected longitudinally, the Origin of the *Stamina* lay open to the Eye; and it very manifeſtly appeared that the petaloid Segments of the Flower far from affording the leaſt Mark of a natural Partition, ſtuck ſo very cloſe to the Tube, that not one of them would quit it without tearing it off by Violence.

The Fruit, though it came not to it's full Growth, plainly evinced, by Inſpection alone, that it is not prickly. Upon Diſſection it afforded a viſcous Juice, and within was a Cavity, the Sides whereof were every where, except at the Bottom, thick ſet with an innumerable Quantity of ſmall *Villi*, to each one of which hung an oblong white, pellucid Veſicle, which is the Rudiment of the future Seed.

VII. *Contrayerva* is a *Spaniſh* Word, ſignifying as much as *Herba contra* [*Venena*] or a Herb againſt Poiſons. And as there are in all Countries different Plants to which that Virtue is aſcribed, the Name of *Contrayerva* ſeems to have been given by the *Spaniards* to as many of them as have come under their Knowledge; for *Hernandez* has deſcribed a Species of *Granadilla* by that Name, and there are ſeveral other Roots that are commonly known by it: But far from pretending to give a Hiſtory of all thoſe Roots, I only offer a ſhort Account of that Plant whoſe Root is called *Contrayerva* here in *England*, and is ſo well known to all that any way deal in Medicines. *An Account of the* Contrayerva, *by* William Houſtoun, *M. D.* N°. 421. p. 195.

The Root itſelf being ſo commonly known it would be ſuperfluous to deſcribe it, I ſhall therefore confine myſelf to the Deſcription of the Plant that produces it, which I have not hitherto met with to my Satisfaction in any Author.

Father *Plumier*, in his Book entituled, *Nova Plantarum Americanarum Genera*, deſcribes a *Genus* which he calls *Dorſtenia*, whereof I have found two Species in the *Weſt-Indies*, the Roots of which are gathered and exported indifferently, as being very much alike, both in Appearance and Virtues. One of theſe I think may be called.

Dorſtenia Dentariæ radice, Sphondylii folio, placenta ovali. And the other *Fig* 103.

Dorſtenia Dentariæ radice, folio minus laciniato, placenta quadrangulari & undulata, *Fig* 109.

The firſt Kind ſeems to be the *Tuzpatli* of *Hernandez*, pag. 147. It's Roots, which are perennial, put forth in the Month of *May* (or as ſoon as it happens to rain) each ſix or eight Leaves four or five

Inches long, and as many broad, cut into ſeveral Segments almoſt as deep as the middle Rib, ſomewhat after the Manner of the *Sphondylium*: They ſtand upon Footſtalks five or ſix Inches long; and from the Middle of them come forth other Footſtalks ſomewhat longer, ſuſtaining each a ſtrange Sort of Body, flat, and ſituated vertically, or with one Edge uppermoſt, which I have called *Placenta*. In this Species it is of an oval Figure, with it's longer Axis parallel to the Footſtalk. One ſide of it is ſmooth and green like the outſide of the *Calix* in other Plants; but from the other ariſe a great many ſmall yellow Apices; and after they are gone, many ſmall roundiſh Seeds begin to appear, which when ripe are ſomewhat like thoſe of *Gromwell* or *Lithoſpermon*. It grows in the Kingdom of *New-Spain*, near old *Vera Cruz*, on the high Ground, by the Side of the River.

The ſecond Kind has much the ſame Number of Leaves growing from each Root, as the former; but of a different Figure, for ſome of them are entire, and ſhaped like thoſe of a *Violet*, others angular like *Ivy*, and ſome almoſt as much divided as the Leaves of the common *Maple*. They are thin, and of a dark green Colour, and ſmooth, or have only a few ſcarce perceptible Hairs on the Back. The Pedicles that ſuſtain the Flowers ariſe immediately from the Root as in the other Species, and attain to the ſame Height of ſix or eight Inches. But the *Placenta* which ſuſtains the Flowers, is in this Kind quadrangular, waved about the Edges, and broader tranſverſly than vertically. Yet the Flowers and Seeds themſelves are perfectly the ſame as in the other. This ſecond Kind grows plentifully on the high rocky Grounds about *Campechy*, where I gathered it in Perfection in the Beginning of *November*, 1730.

I cannot gueſs why Father *Plumier* has called this a monopetalous Plant; for that which he calls the *Petalum*, and I the *Placenta*, is of a green Colour, and (which is of more Conſequence) ſuſtains the Seeds when ripe, and never envelops the Organs of Generation when young; ſo that I think it can by no Means be called a *Petalum*, nor even properly a *Calix* and therefore I have given it the Name of *Placenta*, whoſe Office it certainly performs.

I have not been able to obſerve exactly the Structure of the Organs of Generation, becauſe of their exceſſive Smalneſs; but they appear to the naked Eye as they are repreſented in the Figures I have given of them, and in *Plum. N. G. Tab.* 8. The *Dorſtenia Sphondylii folio Dentariæ radice*, of *Plumier*, differs from both of mine; for in his Drawings done by Order of the late King of *France*, whereof I have ſeen a Copy in the Collection of the late Dr *Sherard*, the Leaves are repreſented ſerrated, the *Placenta* quadrangular, and the Roots conſiſting of ſeveral Knobs tied together Lengthways. From which laſt Particular, I am perſuaded that the Root of that Species is the *Drakena Radix*, mentioned by *Cluſius* in his *Exotics*, pag. 83.

Fig. 108.

Toms Sculp.t

VIII. 1. In my Way thither, I took Notice of the following Plants which I have not observed to be common in other Parts of *England*, and are not taken Notice of by the Bishop of *London*, in his Edition of *Cambden*. *Rare Plants in a Journey to the* Peak *in* Derbyshire; *by* John Martyn *F. R. S.* No. 407. pag. 22.

Stachys Fuchsii, *J. B.* in the Road to *Grantham*, a little beyond *Colesworth*.

Scrophularia Scorodoniæ, *folio Mor.* At *Wollerton*, under the Garden-wall. This does not owe it's Origine in this Place to Seeds, scattered out of the Garden; as I am convinced, by the perusal of a Manuscript Catalogue of the Plants cultivated in that Garden, in which there is no mention made of this Plant.

The *Lychnis*, which grows on *Nottingham-Castle*, is the *Lychnis sylvestris alba* 9 *Clusii*, and not the same with Mr *Ray*'s *Lychnis major noctiflora Dubrensis perennis*, as he suspected.

Festuca humilior panicula brevi heteromalla. Gramen paniculatum, bromoides, minus, paniculis aristatis, unam partem spectantibus Raii Syn. On *Sherwood Forest*.

Salix folio laureo, seu lato glabro odorato Phyt. Brit. Common about *Wingerworth*.

Ladanum arvense, flore amplo luteo; labro purpureo. Lamium cannabinum, flore amplo luteo, labio purpureo Raii Syn. In the Corn in several Places.

Filix mas non ramosa, pinnulis angustis, raris, profunde dentatis Ger. emac. Common about *Wingerworth*.

2. The more rare Plants which I observed in the *Peak* are,

Scariola sylvestris Anguillaræ. Lactuca sylv. murorum flore luteo J. B. On old Walls, and about the Entrance into *Peak's-hole*. It grows also in *Hertfordshire*. I choose to take Notice of it on this Occasion, the rather because *M. Vaillant* has evidently mistaken the Characters of it in his new Distribution of the *Cichoraceous Tribe* in the *Memoirs of the Royal Academy of Sciences* for the Year 1721. He there makes it a Species of *Lactuca*, from which it is very different on his own Principles. According to his Method, the *Empalement* of the *Lactuca* is *squamous*, and the *Down* of the Seed sits upon a *Pedicle*. But this Species has a *simple Empalement* and a *sessile Down*. These Characters evidently distinguish it not only from *Lactuca*, but from every *Genus* in his Method. I shall take leave therefore to constitute a new *Genus*: And as the Name of *Scariola*, by which *Anguillara* has called it, has not yet been appropriated to any other *Genus*, I shall appropriate it to this, and define it, as follows. ——*in the* Peak, *by the same*, No. 407. p. 28.

Scariola is a *Cichoraceous Plant*, with a *simple Empalement*, a *naked Placenta*, and *Seeds* crowned with a *hairy sessile Down*.

Rosa sylv. alba cum aliquo rubore foliis hirsutis J. B. In several Hedges about *Hathersedge*.

Empetrum montanum fructu nigro Tourn. Common on the Mountains.

Oxycoccus, ſeu Vaccinia paluſtria, J. B. On boggy Places, but not very common.

Erica humilis cortice cinereo Arbuti flore albo, H. R. Par. On the Mountains near *Hatherſedge.*

Rubus Idæus ſpinoſus fructu rubro, J. B. In the Hedges.

Geranium ſaxatile Ger. emac. About the Entrance into *Peak's-hole.*

Cochlearia rotundifolia minima Merr. With the preceeding.

Thalictrum minus Ger. In the ſame Place.

Lichenoides ſaxatile, fuſcum, piloſum, varie diviſum. Corallina fuſca folioſa Doody Budd. Hort. ſicc. On the Rocks.

Lichenoides ſaxatile tinctorium foliis piloſis purpureis Dillenii. On the Rocks.

Uſnea ſaxatilis, capillacea. Muſcus corallinus, ſaxatilis, fæniculaceus Raii Syn. On the Rocks near *Darwent.*

Lycopodium Sabinæ facie Fl. Jen. On the Mountains near *Darwent.*

Selago foliis & facie Abietis Fl. Jen. On the Mountains near *Darwent.*

Bryum Hypnoides capitulis, plurimis erectis lanuginoſum Dillenii. On the Mountains.

Cardamine impatiens altera hirſutior Raii Syn. About the Mouth of *Pool's-hole* plentifully.

A Variety of Mr *Ray's Viola montana lutea* with a blue and yellow Flower.

Obſervations upon the Seeds of Plants. By Mr Lewwenhoek, *tranſlated by* John Chamberlayne, *Eſq;* No. 368. p. 200.

IX. I have often turned my Thoughts to the obſerving the ſo called Membranes, in which the Subſtance of Meal, or Flower, is incloſed, like little Packets in Cells or Boxes, which is alſo the caſe of all kinds of Beans, Peaſe, Wheat, Barley and other Grain. I at length, with Aſtoniſhment, diſcovered very plainly, that what I call the Membranes, were endued with an unſpeakable number of little Holes, thro' which, in many places, one might perceive the Light; which Holes we muſt ſuppoſe to be nothing elſe but little Veſſels, which had been torn or cut off, and partly compoſe the Membranes, which I call little Cells, and partly ſerve for the Production of the *Farina*, of which there are an infinite number of Particles in a Pea or Bean, I imagine that each of thoſe mealy Particles receives it's increaſe from a little Veſſel, which proceeds from the Cell; and is imperceptible through it's Smallneſs.

Theſe Veſſels, of which the little Cells, or Caſes moſtly conſiſt, are more eaſy to be diſcovered in Beans and Peaſe, than in any ſort of Legumens or Grains; but in Wheat the Veſſels are difficultly traced in the Cells, and I have been obliged to make very many Obſervations and Experiments, before I could fully ſatisfy myſelf, that I ſaw the torn or broken Veſſels; the Reaſon of which is, that the little Veſſels, of which the Cells or Skins of the Grains of Wheat are compoſed, are exceeding thin and brittle.

More-

Moreover, I have found, upon obſerving the Veſſels, of which the Cells are compoſed, that ſeveral of the Globules in Wheat were broken in pieces in the Operation, and that in one of thoſe ſingle Globules, there were other ſmall Globules encloſed.

I have likewiſe obſerved that the Membranes, or little Cells, in *Barley*, in which the Globules, or Parcels, of the Meal are ſhut up, and receive their increaſe, are thicker and ſtronger than thoſe of *Wheat*.

Although I conclude, that almoſt all Seeds and Grains, as well as their Membranes, or Skins, are of one and the ſame Texture and Configuration, yet for Experiment ſake, I took a large *Almond*, and cut off ſeveral thin Slices from it, and dug out of thoſe Slices, as well as I could, the Subſtance that lay in the little Cells, and viewing them, as nicely as poſſible, with a Microſcope, I obſerved that thoſe Cells, in which the Oyl of the ſaid *Almond* was for the moſt part contained, conſiſted alſo of nothing but little Veſſels.

Now when I perceived, that the before-mentioned little Cells proceeded from the Bark, or Skin, which ſurrounds the Kernel of the Seed, or Grain, I was thinking that, as the mealy Subſtance receives it's increaſe from the Veſſels, which are in the little Cells, and as the Plant is formed between the Cells, during the time that the Seed lies in the Earth, and as the little Orifices in the Skin of Animals and Fruits, are formed in order to diſcharge thereby the Superfluity of their Moiſture, and ſhut in ſuch a manner, that no Moiſture, nor common Air, can get into the ſame, as I have formerly advanced: So on the contrary, the Orifices of Seeds are ſo formed, that many of their little Veſſels admit Moiſture to paſs inwards, and accordingly Water is driven into them by the preſſure of the Air, and cauſes the Seed to ſwell; upon which, a Warmth and Fermentation ſucceeding in the Seed, it requires a greater ſpace, and by the particular Formation of the Particles, which lie in the Cells, and which have derived their Encreaſe from the Cells, the mealy Subſtance, of which they conſiſt, is partly driven out of them into the body of the young Plant, which by this means encreaſes ſo much in bulk, that the Root is now able to ſupply it with Nouriſhment from the Earth, at which time the Seed is found to be diminiſhed in it's bigneſs.

X. I happened to take up a boiled grey Pea, out of which I took a little of the mealy Subſtance, and laid it before a Microſcope, where it appeared to conſiſt of ſuch like Parts as are found in Rats Dung, every one of which Parts conſiſted of a great number of very ſmall Particles. But I could not diſcover any Membranes enveloping thoſe Parts, from whence I concluded, that thoſe Membranes were deſtroyed and diſſolved by the hot Water. *Of the Veſſels in Grey Peas by the ſame, N°. 368. P. 199.*

Upon this, I took another Grey Pea, which had not been boiled, and cut it into very thin Slices, when I not only ſaw the Membranes,

in which the Parts of the mealy Subſtance had been encloſed, but found likewiſe, that thoſe Membranes conſiſted of nothing elſe but a great number of very ſmall Veſſels, like the Membranes, as they are commonly called, which ſurround the Muſcles and muſcular Fibres in Beaſts and Fiſh.

Obſervations upon the Veſſels in ſeveral ſorts of Wood, by the ſame, No. 367. p. 134.

XI. I procured a piece of reddiſh Wood brought from *Amboina*, ſawed off at the end of a Board, as likewiſe ſome of the Chips, in order to obſerve the Veſſels therein; and, cutting the Wood through all manner of ways, I found that in one place it appeared whitiſh, at a ſmall diſtance red, and in another place blackiſh. Upon cutting it tranſverſly, I ſaw the Orifices of the aſcending Veſſels, which ran along the length of the Wood, and appeared of ſuch a ſize in the Microſcope, that one would have judged a Pea might paſs through them. Where the Wood looked reddiſh, I found theſe great Veſſels filled with a ſubſtance of a fine red colour, ſo that I imagined, that theſe great Veſſels carried a red Sap into the Horizontal Veſſels, which appeared ſo very numerous, and ſo thick together, that they cauſed the Wood to apppear of the ſame colour with the red Subſtance which was contained in them.

I afterwards cut off ſome very thin ſlices tranſverſly and putting them into a *China* Cup, I poured hot Water upon them, and ſuffered them to lie in it for ſome time; then viewing them with a Microſcope, I obſerved that the red Subſtance was extracted by the Water, and no red colour was now to be found in any of the Veſſels.

What ſeemed the ſtrangeſt to me in this Wood was, that cutting through it lengthways, as I frequently did, I obſerved it to be of a fine red colour for one Hair's breadth, and a Hair's breadth farther it appeared white; and the aſcending Veſſels ſeemed to be ſmaller, where the Wood was red, than where it was white: which narrowneſs of the red Veſſels I judged to proceed from the Sap contained in them.

In viewing the aſcending Veſſels in Oak, I found ſome other Veſſels which entered into their ſides, and appeared to me like ſo many ſmall round holes, eſpecially where the Horizontal Veſſels lay, which I judged to be united to the aſcending Veſſels, by means of thoſe ſmall Orifices, and thereby to diſcharge part of their Sap into them.

Taking a ſmall Twig of an Oak, which in ſeven Years growth was grown to about the thickneſs of one's Finger, I cut it through according to the length both of the aſcending and horizontal Veſſels which laſt I ſaw lying in great Numbers very cloſe together, and proceeding directly from the Pith of the Twig.

I have likewiſe made ſome Obſervations upon Fir Wood, in which the aſcending Veſſels conſiſt of ſo very fine and thin a Subſtance, that they exhibit a very delightful Spectacle in the Microſcope. In theſe aſcending Veſſels I imagined that I ſaw ſome Globules, with a ſmall opening

opening in their middle, which ſeemed to be of a cloſer and denſer Subſtance than the reſt of the Wood. But I afterwards found myſelf miſtaken, and that theſe ſuppoſed Globules were nothing elſe but the Orifices, whereby the aſcending and horizontal Veſſels were united together, and through which the Sap was carried from the one to the other.

Of the Pores of the Leaves of Box; and of the Down of Peaches and Quinces, by the ſame. N°. 369. p. 231.

XII. Ex Planta illius Buxi, quæ Vulgo *Palma Ceres* appellatur, folium decerpſi, & in partes divulſum ope Microſcopii contemplatus ſum. Tum vero partes illas, per quas Tranſpiratio vel Exhalatio fit, clariſſime viſu diſtinxi. Adhæc complures percepi exiguiſſimos Hiatus, qui lucem tranſmittebant: Quos tamen commodius majorique numero percepi, cum partes prædicti folii aliquanto eſſent ficciores.

Ex alia Buxi Arbuſculâ quædam Foliola, partim adhuc virentia, partim exſiccata, mihi adferenda curavi, ut illorum Texturam, quantum poſſibile eſſet, inveſtigarem: Quod eo Succeſſu feci; ut iſtiuſmodi Oſcula, ſive Spiracula, in foliis iſtis clarius Viſu perceperim, quam in ullis unquam Fructibus ante percepiſſem. Ut autem Multitudinem Oſculorum quæ in tali Foliolo percepi, velut Oculis expoſitam haberem; Folium Buxeum Lineali impoſui cupreo, quod in varias partes diſtinctum erat: Comperique Longitudinem Folii parem eſſe octonis partibus Pollicis, in decem partes diſtributi Folii vero Latitudinem cum medietate pollicis, ſive quinque decimis partibus exæquari.

Jam vero ponamus tali Foliolo Figuram eſſe Ovatam; adhæc Latitudinem ejus atque Longitudinem conjungamus: Tum exſurget numerus 13, cujus dimidium ſit 6 ½. Dein ponamus idem Foliolum, poſt illam Latitudinis atque Longitudinis conjunctionem, inſtar Circuli eſſe rotundum; illiuſque Diametrum 6 ½ decimis Pollicis partibus ex æquo reſpondere.

Exinde juxta Foliolum ante dictum, locavi Pilum Porcinum; quem adhibito Microſcopio contemplatus, judicavi duodecim Buxi Oſcula, ſi ſibi contigua jacerent, cum Diametro Pili Porcini Longitudine exæquari; Sexaginta vero Pilos Porcinos judicabam Magnitudinis eſſe pollicaris. Sequitur decimam quamque Pollicis partem ſex Diametris Pilorum Porcinorum Longitudine parem eſſe; dimidiatam vero Diametron Folioli Buxei cum 19 ½ Diametris Pilorum Porcinorum exæquari. Quæ 19 ½ Diametri, ſi duodecies, id eſt juxta numerum Oſculorum, multiplicentur; efficitur numerus 234, quam Longitudinem dimidiatus Folioli Buxei circulus ex antedictis habet.

Ut autem quid tali Circulo contineatur ſupputemus, primo cum Geometris ſtatuendum eſt; quæ proportio eſt numeri 14 ad numerum 11, eandem Proportionem eſſe inter numerum quadratum Diametri cujuſvis Circuli, & ea quæ Circulo ipſo continentur. Sequitur unam Folii Buxei Superficiem Oſculis 172090 præditam eſſe. Cum autem altera Superficies haud paucioribus inſtructa ſit; tandem exſurget

numerus Oſculorum 344180, quorum Ope Perſpiratio & Exhalatio fiat.

Cum Lanuginem illam, quæ Mala Perſica, vulgo Montana conveſtit, nupera Æſtate ſine Microſcopio conſiderarem; Fruſtula quædam Mali Perſici, ex cortice exciſa, ante Microſcopium collocavi. Tum vero judicabam Floccos illos Laneos Multitudine pares eſſe Oſculis per cutem Mali Perſici diffuſis. Et quemadmodum Oſcula Fructuum velut inter duo labiola pateſcere, nec plane rotunda ſed aliquantulum oblonga eſſe, jam ante monui; ſic Flocci Lanei, ex Oſculis dictis efflorescentes, non omnino rotundi ſunt, ſed nonnihil plani. Sed & complures in medio Ruga quadam notatos eſſe videbam.

Ut autem Multitudinem Oſculorum halitus exſpirantium palam proponam; unàque ingentem numerum exhalantium humorum, qui Aërem ingreſſi in particulas oblongas, ſed alias aliis longiores ſpiſeſcunt, Oculis ſubjiciam; exiguam Mali Perſici portionem delineari
Fig. 110. A B F G perpuſillum eſt Fruſtum Mali & Corticis Perſici, B C D E F lanugo Malo adhæreſcens deſignatur.

Magnitudinem dicti Fruſtuli, per Iconem deſignati, ſic æſtimare poteris: Tres Vultus mei Pilos Microſcopio applicatos habebam, quos Pictori poſt Iconis modo dictæ Delineationem intuendos exhibui Cum deinde ejuſdem Iconis Longitudinem, a G ad A in 16 Partes diſtribuiſſem; rogavi quot latorum pilorum Diametros in illa Iconis Longitudine contineri judicaret; qui, *ne octo quidem* reſpondit. Quod ſi verum eſſe ſtatuamus, quam incredibili Floccorum Laneorum Multitudine neceſſe eſt Malum Perſicum circumveſtiri!

Cum poſtea Mala Cydonia permaturuiſſent, quaſdam etiam Mali Cydonii particulas ad Microſcopium applicavi; & Lanuginem, quæ ex Malo Cydonio exhalatur, neque Lanugini Mali Perſici copiâ
Fig. 111. cedit, delineandam curavi; H I N O perparva eſt portio Mali Corticiſque Cydonii, I K L M N Lanugo ex Malis Cydoniis exſudans. Quæ Lanugo, licet in Cydoniis longior quam in Perſicis, non tamen in illis erigitur, ſicut in iſtis; ſed criſpando ſibi invicem implectitur.

The Anatomical Preparation of Vegetables, by Albertus Seba, *F. R. S.* N°. 416. pag. 441.

XIII. Thoſe Leaves only of Plants, are fit for this Purpoſe, whoſe inward Structure is compoſed of woody Fibres; and which are of a pretty good thickneſs and conſiſtence, as the Leaves of Oranges, Lemons, Jaſmins, Bays, Roſes, Cherries, Apricocks, Peaches, Plumbs, Apples, Pears, Poplirs, Pines, Oaks, Ivy, *&c.*

There are ſeveral other Leaves which have no woody Fibres or Veins; as for Inſtance of Vines and Lime Trees, but theſe diſſolve without ſeparating.

Theſe Leaves are to be gathered in *June* or *July*, when they are full grown and have not been damaged by Worms or Caterpillars. They are to be put into an earthen Pot or large Glaſs, with a good deal of Rain-Water, the Pot or Glaſs being kept uncovered and ſo

expoſed


C
B
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expoſed to the Sun or open Air. The Leaves muſt be quite covered with Water, and as it evaporates, a freſh quantity muſt be poured in. In about a Month's time ſome of the Leaves will begin to putrify, but, others muſt be kept two Months or longer. When the two external Membranes begin to ſeparate, and the green Subſtance of the Leaf to grow liquid, then it is Time to perform the Operation. The Leaf is to be put into a white and flat earthen Plate or Diſh filled with clear Water; then upon gently ſqueezing it with the Finger, it will open on one ſide and the green Subſtance will run out. Immediately on that the two outer Membranes muſt be ſtript off chiefly in the middle and along the Nerves when they adhere cloſeſt: If there is once an Opening, they will go off very eaſily. The Skeleton that remains between is afterwards waſhed in clear Water, and kept between the Leaves of a Book.

The Method of preparing Fruits; as Apples, Pears, Plumbs, Cherries, Peaches and the like, is as follows.

The fineſt and largeſt Pears that are ſoft and not Stony, are fitteſt for this Purpoſe, Firſt, they are to be nicely pared without ſqueezing them, and Care taken not to hurt the Stalk or the Crown. This done, put them into a Pot of Rain or freſh Spring-Water; cover it, and let them boil gently till they grow throughly ſoft; then take them out and put them into a Baſon of cold Water: Then take out one of them and holding it by the Stalk with one Hand, and with one Finger and the Thumb of the other Hand, rub the Pulp gently off, beginning near the Stalk and rubbing equally towards the Crown, and you will eaſily ſee in the Water how the Pulp ſeparates from the Fibres, which being moſt tender towards the Extremities, it is there the greateſt Care is to be taken. No Inſtrument is of any uſe in this Operation, except laſt of all a Penknife to ſeparate the Pulp ſticking to the Core. In order to ſee how the Operation advances, you may fling away the muddy Water from Time to Time, and pour on clean: All being ſeparated, the Skeleton is to be preſerved in Spirits of Wine rectified. The ſame to be obſerved with relation to Apples, Plumbs, Peaches and the like.

Carrots and other Roots, that have woody Fibres muſt be boiled without paring, till they grow ſoft, and the Pulp comes off. Not only many ſorts of Roots, but alſo the Barks of ſeveral Trees may be reduced after this Method into Skeletons, preſenting rare and curious Views of Vegetables.

☞ *This Paper is corrected from a Tranſlation of the ſame Original, by the late Dr* Scheuchzer. *It was read before the Society* Oct. 17. 1728, *above two Years before the publication of Mr* Zolman's *Tranſlation in the Philoſophical Tranſactions.*

Of the Veins and Arteries of Leaves. By Frank Nicholls, *M. D. F. R. S.* No. 414. pag. 371.

XIV. By a Letter from Dr *Fuller* in *Holland* to the Preſident, and communicated about *October* 1729, the Society was informed, that Profeſſor *Ruyſch* had obſerved ſomething in the diſſecting of Leaves analogous to the Veins and Arteries of Animals; but without explaining in what Manner theſe different Veſſels were diſpoſed, or by what Means they may be diſtinguiſhed from each other.

When I examined the Collections of *Frederic Ruyſch* and *Albert Seba* at *Amſterdam*, in both which were great Variety of diſſected Leaves, they made no Mention of ſuch a Diſcovery; although in a Leaf from the Collection of *Ruyſch* I could (with a Glaſs) obſerve the Fibres to be double towards the Edges of the Leaf; which at that Time I imagined to be an unnatural Diviſion of the Fibres, as in decayed Sticks.

In the mean Time, *Albert Seba* having communicated the Method of diſſecting Leaves, to the Society, I ſeparated the pulpous from the fibrous Parts of ſeveral Leaves after his Method; when examining them by Glaſſes, and in Water, I found that each Fibre was naturally ſeparated into two diſtinct Fibres by a thin *Stratum* of the pulpous Subſtance; and that this Separation was continued through all the Fibres and Stem of the Leaf, ſo as to form two diſtinct Planes of ſimilar Net-work.

Though this Duplication of the Veſſels in Leaves ſeems to point out an Analogy between them and the Veins and Arteries of Animals, yet I ſee no probable Means of gueſſing which are the arterial and which the veinal Fibres.

That I might illuſtrate this Matter, as it appeared to me, I have prepared two Leaves, the one of an Apple (*Fig.* 112.) the other of a Cherry (*Fig.* 113.) in which, as well the Separation of the Fibres and Stem, as the pulpous Subſtance, by which they are naturally ſeparated, are very obvious.

Fig. 112, 113.

Of the change of Colour in Grapes *and* Jaſmine, *by Mr* Henry Cane, No. 366. pag. 102.

XV. About ſix Years ago *, I planted a cutting of a Vine againſt a Wall, on an Eaſtern Aſpect, where it has the Sun from it's Riſing till half an Hour after twelve. The ſoil is a ſtiff Clay, but to make it Work the better, I meliorated that, by mixing ſome Rubbiſh of the Foundation of an old Brick-Wall, where it now grows. In *January* laſt was twelve Month I pruned it, and the Figure was thus,

Left Hand T Right Hand *Black*

At time of Year it ſhot at both Hands about twenty two Inches of a ſide, before it came to a Joint; that on the Right was a very luxurious exuberant Branch, as big as the body of the Tree, the other ſide not half ſo thick or big, and the Leaves on the Right were as big again as the other on the left Hand, and I fancy the largeſt that were ever ſeen. The right Hand bears a very large and good black

* *This was written in* October, 1720.

Grape,

Grape, and large Bunches; the left hand very good white Grapes, and I had laſt Year more Bunches of the white, than of the black; and whereas in all Vines bearing black and blue Grapes the Leaves die red, theſe died white on the black ſide as well as t'other. Laſt *January* I pruned the Tree again, but tacked up more of the right Hand (being black) than I did on the left, for which reaſon I had this Year a great many more of the Black than I had of the white, and they ripened for the Seaſon of the Year very well; divers Gentlemen of the Country both ſaw them laſt Year and this Year, and taſted of them. I gathered the laſt about eight days ſince, and the Leaves die white this Year alſo, being the ſecond Year that ever it bore. I think to prune it pretty cloſe on both ſides this Year, and to plant out divers cuttings of both ſorts of it.

I will mention one thing more, which I have experienced about 28 Years ſince; I do it becauſe Mr *Lawrence* in his firſt Tract of Gardening, makes mention of the Plant, but I take mine to be a much different caſe from his; I mean the yellow and green ſtriped *Jeſſamine*. In the Month of *April* Ann. 1692, having a ſmall Plant of our common white *Jeſſamine*, which ſtood in the ground, and was no bigger than a Tobacco-pipe, I cut it off at two joints above the ground, and grafted it with a cutting of the yellow ſtriped; it took and ſhot a ſmall weak Shoot, and in a Month or five Weeks after, it was blighted, and I perceived it had killed the Graft, and ſome part of the Stock below, and ſo I took my knife and cut it to the quick, which was near the next knot or joint to the Ground, and let it ſtand, thinking to graft it again at Spring, as before, but forgot it 'till the Seaſon was paſt. At length going that way I ſaw it had broke out at the next joint with ſeveral Shoots of the yellow and green ſtriped, and not only there, but it had alſo made a ſtrong Shoot from the Root, of yellow and green ſtriped; after a while I took it up with Mold to the Root, and put it in a Pot, and it flouriſhed all the Summer. But afterwards having made a preſent of it, it flouriſhed two or three Years, and then for want of ſhifting the Pot in time, it was matted ſo to the ſides and bottom of the Pot, that it died; I alſo at that time gave ſeveral of my Acquaintance an account of the Circulation and Deſcent of the Sap in that Plant, and I have tried ſeveral other ſorts of variegated Plants, but do not find any of them to tranſmute, as that *Jeſſamine* will do.

XVI. The Plants of *England*, as well thoſe of the Fields and Orchards, as of the Garden, that have been brought over hither, ſuit mighty well with our Soil, and grow here to great Perfection. *Obſervations on ſome of the Plants in* New-England, *with remarkable Inſtances of the Nature and Power of Vegetation, by*

Our Apples are, without Doubt, as good as thoſe of *England*, and much fairer to look to, and ſo are the Pears; but we have not got of all the Sorts.

Our Peaches do rather excel thoſe of *England*, and then we have not the Trouble or Expence of Walls for them; for our Peach Trees are

the Hon. Paul Dudley, *Esq;* F. R. S. No. 385. p. 194.

are all Standards, and I have had, in my own Garden, seven or eight Hundred fine Peaches of the Rare-ripes, growing at a Time on one Tree.

Our People, of late Years, have run so much upon Orchards, that in a Village near *Boston*, consisting of about forty Families, they made near three Thousand Barrels of Cyder. This was in the Year 1721. And, in another Town of two Hundred Families, in the same Year, I am credibly inform'd, they made near ten Thousand Barrels. Some of our Apple Trees, will make six, some have made seven Barrels of Cyder, but this is not common; and the Apples will yield from seven, to nine Bushels for a Barrel of Cyder. A good Apple Tree, with us, will measure from six to ten Foot in Girt. I have seen a fine Pearmain, at a Foot from the Ground, measure ten Feet, and four Inches round. This Tree, in one Year, has born thirty eight Bushels, (by Measure) of as fine Pearmains, as ever I saw in *England*. A *Kentish* Pippin at three Foot from the Ground, seven Foot in Girt; a Golden Rossetin six Foot round. The largest Apple Tree, that I could find, was ten Foot and six Inches round, but this was no Graft.

Pear Trees.

An *Orange* Pear Tree grows the largest, and yields the fairest Fruit. I know one of them near forty Foot high, that measures six Foot and six Inches in Girt, a Yard from the Ground, and has born thirty Bushels at a Time; and this Year I measured an *Orange* Pear, that grew in my own Orchard, of eleven Inches round the Bulge. I have a Warden Pear Tree, that measures five Foot six Inches round. One of my Neighbours has a *Bergamot* Pear Tree, that was brought from *England* in a Box, about the Year 1643, that now measures six Foot about, and has born twenty two Bushels of fine Pears in one Year. About twenty Years since, the Owner took a Cyon, and grafted it upon a common Hedge Pear, but the Fruit does not prove altogether so good, and the Rind, or Skin, is thicker than that of the Original.

Peach Trees.

Our Peach Trees are large and fruitful, and bear commonly in three Years from the Stone. I have one in my Garden of twelve Years Growth, that measures two Foot and an Inch in Girt, a Yard from the Ground, which, two Years ago, bore me near a Bushel of fine Peaches. Our common Cherries are not so good as the *Kentish* Cherries of *England*, and we have no Dukes, or Heart Cherries, unless in two or three Gardens.

Trees of the Wood.

Some Years since, I measured a *Platanus Occidentalis*, or *Button Wood* Tree (as they are called here) of nine Yards in Girt, and it held it's Bigness a great Way up. This Tree, when it was cut down, I am informed, made twenty two Cord of Wood. A Gentleman tells me, that in the Forest, he met with a streight Ash, that grew like a Pillar, of a great Height, and free from Limbs, that measured fourteen Feet eight Inches round, near a Yard from the Ground; and,

and, the other, Day, I met with a *Saſſafras* Tree, that meaſured five Foot three Inches in Girt. I meddle not here with our noble Pines and Cedars, becauſe I deſign to treat of them in a Chapter of the Evergreens of this Country. Among our Trees of quick and eaſy Growth, the *Button Wood* before-mentioned, and the *Locuſt* Tree, are the moſt remarkable: As to the latter, by the Deſcription Mr *Moore*, while in *New-England*, gave me of the *Manna* Tree, our *Locuſt* Tree may be called the *American* Manna. I have known a Seed of it blown off from the Tree into my Garden, that took Root of itſelf, and, in leſs than two Years, was got above ſix Foot high, and as big about, as a common walking Cane. The *Platanus* I have frequently propagated, by cutting off Sticks of five or ſix Foot long, and ſetting them a Foot deep into the Ground in the Spring of the Year, when the Seaſon is wet; they thrive beſt in a moiſt Soil.

Garden. An Onion, ſet out for Seed, will riſe to four Foot nine Inches in Height. A Parſnip will reach to eight Foot, red *Orrice* will mount nine Foot, white *Orrice* eight. In the Paſtures, I meaſured Seed *Mullen* nine Foot two Inches in Height, and one of the common Thiſtles above eight Foot.

Vegetation. Among the remarkable Inſtances of the Power of Vegetation, I ſhall begin with an Account of a Pompion Seed, which I have well atteſted, from a worthy Divine *. *Pompion.* The Relation is as follows: That in the Year 1699, a ſingle Pompion Seed was accidentally dropped in a ſmall Paſture where Cattle had been foddered for ſome Time. This ſingle Seed took Root of itſelf, and without any Manner of Care; the Vine run along over ſeveral Fences, and ſpread over a large Piece of Ground far and wide, and continued it's Progreſs till the Froſt came and killed it. This Seed had no more than one Stalk, but a very large one; for it meaſured eight Inches round; from this ſingle Vine, they gathered two hundred and ſixty Pompions; and, one with another, as big as an half Peck; enough in the Whole, to fill a large Tumbrel, beſides a conſiderable Number of ſmall and unripe Pompions, that they made no Account of. The *Philoſophical Tranſactions* give an Account of a ſingle Plant of Barley, that by ſteeping and watering with *Salt-Petre* diſſolved in Water, produced two hundred and forty nine Stalks, and eighteen thouſand Grains; but then there was Art, and even Force in that Caſe; whereas in ours, there was nothing but pure Nature and Accident.

Indian Corn. Our *Indian* Corn is the moſt prolific Grain that we have, and commonly produces twelve hundred, and often two thouſand Grains from one; but the faireſt Computation is thus; ſix Quarts of this Grain will plant an Acre of Ground, and it is not unuſual for an Acre of good Ground to produce fifty Buſhels of Corn. *Indian* Corn is of ſeveral Colours, as blue, white, red, and yellow; and if they are planted

* *The Rev. Mr* Edwards *of* Windſor.

ſeparately, ſo that no other Sort be near them, they will keep to their own Colour. But if in the ſame Field, you plant the blue Corn in one Row of Hills (as we term them) and the white, or yellow, in the next Row, they will mix and interchange their Colours; that is, ſome of the Ears of Corn, in the blue Corn Rows, ſhall be white, or yellow; and ſome again, in the white or yellow Rows, ſhall be blue. Our Hills of *Indian* Corn are generally about four Foot aſunder, and ſo continued in a ſtreight Line, as far as the Field will allow; and then a ſecond Line, or Row of Hills, and ſo on; and yet this mixing and interchanging of Colours has been obſerved, when the Diſtance between the Rows of Hills, has been ſeveral Yards; and a worthy Clergyman *, of an Iſland in this Province, aſſures me, that the blue Corn has thus communicated, or exchanged, even at the Diſtance of four or five Rods; and, particularly in one Place, where there was a broad Ditch of Water betwixt them. Some of our People, but eſpecially the *Ab-Origines*, have been of Opinion, that this Commixtion, and Interchange, was owing to the Roots, and ſmall Fibres reaching to and communicating with one another; but this muſt certainly be a Miſtake, conſidering the great Diſtance of the Communication, eſpecially at ſome Times, and croſs a Canal of Water; for the ſmalleſt Fibres of the Roots of our *Indian* Corn, cannot extend above four or five Foot. I am therefore humbly of Opinion, that the *Stamina*, or Principles of this wonderful Copulation, or mixing of Colours, are carried by the Wind; and that the Seaſon of it is, when the Corn is in the Earing, and while the Milk is in the Grain, for at that Time, the Corn is in a Sort of Eſtuation, and emits a ſtrong Scent. One Thing, which confirms the Air's being the Medium of this Communication of Colours in the Corn, is an Obſervation of one of my Neighbours, that a cloſe, high board Fence, between two Fields of Corn that were of a different Colour, entirely prevented any Mixture or Alteration of Colour, from that they were planted with.

Apple Tree, without Bloſſoms.

An Apple Tree in my own Town bears a conſiderable Quantity of Apples, eſpecially every other Year, which never had a Bloſſom; I had formerly heard the Owner ſpeak of it: But for the three laſt Years, I made it my Buſineſs, in the proper Seaſon, to go and obſerve it myſelf; and when all the reſt of the Orchard was in the Bloom, this Tree had not one Bloſſom. Not being contented with once going, I went again, and again, till I found the young Apples perfectly formed. The laſt Year, I went early, not knowing but that it might blow ſooner than the other Trees, but I found no Bloſſoms; and the Owner, with many of his Neighbours, aſſured me, they have known the Tree theſe forty Years, and that it never had a Bloſſom. I opened ſeveral of the Apples, and obſerved but very

* *The Rev. Mr* Mayhew, *of* Martha's *Vineyard.*

few

few Seeds in them; and some of them lodged single in the Side of the Apple. This Tree was no Graft, and the Fruit but ordinary for Taste. I could not perceive, by my Observation, but that, in all other Respects, it fructified like other Apple Trees.

XVII. It is no small Satisfaction, that what I advanced in my *Botanic Essays* is now so fully confirmed by Experiments made by some curious Gardeners, among whom is Mr *Philip Miller*, who writes some word, *November* 11, 1721,

Observations upon the Generation of Plants, by Patrick Blair, *M. D. F. R. S.* No. 369. p. 216.

That in Pursuance of my Advice he separated the Male Plants of the Spinage from the Female; the Consequence of which was, that the Seeds swelled to the usual Bigness; but that they did not grow when he sowed them. He searched into the Seed, and found they wanted the *Punctum Vitæ*, which perhaps might have been the Case with Mr *Geoffroy*; but if not, the female *Embryones* might have been impregnated another Way, as he experimented with twelve Tulips, which he set by themselves about six or seven Yards from any other, and as soon as they blew, he took out the *Stamina* so very carefully, that he scattered none of the Dust, and about two Days afterwards, he saw Bees working on Tulips, in a Bed where he did not take out the *Stamina*, and when they came out, they were loaded with the Dust on their Bodies and Legs: He saw them fly into the Tulips, where he had taken out the *Stamina*, and when they came out, he went and found they had left behind them sufficient to impregnate these Flowers, for they bore good ripe Seed; which persuades him, that the *Farina* may be carried from Place to Place by Insects, and when they happen upon a Flower, whose *Uterus* is capable of being impregnated by such a Dust, it may be thus effected.

I am of Opinion, this will not suit with Mr *Morland*'s Scheme. For tho' we may suppose the *Stamina* of every Flower to be loaded with a due Proportion of the *Farina* yet this accidental Conveyance of it to a neighbouring Flower, may be rather less than greater than is necessary: So that, if wanting, then those *Embryones*, which had not received it's determined Particle into their Bosom, must be defective in Bulk, or barren in growing, but here all were equally filled.

By another Letter, *October* 19. 1721, he informs me, that he bought a Parcel of *Savoy* Seeds of a Neighbour, which he sowed, and planted out the Plants; but was surprized to see the Production: For he had half of them red Cabbages, and some white Cabbages, and some Savoys with red Ribs, and some neither, one Sort nor other, but a Mixture of all Sorts together in one Plant. He went to the Gardener and told him his Tale, who shewed him that he was in the same Condition, but did not know how it should come to pass, for he was sure he took special Care in saving of the Seed. Being asked how and where he planted them for Seed, he shewed him them under a *South West* Hedge, and told him the Man-

ner in which he planted them: Firſt, a Dozen of white Cabbages, then a Dozen of Savoys, and then a Dozen of Red. Then he immediately thought how it came to paſs, by the *Effluvia* impregnating the *Uterus* of one another; and it is very common for our Gardeners to plant white and red Cabbages together for Seed, and they are as often diſappointed by having a Degeneracy of both Kinds, which they attribute to the Soil, They ſend to *Holland* for a freſh Supply of Seeds, and ſay our Soil will not continue that Sort good. He told them his Opinion, and they laugh at him for it, and will not be turned out of their Road, although they ſhould have never ſo many Experiments ſhewed them.

This Experiment is a moſt convincing Argument for the *Effluvia*; for did each Grain of the *Farina*, enter the *Piſtillum* to it's proper *Uterus*, this mongrel Kind would never be produced. For if the individual Plant be in each Grain of the Male *Farina*, how can it be ſo far diſmembered, as that one Part ſhall go to the making up of the Ribs of Red Cabbage, and another to compoſe the reſt of a Savoy Plant. Analogous to this, is what I lately obſerved in a Spaniel Bitch, of ſo good a Kind, that when ſhe became proud, Care was taken to let her have good Dogs. The Litter ſhe produced, conſiſted of Puppies ſome piebald, like one of the Dogs that had lined her, of the ſame Shape, Colour, and Spots; others like another; and a third partaking of both, with ſpots from the Bitch interſperſed. This is a farther Confirmation of what I have advanced, *Eſſay* 4. where, pag. 310, I only aſſert, that ſeveral Fœtus's partake equally of Male and Female; but here two Males concur with one Female in the Compoſition of a fourth Body, made up of all the three: And one Seed produces a Cabbage conſiſting of three different Species, which could never happen, did theſe organized *Animalcula*, or Granules of the *Farina*, become a *Fœtus*, or contain the *Folia Seminalia* of a Plant. This methinks is ſufficient to anſwer what Mr *Bradley* has ſo ſtrenuouſly contended for, *Works of Nature*, *p.* 9. *& ſeq.*

I could deſcant yet more upon this Obſervation, and conſider how far this may lead us into the infinite Variegations and Stripes, in not only annual Flowers, ſuch as Poppies, *Conſolida Regalis*, and Bottles, but alſo in perennial Roots; ſuch as Auricula's, Couſlips, *&c.* of a lower Size, which is hinted by Mr *Bradley*; he having received that Notion from Mr *Du Bois*, as I have been credibly informed; and in Plants of larger Size, not of a Bulbous, but Carnous Root, ſuch as Columbines; where there is a vaſt Variety: And in this Plant it is moſt eſpecially to be obſerved, that though the indigenous one, from which all the other ſeem only to be Variations, and not determinate Species, be of a blue Colour, conſiſting of ten alternate Petala, *viz.* five corniculate, and five plain; yet into how many other Kinds of Flowers is it ſubdivided; ſuch as pale yel-

low

low, with bluiſh red, purple, dark Stripes vaſtly double, blue, blackiſh red, *&c.* Some with corniculate *Petala*, and ſome only with plain, and how in ſingle Flowers it imitates all the Colours we ſee Pigeons endowed with. I ſay it is worthy of Conſideration, whether the *Farina* may do this, ſince I do not underſtand there has been much Art uſed in making theſe Flowers break, as Tulips, or to cultivate a Set of Breeders; but that a richer Soil may produce a double flower; and a ſuitable Loam may produce the Variety of Colours; the *Farina* from ſeveral Flowers may occaſion the Stripes, and the *Stamina* ariſing from the plain *Petala*, rather than the *Cornicula*, pouring out the *Farina*, may cauſe the Flowers with the plain *Petala*. So that were I to extend this to a great many other Plants, and were there proper Obſervations made in them, conſiderable Improvements might be made upon this Doctrine of the Sexes of Plants. For after the Flowers, we come next to the Variegation of the Seed of ſome Plants, particular the *Phaſeoli*, whoſe various Spots and Colours, and even the Bigneſs too, may very much depend upon the *Effluvia* from the *Farina*, when ſeveral Kinds are ſown together. For do but conſider three plain Colours, a White, Red, and dark Blue, and you may obſerve how many Deſcendants, and what a Variety of Spots may proceed from them, the Lupines alſo in ſome Meaſure may be brought in here, and I know not but that the *Medica cochleata falcata lunata*, may be multiplied in it's Variations after the ſame Manner. But it is Time to proceed to another Experiment of my Correſpondent Mr *Miller*.

Being perſuaded to it by an ingenious Gardener, he pulled off all the Male-Flowers of ſome Melon Plants ſo ſoon as they appeared; but inſtead of finding, as his Friend informed him, that theſe Flowers exhauſted the Nouriſhment from the Fruit; he found that, without theſe Flowers, none of the Melons would grow.

As this Experiment is a plain Indication of the Neceſſity of the *Farina*, ſo it confirms the Uſe I have aſſigned to the Leaves, *viz.* that by entring the Capillaries of the Leaves, and returning, the nutritive Particles may be more attenuated: So here, the *Petala* of the Male-Flowers may ſerve for the ſame Purpoſe; for by the Largeneſs of the *Tubuli* in theſe *Pomiferæ ſcandentes*, a groſs viſcid Sap is received, which even the Leaves themſelves are not ſufficient to attenuate, ſo as to be fit for compoſing the more ſubtile Part of the Fruit; until by repeated Circulation through the *Petala* of the Male-Flowers, it may be rendered fit for ſuch a Purpoſe. Indeed, the Female-Flowers upon the Top of the *Rudimentum Fructus*, may in ſome Meaſure ſerve for this Purpoſe. But as the Male-Flowers are, generally ſpeaking, more numerous than the Female, ſo their being removed muſt deprive the *Embryones* of a very great Aſſiſtance towards it's being perfected: I may add, that the Orifices of the Pedicles, when the Flowers are pulled off, muſt loſe ſo much of the Sap,

that the whole Plant muſt be thereby ſo impoveriſhed, as not to be able to bring forth the deſigned Fruit; all this, beſide the Want of the conſiderable Supply of the *Farina Fœcundans*.

I deſigned to have given a few Thoughts concerning the Variegation of Leaves and Flowers, being unwilling to admit of Mr *Bradley*'s Sickneſs or Weakneſs of the Sap: But I ſhall reſerve that to a more convenient Opportunity, being at preſent intent upon making ſome farther Improvements upon the Generation and Nouriſhment of Plants.

The Propagation of Miſſelto, *by the Rev. Mr* Edmond Barrel, *Rector of* Sutton *in* Kent. N°. 397. p. 215.

XVIII. 1. The Berries of *Miſſelto* have within their viſcid Pulp a Kernel covered with a thin whitiſh Skin; the inward Subſtance whereof is deeply green, and harder than the Subſtance of a *Piſtachio* Nut's Kernel. It is flattiſh, and ſhaped ſometimes like a Heart, ſometimes oblong, both are as truly Seed, as any Plant can have. Thoſe of the oblong Shape put out but one *Germen*; thoſe like an Heart, have two, which prove two diſtinct Plants.

Fig. 114. *Fig.* 115.

Sir *John Colebatch* recommends the ſowing this Seed by way of Inoculation: Accordingly in *Feb.* $17\frac{18}{19}$, I endeavoured to place the Berries, within the Bark of *Oak*, *Aſh*, *Beech*, *Pear*, and *Apple*-trees, by making ſeveral Cuts and Gaſhes in the upright Sides of the Trees. The whole Berries would not ſtay in any of them; and when I broke them, the Seed always ſlipped out to the Edge of the Cut, and then it ſtuck to the Bark, by means of the ſlimy Subſtance wherewith it is encompaſſed. I alſo ſtuck one Seed on the bare Bark, without any cutting at all: This ſucceeded beſt, and being the Heart-like ſhape, gave me two Plants. For about the 28*th* of *March* 1719. this with two more on the *Apple*-tree, and one on the *Pear*-tree, began to ſhoot; and the Growth was in this manner:

The viſcous Matter having ſtuck the Seed on, and (as it dried) drawn the Seed cloſe and flat down to the Bark of the Tree, there began, in *March* and *April*, to ſpring out of that end of the Seed which had been toward the Eye of the Berry, a ſmall deep green Shoot or Twigg, very like a ſhort Piece of a little Claſper of the Vine. At firſt, it aroſe upward from the Bark and then turning again, as it approached the Tree, it ſwelled out ſomewhat bigger round about the End; yet leaving the very Tip or Bottom, quite flat, forming (as it were) a Foot to ſtand upon; not unlike the bottom of ſome Braſs Peſtles. This Foot, when it came to the Bark, which was about *May* or *June* 1719, fixed itſelf thereon. Being thus faſtened at both Ends, it made a little Arch whoſe Diameter was as long as the Seed, or about $\frac{1}{10}$ of an Inch.

In this Condition, it remained all that Year, till about *March* or *April* 1720, and then that part or end of our little Seedling, which was joyned to the Bark, at the place where the Seed firſt ſhot forth, let go it's hold, and raiſing itſelf upward, put forth Leaves, and became the Head of the Plant: and the other end, which ſprung out

firſt, and had taken footing in another Place, became the Root of the Plant.

'Tis no uncommon thing, for Seeds of *Ever-greens* to be two Years before they ſpring out of the Ground. And the change of the Ends, firſt one of them ſhooting out, and then the other, was what ſurprized me moſt at firſt; but on further reflection I found, that Nature, in this Plant, is uniform to her other Productions; in carrying the Sap firſt one way to form the Root, and then turning the Courſe of it back again to ſend out the upper parts of the Plant. The ſtrangeſt and moſt wonderful part is, that the rooting End ſhould make it's firſt ſhoot into the open Air, and then turn it ſelf down to find a proper Place to fix upon. Who could have ſuppoſed, that a Plant, whoſe Berry is the moſt orbicular of any, and therefore the leaſt likely to lie quiet in any Situation, and whoſe proper place of growth is a round and wavering Bough, or upright ſide of a Tree, ſhould after it is once fixed, leave it's firſt footing, and ſeek out a new point in the Bark to grow upon.

This is indeed the great Secret of the matter, and ſeems to be the very thing that hath kept the World in Ignorance, about the growing of this Seed. For by requiring a new ſmooth Place of the Bark whereon to fix the rooting Part, it hath fruſtrated all attempts of ſowing it in the uſual way of other Seeds.

Theophraſtus, (about two Thouſand Years ago) ſeems to endeavour at a Reaſon, why this Seed could not grow in the Earth: But all that he, or any one ſince, hath ſaid upon it, is only to agree, that in Fact it doth not, and to wonder why ſo perfect a Seed ſhould not grow in the Earth. That Antient Author rationally concluded, from it's having a Seed, that the Plant muſt come from that Seed: Whereas latter Times have been ſo fond of allowing Chance a ſhare in the Productions of Nature, that *Scaliger* hath not only experimentally confuted the common Notion of *Miſſelto*'s being ſown in the Dung of the *Thruſh*; but argueth alſo, very ſtenuouſly, againſt the Poſſibility of this Plant's growing from it's Seed. Even the great Lord *Bacon*, Sir *Thomas Brown*, *Lobel*, and the inquiſitive Mr *Ray* (ſo late as 1673,) do all give into it, that this Plant, hath a ſpontaneous and equivocal, rather than a ſeminal and univocal Generation.

Scaliger's ſtrongeſt Objection is, *Quod è Ramis quibuſdam exit Viſcus, quo in loco nullis modis vel ſtercus conſiſtere, vel ſemen unquam potuerit hærere —— Nihilo enim commodius conſiſtere quam in re proclivi Globum.* *Lobel* objects againſt it, becauſe of the Imperfection of the Berry *Acinulo illo pallido pellucido.* Mr *Ray*'s Argument is, *Viſcus innatus etiam in pronâ ramorum parte.*

If Nature had been well examined, it would have appeared, that this Seed is of a ſubſtance equal to other Kernels; and that the Pulp of the Berry, wherewith the Seed is ſurrounded, is of a more clammy ſticking nature than the Pulp of other Berries, for this very Purpoſe that

that it might be of ſtrength ſufficient to fix the Seed on any Tree, how moveable or upright ſoever the Bough or Twig ſhould be whereon it chanced to light.

And doubtleſs the Birds are (tho' not by their Dung) Sowers of this, as they are of many other Seeds, which they carry away for Food; but often drop in Places where they could otherwiſe never have come.

I went to gather ſome *Miſſelto*-Berries and found a Leaf with a Seed ſticking thereon; doubtleſs by a caſual Fall out of the Bill of ſome Bird, that has broken the Berry as ſhe was eating it. There is both a dry ſtring of the Slime, and a dry ſpot of the ſame, upon the Leaf that ſhow how the Seed was detained there, in this Caſe; and how it muſt be done in like manner any where elſe.

I have ſown theſe Seeds, on near thirty ſorts of Trees and ſhrubs, and yet never had above ten Plants, that held out the ſecond Year ſo that we need not wonder, at the little Succeſs, that others have had, in their trials. This is alſo the Reaſon, why I have not been able to make many other Experiments about the growth of this Plant. However, ſome Caſualties have furniſhed me with two or three; which ſomewhat further explain the Nature of this Plant's growing.

1. One of my little Plants ſown in *Apr.* 1724. which was fixed at both Ends in it's Arch-like Form, had in *Sept.* 1724, the middle part broken off; the two Ends keeping ſtill faſt to the Tree. Which ſhews, how firmly the two Ends adhere, while it is in that ſtate; and they both continued green ſome time, and then withered away.

2. That one Seed, which grew on a *Pear*-tree, in $17\frac{14}{19}$, was the next Spring $17\frac{19}{20}$, looſened from the Tree at one End, as the others were: Yet this ſeedling Sprout, never put out any Leaves at all; but continued in the ſame ſtate, neither bigger nor leſs, near ſix Years; that is, till it was broken off by chance in *July* 1725. This ſeems to me a very ſtrange thing: For, a ſeedling Plant (of any kind) is, but as it were an *Embryo*, till it have put forth Leaves.

3. My moſt thriving pair of Plants, of the Year $17\frac{14}{19}$, being about three Inches in length, were on the 21*ſt* of *May* 1722, ſtruck off, by the falling of a Rake-handle againſt them. They took away with them, only the outmoſt thin ſkin of the Tree; and I could not ſee any ſigns, of deeper Rooting. But as I looked, now and then, on the Place, where the *Miſſelto* had grown, I thought, I obſerved the Bark to ſwell up a little; and on the 12*th* of *March* $17\frac{2}{3}$, I perceived 3 or 4 little Buds, putting forth, and another Bud was put out by the 18*th* of *March*. They all grew on, to have Leaves that Summer; and now *Febr.* $17\frac{17}{17}$, they are a Cluſter of Boughs, of 4 or 5 Joints in heighth, and bore Berries this Winter; whereas two others on the ſame Tree, and which were alſo ſown at the ſame time

time, in 1718, and are 6 or 7 Joints in heighth, have not yet born any Berries.

The thriving of theſe Plants, ſo well again, after they were broken off; made me reflect, on the *Druids* way, of cutting *Miſſelto* from the *Oak*, with a Golden Inſtrument; a Metal not apt to take a good Edge, and poſſibly, the bluntneſs of the Inſtrument, might be a means, to preſerve, a future growth, of the ſame Plant; which doubtleſs, they as well as we, find to be very rarely upon the *Oak*. I might ſuggeſt ſome Reaſons for this Scarcity, from the Nature of that Bark; and I might obſerve many miſtakes, into which both Modern and Ancient Writers run, when they mention this Plant. But I have been ſo tedious already, that I ſhall add only this one Obſervation; that there is almoſt every Year, on moſt *Miſſelto*-Buſhes, a viſible Proof, that the Kernel hath a vegetative Life in it: For when the Berries hang on till *May* or *June*, the Seed will make it's little Shoot in the Berry, as the Kernels of Lemons, and you may ſee it coming out at the Eye of the Berry.

2. The Birds do not often permit any Berries to be found ſo late as in *May*, but as I have formerly obſerved this, ſo I have met with ſome this Year, whereof I have herewith ſent you a *Specimen*; wherein you will find both old ripe Berries and young green ones, on the ſame Stalks; and in the old you may ſee (even through their Skin) the little *Germen* putting forth it's Head from the Seed or Kernel. I have likewiſe formerly had a Suſpicion that the Plants of *Miſſelto* are ſome *Male*, ſome *Female*. I am now further perſwaded, that it may be ſo. *A germinating Principle in it's Seeds, by the ſame*, N°. 399. p. 306.

3. I have (from my own ſowing of the Berries) four thriving Plants of *Miſſelto* growing on one Tree in my Garden. Theſe, being often in my View, gave me the firſt Apprehenſion, of there being any Difference of Sex, in this Shrub. They were not of Age to bear Flower or Fruit till 1726; when one of them bore a Berry or two; and expecting that they ſhould all do ſo the following Year, I frequently examined them, and found that two Plants had Berries, and two had none. I then went and examined the *Miſſelto* on other Trees, which have Plants of above 20 Years Growth. And I find the Method of Nature to be thus. *A Difference of Sex in it, by the ſame* N°. 405. p. 547.

Dr *Grew* obſerves, that many Plants make a viſible Preparation in the former Year for the Flower and Fruit of the next Seaſon. This is done by *Miſſelto*. At the latter End of *May*, the Male Plants put out little Knobs, at the Joints and Tops of their Boughs; which at firſt are not very unlike the young green Berries; but they ſoon appear evidently diſtinct from them, and being by the latter End of *July*, grown as large as the Berries, are then not at all like them; ſpreading wider upwards, and having 3, or 4, or 5 Buds, at the Top of each Knob. About *June*, the Female Plant alſo makes a like Preparation; putting out at the Joints and Tops of the Boughs,

Knobs, which are more ſharp, and ſhorter than thoſe of the Male; with 1, or 2, but moſt commonly with 3 Buds, or ſmall Points at the Top of each Knob. I call them Buds, becauſe in their Seaſon they open into Flowers, both in the Male and Female Plants; all the reſt of the Knob ſerving only for Footſtalks to the Flowers, in the one Sort, and to both Flower and Fruit in the other. By the latter End of *Auguſt* the Berries are grown much larger than the Knobs on the Male Plants. And from thence, till late in *January*, there is little worth Remark in either Plant; only the Berry grows ſomewhat bigger, and becomes ripe; and the Knobs on the Male grow more and more yellow; ſo that one may, at that Time, diſcern a Male from a Female Plant, at a conſiderable Diſtance. By the 20th of *February* *Miſſelto* is in Bloom, both Male and Female. The Knobs of the Male are open at the Top with 3, or 4, or 5 Bloſſoms; which are very well deſcribed (though in ſhort) in *Boerhaave's Hiſtoria Plantarum.*

The Female Plant flowereth alſo now, with a Bloſſom (which *Boerhaave* calls the Ovarium) exactly like the Male Flower; ſave only, that the whole Female Flower is not bigger than one Leaf of the Male Flower. They both continue in full Bloom till the Middle of *March*, when the Male Bloſſoms begin to wither and drop off. And by the 20th of *March* the young Berries begin to ſhew themſelves, ſwelling forth, one under each Female Bloſſom; which often adheres to the Top of the Berry; and being carried up with it, preſently withers, and ſoon falls off again; tho' ſome continued on till the 12th of *May*, when the Berries were of the Size of a great Pin's Head.

This compleated the Year's Obſervation. And I think it is much to be wondered at, that this Plant, which hath been the Admiration of all Ages, ſhould (ſcarce ever) find one Obſerver ſo curious as to follow the Changes of it, through one whole Year's Revolution. For if this had been done with any Accuracy, it muſt have been very evident, that one Sort of *Miſſelto* was very different from the other: One Sort bearing very ſmall Flowers with Berries ſucceeding them: the other bearing much larger Flowers, not ſucceeded by any Berries; the very Footſtalk of the Male falling off with the Flower; whereas the Footſtalk of the Female, becomes a Footſtalk to the Berry.

New Experiments, relating to the different, and ſometimes contrary, Motion of the Sap in Plants, by Thomas Fairchild, Gardener *at* Hoxton. No. 384. pag. 127.

XIX. Some Years ago, I ſhewed ſome Experiments before the *Royal Society*, and they were pleaſed to allow the Experiments to be new and uſeful; which encouraged me to try further, and bring more Experiments, in order to ſhew the Courſe of the Sap; which I find, by Experience, will be ſo uſeful, that I can make barren Trees fruitful, and decaying Trees healthful, and render the Syſtem of Gardening and Planting more uſeful to the Public.

I ſhewed

I ſhewed the *Laureola*, grafted upon the *Mezereon*, and the *Evergreen Oak* of *Virginia* upon the common *Engliſh Oak*; both which hold their Leaves all the Winter, and are in good State and flouriſhing, though grafted on Plants that drop their Leaves in Winter; which plainly proves that the Juices riſe upwards, in Winter, in thoſe Plants that drop their Leaves, otherwiſe the *Evergreens* that are grafted on them would ſoon periſh.

I believe by grafting the Variety of foreign Oaks on the *Engliſh*, we might make the Timber more firm and laſting, than it is in it's own Nature, when raiſed from foreign Acorns: For as the Crab Stock maketh the Wood of the Apple-Tree more firm and laſting, than that on the Apple-Stock, and the Peaches and Almonds, budded on Plums, are more laſting than thoſe on Peach-Stocks; ſo by the contrary Rule, all firm Timber, grafted on ſpungy Stocks, would be made worſe than it would be on it's own Bottom. For Example, If that which is called the *Engliſh Elm*, ſhould be grafted on that which is called the *Dutch*, it would partake of abundance of the ſpungy Juices of the Stock, whereby the Timber would become unfit for the Purpoſes it is now uſed for.

The firſt Experiment, I have now to offer is made on the *New England Cedar*, or rather *Juniper*, grafted on the *Virginia*; and what is remarkable in it, is, That the Branch, which is grafted, is left ſeveral Inches below the Grafting, which Part continues growing as well as the upper Part above the Grafting.

The ſecond is on the *Viburnum*, the Top of which being planted in the Ground, is become Roots; and the Roots being turned up, are become Branches. I find the Plant in as good State of growing as it was in it's natural State.

The third is on a Pear-Tree, which I enarched upon two Pear-Stocks, in *March* $17\frac{21}{22}$. which is now in a good flouriſhing State with a Branch in Bloſſom, and receiveth no Nouriſhment but by the two enarched Branches, the Root being out of the Ground; and though it was done above two Years ago, it is now ſhooting Suckers out of the Root, which proveth that the Branches are as uſeful to ſupport the Roots, as the Roots the Branches; and it is therefore no Wonder that ſo many Trees miſcarry in planting, when there are no Branches left on the Head.

The fourth is on the Cedar of *Libanus*, grafted on the *Laryx*, which drops it's Leaves in the Winter; yet maintains the Cedar in as flouriſhing a Condition, as if it had been on a Tree that held the Leaves all the Winter; and the Part of the Graft, left below the Grafting, is in as good Health as the Part above it.

XX. In 1724, I had a Parcel of freſh *Coco-Nuts* from *Barbadoes*: Part of theſe Nuts I diveſted of their outer Coat, or Huſk, and the other Part I left entire as I received them. Both theſe Parcels I planted in large Pots, filled with good freſh Earth, and plunged the Pots *A Method of raiſing ſome exotic Seeds, which have been judged*

almoſt impoſſible to be raiſed in England, *by Mr* Phillip Miller, No. 403. p. 485.

into a Hot-bed made with *Tanners-bark*; giving them gentle and frequent Waterings as the Earth in the Pots ſeemed to require; but had not one, out of the whole Number, which made any Attempt to ſhoot, as I could perceive; and upon taking them out of the Pots, I found they were rotten. About four Months after, I received another freſh Parcel which I treated in another Manner: From part of theſe I cut off the outer Coat or Huſk, and the other Part I left intire as before: But ſuppoſing it was owing to my planting the other Parcel in *Pots*, that they did not ſucceed, I made a freſh Hot-bed (with *Horſe-dung*) and covered it over with *freſh Earth*, about 18 Inches thick, in which I planted the Nuts: Obſerving as before, to ſupply it with *convenient Moiſture*, as alſo to keep the Hot-bed in an *equal Temper of Heat* (which I was guided to do by a *Thermometer* graduated for the Uſe of *Hot-beds*); but with all my Care I had no better Succeſs than before; not one of the Nuts making any Eſſay towards *ſhooting*. The Year following I had another Parcel of *Coco-Nuts* given me, which, conſidering my former ill Succeſs, I planted in a different Manner. Having a Hot-bed, which had been lately made with *Tanners-bark*, and which was filled with Pots of exotic Plants, I removed two of the largeſt Pots, which were placed in the Middle of the Bed, and opening the *Tanners-bark* under the Place where the two Pots ſtood, I placed the two *Coco-Nuts* therein, laying them Sideways, to prevent the *Moiſture* (which might deſcend from the Pots) from entring the Hole at the Baſe of the Fruit, and thereby rot the ſeminal Plant upon it's firſt *germinating*. I then covered the Nuts over with the *Bark* two or three Inches thick, and placed the two Pots over them in their former Station. In this Place I let the Nuts remain for ſix Weeks; when removing the two Pots, and uncovering the Nuts, I found them both ſhot from the *Hole* in the *Baſe* of the Fruit, an Inch in Length; and from the other *End* of the Fruit were ſeveral Fibres emitted two or three Inches in Length. Finding them in ſuch a Forwardneſs, I took them out of the *Bark*, and planted them in large Pots, filled with *good freſh Earth*, plunging the Pots down to their Rims in the *Tanners-bark*, and covering the Surface of the Earth in the Pots half an Inch thick with the ſame: Soon after which the young Shoots were above two Inches long, and continued to thrive very well. I have communicated this Method ſince to ſome of my Acquaintance, who have tried it with the ſame Succeſs and if the Nuts are freſh, ſcarce any of them miſcarry. This led me to try if the ſame Method would ſucceed as well with other *hard-ſhelled, exotic Seeds*, which I could not, by any Method I had before tried, get to grow, as the *Bonduc*, or *Nickar-Tree*; the *Abrus*, or *Wild Liquorice*; the *Phaſeolus Braſilianus fruteſcens lobis villoſis pungentibus maximus Hermanni*, or *Horſe-eye Bean*; with ſeveral others; and I have found it both a ſure and expeditious Way to raiſe *any Sort* of *hard ſhelled Fruits*, or *Seeds*. For the *Heat* and *Moiſture* (which are abſolutely

abſolutely neceſſary to promote Vegetation) they here enjoy in an *equal* and *regular* Manner; the *Tanners-bark* (if rightly managed) keeping to near an *Equality* of Heat for ſix Months, and the *Water* which deſcends from the Pots, when they are watered, is by the Bark detained from being too ſoon diſſipated: which cannot be obtained in a common Hot-bed, the Earth in ſuch being worked away by the Water, and thereby leaving the Seeds often deſtitute of Moiſture. Some of theſe Seeds I have had ſhoot in a Fortnight's Time; which I am informed, would not have ſo done in a Month in their native Soil and Climate. I have alſo found this to be an excellent Method to reſtore Orange (or any other exotic) Trees, which have ſuffered by a tedious Paſſage, in being too long out of the Ground: Inſomuch that I recovered two Orange-trees which had been ten Months without either Earth or Water.

An Account of Bulbous *Plants flowering much ſooner when their Bulbs are placed upon Bottles, filled with Water, than when planted in the Ground, by Mr* Triewald, *F.R.S.* N°. 418. p. 80.

XXI. 1. In *September* laſt I placed ſome Bulbs of *Tulips*, and other Flowers, in Water as the Figures repreſent; at which Time I put into each Glaſs two Grains of *Saltpetre*. Theſe Glaſſes I kept in my Study, ſometimes on a Shelf, at other times before the Window. In a Fortnight's Time I begun to find that they ſtruck new Roots; the latter End of *November* they put forth Leaves, and in *January* they all flowered, as well as if they had been on a Garden-bed; whereas in Gardens we ſeldom ſee in *Sweden*, *Tulips*, before the latter End of *May*, and this Year they are later, the Ground being yet covered with Abundance of Ice and Snow.

Though theſe Experiments ſeem to be calculated for nothing but Delight, yet I think they have furniſhed me with ſome Lights, as to the Riſe of the Sap in Plants. *Fig.* 116, 117.

Experiments, relating to the ſame Subject, by Mr Philip Miller, *F.R.S.* N°. 418. p. 81.

2. The Glaſſes marked Numb. 1, were Roots of a *Hyacinth*, commonly known by the Name of *Pulchra*. Numb. 2. were Roots of the common *Oriental blue Hyacinth*. The Flowers of theſe were not ſo large as they are commonly produced when planted in a Bed of Earth; but this was occaſioned by the Bulbs dividing into ſeveral Off-ſets, each of which are as ſo many different ſmall Roots, ſending forth Stems and Leaves. Numb. 3, was a Bulb of a *Tulip*, which though placed on the Glaſs of Water at the ſame Time as the *Hyacinths*, yet was not likely to flower in a Month. Numb. 4, was a Root of *Narciſſus*. This was alſo as backward as the *Tulip*, though put upon the Water at the ſame Time with the *Hyacinths*. Theſe Roots were placed upon the Glaſſes the Beginning of *November* laſt; at which Time I put them into a Green-Houſe, where the Air was kept conſtantly in a temperate Warmth. The Glaſſes were filled with common *Thames* Water, ſo near to the Top, that when the Bulbs were placed upon the Glaſſes, it might be about a quarter of an Inch below the Bottom of the Bulbs. Into thoſe Glaſſes marked Numb. 5, I put a ſmall Quantity of common Garden Mould, to try whether that would forward their Flowering, or encreaſe their Strength: But I

found that all the Roots which were placed on thoſe Glaſſes, into which the Earth was put, were at leaſt a Fortnight later than the others before their Fibres were emitted, and their Progreſs has been ſince much ſlower. I alſo obſerved that the Water, in thoſe Glaſſes where the Earth was put, did not waſte above half ſo faſt, as it did in thoſe Glaſſes where there was none; which, I conceive, might be occaſioned by the terreſtrial Matter mixing with the Water, and ſo rendered it thicker, and leſs capable of being attracted by the Plants or evaporating by the Heat. And from thoſe Glaſſes, where the Bulbs did not exactly cover their Necks, the Water evaporated much faſter than from thoſe where the Bulbs did entirely cover the Tops of the Glaſſes, ſo as to leave no Vacuities round them.

In about a Month after the Roots were put upon the Glaſſes of Water they began to put out their Fibres into the Water; but they did not begin to put forth their Leaves, until their Fibres were extended all over the Glaſſes, and were almoſt as full grown as at preſent. When their Leaves began to appear, the Buds of the *Hyacinth-Flowers* were ſoon viſible, and in about three Weeks Time were fully blown. The *Tulips* and *Narciſſus's* being much backwarder than the *Hyacinths* (as they always are when planted in a Garden) theſe ſhould always be placed upon the Glaſſes of Water ſix Weeks or two Months earlier in the Seaſon than the *Hyacinths*, when they are deſigned to flower at the ſame Time; and the *Præcoces* (or early blowing) *Tulips* ſhould always be choſen for this Purpoſe.

By this Method a Perſon who has not a Garden, may have ſome of theſe Flowers growing in his Chambers, where, if they are not kept too cloſe from the Air, or in a Place too warm, they will flower almoſt as well as in a Bed of Earth, provided the Roots are good, and are every Year renewed; eſpecially the *Tulips*, becauſe they every Year form new Bulbs, the old ones being always exhauſted in nouriſhing the Leaves and Flowers, a new Bulb is annually produced by the Side of the Flower-ſtem. The *Hyacinths* I have obſerved to flower two Years ſucceſſively upon Glaſſes of Water; but their Flowers were very weak the ſecond Year. So that it is much the better Way to have freſh Roots every Year.

f the Small-ſs of the pine Plants, Dr Scheuzer *F. R. S.* 406. p. 3.

XXII. They become leſs and leſs, in proportion as the Mountains, upon which they grow, riſe higher. Whether this be owing to the Sharpneſs and Purity of the Alpine Air, or the decreaſing Preſſure of the Atmoſphere, which is far leſs upon Mountains than in Valleys and lower Countries, or to a Want of a ſufficient Quantity of ſubterraneous Heat, to puſh the Nouriſhment into the Roots and Veſſels of the Plants, or rather to a joint Concurrence of theſe and other Cauſes, would require a more leiſurely Conſideration. The Thing itſelf is an indiſputable Matter of Fact, and it extends alſo to Trees and Shrubs, which become ſmaller, as they grow higher. Nay, what is ſtill more remarkable, no Trees will grow beyond a certain Height,

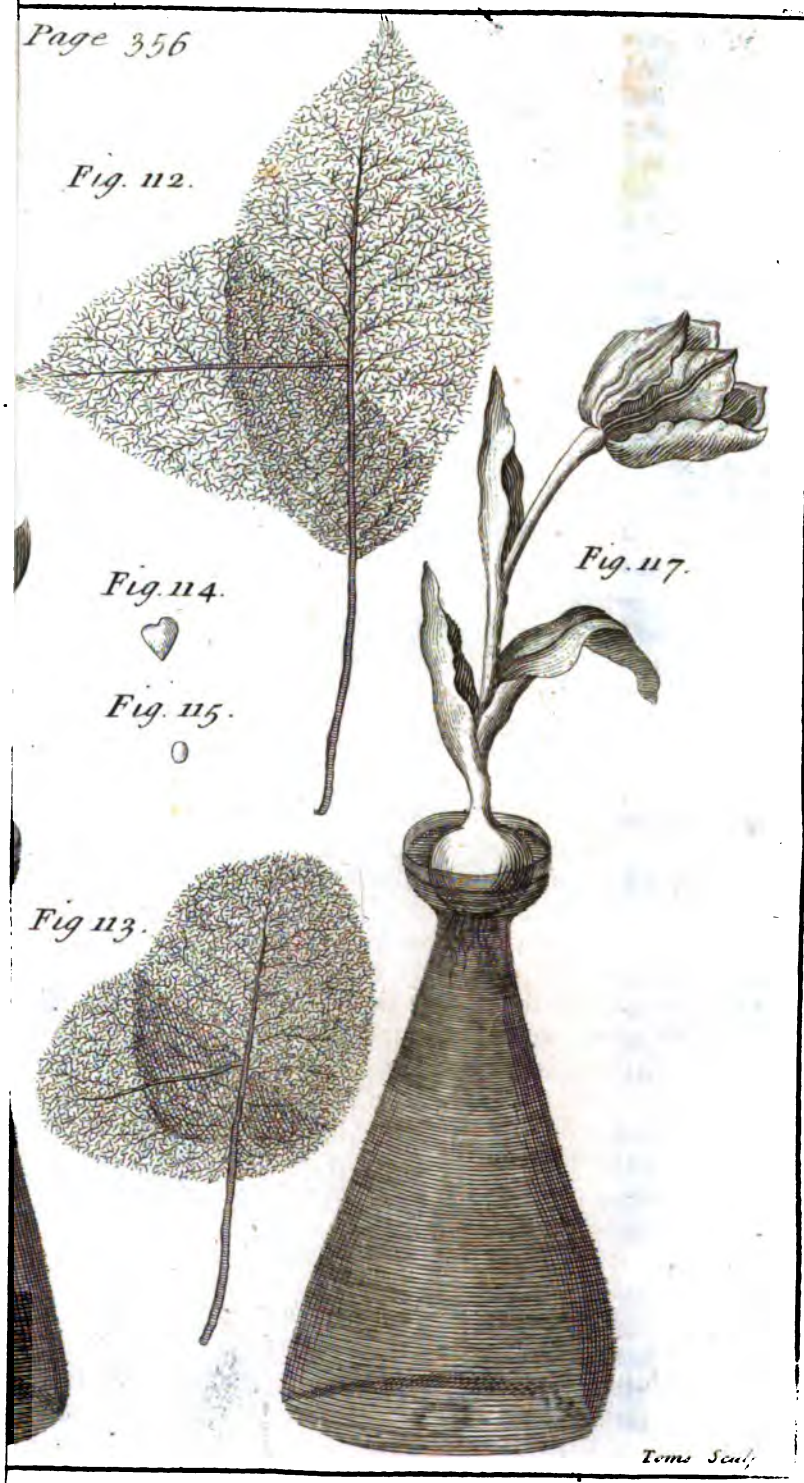


Fig. 112.
Fig. 114.
Fig. 115.
Fig. 117.
Fig 113.
Toms Sculp.

which is the Reaſon why the Tops of Mountains appear ſo bare and naked, if viewed at a Diſtance, though a curious Traveller ſhall not fail meeting upon their rich Paſtures with an agreeable Variety of beautiful Plants. The Height, where the Trees ceaſe to grow, hath been found, by Barometrical Obſervations, nearly to be the ſame in divers Parts of *Swiſſerland*. Otherwiſe, the Smallneſs of the Alpine Plants is abundantly compenſated by the Richneſs of their Virtues, which are, as it were, purpoſely centred there into ſo narrow a Compaſs.

A new Family of Plants called Oxyoïdes, *by Monſ.* Garcin. *Tranſlated from the* French, *by* John Martyn, *F. R. S.* N° 415. pag. 377.

XXIII. 1. The *Oxyoïdes* is a Family of Plants, whoſe Flower and Fruit are altogether like thoſe of the *Oxys*; that is, the Flower is compleat, regular, polypetalous and hermaphrodite; containing the *Ovary*, which afterwards becomes, as in *Oxys*, a five-cornered Fruit, divided into five Cells, filled with ſmall Seeds; each of which is covered by a Membrane, like a Hood, which opens, when ripe; and by an elaſtic Motion, makes the Seed leap out.

The true Characters by which it is diſtinguiſhed from the *Oxys*, are, that the Leaves are diſpoſed by Pairs along a Rib, without being terminated by an odd one, which makes them entirely reſemble thoſe of the *Tamarind*. That theſe Leaves are all gathered together, in an Umbel, on the Top of a naked Stalk: That they are not in the leaſt Degree acid, and that they ſhew as great a Senſibility, on being touched, as the Species of *Mimoſa*.

The Species of this *Genus* are,

I. *Oxyoïdes Javanica, ſenſitiva, caule rubeſcente, birſuto flore luteo, minore.* *Fig.* 118.

II. *Oxyoïdes Malabarica, ſenſitiva, caule viridi, glabro altiore, flore majore.* *Fig.* 119.

Deſcription of of the firſt Species.

The firſt uſually grows to the Height of half a Foot. It is compoſed of a naked Stalk, Ribs of Leaves, and Pedicles of Flowers. Each of theſe Parts is of equal Length, and uſually three Inches, when they are at their full Growth; and the whole is diſpoſed in an Umbel.

The Root, which is almoſt as long as the Stalk, runs ſtraight down and ſometimes obliquely into the Ground. It grows taper from it's Neck, which is of the ſame Thickneſs with the Stalk. It is ſet with ſmall Fibres, a little waved and white, and giving Riſe to other pretty ſhort Filaments. The whole Root is whitiſh.

The Stalk ariſes ſometimes ſtraight, and ſometimes crooked; ſometimes wrinkled, and ſometimes plain throughout it's whole Length, pretty downy, or rather hairy, and always reddiſh in ſome Places. It is from a Line and a half to two Lines thick towards the Top, and uſually ſomething leſs towards the Bottom. This Stalk, which forms a kind of Button,

or

or little Head, at the Top, gives Riſe at that Place to all the other Parts of the Plant; that is, to the Ribs of the Leaves, and the Pedicles of the Flowers; which makes the whole Tuft reſemble an Umbel.

The Ribs of the Leaves, which grow from the Top of this Stalk, go on encreaſing till they equal the Length of the Stalk. They are about the Thickneſs of the treble String of a Violin, and equal throughout their whole Length. They are a little downy like the Stalk.

The Leaves, which grow by Pairs, occupy two thirds of the Rib; that Part which is next the Stalk being naked. The firſt Pair of Leaves is the leaſt, and the laſt Pair always the largeſt. Theſe are commonly half an Inch long, and the ſmalleſt are not above half the Size of the largeſt. Theſe Leaves grow ſo near the Rib, that they ſeem to have no Tail. Their Baſe is always the broadeſt Part of the whole Rib, and always parallel to the Rib: The reſt of the Leaf bends itſelf a little forwards. The Middle of their Length is uſually their narroweſt Part, and from thence they are gradually enlarged, and rounded at their Extremities. The Baſes of all the Pairs are almoſt of the ſame Bigneſs, except the laſt, which has the Breadth on one Side only of the little Nerve, which traverſes the Leaf, to avoid incommoding itſelf with it's Neighbour but to make Amends, the Leaves of this Pair are broader than the others, a little below their Extremities, eſpecially outwards. They are all traverſed lengthwiſe by a fine Nerve, or Thread, always bent like the Leaf on the Side of the laſt Pair. They are of a lively Green on the Inſide, and a little whitiſh on the Outſide. Their Plain is garniſhed with a great Number of very ſlender Threads, almoſt imperceptible, but parallel, which grow alſo by Pairs, and are placed at acute Angles with their little common Nerve, and grow ſmaller at the Edge of their Leaf. In ſhort, their Poſition and Figure come pretty near to thoſe of the *Tamarind.* The Number is uſually from eight to ten Pairs, and they are as ſenſible on being touched, as thoſe of the Species of *Mimoſa.* They ſhut themſelves up at Sun-ſet, as it were to ſleep, after the ſame manner with the Leaves of the *Tamarind.* The Ribs are in Number from two to three Dozen; and the Pedicles of the Flowers are about a fourth Part fewer in Number: they appear of different Lengths, becauſe the ſhorteſt are the youngeſt, but at laſt they uſually grow to almoſt the ſame Length with the firſt. The opening of the Leaves is performed almoſt after the ſame manner with that of the Top of the Spikes of the Species of *Heliotropium,* unrolling like the Tail of a *Scorpion.* The Ribs and the Pedicles are a little hairy, as well as the Stalk. The Pedicles are of the ſame Thickneſs with the Ribs.

The Flower, though it ſeems to be monopetalous, is not ſo, any more than the Species of *Oxys,* which ſeem to be ſo too: Otherwiſe the Principles of Monſ. *Vaillant* would be falſe, who has laid it down

down as a Rule, that in all monopetalous Flowers the Chives grow from the Sides of the Flower. And that thoſe which grow from the Baſe of the Embryon, or rather from the Ovary, are always polypetalous. In ſhort, if we examine them nicely, which no one has done till now, we may obſerve, that theſe Flowers have no *Anus* at the Baſe, but that the Petals, which are always five in Number, have their Baſes ſeparated very diſtinctly one from another; and though they are re-united about the Middle, which makes them look as if they were of one Piece, yet they may be ſeparated without tearing.

The Petals are equal, they are from 3 Lines to 3½ long, and towards the Extremity about a third Part as broad as they are long. They are lightly cut in like a Heart at their Extremities. They are of a Lemon Colour, paler or deeper, according to the Moiſture or Heat of the Seaſon. Each of them has a ſmall Streak running through their Middle lengthwiſe. They are covered by their Empalement about two Thirds of their Height, and from thence they open in Form of a Bell. They are very tender, and laſt but the Space of one Morning.

The Empalement is one-leaved: It is two Lines high, and the half of this Height makes the Thickneſs of it's Baſe. It divides a little below the Top into five Lobes, very ſharp at their Extremities. It is pale-green, regular, and a little hairy.

The Chives grow from the Baſe of the Embryon, being twice the Number of the Petals, five of them being higher than the other five. The higheſt reach up to about the Middle of the Petals. Their Summits are of the ſame Colour with the Petals, and the Chives of the ſame with the Empalement, or a little brighter.

The Ovary is very ſmall and round, but a little furrowed into five Ribs, the Diameter of which is about one Third, or almoſt half a Line. It is crowned by five Teeth, which form the Body of the Style.

This Ovary afterwards becomes a dry Fruit, of an oval Form, ſtarred with five Furrows, of which the leaſt Diameter is about one and a half or two Lines. This Fruit is divided into five Cells, and opens at the Top when ripe, and then expands itſelf by little and little to it's very Baſe, and diſcloſes ſmall, round Seeds, lodged four together in each Cell. They are each of them covered with a little Hood, or very fine Membrane, which on the Encreaſe of the Bulk of the Seed, opens itſelf with Violence, and throws it on the Ground. The Colour of the Seed pretty nearly reſembles that of *Pſyllium*.

Each Pedicle, during the Time of it's Encreaſe, continually puts forth new Buds, and new Flowers, in the ſame manner as the Stalk continually puts forth at the Top new Leaves and new Pedicles. The

Number of theſe Buds is uſually five or ſix at the Top of each Pedicle enlarged into a Head. Theſe Buds grow, encreaſe and expand themſelves one after another, which is the Cauſe that this Plant, when once it begins to flower, puts forth new Flowers every Morning, which are quite vaniſhed in the Afternoon. The little Bunches of Buds, each of which adorns a large Pedicle, are encompaſſed with little Points, which compoſe a kind of common Empalement. The little Pedicle, which is proper to each Flower, is ſlender, and a full Line long, ſo that it's Length is equal to the Diameter of the Empalement.

The Diameter of the Flower, when it is moſt expanded, is four Lines.

The Petals make the Empalement expand itſelf a little: but when the Flower is faded, the Lobes of the Empalement draw together, and form a pyramidal Body; but when the Ovary grows bigger, and becomes the Fruit, the Lobes of the Empalement expand again without changing their Shape; becauſe the Body of this Empalement encreaſes it's Diameter by the Effort which the Fruit makes within it.

This Plant is very ſenſible of the leaſt Cold: It loves warm and moiſt Places. It is found in the Iſland of *Java*, and probably in the other Iſlands of the *Sonde* and the *Moluccas*. When one touches it's Leaves, they cloſe immediately, and open again by little and little. The more they are warmed by the Sun, whilſt their Soil is moiſt, the more impetuouſly they cloſe againſt one another. The *Portugueſe Indians* call it *Dormidera*, becauſe, on being touched, it ſeems to ſleep, by ſhutting up it's Leaves; or elſe, becauſe ſome among them think it procures Sleep by being put under the Ear, as I have ſeen practiſed. The Leaves of this Species have no Acidity in their Taſte, and give but a faint Tincture of Red to the blue Paper.

I thought this Plant curious and rare enough to be communicated to the curious *Engliſh* Botaniſts. I had the Pleaſure to ſee a little while ago, in Dr *Blair*, that the Flower of the *Oxys* was pentapetalous.

The Flower of the Oxyoïdes.

Fig. 120.

Fig. 121.

Fig. 122.

Fig. 120. The Empalement. *Fig.* 121. The Flower, the Petals of which are joined together. *Fig.* 122. A Petal apart.

A Remark by John Martyn. *F.R.S.* No. 415. P. 384.

2. We are obliged to Monſ. *Garcin* for his curious Deſcription of this Plant, by which it's Genus is determined. It is however by now means a new Species, having been deſcribed long ago by *Acoſta*, and other Authors, under the Name of *Herba viva*. I have ſeen a fair Specimen of it in Sir *Hans Sloane*'s *Hortus Siccus*, with which Monſ. *Garcin*'s Figure

Figure agrees very exactly. It was the first Sensitive Plant known in *Europe*, and very different from those which are now brought from *America*, and cultivated in our Gardens under that Name.

Remarks on the Family of Plants named Musa, *by Mr* Garcin. *Translated by the same*, No. 415. p. 384.

XXIV. Almost all the Writers of Botany have looked on this Family as a Tree, on account of it's Bigness, though it is tender, spungy, membranous and succulent, not at all hard or woody. It's Stalk is slender and supple, not able to keep itself upright, without a great Number of thick, membranous Sheaths, which cloath it's whole Bulk, and defend it from the Injuries of the Weather. Besides, this Plant being annual bears Fruit but once, and then by Degrees perishes.

Trees, on the other Side, which are ligneous, hard and perennial, bear Fruit several times. The Bigness then of a Plant does not seem to be a Character sufficient, to distinguish a real Tree from a Plant that is not one.

Again, the same Botanists have placed the *Musa* in the *Palmaceous* Class, which are all Trees, perhaps on account of this Plant's having but one Stalk, without any Branches; and because the great Leaves at the Top of it divide, when they grow old, in such a manner as to resemble, in some Degree, a Sort of *Palm*.

Having had an Opportunity in the *Indies* to consider this Plant better, I soon found that it justly belonged to the *Liliaceous* Tribe. It is known that the *Liliaceous* Plants have several Characters, which distinguish them very well. Their Roots are either bulbous, tuberous, or consisting of thick, fleshy Fibres: Their Leaves involve the Stalk, more or less, at their Bases. The Substance of their Flowers is filled with silver Spangles; and lastly, their Fruits are always divided into three Cells. The *Musa* has all these Characters. *Labat* says in his Travels, that the Root of this Plant is a thick Bulb, round and massy, emitting Fibres. *Marcgrave*, who has given a full Description of this Plant under the Name of *Pacoeira*, has observed, that, at it's first appearance, it sends forth two or three Leaves, rolled up like a Horn, which unrol themselves, and grow after the Manner of the *Cannacorus*. And, according to my Observation, the Fruit in all it's Species, is constantly divided into three Cells which is sufficient to shew, that it is a true *Liliaceous* Plant.

As *Marcgrave*, and the Authors of the *Hortus Malabaricus* have largely described this Plant, I shall content myself with only giving a Definition of this *Genus*, to make it better known.

The *Musa* is a *Liliaceous* Plant, with a monopetalous, irregular Flower, incompleat and hermaphrodite, composed of a Tube, which is filled with the Ovary, and a Pavillion divided into several Lobes, and forming a kind of Mouth. The Ovary, which adheres strongly to the Tube, is triangular, and crowned with five Chives, which grow from the Sides of the Flower: it has also a Style, which is terminated by a little Head. It afterwards becomes a soft, angular,

long, crooked Fruit, something like a *Cucumber*. This Fruit, when ripe, is fleshy, and divided into three Cells, filled with a mucilaginous Pulp; under which the Seed is placed along a *Placenta*, which serves as an *Axis* to the Fruit.

This Seed is small, round, edged with an almost imperceptible Leaf. The Flowers grow at the End of the Stalk, in Knots disposed in a Spike. Each Knot is loaded with two Rows of Flowers, covered with a membranous, hollow, thick, oval Covering, which serves them for a common Empalement. In the *Hortus Malabaricus* there are three Plates, which give a good Representation of the Plant, it's Flower, and it's Fruit; but I have observed three Defects in them: 1. The Flower is not represented in it's most perfect State, but almost withered, and so it's Pavilion too much cleft, which makes the Flower seem tetrapetalous; for the Flowers of these Plants divide when they are old, as well as the Leaves. 2. The three Cells are not shewn distinctly, in the transverse Section of the Fruit. 3. That the Seed is not represented at all.

This Family, comprehends about twenty-five Species, known to the *Indians*, the Differences of which are usually taken from their Fruits. This Plant does not perish before it has ripened it's Fruit whence it might last longer in a temperate Climate, cool enough to retard it's Fruit.

The Bark of the Fruit is formed of the Tube of the Flower; and the Lobes dry away during the growth of the Fruit.

Fig. 123. *Fig.* 123. The Fruit of the *Musa* half stripped of it's Bark. *Fig.* 124. *Fig.* 124. cut through the Middle. *Fig.* 125. cut transversly, distinguishing the three Cells and the Seeds. *Fig.* 125. *Fig.* 126. Another Species of *Musa* cut transversly, represented in *Fig.* 126. the *Hortus Malabaricus*, but having the Cells better distinguished here. The six black Points are the Seed.

A Method of discovering the Virtues of Plants by their external Structure, by Patrick Blair *M. D. F. R. S.* No. 364. p. 30.

XXV. I cannot enough admire the Judiciousness and Sagacity of the Ancients, who, without any of those means made use of by the Moderns, have handed down to us such an account of the Virtues of those Plants, which are more particularly dedicated to Uses in Physic, that all the laborious Endeavours of their inquisitive Successors, have never been able to outdo them. It must have been a long Tract of Experience, which enabled *Dioscorides* and *Theophrastus* to collect and receive from their wise Ancestors, such a lasting Catalogue of the Virtues of Plants, as scarce any thing has been added to even to this day. The Royal Academy at *Paris*, has been at great pains to find out the Virtues of Plants by the Chymical Analysis, and several other Experiments, of which we have the Abstracts in *Tournefort*'s *Histoire des Plantes aux environs de Paris*, and *Tauvry*'s *Traité des Medicaments*: But these laborious Endeavours only serve to confirm what the Ancients advanced, without any new Discovery. For *Tournefort*, after having made the Experiments with the *Tournesol* and

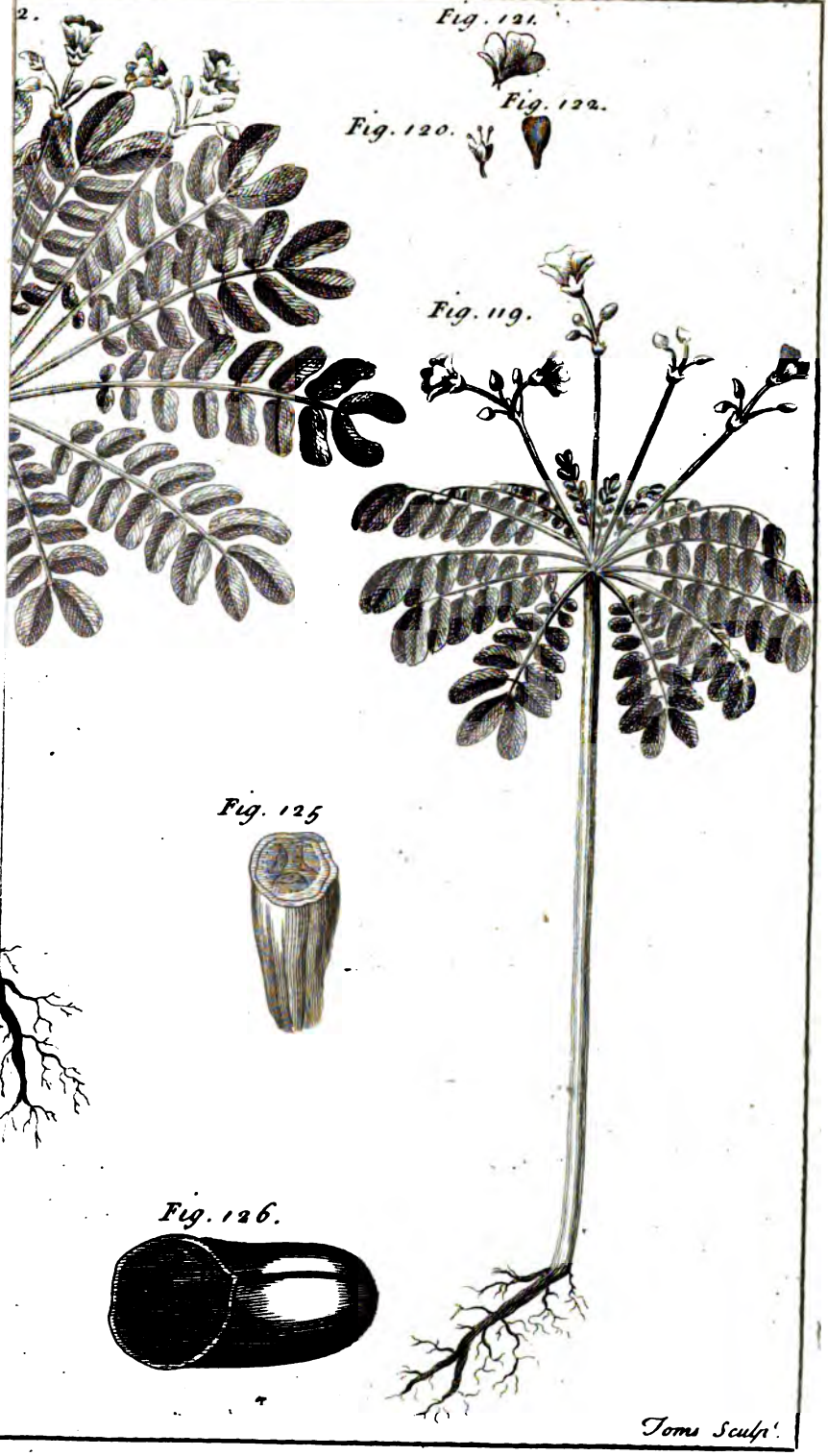
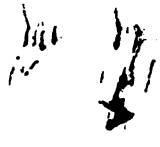


Fig. 121.
Fig. 122.
Fig. 120.
Fig. 119.
Fig. 125
Fig. 126.
Toms Sculp.



and blue Paper, and given an exact Account of the several active Chymical Principles, which are observ'd in such and such a Plant, usually concludes. *Therefore, 'tis not surprising if it is endowed with such Virtues*; which is nothing but giving a Reason why the Ancients believed they were good for such a Distemper.

The Means used by our Forefathers to discover the Virtues of Plants, and their Use in the several Diseases, as they were the most simple, so they are most assisting at this very time. It seems they narrowly considered their *Facies externa*, and thus concluded; If such a Plant partake of such Virtues, such another so very like to it, must be endowed with the same, *v. g. Apium* and *Fœniculum* have the same manner of flowering; both produce their Seed after the same manner; their Roots are both alike, being long, white, streight, carnous, *&c.* Therefore since a long Tract of Experience, handed down by Tradition, shews that such a Plant has such Virtues, such another like it must have the same. Thus we find *Apium*, *Fœniculum Petroselinum*, all joined together, and prescribed as the opening Roots in the *Dispensatory*. This induced the Celebrated Dr *Herman* to lay down these general Maxims, *Quæcunque flore & semine conveniunt eadem possident virtutes:* And *Omnia semina striata sunt carminativa.*

Thus at the first view, without knowing the Characteristics so nicely as Botanists do, but only exactly observing the *Facies externa* of the Plant, when the Virtue of one Species is known, the Virtues of all the Congeners may be guessed at, if not fully determined.

The next simple Method of the Ancients, to discover the Virtues of Plants, seems to have been the Taste and Smell. Thus *Apium* and *Petroselinum* have a Taste resembling each other, therefore they are to be prescribed together. The Seeds of *Fœniculum* and *Anisum* have much the same Taste and Smell, and therefore both of them must be Carminative, *&c.* They had likewise recourse to the Temperament and Qualities, such as Hot and Dry, Cold and Moist, in the 1st, 2d, 3d, and 4th Degrees. But since the Taste is not always the same in one Person, and that different Persons have different Sensations; that, as being too much subjected to the different Tempers and Imaginations of People, is deservedly exploded.

I have lately composed a Compendious Scheme of all the Plants used in Physic; in which, that I might render it less liable to Objection, and not seem to introduce any Innovation in the Distribution, I have not so strictly observed the making their Characteristic Notes and Virtues agree, as the distributing them according to their Operations.

The first Distribution, is, by joining together all those which are prescribed under one Title in the Shops; such as the Opening Roots, Emollient and Capillary Herbs, Cordial Flowers, hot and cold, greater and lesser Seeds. In this I have not kept to the *Dispensatory* Catalogue, but have added several Congeners, that I might give a

Specimen of what is propoſed concerning the Virtues and Characters. Thus I have added *Cuminum* and *Meum* to *Fœniculum*; *Laurus Alexandrina*, and *Hippogloſſum* to *Ruſcus*; *Alcea* to *Malva* and *Altbea*; *Bonus Henricus*, *Atriplex*, *&c.* to *Beta*, under the Title of *Oleraceous Emollients*; *Lingua Cervina*, *Polypodium*, *&c.* to the Capillary Herbs; and ſo on in the Cordial Flowers, and hot and cold Seeds.

I have, 2dly, diſtributed the Plants into ſuch as are Altering and Evacuating. The Altering are divided into thoſe that conſiſt of Groſs, and ſuch as are ſaid to conſiſt of Tenuious and Subtile Particles. Thoſe conſiſting of Groſs Particles, are Aſtringent. Such as prevent Abortion and Ruptures, Stoppers of the *Fluxus menſtruus immodicus*, *Fluor Albus*, *Diarrhœa*, *Dyſentery*; good in Burnings, Bruiſes, Cancers, ſpitting of Blood. Groſs Medicines are Narcotics, Vulnerary, good for Scrophulous Tumors, Squinancy, Refrigerators.

Plants conſiſting of ſubtile Particles, are Aperient; ſuch are all Opthalmics, Arthritics, Nephritics, Lithontriptics, Diuretics, Hydropics. They are alſo Pectoral, Anti-Apoplectic, Paralytic, Hyſteric, Hypochondriac. Provokers of Birth, Febrifuges, Scorbutics, Stomachics, Vermifuges.

The Evacuating Medicines are Emetic, or ſuch as work upward; or Laxative and Purgative, ſuch as work downwards. The Nutritive Medicines are the *Plantæ Cereales* and *Leguminoſæ*.

It is here to be noted, that I have not inſerted any Plant in this Table, but ſuch as are indigenous in *Britain*, or are cultivated in *Britiſh* Gardens; and to render it ſtill the more uſeful, I have added ſuch particular Parts as are uſed in the Shops; *viz.* The Root, Herbs, Leaves, Tops, Flowers, Fruit, Nuts, Bark, and Wood.

Having thus reduced within a ſmall Compaſs the moſt conſiderable Virtues of Plants, both General and Specific, and ſhewn the moſt eaſy, ſimple, and natural Method of diſcovering them, I would not be ſo far miſunderſtood, as if I were averſe from uſing other Experiments in finding them out. On the contrary, I could heartily recommend another Method, hitherto much neglected, and which I am convinced would be of great Uſe, if accurately gone about; and that is, their Infuſion in different Liquors, in order to find out the proper *Menſtruum* for extracting their more uſeful Parts.

Every Phyſician is ſenſible, that there are ſeveral Simples, and theſe ſpecific too, which adhibited in Subſtance, are of great Efficacy; whereas, if their Contexture is diſſolved, their Parts can never be ſo re-united as to produce the ſame effect. Thus *Cortex Peruvianus* is never ſo effectual, as when given in Powder. That there are others which will communicate their uſeful Particles when infuſed, to one Liquor and not to another; and that the ſame Subſtance will impregnate two Liquors diverſely, according to the different *Menſtruums*. *Lemery* adviſes to infuſe *Opium* in Water and Spirit of Wine,

ſeparately; and after to mix both Infuſions together, in order to make the *Laudanum* or Extract; wiſely conſidering, that the Water will be impregnated by the more ſoluble ſaline Particles, whereas the Spirit will only imbibe the more reſinous; for Water is the proper *Menſtruum* for a ſaline Subſtance, which will not diſſolve in Spirit of Wine; this rather hardening and preſerving it from being diſſolved, either by Air or Water. Thus the moſt convenient way to preſerve the volatile Salt of Animals, is to keep it in Brandy; and every one knows, that Water immediately diſſolves Sugar, which Brandy will not do. Therefore *Senna* will impart it's purgative Quality to Water or Ale, having it's ſaline Particles more diſengaged; but the purgative Virtue of *Jalap* conſiſting in it's Reſin, requires Wine or Brandy for the *Menſtruum* or Diſſolvent.

Therefore, in my Opinion, a moſt proper Means to find out the Virtues of Plants, is to have recourſe to the proper *Menſtruums*. A Simple may be infuſed in Rain Water, Snow Water, or pure Fountain Water; if it's Texture is looſe, and it abound with ſaline Particles, thoſe pure Elements will be impregnated by it; but if the Texture be more compact, firm and ſolid, if it's Particles are more fixed, Mineral Waters; or by the addition of a proportional quantity of the fixed Salt of a Plant, a proper *Menſtruum* may be prepared. And next to the adhibiting of the Bitters in ſubſtance, ſuch as Wormwood, Gentian, and Camomile Flowers, this is the moſt convenient way of adminiſtring them; not but their Tincture extracted by Brandy or Wine may do very well; But ſince they abound very much with a fixed Salt, a great deal of their Virtue may be communicated to a leſs ſpirituous Liquor, when a more ſpirituous will not extract it. The proper means to know which *Menſtruum* will beſt extract the more uſeful parts of any Simple, or rather ſuſpend it's more ſolid Particles, is to uſe the Hydroſtatical Ballance; when having weighed the *Menſtruum* before Infuſion, and after the *Materies* has been infuſed for ſome time, it will ſoon be obſerved by the Augmentation of the Weight, how far the *Menſtruum* is impregnated, and which is the moſt proper Diſſolvent. The propereſt Method of adhibiting the fixed Simples, if not in Subſtance, is by Decoction, Infuſion, or Tincture. (It is called Infuſion, when the *Menſtruum* is either Water, Ale, or Wine; but a Tincture, when Brandy is employed;) and the beſt way to obtain the uſeful Particles of volatile, tenuious, or ſubtile Subſtances, is by Diſtillation. Theſe may indeed be proper Ingredients for an Infuſion or Tincture. But there are a great many fixed Subſtances as improper for Diſtillation, as the Volatile are improper for Extracts.

Laurel Water a dangerous Poiſon, by T. Madden, *M. D.* N°. 418. p. 84.

XXVI. 1. A very extraordinary Accident that fell out at *Dublin*, ſome Months ago, has diſcovered to us a moſt dangerous Poiſon, which was never before known to be ſo, though it has been in frequent Uſe among us. I mean the Simple Water, diſtilled from the Leaves

Leaves of the *Lauro-ceraſus.* It is at firſt of a Milky Colour, but the Oil which comes over the Helm with it, being in a good Meaſure ſeparated from the Phlegm, by paſſing it through a Flannel-Bag, it becomes as clear as common Water.

It has the Smell of the bitter Almond, or Peach-Kernel, and has been for many Years in frequent Uſe among our Houſewives and Cooks, to give that agreeable Flavour to their Creams and Puddings. It has alſo been much in Uſe among our Drinkers of Drams and the Proportion they generally uſe it in, has been one Part of *Laurel-Water* to four of *Brandy.*

Nor has this Practice (however frequent) ever been attended with any apparent ill Conſequences, till ſome Time in *Sept.* 1728, when it happened that one *Martha Boyſe*, a Servant, who lived with a Perſon that ſold great Quantities of this *Water*, got a Bottle of it from her Miſtreſs, and gave it to her Mother *Anne Boyſe* as a very rich Cordial.

Anne Boyſe made a Preſent of it to *Frances Eaton* her Siſter, who being a Shopkeeper in the Town, gave about two Ounces of it to a Woman called *Mary Whaley*, who had bought ſome Goods of her.

Mary Whaley drank about two Thirds of what was filled out, and went away. *Frances Eaton* drank the reſt. *Mary Whaley* went to another Shop to buy ſomewhat elſe, and in about a quarter of an Hour after ſhe had drank the *Water* (as I am informed) ſhe complained of a violent Diſorder in her Stomach. She was carried Home, and from that Time loſt her Speech, and died in about an Hour, without Vomiting, or Purging, or any Convulſion.

The Shopkeeper, *Frances Eaton*, ſent Word to her Siſter *Anne Boyſe* of what had happened, who came to her upon the Meſſage, and affirmed, that it was not poſſible the Cordial (as ſhe called it) could have occaſioned the Death of the Woman; and to convince her of it, ſhe filled out about three Spoonfuls, and drank it. She continued talking with *Frances Eaton* about two Minutes longer, and was ſo earneſt to perſuade her of the Liquor's being inoffenſive, that ſhe filled out two Spoonfuls more, and drank it off. She was hardly well ſeated in her Chair, when ſhe died, without the leaſt Groan or Convulſion.

Frances Eaton, who, as was before obſerved, had drank ſomewhat above a Spoonful, found no Diſorder in her Stomach, or elſewhere; but to prevent any ill Conſequence, took a Vomit immediately, and has been well ever ſince.

Mary Whaley was buried without being examined by any one, that I can find, except the Coroner. I went to ſee *Anne Boyſe* about Twenty-four Hours after her Death, but could not prevail to have her opened. She was about ſixty Years old; her Countenance and Skin appeared well coloured, and her Features were hardly altered,

ſo that ſhe looked like one aſleep. Her Belly was not ſwelled, nor had ſhe any other external Mark of Poiſon.

This Accident brought into Diſcourſe another of the like Nature which happened about four Years ſince in the Town of *Kilkenny*. A young Gentleman, Son to Mr —— *Evans*, an Alderman of the Town, miſtook a Bottle of this *Laurel Water*, for a Bottle of *Ptiſan*. What Quantity he drank is uncertain, but he died in a few Minutes complaining of a violent Diſorder in his Stomach. This Affair was not much regarded at that Time, becauſe he laboured under a Diſtemper, to which, or to an improper Uſe of Remedies, his Death was attributed by thoſe about him.

To ſatisfy myſelf farther as to the Effects of this Poiſon, I made ſome Experiments, in Conjunction with a few of my Friends, an Account of which follows.

I. *Oct.* 3, 1728, We gave a large Setting-Dog three Ounces of *Laurel Water* by the Mouth. In three Minutes he began to be ſtrongly convulſed. His Convulſions continued about five Minutes; after which I untied him. He then fell into a moſt violent Difficulty of Breathing, which laſted about eight Minutes, and abated gradually; upon which he endeavoured to raiſe himſelf, but could not.

I tied him down again, and gave him an Ounce and an half more, upon which he ſunk at once, and without any Return of his Convulſions, or Difficulty of Breathing, expired in two Minutes.

Upon opening the Stomach, I found in it the whole Quantity of Water which he had taken; it's Surface was covered with Froth, but it was not otherwiſe altered in it's Colour, Conſiſtence, or Smell. The Inſide of the Stomach was not at all inflamed, nor was there any viſible Alteration in the *Tunica Villoſa*.

The Veins of the Stomach, all the *Meſaraic* Veins, and likewiſe the *Vena Cava*, were much diſtended with Blood; the *Arteries*, on the contrary, were remarkably empty. The *Liver* and *Gall-Bladder* were no Way altered. The *Kidneys* were unuſually full of Blood, and appeared of a bluiſh Colour, almoſt as deep as that of the Violet Plumb. Upon making an Inciſion into one of the *Kidnies*, the Blood flowed in much greater Plenty, and was more fluid than uſual. In the *Heart* there appeared nothing præternatural. The *Brain* was no way altered.

II. *October* 24, We gave an Ounce and a half of the ſame *Water* to a Bitch of a ſmaller Size. She was immediately let looſe, and in two Minutes loſt the Uſe of her Limbs. She attempted ſeveral Times to raiſe herſelf, and walk, but ſhe ſtaggered and reeled about, and then fell down. She repeated this without ceaſing about five or ſix Minutes. At laſt ſhe was violently convulſed, eſpecially in the Muſcles that extend the *Head* and *Spine*. About the Space of a Minute

ſhe

ſhe had that Sort of Convulſion called the *Opiſthotonos*, the Back of her *Head* being drawn almoſt to her *Tail*.

After this ſhe vomited plentifully, and her Convulſions ceaſed. She then lay ſtill for ſeven or eight Minutes, labouring for Breath (though not ſo violently as in the former Caſe) and foaming at the Mouth. We gave her an Ounce more of the Water; upon which her Difficulty of breathing encreaſed, and ſhe died in two Minutes.

Upon opening the *Abdomen*, the *Thorax*, and the *Head*, we found every thing in the ſame State as in the former Inſtance.

III. *October* 25, We gave two Ounces of the *Water* to a Dog of the ſame Size with the former, which produced the like Appearances as in the foregoing Caſe. This Dog was dying half an Hour; for the Doſe was not repeated, becauſe he did not vomit up what he had taken. Upon opening him, we found every thing in the ſame State as in the former Inſtance.

IV. *October* 26, We gave two Drams and a half of the Water to a Dog of a middle Size, and immediately untied him. He then ran about the Room very briſkly for about a Minute, and ſeemed to be no Way affected with it; yet he ſoon loſt the Uſe of his Limbs. He often attempted to raiſe himſelf, and walk, but ſtill fell down again before he had moved two Yards from the Place.

After this he vomited plentifully, conſidering that he had faſted 24 Hours, upon which he was ſeized with a Convulſion more violent than any of the former Dogs, eſpecially in the Muſcles that extend the *Head* and *Spine*. Theſe Convulſions continued about eight or ten Minutes; upon their ceaſing, he lay ſtill, breathing deeply, though regularly and ſeemed to be aſleep. In about ten Minutes he raiſed himſelf, took ſome Food, and walked about tolerably well. We left him, and returning after three Hours, we found him perfectly recovered.

V. *October* 28, We injected an Ounce of the Water into the *Inteſtinum rectum* of a ſtrong Spaniel Dog, and let him looſe. In the Space of two Minutes he began to loſe the Uſe of his Limbs, and to ſtagger as the others had done. He was convulſed more violently than any of the reſt, and chiefly in the Muſcles of the *Neck* and *Spine*. The Muſcles of his *Eyes* were ſtrongly convulſed, which Appearence was not obſerved in the other Dogs. He foamed at the Mouth, yelled frequently, and breathed with more Difficulty than any of the reſt. His Convulſions continued twenty Minutes; upon their ceaſing he lay quiet, as though he ſlept, only that his Eyes were open. His Limbs were now grown perfectly paralytic.

We raiſed him up ſeveral Times, and ſet him on his Legs, but he did not attempt to uſe them. He continued in this Way about fifteen Minutes longer, and then was ſeized with another violent Convulſion, which in five Minutes put an End to his Life.

Upon

Upon opening the *Abdomen*, we found the Veins of the *Stomach* and *Guts* very much diſtended with Blood, as in all the former Inſtances. In the *Heart*, *Lungs* and *Brain*, there was no viſible Alteration.

VI. *October* 30, We injected an Ounce and a half of the *Water*, diluted with three Ounces of common Water warmed, into the *Anus* of a ſmall Bitch. Before we could untie her ſhe was ſeized with Convulſions, and yelled much. She fell as ſoon as ſhe was looſed, and never after endeavoured to riſe. She had Convulſions, and great Difficulty of Breathing about two Minutes. She then lay ſtill, with her Limbs ſtiff and extended, about three Minutes; during which Time her lower Jaw was convulſed, and pulled alternately to and from the upper Jaw, with a very quick Motion.

After this her Limbs became paralytic, and ſhe gaſped for Breath about two Minutes longer. She was quite dead in ſeven or eight Minutes from the Injection of the Clyſter.

In the *Abdomen*, *Thorax*, and *Brain* every thing appeared as uſual.

VII. *Nov.* 2, We injected half an Ounce of the Water, diluted with three Ounces of common Water warmed, into the *Anus* of a ſmall Bitch. In the Space of four Minutes ſhe began to breathe with Difficulty. We let her looſe, but ſhe was not able to ſtand, or walk without ſtumbling. The Muſcles that extend the *Head* were convulſed, and her Fore-legs were affected for three or four Minutes with a *Tetanus*, but had no convulſive Motion. She vomited and purged plentifully. She did not yell, nor ſeem to ſuffer much Pain, nor did ſhe loſe her Senſes all the Time. In half an Hour ſhe recovered.

VIII. The next Day, we injected a Drachm of the Water into the external *Jugular* of the ſame Bitch. She was ſeized with Convulſions as violent as the former, before we could untie her. They laſted about five Minutes; after which ſhe recovered gradually, and continued well.

IX. *Nov.* 20, We injected four Ounces of the Water by the *Anus*, without any Dilution, into a ſtrong Dog of a middling Size. He was ſeized with Convulſions and Difficulty of Breathing, in leſs than two Minutes after the Injection. He fell to the Ground as ſoon as his Convulſions began, and never once attempted to riſe; nor were his Convulſions in any Sort ſo violent, neither did they continue ſo long as in the former Inſtances. He bled at the Noſe about four Spoonfuls. The Blood was of a very bright florid Colour, his Convulſions laſted about four Minutes; after which he became entirely paralytic, and died in three Minutes more.

We found the *Stomach*, *Inteſtines*, *Liver*, *&c.* in the ſame State as thoſe abovementioned. Upon cutting about an Inch from the lower

Part of one of the Lobes of the *Lungs*, the Blood flowed from it in great Plenty, and appeared more florid and fluid than uſual.

X. *Dec.* 14, We gave five Ounces of *Laurel Water* by Clyſter to a Dog ſomewhat of the Size and Shape of the *Italian* Greyhound. He ſeemed at firſt to be no Way affected with it, but in about five Minutes he began to droop, and loſe the Uſe of his Limbs. He did not once yell, or ſtruggle, as the others had done, but ſunk gradually, till he became at laſt entirely paralytic. He had not any Convulſion, except a kind of *Spaſmus Cynicus*, a few Minutes before he died, which happened in half an Hour after the Injection of the Clyſter.

Upon opening the *Abdomen*, we found the Veins much diſtended with Blood, as were alſo the Veins and Sinuſes of the Brain.

XI. *Dec.* 19, We gave three Ounces of the Water in the ſame Manner to a Cur of the Lap-dog Size. He died in ſeven Minutes, without any Convulſion, except a *Tetanus* in the Muſcles that extend the *Head.*

The *Lauro-Ceraſus* being an Ever-green, and abounding with a warm eſſential Oil, we imagined that other Ever-greens might partake of the ſame poiſonous Quality.

Accordingly we made Trial of a Water diſtilled in an *Alembic* from the Leaves of the *Yew-Tree*, ſo much talked of by the Ancients, and whoſe very Shade they ſuppoſed to be fatal to thoſe who ſat or ſlept under it.

XII. We gave three Ounces of this Water by Clyſter to a very ſmall Cur Dog, but he was not in the leaſt affected with it.

XIII. We alſo gave, by the Mouth, two Ounces of a Water diſtilled from the Leaves of the *Bay-Tree*, to a young Spaniel, without any Effect.

XIV. We afterwards made an Experiment with the diſtilled Water of *Box-Leaves*, which had a very ſtrong *Narcotic* Smell. We injected five Ounces of this Water, by the *Anus*, into a ſmall Cur Dog, but he was no Way affected with it, though we kept him twelve Hours after the Operation.

XV. Being deſirous to know whether the Virulency of *Laurel-Water* was owing to the Fire in Diſtillation, we poured warm Water upon ſome *Laurel*-Leaves bruiſed, and made a ſtrong Infuſion of them. We poured an Ounce of it down a Dog's Throat, half of which was ſuppoſed to enter the Stomach, and five Minutes after another Ounce was given in like Manner. The Dog ſeemed to be ſomewhat ſick at his Stomach, but was ſoon as lively as ever. A few Minutes after this another Ounce was given to him by the Mouth of which we ſuppoſe a fourth Part to have been loſt. He ſoon after ſtared, and trembled very much. In five Minutes another Ounce was exhibited, upon which he trembled as before, but in a little Time he appeared eaſy and lively.

Imagining that theſe ſmall Quantities loſt their Power, during the Intervals of giving them, in ten Minutes after his taking the former Doſe, we poured down his Throat two Ounces and a half at once. He immediately tumbled on his Back convulſed, and tumbled over three or four times, but quickly returned to his Feet. He ſtaggered, his Eyes ſtared, and he ſat down like a Dog that is tired. At length he ſhut his Eyes, his Neck became extended, and we apprehended he was falling into Convulſions; but inſtead thereof he vomited a vaſt Quantity of indigeſted *Chyle*, in which appeared a great Portion of the Infuſion; after which he ſeemed to be perfectly recovered.

XVI. In about twenty-five Minutes after this we gave the ſame Dog by the Mouth two Ounces of the Juice expreſſed from *Laurel*-Leaves, and in about ten Minutes more another Ounce was given him in the ſame Manner. In a few Minutes he began to loſe the Uſe of his hinder Legs, but he quickly recovered them. Upon his taking another Ounce ſoon after the former, he fell into a great Difficulty of Breathing, and yelled much. After this he was ſeized with very ſtrong Convulſions, which affected his lower Jaw and hinder Legs moſt remarkably.

In about the Space of five Minutes theſe Convulſions were ſucceeded by an entire Reſolution of all the Limbs. He breathed with great Difficulty, and very ſlowly. No Appearance of Expiration. Sometimes we obſerved two Attempts at Inſpiration without Intermiſſion, or cloſing of the Mouth. At other times there was near the Space of a Minute between two Inſpirations.

After this he was ſeized with a Trembling in his Limbs, and in about three Quarters of an Hour from his taking the laſt Ounce, he died without any Struggling, with his Tail extended.

There were ſeveral other Experiments made of the ſame Kind, by ſome Gentlemen of the Profeſſion here, which correſponded exactly with the foregoing, excepting this one Circumſtance, that they were of Opinion, that this Poiſon occaſioned an Inflammation in the *Stomach* and *Guts*.

Towards clearing this Diſpute, We, who thought otherwiſe, put together the following Hints, from which it appears that the Fact is not as they imagined, and that notwithſtanding we find, upon an Animal's being killed by this Poiſon, the Veins greatly diſtended with Blood, yet there is not any Inflammation produced by it.

I do not know any thing that will illuſtrate this Matter better, than the Analogy which may be obſerved between the Convulſions occaſioned by the Epilepſy, and thoſe which are the Effect of *Laurel Water*.

For Inſtance, in the Epilepſy, the Body is univerſally convulſed, eſpecially the Muſcles of the *Neck*, the *Tongue*, the lower *Jaw*, and thoſe of the *Arms*.

The Effect of theſe Convulſions is this: The *Heart* beats with unuſual Violence and Frequency, the neceſſary Conſequence of which is, that the Blood will be thrown in greater Plenty from the Arteries into the Veins. But becauſe the Muſcles compreſs the Veins more than the Arteries (whoſe Syſtole does enable them to overcome that Preſſure) therefore the Blood, which is ſtill puſhed forward by the Syſtole of the Heart into the Veins, will be retained there by the aforeſaid Preſſure of the Muſcles, and will return in a very ſmall Quantity to the *Heart*.

For Example, the *Abdominal* Muſcles being convulſed, preſs the *Stomach* and *Inteſtines* upon the *Vena Cava aſcendens*, and likewiſe upon the *Vena Portæ*; by which Means the Blood, returning from the lower Extremities, is retained in thoſe Veſſels. Accordingly we ſee the viſible and immediate Effects of this Preſſure are the forcing out the Excrements of the *Bladder* and *Inteſtines*, and very frequently the *Profluvium Seminis*.

In like Manner the Preſſure of the Muſcles of the *Neck*, *Tongue*, and lower *Jaw* upon the *Jugular* Veins and their Branches, will not ſuffer the Blood to return to the *Heart* by the *Vena Cava deſcendens*.

To this we may add the Preſſure of the *Diaphragm* and *Ribs* upon the *Lungs*, by which Means the Trunks of the *Vena Cava aſcendens* and *deſcendens* are compreſſed at their Inſertion into the *Heart*.

Hence follows that frightful Blackneſs of the Face during the Paroxyſm, and the prodigous Swelling of the Veins of the Head, eſpecially the Temporal.

The neceſſary Conſequence of all this muſt be, that if the Convulſion laſts long enough the Man muſt die, on Account of the Blood being thrown out of the Arteries into the Veins, and not returning to the Heart. And I make no Queſtion, that if ſuch a Perſon was opened after Death, we ſhould find the *Vena Cava*, the *Vena Portæ*, the Veins and Sinuſes of the *Brain*, together with all their ſmalleſt Ramifications, very much diſtended with Blood, and the Arteries on the contrary almoſt empty.

But if the Epileptic Convulſion ceaſes before the Circulation of the Blood is entirely ſtopped, then all becomes calm again, the Preſſure is taken off the Veins, the Blood returns to it's uſual Courſe, and in a few Hours the ſick Perſon is perfectly recovered.

And yet all this violent Convulſion of the Body, this prodigious Diſtenſion of the Veins, and Interception of the Courſe of the Blood paſſes without any Inflammation, as appears from the ſpeedy Recovery of the ſick Perſon: For if the Convulſion had occaſioned an Inflammation, a Fever muſt neceſſarily have enſued, which would diſcover itſelf by manifeſt Tokens, and would require a much longer Time for it's Abatement.

Let us now obſerve the Analogy between theſe Appearances, and thoſe produced by *Laurel Water*.

We find by Experiment, that an Ounce, or even two Drachms and a half, of *Laurel Water* will occaſion more violent Convulſions than three Ounces, or even five of it. *Exp.* 4, 5 to 11. If therefore an Inflammation was the neceſſary Conſequence of this Water being taken into the *Stomach* or *Guts*, the more violent the Convulſion is, the greater the Inflammation ought to be.

On the contrary we find, that the more violent the Convulſion is, the greater is the Probability that the Creature will recover. *Exp.* 4 to 7. And when it ſo falls out, the Manner is exactly the ſame as in the Recovery of an Epileptic Perſon. In a few Minutes the Creature becomes as briſk as if no ſuch Thing had happened.

Now if an Inflammation was at all the neceſſary Conſequence of this Poiſon, though the Creature recovers, yet there muſt be ſome Inflammation, greater or leſs, produced, which muſt occaſion more violent and laſting Symptoms. But ſince none ſuch appear, ſince the Recovery is ſo ſudden and effectual, it is the ſtrongeſt and plaineſt Argument, that there is not any Inflammation produced.

If the *Laurel Water* is adminiſtred to the Quantity of an Ounce or more, the Creature unavoidably dies in a few Minutes, and upon opening him the Appearances are theſe. Both the Trunks of the *Vena Cava*, and all the Ramifications of the *Meſeraic* Veins are greatly diſtended with Blood. Theſe Veſſels are eaſily diſtinguiſhed from the Arteries, not only by the Thinneſs of their Coats, but alſo by the Colour which the Blood exhibits to the Eye. Now I conceive that all Inflammations have their Beginning in the Arteries, and that they are produced, becauſe there is no free Paſſage for the Blood into the Veins. But if once this Paſſage becomes free (as in this Caſe it ſurely is, for we find all the Veins diſtended with Blood beyond their natural Dimenſions) the Inflammation is then at an End, the Cauſe which produced it being taken off.

Moreover, the Fact laid down, that the Veins are preternaturally diſtended with Blood, does neceſſarily conclude, that the Arteries are not diſtended with it, and conſequently that there cannot be any Inflammation; for if the Quantity of Blood is encreaſed in the Veins, it muſt be proportionably diminiſhed in the Arteries.

To what has been ſaid, we may add the following Obſervation; *viz.* that if there was any Inflammation produced by this Poiſon, it ought to appear moſt remarkable on the Inſide of the *Stomach* and *Inteſtines*, becauſe of the immediate Contact it has with thoſe Parts.

All other Poiſons which occaſion Inflammations in the *Stomach* and *Guts*, do firſt operate upon the Blood-Veſſels, and corrode the Parts inflamed. They occaſion Vomitings and Fluxes of Blood, which at length terminate in Convulſions.

One

One may very eaſily be deceived upon opening the *Stomach* of a Dog, and may miſtake the Redneſs of the *Tunica Villoſa* for an Inflammation.

The inner Coat of a Dog's Stomach is naturally of a ruddy Fleſh-colour, and therefore of all domeſtic Animals a Dog has the quickeſt and ſtrongeſt Digeſtion. Accordingly we ſee, that they ſwallow Bones, and digeſt them perfectly well; and although they are but half chewed when taken into the Stomach, yet they are at laſt reduced to as ſoft a Conſiſtence as any other Part of their Aliment. It is for this Reaſon, therefore, that the Stomachs of Dogs are more plentifully ſupplied with Blood than thoſe of other Animals; by which Means not only the muſcular Force of the Stomach, but it's Warmth alſo, which is the principal Inſtrument of Digeſtion, is very much increaſed.

N. B. The 15th and 16th *Experiments* were communicated to me by Dr *Stephens*, a Fellow of our College of Phyſicians.

An Antidote to this Poiſon, by Dr John Rutty. N°. 418. pag 100.

2. *Bole*, *Vinegar* and *Milk* were given to a Dog which had ſwallowed ſome of the *Laurel Water*: The *Bole* and *Vinegar* were not obſerved to do much good, but the Dog which drank the *Milk* recovered without any bad Symptoms; but at that Diſtance of Time the Doctor could not recollect the Proportions that were given: He thinks a Pint of *Milk*.

Experiments concerning the poiſonous Quality *of the* Laurel Water, *by* Cromwell Mortimer, *M. D. R. S. Sec.* N°. 420. pag. 163.

3. I took a Peck of Laurel Leaves, and put them into an Alembic with three Gallons of Water, which I diſtilled in the common Way. The Fire at firſt being too hot, there came over an Oilineſs with the Water, (1.) which made it appear milky, till about half a Pint had run: This taſted and ſmelt very ſtrong like Apricock Kernels, as did the next Running, (2.), which was clearer. I kept the firſt Quart by itſelf; then I drew off another Quart, (3.) which was not near ſo ſtrong in Taſte or Smell, but rather reſembled *Black-Cherry Water*: The Remainder was almoſt inſipid. The Leaves after the Diſtillation looked browniſh, were brittle, and taſted bitter without the Roughneſs or Apricock-Kernel Flavour, which they have while freſh.

In the Afternoon of the ſame Day I took a Mungrel Puppy, weighing two Pounds and an half, about ſixteen Days old; it had ſucked the Bitch in the Forenoon, but had now faſted ſix Hours. I took one Ounce of the third Water, and gave ſome of it to the Puppy, gradually by Tea-Spoonfuls, that it might the better ſwallow it. When it had taken half the Quantity, I let it go; it walked about pretty ſtrongly for five Minutes, when it began to foam at the Mouth, and ſoon after vomited up ſome curdled Milk, and then diſcharged the *Fæces alvinæ*, after which the Sickneſs ſeemed to go off: I then gave it three Tea-Spoonfuls more; in ten Minutes it began to ſtagger, and draw it's hind Parts after it; it ſat upon it's Breech, whined, and made ſeveral Efforts to vomit, but never brought any thing

thing up; and then again would walk about, and ſit down and whine, and again ſeem to recover for about fifteen Minutes longer: Then thinking the ſecond Water would diſpatch it ſooner, it ſeeming to be very uneaſy, I took one Ounce and half of the ſecond Running: I gave it firſt three Tea Spoonfuls, and ſet it down, when in two Minutes time it became ſtrongly convulſed, put out the Tongue, and made ſtrong Efforts to vomit, but to no Effect; it could not ſtand, but lay with it's hind Legs ſtretched out: Five Minutes after I gave three Tea Spoonfuls more, when it was ſtronger convulſed, rolled over and over ſeveral times, drew it's Head back to it's Rump, then lay on it's Side and panted much: About eight Minutes after, I gave it two Tea-Spoonfuls more and it had freſh and ſtrong Convulſions, but kept lying on it's Side, and thus ſtretching out it's four Legs one after another, drawing in it's Flanks very quick; in fifteen Minutes more it died, being in all about an Hour from the firſt Doſe.

An Hour after it was dead I opened it, and found all the Contents of the *Abdomen* well; the Stomach was diſtended with Wind, it appeared empty of Milk, but full of Froth, and a clear *Mucus* of a much thicker Conſiſtence than the *Liquor Gaſtricus* naturally is; they had no Smell at all, the inſide of the Stomach was not at all inflamed.

On opening the *Thorax* I found the Lungs a little redder than natural, with ſome Veſſels on the outward Membrane of them very turgid: On cutting them out a pretty deal of clear red Blood ran from them. The Veins and both Ventricles of the Heart were turgid and full of coagulated Blood, of a dark brown Colour, which tinged my Fingers of a dirty yellow, as if ſome Gall had been mixed with it. There was no Blood in the Arteries; the *Foramen Ovale* was open.

On opening the Head, the *Dura Mater* appeared livid, as if bruiſed, it's Veſſels and the *Sinus falci-formis* were turgid and full of the ſame Blood, as the Heart and Veſſels near it. The cortical Subſtance of the Brain looked of an unuſual livid Colour.

Next Day about Five in the Afternoon I took a large Maſtiff Dog weighing ſeventy-five Pounds. We tied him to a Poſt as he ſtood on his Legs, one holding him ſtrongly by the Tail, he being very fierce and unmanageable: We injected *per Anum* three Ounces of the ſecond Running; in five Minutes he trembled and ſtaggered much, would let us handle him, he drew his hind Legs after him, tumbled on his Head, panted and ſlabbered, but gradually recovered ſo as to ſtand up, though reeling and often ſinking with his hind Legs. Fifteen Minutes after, we injected one Ounce more; he immediately ſtaggered and ſunk behind, ſoon after he made Water plentifully. We then led him to another Kennel, where he ſoon diſcharged the *Fæces alvinæ* plentifully, but of a hard Conſiſtence:

The

The *Fæces* ſeemed moiſtened with the laſt injected Ounce, which I imagined came away by this Stool; I therefore immediately injected another Ounce, upon which he ſeemed more uneaſy than before, tumbling on one Side, and in about ten Minutes after, he fell faſt aſleep, breathing with Difficulty; half an Hour after, I rouzed him, found him ſlabbering, drowzy, ſinking behind, and giddy: About an Hour and a Quarter after the firſt Injection, I found him as before, but provoking him with a Stick, he bit at it, and tho' naturally fierce, he was very quiet when I did not ſtrike him; in a few Minutes he reeled and fell a ſnoaring again: About Nine at Night he ſeemed very well, only drowzy. We left him all that Night without Water and Victuals, but thro' Hunger he eat ſome of the Straw he lay on, as we found afterwards upon opening his Stomach. Next Morning, we gave him Water and Bones; he drank greedily, and eat the Bones, Bread, and whatever was given him, ſeeming perfectly recovered and well all Day and the next Night, only very thirſty, and a little drowzy, but perfectly gentle.

About Nine o'Clock the next Morning, we faſtened him to a Poſt, and put a Rope into his Mouth, by which his Noſe was tied faſt to a Rail, great Care being taken that there ſhould be no Rope about his Neck ſo tight, as to hinder his ſwallowing or his breathing: I then gave him three Ounces of the ſecond Running, at three times, with a Horn, ſuch as they drench Horſes with; he ſwallowed it with great Difficulty, and guggled ſome up again: To prevent which, I thruſt the Horn a good way down his Throat. We then untied him from the Poſt, to ſee how he could walk, but he inſtantly reeled, fell down, rolled over and over, diſcharged much Urine, and ſome hard *Fæces alvinæ*, had no motion to vomit, but dribbled much, panted, and ſhewed great Difficulty of breathing, ſnuffing up the Air with his Noſtrils, holding his Noſe up, as he ſat on his Breech; for he could not then ſtand on his hind Legs: He often ſhook his Head, as if ſtung by ſome Fly: He gradually recovered, and in about twenty Minutes time could walk about very ſteadily on all his Legs, tho' he ſtill appeared weakeſt behind: Wherefore imagining he might linger a long time, or perhaps recover entirely, we made him faſt again, and gave him three Ounces more, near half of which he ſpilt; and indeed out of the ſix Ounces, I don't believe above three or four entered his Stomach: He gave one terrible loud Howl, and ſunk down at once, before we could untie him from the Poſt, to ſee whether he could walk or not. He never offered to riſe again, but lay on one Side, panted, hung his Tongue out, and ſlabbered much, ſtretched all four Legs out three or four times, and was quite dead and motionleſs in about five Minutes time. I did not obſerve any Convulſion in the Muſcles of the Neck and Back, nor was his Head and Tail drawn nearer together, as in the Puppy.

About

About half an Hour after I opened him, being ſtill warm. I found the Bladder contracted and empty; the *Rectum* ſlightly inflamed, the ſmall Guts not diſtended with Wind, but contracted, and almoſt cloſe; the Bile was evacuated in a great Quantity into the *Duodenum*, and was very thick, appearing like congealed Honey; the Gall-bladder was almoſt empty; but what remained in it was as thick as the other; to the Inſide of the Gall-bladder there adhered ſeveral Excreſcencies in Form and Size of Lentils, like Drops of ſoftiſh yellow Wax: The Liver was exceedingly inflamed, and almoſt livid: The Stomach was contracted near the *Pylorus*, and again about three Inches above it; we found ſome pieces of Bone in it, a pretty deal of Straw, and about two Ounces of Fluid, which ſmelt ſtrong of the Laurel Water; but no *Mucus*, as in the Puppy: Some of the *Villi* ſeemed ſlightly inflamed, the Blood Veſſels being very turgid: There was a great deal of *Mucus* in the *Oeſophagus*, which did not ſeem inflamed. The Lungs appeared exceedingly contracted, and very red and inflamed. The *Vena cava* and all the Veins were vaſtly diſtended, and the Blood in them coagulated, tho' the Body was yet hot. There was little or no Blood in the *Aorta*; only on preſſing it, a ſmall Quantity of a tranſparent Fluid, which I took for *Serum*, flowed out of it. The Blood was ſtrongly coagulated in the right Auricle and Ventricle of the Heart, being of a very dark Colour, and filled them quite; but the left Auricle and Ventricle contained only a ſmall Clot of congealed Blood, which looked more red and florid: I kept ſome Clots of the Blood out of the Vein, and alſo out of the left Ventricle, twenty-four Hours, but neither of them liquified or run into *Serum*. I had the Head cut off, but Buſineſs preventing, I did not open it till twenty-four Hours after; a great deal of Blood drained from it, and upon opening it, the Veſſels did not then appear diſtended, but the *Dura Mater* looked livid: There was no Blood at all in the *Sinus falciformis*; the Brain looked very well; the Veſſels of the *Plexus Choroides* in each Ventricle were not diſtended, but livid, nor were they burſt, there being no Extravaſation in the Ventricles, only a very ſmall Quantity of Lymph; which was the Caſe likewiſe of the *Pericardium*, which had not above a Tea Spoonful of Water in it.

In both theſe Inſtances this Poiſon ſeems to act by coagulating the Blood; ſo that it can't paſs the Lungs or Brain: And I take it, that the Puppy lived longer than the great Dog; becauſe in the Puppy the *Foramen Ovale* was open, by which the thickened Blood could paſs, and perform a few Circulations more than it could have done, had it had the Lungs to paſs thro'; and that in the Puppy the Brain was the Part the moſt affected, as was evident from the Convulſions it had. Whereas the Dog was little convulſed, but ſeemed to die of a Difficulty of Breathing; and the greateſt Accumulation was found at the right Ventricle of the Heart.

I got a middling ſiz'd Spaniel and poured ſome Laurel Water down his Throat: He ſtruggled pretty much at firſt, and whined; but when about an Ounce and half of it was down, he ceaſed ſtruggling; that he might not be too long a dying, as much more was given him; he ſpilt about one third of the whole Quantity: He was then laid down on the Ground, but never offered to get up, only ſtretching out his Legs, expired preſently. Mr *Ranby*, opened him immediately; there was about two Ounces of the Laurel Water found in his Stomach, and ſome frothy *Mucus*; the Veins in general were very turgid, but the Blood was ſtill fluid; and indeed we could diſcern no Alteration in any of the *Viſcera*.

I gave four Ounces of Laurel Water to Dr *Porter*, who forced three Ounces down a pretty large Dog. The Creature inſtantly returned about two Ounces by Vomit, clear and unaltered; in a few Minutes he grew prodigiouſly convulſed, ſoon after became motionleſs, and to all appearance was dying. Within ten Minutes he vomited a ſecond time, and threw up a ſmall Quantity of a viſcid green, and very frothy Matter: From which Moment he began to recover, and within half an Hour was perfectly well. He was kept in the Yard all Night, and the next Morning not the leaſt Diſorder being to be perceived in him, he was turned out of Doors.

About half an Hour after Six in the Evening I gave about half an Ounce of the *Laurel Water* to a middle-ſized Spaniel weighing near ſixteen Pound, which he ſwallowed with great Reluctance. He remained about a Minute and half on his Legs; he then began to reel, and in about three Minutes more fell into moſt violent Convulſions, and his Neck and Tail were ſtrongly drawn toward each other; he neither vomited nor purged, but we expected he would expire every Minute, the Convulſions being ſo exceedingly ſtrong, when ſome of the Company called for ſome Milk, in order to try whether it would prove an Antidote to ſo *deſperate a Poiſon*. We poured a little Milk into his Throat, which at firſt he could not ſwallow, but guggled it up again as if almoſt ſtrangled with it. After ſeveral Trials he began to ſwallow ſome, about a ſpoonful at a time, and ſeemed a little relieved, his Convulſions leaving him, only fetching his Breath very hard; but he lay ſtill and ſnorted, as if in a profound Sleep; and the Milk frothed out of his Noſe: On rouzing him, he opened his Eyes, and ſwallowed the Milk better, which ſeemed to revive him much; ſo that the Company imagining he would entirely recover, went away. I ſtaid ſome time longer, till at laſt he began to lap the Milk himſelf when held up to it: He vomited up a pretty deal of Milk, which relieved him more; and then he lapped again, but could not ſtand on his Legs. I left him in this Condition about ſeven o'Clock, thinking he would have recovered, and left Orders that he ſhould have a Pan of Milk, and another of Water, about a Pint of each, ſet by him, and that he ſhould be

kept ſhut up all Night.. About eleven o'Clock he was ſeen walking about; but next Morning he was found dead, after having drank up all the Milk and Water, and having vomited and purged pretty much.

XXVII. Maple Sugar is made of the Juice of Upland Maple, or Maple Trees that grow upon the Highlands. You box the Tree, as we call it, *i. e.* make a hole with an Axe, or Chizzel, into the Side of the Tree, within a Foot of the Ground; the Box you make may hold about a Pint, and therefore it muſt ſhelve inwards, or towards the bottom of the Tree; you muſt alſo bark the Tree above the Box to ſteer or direct the Juice to the Box. *The Method of making Sugar from the Juice of the* Maple Tree *in* New England, *by* Paul Dudley, *Eſq;* F. R. S. N°. 364. p. 27.

You muſt alſo Tap the Tree with a ſmall Gimblet below your Box, ſo as to draw the Liquor off. When you have pierced or tapped your Tree, or Box, you put in a Reed, or Pipe, or a bit of Cedar ſcored with a Channel, and put a Bowl, Tray or ſmall Caſk at the Foot of the Tree, to receive your Liquor, and ſo tend the Veſſels as they are full.

After you have got your Liquor, you boil it in a Pot, Kettle, or Copper. Ten Gallons will make ſomewhat better than a pound of Sugar.

It becomes Sugar by the thin part evaporating in the boiling, for you muſt boil it till it is as thick as Treacle. Ten Gallons muſt boil till it comes to a Pint and half.

A Kettle of twenty Gallons will be near 16 Hours in boiling, before you can reduce in to three Pints; a good Fire may do it ſooner.

When you take it off, you muſt keep almoſt continually ſtirring it, in order to make it Sugar: otherwiſe it will candy as hard as a Rock.

Some put in a little Beef Suet, as big as a Walnut, when they take it off the Fire, to make it turn the better to Sugar, and to prevent it's candying, but it will do without. A good large Tree will yield twenty Gallons. The Seaſon of the Year is from the beginning of *February* to the beginning of *April.*

Mr Dudley *in a following Letter adds this Note.*

I have nothing to add to my Chapter of Maple Sugar, but that our Phyſicians look upon it not only to be as good for common uſe as the *Weſt India* Sugar, but to exceed all other for it's Medicinal Virtue.

XXVIII. The Apple, that produces the *Moloſſes*, is a Summer-Sweeting, of a middling Size, pleaſant to the Taſte, and full of Juice, ſo that ſeven Buſhels will make a Barrel of Cyder. The manner of making it is thus; you grind and preſs the Apples, and then take the Juice and boil it in a Copper till three Quarters of it is waſted, which will be done in about ſix Hours gentle boiling; and by that Time it comes to be of the Sweetneſs and Conſiſtency of *Moloſſes.* *A new Sort of* Moloſſes *made of Apples; by the ſame.* N°. 374. p. 231.

Some of our People ſcum the Cyder as it boils, others do not, and yet there ſeems to be no great difference in the Goodneſs.

This new *Moloſſes* anſwers all the Ends of that made of the ſweet Cane imported from beyond Sea. It ſerves not only for Food and brewing, but is of great Uſe alſo in preſerving of Cyder; two Quarts of it put into a Barrel of rack'd Cyder, will both preſerve and give it a very agreeable Colour.

The Apple *Moloſſes* was diſcovered a few Years ſince, by a Gentleman * of my Acquaintance, at *Woodſtock*, in this Province, a Town remote from the Sea, and where the *Weſt-India Moloſſes* is dear and ſcarce; he ingenuouſly confeſſes the Diſcovery was purely accidental; but ever ſince he has ſupplied his Family with *Moloſſes* out of his Orchard, and his Neighbours alſo now do the like to their great Advantage.

Our Country Farmers run much upon planting Orchards of theſe Sweetings, for fatting their Swine, and aſſure me it makes the beſt ſort of Pork. And I know the Cyder made of them to be better than that of other Fruit for Taſte, Colour, and keeping.

Young Aſh-trees ſpringing from rotten Wood, by Mr G. Cramer Prof. Math. Genev. N°. 413. p. 282.

XXIX. A Friend of mine having cauſed ſome Aſhen Pipes (that brought Water to his Fountain during at leaſt twelve Years) to be taken out of the Earth, they were left in a Yard not paved, where they rotted almoſt entirely: But in their room there did ſhoot forth from the Earth, a little Foreſt of Aſh-trees. They are now in a flouriſhing Way, and about 3 or 4 Foot high. It is remarkable, that more than fifty young Trees are ſprung up exactly where the Pipes had been laid, and no where elſe in the Yard. There is no Aſh-tree there about, nor perhaps at a very great Diſtance, the Yard being in the Town.

A Botanical Invitation *to forward an Hiſtory of the Plants of* Swiſſerland; *by* John Jacob Scheuchzer, *M. D. F. R. S. Tranſlated by Mr* Zollman, *F. R. S.* N°. 421. p. 219.

XXX. Any body, that is acquainted with my Writings concerning the Natural Hiſtory of *Swiſſerland*, will be ſenſible that we ſtill want a *Botanography*, or Deſcription of the Plants, which is one of it's principal Parts; nay, that to which I chiefly have applied myſelf, and I dare add, without Offence to the cenſorious, which the World has long been in Expectation of: ſome Obſervations diſperſed in my *Itinera Alpina*, publiſhed at *London* and *Leyden*, have raiſed a Deſire for it among Botaniſts. It will thence appear to every one who applies himſelf to a Study as difficult as it is delightful, that I ſpared neither Labour nor Expences in ſearching after Plants of all Kinds that grow ſpontaneouſly in *Swiſſerland*, and deſcribing them in the Places where they grow, in gathering them into Herbals, in comparing them with the Deſcriptions and Characters given of them by *Geſner*, the *Bauhin*'s, *Ray*, *Tournefort*, *Boccone*, and others, in ſeparating what ought to be ſeparated, in joining what ought to be joined, in reſolving what is dubious, in retrenching what is ſuperfluous, in

* J. Chandler, *Eſq;*

ſupplying what is defective, in ſhewing the Uſe of native Plants, and trying them myſelf in my Practice. Of theſe my *Hiſtory of* Swiſs *Plants* which I am now hard at Work upon, is to conſiſt: Of which, and it's Method, I intend now to give a brief Account, and draw up a Sort of Plan of it, in order to engage other Perſons by this Invitatory Paper, as I may call it, to join with me in this Labour.

This Work will be in the Form of a Dictionary, to the End it may ſerve at the ſame time for an *Index*. I therefore am diſpoſing in an Alphabetical Order, the Various Kinds and Characters, ſubjoining to each of them the proper Species hitherto obſerved in *Swiſſerland*, either by myſelf or by others, together with the ſynonymous Names uſed by the different Authors, which are again to be inſerted in their proper Places, according to the Order of the Alphabet. I am adding, and remarking under each Plant, whatever ſeems to be wanting in their Deſcription by other Authors, or is any ways neceſſary for the fuller Knowledge of them, or is applicable to Medicinal or other Uſes. Beſides other Prints, there will appear in the Work itſelf thoſe of *Fuchſius* in Folio, I having purchaſed the Original Plates. I would add all the *Alpine* Plants, had I ſome Patrons at Hand who would bear the Expence of engraving the Copper Plates, or doing the wooden Cuts; an Aſſiſtance which may be beſt expected from the *Engliſh* Nation, and their *Society*.

A Catalogue of Plants preſented to the Royal Society by the Company of Apothecaries of London; purſuant to the Direction of Sir Hans Sloane, Bart.

XXXI. The Company of *Apothecaries* of *London*, having, in the Year 1673, eſtabliſhed a Phyſic-Garden, which they have ſince furniſhed with a great Variety of Plants, for the Improvement of their Members in the Knowledge of Botany; Sir *Hans Sloane*, Bart. in order to encourage and promote an Undertaking ſo ſerviceable to the Public, has generouſly granted to the Company the Inheritance of the ſaid Garden, being part of his Eſtate and Manor of *Chelſey*, on condition that it be for ever kept up and maintained by the Company as a Phyſic-Garden; and as an Evidence of it's being ſo maintained, he has directed and obliged the Company, in Conſideration of the ſaid Grant, to preſent Yearly, for ever, to the *Royal Society*, at one of their weekly Meetings, fifty Specimens of Plants, that have grown in the ſaid Garden the preceding Year, which are all to be ſpecifically diſtinct from each other, until the Number of 2000 Plants be completed. Which Specimens, together with thoſe that are to follow them in ſubſequent Years, will, by order of the *Royal Society*, be carefully preſerved for the Satisfaction of ſuch curious Perſons, as may deſire to have recourſe to them.

The-

The Catalogue by Mr ISAAC RAND. F.R.S.

No. 399. p. 293. Ann. 1726. 201. Abutilon Dod. 656.
1731. 452. Abutilon Americanum, foliis variis, flore eleganti cæruleo calyce infidente.
1731. 453. Abutilon Americanum folio longius cuſpidato, fructu quinquecapſulari.
No. 399. p. 293. 1726. 202. Abutilon Americanum, fructu ſubrotundo pendulo, è capſulis veſicariis criſpis conflato.
1731. 451. Abutilon Americanum, viſcoſum, graveolens, minimo flore & fructu.
No. 383. p. 93. 1723. 51. Abutilon Carolinianum, reptans, Alceæ foliis, gilvo flore.
No. 417. p. 1. 1729. 351. Acer Fraxini foliis, ſerratis. *Acer maximum, foliis trifidis & quinquefidis, Virginianum.* Pluk. Phyt. Tab. 123. Fig 4 & 5.
No. 407. p. 1. 1727. 251. Acetoſa Ocimi folio, Neapolitana C. B. 114.
No. 407. p. 1. 1727. 252. Acetoſa veſicaria peregrina Hort. Eyſt.
No. 422. p. 223. 1730. 401. Adhatoda Zeylanenſium. Hort Lugd. Bat. 642.
No. 422. p. 223. 1730. 403. Ageratum breviori & latiori folio. *Ptarmica lutea, ſuaveolens, corymbis longioribus & magis compactis.* T. Inſt. 497.
No. 422. p. 223. 1730. 402. Ageratum foliis ſerratis. C. B. 221. *Ageratum pleriſque*; *Herba Julia quibuſdam* J. B. 111. pag. 142.
No. 422. p. 223. 1730. 404. Ageratum Hiſpanicum; amplioribus foliis; floſculis minoribus.
No. 417. p. 1. 1729. 354. Agrimonia minor; flore albo. H. C. Boer. Ind.
No. 417. p. 1. 1729. 352. Agrimonia odorata. Cam. Hort.
No. 417. p. 1. 1729. 353. Agrimonia officinarum. T. Inſt. 301.
1731. 454. Alaternoides Africana, Ericæ foliis, floribus albicantibus & muſcoſis. H. Amſt. 11. pag. 1.
No. 407. p. 1. 1727. 253. Alcea Afra, fruteſcens, folio Groſſulariæ; flore parvo rubro Boer. Ind. alt. 271.
No. 407. p. 1. 1727. 254. Alcea Afra, fruteſcens, Groſſulariæ folio ampliore; unguibus florum atro-rubentibus.
No. 395. p. 125. 1725. 152. Alchimilla Alpina, pubeſcens, minor, H. Reg. Par.
No. 407. p. 1. 1727. 255. Alchimilla montana minima Col. Ecphr. 146.
No. 395. p. 125. 1725. 151. Alchimilla vulgaris C. B. 319.
No. 399. p. 393. 1726. 203. Alkekengi Barbadenſe, patulum, parvo flore; fructu amplo mucrone productiori.
No. 399. p. 293. 1726. 205. Alkekengi Curaſſavicum, foliis Origani incanis, flore vietè Sulphureo, fundo purpureo Boerh. Ind. alt. 11. p. 66.
No. 399. p. 293. 1726. 204. Alkekengi Indicum majus, T. Inſt. 151.

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206. Alkekengi Verticillato ſimile; foliis anguſtioribus, utrinque a cuminatis. No. 399. p. 293. Ann. 1726.
207. Alkekengi Virginianum perenne majus; flore luteo amplo fructu minimo. No. 399. p. 293. 1726.
258. Althæa arborea, folio amplo ſerrato. No. 407. p. 1. 1727.
259. Althæa Dioſcoridis & Plinii C. B. 315. No. 407. p. 1. 1727.
260. Althæa Dioſcoridis & Plinii, folio magis angulato. T. Inſt. 97. No. 407. p. 1. 1727.
257. Althæa fruteſcens Bryoniæ folio. C. B. 316. No. 407. p. 1. 1727.
256. Althæa fruteſcens, folio acuto, parvo flore, C. B. 316. No. 407. p. 1. 1727.
53. Alyſſon Veronicæ folio T. Inſt. 217. *Burſa Paſtoris major loculo oblongo.* C. B. Prod. No. 383. p. 93. 1723.
455. Amaranthoides humile, Polygoni folio, Sloan, Hiſt. Jam. Tab. 36. f. 2. 1731.
261. Ambroſia gigantea, inodora; foliis aſperis trifidis Baniſt. Cat. Raii. Hiſt. Ap. 1928. No. 407. p. 1. 1727.
52. Ambroſia maritima, Artemiſiæ foliis inodoris, elatior H. Lugd. Bat. No. 383. p. 93. 1725.
456. Ammi majus foliis plurimum inciſis, & nonnihil eriſpis C. B. 159. 1731.
208. Ammi perenne Moris, Umb. 22. No. 399. p. 293. 1726.
355. Anapodophyllon Canadenſe Morini. T. Inſt. 239. No. 417. p. 1. 1729.
1. Anemone Virginiana, tertiæ Matthioli ſimilis, flore parvo. Par. Bat. 18. No. 376. p. 280. 1722.
457. Anemonoſpermos Afra; folio Jacobææ, tenuiter laciato flore aurantio pulcherrimo Boer. Ind. alt. 100. 1731.
458. Anemonoſpermos Africana, folio Cardui Benedicti florum radiis intus albicantibus Hort. Amſt. II. 45. 1731.
459. Anemonoſpermos Africana, folio minus laciniato, flore intus aureo, foris punicante. 1731.
301. Anonis Americana; folio latiori, ſubrotundo. T. Inſt. 409. No. 412. p. 219. 1728.
405. Anonis pulchra viſu; folio Ciceris; Ornithopodii ſiliquis, annuentibus; Hort. Cath. 18. No. 422. p. 223. 1730.
408. Aparine minima, D. Sherard. Raii. Syn. Ed. 2. 118. No. 422. p. 223. 1730.
406. Aparine ſemine Coriandri ſaccharati. Park. Theat. 567. No. 422. p. 223. 1730.
407. Aparine ſemine læviore, Raii Hiſt. 484. No. 422. p. 223. 1730.
356. Apocynoides ſubhirſuta; floribus aurantiis. No. 417. p. 1. 1729.
460. Apocynum Americanum foliis Androſæmi majoris, flore Lilii Convallium, ſuave rubentis H. R. Par. 1731.
461. Apocynum erectum folio oblongo, flore umbellato, petalis coccineis reflexis Sloane Hiſt. 1. 206. Tab. 129. fig 4 & 5. 1731.

302. Apo-

No. 412. p. 219. Ann. 1728. 302. Apocynum fruteſcens; Salicis folio, anguſto. An *Apocynum erectum, Africanum; villoſo fructu; Salicis folio, glabro, anguſto.* Par. Bat. 24?

1731. 462. Apocynum minus, rectum Canadenſe Cornut. 93.

No. 399. p. 293. 1726. 209. Apocynum ſcandens, Africanum, Convolvuli minoris folio & caule hirſutis, Pluk. Phyt. Tab. 137. fig. 4.

No. 417. p. 1. 1728. 357. Aracus q. Vicia ſegetum; ſingularibus ſiliquis glabris C.B. 345.

No. 422. p. 223. 1730. 409. Arundo arborea Indica; amplo pediculato folio. *Bambu altera Species* Raii Hiſt. 1316. Beeſha. Hort Malab. Tom. 5. Tab. 60.

No. 407. p. 1. 1727. 262. Aſperugo vulgaris T. Inſt. 135.

No. 395. p. 125. 1725. 153. After Americanus Belvideræ foliis, floribus ex cæruleo albicantibus, ſpicis prælongis. Pluk. Phyt. Tab. 78. fig. 5.

No. 412. p. 219. 1728 303. After Americanus, ſerotinus, altiſſimus; folio brevi, caulem amplectente.

No. 395. p. 125. 1725. 156. After maritimus flavus, Crithmum chryſanthemum dictus. Raii. Hiſt. 268.

No. 383. p. 93. 1723. 55. After montanus Salicis glabro folio. C. B. 266.

No. 383. p. 93. 1723. 54. After peregrinus, Ciſti folio non crenato flore magno, luteo. Pluk. Phyt. T. 16. f. 2.

No. 395. p. 125. 1725. 154. After Virginianus, anguſtifolius, ſerotinus, parvo albente flore, Park. Th. 132.

No. 395. p. 125. 1725. 155. After Virginianus, pyramidatus, Hyſſopi foliis, aſperis, calycis ſquamulis foliaceis.

No. 407. p. 1. 1727. 263. Barba Jovis, Caroliniana, arboreſcens; Pſeudoacaciæ foliis, *Baſtard Indigo*, incolis.

No. 376. p. 280. 1722. 2. Bellis Africana, capitulo aphyllo luteo, Coronopi folio, caulibus procumbentibus. H. Lugd. Bat.

No. 412. p. 219. 1728. 304. Betonica maxima; Scrophulariæ folio; flore è luteo palleſcente. Schol. Bot. 64.

No. 412. p. 219. 1728. 305. Betonica maxima; Scrophulariæ folio; floribus incarnatis. Par. Bat 106.

No. 399. p. 293. 1726. 210. Bidens Americana Apii folii. T. 462.

No. 399. p. 293. 1726. 211. Bidens Americana nodiflora foliis latis acuminatis. *Chryſanthemum Conyzoides, nodiflorum; ſemine roſtrato bidente, Sloan.* Hiſt. Vol. 1. p. 62. Tab. 154. f. 4.

No. 399. p. 294. 1726. 212. Bidens Caroliniana; florum radiis latiſſimis, inſigniter dentatis; ſemine alato, per maturitatem convoluto.

No. 383. p. 93. 1723. 56. Bidens Indica, Hieracii folio, caule alato. T. Inſt. 462.

No. 383. p. 93. 1723. 57. Blitum monoſpermum, indicum, aculeatum. Breyn. Prod. 18.

58. Blitum

58.	Blitum quod Amaranthus Græcus, ſylveſtris, anguſtifolius. T. Cor. 17.	No. 383. p. 93.	Ann. 1723.
358.	Draſſica orientalis, perfoliata; flore albo; ſiliqua quadrangula T. Cor. 16.	No. 417. p. 1.	1729.
157.	Brunella Caroliniana, magno flore, dilute cœruleo; internodiis prælongis.	No. 395. p. 125.	1725.
359.	Brunella laciniata; flore elegantiſſime ſulphureo. Boer. Ind. alt. 169.	No. 417. p. 1.	1729.
158.	Brunella Novæ Angliæ, major; foliis longius mucronatis.	No. 395. p. 125.	1725.
213.	Bugloſſum Luſitanicum, bullatis foliis Moriſ. Hort. Bleſ. 1.	No. 399. p. 294.	1726.
3.	Bupleurum anguſtifolium. Dod. 633.	No. 376. p. 280.	1722.
4.	Calamintha, magno flore, C. B. 229.	No. 376. p. 280.	1722.
59.	Calcitrapoides pumila, ſupina, tenuifolia, calyce turbinato. D. Vaillant. Act. Ac. Par.	No. 383. p. 93.	1723.
214.	Caltha Africana, flore intus albo foris violaceo T. Inſt. 499.	No. 399. p. 294.	1726.
410.	Canna Indica; radice alba, alexipharmica, Sloan. Cat. Jam. 122. Hiſt. Tab. 149. fig. 2. *Arrow-root.*	No. 422. p. 224.	1730.
216.	Cardamine impatiens altera hirſutior. Raii Synopſ.	No. 399. p. 294.	1726.
215.	Cardamine impatiens, vulgo Sium minus impatiens, Gerard.	No. 399. p. 294.	1726.
5.	Carduus capite rotundo tomentoſo. C. B. 382.	No. 376. p. 280.	1722.
264.	Carlina patula, Atractylidis folio & facie T. Inſt. 500.	No. 407. p. 1.	1727.
412.	Caryophyllata, aquatica, nutante flore C. B. 321.	No. 422. p. 224.	1730.
413.	Caryophyllata major; nutante flore.	No. 422. p. 224.	1730.
414.	Caryophyllata Virginiana; albo flore, minore; radice inodora. H. Lugd. Bat. 121.	No. 422. p. 224.	1730.
411.	Caryophyllata vulgaris. C. B. 321.	No. 422. p. 224.	1730.
60.	Caſſia decaphylla, Orobi Pannonici foliis mucronatis.	No. 383. p. 93.	1723.
360.	Caſſida Cretica; fruticoſa; Catariæ folio; flore albo. T. Cor. 11.	No. 417. p. 1.	1729.
362.	Caſſida orientalis; Chamædryos folio; flore luteo. T. Cor. 11.	No. 417. p. 2.	1729.
361.	Caſſida paluſtris, vulgatior; flore cœruleo. T. Inſt. 182.	No. 417. p. 1.	1729.
62.	Cataria anguſtifolia minor. T. Inſt. 202.	No. 383. p. 93.	1723.
64.	Cataria Hiſpanica, Betonicæ folio anguſtiori, flore albo. T. Inſt. 202.	No. 383. p. 94.	1723.
65.	Cataria Luſitanica, erecta, Betonicæ folio, tuberoſa radice. T. Inſt.	No. 383. p. 94.	1723.
61.	Cataria major vulgaris. T. Inſt. 202.	No. 383. p. 93.	1723.
67.	Cataria orientalis, Teucrij folio, Lavendulæ odore, verticillis florum craſſiſſimis. T. Cor. 13.	No. 383. p. 94.	1723.

No. 383. p. 94. Ann. 1723. 66. Cataria quæ Horminum ſpicatum, Lavendulæ flore & odore. Boccon. rar. 48.

No. 383. p. 93. 1723. 63. Cataria quæ Nepeta Pannonica major & elatior. H. Ox. 3. 415.

No. 395. p. 125. 1725. 159. Caucalis Hiſpanica, Cam. Hort. 37. fig. XI.

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No. 422. p. 224. 1730. 416. Chamædrys Alpina, fruteſcens; folio ſplendente. T. Inſt. 205.

No. 412. p. 219. 1728. 307. Chamædrys; foliis parvis leviter crenatis.

No. 412. p. 219. 1728. 308. Chamædrys; fruteſcens; Teucrium vulgo. T. Inſt. 205.

No. 412. p. 219. 1728. 209. Chamædrys; laciniatis foliis. Lob. Icon. 385.

No. 412. p. 219. 1728. 210. Chamædrys, quæ *Teucrium Hiſpanicum, ſupinum; Verbenæ tenuifoliæ foliis.* D. *Goiffon.* D. *Juſſieu.*

No. 412. p. 219. 1728. 306. Chamædrys, vulgo vera exiſtimata. J. B. 3. 988.

No. 422. p. 224. 1730. 419. Chamæmelum Hiſpanicum, humile, ramoſiſſimum; Cotulæ fœtidæ facie.

No. 422. p. 224. 1730. 418. Chamæmelum incanum; Abſinthii vulgaris folio, D. Vaillant. Ac. Reg. Sc. 1720.

No. 422. p. 224. 1730. 417. Chamæmelum montanum; Abſinthii folio; Parthenii odore. Hort. Cath.

No. 422. p. 224. 1730. 420. Chelone Acadienſis; flore albo. D. Tournef. Ac. Reg. Sc. 1706. Joſſelyn *New England's Rarities*, Num. 6. *p.* 78, & 79.

No. 383. p. 94. 1723. 69. Chryſanthemum flore luteo, aphyllo minore. Bar. Icon. 452.

No. 376. p. 280. 1722. 6. Cryſanthemum perenne, minus, Salicis folio glabro H. Ox. p. 3. 21.

No. 383. p. 94. 1723. 68. Chryſanthemum tenuifolium, flore bullato aureo Bar. Ic. 450.

No. 407. p. 1. 1727. 266. Circæa Lutetiana Lob. icon. 266.

No. 407. p. 1. 1727. 267. Circæa minima. Col. Ecphr. 80.

No. 376. p. 280. 1722. 7. Cirſium altiſſimum, albis maculis notatum, ſemine. viſcoſo. *Carduus albis maculis notatus, capitulis Cirſii.* Schol. Bot. 215.

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No. 376. p. 280. 1722. 8. Clematitis cœrulea erecta. C. B. 300.

No. 399. p. 294. 1726. 217. Clematitis peregrina foliis pyri inciſis C. B. 300.

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219.	Coma aurea Africana fruticans, foliis Crithmi marini H. Amſt. 2. 99.	No. 399. p. 294. Ann.	1726.
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268.	Conyza Africana, fruteſcens; foliis Salviæ; odore Camphoræ. T. Inſt. 455.	No. 407. p. 1.	1727.
11.	Conyza Africana, Senecionis flore, retuſis foliis H. Lugd. Bat.	No. 376. p. 281.	1722.
312.	Conyza Orientalis, humilis; Verbaſci folio, candidiſſimo. *An Conyza tomentoſa & candidiſſima; ſubrotundo, craſſo folio; flore luteo D. Sherard. Ac. Reg. Sc. Par. An.* 1719.	No. 412. p. 220.	1728.
218.	Corchorus ſive Melochia J. B. 2. 982.	No. 399. p. 294.	1726.
160.	Corchorus, Americana, prælongis foliis, capſula ſtriata, ſubrotunda, brevi, Pluk. Phyt. Tab. 255. fig. 4.	No. 395. p. 125.	1725.
12.	Corona Solis altiſſima, alato caule. T. Inſt. 490.	No. 376. p. 281.	1722.
161.	Corona Solis Caroliniana, parvis floribus, folio trinervi amplo, aſpero, pediculo alato.	No. 395. p. 125.	1725.
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313.	Corona Solis; Trachelii folio; radice repente. T. Inſt. 490.	No. 412. p. 220.	1728.
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315.	Corona Solis; Trachelii folio, tenuiore; calyce floris foliato.	No. 412. p. 220.	1728.
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466.	Cyanus montanus latifolius vel Verbaſculum Cyanoides C. B. 273.		1731.
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364.	Daucus, qui Paſtinaca Œnanthes folio Boccon. rar. 75.	No. 417. p. 2.	1729.
17.	Dens Leonis, foliis Eryſimi vulgaris. T. Cor. 35.	No. 376. p. 281.	1722.
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No. 412. p. 220. Ann. 1728. 319. Doria; quæ *Jacobæa Orientalis, Limonii folio.* T. Cor. 36.
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No. 412. p. 220. 1728. 321. Elatine; folio ſubrotundo. C. B. 253.
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1731. 468. Elichryſum Africanum folio oblongo ſubtus cano, ſupra viridi, flore luteo Boer. Ind. 42.
1731. 469. Elichryſum Africanum folio oblongo, anguſto, flore rubello, poſtea aureo Boer. Ind. 42.
1731. 470. Elichryſum Americanum annuum folio oblongo ex anguſto in orbem deſinente.
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No. 422. p. 224. 1730. 422. Eupatoriophalacron Americanum, procumbens; albis floribus; foliis parvis undulatis, aſperis.
No. 422. p. 224. 1730. 423. Eupatoriophalacron Americanum, Scrophulariæ acutiore folio; diſco luteo, prominente, ſtipato, vix radiato.
No. 422. p. 224. 1730. 421. Eupatoriophalacron, Balſaminæ fœminæ folio; flore albo diſcoide. D. Vaillant. Ac. Reg. Sc. 1720. *Scabioſa Conyzoides, Americana; capitulis & floribus albidis parvis. P. B. P. Pluk. Phyt. Tab.* 109. f. 1.
No. 422. p. 225. 1730. 424. Eupatoriophalacron Indicum; Scrophulariæ folio; capitulo parvo, radiis quinis ad Baſin ornato, hiſpidis & glutinoſis. *An Cichoreo affinis Lampſana Sinica, Mentaſtri foliis; calyce fimbriato, hiſpido.* Sinice *Hi-bim-tſaw dicta?* Pluk. Amalt. 58. Phyt. Tab. 380. Fig. 2.
No. 395. p. 126. 1725. 166. Eupatorium Senecionis facie, folio Lamii. Par. Bat. Ic. 161.
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366. Frutex Africanus, Ambram ſpirans Pluk. Phyt. Tab. 183. Fig. 1. No. 417. p. 2. Ann. 1729.

168. Fumaria minor, tenuifolia, caulículis procumbentibus & caducis. C. B. 143. No. 395. p. 126. 1725.

471. Galeopſis fœtidiſſima ſpica longiſſima alba Micheli. 1731.

367. Galeopſis Hiſpanica; fruteſcens; Teucrii folio. T. Inſt. 186. No. 417. p. 2. 1729.

169. Geniſta Hiſpanica humilis, floribus congeſtis villoſis. Sparto primo affinis, C. B. 396. No. 395. p. 126. 1725.

133. Geranium acu longiſſimâ, Cicutæ folio tenuius laciniato. *Geranium Cicutæ folio, viſcoſum, acu longiſſima D. Juſſieu.* No. 388. p. 306. 1724.

324. Geranium Ægyptiacum; Althææ folio, ſubtus glauco. Lippii D. Juſſieu. No. 412. p. 220. 1728.

135. Geranium Æthiopicum, noctu olens, radice tuberoſa, foliis Myrrhidis anguſtioribus Breyn. Cent. No. 388. p. 307. 1724.

142. Geranium Africanum Alchimillæ hirſuto folio, floribus albidis. H. Lugd. Bat. 282. No. 388. p. 307. 1724.

147. Geranium Africanum arboreſcens, Alchimillæ hirſuto folio, floribus rubicundis. Com. Præl. 51. No. 388. p. 307. 1724.

148. Geranium Africanum arboreſcens folio Malvæ plano lucido, glabro, flore Kermeſino, Di van Leur. Boerh. Ind. 109. No. 388. p. 307. 1724.

150. Geranium Africanum arboreſcens Ibiſci folio anguloſo; floribus amplis purpureis: *Geranium Africanum fruteſcens, Alchimillæ folio hirſuto, cum fimbriis purpureis. Boer. Ind.* 110. No. 388. p. 307. 1724.

149. Geranium Africanum arboreſcens Ibiſci folio rotundo; Carlinæ odore H. L. Bat. 274. No. 388. p. 307. 1724.

146. Geranium Africanum arboreſcens, Malvæ folio mucronato, petalis florum inferioribus vix conſpicuis. No. 388. p. 307. 1724.

139. Geranium Africanum Betonicæ folio, procumbens, floribus parvis, eleganter variegatis. Pluk. Alm. 169. No. 388. p. 307. 1724.

136. Geranium Africanum Coriandri folio, floribus incarnatis, minus H. L. Bat. 279. No. 388. p. 307. 1725.

140. Geranium Africanum foliis inferioribus Aſari, ſuperioribus Staphidis agriæ, maculatis, ſplendentibus, & Acetoſæ ſapore. Com. Præl. 52. No. 388. p. 307. 1724.

143. Geranium Africanum folio Malvæ craſſo, molli, odoratiſſimo, floſculo pentapetalo, albo. Boerh. Ind. alt. 263. No. 388. p. 307. 1724.

137. Geranium Africanum fruteſcens, Chelidonii folio, petalis florum anguſtis, albidis; carnoſo caudice. No. 388. p. 307. 1724.

141. Geranium Africanum fruteſcens, folio craſſo & glauco, Acetoſæ Sapore Com. Præl. 54. No. 388. p. 307. 1724.

No. 383. p. 94. Ann. 1723. 71. Helianthemum Anglicum, vulgari ſimile, flore ſtellato.

No. 383. p. 94. 1723. 73. Helianthemum Halimi folio, anguſtiore, acuto. *An Ciſtus Halimi folio, 2. Cluſ. Hiſt. 71?*

No. 407. p. 2. 1727. 274. Heliotropium Americanum, cœruleum; foliis Horminis. Dodart mem. 83.

No. 407. p. 2. 1727. 275. Heliotropium majus Dioſcoridi. C. B. 253.

1731. 473. Heliotropium maritimum, minus, folio glauco, flore albo Sloane Hiſt. 1. 213. Tab. 132. f. 3.

No. 412. p. 221. 1728. 327. Hermannia; Alni folio parvo. *An Ketmia Africana, fruticans & erecta; Alni foliis latioribus & majoribus; flore ſpirali ſulphureo. Hort. Amſt. p. 2. 155?*

No. 395. p. 126. 1725. 172. Hermannia fruteſcens, foliis oblongis, ad apices ſolum modo, ferratis.

No. 412. p. 221. 1728. 326. Hermannia fruteſcens; folio Ibiſci, hirſuto, molli, caule piloſo. Boerh. Ind. 1. 115.

No. 412. p. 221. 1728. 328. Hermannia; minimo Alni folio. *An Ketmia, Africana fruticans & erecta Alni foliis triplo minoribus. Hort. Amſt. p. 2. 155?*

No. 422. p. 225. 1730. 428. Herniaria glabra. J. B. III. 378.

No. 422. p. 225. 1730. 429. Herniaria hirſuta. J. B. III. 379.

No. 383. p. 94. 1723. 75. Hieracium Caſtorei odore noſtras. *Hieracium Cichorei, vel potius Stœbes folio, hirſutum. Raii Cat. Cantab.*

No. 417. p. 2. 1729. 373. Hieracium fruticoſum; anguſtiſſimo, incano folio. H. L. Bat. 316.

No. 417. p. 2. 1729. 374. Hieracium *Pulmonaria* dictum, latifolium, humilius; ramulis expanſis.

No. 383. p. 94. 1723. 74. Hieracium Pyrenaicum Blattariæ folio, minus hirſutum. Schol. Bot.

No. 376. p. 281. 1722. 22. Horminum ſylveſtre latifolium, verticillatum C. B. 238.

No. 376. p. 281. 1722. 23. Hypericum perfoliatum & perforatum. T. Inſt. 255.

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No. 412. p. 221. 1728. 329. Jacobæa Hiſpanica, minus laciniata; petalis breviſſimis. T. Inſt. 486.

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No 395. p. 126. 1725. 174. Jacobæa Sicula, Chryſanthemi facie Boc. rar. p. 66.

330. Jaſminum Arabicum; Caſtaneæ folio; flore albo, odoratiſſimo; cujus fructus Coffy in officinis. Boerh. Ind. alt. 217. *Arbor Yemenſis fructum Coſe ferens. D. Douglas.* — No. 412. p. 221. Ann. 1728.

220. Kali ſpinoſum, foliis longioribus & anguſtioribus T. Inſt. 247. — No. 399 p. 294. 1726.

221. Kali ſpinoſum foliis craſſioribus & brevioribus, T. Inſt. 247. — No. 399. p. 294. 1726.

277. Ketmia Syrorum quibuſdam. C. B. 316. — No. 407. p. 2. 1727.

222. Lactuca Canadenſis, altiſſima latifolia, flore leucophæo T. Inſt. 474. — No. 399. p. 294. 1726.

335. Lactuca perennis, humilior; flore cœruleo. T. Inſt. 473. — No. 412. p. 221. 1728.

375. Lamium Garganicum, ſubincanum; flore purpuraſcente; cum labio ſuperiori crenato. Micheli Hort. Piſan. 93. Tab. 32. — No. 417. p. 2. 1729.

376. Lamium orientale, argentatum, annuum; flore albo. *Lamium Moſchatum foliorum marginibus argentatis. Wheeleri Itin.* — No. 417. p. 3. 1729.

377. Lamium purpureum, perenne; foliis acutis profunde inciſis. *Lamium; folio oblongo; flore rubro. Park. Theat.* 606. — No. 417. p. 3. 1729.

223. Lathyrus ſylveſtris major flore minore; foliis longius mucronatis. — No. 399. p. 294. 1726.

224. Lavendula folio diſſecto, C. B. 216. — No. 399. p. 294. 1726.

279. Linaria cærulea, foliis brevioribus, & anguſtioribus. Raii Syn. Ed. 3. 282. — No. 407. p. 2. 1727.

278. Linaria capillaceo folio. C. B. 213. — No. 407. p. 2. 1727.

333. Linaria Hiſpanica, procumbens; foliis uncialibus, glaucis, flore flaveſcente, pulchrè ſtriato labiis nigro-purpureis. — No. 412. p. 221. 1728.

332. Linaria lutea elatior & ramoſior; flore minori. — No. 412. p. 221. 1728.

334. Linaria multicaulis, erecta annua, anguſto Mollugi-nis folio; floribus luteis rarè diſpoſitis. — No. 412. p. 221. 1728.

331. Linaria vulgaris lutea; flore majore. C. B. 212. — No. 412. p. 221. 1728.

27. Lotus pentaphyllos minor hirſutus, ſiliqua anguſtiſſima C. B. 332. — No. 376. p. 282. 1722.

28. Lunaria vaſculo ſublongo intorto. Raii Syn. 164. — No. 376. p. 282. 1722.

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231. Lychnis fruteſcens, Myrtifolia, Been albo ſimilis C. B. 205. — No. 399. p. 295. 1726.

378. Lychnis Hiſpanica; folio Kali; multiflora. T. Inſt. 338. — No. 417. p. 3. 1729.

225. Lychnis Hiſpanica major latifolia flore albo. — No. 399. p. 294. 1726.

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No. 399. p. 294. 1726. 226. Lychnis maritima repens, C. B. 205.

No. 399. p. 294. 1726. 228. Lychnis Orientalis Bupleuri folio T. Cor. 24.

No. 399. p. 294. 1726. 229. Lychnis Orientalis calyce pyramidato, ſtriato, longiſſimo; T. Cor. 24.

No. 399. p. 294. 1726. 230. Lychnis Orientalis foliis carnoſis; caule ramoſiſſimo; floſculis minutis onuſto. *Lychnis Orientalis Saponariæ folio & facie, flore parvo & multiplici.*

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No. 399. p. 295. 1726. 233. Lychnis ſylveſtris viſcoſa rubra anguſtifolia, C. B. 205.

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No. 383. p. 94. 1723. 80. Malva Or. erecta, major, flore vix conſpicuo. D. Sherard.

No. 383. p. 94. 1723. 77. Malva Sinenſis, annua, erecta flore minimo. *Ki-tſai-tſe dicta.*

No. 383. p. 94. 1723. 79. Malva ſylveſtris, foliis ſinuatis minoribus, floſculis minimis, Anglica. Boer, Ind. 2. 268.

No. 383. p. 95. 1723. 82. Malva Syriaca, *Ela Haur taunal dicta. Malva Cretica, annua, altiſſima, flore parvo, ad alas umbellato. T. Cor.* 2.

No. 399. p. 295. 1726. 242. Malvinda Abutili folio, flore luteo ſpicato. *Althæa Indica Abutili ſubrotundo folio, flore luteo ſpicato. Pluk. Phyt. Tab.* 74. fig. 6.

No. 399. p. 295. 1726. 243. Malvinda Abutili folio; flore luteo ſpicato minor.

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No. 399. p. 295. 1726. 240. Malvinda Pimpinellæ majoris folio, anguſtiori ſemine bidente.

239. Malvinda

239. Malvinda Pimpinellæ majoris folio, ſemine bidente. No. 399. p. 295. Ann. 1726.
241. Malvinda profundius ſerrato folio, ſemine tridente. No. 399. p. 295. 1726.
238. Malvinda Ulmifolia ſemine bidente. *Malva Ulmifolia, ſemine cum gemino roſtro*, T. Inſt. 96. No. 399. p. 295. 1726.
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474. Malvinda Xanthii fere folio, fructu lappaceo, pentacocco. *Trifolio affinis, Indiæ Orientalis Xanthii facie Breyn. Cent. Tab.* 135. 1731.
176. Marrubium album, foliis amplis, ferè circinatis. No. 395. p. 126. 1725.
31. Marrubium Hiſpanicum ſupinum, foliis ſericeis argenteis T. Inſt. 192. No. 376. p. 282. 1722.
476. Martynia annua villoſa & viſcoſa folio ſubrotundo flore magno rubro. D. Houſtoun. 1731.
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436. Medica fructu ovali ſpinoſo. *Medica Πικραπ. fructu ovali; ſpinulis brevioribus & rigidioribus. R. Hiſt.* 963. No. 422. p. 225. 1730.
432. Medica hirſuta, echinis rigidioribus. J. B. 11. 385. No. 422. p. 225. 1730.
438. Medica Hiſpanica; fructu echinato, ſubhirſuto, ſphæroide. No. 422. p. 225. 1730.
433. Medica magna, turbinata. J. B. 11. 385. No. 422. p. 225. 1730.
440. Medica marina Lob. icon. 38. Trifolium cochleatum, maritimum, tomentoſum. C. B. 329. No. 422. p. 226. 1730.
435. Medica maritima, noſtras; modiolis ſpinoſis. *Trifolium cochleatum; modiolis ſpinoſis. Raii Syn. Ed.* 2. 197. No. 422. p. 225. 1730.
437. Medica Orientalis; fructu rotundiore, ſubhirſuto, tuberculis raris obſito. No. 422. p. 225. 1730.
431. Medica ſcutellata. J. B. 11. 384. No. 422. p. 225. 1730.
434. Medica tornata, minor, lenis Park. Theat. 1116. No. 422. p. 225. 1730.
441. Melilotus Meſſanenſis, procumbens; folliculis rugoſis, ſublongis; ſpicis florum brevioribus. Raii Hiſt. 952. No. 422. p. 226. 1730.
386. Mentha *Siſymbrium*, dicta, hirſuta, rotundifolia; odore Aurantii D. Manningham. *Mentha, Siſymbrium dicta, hirſuta; glomerulis & foliis minoribus ac rotundioribus. Raii Syn Ed.* 3. 233. No. 417. p. 3. 1729.
380. Millefolium album, incanum; ſegmentis foliorum latioribus. No. 417. p. 3. 1729.
385. Millefolium; foliis Sophiæ fere diviſura; floribus parvis, ex albo flaveſcentibus. No. 417. p. 3. 1729.
383. Millefolium, minus, tenuifolium; Tanaceti odore Barrel. obſ. N°. 1117. No. 417. p. 3. 1729.
381. Millefolium nobile Tragi. 476. No. 417. p. 3. 1729.

No. 412. p. 219. Ann. 1728. 302. Apocynum fruteſcens; Salicis folio, anguſto. An *Apocynum erectum, Africanum; villoſo fructu; Salicis folio, glabro, anguſto.* Par. Bat. 24?

1731. 462. Apocynum minus, rectum Canadenſe Cornut. 93.

No. 399. p. 293. 1726. 209. Apocynum ſcandens, Africanum, Convolvuli minoris folio & caule hirſutis, Pluk. Phyt. Tab. 137. fig. 4.

No. 417. p. 1. 1728. 357. Aracus q. Vicia ſegetum; ſingularibus ſiliquis glabris C.B. 345.

No. 422. p. 223. 1730. 409. Arundo arborea Indica; amplo pediculato folio. *Bambu altera Species* Raii Hiſt. 1316. Beeſha. Hort Malab. Tom. 5. Tab. 60.

No. 407. p. 1. 1727. 262. Aſperugo vulgaris T. Inſt. 135.

No. 395. p. 125. 1725. 153. After Americanus Belvideræ foliis, floribus ex cæruleo albicantibus, ſpicis prælongis. Pluk. Phyt. Tab. 78. fig. 5.

No. 412. p. 219. 1728 303. After Americanus, ſerotinus, altiſſimus; folio brevi, caulem amplectente.

No. 395. p. 125. 1725. 156. After maritimus flavus, Crithmum chryſanthemum dictus. Raii. Hiſt. 268.

No. 383. p. 93. 1723. 55. After montanus Salicis glabro folio. C. B. 266.

No. 383. p. 93. 1723. 54. After peregrinus, Ciſti folio non crenato flore magno, luteo. Pluk. Phyt. T. 16. f. 2.

No. 395. p. 125. 1725. 154. After Virginianus, anguſtifolius, ſerotinus, parvo albente flore, Park. Th. 132.

No. 395. p. 125. 1725. 155. After Virginianus, pyramidatus, Hyſſopi foliis, aſperis, calycis ſquamulis foliaceis.

No. 407. p. 1. 1727. 263. Barba Jovis, Caroliniana, arboreſcens; Pſeudoacaciæ foliis, *Baſtard Indigo*, incolis.

No. 376. p. 280. 1722. 2. Bellis Africana, capitulo aphyllo luteo, Coronopi folio, caulibus procumbentibus. H. Lugd. Bat.

No. 412. p. 219. 1728. 304. Betonica maxima; Scrophulariæ folio; flore è luteo palleſcente. Schol. Bot. 64.

No. 412. p. 219. 1728. 305. Betonica maxima; Scrophulariæ folio; floribus incarnatis. Par. Bat 106.

No. 399. p. 293. 1726. 210. Bidens Americana Apii folii. T. 462.

No. 399. p. 293. 1726. 211. Bidens Americana nodiflora foliis latis acuminatis. *Chryſanthemum Conyzoides, nodiflorum; ſemine roſtrato bidente, Sloan.* Hiſt. Vol. 1. p. 62. Tab. 154. f. 4.

No. 399. p. 294. 1726. 212. Bidens Caroliniana; florum radiis latiſſimis, inſigniter dentatis; ſemine alato, per maturitatem convoluto.

No. 383. p. 93. 1723. 56. Bidens Indica, Hieracii folio, caule alato. T. Inſt. 462.

No. 383. p. 93. 1723. 57. Blitum monoſpermum, indicum, aculeatum. Breyn. Prod. 18.

58. Blitum

58. Blitum quod Amaranthus Græcus, ſylveſtris, anguſtifolius. T. Cor. 17. No. 383. p. 93. Ann. 1723.
358. Braſſica orientalis, perfoliata; flore albo; ſiliqua quadrangula T. Cor. 16. No. 417. p. 1. 1729.
157. Brunella Caroliniana, magno flore, dilute cœruleo; internodiis prælongis. No. 395. p. 125. 1725.
359. Brunella laciniata; flore elegantiſſime ſulphureo. Boer. Ind. alt. 169. No. 417. p. 1. 1729.
158. Brunella Novæ Angliæ, major; foliis longius mucronatis. No. 395. p. 125. 1725.
213. Bugloſſum Luſitanicum, bullatis foliis Moriſ. Hort. Bleſ. 1. No. 399. p. 294. 1726.
3. Bupleurum anguſtifolium. Dod. 633. No. 376. p. 280. 1722.
4. Calamintha, magno flore, C. B. 229. No. 376. p. 280. 1722.
59. Calcitrapoides pumila, ſupina, tenuifolia, calyce turbinato. D. Vaillant. Act. Ac. Par. No. 383. p. 93. 1723.
214. Caltha Africana, flore intus albo foris violaceo T. Inſt. 499. No. 399. p. 294. 1726.
410. Canna Indica; radice alba, alexipharmica, Sloan. Cat. Jam. 122. Hiſt. Tab. 149. fig. 2. *Arrow-root.* No. 422. p. 224. 1730.
216. Cardamine impatiens altera hirſutior. Raii Synopſ. No. 399. p. 294. 1726.
215. Cardamine impatiens, vulgo Sium minus impatiens, Gerard. No. 399. p. 294. 1726.
5. Carduus capite rotundo tomentoſo. C. B. 382. No. 376. p. 280. 1722.
264. Carlina patula, Atractylidis folio & facie T. Inſt. 500. No. 407. p. 1. 1727.
412. Caryophyllata, aquatica, nutante flore C. B. 321. No. 422. p. 224. 1730.
413. Caryophyllata major; nutante flore. No. 422. p. 224. 1730.
414. Caryophyllata Virginiana; albo flore, minore; radice inodora. H. Lugd. Bat. 121. No. 422. p. 224. 1730.
411. Caryophyllata vulgaris. C. B. 321. No. 422. p. 224. 1730.
60. Caſſia decaphylla, Orobi Pannonici foliis mucronatis. No. 383. p. 93. 1723.
360. Caſſida Cretica; fruticoſa; Catariæ folio; flore albo. T. Cor. 11. No. 417. p. 1. 1729.
362. Caſſida orientalis; Chamædryos folio; flore luteo. T. Cor. 11. No. 417. p. 2. 1729.
361. Caſſida paluſtris, vulgatior; flore cœruleo. T. Inſt. 182. No. 417. p. 1. 1729.
62. Cataria anguſtifolia minor. T. Inſt. 202. No. 383. p. 93. 1723.
64. Cataria Hiſpanica, Betonicæ folio anguſtiori, flore albo. T. Inſt. 202. No. 383. p. 94. 1723.
65. Cataria Luſitanica, erecta, Betonicæ folio, tuberoſa radice. T. Inſt. No. 383. p. 94. 1723.
61. Cataria major vulgaris. T. Inſt. 202. No. 383. p. 93. 1723.
67. Cataria orientalis, Teucrij folio, Lavendulæ odore, verticillis florum craſſiſſimis. T. Cor. 13. No. 383. p. 94. 1723.

No. 383. p. 94. Ann. 1723. 66. Cataria quæ Horminum ſpicatum, Lavendulæ flore & odore. Boccon. rar. 48.

No. 383. p. 93. 1723. 63. Cataria quæ Nepeta Pannonica major & elatior. H. Ox. 3. 415.

No. 395. p. 125. 1725. 159. Caucalis Hiſpanica, Cam. Hort. 37. fig. XI.

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No. 412. p. 219. 1728. 307. Chamædrys; foliis parvis leviter crenatis.

No. 412. p. 219. 1728. 308. Chamædrys; fruteſcens; Teucrium vulgo. T. Inſt. 205.

No. 412. p. 219. 1728. 209. Chamædrys; laciniatis foliis. Lob. Icon. 385.

No. 412. p. 219. 1728. 210. Chamædrys, quæ *Teucrium Hiſpanicum, ſupinum; Verbenæ tenuifoliæ foliis.* D. *Goiffon.* D. *Juſſieu.*

No. 412. p. 219. 1728. 306. Chamædrys, vulgo vera exiſtimata. J. B. 3. 988.

No. 422. p. 224. 1730. 419. Chamæmelum Hiſpanicum, humile, ramoſiſſimum; Cotulæ fœtidæ facie.

No. 422. p. 224. 1730. 418. Chamæmelum incanum; Abſinthii vulgaris folio, D. Vaillant. Ac. Reg. Sc. 1720.

No. 422. p. 224. 1730. 417. Chamæmelum montanum; Abſinthii folio; Parthenii odore. Hort. Cath.

No. 422. p. 224. 1730. 420. Chelone Acadienſis; flore albo. D. Tourneſ. Ac. Reg. Sc. 1706. Joſſelyn *New England's Rarities*, Num. 6. *p.* 78, & 79.

No. 383. p. 94. 1723. 69. Chryſanthemum flore luteo, aphyllo minore. Bar. Icon. 452.

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No. 383. p. 94. 1723. 68. Chryſanthemum tenuifolium, flore bullato aureo Bar. Ic. 450.

No. 407. p. 1. 1727. 266. Circæa Lutetiana Lob. icon. 266.

No. 407. p. 1. 1727. 267. Circæa minima. Col. Ecphr. 80.

No. 376. p. 280. 1722. 7. Cirſium altiſſimum, albis maculis notatum, ſemine viſcoſo. *Carduus albis maculis notatus, capitulis Cirſii.* Schol. Bot. 215.

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No. 376. p. 280. 1722. 8. Clematitis cœrulea erecta. C. B. 300.

No. 399. p. 294. 1726. 217. Clematitis peregrina foliis pyri inciſis C. B. 300.

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1731. 463. Colutea Orientalis, flore ſanguinei coloris, lutea macula notato T. Cor. 44

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219.	Coma aurea Africana fruticans, foliis Crithmi marini H. Amst. 2. 99.	No. 399. p. 294.	Ann. 1726.
464.	Coma aurea Germanica Park. Theat 688.		1731.
311.	Commelina graminea, latifolia; flore cœruleo. Plum. N. Gen. Plant.	No. 412. p. 219.	1728.
363.	Convolvulus Canarienſis; longioribus foliis, mollibus & incanis. Pluk. Phyt. Tab. 325. fig. 1.	No. 417. p. 2.	1729.
268.	Conyza Africana, fruteſcens; foliis Salviæ; odore Camphoræ. T. Inſt. 455.	No. 407. p. 1.	1727.
11.	Conyza Africana, Senecionis flore, retuſis foliis H. Lugd. Bat.	No. 376. p. 281.	1722.
312.	Conyza Orientalis, humilis; Verbaſci folio, candidiſſimo. *An Conyza tomentoſa & candidiſſima; ſubrotundo, craſſo folio; flore luteo D. Sherard. Ac. Reg. Sc. Par. An.* 1719.	No. 412. p. 220.	1728.
218.	Corchorus ſive Melochia J. B. 2. 982.	No. 399. p. 294.	1726.
160.	Corchorus, Americana, prælongis foliis, capſula ſtriata, ſubrotunda, brevi, Pluk. Phyt. Tab. 255. fig. 4.	No. 395. p. 125.	1725.
12.	Corona Solis altiſſima, alato caule. T. Inſt. 490.	No. 376. p. 281.	1722.
161.	Corona Solis Caroliniana, parvis floribus, folio trinervi amplo, aſpero, pediculo alato.	No. 395. p. 125.	1725.
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371. Heleniastrum; folio longiore & angustiore. D. Vaillant. Acad. Reg. Par. anno 1720. No. 417. p. 2. 1729.
372. Heleniastrum serius florens; latiore folio; ramosissimum. An Heleniastrum; folio breviore & latiore. Ejusdem. ibid ?. No. 417. p. 2. 1729.
72. Helianthemum ampliore folio, flore roseo. D. Sherard. No. 383. p. 94. 1723.

71. Heli-

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330. Jaſminum Arabicum; Caſtaneæ folio; flore albo, odoratiſſimo; cujus fructus Coffy in officinis. Boerh. Ind. alt. 217. *Arbor Yemenſis fructum Coſe ferens. D. Douglas.* — No. 412. p. 221. Ann. 1728.

220. Kali ſpinoſum, foliis longioribus & anguſtioribus T. Inſt. 247. — No. 399 p. 294. 1726.

221. Kali ſpinoſum foliis craſſioribus & brevioribus, T. Inſt. 247. — No. 399. p. 294. 1726.

277. Ketmia Syrorum quibuſdam. C. B. 316. — No. 407. p. 2. 1727.

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335. Lactuca perennis, humilior; flore cœruleo. T. Inſt. 473. — No. 412. p. 221. 1728.

375. Lamium Garganicum, ſubincanum; flore purpuraſcente; cum labio ſuperiori crenato. Micheli Hort. Piſan. 93. Tab. 32. — No. 417. p. 2. 1729.

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377. Lamium purpureum, perenne; foliis acutis profunde inciſis. *Lamium; folio oblongo; flore rubro. Park. Theat.* 606. — No. 417. p. 3. 1729.

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224. Lavendula folio diſſecto, C. B. 216. — No. 399. p. 294. 1726.

279. Linaria cærulea, foliis brevioribus, & anguſtioribus. Raii Syn. Ed. 3. 282. — No. 407. p. 2. 1727.

278. Linaria capillaceo folio. C. B. 213. — No. 407. p. 2. 1727.

333. Linaria Hiſpanica, procumbens; foliis uncialibus, glaucis, flore flaveſcente, pulchrè ſtriato labiis nigro-purpureis. — No. 412. p. 221. 1728.

332. Linaria lutea elatior & ramoſior; flore minori. — No. 412. p. 221. 1728.

334. Linaria multicaulis, erecta annua, anguſto Mollugi-nis folio; floribus luteis rarè diſpoſitis. — No. 412. p. 221. 1728.

331. Linaria vulgaris lutea; flore majore. C. B. 212. — No. 412. p. 221. 1728.

27. Lotus pentaphyllos minor hirſutus, ſiliqua anguſtiſſima C. B. 332. — No. 376. p. 282. 1722.

28. Lunaria vaſculo ſublongo intorto. Raii Syn. 164. — No. 376. p. 282. 1722.

175. Lychnidea Virginiana, Holoſtei ampliore folio, floribus umbellatis purpureis. — No. 395. p. 126. 1725.

231. Lychnis fruteſcens, Myrtifolia, Been albo ſimilis C. B. 205. — No. 399. p. 295. 1726.

378. Lychnis Hiſpanica; folio Kali; multiflora. T. Inſt. 338. — No. 417. p. 3. 1729.

225. Lychnis Hiſpanica major latifolia flore albo. — No. 399. p. 294. 1726.

No. 376. p. 282. Ann. 1722. 29. Lychnis Linifolia toroſis & laxioribus capitulis. Bar. obſ. 64.

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No. 399. p. 295. 1726. 233. Lychnis ſylveſtris viſcoſa rubra anguſtifolia, C. B. 205.

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No. 399. p. 295. 1726. 242. Malvinda Abutili folio, flore luteo ſpicato. *Althæa Indica Abutili ſubrotundo folio, flore luteo ſpicato. Pluk. Phyt. Tab.* 74. fig. 6.

No. 399. p. 295. 1726. 243. Malvinda Abutili folio; flore luteo ſpicato minor.

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No. 399. p. 295. 1726. 240. Malvinda Pimpinellæ majoris folio, anguſtiori ſemine bidente.

239. Malvinda

239.	Malvinda Pimpinellæ majoris folio, semine bidente.	No. 399. p. 295.	Ann. 1726.
241.	Malvinda profundius serrato folio, semine tridente.	No. 399. p. 295.	1726.
238.	Malvinda Ulmifolia semine bidente. *Malva Ulmifolia, semine cum gemino rostro*, T. Inst. 96.	No. 399. p. 295.	1726.
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176.	Marrubium album, foliis amplis, ferè circinatis.	No. 395. p. 126.	1725.
31.	Marrubium Hispanicum supinum, foliis sericeis argenteis T. Inst. 192.	No. 376. p. 282.	1722.
476.	Martynia annua villosa & viscosa folio subrotundo flore magno rubro. D. Houstoun.		1731.
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432.	Medica hirsuta, echinis rigidioribus. J. B. II. 385.	No. 422. p. 225.	1730.
438.	Medica Hispanica; fructu echinato, subhirsuto, sphæroide.	No. 422. p. 225.	1730.
433.	Medica magna, turbinata. J. B. II. 385.	No. 422. p. 225.	1730.
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435.	Medica maritima, nostras; modiolis spinosis. *Trifolium cochleatum; modiolis spinosis. Raii Syn. Ed.* 2. 197.	No. 422. p. 225.	1730.
437.	Medica Orientalis; fructu rotundiore, subhirsuto, tuberculis raris obsito.	No. 422. p. 225.	1730.
431.	Medica scutellata. J. B. II. 384.	No. 422. p. 225.	1730.
434.	Medica tornata, minor, lenis Park. Theat. 1116.	No. 422. p. 225.	1730.
441.	Melilotus Messanensis, procumbens; folliculis rugosis, sublongis; spicis florum brevioribus. Raii Hist. 952.	No. 422. p. 226.	1730.
386.	Mentha *Sisymbrium*, dicta, hirsuta, rotundifolia; odore Aurantii D. Manningham. *Mentha, Sisymbrium dicta, hirsuta; glomerulis & foliis minoribus ac rotundioribus. Raii Syn Ed.* 3. 233.	No. 417. p. 3.	1729.
380.	Millefolium album, incanum; segmentis foliorum latioribus.	No. 417. p. 3.	1729.
385.	Millefolium; foliis Sophiæ fere divisura; floribus parvis, ex albo flavescentibus.	No. 417. p. 3.	1729.
383.	Millefolium, minus, tenuifolium; Tanaceti odore Barrel. obs. N°. 1117.	No. 417. p. 3.	1729.
381.	Millefolium nobile Tragi. 476.	No. 417. p. 3.	1729.