

Chimney-Corner, continually stirring it, whilst it burns ; which ought to be for the Space of half an Hour, at least. When you would extinguish the Flame, clap the Cover on it, and if it does exactly cover it, you will presently extinguish it, otherwise you must put a Linnen Cloth likewise, that no Air may enter ; then let it cool a little, and pour it into a Vessel, wherein you will preserve it. This they call the weaker Oil, in Comparison of the following, which they call the strong Oil.

AND this is made by putting fresh and crude Oil into the same Pot, and ordering it just as you did the weak, only suffering it to burn a great deal longer, and stirring it often, till it become thick and glewy ; so that dropping a little of it upon a cold Plate, it may, in a little Time, be drawn out into Threads, like a Syrup. Some Workmen put into it an Onion, or a Crust of Bread whilst it boils, and hold that it helps to cleanse the Greasiness of it.

IF it hap that the Fire be too violently taken, cast in a Quarter of a Pint of crude Oil ; but to prevent all Accidents, boil it in an open Court.

THIS done, grind, of the aforesaid *German* Black, on a very clean Stone and Mullar, about half a Pound, pouring on it, at several Times, more or less, as you see Occasion, about half a Pint of the weaker Oil (for some Blacking will take up more than other some) but be extreamly careful, not to pour on too much. After you have thus grossly ground it over, re-grind it over again, by a little and a little at a Time, till it become very fine ; then put it altogether on the Stone, and add to it about the Quantity of a small Hen Egg, of your thicker, or strong Oil, blend them well together, and cover them very close, in a well-glaz'd earthen Pot, to preserve it well from Dust, for your Use.

N. B.

N. B. F O R Plates that are worn, or not deeply graven, you need not put so much strong Oil into the Ink : Likewise your Black must be good, and well ground, else it will give no good Impression, and will quickly wear the Plate. And if the Oils be not burn'd into a due Consistency, the Black will be left behind, in the Hatches of the Plate, and the Impression will be pale, and nothing worth.

J. E V E L Y N.

*Divers curious Receipts, collected by
Dr. Hook.*

To give Iron the Colour of Copper.

TAKE one Ounce of Copper Plates, cleansed in the Fire ; three Ounces of *Aqua Fortis* ; dissolve the Copper, and when 'tis cold, use it by washing your Iron with it, by the Help of a Feather ; 'tis presently cleansed and smooth, and will be of a Copper Colour ; by much using or rubbing, 'twill wear off, but may be renew'd the same Way.

A Way of gilding with Gold upon Silver.

B E A T a Ducket thin, and dissolve it in two Ounces of *Aqua Regia* ; dip clean Rags in it, and let them dry ; burn the Rags, and, with the Tinder thereof, rub the Silver with a little Spittle ; be sure first, that the Silver be cleansed from Grease.

To

To make Copper into a Metal like Gold.

Rec. Distill'd *Verdigrease* four Ounces; *Tutiæ Alexandrinæ præparatæ*, two Ounces; *Salt Petre*, one Ounce; *Borax*, half an Ounce; mix all together with Oil, till they be as thick as Pap; then melt it in a Crucible, and pour it into a Fire-Shovel, first well warmed.

Memorandum. My Author says, That this will not only appear, but work like coarse Gold; that he sold it as dear as Silver; that the King of Poland had a Service of it, only mixing 15 Ounces of Gold, to 100 Ounces of this Metal.

To whiten Copper throughout.

TAKE thin Plates of Copper, as thin as a Knife, heat them 6 or 7 Times, and quench them in Water; then melt them, and to each Pound add 4 Ounces of *Salt Petre*, and 4 Ounces of *Arsenick*, well powder'd and mix'd, and first melted apart in another Crucible, by gentle Degrees; then take them out, and powder them; then take *Venetian Borax*, and white *Tartar*, of each an Ounce and half; then melt these, with the former Powder, in a Crucible, and pour them out into some iron Receiver; it will appear as clear as Crystal, and is called *Crystallinum fixum arsenicum*. Of this clear Matter, broken into little Pieces, throw into the melted Copper (by small Pieces at a Time, staying 5 or 6 Minutes between each Injection) 4 Ounces; when all is thrown in, increase the Fire, till all be well melted together for a Quarter of an Hour; then pour it out into an Ingot.

N. B. To

N. B. To make this Matter the more malleable, add a Quarter of a Pound of Silver first melted, and the former Metal poured into it, and then proceed *at supra*, where indeed the Crystalline Powder ought first to be prepar'd.

N. B. Also that this Process is not to be done in a close Room, by reason of the poisonous Steams of the Arsenick.

To make transparent Silver.

Rec. Refin'd Silver, one Ounce ; dissolve it in two Ounces of *Aqua Fortis*, precipitate it with a Pugil of Salt, then strain it through a Paper, and the Remainder melt in a Crucible, for about half an Hour, and pour it out, and 'twill be transparent.

Dissolutions. Gold is dissolved in *Aqua Regis*; 'tis precipitated with Silver, or sooner with Quicksilver; all other Metals are dissolved by *Aqua Fortis*; Silver then is precipitated with Copper; Copper by Iron; Iron by Lead or Tin; Tin by Lead or common Salt. *Aqua Fortis* is made by Niter, Vitriol and Sand. *Aqua Regis* is made of *Aqua Fortis* and *Sal Armoniac*. *Sal Armoniac* is made of Camel's Urine, press'd out of the Dung; or out of Horse Urine, press'd out of the Dung. Volatile Salt is extracted out of Urine, Blood, Soap, and Hartshorn.

N. B. After the Dissolution, there remains a black Sand, the Author says 'tis Gold; it may be edulcorated by Water. The first Water of the Dissolution dyed the Hair of my Horse of a Purple Colour, and Yellow and Black; if there had been more Silver, or the *Aqua Fortis* stronger, it had been quite Black; it is apt to burn the Skin, but then did not.

The

The Roman Pomade.

T A K E Apples of a good Smell: Pare and core them, and cut each into six Pieces; then take Hog's Grease of the Bowels, which has not been melted, wash it in Orange and Citron Flower Water *aa*; then add *Cloves*, *Cinnamon*, *Galinga*, *Ligni Santali aa 3j.* *Ligni Rosarum*, *Sassafras*, *Violetarum Radicum*, *Benjamin*, *Storax Calamita aa 3j.* chop all into small Pieces, and mingle them with the Apples and the Lard; pour over all, Rose-water a Finger high, and let it boil on a gentle Fire, till all the Moisture be gone; then strain it whilst hot through a Cloath, and afterwards mix therewith six Ounces of white Wax melted, and well stirred together; this must be done in a new earthen Pot, and while you are stirring it, yet hot, pour in one after another of Oil of Cinnamon, of Citrons, Oranges, Roses, and Jasmine, *aa* six Drops.

To perfume Clothes.

T A K E dry'd Red Roses, and, to encrease their Smell, pour on them fresh Rose-Water, and still drying between in the Shade; then take *Cloves*, *Cinnamon*, *Spikenard Seed*, *Storax*, *Calamita*, *Benjamin*, *Violet Roots*, *Nutmegs*, *aa 3ij.* to a Pound of Roses; beat them all into small Pieces, and mix them with the Roses, and put them into perfuming Bags.

Cypress Powder for the Hair.

T A K E Red Rose Leaves in Powder, wet them as before, add Musk 12 Grains, Civet 10 Grains, Ambergrease 8 Grains, Cinnamon, and Storax Calamita
O

lamita $\frac{aa}{aa}$ iij. Cloves, $\frac{3}{3}$ ij. of the Moss of an Oak, one Pound, well dry'd, and powdered, and six Times washed with Rose-water as before; then add three Ounces of Violet Roots in Powder, mix all together, and pass them through a Searce, and use it.

To marble a Globe Glass.

G R I N D well on a Stone, *Minium* for Red, *Turmeric*, or rather *Cerussa Citrina*, for Yellow, *Smalt* for Blue, *Verdigrease* for Green, *Ceruse*, or *Chalk*, for White. Work each in Oil separate, and with a Hog's-Hair Pencil, single or mix'd as you think fit, scatter the same into the Glass, and roll it, or dispose the Colours, as you like. Then last of all, fling a little Mead amongst them, which covers all.

FOR the magick Lanthorn, paint the Glasses with transparent Colours, tempered with Oil of Spike.

To gild Carps, Crawfish, &c.

W A R M an earthen Pot, till it receive as much white Pitch as will stick round it within; then strew finely powder'd Amber over the white Pitch; when 'tis growing cold, pour into it *Oleum Lini*, three Pound; *Oleum Terebinth*, one Pound well mixed together. Close up all, and boil them an Hour on a gentle Fire: This is a Varnish. Grind some of this on a Painter's Stone, throwing to it fine Powder of Pumice-Stone, till it be as thick as ordinary Paint; then take a live Carp, or Craw-fish, out of the Water, and dry it well with a Linnen Cloath; then daub it over with this Paint, it will presently dry, before which spread your Leaf Gold, and gently press it with a soft dry Cloath, and then you may let it go into the Water. For the more this Varnish is in the Water, the harder it dries and grows, and does the Fish no Hurt.

Many

Many such gilded Fish are in the Prince of *Silacaw's* Garden in *Bohemia*, 18 Leagues from *Prague*; he has 200 thus gilded.

The four Elements put in a Cylindrical Glass with a Foot.

Spirit of Wine, Oil of Tartar *per deliquium*, Spirit of Turpentine and Antimony grossly beaten: Take of each an equal Quantity, and no two of these will mix.

To Foil Glass.

TAKE a Sheet of *Muscovy*, or other Glass, as big as convenient, and as thin as possibly it can be made: Get also some *Tin-Foil*, and laying it upon a Sheet of very fine Paper, most curiously sleeked, that also being laid upon a Plain that is exactly plain and smooth; then with a clean Cloath, or Piece of Leather, make your *Tin-Foil* clean, and to lie very smooth, that there may be no Wrinkles in it; this done, put on a little Quicksilver, and rub it upon it, with a Cloath, or Piece of Leather, so long, until it be all Black therewith; then with a Cloth rub that also clean off; this done, put on as much Quicksilver as will cover the *Tin-Foil* all over; then upon that, as close to it as possibly you can, slide on the *Muscovy* Glass, shoving off as much of the *Mercury* as you can: This done, clap down the other half Sheet upon it, which must be exceeding fine, and most exactly polish'd; upon this lay a Plane, that is very smooth, lest otherwise it cause Wrinkles; then press it, so as it may be plain, for 12 Hours; then take it out, and let it stand, or hang upright, so as it may send away the loose Quicksilver; afterwards order it as you please.

After this Manner all Sorts of Glass are foiled.

A Discourse of Mr. John Caswell, late Savilian Professor of Oxford, concerning the going back of the Shadow on a Sun-Dial. Read at a Meeting of the Philosophical Society, at Oxford, June the 22d. 1686.

UPON reading the Minutes of the *Dublin Society*, of Mar. 1. that Mr. *Tolet* had discours'd of the Shadows going twice Forward, and twice Backward, in the same Day, in a Place of the *Torrid Zone*: It was desired by our Members, then present, that I would take it upon me, to explain, at our next Meeting, how this might be. In answer thereto, I have shewn, in the following Discourse, how the Shadow of a Stile, perpendicular to the Horizon, does go Backward in the *Torrid Zone*, but not of those Stiles that point to the Pole, as it is in Common Dials; also how, by directing the Stile betwixt the Tropicks, the Shadow may go back on Horizontal Dials in all Latitudes, and in all other Plains, if the Sun does not leave them too soon; together with the Calculation of the Time, and Quantity, of the Shadow's Regression, according to any given Situation of the Stile and Plane.

By a Stile, I understand a streight Line infisting on a Plane, and casting a Shadow thereon.

A perpendicular Stile, I call that which is perpendicular to the Plane; an oblique Stile, which is oblique.

WHEN I mention a Stile, without distinguishing perpendicular or oblique, it is to be understood of either.

By the Meridian of the Plane, I mean a great Circle drawn thro' the Pole of the World, and Poles of the Plane.

SUPPOSE a Circle describ'd on the Plane from the Foot of the Stile (*i. e.* the Point where it cuts the Plane), as a Center: The Way of the Shadow I reckon on the Circumference of this Circle: And Note, when the Shadow goes one Way round this Circle, without any Change, during one Day, I say, 'tis wholly Direct: But if it changes its Course, the first Motion it takes before the Change, I call Regression, or Backward; and the second Motion I call Progression, or Forward; for 'tis the first Motion that I conceive contrary to what is usual, and which I therefore call Retrograde, rather than Direct. In this Sense the Shadow may be twice Retrograde, and once Direct in the same Day, as shall be demonstrated.

Prop. I. THE Shadow of the Stile, on the Plane, is the common Section of the Plane, with a great Circle drawn thro' the Sun and Stile.

Prop. II. THE Semidiameter of the Earth is insensible, in respect of the vast Distance of the Sun from us; therefore the Foot of the Stile, which is really at the Surface of the Earth, may be suppos'd the Center of the Earth; and consequently the Plane of the Dial may be taken for the Plane of a great Circle of the Sphere, parallel thereto.

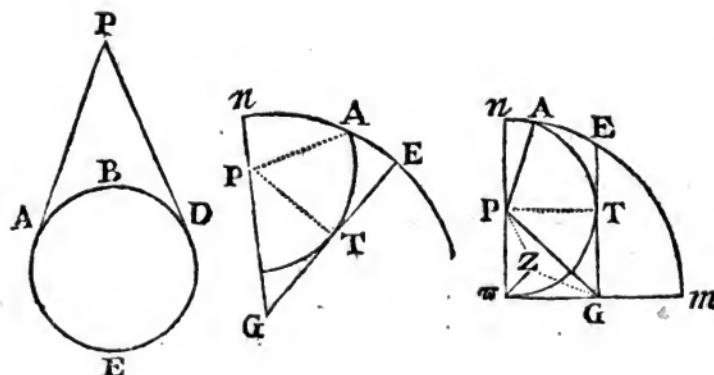
Prop. III. THE Shadow cannot go Backward (in the same Day, and so understand in the following), if the Stile continu'd does cut the Plane of the Diurnal Circle, (*i. e.* which the Sun describes in the Heavens, and which is otherwise call'd the Sun's Parallel, or a Parallel to the Äquator) in, or within its Perimeter, because the Shadow is always in a Plane, drawn thro' the Sun and Stile, if the Point of Section is in, or within the Diurnal Circle's Perimeter, because the Sun goe constantly Forward, so will the Shadow.

Cor. I. If the Stile be the Axis of the World, the Shadow cannot go back: For the Axis cuts all the Parallels of the Æquator in their Centers; therefore in no Latitude can a Plane and Stile be plac'd, that the Shadow, which shews the Hour, with its whole Length, may go backward; only a Stile may be so plac'd, that its Shadow may go backward, and a Nodus therein shew the Hour.

Cor. II. The Shadow cannot be made to go backward, on either of the Æquinoctional Days, for then the Sun's Diurnal Circle, being a great Circle, is cut by the Stile, thro' the Center.

Cor. III. The Shadow cannot go back, if the Stile point without the Tropicks; for then it will cut the Planes of all the Diurnal Circles within their Perimeters.

Prop. IV. If the Stile cut the Plane of the Diurnal Circle, without its Perimeter, the Shadow will go forward and backward in 24 Hours; provided the Sun shine, a sufficient Part of the 24 Hours, on the Plane. For suppose P, the Point



where the Stile cuts the Plane of the Diurnal Circle; from P draw two Lines touching this Circle in A D; 'tis evident the Shadow goes one Way, while

while the Sun passes the Arc ABD; but the contrary Way, while it passes DEA.

Cor. If the Arc which the Sun describes, while it shines on the Plane, be Part of ABD, and Part of DEA, the Shadow will go forward and backward.

Prop. V. If from that Point in the Surface of the Globe, which represents the Top of the Stile, two great Circles be drawn, touching the Sun's Parallel; and if the Dial-Plane cut off an Arc of the Parallel, of which all, or part, is visible, (*i. e.* above the Horizon); if also either of the Points of Contact be included within the Extreams of this visible Arc; then will the Shadow go backward, till the Sun come to the Point of Contact; after which it will go forward, till it come to the other Point of Contact; and then the Shadow will go backward again.

Cor. I. The Shadow, in one Day's Time, in any Latitude, however the Plane and Stile be plac'd, can change its Course but twice, (*i. e.*) it may be Retrograde, Direct and Retrograde, but not a second Time Direct.

Cor. II. 'T is evident, there are in any Latitude innumerable Diversities of Inclinations of the Dial-Plane to the Horizon, and of the Stile to the Plane; also of Declinations of both Stile and Plane from the Meridian, whereby the Shadow may be made to go backward.

Prop. VI. THE Shadow cannot go back, while the Sun is nearer the *Aequator*, than the Top of the Stile to the *Aequator*. And this holds good, whether the Sun and Top of the Stile be on the same, or different Sides of the *Aequator*. For the Planes of all Diurnal Circles, which are nearer to

200 *A Discourse of the going back of the Aequator, than the Top of the Stile, are cut by the Stile within their Perimeters, because the Stile passes thro' the Center of the Sphere.*

Cor. THE nearer the Stile points to the Aequator, the more Days in the Year will the Shadow go back; but then, in any one Day, it will go back the less, *cæteris paribus*.

Prop. VII. THE Shadow of a Stile pointing to any one Place of the Heavens, betwixt the Aequator and either Tropic, will go back all those Days, wherein the Sun's Parallel is farther from the Aequator, than the Top of the Stile is from the Aequator. And this holds, whether the Sun, and the Top of the Stile, be on the same, or different Sides of the Aequator: But with this *Proviso*, in both Cases, that the Point of Contact lie in the visible Diurnal Arc above the Plane. For Example, In our Latitude of Oxford, if a Stile Point as far North, as is the Beginning of the Sign *Taurus*; then the Shadow will be Retrograde every Day, while the Sun is passing thro' *Taurus, Gemini, Cancer, Leo*. But while the Sun passes through *Virgo* and *Libra*, the Shadow is only Direct, or Forward; then in passing thro' *Scorpio, Sagittarius, Capricorn* and *Aquarius*, 'tis Retrograde again: But with this Difference, that if the Shadow is twice Retrograde, any Day, while the Sun runs a Northern Parallel, then it will not be Retrograde once, in the Day of the Opposite Southern Parallel. But if the Shadow is once Retrograde, in a Day of the Northern Parallel, then it will also be once Retrograde, in the Day of the Opposite Parallel.

Prop. VIII. If a perpendicular Stile point any where in the Aequator, the Shadow cannot go back any Day in the whole Year; for all the Points

Points of Contact lie in the Dial-Plane, to wit, there, where 'tis cross'd by the Diurnal Circles.

Prop. IX. If an Oblique Stile point to the common Section of the *Aequator*, and the *Meridian* of the Plane ; the Shadow will be Retrograde, during that half Year, while the Sun has Declination toward that Pole, which is elevated above the Plane. The other half Year, while the Sun is toward the depress'd Pole, the Shadow will be only Direct; for in the first half Year, the Points of Contact are above the Plane ; in the Second, under.

Prop. X. If an Oblique Stile point to any Place of the *Aequator* in the Heavens, except there, where the *Meridian* of the Plane crosses the *Aequator*; if withal, a great Circle describ'd from the Top of the Stile on the Globe, as a Pole, does cross the long Diurnal Arcs ; (*i. e.*) of those Parallels which are toward that Pole of the World, which is elevated above the Plane ; I say, if the said Circle cross the long Arcs any where above the Plane, then will the Shadow be Retrograde, those Days, in which the Sun describes those Arcs, and on no other Days ; for where the said Circle crosses the Arcs, are the Points of Contact. For Example ; In all Direct South-reclining Planes, above which the North Pole is elevated, the Shadow goes back all our Summer half Year ; but it is only Direct all the Winter half Year. But in other Planes, the too great Declination, or Inclination of the Plane, may cause the Points of Contact to fall under the Plane ; so as only in a small Part of Summer, and in no Part of Winter, the Shadow may go back.

P R O B L E M.

Any Day being given, together with the Latitude of the Place, and the Situation of the Stile and Plane, to calculate the Time and Quantity of the Shadow's Regression on that Day.

S U P P O S E the Dial-Plane were *Horizontal*, and the Stile perpendicular thereto ; because the Stile must point within the Tropicks, then this Case can happen only in the *Torrid Zone*, yet not in the *Æquator* (*by Prop. 8.*) ; nor can the Shadow go back, when the Sun is on one Side of the *Æquator*, and the Stile on the other, tho' at less Distance, because the Points of Contact are both under the *Horizon* ; but then, to recompence this, the Shadow is twice Retrograde every Day ; which to calculate, suppose Z the Zenith of the Place 10 Degrees North of the *Æquator*, which is now suppos'd the Pole of the Plane, and the Top of the Stile in the Heavens. Suppose the Sun in the Tropic of *Cancer*, and P the Pole of the World, T the Point of Contact (*i. e.*) where the great Circle, ZT, drawn from the Top of the Stile, touches the Tropic. Then in the right-angled Triangle ZPT, beside the Right-angle T, there is given PT, the Sun's Co-declination, and PZ the Colatitude of the Place ; thence may be found the Angle ZPT, (*as in Fig. 3.*) the Sun's Distance from the Meridian, when the Shadow begins to change its Course ; also the Angle PZT, from which, if you take the Sun's Azimuth from the North, at Rising, the Residue is the Quantity of the Shadow's Regression on the Circle of the Dial-Plane.

W H A T has been said of an *Horizontal Plane*, in the *Torrid Zone*, holds true for any Latitude out of the *Torrid Zone*, if you incline the former Plane, till

till its perpendicular Stile point in the Meridian 10 Degrees above the *Aequator*, (*i. e.*) where it did in the Torrid Zone.

At 5 Hours 42 Minutes in the Morning, the Sun rises on this Plane ; at 7 Hours 36 Minutes, the Shadow changes its Course ; so the Duration of Regression is 1 Hour 54 Minutes ; the Quantity of Regression is 4 Degrees 26 Minutes. And so much, and at the same Distance from the Meridian, is the Retrogradation in the Afternoon. Thus it is at the Summer Solstice on this Plane, but the Regression will grow every Day less, as the Sun, in his Diurnal Course, comes nearer the Top of the Stile ; so as when the Sun runs over the Stile, then the Regression ceases.

E X A M P L E II.

SUPPOSE an *Horizontal Plane*, in the Latitude of *Oxford*, and the Sun in *Cancer*, the Stile pointing to *G*, (in *Fig. 2.*) 10 Degrees in the Meridian, above the *Aequator*: From *G* draw a great Circle, touching the Tropick of *Cancer* in *T*; suppose this Circle, (continu'd) to cut the Horizon in *E P*, to be the Pole of the World, and that the Circle *GP* (continued) cuts the Horizon in *n*, and that the Tropick cuts the Horizon in *A*. In the right-angled Triangle *GTP*, *GP* and *PT* are known ; thence may be found the Angle *TPG*, the Sun's Distance from the Meridian, when the Shadow changes its Way, and the Angle *PGT* ; then in the right-angled Triangle, *PnA*, *Pn* the Height of the Pole, and *PA*, the Sun's Co-declination, are given ; thence *nA* may be found, and in the right-angled Triangle *GnE*, *Gn*, and the Angle *EGn = PGT*, are known, thence *En* may be found ; but *nE - nA = AE*, which is the Quantity of the Shadow's Regression ; viz. The Shadow, in this Example, begins to change

change at 7 Hours 36 Minutes, in the Morning, and the Sun rises at 3 Hours 46 Minutes; therefore the Duration of Regression is 3 Hours 50 Minutes, and the Quantity of Regression 12 Degrees, 25 Minutes. And so much, and at the same Distance from the Meridian, 'tis again in the Afternoon.

E X A M P L E III.

A PLANE having any given Position, suppose 14 Degrees Declination, or Azimuth, Westward, and 71 Degrees Reclination, (*i.e.*) its Pole π (in Fig. 3.) 19 Degrees from the Zenith Z, suppose of Oxford, which is Distant from P, the Pole of the World, 38 Degrees 14 Minutes; also a Stile being any Ways inclin'd to this Plane, yet so as to point betwixt the Tropicks; as suppose G the Top of the Stile, or Gnomon of the Globe, has 23 Degrees Azimuth, Eastward, and 42 Degrees Distance from the Zenith, on any Day propos'd; suppose at the Summer Solstice, when the Sun is farther from the Æquator, than G from the Æquator; to find when the Sun shall begin, and cease to shine on the Plane, and whether the Shadow shall at all be Retrograde in the Morning; and if so, how much, and when it shall be? (Like to which is the Calculation for the Evening).

FROM G draw a great Circle, touching the Tropick in T, and cutting the Dial-Circle in E; produce the great Circles π P, π G, till they cut the Dial-Circle in N, M. Suppose A the Point, where the Tropick cuts the Dial-Circle. First in the Triangle GZP, we have GZ, ZP and the Angle GZP, thence we may find the Angle GPZ, and ZGP, and PG; then in the right-angled Triangle PTG, we have PG, and PT, the Sun's Co-declination; thence we may have the Angle GPT, and the Angle PGT. Then the Angle ZPG + GPT = ZPT,

the

the Distance of the Sun from the Meridian, when the Shadow ceases to be Retrograde, or first changes its Way. In the Triangle $\angle ZG$, we have $\angle Z$, ZG , and the Angle $\angle ZG$; thence we may find $\angle G$, the Angle $\angle GZ$, and the Angle $\angle G \angle Z$. In the Triangle $P \angle Z$, we have ZP , Z , and the Angle $\angle ZP$; thence we may have P , the Angle $\angle PZ$, and $\angle PZ$; then the Quadrant $\angle n - \angle P = Pn$; and the Quadrant $\angle m - \angle G = Gm$; and the Angle $\angle PZ + \angle GZ = \angle PG$ $= nm$. Then the two Right-angles — $ZG \angle - ZGP - PGT = EGm$. Then in the right-angled Triangle EGm , we have the Angle EGm , and Gm ; thence we may find mE . Then in the right-angled Triangle PnA , we know Pn , and PA , the Sun's Co-declination; thence we may get NA , and the Angle nPA . Then the two right Angles, — $\angle PZ - \angle PA = ZPA$, which is the Time before Noon, at which the Sun begins to shine on the Plane. Then $ZPA - ZPT = APT$, is the Duration of the Shadow's Regression. If ZPA is not bigger than ZPT , the the Shadow will not be Retrograde at all. Lastly, $m n - m E - n A = AE$, the Quantity of Regression.



Dr.

Dr. H o o k's Way to find expeditiously and certainly, the true Meridian ; being somewhat different from the Method in his Posthumous Works, pag 361.

PROVIDE a short Telescope of 1 Foot, or 18 Inches in Length, fitted with a Glass-Plate in the Focus ; upon which proper Circles must be drawn, with the Point of a Diamond, for the Pole Star, and two other Stars not far distant from the Pole, which is supposed to be in the Center of this Glass. This Telescope must be fitted with two Plumb-Lines. Now by this Instrument, in any fair Night, tho' the Moon shine, it will be very easy to discover the proper Stars, thro' this Telescope, and to see that each of them be in its proper Circle, about the Polar Point: At which Time, the Axis of the Glass will be in the true Meridian, and, if fitted with the Quadrant, give the Altitude; and the Plumb-Lines being in the Meridian, there may be a Compass suspended by them, which will also shew the Variation easily and certainly. This Instrument is sufficiently intelligible, without any Scheme, which is therefore omitted.

ANOTHER Way is wholly new, and the Observations are made without an Instrument, and the Refractions of the Air do no ways influence either the Observations or Deductions. And that is, by observing, with Plumb-Lines, or other proper Instruments, either both at the same Time, if it may be, or one at one Time, and the other at another, with a true Account of the interposed Time, two Azimuth Lines, in each of which are found two considerable Stars. By the Help of which two Observations, and a true Projection of

the

the Sphere of the Stars, it will be easy and obvious, to any Navigator, to find the Latitude of the Place, the Meridian Line, and the Azimuths of the Stars.

These two Ways were proposed to the Royal Society, April 27. 1687.

W. DERHAM.

An Experiment shewn before the Royal Society, Jan. 26. 1689. by Dr. Hooke, of the Penetration of Dimensions in the Mixture of Vitriol and fair Water.

THO' several Experiments have been made of the dissolving of several differing Sorts of Salts, successively in the same Water, after it has been satiated with one particular Salt, so as to dissolve, or take into it no more of that Salt ; yet, in all these Experiments, there seems not to be any real Penetration of Dimensions ; nor do I know of any other Experiment of the like Nature, that has been made by any Person. But, I conceive, it is very considerable in this, that Water, which has not (by the greatest Force which has been yet applied to it) been compress'd into lesser Dimensions, should yet admit a thicker, closer, and more ponderous Liquor to penetrate its Dimensions, without any Pressure or Force put to assist the Operation ; and that two Liquors, so differing in other Qualities, should so readily, and harmoniously join and incorporate together. They differ first in Weight ; for I find that the Oil of Vitriol, to the Water, is very near as 9 to 5 ; they differ in the Taste, the one being the greatest Acid, we know,

know, and the other perfectly insipid ; the one very sluggish, and not rising in Fumes, but with violent Heat ; the other evaporating very easily. It were too long to mention many other differing Qualifications and Effects ; but this is worthy noting, that the Mixture of those two Liquors, both actually cold, produces a very strong actual Heat, and thereby causes a Rising of many small Bubbles out of the Water, and also an Expansion of both, for a Time, as plainly appears ; for that as the Mixture grows cold, so it retires and shrinks into lesser Dimensions, as is visible to the Eye.

Now that I might give a more exact Account of the Success I had, and what was likely to be expected upon another Trial ; here I tried the Experiment with all the Care I could. First then we weighed the Bolt-head, and found its Weight, empty, $2085\frac{1}{2}$ Grains. Then we filled it almost to the Top of the Neck, with common Water, and found its Weight to be 8775 Grains ; from which, taking the Weight of the Bolt-head, we found the Water to weigh $6689\frac{1}{2}$ Grains ; then making a Mark on the Neck, at the Top of the Water, we poured out so much as filled a small Glas Cane, and set a Mark at the Top of the remaining Water, and found it 18 Inches and a half below the first Mark ; the Bolt-head, and Water, now weighed 8255 Grains ; whence the Weight of the Water, taken out, was 520 Grains. Then pouring off the Water, in the Cane, we filled it with Oil of Vitriol, and pouring it into the Bolt-head, we found it not to fill the former Space, and to make a considerable Heat in the Water, and many small Bubbles to rise : We then weighed it again, and found the Bolt-head, and Mixture, to weigh 9210 Grains ; whence we found the Weight of the Oil of Vitriol to be 945 Grains : We let the Mixture stand about Half an Hour, by which Time

Time we found they were so condensed, that 5 Inches and half, of the 18 Inches and half, of the Neck, were left empty, which is near a third Part of the Dimensions of the Oil of Vitriol, that was poured therein; then we filled up the Vacuity, and found it to contain 138 Grains; which compared to the whole Bulk of Water, that fill'd the Bolt-head, is between a 48th and a 49th Part; for as 138 to 6689 $\frac{1}{2}$, so 1, to 48 $\frac{1}{2}$.

FROM which Observations I deduce, that in this Experiment there is somewhat more than a bare Mixture of Fluid with Fluid, as of Water with Water; where tho' they may intimately mix, and temper together, and become one uniform Fluid, yet each of them, and every Part of each, keeps its former Dimensions and specifick Gravities; or of Water with Wine, Ale, or the like inspissated Liquors; or with saline Solutions, as of Salt, Niter, Allum, Vitriol, &c. In all which, I conceive, that there is nothing but a mixing, tempering, or dilating, as in the Mixture of two Liquors of the same Kind. Now, as I formerly hinted, I do not at all doubt, but that there may be found many other Liquors which may have the like Effects, one upon the other, upon Mixture; so that there may be also found Instances of a differing Nature, where the Mixture shall increase the Dimensions of the Particulars, and diminish the specifick Gravity, either of one, or both. But I think there have not yet been produced any Instances of these, or the other Kind, at least, I think, they have not yet been proved such.

Mr. Waller recommended the Trial of this Experiment to Mr. Hawkesbee, and if the Reader hath a Mind to see the Success thereof, he may find it in the Philos. Transf. of 1711. N° 331.

WILLIAM DERHAM.

An Account of the Plant, call'd Bangue, before the Royal Society, Dec. 18. 1689.

IT is a certain Plant which grows very common in *India*, and the Vertues, or Quality thereof, are there very well known ; and the Use thereof (tho' the Effects are very strange, and, at first hearing, frightful enough) is very general and frequent ; and the Person, from whom I receiv'd it, hath made very many Trials of it, on himself, with very good Effect. "Tis call'd, by the *Moors*, *Gange* ; by the *Chingalese*, *Comsa*, and by the *Portugals*, *Bangue*. The Dose of it is about as much as may fill a common Tobacco-Pipe, the Leaves and Seeds being dried first, and pretty finely powdered. This Powder being chewed and swallowed, or washed down, by a small Cup of Water, doth, in a short Time, quite take away the Memory and Understanding ; so that the Patient understands not, nor remembereth any Thing that he seeth, heareth, or doth, in that Extasie, but becomes, as it were, a mere Natural, being unable to speak a Word of Sense ; yet is he very merry, and laughs, and sings, and speaks Words without any Coherence, not knowing what he saith or doth ; yet is he not giddy, or drunk, but walks and dances, and sheweth many odd Tricks ; after a little Time he falls asleep, and sleepeth very soundly and quietly ; and when he wakes, he finds himself mightily refresh'd, and exceeding hungry. And that which troubled his Stomach, or Head, before he took it, is perfectly carried off without leaving any ill Symptom, as Giddiness, Pain in the Head or Stomach, or Defect of Memory of any Thing (besides of what happened) during the Time of its Operation. And he

he assures me, that he hath often taken it, when he has found himself out of Order, either by drinking bad Water, or eating of some Things which have not agreed with him. He saith, moreover, that 'tis commonly made Use of, by the Heathen Priests, or rambling Mendicant Heathen Friars, who will many of them meet together, and every of them dose themselves with this Medicine, and then ramble several Ways, talking they know not what, pretending after that, they were inspired. The Plant is so like to Hemp, in all its Parts, both Seed, Leaves, Stalk, and Flower, that it may be said to be only *Indian* Hemp. Here are divers of the Seeds, which I intend to try this Spring, to see if the Plant can be here produced, and to examine, if it can be raised, whether it will have the same Vertues. Several Trials have been lately made with some of this, which I here produce, but it hath lost its Virtue, producing none of the Effects before-mentioned; nor had it any other Operation, good or bad, since I receiv'd it with this Account I have related; imagining I had met with somewhat like it in *Linscotten's Voyages*, which the Reader may peruse at his Leisure.

I HAVE formerly given an Account of the Effects of the Roots of *Hemlock*, accidentally eaten by some young Children, which, at first, had an Operation on them much of the like Nature with this Vegetable; and possibly the last Effects might not have been much differing, if they had not made Use of Medicines, to recover them out of the Trance, before the Period of its Operation, tho' that be uncertain, and wants Experiences to ascertain it. Whereas this I have here produced, is so well known and experimented by Thousands; and the Person that brought it has so often experimented it himself, that there is no Cause of Fear, tho' possibly there may be of Laughter. It may therefore,

fore, if it can be here produced, possibly prove as considerable a Medicine in Drugs, as any that is brought from the *Indies*; and may possibly be of considerable Use for Lunaticks, or for other Distempers of the Head and Stomach, for that it seemeth to put a Man into a Dream, or make him asleep, whilst yet he seems to be awake, but at last ends in a profound Sleep, which rectifies all; whereas Lunaticks are much in the same Estate, but cannot obtain that, which should, and in all Probability would, cure them, and that is a profound and quiet Sleep.

Observations about Gems, and other valuable Commodities, extracted by Dr. Hook, Dec. 15. 1690. from Captain Knox's Journal; which I think worth publishing, by reason they are Rules observed at this Day.

Directions for Knowledge of Bezoar Stones.

TH E Monky Bezoars, which are long, are the best; those, that are rough, prove commonly faulty, breaking with Stones in the Middle; others in Form of Tuns, somewhat flat, which break in smaller Stones in the Middle, are better than the rough ones. *Bezoar* is tried fundry Ways, as the rubbing Chalk upon a Paper, then rubbing the Stone upon the Chalk; if it leave an Olive Colour, it is good; also touch any with a red-hot Iron, which you suspect, because their Colour is lighter than ordinarily they use to be; and if they fry, like Rosin or Wax, they are naught. Sometimes they are tried by putting them into clear Water; and if there

there arise upon them finall white Bubbles, they are good, if none, they are doubtful; the Use of the hot Iron is esteemed infallible.

IT is best to buy *Musk* in the Cod, for so it will be preserved; that which openeth with a bright Musk Colour, is the best. When taken out of the Cod, if a little chewed, and rubbed with a Knife on thin Paper, it look smooth, bright, or yellowish, 'tis probably good; but if of a Colour, as 'twere mixed with Gravel, 'tis bad; the Goodness is best discovered by the Scent.

Ambergriece, the best is Grey. For Trial, if a little be chewed, and yield an odoriferous Flavour, feeling, in Substance, like Bees-Wax, 'tis good, else not.

The Names of Precious Stones.

Diamond, Ruby, Saphir, Emerald, Topas, Hyacinth, Amethyst, Garnat, Chrysolite, Turcois, Agate, Splen, Jasper, Lapis Lazuli, Opal, Vermilion, Clystropic, Cornelian, Onyx, Bezear.

THE *Diamond* is the hardest, and, when cut, the most beautiful of all Stones; In Knowledge whereof, there is great Difficulty, having a Crust on them before they are cut; therefore Caution to be used in buying them is before-hand, to make a Pattern in Lead; their Waters are White, Brown, Yellow, Blue, Green, and Reddish; whereof take Notice, rating them according to their Waters; in our Climate, the perfect white Water is most esteem'd. *Brut-Stone*, or rough and un-cut Stones, are in Value half the Price of cut, or polish'd Stones; neither too thick, nor too thin in Substance, is best. A thick Stone, which is high and narrow, fable, not making a Shew answerable to its Weight, must be valued at less than that which is well spread, hath its Corners perfect, and a pure white Water, without Spots or Foulness, is called a *Paragon-Stone*,

and in full Perfection. Un-cut Stones are distinguished into two Sorts, thick or pointed, which are called *Naif-Stones*, and flat Stones; the flat Stones are to be cut into Roses, or thin Stones; the *Naif* into thick Stones; and those rough Stones, which will bear a good Shape, with least diminishing in cutting, are in best Esteem.

The Names of rough Stones, according to their Form and Substance: The rough Diamonds, that seem greenest, prove of a good Water, when cut; those that seem white, when rough, grow bluish often, when cut. \diamond A Point. \triangle A half Point. \bowtie

A thick Stone. \bowtie A half ground Stone. \square

A thin Stone. $\bowtie\bowtie$ A Rose Stone, if round; if long, a *Foseel*. $\bowtie\bowtie$ A *Naif*. Care is also to be taken in Choice of rough Diamond, to avoid those that have Veins; for they will never cut well, but seem as filed with a rough File. For vending, Stones of six Grains, or under, to one Grain and half, are best. *For Trial of a Diamond*; Take a pointed Diamond, such as *Glaziers* use, try it on any Stone but a Diamond, and it will cut it. The Diamond that is of a sandy, or hath any Foulness in it, or is of a blue, brown, or yellow Water, is not worth half the Price of a perfect Stone, of a white Water.

For cutting of Diamonds: You must never mould any of them in Sand, or Cuttle Bone, but you must use the second Lead to make a Pattern of, because the first will come somewhat less than the other; never cast it off, but of the perfect Lead; then make a Pattern of it; but first weigh the Lead, and set down the Weight; after, form the Lead to the best and most advantageous Shape, for the Stone, then re-weigh the Lead again, and set down the Weight; by which you may see what the Stone will lose, by cutting to that Shape;

the Lead is three times the Weight of the Stone : This is a sure Rule, commonly it loseth about $\frac{1}{3}$ Part in cutting.

To make Diamonds clean : If you see a thick Table-Diamond in a Ring, a Jewel, or in a Locket for a Jewel, you must first make it clean, either with a little Pumice-Stone, or with a few hot Ashes, or with a little Oil, and boil it, 'twill make it very clean.

Valuation of Diamonds : There is a Rule accurately to be observ'd ; which is, a Stone of one Carack is worth 10*l.* One of two Caracks is worth $2 \times 2 \times 10\text{ l.} = 40\text{ l.}$ One of three Caracks is $3 \times 3 \times 10\text{ l.} = 90\text{ l.}$ This, for even Caracks, comes nearest the true Value ; but for $\frac{1}{2}$, or $\frac{1}{4}$ of a Carack, tho' a Stone of two Caracks be worth 40*l.* yet, in this Rule of Reckoning (meaning $\frac{1}{2}$ a Carack so valued) it is valued but at $\frac{1}{4}$ of a Carack, which is 50*s.* and one of $\frac{1}{4}$ of a Carack but at $\frac{1}{4}$ of 50*s.* tho' a single Stone, one Quarter of a Grain, or $\frac{1}{4}$, worth 30*s.* as for Example. You would know what a Stone of six Grains is worth ; six Grains is $3\frac{1}{2}$ Caracks ; 3 times 3 is 9, and 9 times 50*s.* is 22*l.* 10*s.* which is the Value of the Stone. So of five Grains, 5 times 5 is 25, and 25 times 12*s.* 6*d.* is 15*l.* 12*s.* 6*d.*

To make a Foil for a Diamond. A Foil, to be set under a thick Table-Diamond, is made with black Ivory and Mastick, picked, and made very clear, with a little Oil of Mastick, to incorporate them. Black Ivory and Turpentine, heated on the Fire, is good, but the former is better. For a thin Table, black Ivory, scraped very fine, is good ; or take a Coal of the said Ivory, with a little Oil of Mastick, and dry the same ; or Ivory, with a little Gum ; fair Water, is also good.

If you sell a Diamond, that hath high Bissals, then you may set it upon full-scraped Ivory, which graceth the Play of them.

A ROSE Diamond, that is very thick; it's good to set it close upon the Ivory, and it will play very well; or black Velvet is good, under a thin Table Diamond, scraped as you do Lint.

THERE are four Sorts of *Oriental Rubies*; that which is hardest, the best and fairest Colour, if it be very fair, and cut Diamond-cut, is no less esteem'd than a Diamond, for the Weight; but 'tis rare to see such an one. The second Sort of Rubies is white, oriental, and hard, which also is of good Esteem, if cut of a Diamond-cut, but not of so high a Price, as the perfect red Ruby; but yet if it be in Perfection, 'tis very rare, there being few of this Sort. The third Sort is called a *Spinell*, which is softer than the former, and of less Esteem, being not so hard, nor hath it the Life of the other, nor so perfect a Colour: 'Tis naturally somewhat greasy in cutting because of its Softness. The fourth is called a *Ballace Ruby*, not so much esteem'd as the *Spinell*, being not so well colour'd; 'tis also greasy, and will scarce take a Polish, and looks like a *Garnet*.

THERE are three Sorts of *Saphirs*; one perfect blue, and very hard, which if cut of a Diamond-cut, and without *Calcedonie*, is of very good Esteem. The second is perfect white, and very hard, which if of a Diamond-cut, and without Elemish, is likewise esteem'd. The third, call'd *Water Saphirs*, are of small Esteem, being not so hard as the other, and commonly of a dead waterish Colour.



A Copy of the Account, which Dr. WALLIS gave to Dr. BERNARD, one of the Delegates for Printing, by a Messenger sent from Oxford for that Purpose, the Delegates having agreed to be determined by his Opinion in the Case, at Serjeant's-Inn, in Fleet-street. Jan. 23. 1691.

Reverend SIR,

IN Answer to yours, of June 20. concerning the Business of *Printing*, the brief History is this:

As to the University's Right of Printing all Manner of Books vendible, before our Charter of King Charles I. it is not needful to trouble you at present; but the Use of Printing was first brought into *England* by the University, and at their Charges, and here practised many Years, before there was any Printing in *London*; and we have been in the continual Possession of it ever since, and long before there was any Restraint put upon Printing, which was not at all, till Queen *Elizabeth's* Time.

ABOUT 8 Car. I. (and by several Charters since) our ancient Right is recognized, and further granted to us; besides which Charter, Arch-Bishop *Laud* did procure, from the *Stationers of London* (by Indenture under their Seal) a Grant from them of one Copy, for the *Bodleian Library*, of all Books thenceforth to be printed in their Company, in Consideration of a Lease, to them granted, of transcribing Copies (in that Library) of Manuscripts there, for them to print. And Sir *Thomas Bodley* gave to the Company a Piece of Plate of 60*l.* But this, tho', for some Time, whilst

whilst Arch-Bishop Laud lived, 'twas, in Part, observed, hath since been wholly neglected, and they give us none upon that Account.

THERE was, at the same Time, an Agreement between the University, and that Company, (for three Years) in behalf of the Company, the King's Printers, and Mr. Norton, (with a Covenant to renew at the End of that three Years) whereby the University agreed to forbear the Printing of certain Books, and the Company to pay 200*l.* a Year for such Forbearance, which 200*l.* was, by Agreement among themselves, to be raised in a certain Proportion; viz. So much by the Company, so much by the King's Printers, and so much by Mr. Norton. But as to this Partition between themselves, the University was not concerned. This 200*l.* was paid for the first three Years, and the Agreement renewed, with like Covenants, for another three Years, and observed by them for some Time; but, the Wars coming on, the University did still forbear Printing, but the Stationers gave us no Money; and thus it continued till about the Year 1653. nor would the Company be prevail'd with, either to renew their old Agreement, or enter into any new one, to that Purpose; but did enjoy the Benefit of our Forbearance, without giving us any Consideration for it.

THE University thereupon gave Leave to their Printers (*Litchfield and Hall*) to comprint with them divers beneficial Books, which presently brought them to such Terms of Agreement, (that being the only Means to bring them to Reason) tho' it was then agreed to forbear, they paying the Rent of 120*l.* which Fall of Rent was agreed to, upon their Complaint of Poverty and Decay of Trade.

AFTER the Return of King Charles II. Dr. Bailey, when he was Vice-Chancellor, brought it up to the old Rent of 200*l.* and so it continued for some While.

WHEN the University devolved their Power on Dr. Fell, (since Bishop of Oxford) and some others, they continued the like Agreement, with the Company, in behalf of themselves, and some others concerned with them, which continued for some Time longer.

BUT after a While, the King's Printers of Bibles, presuming that we had not Stock enough to coimprint Bibles with them, broke off their Agreement, and would pay their Proportion no longer; bidding us print Bibles, if we pleased, they would give us nothing to forbear.

MEAN while the Company and Mr. Norton, being well aware that we might, with a little Stock, be able to do them a Prejudice, by printing Grammars, Almanacks, and School-Books, were willing to continue the Agreement, as to their Proportions.

WHEREUPON the Bishop and Dr. Tates, continuing to pay us 200*l.* as before, did agree with the Company and Mr. Norton, for so much as their Proportion came to, but did bear the Loss, out of their own Purses, of that which the King's Printers were to pay; and this for divers Years, before they could put themselves into a Capacity of printing Bibles.

AFTER some Years, Dr. Tates brought into the Stock, for Printing (as I have been told) a Stock of 4 or 5000*l.* which did inable them to set upon the printing of Bibles.

THEREUPON the Bishop and he printed a Bible in Quarto, which the King's Printers, being aware of, did print another, just in the same Volume, and sold it to Loss; and did lose by it, as themselves

themselves did acknowledge, above 500*l.* desiring, thereby, to break our Design in Printing, by forcing us to sell so cheap, as to lose by it, or else to have the Bibles lie upon their Hands unfolded; whilst themselves would make themselves whole, by setting a higher Price on Bibles in other Volumes: And thus they threatened to do, with whatever Volumes we should print, presuming that we were not in a Capacity to print in all Volumes.

THE Bishop and Dr. *Tates*, finding themselves thus over-reached, found it necessary to take in with them some *London Booksellers*, as well for the better vending of Books, which did already lie upon their Hands, as for the Increase of their Stock, that they might be in a Capacity to print in other Volumes also, which did effectually counterwork that Design.

HEREUPON they first took in *Moses Pitt*, and one other; but finding these not enough to do the Work, they further took in Mr. *Parker* and Mr. *Guy*; those took off all the Books which the Bishop and Dr. *Tates* had lying upon their Hands, and did effectually set upon printing of the Bible in several Volumes: With so much Struggling it was; and with so great Charges, before we could get into a Capacity to print Bibles, without great Loss.

THIS Difficulty being thus master'd, their next Attempt upon us was by a Suit at the Council-Table, about the Year, as I remember, 1679, which put us to 2 or 300*l.* Charges; which was born partly by the University, partly by the Bishop, and partly by our Printers, endeavouring, thereby, to get us restrained from printing Bibles at all, or, at least, confined only to some few Sorts; in which Suit, Mr. *Pitt*, Mr. *Parker*, and Mr. *Guy*, were very industrious, and diligent in soliciting the Business, retaining and instructing the Council, and giving us

us other Assistance, which we could very ill have spared ; the present Bishop of St. Asaph, and other Friends, were likewise assistant to us.

THE Issue of this Suit going for us, their next Attempt was, the setting a Multitude of Presses to Work, to print vast Numbers off, and by selling them cheap, to break our Printers ; so that now the Contest was, whether should print most, and sell cheapest ; whereby the Price of Bibles, for the Advantage of the Publick, was brought down to less than Half of what they were before sold at ; and many hundred Thousands of Bibles, printed and sold, more than otherwise would have been ; and our own People at home, and abroad in our Plantations, furnished from hence, which before were wont to be furnished in vast Numbers from *Holland*, where Bibles were printed, far more than in *England*, because cheaper ; for the King's Printers did not, now, print and sell fewer Bibles, by reason of our Comprinting, but only they sold them cheaper.

THEIR next Attempt on us, was a long Suit in Chancery, for two or three Years, to the Charges of a great many hundred Pounds, born as before, partly by the University, partly by the Bishop, and partly by our Printers ; wherein we thought, the Lord-Keeper North bore very hardly upon us (and was afterwards convinced that he had done so) but did at length dismiss us, to a Trial at Common Law : After which, if there were Occasion, it was to return again to Chancery.

AFTER this, they vexed us with two Suits at Common Law, which are yet depending ; one in the Name of the King's Printers ; the other in the Name of the Company ; to which we were fain, at great Charges, to put in Pleas, and to have it agreed at the Barr divers Times ; but finding the Court inclinable to do us Right, they have, by delaying Proceedings, kept it off from Judgment, and the Suits are still depending.

THEY

THEY then prevailed with the Bishop of Oxford to separate the Interests; and whereas before, while Dr. Yates was alive, they had let the whole to our Printers, at 200*l.* and left it to them to agree with the Company, upon the Point of Forbearance, who knew, better than we did, how to hold the Company to their Agreement: The Bishop would let, to our Printers, the Business of printing Bibles and Common-Prayer Books at Part of that Sum, and agreed with the Stationers for another Part of that Sum, to forbear printing their Copies; and this by Agreement between the University and the Stationers, for three Years, with a Clause of Renewal after that Time.

THE Stationers now being got free of our Printers, who knew how to keep them to Terms, (better than we) they broke with us: They paid their Rent for about one Year, but then first delay'd, and then refus'd to pay their Rent, till there was five Quarters behind, and told us we should be paid all the next Term, upon the *Quo Warranto*.

FOR in the Interim of this their Delay, to pay their Rent, they had caused a *Quo Warranto* to be brought against the University, of which they hoped the like Issue, as of the other *Quo Warranto*'s; towards the obtaining of which, we are told of a Plate of 500 Guineas went one Way, and a Tun of Wine another Way; and 300*l.* allowed to *Henry Hill* upon his Account, for secret Service; and of a Bible to be presented to somebody (with silver Clasps and Bosses, &c.) which cost 60*l.* the Binding; but these being Works of Darkness, I cannot tell what to say to them; but this we are sure of, that the *Quo Warranto* was brought, and that 14 of the chief Men of the Company did, at once, attend at the Attorney-General's Chamber, when it was there to be argued; though they would

would now persuade us, that it was only *Henry Hill's Doing*.

For this Arrear of Rent we did commence a Suit, (which is, I think, yet depending) but the *Quo Warranto* being then actually brought (which they hoped should pay all their Debts) we were advised, as a quicker Way (they having broken their Articles, by Non-Payment of Rent) to forbear no longer, but comprint upon them, which presently brought them to Order; and, (notwithstanding the *Quo Warranto* depending) brought down their Money, and would have paid, not only the five Quarter's Arrears (for which we had commenced the Action) but another Quarter's Rent too, which we could not safely receive, because we had comprinted upon them; but would not pay those Arrears, unless we would take that further Rent; and so that Arrear, and all the Rent, ever since remains unpaid by them to this Day.

'Tis true, that *Parker* and *Guy* did then deposit, with the Vice-Chancellor, Dr. *Ironside*, that Arrear of 240*l.* or rather so much Money instead thereof, and all the growing Rent ever since; and also, at their own Charge, of 200*l.* at least, maintain that Suit of the *Quo Warranto*; which Kind of Law-Suits were wont to be partly born by the University, and by the Bishop, hoping, in Time, to make themselves whole again from the Company, but (for some Reasons) cannot do it yet; and never meant, if they continue our Printers, to trouble the University to get in those Arrears, or Charges, because they think they can get it in, easier than we can, if we do not disable them.

But if we take our Power out of our own Printers Hands, whose Interest it is, as well as ours, to preserve it, and put it into the Hands of those, whose Interest it is to destroy it, we shall disable both them and ourselves for recovering those

those Arrears or Charges ; and whatever Agreement we make with them, we may expect (upon the first Opportunity) to have them broken, as hitherto they have been ; and if we once let fall our Printing, we can never hope to recover it again ; for where shall we find another Dr. Tates, to furnish us with such another Stock, and run through the many Difficulties to re-establish what we now have, and may continue, without Trouble, if we please.

ON the other Hand, I do not know that *Parker* and *Guy*, who are now your Printers, have ever failed in paying you, to a Penny, whatever they promised ; nor do I find that the Company do charge them to have ever failed in any Agreement made with them, tho' but verbal.

THIS is the Account, which, as to Matter of Fact, I can on the sudden give you, from

SIR,

Yours to serve you,

JOHN WALLIS.



Dr.

Dr. Hook's Description of some Instruments for Sounding the great Depths of the Sea, and bringing Accounts of several Kinds from the Bottom of it. Being the Substance of some of his Lectures, in December, 1691.

In the *Philos. Transact.* N. 9. and 24. we have a Description of an Instrument, to sound the greatest Depths of the Sea: But there were two great Difficulties that attended it: The first was, That it was necessary to make the Weight, that was to sink the Ball, of a certain Size and Figure, so proportioned to the Ball, as that the Velocity of them, downwards, when united, should be equal to the Velocity of the Ball alone, when it ascended in its Return; in Order to which, it required to be prepared with Care, and required also some Charge, it being almost necessary to make it of Lead, of a certain Weight and Figure. The other was, the Difficulty of discovering the Ball at the first Moment of its Return, which was likewise of absolute Necessity; and it was likewise necessary to keep the Time most exactly of its Stay, or Continuance, under the Surface of the Water, by the Vibrations of a Pendulum, held in one's Hand; for I was inform'd, that, upon Trial, they have, after some Time, perhaps discover'd the Ball floating in a Place, where they did not at first expect it; and so that Experiment became insignificant, tho' they were at the Charge of losing the leaden Weight, and had used all Diligence to keep the Time, and to watch for the first Appearance of the Ball.

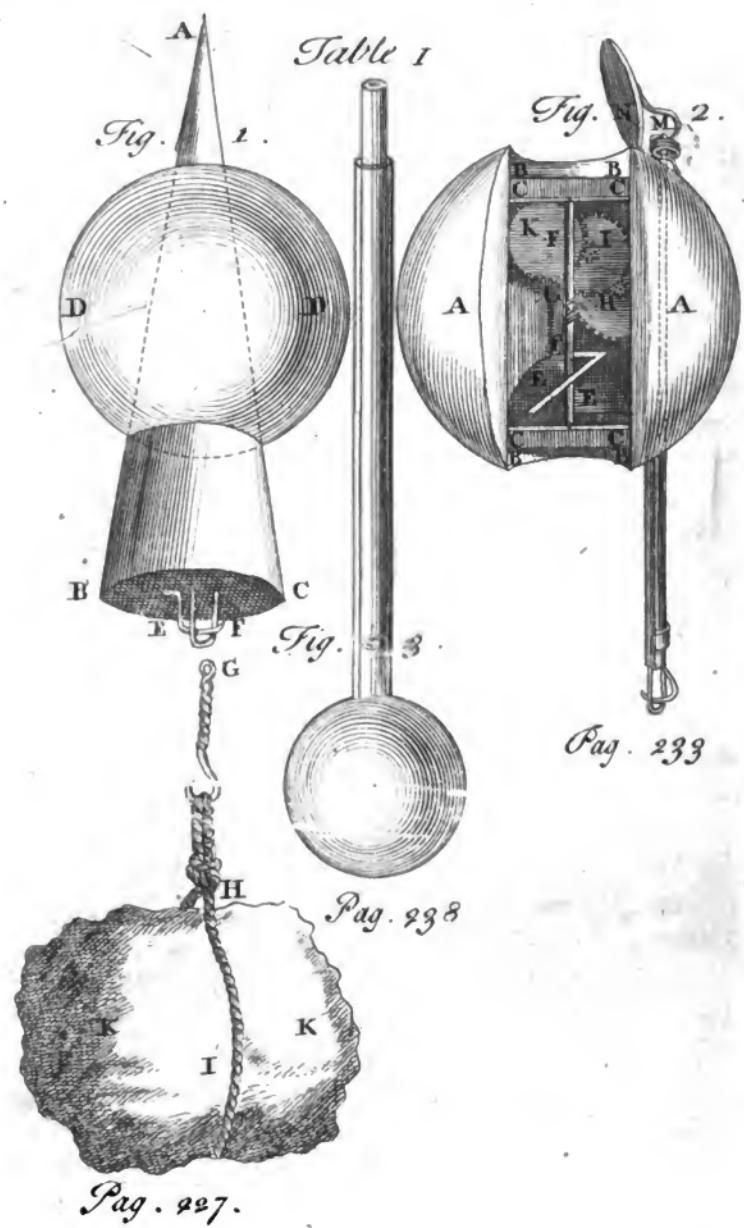
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THIS Way, which I shall now explain, is freed from all these, save only of finding and recovering the Ball, after it is returned from the Bottom; for I have no Need of proportioning my Weight, provided it be heavy enough to sink, nor of making it of this, or that Figure, or of Lead, or any other Metal, since a Stone, if big enough, of any Shape, will do; nor have I any Need of counting the Time of its being under Water, since it will do as well, if I procure the Ball an Hour after it floats; so that all the Trouble is, the fetching in the Ball, when 'tis discovered, and the letting it into the Water, when it begins to sink.

IT remains therefore only to describe the Means and Way, how this Matter is to be effected, and 'tis, in short, no other than what I then experimented, and gave an Account of, in Writing, to this Society; as, I believe, will appear by the Register of that Time, which was, as well as I can remember, in the Year 1661, or 1662; but because few here, now present, may remember it, I shall now again describe it.

IT consists then of three Parts; the first is a Stone, of a sufficient Bigness, to sink it to the Bottom, how deep soever; and the bigger the Stone be, the more Expedition doth this Messenger make to its Stage. Secondly, of a wooden Ball, well pitched, which is carried down, by the Stone, to the Bottom, which then leaving it, it returns, with Speed, to the Top, and there floats upon the Water, from whence it is to be fetched aboard. Thirdly, of a Cylinder, Cone, or Hyperbolick Trumpet, that is to bring back the Information to what Depth it hath descended; this is fastened to the Ball, in the Manner described in the Figure; and at the Bottom of this is fastened the Cock, or Crook, by which they are both pulled down to the Bottom, and then let loose, as was practised



on the former, described in the *Philosophical Transactions*.

THE Cylinder, Hyperbolick Trumpet, or Cone, (Tab. III. Fig. 1.) ABC is to be hollow, made of Tin, or thin Brass, and so contrived, as, by a small Hole, to receive the Water into it, less or more, according to the external Pressure at the Apex A, of the Fluid it descends in; so that it will always, by the Quantity of Water contain'd in it, give a true Account of the Pressure of the Water, at the Bottom, which is always proportionate to the Depth of it, below the Surface; this is shewn by the Compression of the Air included, whose Dimensions are always in reciprocal Proportion to the Pressure. This is to be found after the Ball is returned from the Bottom, by weighing the Quantity of Water, contain'd in the Cone, or other Receiver, and comparing it with as much Water, as will exactly fill it, or by a Measure of Capacity; or thirdly, if the Receptacle be perfectly regular, by a gauging Rod set in its Axis; but the best, and most sure Way, I take, to be by Weight. D D is the Ball, made of light Wood, and well pitch'd, and of sufficient Eigness, to raise up the Cone, with its contained Water, as soon as it is discharged from the Stone or Weight. K K, which is to be of a Weight sufficient to sink it, and then slip from it, at the Bottom, by Means of the Spring-Hook; E F G the Ring to be hung upon the Hook; F H I the Cord. There is nothing in the Contrivance, but what is easy to be made, and the Charge will not amount to a Farthing a Trial.

*Emissarius secundus ad fundum Abyssi, sive
Explorator Distantiae Inanimatus.*

T H E Opinions, concerning the Abyss, seem to have been received, and conveyed to us, from the first and most ancient Times of the World. And we find that *Ovid*, tho' he seems to have understood the Earth to be Spherical, yet he, speaking of the Creation, and first Production of Things, (of which, no doubt, he received his Information from the Writings of *Moses*, or some other that had seen them) makes the Water to be the lowest of all the Elements —— *Circumfluus humor ultima possebit solidumque coercuit Orbem.* I had no further Intention, but to shew, that the Sea was call'd the Abyss, and by the Abyss was meant a Depth, not possible to be sounded, or measured, by the Power of Art: But it is more properly rendered, by our English Translation of the Bible, *the Deep, or the great Deep*, (when the Depth of the Sea is meant) than by the Abyss in the *Vulgar*; yet there are several Expressions that do shew, it was understood to signify a Depth, that was beyond the Power of Man to measure; and so it seems to be meant in the first Chapter of *Ecclesiasticus*, where 'tis said, *Who hath measured the Height of Heaven, the Breadth of the Earth, or the Deep*; that is, the Profundity of the Sea. And so the Expression in the 37th Chapter of *Job* seems to intimate: The Expressions in the Scripture, relating to Physical Matters, being accommodated generally to the most common and believ'd Opinions of Men, concerning them. Certain it is, that no one, yet, hath experimentally found what the greatest Depth of it is, except only in such Places as are measurable by Lines and a Plumbet, and that, for the most Part, near some Land. The greatest that

that I have met with, of that Kind, which I can rely upon, is, what Mr. John Greaves relates, that he tried in the Sea. The Passage is in the 102d Page of his *Pyramydo-graphia*. In the Longitude of 11 Degrees (says he) and in the Latitude of 41 Degrees, having borrowed the Tackling of six Ships, and, in a calm Day, sounded, with a Plumbet of almost 20 Pound Weight, carefully steering the Boat, and keeping the Plumbet in a just Perpendicular, at 1045 English Fathoms; that is, at about an English Mile and a Quarter, in Depth, I could find no Land or Bottom. These are his Words; but where this Place was, I cannot define, because he does not declare from what Meridian he computes his Longitude: Whether it were in the Ocean, to the Westward of Portugal, or in the Straights, about Marseilles; where-ever it were, it was an excellent Place, to have tried many curious and instructive Experiments, that might be there tried, by such as have Opportunity to go that Way again, if it were certainly known. But this Depth is nothing, in Comparison to what Hesiod supposes it, or *Tartarus*, which is the same Abyss; namely, as deep downwards, as the Heaven is high upwards; and that he asserts to be so high, that an iron Axe would be 10 Days in falling, before it would touch the Earth; and just so long would the Axe be falling, before it would arrive at *Tartarus*. But to leave these Poetical Fictions, certain it is, that the Sea is, in some Parts of it, very deep, and it would afford many useful Informations, if Inquiries were carefully made, by Means of my *Explorators*, or *Nuntii Inanimati*; for by some, or other of them, one might be ascertain'd of divers Things, yet, never known to Mankind. That which I described, the last Day, was, for measuring the Distance, which it would effectually do, were it not for one Objection or two,

which may possibly render its Account disputable. The Power of the Spring of the Air, is most certainly in reciprocal Proportion to its Dimensions, to whatever Bulk the same Air be reduced to, by Compression; 'tis certain also, that the Compression, or Trusion, of a fluid Body, is always in Proportion to the Length of the Cylinder compressing; so that the Power of compressing of any one Cylinder, of a certain Height, being known, the Power of any other Cylinder, whose Length is given, is easily found. The like is to be estimated concerning the Powers of the Resistence of the Air, if its Power of Expansion, or Resistence to Condensation, be known, for any one Expansion, or Dimension of it; the Power of Expansion is known, for any other Dimension of it given. So that both the Principles, upon which the last Day's Experiment was founded, are undoubtedly true and genuine, and consequently the Invention, thereupon founded, would succeed; and then, the first *Nuntius Inanimatus* would be a true *Explorator Distantiae*. But there are two Things that may make its Information dubious; the first is, the Uncertainty of the Temper, as to Heat and Cold, in those very deep, sub-marine Regions. For we know that Heat does augment the Power of Expansion in the Air, and Cold doth diminish it; and therefore it will be uncertain, whether all the Contrusion of the Air, at the Bottom, be to be ascribed to the Gravity of the incumbent Cylinder of Water, or to the Coldness of the Water of those Regions, in Part; till therefore the Temperature of those Regions be known, we cannot positively affirm, what Part of its Condensation was to be ascribed to the incumbent cylindrick Weight of the Water.

Explorator

Explorator Temperamenti.

To know this, I have another Messenger, call'd *Explorator Temperamenti*, which shall fetch a true Account thereof; and so that Objection, or Impediment, would be easily enough removed, if Need were.

BUT there is another Objection (which is also very material) against the aforesaid Method, and that is this, That, as 'tis true, that if the Water, at the Top and the Bottom of the Sea, were all of an uniform Nature, then the Rule for its Gravitation, or Pressing, would hold exactly according to the Rules of Proportion, I have before premised, and the Deductions therefrom would be indisputable; but if there be differing Sorts of Water, in differing Depths, as no one has yet ascertain'd us of the Contrary, then differing Sorts of Water will give differing Degrees of Gravitation, or Pressure; and the Proportion I have assign'd, for an uniform Cylinder of Water, will no longer be of Use; for if the Water in *Specie* be heavier, (as most probably it is) then a shorter Cylinder of it will have the same Power to press, that a longer Cylinder hath, of a Water lighter in *Specie*; so that if the Water be twice as heavy, half the Weight will produce the same Effect; and if thrice the Weight, then a third Part of the cylindrick Weight will be only necessary; and if it should be as heavy as Quicksilver, or indeed as heavy as the Stone, or Weight, that sinks the Ball; then the *Explorator* will not dive into it at all, but stay at the Top of it. It is necessary therefore, that we be ascertain'd of the Nature and Condition of the Water, or Liquor, whatever it be, at the Bottom, or in those lower Regions, at any assignable Depths.

Explorator Substantiæ.

AND for these Purposes I have other *Explorators*, that shall bring me a certain Account, what Kind of Water, or other Liquor, it is that possesses such, or such a Depth, be it 500, or 1000, or 1500, or 2000 Fathom deep, or any other greater, or less, assignable Depth; these I call *Exploratores Substantiæ*, and of these I have several Kinds, according to their several Employments and Business. There is yet another Scruple that must be removed also, and that is, Whether the Gravitation, towards the Center of the Earth, do continue the same, at any Depth; or whether it do increase or diminish, according as the Body is posited lower and lower, beneath the Surface of the Sea; for if Gravity do increase, then the Body will move downwards, or sink faster, than at the Top; and if it decrease, it will do the Contrary. Now there have been many, and, among the rest, the incomparable *Verulam*, that have affirmed, that Stones, &c. in the Bottoms of deep Mines, do weigh much lighter, than at the Top; if so, why may not that be true also, of the Depths in the Sea: However it be, it is desirable, in Philosophy, to be ascertained, whether it be so or not; and if it be so, what the Differences really are; for which Purposes I have other *Nuntii* or *Explorators*, that shall certainly inform me, concerning those Particulars also. There are many other particular Inquiries, which one would desire to be ascertain'd of, which I shall afterwards mention, and also furnish or supply Messengers, sufficiently accoutred, to bring back Informations, certain and instructive. But I shall not trouble you with them at present; but if there be an Opportunity of trying these I have named, and many other I could enumerate,

I shall

I shall be ready to give my Assistance: They are Experiments indeed, not to be tried in the Presence, or at the Meeting of this Society, but yet they are such, as it were, very desirable, that the Society had a true Account of them; as there are also Thousands of others, which, it were to be wished, this Society would procure Informations of; which, I conceive, is in their Power to effect, if due Means and Methods were made use of, for effecting those Ends. The Harvest is great, but the Labourers are few; and without Hands and Heads too, little can be expected; and to rely only upon Time and Chance, is, probably the most likely Way to have all our Hopes frustrated.

Explorator Profunditatis.

BUT to leave this Digression, I shall, at present, only describe another Messenger, who is to be *Explorator Profunditatis*, or a true Surveyor of the Distance, which is not at all liable to the Uncertainties of the last, or any other, as I conceive; for be the Heat or Cold, of that Climate, what it will, or whatever the Density or Rarity, whatever the Gravity or Levity of the Water, whatever the gravitating Power, whether the same, greater, or less, whatever the Spring of the Air be, &c. none of these, or any other, that I can think of, will be material, but the Messenger will return, with a true Account of what he was sent to inquire.

THIS *Explorator* has divers Parts, much the same with the former; as first, a large Ball of Wood, or (*Tab. III. Fig. 2.*) some other convenient Material, which may be able to rise from the Bottom, after the Weight, that sunk it, is separated from it; this

Ball

Ball is marked in the Figure by A A ; this has a cylindrick Hole, B B B B, open quite through the Middle of it, that the Water may pass freely thro' it, as it descends to the Bottom ; in this I place two Plates, C C, C C, edge-wise, to the Passage of the Water, which have each a Center-Hole to receive ; and hold the Pivots of an Axis F F, so as to move freely therein : Upon this Axis are fastened 4 Vanes, in the Manner as I have formerly describ'd, for Measuring the Way of a Ship thro' the Sea ; these are marked with E E E ; this Axis has a Screw Pinion on it at G, which every Revolution turneth one Tooth of a Wheel of Account, H, whose Pinion turneth I, whose Pinion turneth K, &c. these keep a certain Account, how many Revolutions the Vanes do make, in their Passage to the Bottom ; and the Revolutions do measure the Body of Water, they have passed thro', in their whole Descent ; but that the Rising of the Ball may not cause the Vanes to return backwards, I have several Inventions ; that I shall mention, at present, is very easy, namely, a Lid, or Cover to the cylindrick Passage, which is shut so soon as ever the Weight leaves the Ball, which I effect by the Spring M, which is kept down close to the Ball, whilst it is descending, but springs up so soon as the Weight is left, it shutteth the Cover N, which stops the cylindrick Hole.



Dr.

Dr. H o o k's Lecture, read Dec. 16. 1691.

In my preceding Lectures, I have described two of my *Nuntii Inanimati*, or *Exploratores Abyssi*, whose Business it is to bring back a certain Account of the Distance, or Space, between the Top and the Bottom of the Sea, which I made Choice of, in the first Place, to equip, they being previous, and the Forerunners of all the rest. The first of these, tho' it would do well enough in moderate Depths, where there is no great Difference in the Temperature of the Water, as to Heat and Cold, and other Qualities; yet in greater, especially in very profound Depths, I conceive, it may be liable to Uncertainty, for the Causes I did the last Day mention; which to prevent, and obviate any other Cause of Doubt, which I could, or can yet think of, I did contrive the second *Explorator Distantiae*, which I described the last Day; the Contrivance of which is such, as, I conceive, will most exactly measure the said Distance, and bring back the true Account thereof. The Way I mention'd, the last Day, was contrived only to measure the Length of its Descent; which, I conceive, will be sufficient Assurance of the Extent, or Depth, thereof. However, if any shall desire to be more ascertain'd of the Truth and Exactness thereof, I have contrived a Variation of, or Addition to, the same, which is only another Prismatick Box, or Hole, with the same Kind of Helical Vanes and Wheels of Account, as the former had, which is so adapted to the Float, and contrived, that, all the while the Weight is descending, this additional Way-wiser shall stand still; and so soon as ever the Float is freed from the Weight that sank it, and it begins to ascend, this doth

doth then begin to move, and so continues, till it arrive at the Top of the Water: So that as the former did measure the Length descended, so this doth measure the same ascended; which if they be found to agree, twill be a double Confirmation of the Certainty of the Experiment. I know it will be objected, that this will make the *Apparatus* very chargeable and difficult; and (as seeming complicate) to be apt to be out of Order; and few will use the Caution and Circumspection, that such an Instrument will necessarily require: To which I answer, that I can make the whole so easy, and obvious, that the whole Instrument need not cost above a Crown; and that any one, almost, shall be able to make, or to mend it; and any one, that can but write and read, can be able to make Trial therewith, and keep Account thereof; nor will it easily be so out of Order, but that it may easily be mended, and set to Rights again. This, I conceive, will do; all that needs to be done, to perfect this Enquiry, which being the first, and principal, I have been the more curious, to obviate all Objections, and to reduce it to as easy and plain a Way, as can well be desired, considering the many Difficulties which are to be provided against. I have not made a Module of this third, and most compleat Contrivance of all the three; but I have prepared a Draught, so that those, who understood, and remember the Contrivances of the first and second, will easily comprehend the Fabrick of this.

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The Third Explorator Distantiæ.

A A represents the Ball, or Float of Wood, through which is put B B, a Stick fixed on the Top of it, for the more notable Sign, or Signal, (by which to find it, in the Sea, after its Return) but bigger, and more substantial downwards, that it may be the more fit to hold the Staple, and Hook at the Bottom C C, and likewise the Cross-Piece E E, which passes through a Mortice made in it, and is thereby kept at Right-angles with it ; upon the Ends of this Cross-piece, E E, are fixed two prismatick Boxes, F F, and G G ; F F is the Box that holds the Vanes and Way-wiser, made after the same Manner, as was that of the second Module, which I shew'd the last Day, with no other Difference, but that in this Contrivance, the Box is shut by the Water, so soon as ever it begins to ascend, without any Need of the Spring which I had made in the second ; and that the Box is made to open one Side, the better to fix the Vane and Way-wiser ; and likewise the Inside of it is square, the better to be kept steady in the Water, so that it shall not be winded, or twisted by the Helical Vanes ; which it would be more apt to be a little, if the Hollow of it were truly cylindrick. (*Table IV. Fig. 1.*) G G is exactly the same Kind of prismatick Box, with Vanes, and Way-wiser, as the former, but it is perfectly inverted, with respect to the former ; for in the former, the Valve, or Lid to cover it, is placed, or fixed by Hinges, to the Top, so that the Water shuts it, and keeps it so, all the while it ascends. In this, G G the Valve, or Lid, is placed at the Bottom, and remains shut all the Way it descends ; but so soon as it begins to ascend, 'tis opened, and the Vanes are turned by the Boxes passing through the Water.

Water. The Contrivance, for the opening and shutting these Lids, is by an equal Flat, fixed on the Axis of each, at Right-angles with them, that of the ascending Way-wiser, G G, is drawn, and marked with H H in the Figure. Thus, I conceive, I have sufficiently accoutréed my first *Explorator*, who is to inform me of the Depth; and is, indeed, to be the General Post that must fetch me all the other Informations I desire.

The Thermometer, or Explorator Temp- raturæ.

IN the next Place, I desire to be informed of the Temperature of those lower Regions, as to Heat and Cold: And for this Purpose I have contriv'd a Thermometer, that shall certainly inform me; this is nothing but a small Bolt-head, filled up with Spirit of Wine, to a convenient Height of the Stem, with a small Embolus and Valve; the Embolus is made so, as to be thrust down the Neck, as the Spirit of Wine shall be contracted by Cold; and the Valve is to let out the Spirit of Wine, when it is again expanded with Heat, in its Ascent; 'tis very plain, and easy to be apprehended, especially when that is viewed, which I have here provided: It may, possibly, be thought that the great Pressure, of the incumbent Body of Water, may contribute somewhat to the Contraction, or Shrinking, of the Spirit; but tho' I am inclin'd to think, that That will not cause any sensible Variation, yet, to try that, I shall shew a Means how it may be discovered; which Discovery, of it self, will be a Discovery very considerable, (*Tab. III. Fig. 4.*) because none of the Ways, that have hitherto been attempted, have proved effectual,

effectual, for the Condensation of any Fluid, by Pressure only, though there have been made many Experiments, by this Society, on Purpose for such a Discovery.

Explorator Gravitationis.

NEXT I desire to be informed, whether the Pressure of the Water do exactly keep the Proportion which I have assign'd it: And for this Purpose, the perforated Cone, described in the first *Explorator*, sent down, and brought back with the *Thermometer*, will give an Account thereof; for by the *Thermometer*, (*Table III. Fig. 1.*) we shall be informed, what is the Degree of Cold, and consequently we shall know, what Part of the Condensation of the Air, in the Cone, is due to that, and consequently what Part is to be ascribed to the Pressure; and by the Way-wiser, or third *Explorator*, we are assured of the Depth, and consequently we may know, whether those do answer to each other, according to the Theory, or Proposition assigned.

THIS I mention, to shew that no one of the Instruments, I have already described, or shall, for the future, explain, are useless, or superabundant; for that, before I leave this Subject, I shall shew for what peculiar Use each of them is principally designed, tho' many of them will not only serve for that one, but for the Assistance of many others; where they will be of as necessary a Use, in Comitance with others, as they are singly necessary for that End, for which they were principally designed.

It may possibly be queried, why I make use of Spirit of Wine to fill my Thermometer, and not of Water, or other Liquor: To which I answer, That first I found so many Trials, which I purposely made, to perfect that Kind of Thermometers, (of which, I believe, I made the first that were made in *England*, from the Sight of a very small one, brought out of *Italy*, about 30 Years since, by the President) that this Spirit was the most sensible of any Liquor, I could then meet with, of the Degrees of Heat and Cold. And secondly, because this Liquor was capable of enduring the greatest Degree of Cold, I could give it, by the Means of Salt and Ice, and yet remain'd fluid, without Congelation, but did continue to shrink to the last. Now what the Temper of the Sea may be, at those vast Depths, whither this is design'd to be sent, no Man now living, or ever did live upon the Earth, hath experimentally known, (as I am, with good Reason, perswaded). But, by Conjectures, one may be induced to expect, that the Cold should be there very predominant, and, in Probability, such as would congeal, and turn to Ice, a Body of fresh Water. And 'tis, in Probability, one of the Causes that the Sea was made to abound with Salts, by the Divine Providence, who adapted every Thing to its proper Use and End; for 'tis very hard to suppose, that the Heat of the Sun should communicate so powerful an Influence from the Top, or Surface of the Sea, downwards; for the Parts of any uniform Fluid, that are warmer than the rest, are also lighter, and consequently will ascend upwards; but that the heated Particles, at the Top, should sink, or descend, 'tis not to be supposed. Again, that the Light, and, possibly, somewhat of the Heat of the Sun, may be communicated to the Bottom, if the Water be clear, 'tis not to be denied,

denied, but then it must be so small a Part, of what we see necessary, to keep fresh Water from freezing here above ; first, by reason of the Quantity reflected by the Superficies of the Water ; and secondly, by the Opacities, that must necessarily obstruct their Passage, thro' so vast a Thickness, that no Part, near the Poles of the Earth, can receive so little Benefit of these two Qualifications of the Sun, as these Parts must needs do. It seems therefore reasonable to me to suppose, that where there is such a Defect of Heat, Nature does supply a more copious Quantity of Salt, or some other such Body, as is able to resist Congelation, whether Saline or Metallick ; as Quicksilver, or such like, Time and Experiments may inform us : Which Experiments, how they may be made, I shall, the next Day, inform you, and furnish you with such Emissaries, as shall bring back a true Account of what Kind of Substance the Mass of the Sea is composed, at any assignable Depth, not only at the Bottom, but of any interjacent Part assigned, between the Top and Bottom.

Lecture read Dec. 23. 1691.

I HAVE, in my preceding Lectures, endeavoured to shew by what Methods, and by what Kind of Instruments, we may be experimentally ascertain'd of several desirable Informations, about the lower Regions of the Abyss, or Great Deep. As first, and principally, what the Depth of the Sea may be, in any Place we desire to measure it ; and this by several Instruments of differing Construction, and upon different Principles ; the last of which, I conceive, to be so compleat, and perfect, as to obviate any Objection that can be made

R. against

against it; as particularly that which was objected the last Day, that if the Water should move upwards or downwards, (tho' such Kind of Motions cannot, with any Ground, or Probability, be imagin'd, or supposed, since the Bottom, or Ground, is a Bound to the Water below, and the Superficies, or Air, is a Bound to the Water above; so that unless there be a Vent one Way, that is downwards into, or out of the Earth, or upwards, into the Air, there can be no Reafon given why there should be such a Motion) but it may be said, that there may be, in some Places, some such *Voragoes*, as Father *Kircher* imagines, in his *Mundus Subterraneus*; that is, such subterraneous Passages, as convey the Water of the Sea from one Place to another: of which Kind he tells us of many, tho', I doubt, it will be difficult to prove any one of them. I know, indeed, that Mr. *Hacluit* hath taken a Passage out of *Gerrardus Mercator's General Map*, which doth hint at some such Extravagancies; his Words are these:

‘ Touching the Description of the North Parts,
‘ I have taken the same out of the Voyage of
‘ James Crogen, of Hartzeron Buske, which al-
‘ ledgeth certain Conquests, of Arthur, King of
‘ Britain; and the most Part, and chiefest Things
‘ among the rest, he learned from a certain Priest,
‘ in the King of Norway’s Court, in the Year
‘ 1364. this Priest was descended from them,
‘ which King Arthur had sent to inhabit these
‘ Islands; and he reported, that in the Year 1360,
‘ a certain English Friar, a Franciscan, and a
‘ Mathematician of Oxford (possibly he meant
‘ Roger Bacon, or some of his Disciples) who
‘ leaving them, and passing further, by his Magi-
‘ cal Art, described all those Places that he saw,
‘ and took the Height of them with his Astrolobe,
‘ according to the Form that I (*Gerrard Merca-*

' tor) have set down in my Map, and as I have taken it out of the Account of the aforesaid James Crogen. He said, that those four In-draughts were drawn into an inward Gulf, or Whirlpool, with so great a Force, that the Ships, which once entered therein, could, by no Means, be driven back again, and that there is never so much Wind, in those Parts, as to drive a Corn-Mill.

Geraldus Cambrensis (who flourished in the Year 1210. under King John) in his Book of the Miracles of Ireland, hath certain Words altogether alike with these; viz. ' Not far from these Islands (namely the *Hebrides, &c.*) towards the North, there is a certain wonderful Whirlpool of the Sea, whereunto all the Waves of the Sea, from far, have their Course and Recourse, as it were, without a Stop; which (these conveying them into the secret Receptacles of Nature) are swallowed up, as it were, into a Bottomless Pit; and if it chance that any Ship do pass this Way, it is pushed, and drawn with such Violence of the Waves, that eftsoones, without Remedy, the Force of the Whirlpool devoureth the same.

' THE Philosophers describe four In-draughts of this Ocean Sea, in four opposite Quarters of the World; from whence many do conjecture, that as well the Flowing of the Sea, as the Blasts of the Wind, have their first Original.' Thus far is Mr. Hacluit's Quotation of Mercator. Mr. Hacluit adds, in the Margin [*There is a notable Whirlpool on the Coast of Norway, call'd Malestrome, about the Latitude 68.*] The best Account of this *Malestrome*, that I can learn, is, that it is a Circulation of the Water of the Sea, caused by some submarine Rocks. But Father Kircher, who is good at Fiction, has found a subterraneous Passage for it, into the End of the *Bothnian Gulf*,

and from thence another, into the *White Sea*, not far from *Archangel*. I grant such a Passage may be possible, but I should be glad to have it proved; or indeed, any one of those many, which *Kircher* has asserted, in his *Mundus Subterraneus*. So that if there be any such Place in the World, it is not yet found out, or proved: And therefore there is no great Cause of supposing many, or making that an Objection against my third *Explorator*, who will perform his Busines, tho' that were actually so; that is, tho' the Motion of the Water were directly upwards, or directly downwards; and not only that, but it will also, over and above, tell you, what that Motion is. This is evident, by comparing the Ascent with the Descent, for half the Sum will be the true Depth, and half the Difference will be the Motion of the Water, whether upwards or downwards, which the Way-wifers will certainly inform you of. But this, I suppose will be needless; however, I was willing to remove the Stumbling-Block, tho' it was but a Straw.

Explorator Qualitatum.

TO proceed then, I shall next shew how to fetch a Quantity of Water from the Bottom, or from any intermediate Space, or Distance from the Top.

THIS I perform, by means of a Bucket, the same I have formerly here describ'd, and verified by Trials; or by another Contrivance not much unlike it, which I shall by and by describe. The former Contrivance will serve indifferently, both for fetching the Water from the Bottom, or from any intermediate Part; but for the intermediate Parts, there is an additional Contrivance, or Invention,

vention, for freeing the Float from the descending Weight, or Stone, after it hath been carried down a certain Number of Fathoms, which the following plain Contrivance will effectually perform, at any determined Distance, let it be 100, 500, 1000, 1200, 1500, 2000, or more Fathoms required, where there is first found to be Depth, sufficient for to make such Experiments, which is necessary to be first well assured of by the third *Explorator Distantiae*; because, if the Depth be not sufficient, that is, if the Stone, or descending Weight, do touch the Bottom, before it hath descended the designed Number of Fathoms, it will detain the Float, and not dismiss the *Explorator*, to return with its Message. The Reason of which, you will presently apprehend, when I have describ'd the Invention for the Performance thereof; tho' yet, with a small additional Spring, it will serve for both Purposes. I make use of the third and last *Explorator* for this Purpose. I fit to it two Buckets of Wood, made, according to the Contrivance I have formerly describ'd*; these are fasten'd to the lower End of the Stick, which pas-feth thro' the Ball, or Float, as I shew'd the last Meeting, and the Buckets are set at Right-angles, to the Bar that carries the Way-wifers, or Mensurators, as appears in the Figure which I have here design'd, where A A represents the Ball, or Float; B B the Stick thrust thro' it; C C C C the Crofs-Bar, for carrying the Way-wifers; D D. D D, the two Buckets, plac'd or fix'd by their Arms E E. E E, to the said Stick, at Right-angles to the Bar; C C. C C. F F. F F represent the Covers at the Top of each; and G G. G G, the Valves, or Shutters for the Bottom; (Tab. II.

* See the Description of these Buckets in Philosophical Transact.
N° 9 and 24.

Fig. 2.) These being within the Box, or Bucket, cannot be well expressed by Delineation, but are faintly design'd by prick'd Lines; and the Description and Modules, I formerly made, do make the Design sufficiently plain. These Valves, or Shutters do stand open and upright, all the Time that the Float descends, and the Water passeth freely through them, changing every Bucket's Length that the *Explorator* descends; but so soon as ever it begins to re-ascend, they are presently closed, and shut into them their whole Capacity, fill'd with the Water in which they then are. This being then understood, for fetching up the Water at the Bottom, how deep soever, there needs no other Contrivance than what I formerly describ'd; for so soon as the Weight doth touch the Bottom, the Float, and all its Furniture, is freed from it, and so is at Liberty to re-ascend, and carry back with it, what it was design'd to fetch. But for fetching up the Water from any intermediate Depth, (as at 100, 200, 500, 1000, 1500, &c. Fathoms below the Surface) I have invented an easy Expedient, which is to let go the Weight, that sinks the *Explorator*, at any Station of Depth design'd. I have already explained the *Way-wiser*, or *Mensurator* of the Depth descended; one of the Wheels of which doth keep Account of every hundred Fathom descended: Upon this Wheel I put on a springing round Plate, with a Hoop about the Edge of it, which hath one Notch in the Circumference, or Hoop; this Notch I can set against any Number of the Plate, in the same Nature as 'tis common for setting the Alarm of a Clock, to go off at a certain Time designed; which, to effect, I have contrived a very easy Expedient, which the third Figure doth represent. (*Table II. Fig. 3.*) Suppose then B B, to represent the lower End of the Stick that hath the Way-wisers and

and Buckets, in the End of which is fixed C c, which is a Staple made of a flat Iron Plate ; between the Sides of this is fastened, by a Pin c, the Hook d e by the End d of which, doth hang the Wire of the Weight ; this Hook is kept in this Posture, by a small Piece of Wood or Iron f g ; the End f is cut sloping, to answer the Slope of the End e, of the Hook d. Now so long as the End g, of the Trigger (as I may call it) is detain'd within the Hoop of the Wheel of Account h b, of the Way-wiser, so long is the Hook, d e, kept firm in the Posture it is here designed, and so retains, or holds the Float and Furniture fast to the descending Weight ; but so soon as the Way-wiser has measured the Number of Fathoms designed, and the Notch in the Hoop be brought to the Place, where the End of the Trigger g may slip out, the Hook has no longer any Power to hold fast to the descending Weight, but presently lets it go, and the Float returns, and the Buckets close, and bring back their Bellies full of the Water of that Part ; or the Temperature, if the Thermometer be hanged to the Stick ; or the Pressure, if the Cone, together also with the Degree of Gravitation.

I SHALL only add one more Enquiry to be resolved of at present, and that is to know, what Alteration so great a Condensation, or Compression, as must necessarily be caused at so great a Depth, will be produced in the Body of the Air, so condensed ; that is, since the Air is but about 7 or 800 Times, at most, lighter than Water, and that 2200 Fathoms Pressure will, according to our Theory, reduce it to as dense a Body ; whether, I say, this Condensation will not actually reduce the whole Body of the Air, so condensed, into perfect Water. This may be easily tried, by letting down, with the Explorator, a small Glass Bolt-head, filled with Air, with the Mouth of the

Stem, or Neck, turned downwards, and contracting the End of the same, by a Lamp, into a small Perforation, to let in the Water thereby under the Air, as it descends, and to let out the Water, if the Air do again expand, as it re-ascends. This is so easy to be apprehended, that I thought it needless to add any Delineation, for the further Explication thereof.

Observations of the Lake-Wetter in Swedeland, made in the Year 1688.

THREE being some Congruity between the following Observations, and that which Dr. Hook had said in his Lectures, about sounding the Sea, I find that he took the Opportunity to entertain the Society with the following curious Relations, by concluding his last Lecture with them. But who the Author of them was, I have not found.

W. DERHAM.

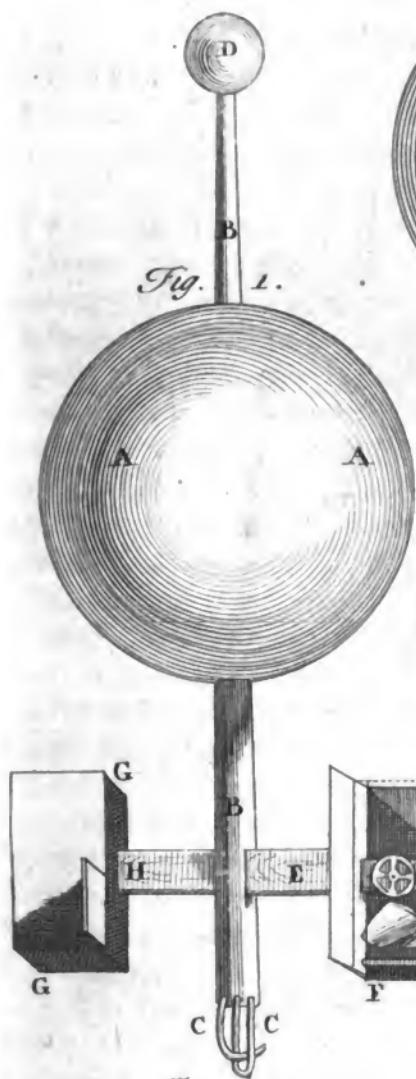
WHEREAS Olaus Magnus, and divers other Authors have related wonderful and unusual Matters concerning the *Lake-Wetter* in *Swedeland*, I thought it worth while, for enquiring, more particularly, concerning the Nature of it, and the Truth of the Relations, to visit the Place my self, one Summer, whilst I went to the *Medivian Acidulæ*; thereby to be informed, from the neighbouring Inhabitants, of good Repute, of what I should enquire, and of what I could not be able to observe my self. The Sum of which I have here comprised, that it may appear, both whatever is there more strange, and also that the Truth of Histories may

may be distinguish'd from Fictions. Geographers have so well described the Lake, that 'twill be lost Labour to add to it. It extendeth from *Askersund*, on the North, to *Jonekopen* towards the South, 14 Swedish Miles, each of which is six English, and ten of them make a Degree; its greatest Breadth three, in some Places only two such Miles. It divides *Gothland* in two Parts; that on the East is call'd *Ostrogothia*, that on the West, *Wefrogothia*; near the Bound of it is a celebrated Mountain, *Abme*; or *Obme*, and near it the City *Wadstein*, and its Castle on the East Side; and opposite to it, on the West Side, is the old Town *Hio*; the Lake, by Reason of Mountains and Hills that encompas it, some with their Cliffs, others at some Distance, to the Spectators always appears depreſſ'd, or funk into the Earth. The Depth of it is very differing, but yet great, in some Places but fourscore Fathoms; but on the Side of *Ostrogothia*, and in some of *Wefrogothia*, no Bottom can be found, at 300 Fathom deep. Of this I was assured, by an Experiment which Mr. *Ericus Simonius*, the Minister and *Præpositus* of *Wadstein*, a Person worthy of Honour and Credit, communicated to me (he, being by long Experience well informed concerning this Place, was highly assist- ant to me by his Information) he told me that not long since, one *Benedictus Amberri*, a Citizen of *Wadstein*, who sounding the *Wetter*, near the Shoar of the City *Grennen*, with some hundred Fathoms of Line, hanging an Axe instead of a Weight to it; and upon pulling it up, he found his Axe lost, and, instead thereof, a Horse Head fast to the End of his Line, but could find no Bottom. Such another Abyſſ is near the Cliffs of the Mountain *Obme*, call'd the *West-Wall*, which has eluded the Industry of all that

‘ that have sounded it ; whence none will approach
‘ that Part, for fear of a West Wind, which, ri-
‘ sing suddenly, would dash them against the
‘ Cliff, there being no Anchoring to hinder it.
‘ So also on the *Westrogothian* Side, the Gover-
‘ nor, Count *John Oxensterne*, desiring to sound
‘ the Depth with 300 Fathom of Line, could find
‘ no Bottom ; as the Fishermen, who made the
‘ Trials, and are yet alive, do testify. The Wa-
‘ ter is very clear, as well as deep, so that a small
‘ Piece of Money may be seen to a great Depth.
‘ Mr. *Ericus Simonius* has seen a small Piece of
‘ Silver, in a calm Day, 60 Cubits deep ; but the
‘ Water, at a greater Depth from the Superficies,
‘ seems tinged with a Kind of Green. And won-
‘ derful ’tis, that notwithstanding such Abundance
‘ of Filth is wash’d into it from the circumjacent
‘ Hills and Woods, yet the Water should not be
‘ sullied. Tho’ this Lake exceeds most for Am-
‘ plitude, yet ’tis free from Rocks, and has few
‘ Islands ; the chief of which is *Visingsoe*, the Seat
‘ formerly of the Counts of *Brabe* : It lies in the
‘ Middle of the Water, between *Grennam* of *Smo-*
‘ *land*, and *Westrogothia* ; and on the North, op-
‘ posite to the *Acidulae Medivientes*, lies the Island
‘ *Rocknens*. Some few other Islands, and those
‘ very small, lie near the Shores ; but the *Wetter*
‘ lying exposed to the Winds, and being encom-
‘ passed with Mountains, ’tis no Wonder that it
‘ lies seldom quiet, but is continually ruffled with
‘ Storms and copling Seas, which does sufficiently
‘ toss the Vessels on it ; and this oftentimes hap-
‘ pens so suddenly, and unexpected, that its Sur-
‘ face, being as smooth as a Looking-glass, becomes
‘ to be secretly moved, before any the least Breath
‘ of Air can be felt ; which seems to be caused by
‘ a Storm in some other Part of it, that communi-
‘ cates it under Water, before it can arrive above

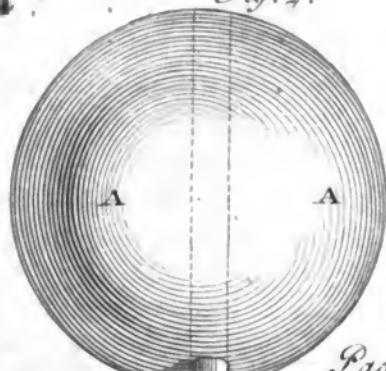
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Table



Pag. 237.

Fig. 2.



*Pag.
245.*

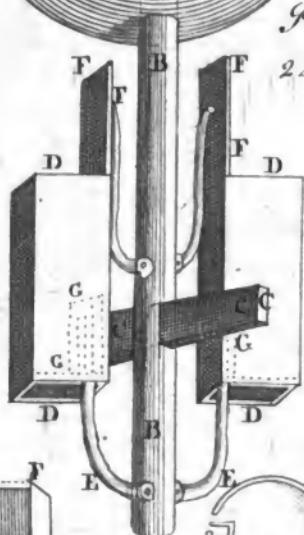


Fig.

Pag. 246



to front p. 250

‘ by the Air ; for it often happens, in the *Wetter*,
‘ that Ships are ruffled, and driven with Storms
‘ in one Part, whilst others, hard by, are rowing
‘ and becalm’d ; which is a plain Sign that these
‘ are caused by the Eruption of subterraneouſ
‘ Winds, as *Varenius* explains them, in his Gene-
‘ ral Geography. Divers Phænomena confirm this
‘ Suspicion : For, upon the approaching of a
‘ Storm, and Tempeſt of Rain, there is perceiv’d
‘ a Rumbling, or thundring Noife, of the Water,
‘ whilst the Air is yet ſerene and calm ; which
‘ happen’d to me alſo going to the *Acidulæ* ; for
‘ I heard that Thundring, whilst the Air was moſt
‘ calm; but always a whirling Storm preſently fol-
‘ lowed. This the Inhabitants of *Wifingſoe* do
‘ more plainly know ; who, lying opposite to thoſe
‘ Islands whence the Storm comes the next Day,
‘ do hear this thundring Noife, like the Discharge
‘ of Cannon. And when this Roaring is heard
‘ from the Eaſt, the Eaſt Wind rageth, with Hail
‘ and Rain. The ſudden Huffing of Vapours, and
‘ Riſing and Gathering of them together, which
‘ ſome have remarked in this Lake, are worthy
‘ Notice. Some ſuch thing the Architect *Abrabam*
‘ *Winandz* (paſſing theſe Coaſts with his Compa-
‘ ny) obſerved, not without Admiration, that the
‘ Water being yet calm, there were darted out,
‘ as ’twere from the Bottom, certain ſmall Clouds,
‘ which, coalescing together in the Air, infested
‘ the Travellers all Day with ſmall Rain ; all
‘ which do conſpire to prove theſe subterraneouſ
‘ Winds.

‘ To the ſame Cause, without doubt, ’tis, that
‘ the Ice in the Spring is one Hour ſo thick and
‘ ſtrong, as to bear Horses and Trahys, upon the
‘ Coming of a Storm ; the next Hour, thoſe, that
‘ were ſecurely carry’d in theſe Tra’ys on the Ice,
‘ may as ſafely navigate the Lake in Boats, the
‘ Ice

' Ice so suddenly breaking and disappearing. But
' before such Kind of Ruptures happen, there
' is heard a Roaring of the Water, which,
' with Terror, warns the Travellers to fly off;
' though oftentimes such, as are far from the
' Shore, are either drowned presently, or, with
' great Difficulty, at last escape on Pieces of Ice.
' Sometimes also the Ice suddenly sinks, when the
' Air is not in the least moved. Now, whether
' metallick *Halitus*'s may contribute to the Rai-
' sing these subterraneous Winds, for the present,
' I shall not dispute: But that such are not there
' wanting, the divers Mountains that encompass
' the *Wetter* on the North, and the *Westrogothian*
' Shores, richly furnish'd with Iron Ore, and also
' with others more rich lately discover'd, and
' others also, as *Antimony*, *Magnesia*, *Mica Sterill*
' but shining, the Species of *Galæna*, *Ochre*, *Py-
rites*, &c. whence have been extracted *Sulphur*,
' *Vitriol*, *Alum*, and other mineral Juices, do
' plainly prove. Nay, the Water affords great
' Quantity of *Pyrites*, and a Kind of Iron
' *Ocbre*; divers Pieces of which I my self, for
' Curiosity, collected. To these also are to be
' ascribed the *Ignes fatui*, frequently observed not
' only upon the Shores; but, in the Night, up-
' on the Middle of the Lake, they fly to and fro,
' and confound the Fishermen; which are gene-
' rally ascribed to an Increase of metallick and
' sulphureous Vapours: Nor are the *Granates*,
' *Porphyrries*, *Jaspers*, *Chrystals*, and divers other
' choice Stones, such as were heretofore collected
' by the Count *Peter Brabe*, and by Art reduced
' to such Lustre as to be used for Marriage Jewels
' at *Wisingburg*, to be believed to be generated
' without mineral Steams: For, all these are the
' Off-spring of Minerals, as are also the *Acidula*
' *Medivienenses*, of which more another Time.

BUT

‘ But among many other strange Qualifications
‘ of our Lake, we must not pass over the won-
‘ drous submarine *Vortices*, and pertinacious Tor-
‘ rents, which cause great Trouble to the Fisher-
‘ men, when the Wind sets against the only Exit
‘ of this Lake ; from which venting of Rivers
‘ and Winds from below, and its unfathomable
‘ Depth, ‘tis believ’d that the *Wetter* has Com-
‘ munication, by subterraneous Passages, with
‘ another *Swedish* Lake, called the *Wenner*, about
‘ ten *Swedish* Miles distant : And the several *Vo-*
‘ *ragoes*, that are between these two, do seem to
‘ confirm the Conjecture ; two of which lying in
‘ the Parish of *Fagren*, and called, the one the
‘ *black*, and the other the *white Vorago*, Mr. *Had-*
‘ *dorpius*, a celebrated Antiquary of *Sweden*, has
‘ endeavoured to found, but found them of un-
‘ measurable Depth ; he observ’d also an intestine
‘ Motion in them, as if they were in a Fermenta-
‘ tion. This Opinion also is augmented, by rea-
‘ son the Water of the *Wetter* is some Years aug-
‘ mented, and the next Years considerably dimi-
‘ nish’d. Mr. *Daniel Ridelius*, the Pastor of *Mo-*
‘ *talen*, has noted, that these last seven Years the
‘ Water of some Parts of the *Wetter* has so much
‘ wasted, that many Places were left bare which
‘ used to be cover’d with Water to carry Boats ;
‘ whereas the Rains have been very plentiful all
‘ about in the Years 1680, 1682, 1684, 1685 ;
‘ but, in the Year 1686, towards Autumn, the
‘ Water began again to increase, and has conti-
‘ nued so to this present Year 1688 ; but whether
‘ our Lake does observe such Periods of seven
‘ Years in Increasing, and seven in Decreasing, as
‘ the *Wenner* is assertd to do, by those that have
‘ enquired, I cannot now positively assert. It is
‘ also wonderful, that in a calm Air the Guns of
‘ *Stockholm*, and other Places 30 Miles distant,
‘ are

are plainly heard here: As, when in the Year 1685, the Princes were buried at *Stockholm*, every Shot was distinctly heard here at Five of the Clock: So also, the Broad-sides at the Sea-fight in the Year 1676, at about 30 Miles Distance, were distinctly remarked. But what *Olaus Magnus*, *Messenius*, and other Historians, relate of the Cave of *Gilbert*, in the Island of *Wisingsoe*, I leave to their Credit: Only, this is true, there is a Cave, at present, that is fill'd with a Stench of Sulphur very odious, which, with the Consent of the Inhabitants, has been collected into a Cave near the Water of the Lake; which, by being long pent up, it eruptates noxious and sulphureous Vapours, which others have ascribed to other Causes, which I cannot approve: And Antiquity has discover'd its Weakness, in so easily giving Credit to such Fables; tho' they relate stupendious Things of the said *Gilbert*, and his *Præceptor Catillus Runnes*. But that there do appear divers *Spectra* and Phantoms in the neighbouring Parts in the Shape of Women, Horses, or other Animals, none that are intent about these Matters do gainsay. These might be evinced by Relations of modern, as well as antient Times; but, for the present, I omit them. But I must not omit the celebrated River *Motala* (the only Mouth of this Lake) which at certain Times seems at a Stay, and dried, so that one may go and take up the Fish that are left at the Bottom, without Impediment, as it happen'd in the Years 1682, and 1685, at *Christmas*. And the common Inhabitants believe, that this Stop of the Water never happens, but either Dearness of Corn, War, or some other publick Calamity is portended by it; as much as the *English* believe the Coming of a Whale into the *Thames* is omitted.

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‘ nous. But, for my self, as a Naturalist, enquiring only the Causes of natural Effects, they were no ways satisfactory to me, unless I found them conformable to the known Laws of Nature: I was therefore more sollicitous about those Things which were advantageous to this Purpose, for explaining this Phænomenon of the River, tho’ I had not the Opportunity of seeing this Stopping: And tho’ they divers Ways endeavour to solve the Phænomena, by saying, that at that Instant the Waters do recede from the Shores, and go to the Bottom; yet I always suspected, that the Ice, or Snow, did some ways obstruct the Passage of the Water above, whilst at the same Time the inward Water flowed out into the Sea. What hinted this Conjecture was, 1. That this Mutation never happened in the Spring, Summer, or Autumn, but always about *Christmas*, or in the Beginning of the Year. 2. That this only happen’d near the Bridge, where the Water is but three Ells deep, and the Heaps of Stone, on which the Bridge is founded, do impede its Course. And this Suspicion the Pastor of the Church of *Motalen*, who lives hard by the Bridge-Foot, does judge very rational, from his own and others Experience; for he has noted, that divers long Plants, such as *Potamogiton*, *Polygonum aquaticum*, &c. do grow in the Parts near the Bridge, and that by these the Ice and Snow will be clodded and bound together, which, being carried by the River to the Bridge-Foot, do in Time so accumulate against it, as to make an absolute Dam to the River. The Millers also that live there confess, that usually, before such a Stop, there are divers white Lumps flow out of the Lake, which sticking to the Bodies they meet with, like Glue, do by degrees sink there to the Bottom.

‘ Nor

‘ Nor is it unfrequent, that all the Water of the
‘ Lake shall be one Day quiet, and the next Day
‘ be stopped near the Bridge. Whatever it be,
‘ ’tis wondrous that this Retardation happens not
‘ in the sharpest Winters, but in a more mild Sea-
‘ son, and for the most part about *Christmas* or
‘ *New-Year’s-Tide*, when the Cold is yet intense
‘ under the Water, tho’ more mild in the Air ;
‘ or, that the Ice, being less harden’d, is detain’d
‘ and implicated by the Weeds which cause these
‘ Obstructions. Before I leave this Subject, I
‘ cannot pass by the mentioning what I understood
‘ from the Reports of the ingenious Pastor of
‘ *Nijen*, (where the *Acidulæ Medivienenses* are) and
‘ of divers others, concerning a certain Fountain
‘ not far from the Shore of the *Wetter*, in the Pa-
‘ rish of *Nijen* not far from the Church, and Pa-
‘ stor Mr. *Jonas Frodel*’s House ; to wit, That
‘ they call this Fountain the *Foreteller of Dearth* ;
‘ because it is never so fill’d with Water, as when
‘ a Dearth succeeds the next Year. ’Tis encom-
‘ passed round with soft sandy Hills, between
‘ which and the Fountain is a low Vale, but
‘ not marshy : Out of this, by occult Passages,
‘ issues this Fountain ; singular in this, that in
‘ rainy Summers it waxeth dry, and in dry Sum-
‘ mers, when Famine is fear’d, or (by others whom
‘ I regard not) War, it overflows the King’s
‘ Highways of *Wodstein* and *Motala*, as is attested
‘ by many of the Inhabitants : Nor does it contra-
‘ dict this Report, this present dry Summer ; for it
‘ abounds with Water, now all the neighbouring
‘ Fountains are dry’d up. And though this may
‘ seem fabulous or superstitious, yet ’tis confirm’d
‘ by many Experiments ; which shews, that there
‘ are many internal Operations of Nature that yet
‘ are kept secret, and cover’d with a Veil, which
‘ we are yet unsufficient to discover. However, the
‘ fol-

following Observations may somewhat assist : 1. That this Scarcity of Corn is foretold to *Ostro-gothia* and the Places near the Fountain. 2. That in all this Region, and especially near the Fountain, the Plain is sandy, but in some Places it is thick Clay ; which require much Water to make them useful. 3. That Corn is thin only in dry Years ; the contrary of which happens in *Jemtia* and other Northern Provinces. 4. That the Phænomena of Meteors are caused by subterraneous Influences for the most part. 5. That this Fountain is supply'd by straining through secret sandy Veins from these Sand-Hills. 6. That from some natural Causes, the Waters may ascend against a dry Season, and sink against a wet Season.

Dr. Hook's Discourse concerning Telescopes and Microscopes; with a short Account of their Inventors, read in February 1691-2

Of Friar Bacon, Baptista Porta, Diggs, Metius, Galileo, and other Inventors of Telescopes.

How much the great Improvements of natural Knowledge have been owing to the Discoveries and Improvements that have been made in Opticks, I think few can be ignorant of, that have inquired into the Reasons and Grounds of the Progresses made in this last Century, since it hath been actually effected : For, though it be evident that *Roger Bacon* did understand somewhat of the Grounds of it, and, in Probability, would have further improv'd that his Knowledge, if he had met with a Generation worthy thereof ; yet such was the ill Treatment he receiv'd by false

S ‘ Accu-

Accusations, scandalous Reports, Imprisonment, and Loss of Places, that we hear no more concerning it, but only some Hints that he gave, of his being able to see things at a Distance as if they were near, in his Apology for himself, addressed to the then Pope, to protect him against his Persecutors. This Persecution quash'd it for that Time; and we find nothing of the Revival thereof, till the *Lyncean Academy* became founded in *Italy*; where, from the Encouragement that divers ingenious Men received, it was again started: And we find that *Johannes Baptista Porta* had made a Discovery of it, as is very plain by some Passages of his natural Magick; and our *Diggs* had done the same thing here, as is testified by his Son, who printed some of his Father's Works after his Death. These two Testimonies we have, that somewhat like the Telescope was known in the preceding Century, both the said Books being printed before the Beginning of this Century. We find nothing further concerning its Description, or Use, besides the Hint that it was then known to these two Men, some Years before *Galileo* put it in Practice. In the Beginning of the present 17th Century, *Metius*, a Spectacle-maker in *Holland*, light upon a Composition of a Convex, with a concave Glass set at due Distance in a Tube, which made a perspective Glass to see Objects at a Distance. And *Galileo*, in *Italy*, whether excited by a Hint thence received, or from *Baptista Porta*, or by his own good Genius, is uncertain, did the same thing at *Florence*: But not contented with the bare Invention, and Use for terrestrial Objects, he improved it farther, and made Use thereof for Discoveries of the Cœlestial Bodies. By this Means he detected the *Galaxia* to be an infinite Congeries of small Stars; as also the cloudy Stars, to be of a like Composition.

By

By the same he discovered the Roughness and Inequality of the Surface of the *Moon*, and the Phænomena of the Shadows and Lights of those rough and uneven Parts, and the Progress and Recess of the Light of the *Sun* thereupon. By this he discovered the four Stars about *Jupiter*, and in some Sort adjusted their Periods, and hinted the Use of them, for the Discovery of the Longitude of Places upon the Earth. By this also he discover'd the unusual Figure of the Body of *Saturn*, the Waxing and Waining of the Light of *Venus*, and the Spots in the Face of the *Sun*, together with their Motions and Changes; which last, whether it were not primarily, or at least at the same Time, detected by *Scheiner*, is disputable, since both lay Claim to it. This, I think, may truly be said for *Scheiner*, that whoever first detected them, he was the Man that perfected the Theory of them, so far as it has hitherto gone; which he hath performed in that most elaborate Work of his *Rosa Ursina*.

THESE Discourses excited the Curious of those Times to inquire into and improve the Knowledge of Opticks, especially that Part of it which had been least cultivated, namely, the Business of Refractions. (*Stelliola*, who was a *Lyncean*, seems to have been the first that discover'd the Ground of Refraction, in his Book *Il Telescopio overo il Specillo Celeste.*) *Kepler*, in his Opticks, explain'd the Reason of the Phænomena of *Senses*, and the Causes thereof; and also, that the spherical Surface did not give the true Figure requisite to refract all the parallel Rays that fell upon it to one Point, but a Figure somewhat elliptical; but made no Demonstration what the true Figure was, nor the true Proportion of Refraction. But *Descartes*, by these two Helps, went through with the Demonstration, and proved both the true elliptical

260 Dr. Hooke's Discourse concerning
cal Figure, and also most ingeniously and mecha-
nically explain'd the Ground and Cause of Re-
fraction.

FERMAT soon after, taking a contrary Sup-
position, explain'd the same Phænomena ; as did
also Emanuel Maignan, in his *Perspettiva Horaria*,
by a third Supposition ; and our Countryman Mr.
Hobbs by a fourth ; but these two last by Ways
less intelligible and more improbable. Others since
have gone other Ways, but fall short of the first.
However, the first Successes caused it to be ex-
ceedingly cultivated by very many ingenious Men.
And that not only as to the Theory, but as to the
Practice also : Thence many Attempts have
been made by divers ingenious Men, as *Descartes*,
Hevelius, Sir *Paul Neile*, *Divini*, Mr. *Smetwick*,
and others, to make Object-Glasses and Eye-Glasses
of elliptical Figures, but all without Success.
However, of the spherical Figure they made good
Improvements, by making Object-Glasses of much
greater Lengths, and truer Figures, than they
were at first able to do : For, *Galileo's Glass*, of
which he made so good Use, I have been inform-
ed, was not above four or five Foot long, at the
most ; and, I am apt to think, that the Glass, *He-
velius* used for his *Selenography*, was not better,
if, at most, it were so good ; since as many Parti-
culars, as he has noted in that Book, may be made
with a Glass of three Foot. But Sir *Paul Neile*
made some of 36 Foot pretty good, and one of
50, as I have been informed, but not answerable.
Divini and *Campani* made also Glasses of those
Lengths, but how good I cannot knowingly af-
firm : However, if we may be allowed to judge of
them by the Discoveries they made with them of
the true Figure of *Saturn*, I conceive they were
but ordinary, and did not exceed our 12 or 15
Foot Telescopes ; for, by one of that Length, I
plain-

plainly discover'd the Ring and Satellite of *Saturn*, to be as Monsieur *Hugenius* doth assert in his Book; and, with the same Telescope, I first discovered the permanent Spot in the Belt of *Jupiter*, which proved its diurnal Motion on its Axis. Since that, Mr. *Reive* first, and then Mr. *Cox*, made some good Glasses of 50 and 60 Foot long, and the last one of 100; but how good, I cannot assert, having not made Trial of it. And, as it hath been cultivated here, so others, in *France* and *Italy*, have not been idle: Particularly one Mr. *Borelli*, at *Paris*, who presented one of a considerable Length, to this Society, which Mr. *Flamsteed*, I suppose, has in his Keeping, Sir *Jon. Moor* having borrowed it of the Society for his Use. But tho' there has been some Life left in the Grinders of Glasses, yet the Warmth of those, that should have used them, has grown cool; and little of new Discoveries hath been made by them, besides what Mr. *Cassini* has done at *Paris*, in discovering four new Satellites about *Saturn*, besides that of Mr. *Zulichem*.

MUCH the same has been the Fate of Microscopes, as to their Invention, Improvements, Use, Neglect and Slighting, which are now reduced almost to a single Votary, which is Mr. *Leeuwenhoek*; besides whom, I hear of none that make any other Use of that Instrument, but for Diversion and Pastime, and that by reason it is become a portable Instrument, and easy to be carried in one's Pocket.

IF we enquire into the Reason of this Change of Humour, in Men of Learning, in so short a Time, we shall find that most of those, who formerly promoted these Enquiries, are gone off the Stage; and with the present Generation of Men the Opinion prevails, that the Subjects to be enquired into are exhausted, and no more is to be

done: Besides, they pretend that all the Discoveries that have been hitherto, or that can be made, for the future, by these Instruments will afford no gainful Profit, and all other Notions are insipid with them, besides such as bring ready Money.

But those, who make such Estimates, may, perhaps, find themselves very much mistaken in their Judgment, if the Subjects were duly prosecuted, as they are capable of so being. For, as to the Discoveries that may be made in both Kinds, I conceive they are vastly greater, both for Number and Value, than those few that have been already made; and not only for the Information of the Intellect, but what answers their greatest Objection, even for the increasing their Treasure.

HAVING given this short Account of the History of Telescopes, as also of the Use and Discoveries that have been hitherto made with them, which, as they have been very considerable, as to the Improvement of the physical or natural Knowledge of the Cœlestial Phænomena, I may observe that a further Improvement and Use of them, will, in all Probability, afford much greater, and more considerable, not only for the perfecting and completing the Knowledge of those Particulars which have been already, in Part, detected; but also for making of other new Discoveries, which as they are yet much further removed from the Power of the Senses to comprehend, so they have been, upon that Account, never afforded Entrance into the Imagination and Intellect; if at least Aristotle's Maxim be true, That there is nothing in the Intellect, but what was first in the Sense: And tho' there are many Things that may be imagined, and guessed at, by Analogy, and the Uniformity of the Proceedings and Productions of Nature; yet there are certain Non-pareils of Nature, of which Kind, possibly, nothing like them have been produced in

all

all those Particulars, which are more common and obvious, as I might instance in the Body of *Saturn*. For who would ever have imagined such a Configuration or Fabrick, as that of the Ring of *Saturn*? what is there in all the other Celestial Bodies, we yet know, that is analogous to it? and from the Imperfection of the first Telescopes, what extravagant and irrational Conceptions were formed thereof, as does more evidently appear, by the Descriptions and Explications of the Phænomena of it, before the more perfect Discovery made by Mons^f. Chr. *Huygens*, and his ingenious Explications thereupon. And that *Autopsia* is not only useful, but absolutely necessary, to give one a true *Idea* and Conception of many Phænomena, without which, the Imagination is very apt to rove, and go out of the true Way, as I might confirm by many Instances, there being enough; but I shall only mention one, namely, that of Dr. *Vossius*, his Explication of the Phænomena of the Moon, published in his last Book, upon which I did formerly read a Lecture to this Society, to shew the Irrationality thereof, and how little Ground or Probability there was to be found in all the Phænomena of that Planet, viewed and examined with a good Telescope. And therefore I did conclude, that that learned Man did never, himself, observe the Phænomena, or if he ever did, it was certainly with a very small, and very imperfect, Telescope. Upon which Account, *Autopsia* is not only necessary for directing the Mind and Intellect, in its Progress to be made, for what is to be gone thro' with; but 'tis necessary also, for the reducing it to its right Way, from which it may have been misguided, by the false and erroneous Suggestions it hath formerly met with, either in some famous Authors that have positively asserted, or defended a Falsity; or of some other

Person reputed eminently skilful in this, or that Part of Knowledge. With which Kind of Information, how full are the Authors that have treated of some Subjects? and that not one or two, but Hundreds, nay, Thousands, if we consider natural Philosophy and Physick, with the Arts subservient thereunto: What shall we say to the whole Generation of Astrologers, which have yet always prevailed, and possibly always will, with some especially, who have once been prepossessed or prejudiced for it: The like may be said of those who defend the four *Aristotelian Elements*, or the four *Cbymical Principles*, or the three *Cartesian Materia's*, or his *Mundane Vortices*, which are, in Probability, all alike *Chimera's* which have sprung up, and got rooting in the Minds of Men, in several Ages of the World; and having once prevailed, they become prolific, and propagate themselves in new Soils, and new Assertors and Defenders of those Doctrines do daily spring up: Among these may also be ranged the *Solid Orb Men*, the *Plastick Faculty Men*, and the *Sympathy* and *Antipathy Men*, each of which, having once embraced their respective Doctrines, will maintain and defend them to the last, against all others whatsoever. 'Twas from the first of these Sects (as I may call them, from their Division from the true Philosophy) namely, the *Solid Orb Men*, that poor *Galileo* was put into the Inquisition, and, to save his Life, was necessitated to lose his Doctrine, and to unsay what he really knew, and had discovered and asserted; and tho' he, as well as *Copernicus*, was encouraged, at the first, by Popes, Cardinals, and Princes, yet in the Conclusion all fail'd, and their Doctrine must be condemn'd. Thus it happen'd also to *Roger Bacon*, and, I am apt to suspect, to the far greater Man, the Lord Chancellor *Bacon*, for being too prying into the then receiv'd

ceiv'd Philofophy : But notwithstanding all this, there is a real Beauty and Allurement in Truth, that will produce some Votaries in the worst of Times ; and that will in Time prevail, and shine out, and dispel the Clouds of Error that encompass it. *Multi transibunt & augebitur Scientia*, was the prophetick Saying of *Daniel*, and used by the learned *Verulam*. And there is no doubt, but there is yet behind, much more to be discovered, than what is already known, if fit Methods, and fit Instruments be apply'd, and prosecuted with Diligence. Some Uses I have made of the *Telescope*, and not without some considerable Success ; as in the Discovery of the Figure, Motions and Qualities of the *Cometical Bodies* ; as namely, of following them for near a Month after they disappeared, and finding them retrograde, in observing their flame-like Figures and Qualifications ; in discovering the Smallness, or rather Inconsiderableness of their Parallax, by a Way not taken notice of before, by any that I know of : And tho' Mons. *Cassini* has described it in his Observation of the Comet in 1680, yet he hath added nothing more to it, than what I published in my *Cometa* some Years before, save the Application of it to that Comet. By these I discovered the Parallax of the Earth's Orb, and the Visibility of the fix'd Stars, at all Times of the Day. Upon which Occasion I cannot but take Notice of a Passage printed Page) the 385th of *Ozenam's Mathematick Dictionary*, and, by him, said to be written by Mons. *Cassini* ; the Sense is this ; By the Means of great Telescopes, fixed to certain Parts of the Heavens, thro' which the fix'd Stars pass, which are the most proper for this Observation, one may best examine whether there be any Difference (of the Situation of those Stars, as to *Parallax*) in different Seasons of the Year ; for this Design, in the Foundation of

of the Royal Observatory, there is left an Opening thro' all the Vaults, by Means whereof one may see, from the Bottom of the Vaults, the Vertical Stars, thro' Telescope Glasses of 160 Foot in Length, which will be prepared against the Observatory is finished. Notwithstanding the English Astronomers have begun to practise a Method like to this, we are assured, by an Essay of Observations which they have made with great Subtilty, that they have found some such Difference, which have verified that the Diameter of the annual Orb of the Earth hath some sensible Proportion, compared to the Distance of the fix'd Stars; which, nevertheless, is not yet evident to us, by reason that the Observations, we have made of some fix'd Stars Variations, do not agree with this Hypothesis; for that the Variation was not found in the Way that this Hypothesis requires: But if the Observations should confirm it, and be correspondent to the Hypothesis, yet then we may doubt, whether the Variation be from this Cause, or from some constant Variation of some fix'd Stars, which hath no Relation to the Earth's Motion; I suppose, he here means *Mallement de Mesang*, who, to evade the Strength of the Argument for the Earth's Motion, drawn from the sensible Parallax amongst the fix'd Stars, assigns every fix'd Star to move in a small *Epicycle* that will answer the Appearance. (Observe only the Humour and Ingenuity of these great Philosophers and Astronomers, and judge how likely 'tis, by any Means in the World, to convince such of any Error they shall once assert.) Yet, be pleas'd to observe his Conclusion; viz. But when we have found, by a great Number of Observations, that a sufficient Number of the fixed Stars have a Variation conformable to this Hypothesis, then we may judge that there is some Foundation for it, notwithstanding some Irregularity

larity that has been, in Part, observed to the contrary. The Observation is extremely difficult and long, because the Period of the Variation, propos'd to be observ'd, is of a whole Year, and requires that the Instrument shall be unshakeable. It is for this, that it can no where be better done, than in the Royal Observatory. Thus far Mons^r. *Cassini*. To which Mr. *Ozenam* adds, [That the Royal Observatory is a haughty Building, which the King has caused to be built in an eminent Place, without the Suburbs of St. James's, for making Physical and Astronomical Observations; and that it is called Royal, for that it was built by the Munificence of *Louis le Grand*, whose Liberality has extended to divers Persons, distinguished for their Merit, and principally to a certain Number of learned Men, chosen out of the rest, who have endeavoured, with *Eclat*, to make Sciences flourish in this Kingdom, who compose the Academy Royal of Sciences.] When my Attempt first was published, I was informed some of that Assembly were angry at it, for that it had not been first thought of by them; but I confess I did not believe it. But meeting with this Passage does seem to make it probable enough. However, they needed not have regretted it, since there were enough besides, as considerable to have shewn their Penetrancy of Spirit, and Accurateness of Observation; and tho' *England* possibly wants those Assistants which they can boast, yet I hope to shew, that weaker Means may effect many Things that their more powerful have fail'd to perform, if God grant me Life and Health.

If we consider, in the next Place, the Fate of Microscopes, we shall find much the like to have attended their Performances. The first notable Thing performed by it, that I have met with, was the Figure of the Bee made by Sir *Francisco Stelluti*,

Stelluti, a Lyncean, and presented to Pope Urban VIII, which is mention'd by Johannes Faber, in *Historia Plantarum & Animalium Mexicanorum*, lib. i. p. 757. *Tam mirabilem anatomie præbuit partium omnium externarum, quæ in Ape sunt minuto animalculo, obolorum, inquam, linguae, cornuum, juba, baculei, pedis, digitorum, aliarumque, & super in æs incidi commisit, atque felicitati Urbani VIII dedicavit, ut hoc omnia nialim te oenlis tuis intueri quam rudi meo calamo adumbrare.* And Fabius Colonna, upon the same Place, says, it was *Impressum a Lynceorum Academia S. D. N. Papie Urbano VIII in perpetua devotionis symbo- lum oblatum fuit anno 1625.* *Cum nostratis Apis imagine accuratissime a D. Francisco Stelluto novo quodam Microscopio observata, ut qui illam viderit in admirationem incidat; tam multas partes organaque depicta discernit, quæ ab intentioni oculis in ipso animalculo omnino absconduntur.* These Discoveries were also highly favour'd and practis'd by Prince Cesius himself, which greatly encouraged Observers, and produced many in divers Parts of Italy. Accordingly we find some Observations made by Hodteria, in Sicilia, about 1640, and others recorded by Panarolla about the Year 1650, namely, the Porousness of Man's Hair, the red Bands in Urine of caleulous Persons, and the Worms in Vinegar. Many others were also found to make some few Observations in other Countries; but, by Degrees, it is become almost out of Use and Repute: So that Mr. Leentwenhoek seems to be the principal Person left that cultivates those Enquiries. Which is not for Want of considerable Materials to be discover'd, but for Want of the inquisitive Genius of the present Age.

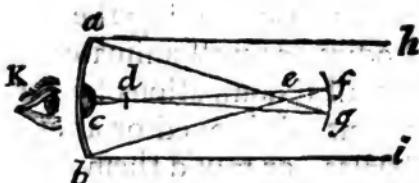
Dr. Hook's Discourses, &c. Dr. Hook's Discourses, &c. Dr. Hook's Discourses, &c.

Dr. Hooke's Invention of a Reflecting Telescope :

WHICH I insert after the foregoing Papers, by Reason of its Congruity therewith; because I know not the Time when this Telescope was invented, whether before, or after Mr. Cassegrain's, in Phil. Trans. N. 83. from which it differs in some very material Matters.

W. D E R H A M.

I HAVE lately made a Telescope by Reflection, with which I look directly at the Object, and see it very distinct, and magnified. And this is by Planting a small *Lens* in the Middle of the *Object Speculum*, and Planting another small *Concave Speculum*, beyond the Focus of the *Object Speculum*; the Manner of which your Lordship will readily understand by the annexed Scheme; where *a b* represents the *Object Specu-*



lum, e the Focus of that Speculum, fg a small concave Speculum, serving to reflect the Rays to a second Focus d, where the Eye k sees the Object by the Help of the small Lens c. 'Tis easy so to contrive the Cell for the Eye, that the Rays that pass on each side of fg shall not disturb Vision.

We long much to hear of Mons. Hugenius's Opticks and Mechanicks: They are Subjects capable of vast Improvements, and cannot be rationally expected from any more likely, than from his

his acute Wit and excellent Pen. But, my Lord,
I fear I have too far trespass'd upon your Lord-
ship's Patience, and must humbly therefore beg
your Lordship's Pardon, and subscribe my self,

My L O R D ,

Your Lordship's most Faithful

and most Humble Servant,

R. H O O K .

*Mr. WALLER's Observations upon Dr.
H O O K ' s Discourses, concerning Tele-
scopes and Microscopes.*

November the 29th 1693, Dr. Hook read a Dis-
course concerning Microscopes, their Uses
and Advantages in discovering the Textures and
Motions of Bodies, as well animate as inanimate ;
observing, that all Examinations by Fire, or Chy-
mical Menstruums, destroyed or altered the com-
pounding Particles, or mix'd them with, and con-
founded them with heterogeneous Parts of the
Fire, or Menstruum, made Use of ; whereas the
Microscope discovers them in their natural State
and Actions. Observing farther, that the Moti-
ons of the Viscera and of the Fluids, in the small
Vessels, are, by that Instrument, to be seen, by
their different Colours and Refractions, through
the transparent Skins and Bodies of many Insects :
Natural History, hitherto, being for the most
Part only conversant about the outward Shape and
Colour of Plants, Animals, and the like ; but the
Microscope would afford a very large Field of En-
quiries

quiries and Observations, not yet much cultivated, which he recommends as one of the most proper Ways of discovering the true Texture and Mechanism of Bodies.

In the next Place, he takes Notice of a Treatise lately publish'd by Sig. *Bonani* in *Latin*, call'd *Micrographia Curiosa*, &c. in which the Author describes the several Sorts o Microscopes, and gives his Way of Grinding Glasses for that Purpose in a Cypher, which Dr. *Hook* thus decyphers. The Tools are to be made of Brads or Tin, and of a due Form; that the Dish ought to be three times as large as the Glas that is to be ground in it; that the Dish is to be held in the Left Hand, and the Glas in the Right, and so wrought and turned every way, one to the other, till the Glas has acquired its due Figure; that the Glas ought first to be ground near the Figure desired, in a larger, and then finish'd in a smaller Dish or Tool. And, for its Polishing, *Bonani* prefers the Way of gluing a fine Paper into the Dish in which it was last ground, and by spreading on the Paper fine Powder of *Tripoli*; work the Glas therein till it has acquir'd its due Polish: And for this he recommends a Mandrill to fix the Dish on, made to run swift round, by Means of a large Wheel. Nevertheless, Dr. *Hook* approves better the Ways used by our Artists by a reciprocating Motion, and judges the bare Tool, without Paper, better for Object-Glasses, at least of Telescopes; tho' for Eye-Glasses he grants the Way by Paper and *Tripoli*, sufficiently exact.

HE concludes this Discourse with the Description of Stings or Thorns of the Prickly Pear, or *Indian Fig*, thus; The brown Tufts on the Prickly Pear consist of a great Number of very small and sharp-pointed Thorns, smaller than the finest Needle, and stiff, so that they easily pierce the Skin
of

of whoever touches them; and what makes them yet more troublesome is, their being all barbed with Thorns like a Bramble, or rather a Bee's Sting, so that they cannot easily be got out, when they are once enter'd into the Skin. Of this he gives a Microscopical Figure.

THE 6th of December following he read a Discourse of Telescopes, in which he observes, that *Galileo* first discover'd the small Stars, not visible to the naked Eye, in the cloudy Stars, and the Galaxy, which *Aristotle* asserted to be a Vapour, with the Figures of the Planets, at first, indeed, not exactly true, as to some of them, with their different Magnitudes, their Revolutions on their Axes, the Satellites of *Jupiter*, &c. He supposes that *Reita* was the first that made Use of Convex Eye-Glasses, taking in a larger Area than the Concave ones used before; and that he invented the Rete, or Mensurator, placed in the common Focus of the Glasses; which Sir *Christopher Wren* perfected, and invented the angular Instrument, consisting of two Telescopes joined at a moveable Joint, so as to take Angles by two Observers, to a Quadrant; and that himself had improved and recommended the Use of Telescope Sights for Astronomical Instruments, in his Animadversions on *Hevelius's Machina Cœlestis*. He proceeds to an Account of the Discoveries made by several learned Men, as the true Figure of *Saturn*, and of its Satellite, by Mons. *Huygens*; the Satellites of *Jupiter* by Mr. *Lawrence Rook*; four other



other Moons about *Saturn*, by *Cassini*, with the Periods of *Jupiter's* Satellites more exactly limited by the same. Next, he mentions his own Telescopical Observations of the Comet in 1664, and 1665. those of the Stars in the *Pleiades*, being 80, great and small, which Observations and Figure of them, in his Micrography, he here asserts to be very exact, and made with great Care; tho' Mr. *Cassini* and *De la Hire* have publish'd Figures of them very different from his, both as to their Number and Situation; whence he infers there has been an Alteration in that Asterism, as, he says, Mr. *De la Hire* also believes, he having found them differing from what he had himself at first observ'd.

Dr. Hook's Lecture here mentioned, being long, and Mr. Waller having extracted every thing in it observable, at least it being contain'd in the preceding Paper, I have therefore chosen to publish Mr. Waller's Extract.

W. DERHAM.

*An Account of an Earthquake at Deal, and
other Places in Kent, Portsmouth, on
Sept. 8. 1692.*

Deal, September 9. 1692.

YESTERDAY the People of this Place and Country were under a great Confusion, occasion'd by an Earthquake, which began precisely at two of the Clock in the Afternoon, and continued about six Minutes; during which Time the **T** **Houses**

Houses shook ; Pewter, Bras, and other Kitchin-Goods, totter'd from the Shelves ; empty Glass-Bottles, where they lay, dash'd one against another ; Beds and Tables in the Houses shook so much, that People could not, for that Time, write ; Some Chimnies fell, and several Houses shaken. This was at *Canterbury*, *Sandwich*, and many Villages thereabouts, tho' not so violent, yet we had the same at *Deal*, particularly at *Deal-Castle* ; altho' the Wall thereof be of a vast Thickness and Strength, yet it shook so much, that the Inhabitants thereof thought it would have fallen on their Heads. In *Deal Town* several Houses shook, and so all the Country over ; some Houses ready to tumble down, others safe, and felt nothing. In this, several Chimnies fell, and some Houses much damnified.

Portsmouth, Sept. 9. 1692.

HE R E fell much Rain Yesterday, and between two and three in the Afternoon this Town and Point, for about three Minutes, had a very sensible Touch of an Earthquake, to the great Terror and Affrightment of many. The Tower of the Church, with many Houses, were found to shake considerably ; but, blessed be God, I hear not of the least Damage, nor any thing more felt thereof since.



A Con-

Fig. III.

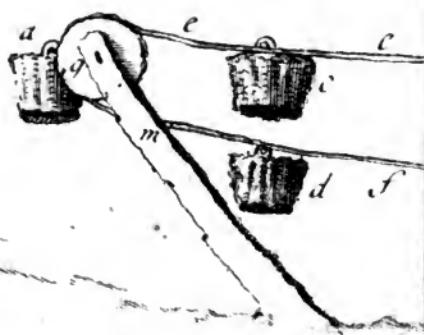
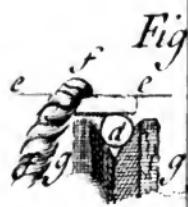


Fig. III.



S. Parker Junr.

*Contrivance which Sir Robert Southwell
saw at Brandenberg, for speedy Convey-
ance of Earth, and to fill up, or raise
Ground, &c. communicated to Dr. Hook,
Sept. 9. 1692.*

The Explanation of the Figures.

F I G U R E I.

- a. The Basket to be filled.
- b. The Basket emptying itself, by the lower Part of it hitting against the Axis of the two Pul- lies, b.
- c. The filled Basket passing from a to b, suppor- ted by the Pulleys, n.
- d. The empty Baskets returning without any Sup- port between the Extremes.
- e.e.e. The Rope carrying the filled Baskets.
- f.f.f. The same Rope returning them empty.
- g. The Pulley at the filling End, supported by the Post m.
- h. The Pulley at the emptying End, supported by the Post k, and turn'd by the Windle i.
- i. The Post to support the interposed Truckles n.

F I G U R E II.

- b. b. The two Pulleys fasten'd on.
- r. r. An Iron Axis to be turned by
- i. q. A Winch, or Windle.
- e. e. The Rope, lying in its tapering Edge, as ex- press'd in Fig. III.
- o. o. The Basket hung by its Handles.
- p. p. A Stick tied with Packthread, or girt on the
Rope e. e. e. e.

T 2

FIG.

FIGURE III.

g.g. The Shape of the Edge of the Pulley, express'd in the first *Fig.* by *b*, which is grooved with a tapering Groove, that may hold the Rope, on which is tied *e*, the Stick thrust thro' the Handle *f.f.* of the Basket.

FIGURE IV.

- a.* The Rope on which is tied
- b.* The Stick, thrust through the Handles of the Basket.
- c.c.* The Truckles Edge, hollowed with a half round *b*, for the Rope to run on.

A small Module would express all the Particulars, much plainer than any Draught. By this Way 'tis easy to transport Earth, Sand, &c. 1, 2, 3, 4, or 500 Yards, whether ascending, or descending; and, I conceive, two Men can do more than six in the common Way.



Transcrips

*Transcript of a Paper of a Quantity of Gold
up the River Gambay, in 1693.*

YOU R Importance, together with my Grati-tude to you, for your most curious Informations and Instructions in the Mechanicks (without which, I confess my Labour had been in vain) has extorted that from me, which, I confess, the Resolution I had a-new taken to the contrary, by resolving never to divulge, either for Love, or Force; to which End I expect, according to your faithful and solemn Vows of Secrecy, both of the Business itself, and likewise of which I would not should be known to the King for 10000*l.* being content with what Proportion it hath pleased God to assign me, as well as with the King's Revenues. Nor shall I wholly, or fully, discover the vast Proportion of Gold I discover'd there, being so much, not fit to be communicated to Paper, as not knowing to whose Eyes, or through whose Hands this may come. I shall only tell you, I was more troubled to obscure its Abundance from my Fellows, than to bring down what I got; and, I am confident, that if your self go upon this Design, and follow the Directions of my Journal, and, attain your Purpose, you your self will be of my Opinion; for, as it is said, *What will the whole World profit a Man, if he lose his Soul:* So I say, What will the Riches of both the Indies advantage, if thereby you forfeit your Security, Life, and Freedom? And how will you be assured of any of these, if these Things should come to Knowledge of such as have Power of you, and to command you in what they please: That I do truly tell you, did I not value my own Peace and Quiet at so high a Rate as I do, I should come willingly, and

manifest it to his Sacred Majesty ; though I am not satisfied in that neither, as not knowing whether the Information may prove good or bad to the Publick ; however, I conjure you a-new, that, whatever you attempt, you conceal me, so that directly or indirectly I be not discover'd.

If you go on the Busines, let your Boat be flat-bottom'd, for mine being some seven Tons, or thereabout, and made after the common Fashion, was extremely troublesome, both at Fords and at Falls, where we were forced to unlade her ; and, having unladed her, to heave her, or launch her over Land : You ought also to have a little Boat for common Use, which you will find extreme useful. You advised me to take 20 Pound of Quicksilver, for Trials ; if you go, take at least 100 Pound, for some in working will be lost, as you know, better than my self : Your Advice also, for 50 Pound of Lead, is too little, take 150 Pound, much more you cannot well carry, for the pestring of your Boat.

THE *Sal Armoniack* I used little of, for it I can give you no Advice : The *Borax* I used all, wished for more, if you go, carry 50 Pound ; my Sand ever did me rare Service, I used it all, better have 10 Pound too much than too little, therefore take 40 Pound. I am confident, if I had carried the Philosophers Bellows, I had done very well ; I was so troubled with fitting the other, tho' I confess them better when a-new placed. *Antimonia Horn* did me little Service ; I believe it rather from my Ignorance, or wanting the perfect Use and Instruction you gave me. Ingots I would take two, I carried but one, I wanted another for Expedition. Wedges 12, with a Sledge or two, or Beetle ; for about 12 English Miles from the first Fall, or somewhat more to the Southward, in the Side of a barren Rock, looking Westward, there

there is a Cliff in the Rock, rather

most rich between the Stones, almost half a Handful thick in some Places. Our Pick-axes did here stand us in no great stead, but having with us some Iron Tools, that we could hardly spare, with much ado made a scurvey Iron Wedge, and presently we found the Benefit of that, for some 12 or 14 Days, till improvidently one of us driving the Wedge up to the Head, and not having another to relieve it, we were forced to leave it behind us, to our great Loss and Grief. Wooden Bowls from *England*, six or eight, are very necessary, and will do better than Gourds, that I was forc'd to make use of; you may take Store of them, 'tis no Sore.

FOR the Crucibles I must inform, that four large melting Pots, in our large Work, will stead you much, and make better Dispatch than six Nests of Crucibles; though you cannot well spare those, I was forced to make use of a broken Earthen Pot, that I carried along with me; I made use of it till it broke, had I had Crucibles, and Pots enough, I had brought so much Gold in Sand or Tyber.

FOR the separating and dissolving Waters, I used but little, because their Use was troublesome, neither had I Conveniences to erect a Still a-shoar; but for the *Aqua Regis* I used it all, and could have done more, if I had had it; yet, in my Opinion, the Trials of Quicksilver are better, had I had it. But I carry Coals to *New Castle*; you know better the Operation than my self. Let your Mortar be of Iron, and large; I wish I had follow'd your Directions in that, for my Brass one put me to a double Trouble, and I was enforced to leave the Refining of much, till I came into *England*, for the Mercury got a *Spurca* from thence, which is communicated to my Gold, which no Art, I understand,

stand, could free it from ; in this Particular you left me lame, or my Memory much failed.

THE RE is a Tree much like our Corners in *England*, but very large, which we felled, and made a Shift to make Charcoal of, which we did thus ; we cut off the Boughs, for we wanted a Saw, and therefore could not meddle with the Body of the Tree, and cut them into short Pieces ; then we digged a good large Fit, or Hole, in the Ground, about a Yard wide, and so deep, or deeper ; in the Bottom we kindled a Fire, and filled it with Wood, and, when it was well burn'd, threw Earth upon it, and damped it ; and, when it was cold, we took out the Coals : You will easily find the Place, if you observe but the Cautions ; you will come to a broad gathering together of Waters, not much inferior to *Ronnander Meer*, in the Edge of *Lancashire* : Here we spent a Week in searching many Creeks and In-falls of Rivers ; but we followed that which points South East and by East. My miserable Ignorance, in the Mathematicks, cannot direct you, neither for Longitude or Latitude. Up the buffing Stream, with sad Labour, we wrought, and sometimes could not go above two Miles in a Day. You must pass the first Fall ; yet there my Exceed of Gold was 47 Grains from 10 Pound of Sand. When we, or you come to the upper Fall, you will be much troubled, I believe, as well as I, to get your Boat over Land ; but being up, proceed till you come to the In-fall of a small Stream to the South, directly thence listen, and you shall hear a Fall of Waters ; you cannot get your Boat thinner, by reason of the Smallness of the Brook ; you will there find our Reliques on the Side of the Rock, with many of our Names, I mean, Letters of our Names, cut with our Knives. Here, tho' the Sand, by the Wash, yield plentifully, yet do you ascend the Top of the Rock, and, pointing your Face

Face directly West, you will observe a Snug of Rocks somewhat to the Left Hand of you ; and, under that, if the Rains and Force of Weather have not washed away the Earth and Stones, you will discover (they being unmoved) the Mouth of the Mine it self ; where, being provided with Materials fit for that Work, you will not desire to proceed any further, or with a richer Vein.

Take this, all along, for a constant Rule, which I, in my Search, observed up the River, That in the low, and woody, and fertile Country, I could never find either Metal or rich Mine, but always among barren Rocks and mountainous Countries, and commonly accompanied with a reddish Kind of Earth. Other Instructions I shall not give you, being (as I conceive) a thing needless to you, unles I should return you your own Principal, this being but only the Interest of what is due, besides that Obligation which tieth me unalterably to remain, &c.

I began my Voyage up the River, *December* the 4th, about two Hours before the Sun set ; in my Company no more than seven Men, besides my self, all *English*, and four *Blacks*, whereof one was a *Maribuck*, who, being acquainted with the *Portugal* Language, I intended for an Interpreter, if I should stand in need ; but the main was, to help us in our Labour against the Stream. My Provisions were chiefly of two Sorts : For my Voyage and for Accommodation, three Barrels of Beef, ten Gammons of Bacon, two Barrels of white Salt, besides Bay Salt for Trade ; also two Hogheads of Biscuit, besides Rice ; half a Barrel of Gunpowder, and Shot proportionable ; Strong-Water, Vinegar, Paper, Beads, Looking-Glasses, Knives 18 d. per Dozen, some Iron, little Brass Chains, Pewter Rings, and a deal of such like Stuff, as

Occa-

Occasion permitted: The other Sort of Provisions were, a Pair of Goldsmiths Bellows, Crucibles four Nests, Scarnelles two Nests, Quicksilver, Borax, Sal-Armoniac, Aqua Regis, Aqua Fortis, a Mortar and Pestle, and Leather Skins to strain, Brabs Scoops and Ladles with long Handles, to take up Sand, and other Implements for my private Design: All which had laden my Boat far deeper than I desir'd; for thereby I drew much Water, which, I was jealous, might hinder our Frogrefs over the Flats, if we should meet with any.

December the 7th, We arrived near *Settico*, being 14 or 15 Leagues above where our Men stay'd; but passed one half League further up, where we anchored, the River there being broad, we always chusing the Middle, as being freest from Disturbance, though it oft fell out otherwise; for our ugly Neighbours, I mean the Sea-Horses and Crocodiles, (it seems) ill pleased or unacquainted with any Co-Partners in these watery Regions, did often disturb us in the Night, not only with their ugly Noises, but their Vicinity to our very Boats, which caused us to keep Watch.

December the 23d, We were much troubled that Day with getting over a Flat, under the Wash of a steep and high Mountain bearing South. Here I first put in Practice my Design, and took up some Sand at the first Trial of the Ford, and, out of five Pound Weight of that Sand, got three or four Grains of Gold. I tried also in another Place of the same Ford, but did get less. I saw neither Town, nor Houses, nor People, since we left *Baracunda*.

January the 14th, At a Ford between two high Mountains, I tried again; and out of ten Pound Weight of Sand, I washed 30 Grains of Gold. I made a Trial likewise with Mercury, and found out

out of five Pound 47 Grains. Here my Hopes increased, yet resolved to try higher.

January the 27th, We were much troubled with great Trees that lay in the Water upon the Side of a Rock, on a craggy, barren Mountain adjoining. I ascended, with three Men with me, to make Discovery ; and carrying a Pick-Axe with me, which, as we were digging up a Piece of Ore, as I conceiv'd, we were assaulted with an incredible Number of monstrous great Baboons ; whom, no Oratory, but our Guns, could persuade to let us retreat to our Boats ; for, having killed two or three of them, so incensed the rest, that had, not the Report of our Guns terrified them, I verily believe, they would have torn us to Pieces : Having attained our Boat, I fell to try my Ore ; which proved but a Sparre.

February the 6th, I made a Trial of a certain glittering Sand, which I took up from the Side of a Rock, the River here inclining Southward, with a sudden Turning like an Elbow. The Wash of this afforded 41 Grains from 10 Pound Weight of Sand : By other Trials, from five Pound Weight of Sand, 57 Grains. Here I thought to make a Stand ; yet, upon more serious Advice, had resolved to proceed.

February the 15th at Night, a Sea-Horse struck our Boat through with one of his Teeth, which troubled us sore, being all bad Carpenters ; which caused us to unload her on a small Pinnacle to mend her ; and, to prevent the like Mischief for the future, I invented this Device, To hang a Lanthorn at our Stern ; and thereby we were freed from all After-Troubles of that Nature, they not daring to come within three or four Boats Length of Light shining in the Water.

February the 24th, I tried the Use of *Virga Divina*, upon a high, barren and rocky Mountain:

tain: But, whether it afforded no Metal, or whether my Rod, being cut in *England*, and being dried and carried far by Sea, had lost its Virtue; or, whether it hath no such Quality (which I rather believe) I am not certain. However, my Companions laugh'd me out of the Conceit.

March the 16th, Between two mountainous Rocks issued a Creek; and, putting up therein, discover'd a Fall of Waters from the South of the River. Here, making Trial by the Way, I found 63 Grains of Gold from five Pound Weight of Sand. Other Trials, more exact, afforded very large Proportions; so that here we spent 20 Days; and, plying hard our Work, in that Time had gotten 12 Pound *Troy*, five Ounces, two Penny-weights, 15 Grains, of good Gold.

March the 31st, Our Materials wasting apace, I was willing to try further, here beginning our greatest Toil; for, often in a Day, we were constrained to strip our selves, and leap into the Water, with main Strength to force our Boats and the Flats. Nor was this our greatest Affliction; for the River Water smells so sweet and musky, that we could not drink of it, nor dress our Meat with it; and, as we conceive, by reason of the Abundance of Crocodiles, which have the same Scent.

April the 7th, We perceived the In-fall of a small River South, the Current quick, the Land all rocky and mountainous, and, in the Silence of the Night, could hear the Noise, perfectly, of a great Fall of Waters; and, before the Mouth of it, anchored that Night.

In the Morning, into that we put, and came as near the Fall as we well could. Our Water failed; but our indefatigable Industry overcame all Difficulties; for, what I could not by Water, I did attempt by Land: Where arriving, I found the long expected

expected End of our most toilsome and long Voyage ; for, I believe, never any Boat, nor any Christians, have been so high in that River, as we. Here, upon the first Trial I made, the Exceed of Gold was so much, that I was surprized with Joy and Admiration : However, here I was resolved to set down my Staff ; and, to that End, the first thing I did, was to go the Boat ; and, about a League and half thence, I found Wood. Here we practised to turn Colliers, and laded our small Boat with as much as she could well carry back ; we went and fell to Work, for which I hope (to God alone be Praise) none of the Company hath Cause to repent, for the great Pains and Labour he took, tho' we chose the worst Time of the Year almost, the Waters being then at the very lowest ; but had we gone immediately after the Rains, which is *June, July and August*, or before the Waters were fallen so low, we had been free from much of that Trouble, at Fords and Falls, by having Water enough to carry us over.

At the End of the Paper are these Words,
Transcribed verbatim from a Paper Manuscript,
lent me by Mr. Fr. Lodwick, Octob. 2. 1693. by
R. H o o k.

This Paper (which I have here publish'd exatly as I found it) I not long since lent to a Person of great Quality, for the Service of the African Company, (then setting out for an Expedition into those Parts) and I hope it hath, or will, prove as much for their Benefit, as my Wishes are. The Paper seems to have been written by one that had gotten great Riches, in King Charles the 11^d's Time, by his Progress up the River Gambay : And his Descriptions of the Openings, and Turnings of the Gambay, the Inlets of other Rivers into

into it, the adjacent Mountains, &c. may be a good Guide to Undertakers, how to find out the Place, where our Author met with Gold, even to Satiety. Who he was, can scarce be known, by conjuring his Friend, Mr. Lodwick, (to whom I conceive this Letter was addressed) to the greatest Secrecy, being, I suppose, afraid to be known, or talked of, lest he should be commanded away, by the King and Government, upon another Expedition, from that peaceable and satisfactory Retirement he enjoyed, after his Acquisition of sufficient Wealth.

W. DERHAM.

Experiments and Observations about heated Iron; communicated to the Royal Society, January 3. 1693-4.

HAVING lately met with some Experiments which are not much known, tho' they are obvious, and easy enough to be observed and experimented, I thought it might not be altogether impertinent, nor unacceptable to this Assembly, to give a short, but true Account thereof; and so much the rather, because they are very pertinent for the Proof and Confirmation of a Theory which I have formerly read before this illustrious Society, and have published in the 8th Observation of my Microg: for the explicating the Phænomena observable about the Sparks of Fire, struck from the Steel, by the Edge of a sharp and hard Flint, or some other such hard and stony Body: These I found to consist of small Globules, looking like melted Iron, or else some small Sliver cut off from the Steel, and thereby made red-hot, but not melted, but keeping the Shape it received by the Stroke,

Stroke, or Gash of the Stone ; which Phænomena I did there thus explicate. — It seems that some of these Sparks, &c. Pag. 45. Line 24, to Pag. 46. Line 14. — Muscovy Glass.

THERE are two Particulars, therefore, that I have there alledged, which, by the Experiments I am now to mention, will receive great Confirmation. And the first of these Experiments is, That two Smiths, taking each his small Bar of Iron, both perfectly cold, and each of them hammering his Bar upon the same Anvil with small Hammers, in a very short Time, and with not very many Strokes, reduced them both to so great a Heat, that immediately laying them one upon another, and continuing to hammer them a very small Time longer, they were thereby perfectly welded, or joined together into one Piece, as firmly, as if they had been welded the common Way, by being sufficiently first heated in the Fire, and then hammered together. This Experiment I have not yet seen tried my self, but I have been assured of the Truth of it by a knowing Person, who saw and examined all Circumstances thereof, insomuch as I do no way doubt the Truth and Certainty thereof.

THE other Experiment is this, That taking a Bar of Iron, and heating it to a white Heat, so that it spurts, or darts out of it every Way, very shining and fiery Rays ; then immediately laying the same on the Anvil, or a Tile, and blowing the glowing Iron with a Pair of Bellows, instead of cooling the same, as most would be ready to expect, the cold fresh Air from the Bellows will make it glow and burn much brighter and hotter, and will continue to do so for a considerable Time ; and if the Bar be sufficiently heated at first, the Bellows, by so blowing, will melt the same, as if it were Pitch or Rosin on Fire. The last Part of this Experiment I have

I have not yet verified my self, but the former Part I have, and observed it to burn and waste under the Blast of the Bellows, as if it had been a Piece of kindled Charcoal, so blowed upon; and the Flame, or Light thereof, to be so very strong and vivid, that one cannot well endure to look upon the same, without much offending the Eyes, as if one look'd upon the very bright Face of the Sun it self.

By the former Experiment it is evident, that the Force of the Blow or Stroke, which is able to cut off a Sliver of hardened Steel, may not only be sufficient to heat the same, to a Degree sufficient to set Fire on the Tinder, but to intend it, so far as to make it of a welding or white Heat, which having acquired, and flying off into the Air, with a very quick Motion, by the 2d Experiment, 'tis evident that the Operation of the Air is sufficient to intend the Heat yet further, so as to melt, or vitrify the same, and thereby to cause it to be formed into a Globule, Ball, or Shell, as it often appears through the Microscope. All which Effects are more easily perform'd on so small a Body, as are those Slivers which are struck or cut off from the hardened Steel. But the Globules, Balls, or Shells, that are made by the melting of the heated Iron, blown on by the Bellows, are much bigger, and more conspicuous, but of the same Form and Substance. Nor is this Combustibility peculiar only to Iron, tho' therein it be very notable and conspicuous, but the other Metals have also their Combustibilities in their distinct Kinds, as Copper, Brads, Lead, Tin and Silver; upon each of which the Menstruum of the Air will work and dissolve, or burn them when they have first been prepared by a proper Degree of Incallescence, as I shall, at some other Time, make manifest, by plain and evident Experiments.

Dr.

Dr. Hook's Account of Mons. De la Hire's Discourse of Frost. 1694.

I HAVE have perus'd the Book of *Dan. Bartoli*, concerning Frost and Ice; and tho' he hath many Arguments to destroy the Sentiment of several of the Moderns on that Subject, of *Valesius*, *Des Cartes*, Mr. *Boyle*, *Olaus Magnus*, Sir *Kenelm Digby*, &c. yet I do not find any other Doctrine affirmed concerning it, but that he conceives it done by a nitrous Substance, which is of a cold and dry Nature, which operates after the same Manner in coagulating the Water, as the Runnet doth in coagulating Milk; but, how that is done, I do not find he does explain.

HAVING therefore fail'd of my Expectation from him, I resolved to see what Satisfaction I should have in perusing a Discourse, upon the same Subject, of a much newer Date, namely, that of Mons. *De la Hire*, publish'd at *Paris* in 1694. whereas that of *Bartoli* was publish'd at *Rome* 1681. This I found to be much more concise, and plain, and positive in what he has deliver'd, and much more clear in explicating of his Notions and Conceptions of it; so that tho' I could not meet with such an Information concerning Ice and Frost, as I could have wished, yet in perusing 16 Pages in *Quarto*, which is the whole Treatise, I was satisfied that I understood fully what he intended to communicate; whereas I was to seek, what was intended by the other, in almost ten Times the Number of Pages.

Mons. *De la Hire* then begins his Discourse, by defining or explaining what he means by Cold; that is, the sensible Quality in Frost; and this, he says, is nothing else but a less Agitation or Moti-

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on of the aqueous Particles, whether blended with the Air, or united in a Mass, than of the like Particles in the Skin, or Pores and Vessels of our Body. He might, he says, have added another Assertion, that all the Agitation of aqueous Particles proceeds from that of the subtile Air; but he thinks it sufficient, for this Discourse, to shew how all the Phænomena of Cold will be plainly solved, by the Explication he has premis'd.

NEX T, he says, that these Particles are depriv'd of their Motion by certain Particles of Salt, which are very minute, long, stiff and sharp, which, by their Motion, are easily carried and blended with the Air, but do more easily insert themselves into the Particles of Water, than of any other Body, nay, even than of the Salts themselves, from whence they proceed, which he reckons to be from common Salt a little, from Niter more, but most of all from *Sal Armoniack*, which Salts do therefore easily dissolve in Water; that these Particles do penetrate Metals, and even Glass, but that they are most entangled, and stay'd by the Particles of Water, which he supposes, with *Des Cartes*, to be long and flexible, like Strings or Threads, and by that Means they destroy the Motion or Fluidity of each other, which composes a solid, hard and dry Body, which is Ice. This Ice, he says, encreases Extension, by Means of these Salts, and so breaks the Vessels that contain'd the Water; and, being so extended, is lighter, and so floats on the Water. Hence 'tis, he says, that Blebs are form'd in the Ice; but his Explication of this Phænomenon is not consonant to the other Suppositions. By the bye, he explains the Expansion of Water by Heat, and that he makes to proceed from the Expansion of the Parts of the Air contained in it. Hence he concludes, that there is a middle State of the Water,

which is its specifick Expansion, and it is then cold, because tho' it may be easily moved, and so retain Motion enough to keep it fluid, yet it has so little Motion of its own, that it communicates none to other Bodies. The Reason, why Oils and Spirits freeze not, he says, is because they have few of those entangling aqueous Particles: By this he gives a Reason of the not freezing of other Bodies. To fortify his Hypothesis, he explains the Experiment of the Expansion of Spirit of Wine, by the Application of Snow; and freezing other Bodies by Application of Niter and *Sal Armoniack*, and Spirit of Wine; and, by the Way, he tells a pretty Method of cleaving Mill-Stones, by the swelling of small wooden Pins, drove into certain Holes, drill'd in a Line on the Stone where 'tis to be cloven. He takes Notice also, that the Refraction of Ice is less than that of Water, and quotes his own Publication of it in 1693. though it was shew'd by me, to this Society, 30 Years before; (but 'tis not usual for those Writers to own Discoveries to be made by any but themselves, who take themselves to have an Empire over all the rest of the World). He also takes Notice of several other Phænomena, and Experiments of Ice and Frost, mentioned by Mr. Boyle, but without naming him. Upon the whole, I conceive, he has more particularly applied the *Cartesian* Notions of Particles, Motions, Figures, &c. to the Explication of these Phænomena of Cold: But as the Supposition of such qualified Particles is wholly precarious, so neither will those, without a great many other supplemental Suppositions, suffice to solve the Phænomena satisfactorily, unless the Particles be supposed to act and operate by Instinct; and tho', possibly, they might serve to put a seemingly probable Explication of these Phænomena of Cold, by supposing them thus, or thus, qualified

and adapted; yet, I very much fear, there are some Phænomena of Heat, or of other Qualities, wherein the same Particles of Bodies are necessary to be introduced as the principal Agents, tho' their Actions in those be quite contrary to their Actions in these. It would be, therefore, but a second lost Labour, to shew that these Particles are of another Nature than what they are here supposed, and to assign them other Figures, Motions, and Qualifications: Because, first, it would be almost as much Labour to demolish this Fabrick, as it was to raise it, and a third fruitless Labour to erect another. Nor can it be expected to be otherwise, till such a Structure be founded upon a natural, firm, and solid Ground, and not upon feigned and imaginary Suppositions.

*An Instrument of Use to take the Draught,
or Picture of any Thing. Communicated
by Dr. Hooke to the Royal Society,
Dec. 19, 1694.*

A MONG the Instruments that may be of Use to curious Navigators and Travellers, one is, for procuring the Pictures, Draughts, or true Forms and Shapes of such Things as are, or may be, taken Notice of by them; that is, not only of the Prospects of Countries, and Coasts, as they appear at Sea from several Distances, and several Positions; but of divers In-land Prospects of Countries, Hills, Towns, Houses, Castles, and the like; as also of any Kind of Trees, Plants, Animals, whether Birds, Beasts, Fishes, Insects; nay, of Men, Habits, Fashions, Behaviours; as also, of all Variety of Artificial Things, as, Utensils,

sils, Instruments, Engines, Ships, Boats, Carriages, Weapons of War, and any other Thing of which an accurate Representation, and Explanation, is desirable. For, tho' a Description in Words may give us some imperfect Conception, and Idea, of the Thing so describ'd; yet no Description, by Words, can give us so full a Representation of the true Form of the Thing describ'd, as a Draught, or Delineation of the same upon Paper. Nor can we so perfectly conceive, or imagine, the true Colours, by Words, as by seeing the very Colour it self imitated and compared with the Life, or the real Thing: Whence we find how imperfectly the Colours of Plants are represented by Herbals, which are wash'd, or colour'd, only from the Descriptions which are made of those Colours in the Books.

Now, though this be not a new Design, or a Thing that has never been done before by any that have given us Accounts of their Travels; yet, if we do but consider, how the most of those have been done, it will, I conceive, make this, which I propound for this Effect, so much the more valuable. 'Tis well known, that the Books commonly made for the Use of Seamen, (now commonly called *Wagoners*, because one *Wagoner* printed a Collection of many such Observations) that these Books, I say, are full of the Prospects of Countries, as they are said to appear upon the Sea, at such Distances and in such Positions: And I lately saw a Book containing the Prospects of all the Western Coasts of *America*; but any one, that understands Prospect, will easily discern, how rude, imperfect, and false a Representation, all such Books contain of the Places themselves: For, not to mention the Impossibilities they often represent, as the Over-hanging of Mountains for half a Mile, or a Mile, which, tho' the Mountain were

made of cast Iron, were impossible to be sustain'd in such a Posture : The extravagant Heights they generally raise the Hills to, and the sudden and very decline Descents they make them have into the Vallies, do plainly enough demonstrate them to be no true Representations of what they are design'd for. And, indeed, they are most made by the Hands of the Mariners, who are, generally, very little skill'd in the Art of Delineation ; and, therefore, 'tis not to be expected that they should be very exact : However, even these are of very good Use for Navigators ; and they furnish them with a better Idea of the Appearance to be look'd for, than Descriptions by many Words would inform them. Again, we find that many Relations of foreign Countries do give us Pictures of Towns, Prospects, People, Actions, Plants, Animals, and the like ; and those beget in us Ideas of Things, as they are there represented. But, if we enquire after the true Authors of those Representations, for the Generality of them, we shall find them to be nothing else but some Picture-drawer, or Engraver, here at Home, who knows no more the Truth of the Things to be represented, than any other Person, that can read the Story, could fancy of himself, without that Help. Such are all the Pictures in the Books of *Theodore de Brie*, concerning the *East and West-Indies* : Such are also the greatest Part of the Pictures in Sir *Thomas Herbert's Travels* ; and those of Mr. *Ogylby's Asia, Africa, and America* ; which are Copies of the Dutch Originals, and are, originally, nothing but Mr. Engraver's Fancy : So that instead of giving us a true Idea, they misguide our Imagination, and lead us into Error, by obtruding upon us the Imaginations of a Person, possibly, more ignorant than our selves.

It is, therefore, the Interest of all such, as desire to be rightly and truly informed for the future, to promote the Use and Practice of some such Contrivance as I shall now describe ; whereby any Person that can but use his Pen, and trace the Profile of what he sees ready drawn for him, shall be able to give us the true Draught of whatever he sees before him, that continues so long Time in the same Posture, as while he can nimbly run over, with his Pen, the Boundaries, or Out-Lines of the Thing to be represented ; which



being once truly taken, 'twill not at all be difficult to add the proper Shadows and Light pertinent thereunto. By the same Instrument also, the Mariner may very easily and truly draw the Prospect

spect of any Shore, and from Time to Time denote the Rising thereof, as he does nearer and nearer approach it, and the Depression, or Sinking of it, as he does recede.

TH E Instrument I mean for this Purpose, is nothing else but a small Picture-Box, much like that which I long since shewed the Society for Drawing the Picture of a Man, or the like ; of the Bigness of the Original, or of any proportionable Bigness that should be desired, as well bigger as smaller, than the Life ; which, I believe, was the first of that Kind which was ever made, or described by any. And, possibly, this may be the first of this Kind, that has been applied to this Use ; tho', upon the first Institution of the Royal Foundation of *Christ-Church*, I propounded it to the Governors there, for the Use of the Children : But Sir *Jon. More* undertaking to write an Institution, and having omitted it, it has not been there brought into Use.

*A Way to measure Heights and Distances,
&c. at Sea, Feb. 13, 1694-5.*

THAT, which I shall at present explain, is a Method of Measuring the Bearing and Distance of Objects seen at Sea, such as Ships, or Shores, Islands, Promontories, Castles, Towns, Mountains ; their Heights, as well as Distances : Also the Course, Length, Breadth, &c. of Rivers, and the like : As also, for knowing the Distance from any Light, or Light-House, seen in the Night. Now, tho' experienced Navigators do, by long Practice and Use, give pretty near Guesses at them ; yet the Way I shall propound, I conceive, will come much nearer, and be much more

more certain, and may easily enough be put in Practice; which if the Gentleman, that describ'd the Coasts of *England*, had known, or put in Practice, I conceive, he would have prevented many Mistakes he has therein committed. However, tho' it be now too late for that Purpose, yet it may be of good Use for such as may attempt the Amendment of those, or any other Coast-Maps, or Charts, for the future. And I have the rather mentioned it at this Time, for that somewhat of that Kind is shortly design'd to be undertaken. And it would be, as I conceive, very much the Interest of all Mariners, Merchants, nay States that are concerned in Maritime Affairs, to be at a constant Charge to have such a Design prosecuted, till it be compleated for the whole World, at least for all Coasts that are traded to, or much frequented, or which are often passed near, or touch'd at, in farther Voyages; that Seamen, in Case of Distress, might know where to find convenient Harbouring, and also Accommodations of fresh Water, Wood, Victuals, &c. I know the Work is great; yet it is necessary, and ought to be done, some Time or other, and therefore the sooner the better. Somewhat of this Kind, I know, is accidentally done almost by every Navigator, and recorded in their Journals; but most of those being kept by themselves, they are of little publick Benefit, and serve only for their own future Information. But those who have made it their Business to collect and digest such Journals, and to print the Results thence deduced, which the *Hollanders* and *English* have prosecuted more than any Nation besides, have very much deserved the Acknowledgments of all the rest of the World; as all such for the future will do, who shall promote and encourage such a Work.

T H E Way then, which I propound, is perform'd by taking the true Bearing of an Object at the same Instant from two Stations, which, the farther they are removed from each other, the more fit they are for this Purpose. Now, because both these Stations are to be comprised within the Ship, or Vessel, made Use of, I would have them to be, at the Extremities, of the Length of the Vessel, to wit, at the Stern and Head, or in the Round upon the Head of the Boltsprit, which will add somewhat to the Distance of the two Stations; for, upon the Measure of that depends the Measure of all the other Lengths or Distances. Now, in each of these Places which are pitched upon for the Stations, I would have a fix'd Frame, or Pedestal, for the holding of the Instrument to be used on it, and the Instrument so fixed to it, as to remain firm and steady in any Posture desired, and yet, with the greatest Ease imaginable, so to be moved, as to respect directly the Object requir'd, and, when the Observation is made, to be as easily removed, and as easy again to be fixed. The Instruments I would have to be Sextants of about two Foot Radius, most exactly graduated; on each Side from the middle Line, that is, to 30 Degrees on each Side, and to be fitted with Perspective Sights, whose *Rete*, or Sight-Point, shall always be in the Center of the Instrument, and that Center always in the Line and *Terminus* of the Distance of the two Stations, which shall be invariable, however the Instruments are moved to respect the Objects; to which Purpose each of the Instruments shall have a double Motion; one of which shall be exactly upon the Line of Distance of the Instruments, whereby the Plane of the whole Instrument is moved; and the other of the Sight, upon the Plane of the Instrument it self, so as to respect the Object, and give the Angle that the Line

Line of the Sight makes with the former Axis of Motion, or with the middle Line of the Instrument; which middle Line ought to be exactly perpendicular to the Axis of the Motion of the Plane of the Instrument, which is the Line of Distance. Next, there should be two expert Observers placed to make Use of these Instruments, and each of them, at the same Instant, should direct his proper Sight to the same Point of the Object; which, that it may be done the more exactly, I think it convenient, especially in large Ships, to have a Line, Packthread, or Wire, to pass between the two Observers, by which they may, at the Instant they desire, advertise the corresponding Observer, of what will be necessary, according to the Signs or Directions they have before mutually agreed upon. By this Method, if well executed, I do not doubt, but that Heights, Distances, and Positions of Objects, seen on the Sea, may be estimated ten times more exact than any that are now made by Judgment, (as they say) or rather by Guess. And, if any one will endeavour to put it in Practice, I shall be very ready to explain any Part thereof more fully, and particularly, for his Information.



Dr.

*Dr. THO. SMITH's Letter to Dr. HALLEY,
Jun. 12. 1695. concerning Mr. Greave's
Observations in Egypt.*

Excerpta out of Mr. Greave's Note-Book.

IN his Astronomical Observations, he begins the Day with the Rising of the Sun, as seeming most natural.

Obliquitas Zodiaci, A. C. 1639. 23° 30' 15".

TH E Colours of the Planets not different at all from what the Antients make them, and from what we see in *England*.

A. D. 1638. Mense Decembri.

Declinatio acus magneticæ a meridiano Alexandriæ occidentem versus, e multis observationibus, iisque accuratis, 5° 45'.

J. GRAVIUS ANGLUS.

TH E Altitude of the Pole at *Alexandria* 31° 10' N. but I find, in other Places of the Book, 31° 5' and 31° 3'. [Which of these three Observations he determined to be the most accurate and certain, I could not find.]

Posidonius, as *Cleomedes* writes, observ'd the Altitude of *Canopus*, at *Alexandria*, to be 7° $\frac{1}{2}$; he observed it there to be but six Degrees, and almost half. *Canopus*, says *Ptolemy*, has Long. 17° 10'. Lat. Austr. 75°. *Snellius* finds the Altitude of the Æquinoctial at *Alexandria* to be 58° 58', and so the Pole consequently 31° 2'. The Sun's Meridian Altitude taken by him,

11 March

11 March 1637. S. V. at Galata, by Constanti-
nople, $49^{\circ} \frac{1}{2}$.

11 Sept. 1638. at Rhodes, $53^{\circ} \frac{1}{2}$.

19 Decemb. 1638. at Alexandria, $35^{\circ} \frac{1}{2}$.

The Diameter of the Sun, taken January 25.
S. V. 1638. $2^{\text{h}} \frac{40}{60}$ p. m. and so again 4^{h} p. m.

As 10000 to 103,

So 100000 to 1030, the Tangent of $35' 25''$
the Diameter of the Sun.

Jan. 29. S. V. 1638. about 5^{h} p. m. he found
the same Diameter.

At the Rising and Setting of the Sun in Ægypt,
especially about Alexandria, there is great Store
of Vapours. At a good Distance from the Hor-
izon, the Body of the Sun grows ruddy, and ap-
pears bigger than it usually seems in England.
Few Nights, and those without Wind, that he
could see the Stars near the Horizon: The Rea-
son was, because when the Winds blow, they raise
Sands, which make, oftentimes, the Sky to look,
as when it is hazy Weather in England.

He could observe no Spots in the Sun, for se-
veral Weeks together, in the latter End of Janu-
ary, February, and March. On the 5th of April,
S. V. 1639. three little Spots in the Sun, whereof
two close together.

At this Day but four Channels, or *Ostia*, of Nile;
two natural, *Damiata* and *Rosetto*, which make the
Delta; and part some twenty Miles below Cairo:
Two Artificial, 1. The one on the South Side of Alexan-
dria, and has its Beginning some 30 Miles a-
bove Rosetto: By this all Merchandise was ancient-
ly brought to Alexandria, which now comes from
Rosetto by *Giermas*, with great Uncertainty, by
reason the *Bocca* of *Nilus* is very dangerous, both
because of the N. W. and N. N. W. Winds, which
bar in all those Ships, as also for the Sands and
Shallows;

302 Dr. Hook's Contrivance to
Shallows; tho', at the overflowing of Nilus, good
Ships may pass.

2. THE other at *Boulas*, where it falls into a
Sinus of the Sea; i. e. in the Mid-way between
Rosetto and *Damiata*, and like to that at *Madiga*,
which is in the Mid-way between *Alexandria* and
Rosetto: Between these two Places, about 40
Miles English, *Rosetto* lies from *Alexandria* East
and by South.

THE Course of *Nilus*, allowing for the several
Turnings S. S. E. wherefore *Memphis* and *Alexan-*
dria cannot be in the same Meridian, nor *Rhedus*;
for from *Rhedus* they sail S. S. E. to *Alexandria*.

*Dr. Hook's Contrivance to augment the
Divisions of the Barometer, in a Discourse
to the Royal Society, Dec. 17. 1695.*

THE following Contrivance I met with in a small
Script of Paper, and find it was a Part of a
larger Discourse on the Subject, which never came
to my Hands.

W. DERHAM.

THE other by a Counterpoise and Wheel,
whereby I could make an Index point the
Divisions of a long spiral Line, not only of one
Revolution of that Line, but many whole Revolu-
tions in a spiral Line: So that if one Round of
the Spiral were six Foot Compass, and so easily sus-
ceptible of 1000 Divisions, I could easily make it
move six or eight Revolutions, each of which should
be equally capable of the like Number of plain and
very visible Divisions, which maketh the Diffe-
rence of two Inches in the common, to become 40
or 50 Foot in this, and consequently capable of
eight

eight or ten Thousand Divisions, as sensible and plain to be seen, as the half Decimals of an Inch ; and the Contrivance is such, that there is no Manner of Stiffness or Rubbing in the Contrivance, but each of these Divisions will be as exactly pointed to by the Index, as the Index, in the common single Barometer, can be pointed to by the Surface of the Mercury ; which, since it is usually comprised within 40 Decimals, or Parts of an Inch, or two Inches, and this Way it may be made 40 or 50 Foot ; it follows, that consequently the Alterations will be 200, or 250 Times more visible and discoverable, than by the common Barometer.

AND having brought it to this Pafs, that I could, by these Methods, be able to make the Smallest Alterations, (that have yet been imagined) to be sensible and measurable, I desisted from improving this Subject, by further Contrivances upon thefe Principles. However, I may, in Time, shew some other Instruments for Discovery of the Weather, that may, come to be of as good Use.



Dr.

Dr. Hook's Conjectures about the odd Phænomena observable in the Shell-Fish called the Nautilus. Read to the Royal Society Dec. 2, 1696.

FOR the right Understanding of this Matter, I shall give a brief Account of this Animal from Aristotle, Pliny, Oppian, Ælian, Bellonius, and their Transcribers, Gesner, Aldrovand, and Jonson, viz. That the Nautilus is an Inhabitant of the Deep : That it bath three Motions, viz. a Power to raise it self up from the Bottom to the Surface of the Sea ; that it can sail thereon ; and again sink itself to the Bottom : That its Shell is made very commodiously for these three Motions, with divers Cells : That it can erect its Shell edge-ways for Sailing : That it bath two (some say three) Arms, or Claws, with a thin and light, but strong Membrane between them, like that of Palmiped Birds : That this it hoists up and spreads like a Sail, and is driven thereby on the Surface of the Sea : Besides which, that it bath also other Parts on each Side of it, that it lets down to steer and guide its Course, as with a Rudder, so long as no Danger is nigh : But, if it perceives any Danger from the more powerful Animals, or Storms, that then it fills its Shell with Water, and suddenly sinks itself to the Bottom.

BUT for the Reader's Diversion, if he bath a Mind to see Oppian the Poet's elegant Description of this Inhabitant of the Waters, as translated by Lippius, he may find it thus in Aldrovand. de Testaceis, l. 3. c. 5.

Quem dicunt nomine vero
Nautilon, insignem ponto sua gloria fecit,

Per

Per freta dum cautus sub Navis imagine ludit.
In fabulo domus est, summa defertur in unda
Pronus, neu pontum capiat, plenusque gravatus;
Cum nando vehitur, per fluctus Amphitrites,
Extemplo versus tumidam per marmoris undam
Labitur, ut nandi doctus, puppisque peritus.
Atque pedes geminos tendit, de more Rudentum,
Quos inter medios tenuis membrana tumescit
Extensa, atque pedes contingunt æquora subter,
Themoni assimiles, navem, piscemque domumque
Deducunt. Si forte malum supereminet ullum,
Absorbet fluctus intus, lymphisque gravatus,
A tumidis trahitur cum pondere fluctibus unda.

Hinc (saith Aldrovand) homines navigia inventerunt, & ex eodem Oppiano citat Lilius Gregorius Gyraldus.

W. D E R H A M.

The Account which Dr. Hook gives is thus :

TH E Structure of the Shell of the *Nautilus*, which as it is very curious, and indeed very wonderful, so it is not less instructive to one that shall contemplate on it ; and to me, as yet, it appears to be the only Instance of a Contrivance truly wonderful ; for that I do not know any thing like it in the whole Genus of Fishes, tho' there are some Instances that tend that Way. It is, in short, this, The Creature, it seems, to whom this Shell is adapted, by Accounts we have of it, is an Inhabitant of the Abyss, or Great Deep ; which how deep it is none yet knows, nor will know, till some of my *Nuntii ad Abyssum* (which I have formerly acquainted you with) be sent thither, and bring back Tidings concerning it ; or, till this our present *Nuncius* can find a Way to manifest, how far he has ascended to come up to the Day, or how far

he descends to go to his Resting-place at the Bottom of the Sea. For these Progresses he is said to make, besides his Voyage, when he sails on the Top of the Ocean. Now being constituted by Nature to perform these, and yet to be without Wings or Fins, to help himself by Labour to move in any of these three Ways ; it is wonderful to consider, by what a plain and easy Contrivance the All-wise Creator has endowed him with sufficient Faculties to perform the same, with very little or no Fatigue at all, but to be carry'd in his Chariot, or rather Ship, from Place to Place, as he has Occasion to change his Residence.

T H E Manner of which (if I am not mistaken in my Conjecture) is this : Nature has furnished him with a curious Shell, dividing it into many distinct Cells or Cavities, by certain Valves, Diaphragms or Partitions, which have no Communication with each other, but only by Means of a Gut or *Ductus*, which passes through them all from the Bowels or Body of the Creature, placed in the Cavity of the Mouth of the Shell to the very End of the Spiral Cone, or conical shaped Shell, which ends in the very Center or Beginning of the proportional *Spira*, and has there a *Spiramentum* or Vent, which I have formerly discover'd, by examining more curiously one of that Kind, by opening it, though it has not hitherto been taken Notice of by any Author that I have met with. The Axis, or middle Line of this Cone, or conically-shap'd Body is spiraled round exactly in a Plane, and not helicated on a conical Surface, as in almost all the Shells of other the conchylious Fishes, it is observable. Now this admirable Structure seems to me not a mere *Lusus Naturæ*, or a Form by Chance, to express, a Variety, but an Emanation of that infinite Wisdom, that appears in the Shapes and Structure of all other created Beings, which

is to endow them with sufficient Abilities to perform those Actions, which are made necessary to their Well-being. Now, the Relations of Histories of this Creature inform us, that it has three Kinds of Motions through the Water, that is, ascending, descending, and progressive; and since there is one Posture of the Shell, that is most proper to perform each of these, therefore it is, as I conceive, that the Shell is so contriv'd, as to be put, and kept in that Position, whilst it performs that Motion: The Shell then is contriv'd to be all a Cavity, and to have no other Part or Bowel of the Creature within the first Cavity, but only a small String, Gut, or *Ductus*, which passeth from the Body of the Creature, placed in the Mouth of the Shell, to the End of the conical Cavity. Now by this I conceive, that when this Cavity is fill'd with Water, the whole Bulk becomes heavier than the Water, and so must sink to the Bottom of the Sea: But when the Cavity is fill'd with Air, then the Whole will be boyant, and lighter than the Water, and so rise to the Top, and float on its Surface: These Powers it would have had, supposing the Cavity of the Shell had had no other but the first or greatest Diaphragm, and the rest had been one entire Cavity: But this would not have disposed the Shell to all those Motions, it is to perform, into the most convenient Postures; for that Posture, that is fittest for its rising, would not be so for its sinking, nor for its failing, nor possibly for its Progression at the Bottom, (if such a Motion it does perform, as to me it seems rational enough to suppose) for that every one of them will need a different Posture. We find, therefore, this Cavity all subdivided by internal Diaphragms or Partitions, into a great Number of distinct Cells, (I have found 40 in some Shells) and every one of these penetrated by this Gut or *Ductus*, so that

by Means thereof, I conceive, the Animal has a Power to fill or empty each of those Cavities with Water, as shall suffice to poise and trim the Posture of his Vessel, or Shell, fittest for that Navigation or Voyage he is to make ; or if he be to rise, then he can empty those Cavities of Water, or fill them with Air which lie toward that Side, that part the Shell, that best penetrate the Water : If he be to descend, he can fill those with Water, and empty the opposite ; if to sail on the Top, he can evacuate those Cavities that will trim his Shell fit to sail with the Mouth of it upwards, that he may there expand his Sails and use his Rudders ; and if to move at the Bottom, he can fill those, and empty the opposite, so as that the Mouth may be downwards, to respect the Ground or Bottom over which he passes, so to discover his proper Nutriment or other Convenience, and to descend to it when he finds it. Now it may be imagined, and objected, that these Operations may be too notional and fanciful, and so seem to have more of Design and Counsel, than the Creature seems to be capable of : To which I answer, that it is no more, nor, may be, so much, as most other Creatures are endow'd with, and constantly perform : For whoever considers what Design and Contrivance there is for the Performance of all muscular Motion, where this or that Muscle is to be strained, and that or the other Muscle is to be relaxed, and presently the quite contrary Effects are to be effected, and all these to proceed from the Will, or Intention of the Creature that moves himself thereby, which Way it pleafeth, will not think it so strange to conceive, that this Creature may have implanted in it a Faculty, to make use of the Organs for Motions, as well as any other : There needs no Institution of a Bird to make use of his Wings to fly, or of his Tail, to poise or guide him in his Flight ;

no,

no, Nature, or the infinitely wise God of Nature hath taken Care to give him an Instinct or Impulse, which enables him to do those Things, that are necessary to be done, for the producing the desired Effect. Now, though the shaping, and trimming, and steering of an artificial Ship, doth require the Understanding of the Men that are to act in that Ship, to know, and accordingly to dispose of all Things, for the effecting what is necessary or desired ; yet 'tis not thence to be argued, that the Operations of animal Motions must be perform'd by the Operations of Reasoning. No Man can tell how, or by what Means, he moves his Finger, or any one Muscle of his Body ; no, Nature hath set all Things in Order, and endow'd us with a Power to perform what is necessary, though we know not how, nor by what Means ; nor is the Notion, I have hinted, so extravagant, or so much beyond the other Contrivances, for the effecting of various Motions in other Animals, as some may imagine, since, when I come to treat of that Subject, I shall shew, and prove several Contrivances, that are actually made Use of, that are abundantly more wonderful.

[*On Dec. 16. following, Dr. Hook resum'd his Considerations of the Nautilus, and having taken Notice of several Transmutations, as particularly of Water into the solid Parts of Vegetables, as also into Earth or Ice ; he then proceeds, and saith,]*

W. DERHAM.

BUT this Metamorphosis, or Transmutation of Elements, I take Notice of here, only by the by, as it may be of some Use for the Explication of another Metamorphosis of a contrary Nature, and that is, of Water into Air, which is by Rarefaction,

for such an Operation Nature seems to have; and somewhat of this Kind is producible by Art, as has been prov'd to this Society by many Experiments, heretofore made, for the Production of artificial Air; which, though under that Notion it seem'd not to be regarded, yet, as such another, published a good While after all those Experiments, as his own, not owning at all he had been inform'd of them, by some of the Members of this Society: But to pass by that at present (because there are Abundance of Instances of the like Nature that have been given, which I may on some other Occasions manifest) I had a further Prospect in the Success of those Trials than what was, for the like Reasons, then spoken of; one of which was, for the Solution of such a Phænomenon as this, of the floating and sinking of the *Nautilus*, which I discoursed of the last Meeting but one. It seem'd, indeed, very strange, how that Creature could so, at his Will fill, and empty, the Cavities of his Shell, with Water; it was easy to conceive, how he could fill his Shell with Water, and so sink himself to the Bottom; but then how (when there, at such a Distance, from the Air) he could evacuate the Water, and fill the Cavities with Air, that was difficult to comprehend, especially being under so great a Pressure of Water: But if Nature had furnish'd him with a Faculty of producing an artificial Air, then the Riddle would quickly be unfolded. I found, therefore, that by Art it was feasable to produce such an artificial Air, and that it was endued with a very great Power of Expansion, so that it would not only make itself Room to expand, notwithstanding the incumbent Pressure of the Air on all Sides; but, if sealed up in strong Glasses, it would break out the Sides there of, which might have as much Power of Expansion as might counterpoise, nay,

nay, out-power both the Pressure of the Air, and also the Water too, though 100 Times greater than that of the Air. It will be, I confess, a difficult Matter for me to prove, that the *Nautili* have such a Power, for that I could never yet get a Sight of that Fish that inhabits those Shells, nor do I find that any of the Authors, that pretend to describe it, have, nor has any of them given a Description of it that can give one any true Idea of it : Yet, methinks, it might be procured from some ingenious Person, that has an Opportunity of visiting the *Barbadoes*, and some of the other Leeward Islands, where there are found great Plenty of a smaller Sort of them, which though of a differing Shape, in the Coil of the conical Body, yet they agree with all the other Kinds of them in having the Diaphragms, and a *Ductus*, or Vessel passing through them all, from the Basis to the Apex of the coiled Cone, and the Axis of that Cone is also coiled in a Plane, as are all the other Kinds of the *Nautili* ; of which I have one here to shew, given me by one who had a whole Box full of them, which he had there collected, and brought with him to *England*.

Some farther Observations relating to the Nautilus, and other Shell-Fish. Read Dec. 23, 1696.

W. D E R H A M.

I Explain'd, the last Day, the Fabrick and Structure of a Creature, which, as Authors inform us, is an Inhabitant of the Abyfs or Great Deep, which does often perform a Voyage from thence to this superior Region of the Air ; and, after the Dispatch of his Busines here, returns again to his own Habitation. I explain'd also, by what Method he per-

form'd these Voyages, as I conceiv'd, from the Consideration of the Structure of the Shell, and the Effects perform'd by it. I cannot be positive in it, as not having ever had an Opportunity to see the Creature itself: But by considering of the Contrivance of other Fishes, to help them to float in the Water, or at least to buoy them up, or counterpoise them with the Water, by the Help of the *Swim*, as 'tis call'd, or Bladders blown up by Air, or Vapours, I think there is great Probability in the Conjecture.

For the *Nantilus* is not the only Inhabitant of the Deep, or of the Bottom of the Sea; no, questionless, there are a Multitude of other Sorts of Animals that are there bred, and do there reside; for we do not only find Oysters, Scallops, Cockles, Periwinkles, and most other Kinds of Shell-Fish, but most Sorts of crustaceous Animals, as various Sorts of Lobsters, various Sorts of Crabs, and various Sorts of Prawns or Shrimps, and such like; nay, we find there also several Sorts of Fishes, not furnish'd either with Shells, or Crusts, which the Fisher-men always find and catch, near the Bottom of the Water, where they fish for them: And I myself have proved, that the best Place, to lay the Bait to catch Whitings, Grundells, Place, Flounders, Beards, is, at within a Fathom of the Ground, where the Depth of the Sea was about 25 Fathoms, or 150 Foot; and, from as great a Depth, I have known Lobsters and Crabs to have been taken by the same Fish-hooks, which were baited for the catching those other Sort of Fishes: And, indeed, most Part of the Lobsters, Crabs, and Prawns, are taken, in Fish-Pots, or Fish-Cages, laid at the Bottom of the Sea, when there has been found a Place frequented by them: As also Scates, Thornbacks, Monk-Fish, Dog-Fish, and the like, which are catched by baited Fish-hooks, laid at the Bottom

cf

of the Sea, they being all ty'd by strong short Lines, ty'd to a Rope, there extended between two Stones, which there keep it extended. So that most Fish, of all Kinds, do, for the most Part, there reside, and thence it is probable to conjecture, that there they find the greatest Part of their Food and Nourishment, and that there do likewise grow abundance of distinct Sorts of Vegetables, which may be useful for that End ; for we find, in Seas that are not very deep, that divers Sorts of Algas, Sea-phans, Sponges, Cotulli, and the like, are there produc'd ; and why then may there not be Multitudes of others ? Nature, we find, does accommodate every thing it produces with all Conveniences, necessary for its Support and Well-being, and fit every Thing necessary for the Carrying on and Perfection of its Designs ; so that I see no Reason to doubt, that these Sub-marine Regions are as well stock'd with Variety of Animals and Vegetables, as the Surface of the Earth, which is only Sub-aerial, only we are lets knowing of them, because they are out of our Element, and we want *Nuntii* or Messengers, to send thither to bring us back Information, and also the Productions and Commodities that this *Terra incognita*, or unknown World, does afford. I have heretofore produced some such *Nuntii*, for this or that particular Design, but when there may be an Opportunity of sending them, I shall be able to produce divers others, for other Purposes, if God spare my Life so long as to see the Seas again free from Rovers, and that the Study of Arts does succeed the Study of Arms. It is now above thirty Years since I try'd many Experiments, for this very End, to know under how great a Pressure a terrestrial or aerial Animal could live, and consequently a Man ; and I shew'd a Way also how to supply him with fresh Air from above, to whatever Depth he should be

be able to descend, without prejudicing his Health or Life : I shew'd also how to accommodate him for seeing with Spectacles, and acting freely in the Water as he could do in the Air, by Means of other Accoutrements, whenever he was able to endure the Pressure. And I have many other Experiments, which would be not only instructive, but useful for these and other Designs, but I want an Apparatus and Assistance to perform them. And, probably, most People will treat me as *Columbus* was, when he pretended the Discovery of a New World to the Westward : But I have been accustomed to such Kind of Treatments, and so the better fitted to bear them. However, I think, that such Objections as most will be apt to make, that Animals and Vegetables cannot be rationally supposed to live and grow under so great a Pressure, so great a Cold, and at so great a Distance from the Air, as many Parts at the Bottom of very deep Seas are liable and subject to ; I say, I think that these Objections may be easily answer'd, by shewing, that they all proceed from wrong Notions that Men have entertain'd, from the small Experience they have had of the Effects, and Powers, and Methods of Nature, and a few Trials will easily convince them of the Erroneousness of them. We have had Instances enough of the Fallaciousness of such immature and hasty Conclusions. The Torrid and Frigid Zones were once concluded uninhabitable ; and to assert *Antipodes* was thought atheistical, heretical, and damnable ; but Time has discover'd the Falsity and Narrowness of those hasty Conclusions.

Dr.

Dr. Hooke's Discourses to the Royal Society, in the Beginning of 1697, concerning Amber.

The Sum of Dr. Hooke's Opinion, in these Discourses, Mr. Waller gives in this following Preface, viz.

HAVING met with a Treatise concerning *Amber*, publish'd by ——— (of which he gave an Account) he proceeds from several Observations therein mentioned, and some of his own, to give his own Sentiments, *viz.* That *Amber* being found almost all over *Prussia*, as well in the Inland Parts, as in the Sea, on the Shore, in the Caverns, Cliffs, and under the Hills, by digging, and this in a Sort of *Minera arenaria*; which, by the Substances found in it, such as Shells petrify'd, and the like, Dr. *Hook* judges to be a certain Layer, or Bed of Sea-Sand, the Remains of the Bottom of some Sea that formerly covered the whole Country, which, in Process of Time, has been rais'd above the Level of the present Sea; but, at a certain Depth, all that sandy Bottom yet remains, containing such Substances as were there deposited, whilst it was in that State; at least, such of them as have not been rotted and consumed by Time, such as petrified Shells, Wood, Bones, with Vitriol, Alum, Niter, and Sea-Salt, together with Lumps of *Amber*, are frequently now found in digging into this Sand, for Wells, or the like. Here he has Recourse to his Hypothesis, formerly discoursed of, for the Solution of these Appearances, *viz.* That not only the Vales, and lower Parts of the Land, have been some Time the Bottom of the Sea, but even the Tops of Hills and Mountains; as the several

veral Substances now found thereon make evident. *Amber* then being thus found, either at the Bottom of the Sea adjoining, or in these Layers of Sand, the Question is, How it came there? and from whence? To answer this Inquiry, tho' the Author of the Treatise is of another Opinion, yet, from several Observations therein mentioned, Dr. *Hook* judges it to have been the Gum of a certain Tree petrified, and altered to the present State and Appearance it has. Thus far Mr. *Waller*; next follows,

Dr. Hook's Discourse of Feb. 24, 1696-7.

I HAVE lately ventured to assert my Opinion, That *Amber* is a Kind of petrified Resin, or the Exudation of some resinous Tree, concreted into a Substance so much seemingly different from it, that most of the Authors that have treated of it, or described it, have been quite of a different Opinion. Nay, even the last, and, I think, much the best, that is, *Philippus Jacobus Hartman*, who has publish'd a Tract, Intituled, *Succini Prussici Historia Physica & Civilis*. For, after he has disproved, as he conceives, all the Opinions of those who have writ of *Amber*, and, amongst the rest, those of such as have inclin'd to think it originally some vegetable Substance, &c. he thus concludes, p. 16. of his 2d Book. *Subterraneum utique succinum apud omnes in confessu esse, idque ex historia satis probari; cum vero, id nec duci nec fundi possit, metallis non accensendum esse, neque ex reliquis fossiliis generibus terris, sulphuri aut bitumini anumerandum, quod soliditas succino major quam quæ ejusmodi fossilibus inest: Lapidem igitur reliquum esse, ut dicamus, & quidem non ex saxorum aut marmorium, sed nec ex lapidum peculiariter ita dictorum genere, sed gemmam, per quam apte responderi possit ad questionem, quid sit cum naturam ejus recte exprimat.*

exprimat. Now, how much the wiser we are, as to the Knowledge of its Nature and original Substance, I leave to others to judge ; to me, I confess, it seems more obscure, than if he had said that *Amber* is *Amber* ; for, what he understands by *Gemma*, to me seems more obscure. He has, indeed, many pertinent Relations, and Observations, which have much assisted me in my Inquiry ; but the Uses and Inferences, he draws from them, are quite contrary to those which I have remarked them for. 'Tis not my Design to contradict his Opinion, or to make Objections to his Doctrines : I think it fairer to propound my own, and leave the Choice to the Judgment of such, as shall consider impartially the one and the other Deduction from the Phænomena, which I take to be what concerns his own Observations truly delivered by him. He relates then, (in his Preface) that he has three or four times visited the *Sudavean Coast*, which is the principal Place of *Prussia*, where the *Amber* is found in the greatest Plenty : And that he there did not only inform himself by what he saw, but by Discoursing and Examining the Searcher, or Fishers, for it, and the Overseers and Governors that took Care of the whole Affair, for the Prince's Interest, that he collected, and carried away with him, not only Pieces of *Amber*, but several Sands, Clays, and other Materials found with them, that he might be inform'd by Judgment of others to whom he shew'd them, &c. This Coast faces the West, and lies about 20 Leagues N. E. by E. of the Town of *Dantzick*. He adds, that it has been found also in many Inland Parts of *Prussia*, as well as upon other Shores of the *Baltick Sea* ; but thinks it to have been carried by the Sea to such Places from this Shore. He mentions a Piece found at *Gilyenburg*, 20 German Miles from the Sea, which was found in

making a Well, which proved to yield salt, not
fresh Water. Also at *Bortenstein*, a Fountain
breaking out brought with it much *Amber*. And
he mentions another two Miles from *Bartenstein*,
which in 1666. broke out in the same Manner,
and vomited, with the *Amber*, a great Quantity of
Sea-Sand, which much damaged the Fields; and
it hollowed the Mountain so much, that the Top
sunk in, and left a soundless Abyss, or Vorago.
The *Amber* thrown off was of divers Colours, and
Bignesses; and there were various Pieces of Wood
also mix'd with the Sand: This Efflux, at last,
ceased; and it has now left a Lake, and prodigious
Caverns. He says further, that digging a Well at
Aschenburg, they found *Amber* in a Bed of Sand,
like Wood; but he thinks the Wood to be Clay,
shaped like Wood. He mentions also many Inland
Lakes where it is sometimes found, far distant
from the Sea. He mentions it found in making
other Wells; one in the Year 1641, another in
1663, at whose Bottom *Amber* was found in Beds
of Sea-Sand. In other Places Trees were found
also in the same Sand. He relates many other
Places of *Prussia*, where, after the same Manner, it
has been found; and he could have instanced also
in abundance more. This I find upon the Whole,
that it is almost all over *Prussia*; that it is gene-
rally found in a Bed of Sand; and, that other
Substances, as Wood, Iron, &c. are often found
in that Sand also. These Substances, Sand, *Am-*
ber, Wood, Trees, &c. he believes (p. 36.) to
be the Product of the Sea; but to be convey'd
thither by subterraneous Passages: And this es-
pecially, for that Planks, Iron, and other Parts of
Vessels, are found in the same Sand of the Inland
Lakes, and Wells, where he thinks it impossible
that there should ever have been any Ships or Ves-
sels. He mentions it to be found in *Pomerania*,

but

but in small Quantities, and that only to have come from *Prussia*: Describing further the Places of the Coasts, where 'tis found in most Plenty, he says, the Rocks and Shore have many petrified Stones, and that the Cliffs, or Banks, are full of Vitriol, or Marquisite Stones; and Plenty of Vitriol, Niter, and other petrifying Salts, are found mixed with the same Sand, in which the Pieces of *Amber* are found. (p. 51.) Quantities also of Thunderbolt Stones, and *Prussian* Diamonds, or Chrystals, are also found with it. He proceeds in his 3d Chapter to describe the proper Vein, or Mine, of *Amber*; and this, he says, no one has truly described besides himself. He says, there are three Kinds of it; namely, a clayish, a woodish, and a sandy Mineral; in one of which it is always found: The clayish is a Sort of blue Clay; the woodish consists of fossil Wood, not vegetable, (as he thinks) but form'd out of the clayish one; some, he says, reject the clayish and sandy Minerals, and think them to be the only true *Minera* of *Amber*: But he, by many Arguments, endeavours to confute their Opinion; especially, that of those who reject the sandy, because they could not conceive, how the Sea-Sand should be carried so far from the Sea; which, he conceives, might be done by the universal Deluge, or by the Breaking out of Fountains, like that which happened 1666. before-mentioned; or, which he sticks to, that it has been convey'd from the Sea by subterraneous Caverns, which he thinks are now, and have been in Time, all fill'd up by it, and so comes to be found all over *Prussia*.

But the other Authors think the woody *Minera*, to be the only and the true *Minera* of *Amber*; yet *Wigandus* thinks, that the Places, where it is found, have been formerly covered and overflowed by the Sea (p. 45.) He grants, that the
Frisch

Frisch Nerwing has been so overflow'd, and is now firm Land ; but is not satisfied concerning other Places, (p. 46.) The woody Vein at *Kraxtepellen* has much Vitriol mix'd with the *Amber* ; and there is much Niter also with the Vitriol, (p. 49.) and that almost every where, where *Amber* is found, there is found much Niter, as the Miners do assert. He adds, That the Sea does petrify Substances into black Stones, as he himself observed at the Places where *Amber* is found in most Plenty, (p. 51.) The Diamonds are found in such petrified Stones, when broken, like those I have formerly described in the hollow Flints, (p. 52.) A woody Vein at *Gross Havenig* he survey'd, and found the Hill to be all sandy, but the middle Part was Wood, like rotten Trees, very black ; they seem'd a Kind of Fir-Trees, others thought them Oaks ; but he seems to slight what Trees they may be like ; for he will have them to be only Clay, or Earth, so shaped, (p. 6.) But that at *Kraxtepellen*, he grants, was yet more plainly like Wood, having nothing of Earthiness mix'd with it. That which when moist was very black, when dried discovered more plainly its Parts, and became of a reddish Colour, (p. 61.) In the Cavities of these 'Trees he found them fill'd with *Amber*, and inclosed in the Wood ; yet he thinks the Wood never was from Trees ; tho' yet he grants, that several of his Friends and Patrons assert them to be true Wood. He adds, (p. 65.) that they found them burn clear without Mineral-stinking ; but, he says, what he had found, stunk of Niter mix'd with Vitriol and Sulphur : But this Stink the Alga burnt also yields, and stinks somewhat like Garlick. He has much more about the *Minera* of *Amber*, &c. which I shall not trouble you with the Epitome of, at present. I shall only acquaint you with what I collected by my Observation of the whole, and

and that is, that all those Parts, where the *Amber* is found, as in Beds, has been sometimes under the Sea, and so has been raised from under it, as I have heretofore made it probable that *England* has been ; that it has been often tumbled with Earthquakes, as *England*, has been where the Fossil Trees are fountid ; that the Trees have formerly grown where the Banks are now found ; that the Gums of these, and such like Trees, having dropped from them, have been, by Rains, wash'd down into the River, and, by their Streams, carried into the Sea ; that greater Quantities have remain'd where the Trees grew ; and when, and where, they came to be thrown down, there they have remained, and since been petrified into *Amber*, by the nitrous, vitriolate, and other saline Substances, the Products of saline Eruptions ; and that has been the true Cause of the Phænomena.

THAT such an Exudation may be from Trees, and that it may be so carried into the Sea, I could produce many Observations ; but I shall only instance in one, at present, and that is, at *Bencoula*, on *Javaghen*, the *English* have a Fort, and Factory, all their Pitch, or Rosin, is collected out of the Stream of the River, or gathered on the Banks and Shores of the Sea : And *Dampier*, in his Voyages, tells us, That the *Cochin China* Men fetch their Pitch from *Pulb Candote*, where, by cutting a Notch in the Bottom of the Tree, it will run, every Day, more than a Quart of Rosin each Tree. As to the Probability of petrifying of such Rosins, I should say more, if I had Assistance for making Experiments, which at present is wanting. But I do not in the least doubt, but that the same thing may be perform'd by Art, which is in this by Nature. I could add many other Arguments for this Conjecture, from the Smells of *Amber*, from the Things inclosed in it ; as also some Observations

about *Ambergreefe*, and some other Petrifications ; but for these I shall take another Opportunity.

Dr. H o o k's second Discourse of Amber.

I A C Q U A I N T E D you, the last Day, with what my Author thought the most general and common *Minera* of *Amber*, which he conceives to be extended over all *Prussia*, as well in all the Inland Parts as in the Sea, on the Shores, and in the Caverns of the Clifts and Hills out of which it is dug ; and this he has confirm'd by many particular Instances, at some of which he had been a Witness, and of others he has had very pertinent Informations. This is the *Minera arenaria*, a certain Layer, or Bed of Sand, which, by the Substances found in it, does to me seem plainly to have been the Bottom of some Sea that has formerly covered all that Country ; which Country has, in Proces of Time, been rais'd above the Level of the Surface of the present Sea ; but yet, at a certain Depth, all that sandy Bottom yet remains, containing such Substances as were there deposited whilst it was in that Estate and Condition ; at least such of them as have not by Length of Time rotted and consumed. These more durable Substances, I say, as the Pyrites and petrified Shells, which he calls Thunderbolts and Wood, Bones, and *Amber*, together with the saline Bodies of Vitriol, Alum, Niter, and Sea Salt, are found to have been, to this Day, preserved in it, and to be found unconsumed by the general Devourer of all Things, *Time*. So that, when they have Occasion of Digging into this Bed of Sand for Wells, or the like, or upon the accidental Eruption of Springs, Lumps and Pieces of *Amber* are often found in it, together also with divers of the

the other permanent Substances found commonly on the Shores of the Sea.

Now, that this is not so impossible or unusual a Phænomenon, as should startle any one's Assent, or Belief of the Truth of it, I did, 33 Years since, prove, by Multitudes of Observations (divers made my self, and many more by others) that all *England* is a most evident Instance and Testimony of the like Phænomena here; that is, that not only the Vales, and lower Parts of the Land, have been sometimes the Bottom of a Sea, but even the Tops of the Hills and Mountains, (such as we have) do plainly, and undeniably, confirm it. How, and when, these Alterations have been effected, I have long since given my Conjectures; but, if God restore my Health, I hope I shall be able to give a more particular, convincing, and satisfactory Account; not only founded upon the Observations and Phænomena I then had for my Directors, but many Hundreds of others, which I have since that Time collected; which have not only confirmed, in the general, what I then pitched upon, but has enabled me to be more particular in the Mode, Time, and Method of them.

Now, if this Phænomenon be thus solved, by granting that all *Prussia* has been formerly under the Sea, and that this *Minera arenaria* is a plain Testimony of it; 'twill not be difficult to conceive how the *Amber* comes to be found in it, since the greatest Part of what is now taken by those, whose Business it is to find it, is by Digging, and Fishing it up out of the Sand of the Shore, or of those Parts that are pretty near contiguous to it, and lie not very deep under the Water; and these Pieces of *Amber* are not found on the Top of this Sand, but buried in, and covered by it, a pretty Depth; nor but that, questionless, the deeper Parts of the Bottom of the Sea, if it were in the same Manner

digged and examined, would yield as great Plenty of it; but I perceive they have not a Method of making such Experiments, and content themselves to fish for it only in the shallower Parts, and on the Shore. But still the Question is, How, and from whence came it, and by what Means to be there placed? That then is the next Enquiry.

AND here, for the answering of this, we must *audire alteram partem*, that is, the Judgment of those which he acknowledges to have been the Principal who have treated of this Subject, and those from whom (besides his own Observations) he hath collected the chiefest of his Informations, whom he calls *Triga eruditorum Prussiae*, i. e. *Aurifaber, Gobelius, & Wigandus, viri de Succini notitia optime meriti*: But, tho' he praiseth these, yet he quotes, and makes Use of the Relations and Testimonies of many others also. But yet, as to the true *Minera*, or Vein, or proper Scent of it, he rejects the Opinion of them all, and endeavours, by his whole Discourse, to confirm his own Opinion; which he calls his own, because, says he, (p. 55.) *Hic locus quidem (quantum scio) diserte a nemine explicatus*. And yet, (he adds) *Proprietas antem venas ut aliorum mineralium ita etiam & succinorum extare, tam certum mihi quam quod certissimum*. (We must allow him some Grains for his Fondness of his own Opinion) *Neque solum id confirmat, quod peculiaris signorum cognitio in fossoribus requiratur, ut quae propter singularis curæ venas indagandi & observandi cuiquam in angulo ad Gross Hubenig ubi preprimis foditur, est demandata, sed quod hujus cætatis eruditæ Physici Chymici qui illa loca adierunt, aut terras inde allatas fuerunt accuratis contemplati, itidem venas mecum statuant, sed & sequentia assertum nostrum manifestum reddent, ubi etiam per totam Prussiam si qua altius ex terra effossa, signa venarum adfuisse constiterit.*

ſiterit. I shall not trouble you with the Relation of these *Sequentia*, but shall only say, that the Hypothesis I have mentioned, of the whole Country's having been sometimes overflowed by the Sea, does give a full Solution, and Explication, of them all; and, indeed, they are, most of them, very confirming Proofs of that Doctrine, if they be duly considered; as I could shew, if it were not too tedious: For, how should the broken Pieces of the pitched Plank of a Ship otherwise come to be found in his *Minera arenaria*, or *Minera lutea*, at so great a Distance from the Sea. He grants, indeed, that the *Amber* found on the Shore, in the Sand, is not there in its proper *Minera*; but is by Accident thrown up by the Working of the Sea, and, by the same Cause, covered and buried in the Sand: But, when it is found in the Inland Parts, then he thinks it to be in its proper *Minera*. *Alii arenosam & luteam negant, & casu vel forte immista succina afferunt, unam ligneam genuinam venam autumantes.* Verum arenosam ut ut illa probarent loca quæ ex Prussia & Pomerania dedimus, quæ scilicet arenis obtutum succinum dedere. Again, *De collibus vero & montibus arenosis idem afferendum*) (that is, that the *Amber* has been accidentally, or by the Working of the Sea, mixed and buried in the Sand), *difficilior est ratio, imprimis quod a mari satis sint remoti.* *Quis vero casus his vel fingi potest succina & quidem non contemnenda copia credidisse?* *An ad inundationes terrarum recurrendum?* Sed illas nondum ubique historica fides satis adstruxit. Potius, ut quæ mea sit sententia exprimam, meatibus subterraneis eadem deberi contendō, & cum scaturigine aliquando ejecta fuisse non aliter quam ad Bartenstein Anno 1666. contigisse recentimus, & hic multum arenæ simul egestum, & credo sub illa etiamnum latere succina. So that we see he is forced, tho' unwillingly, to yield, that

'tis possible the *Minera arenaria* may be a Product of the Sea ; tho', because he finds no History when the Country was overflowed by the Sea, he would evade that Way, and introduce his Notion of subterraneous Passages ; which is, as if a Mariner discovering an Island in some great Ocean, and finding some House on it, but no Inhabitants, should conclude that this House had there grown of itself, or else had been brought thither thro' the Air by some violent Hurricane, and there set down, (for I fancy a Hurricane might as easily carry a House three-score Miles thro' the Air, as subterraneous Passages convey the Sand, and *Amber*, of the Sea-Shore, to a Mountain three-score Miles in the Land,) and he should make this Conclusion, because he wanted a History of the Habitation of this Island by some Men. But (as I said before) we must allow the Author some Grains for his Kindness to his own Off-spring. But, as we have hitherto made him some Grains of Allowance for his Partiality for his Hypothesis of the *Minera arenaria*, and the subterraneous Conveyances, where he is forced to yield it may be Sea-Sand ; so we must now allow him some Drachms, or rather Ounces, where he would evade the *Minera lignea* of *Amber* ; for this *Minera* seems to spoil his *arenaria* : For, tho' almost all the other Authors do make this to be the chiefest, and most natural *Minera*, which affords, by much, the greatest Quantity, and the biggest, and most entire Pieces ; and tho' he agrees with them, by his own Experience and Observation, yet, since it would depose his *Minera arenaria* from the first Dignity, by one Salvo he evades all the Stress of it against his *Minera arenaria*, by making it but one Species of the *Minera lutea* : For, he would have the Wood that is found, not ever to have been Trees, but only Clay so shaped, by he knows not what Cause. For he says,

says, (p. 61.) after he has told the several Opinions of divers Authors concerning the Species of the Trees that compose the *Minera lignea*, *Venrum parum interest scire cuius ligni præferat faciem, cum genuinum lignum non esse in Physicis demonstretur satis.* And so again, after he has more particularly examined the Words and Assertions of the most celebrated Authors, concerning this Opinion, and opposed them, as much as he was able, (which Answers, to me, I confess, seem very insignificant, and, at best, but Evasions) he says, (p. 182.) *Quare cum nec historia nec rationibus solide probari possit, succinum arborum esse succum, parum interest discrimin lacrymæ, gummi, & resinae, hoc loco annotare & disquirere quo nomine convenientius succinum fuerit appellatum.* But, notwithstanding this, what he himself has observed and related, concerning this *Vena lignea*, seems as great an Argument against his own Opinion, as any can be brought. He says then of his own Observations, (p. 59.) *Diversimode contemplari contigit ad Craxtepellem totum montis jugum contextum quasi corticibus grisei coloris vidi. Superiorem enim faciem Soli expositam ita calor exsiccaret: remota vero hac parte extima piceæ nigredinis terra magnis quasi & levibus nitidisque crustis persitus concreta conspiciebatur; atque si cultro diffecabatur, quasi multos molissimos cortices dissecuisses, setta præ se ferebat; introrsum versus vero soliditas compacta terra difficilem sectionem reddebat.*

THIS is his first Observation, which, how plainly it describes Trees, I leave any one, unprejudiced, to judge. First, They were found at the Top of the Mountain, where, in Probability, they had grown; and where, by the way, 'tis not very likely that there should arise a Fountain of Bitumen, or that the *Amber* should be conveyed thither by subterraneous Passages; and yet Plenty is there

dug out : And whilst he was there, he says, there was taken up *unum ghetatum succini* : What *ghetatum* signifies I know not. Next, How proper his Opening, or Dissecting of this Ground, as he calls it, does represent a rotten Tree, you may easily judge: For, first, he describes the Substance of the Bark, or Rind ; next, the sappy Parts of the rotted Tree ; and, lastly, the Heart, or solid woody Part of it.

His second Observation is this, (p. 60.) *Aliter ad Gross Hubenig venam ligneam cum fossorum operis conspicere datum fuit. Mons erat arenosus, plane intermedium erat genus ligni quod putredo emolliuisse videbatur, ut facilissimo negotio bipalio instar mollissimæ terræ a fossoribus radi posset, nigro quasi carbonis colore infectum ; specie abirgno non absimile, imprimis cum in ejusmodi cortices circulares veluti deglubi poterat, & alias ejusmodi intersegmenta, sive lineamenta ostendebat : Abii queruo comparant, sicuti & frusto ligni Spork, scilicet fragmenta quæ cum succino ejici postea dicendum erit, ejusdem generis credunt.* Read the Book, Pag. 61, 62, 63, 64, 65, and 66, to §. VIII.

THAT some of these Pieces of Gum have been found not quite petrified, but only so far as to have some Degree of it, yet to be mouldable like Wax ; Further, that the Country has been sometime overflow'd, and that the Remainders of the Sea have been left in several Parts of the Country : But, besides the Sea-Water, it seems to me, by several Passages in this Book, that I could quote, that the Land of Prussia abounds with these Kinds of petrifying Substances, rather than that that Country was the only Place where those Kind of Trees grew ; and, that it seems by the Differences of Ambers, found in very distant Parts of the Earth, that other Sorts of resinous Gums may be turn'd into Amber, if the petrifying Substances be afforded,

afforded, where such Gums do drop from their proper Trees: Now what is the true petrifying Substance of *Amber*, I have not Observations enough to determine, nor have I wherewith to defray the Charge of Experiments for that Purpose. Some Conjectures I have, concerning other Kinds of Petrifications, for there are many Kinds of that Operation, which I may, some other Time, discourse of, and, if I have Conveniency, shew some Experiments about it: 'Tis a Subject that deserves to be cultivated, for it will afford very much of Information in physical Productions, and 'tis, I conceive, much differing from the Sentiments of Authors I have hitherto met with, who have treated of it. But I fear, I have been too tedious on this Subject, and therefore shall say no more at the present, only I shall shew a Specimen or two of another Sort of Petrification, and those are of Chalk, which though from its Plenty, it be more vile, yet, for that very Cause, it seems to me to be well worthy a more serious and diligent Enquiry, to find out from what Substance that Body had its first Original, for by the Instances that I shall shew, it appears plainly, that it was a fluid Body before it became a solid; and by other Instances also, it appears, that Flints were likewise so before they were petrified into Flints, and so several other stony Concretions, of which Subjects, little is to be found in natural Historians.

A third Discourse of Dr. H o o k's concerning Amber, on May 19, 1697.

SINCE I read some Discourses here the last Vacation, concerning my Conjecture about the Original of *Amber*, in which I endeavour'd, by many Arguments, to prove it to be a Petrification

faction of a vegetable Juice, or the resinous Gum of some Tree, I had Occasion to search into the *Acta Hafniensia* of *Thomas Bartholine*, for another Enquiry, and so accidentally met with some curious Observations of that learned Man, concerning this Subject of *Amber*; some of which I conceive, if not all of them, do much contribute to establish the Doctrine, or Opinion, which I endeavour'd to maintain.

THAT which I principally took Notice of is, the 57th Head or Section of the first Volume, for the Years 1671, and 1672. Published at *Copenhagen*, in the Year 1673. It contains an Account of Observations and Experiments about *Amber*; where, first, he relates, that the Diggers of the new Ditch, about the City of *Copenhagen*, met with Pieces of *Amber* of several Bignesses; and, which was very remarkable, the Diggers took Notice, that wherever they found these Pieces, they found them mix'd with the *Minera* of *Amber*, namely, the Bark or Rinds of Oak-Trees, with which it was not only mixed, but stuck, or glued fast to it, as is to be seen, says he, in the several Pieces which the Diggers have sold to divers curious Persons. There was also another Mineral, which was a black Wood, as if burnt, to which the *Amber* also stuck. I should, says he, have believed it to be some Sort of Bitumen, or black *Amber*, if the Smell of it had not made me of another Mind; for the ill Smell of it, when burnt, made me judge it to be the Remainders of some Pieces of Oak. And yet *Camden*, says he, in his Description of *Whitby*, mentions such a black *Amber*, or Jet, to be found in *England*. The Passage in *Camden* is this; speaking of the Parts near *Whitby*, in the North-Riding of *Yorkshire*, he says, *Fuxta hunc locum & alibi in hoc littore repertum est Succinum nigrum sive Geate, Gagatum aliqui esse existimant, quem inter rariores*

rariores lapides gemmasq; babuerunt veteres.
 Enascitur vero inter cautes ubi rimis debiscunt;
 Et priusquam expoliatur, colore est subrufo, Et æru-
 ginoso. Expolitum autem vere est, ut inquit Solinus,
Nigro-Gemmeus, de quo Rhennius Palemon è Dio-
 nysio.

— *Præfulget nigro splendore Gagates*
Hic lapis ardescens austro perfusus aquarum,
Ast oleo perdens flamas, mirabile visu,
Attritus rapit hic teneras, cœu succina frondes,

Et Marbodæus in suo de Gemmis Libello;
Nascitur in Lycia lapis & prope Gemma Gagates,
Sed genus eximum fœcunda Britannia mittit;
Lucidus & niger, est levis & levissimus idem:
Vicinas paleas trahit attritu calefactus,
Ardet aqua lotus, restinguitur unctus olivo.

Audi etiam Solinum. *Gagates in Britannia plurimus*
optimusq; lapis; si colorem requiras, Nigro-gemmeus;
si qualitatem, nullius fere ponderis; si naturam, aqua
ardet, restinguitur oleo; si potestatem, attritu cale-
factus, applicita detinet. Thus far Camden; from
 all which to me it seems very probable, that the
 true Jet is a Kind of *Amber*, and differs from the
 common yellow *Amber* only in its Colour, which
 is very black; but 'tis found, as the other *Amber*
 generally is, only in small Pieces, most commonly
 in the Clefts of Stones, and which is further re-
 markable, where there are also found several other
 Substances, preserved by Petrification; for just be-
 fore this Passage, about black *Amber*, in the same
 Page 48^s of my Edition, he, mentioning other Re-
 markables of the same Place, says, *Lapides hic in-*
veniuntur, serpentium in spiram revolutorum effi-
gie, naturæ ludentis miracula, (quæ ut inquit ille)
(he means Bede) natura cum veris & seriis negotiis
quasi

quasi fatigata ludendo efformat. Serpentes olim fuisse crederes quos lapideus cortex intexisset. Hilda autem precibus adscribit credulitas, tanquam illa commutasset, &c. I suppose he means the *Cornu-Ammonis* Stone, of which Kind, many are found in *Yorkshire* by several, but more particularly by Sir *Jonas More*, who assured me, he had seen one, and knew where to fetch it, which was full as big as the fore-Wheel of a Coach, which he promised to get, and convey to *London*, whenever he went into that Country; and that there was great Plenty of others of somewhat smaller Sizes, yet of the bigger Kind; divers of which Kind are in the Repository, though found in other Parts, as particularly in the Quarries of *Portland*, and at *Keynsham* in *Somersetshire*, by Mr. *Waller*; nor are these Kind of Petrifications in *Yorkshire* only about *Whitby*, but Multitudes also are found in *Richmondshire*, as the same Author, Mr. *Camden*, testifies, (pag. mibi 489.) *Incisis rupibus & montosa collum eminentia hæc regio fere tota eminent quorum convexa sunt alicubi, sunt satis berbida, &c. Montes plumbo, carbone fossili, necnon ære gravi, &c.* — *Quod in eorum autem summitatibus ut etiam alibi, lapides nonnunquam fuerint reperti, cochleas marinas & alia aquatilia referentes, si non sint naturæ miracula: refusi in omnem terram sub Noe diluvii certa esse indicia cum Orofio Christiano historico judicabo. Sic enim ille scribit, &c.* But to pass this by, which I have only taken Notice of, to shew, that about those Parts there are sufficient Indications of Petrifications of other Substances also; and thence we have the more Reason to conclude, that *Amber* also, both White, Yellow, and Black, are Petrifications also, and that the Colour may proceed, either from the particular Nature of the original Gum, or else from the differing Sorts of the petrifying mineral

mineral Salts ; for 'tis sufficiently known, that Oak turns to Black with a vitriolate Mineral, and to Red with an aluminous ; or that the Black may have been produced by the Effects of a subterraneous Fire there having broke forth, as Pitch and Tar are strain'd by the Power of Fire, in the artificial Making them, by burning of the Wood, out of which they are forced ; and as the vitrious Jet, of which we had formerly some Specimens here, presented by Sir Robert Moray, which were brought from the burning Mount *Hecla* in *Island* ; which black Substance was a perfect Glass, and, by melting of it in the strong Flame of a Lamp, I reduced several Pieces of it to clear transparent Glass, the Thicknes thereof vanishing, by the keeping it for some Time melted in the hot Flame of the Lamp : But however this black *Amber*, or Jet, comes to receive such a Tincture, it seems plainly to me, to be of the same Nature with yellow *Amber*, and both of them very different from those Substances that are originally mineral, as *Asphaltum*, or other bituminous Substances, especially by their Lightness and Fineness of Texture, as their artificial Polish does plainly manifest. And *Bartholine* seems plainly to be convinced of the Truth of this Hypothesis by many Passages, related in this 57th Observation ; as particularly, that it has been left where it was found at *Copenhagen*, by the Sea ; and that all that Country has sometimes, formerly, been overflowed by the Sea. Next, That all *Amber* has been first soft, and, by Proceſs of Time, indurated ; that, when soft, it was the Gum of some Tree ; and, while so, those several Substances were immers'd in it, which afterwards became cased up, and inclosed in the same Substance hardened, or petrified ; as, *Job. Gobelius* had a green Frog so inclosed, and *Frederick III. King of Denmark*, had a Lizard after the same Manner : And Mons. *Picart* was

was presented, by *Scholerus*, with the Cone of a Fir-Tree inclosed in the same Manner. *Non igitur dubitamus*, says *Bartholine*, *liquidam fuisse Resinam vel Lachrymam ex arbore profluentem*, & *vel sale*, *vel temporis diuturnitate in maris littoribus concrescere & indurari*: *Quanquam probabili ratione quoque, alii ex pingui bitumine in istam soliditatem compingi suspicentur*. As to his other Trials about the Dissolution of *Amber*, mentioned in this 57th Section, I omit them, as affording little of Information pertinent to the Solution of this Query, Whether it owes its Original to a vegetable or mineral Substance? And pass on to the 122d Observation of his second Tome; where, upon the Occasion of some Objections made against his Supposition, by *Job. Dan. Major*, Professor in the University of *Kilee*, he has enumerated all the Observations which he conceives to be pertinent to the determining this Controversy.

1. THE Cone of a Fir-Tree included in *Amber*, my Friend *Sextus Scholerus*, Consul of *Copenhagen*, had.

2. I saw, at Mr. *Henry Moniachen*'s, my honoured Kinsman's, a Piece of *Amber*, composed of white, yellow, and green Parts, in which was included a Gnat, and some of the Moss of a Tree.

3. *Wigandus*, in his History of the *Prussia Amber*, relates, that he saw a green Frog, which is used to sit on the green Leaves of Trees, included in a Mass of *Prussia Amber*.

4. THE Sticking of Gumlac to its Sticks gives a Suspicion that *Amber* may stick in the same Manner; tho', being liquid at first, it may not stick to the Twigs, but drop down from them.

5. THAT most Gums, which flow out of Trees, do not carry with them the Impression of those Trees.

6. That

6. THAT those small Creatures, as Flies and Gnats, which are found in *Amber*, do pitch on such Parts of Trees where the Gum trickles down, and so are as likely there intangled in it, as in the Earth; where they do not only abscond, during the Winter Months, benummed as 'twere, and half dead.

7. IF you believe *Tacitus*, Birds also have been found in *Amber*, whose Words, in the Book of the Manners of the *Germans*, are remarkable, and not disbeliev'd by any. *Succum tamen arborum esse intelligas* (says he) *quia terrena quædam atque etiam volucria animalia plerumque interlucent, quæ implicita humore mox durescente materia eluduntur. Fœcundiora igitur nemora lucosque, sicut Orientis secretis, ubi Thura Balsamaque sudantur, ita Occidentis insulis terrisque inesse crediderim, quæ vicini solis radiis expressa atque liquentia in proximum mare labuntur, ac vi tempestatum in adversa littora exundant. Si naturam succini admoto igne tentes, in modum tedaæ accenditur, alitque flamمام pinguem & olenem; mox ut in picem resinamve lentescit*: Thus far *Tacitus*. Now, says *Bartholine*, If this Account be true, why should we doubt the former Arguments; especially, since the natural Historians, *Solinus*, and others, agree with him: Nor is the Fidelity of *Olaus Magnus* to be wholly rejected, tho' he had dreamt in some Things.

8. THE Barks of Trees are always found mingled with the *Amber*, where-ever it has been dug up with us.

9. THE Feathers of Birds have not been observed in *Amber*; because the Bird sits on the Branches, and not against the Body of the Tree, where the Gnats, Flies, and other small Insects do creep.

10. IN *Norway*, where the Pines, and other resinous Trees abound, there are found Lumps of Gums emulating *Amber*. The Inhabitants call it a Stone,

a Stone, and my honoured Kinsman, *Job. Finchius*, brought hither one of those Lumps, which was a Kind of *Amber*; for it seem'd to be a light Stone, or a black Sort of Horn, which would kindle, and burn with Flame; but it stunk much: Otherwise, it seemed a Kind of *Lignum fossile*; yet it did neither burn so readily, nor stink so much, as black *Amber*.

11. As to *Ambergreese*, which is brought from *Florida*, tho' it be doubted by me, whether it be made of the Sperm of a Whale, or the Semen of an Elephant, as *Ctesias* is said, by *Aristotle* in the 2d Book of the *Generation of Animals*, to assert; or of the Dung of certain Birds of the *Maldives*, which feed on odoriferous Plants, as *Ferdinando Lopez* conceives; or a Composition of *Lignum Storax*, *Aloes*, *Civet*, and *Laudanum*, as *Fuchsiius* supposes; or a Kind of Bitumen ouzing out of the Bottom of the Ocean, as *Guliel. Du Val*, in his *Phytologia* asserts it; yet, I dare affirm, that it has the same Original as yellow *Amber*: For, there has been lately found some of it in *Prussia*; and, I cannot doubt, that there may be Trees found in the New World, yielding odoriferous Gums. Thus far *Bartholine*.

To whose Arguments I have only six of my own to add, which seem to me as convincing, if not more, than all these. And those are,

1. THAT it appears, by all the Relations we have of the finding of the yellow, black, or gray *Amber*, that they are never found in any very large Pieces; but only in such Lumps or Pieces, as may very well be supposed the Exudation of a Gum out of one or two Vents of the same Tree. Whereas, were they mineral, I see no Reason why they should not be found in as great Masses as Asphaltum, Canall, Scots-Coal, or Bitumen, are usually found.

2. THAT

2. THAT all Kinds of *Amber*, of whatever Colour, whether white, yellow, green, or black, are very light, and almost of the same Weight with Water, being but $\frac{1}{2}$ Part heavier; so that it will but just sink: Whereas those other Substances, as *Canal*; or *Scots-Coal*, are very heavy generally, and more than double the Weight of Water.

3. NONE of these Substances do seem to have any peculiar Figure, as to be formed into plated or prismatical Bodies, as those Substances I last mentioned have, especially such as have Transparency, as *Talk*, *Selenites*, *Chrystals*, &c. and the Uniformity, or Continuity, of the Mass, plainly proves, that it was perfectly united, whilst yet fluid, and not form'd by ChrySTALLization, or Concretion, as Salts out of Brines, or Sugar-Candy out of Syrups; or petrified Spars, or Chrystral, out of Sea-Water.

4. THAT Turpentine, by being buried in the Earth, for some considerable Time, will yield, upon Distillation, an Oil perfectly resembling Oil of *Amber*, for Colour, and Smell, as was above 30 Years since proved by Dr. *Daniel Cox*.

5. THAT there is no other mineral Substance that is so light and rarified as this, which will take and receive so curious a Gloss, and Polish, as this will receive; whereas, of vegetable Substances, we have Instances enough in hardened Gums, &c.

6. THAT there are Instances enough to be found of the Petrification of vegetable Substances; and so this cannot be look'd on as a Singularity in the Parts.

THESE, I confess, to me seem to be *Experimenta Crucis*, as the Lord *Verulam* says; and I very much doubt, whether there can be any one Argument as convincing, as each of these, for the contrary Opinion. However, I leave every one to judge of both as he shall see most reasonable,

338 *Observations concerning the
and propound these Arguments only, as those
which have inclin'd me to be of this Opinion.*

THE Weight of a Piece of *Amber* in the Air
is, — — — — 2443 grs.

AND in Water — — — 202.

AND is to Water near as $1\frac{2}{3} : 1$ or $\frac{5}{3}$ Parts.

Amber to Water is as 12 to 11.

2443 ($1\frac{2}{3} : 1$)

202

2241

*Observations concerning the Refractions of
the Atmosphere.*

THESE Observations, I conceive, were the
Reverend Mr. Lowthorp's, being written in
his Hand. They bear Date February 14, 1698-9,
and precede the Experiment he made at the Request
of the Royal Society the Month following, March
28, 1699. Of which an Account is given in Phil.
Transact. N° 257.

W. DERHAM.

THE Doctrine of Refractions does so sensibly
affect almost all Astronomical Observations,
that, till that be well establish'd, these will be too
weak to support the Conclusions which are gene-
rally inferr'd from them. At present, this Do-
ctrine is involv'd in this one great Uncertainty,
viz. The Air being no uniform Fluid, the Rays of
Light are not refracted in any one terminated Su-
perficies, but continually into a Curve; and it is
not easy (if possible) to determine the Nature of
that Curve, till we know the Proportion of the
Powers

Powers of Refraction in the several Densities of the Atmosphere.

THAT the Attempts, hitherto made by Astronomers, are not satisfactory; I think, will be allow'd, when it is consider'd, that, if (according to the receiv'd Opinion) the Distance of the Moon be about 60 or 61 Semidiameters of the Earth, and the Horizontal Refraction above 30', the Moon at an Eclipse passes thro' the Focus of the Atmosphere, or very near it; and that every distinct Point of the Moon's Hemisphere is illuminated (even in the Middle of a Central Eclipse) by Rays flowing from every Point of the Sun's Hemisphere, which is directly contrary to the Nature of an Eclipse. We seem, therefore, under a Necessity, either to remove the Moon in the Planetary System above 20 Semidiameters nearer to the Earth, that it may fall into that Part of its Shadow, which the Duration of Central Eclipses require; or to form a new Theory of the Refractions of the Atmosphere. I am sure the first would so far confound our receiv'd Astronomy, that he would be a very bold Man who durst venture to maintain such a Paradox: But I hope the Proposal of the following Experiment, relating to the latter, will be excused; because it may, perhaps, be of Use towards removing this great Doubt.

UPON an Air Pump place a small Receiver of Copper, having, on each Side, an even, well-polish'd, flat Glas, and moderately thin: Let their Angle of Inclination to each other be about 65 Degrees, viz. with a Telescope, thro' these Glasses, whilst the Receiver is full of Air, a Thread placed at least 40 Foot from them; and, as the Pump reduces the Air to several Degrees of Rarity, (which may be measured by a Barometer inserted into an End of the Receiver) remove the Thread, till it appear

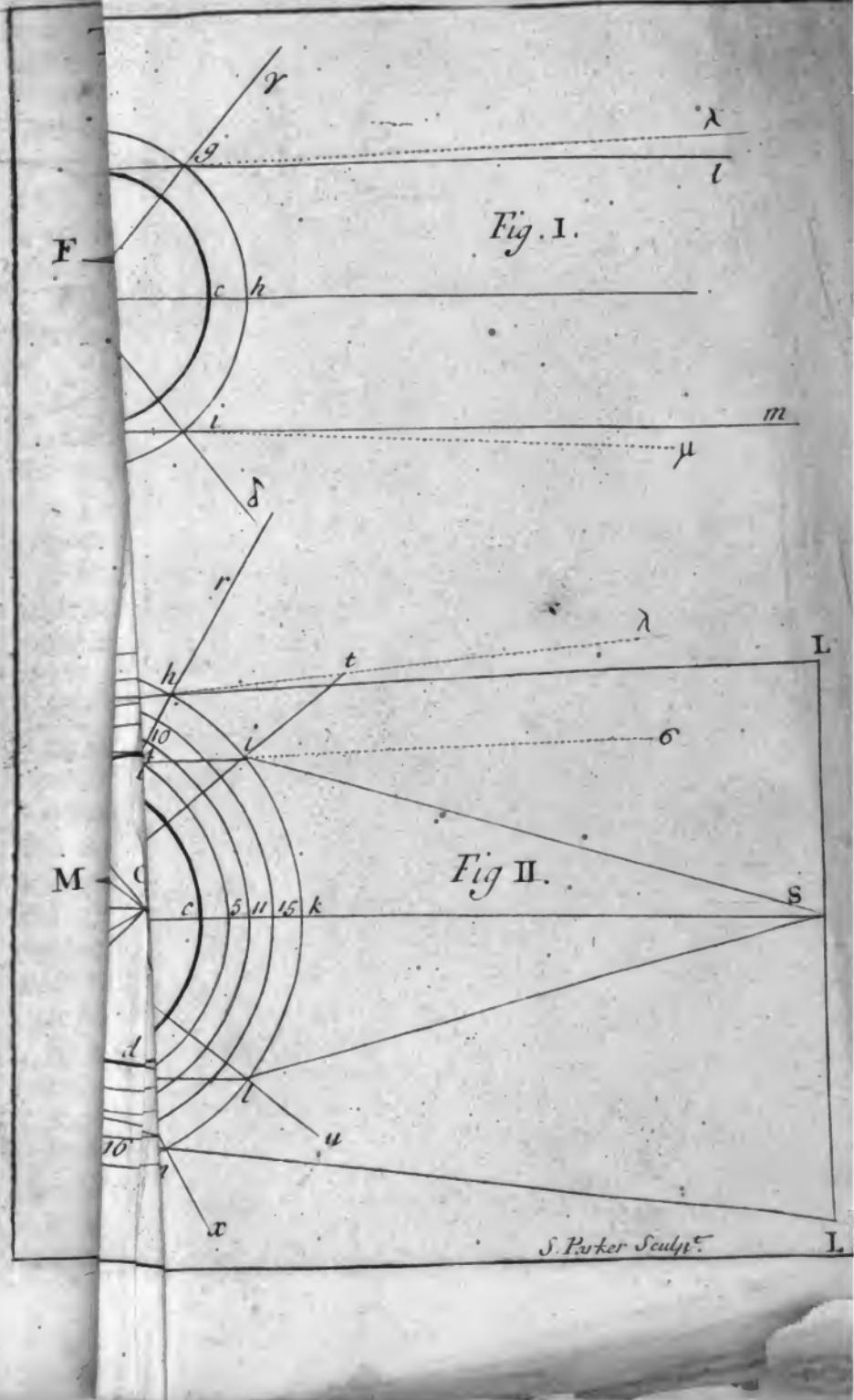
340 *Observations concerning the*
in the same Place in the Focus of the Telescope,
as at first. By this Means the Angles of Refrac-
tion, and Incidence, may be easily found, and more
certainly determin'd, than any other Way yet pub-
llick. And if this Experiment be repeated in se-
veral Temperatures of the Air, I doubt not but
such a Theory of Refractions may be establish'd,
as may be depended upon, to confirm, or reform,
Astronomy.

PERHAPS this Experiment may be made,
more conveniently, by filling the Receiver with
Quicksilver, and pumping it out ; which will leave
the Receiver absolutely void of Air.

THIS Experiment must be made with great
Nicety and Exactness : For, according to the com-
mon Tables of Refraction, this Inclination of the
Glasses to each other (one of them being at Right
Angles to the Axis of the Telescope, and may be
its Object Glass) will not produce, for the Angle
of Refraction, above 4'.

THE Charge will not be above two Guineas,
or two and an Half, if made with Quicksilver ;
and the Materials will be worth most Part of that
Money again, whenever disposed of : But, if the
Air Pump can be so fix'd, as not to shake, or
change its Situation with Working, the Charge
will be very little.

LET $a b c d$ be the Superficies of the Earth,
and $e f g h i k$ of the Air, having a common Cen-
ter C. Then suppose $e g i m$ to be a Cylinder of
Light flowing from a small Part of the Sun, equal
to the Earth, and the extreme Rays $l g$ and $m i$
refracted (by their Immersion into the Air) to-
wards the Perpendiculars νC and δC becoming
thereby Horizontal at b and d ; and by their Emer-
sion out of Air, from the Perpendiculars ϕC and
 χC , and to intersect and the Axis of
the Cylinder of Light at the Focus F. Let the
Angles



Angles of Horizontal Refraction, towards the Perpendicular $\lambda g l$, and $\mu i m$ be $30'$, then the Angles of Horizontal Refraction, towards the Perpendiculars $a f F$, and $s k F$, will be also $30'$, and then the Angles $f F C$ and $k F C$, will be $60'$, or 1° . And then the Semidiameter of the Earth, $b C$, subtending that Angle (and near) is near $\frac{1}{8}$ Part of the Distance of the Focus $F C$, and therefore the Moon's Place at an Eclipse.

Fig. II. LET $a b c d$ be the Superficies of the Earth, and let the Concentric Circles $1, 2, 3, 4, 5, 6, 7$, and $8, 9, 10, 11, 12$, and $13, 14, 15, 16$, and $e f g h i k l m n o$, be supposed so many distinct Densities of the Air, and LL the Diameter of the Sun. If the Rays $S i$ and $S l$, flowing from the Center of the Sun S , be refracted by their Immersion into Air, towards the Perpendiculars $t C$ and $u C$, and become Horizontal at b and d ; and be refracted by their Emersion from the Perpendiculars $p C$ and $z C$, and intersect each other at M ; then the Parallax of the Sun $i S C$ (suppose) $48''$, being subtracted from the Horizontal Refraction, by Immersion $\sigma i S = 30'$, and the remaining $29' 12''$ being added to the Horizontal Refraction, by Emersion $\phi f M = 30'$, the Sum is the Angle $f M C = 59' 12''$; therefore the Semidiameter of the Earth, $b C$, subtending this Angle (and near at Right Angles to $M C$) is more than $\frac{1}{8}$ Part of the Distance of this Intersection, and therefore not far from the Moon's Place in the Middle of a Central Eclipse.

FROM hence 'tis obvious, that, if the rarer Air have a less Power of Refraction, the Rays $L R$ and $L m$, flowing from any Parts of the Sun's Hemisphere, (as L and L) may fall upon some Part of the Atmosphere, where the Angles of Refraction $\lambda b L$, and $\gamma g M$ (being less $\sigma i S$) will direct it to the same Point M . Therefore M is illuminated

by Rays flowing from every Part of the Sun's Hemisphere: And therefore, if the Moon be at this Distance, every distinct Part of its Hemisphere will be illuminated by Rays flowing from every Part of the Sun's Hemisphere.

I am in too much Haste to be exact, either in the Exceptions, or Reasonings, but I hope thus much will sufficiently appear, that it is very difficult to account for the Phases of the Moon upon the receiv'd Hypothesis, and that further Satisfaction is to be wish'd, which is all the Use I design'd to make of them.



*The Sun's Eclipse, as it was observed at
Canterbury, in the Year 1699, September
the 13th, in the Forenoon, by Mr. STEPHEN
GRAY.*

Phases.	Digits Eclip sed.	Time by the Min. Watch			Correct.	What more was worthy Observation.
		h	m	s		
1	0	8	12			The Eclipse began.
2	1	8	18			
3	2 $\frac{1}{4}$	8	24			
4	3	8	29			
5	4	8	34			
6	5	8	34			
7	6	8	47			The Center of the Sun is eclipsed.
8	7 $\frac{1}{4}$	8	55			
9	8	9	c			
10	9	9	8			
11	10	9	17			
12	10 $\frac{1}{4}$	9	24			
13	10	9	30			
14	9	9	38			
15	8 $\frac{5}{6}$	9	41			
16	8	9	45			
17	7 $\frac{1}{2}$	9	49			
18	7	9	53			
19	6 $\frac{1}{3}$	9	57			
20	6	9	59			The Center of the Sun is emerged.
21	5	10	7			
22		10	9			Cloudy.
23		10	20			Cloudy yet.
24	3	10	23			
25	2	10	29			
26	1	10	34			
27	0	10	42			The End of the Eclipse. Latitude of Canterbury $51^{\circ} 15'$

By comparing these Observations of Mr. GRAY with others of the same Eclipse, I find the Difference between the Times of Mr. GRAY's Observations at Canterbury, and those of other Places lying E. and W. of Canterbury, to be as in this Table.

Places where Observations were made.	By the Beginning.		By the Middle.		By the End.		Bear-ing.
	Min.	Sec.	Min.	Sec.	Min.	Sec.	
Oxford, ———			17	00	17	51	W.
Paris, ———	3	00	3	00	3	00	E.
Greenwich, ———					8	30	E.
Herveling, ———	43	00			49	00	E.
Nurenburg, ———	45	14	53	54	51	56	E.
Ciza, ———					53	00	E.
Leipsick, ———	59	00			56	30	E.



Obser-

Observations on the Nostock ; proving it to be a real Plant. By Mons. Geoffroy, Jun. From the Memoirs of the Academie Royale des Sciences. June the 6th, 1708. Mem. Edit. Amst. p. 293.

THE *Nostock* of *Paracelsus*, which he also sometimes calls *Cærefolium*, and which other Writers name *Cæli Flos*, *Cæli Folium*, *Flos Terræ*, looks like a Kind of Jelly, sometimes clear and transparent, sometimes greenish, trembling when fresh. It is found often in the Summer Months between the vernal and autumnal Equinox, before Sun-Rising, in Fields, and on dry sandy Grounds, after a Shower of Rain. After the Sun is up, the Heat of his Rays dries it up, so that there remain only the Skins, or Membranes, of it, of a brown Colour.

THERE is a Doubt, as to the Production of this Substance : Some would have it, that it falls from above, like a Dew ; and that it is the Excrement of the Stars : Others look upon it as a Product of the Earth, and a Sort of Plant.

Mons. *Magnol*, in his *Botanicum Monspeliacum*, names it, *Muscus fugax, membranaceus, pinguis*. Mons. *Tournefort*, in his *Treatise of the Plants about Paris*, calls it *Nostock Ciniflorum*. I take these two to be the only Botanists who have taken Notice of it.

Mr. *Ray* saith nothing of the *Nostock*, as a Plant : But if it be the same with that Jelly which we call Star-fall (which many imagine to be the Substance of those Meteors, that go by the Name of Falling-stars, that shoot across some Part of the Heavens, or seem to fall down in the Night) if,

if, I say, the Nostock be this Jelly, then it is what Mr. Ray takes to be vomited up by Crows, that have overgorged themselves with Frogs.

W. DERHAM.

I THOUGHT good to shew it to the Academy, in its different Ages, that they might be the better assured, that it is a Substance produced by the Earth; and that it is joined to it, or communicates with it, by many small Roots, or Fibres.

THE Embrion of this Plant, at first, looks only like a little, soft, fleshy Tubercl^e, full of little Inequalities, like those on some Strawberries. It is of a green-brown Colour; it grows brighter, or lighter-coloured, as the Skin grows larger; and, at last, this Membrane seems quite opened, and spread upon the Ground, on which it sometimes leaves the Marks impress'd by it.

WHEN the Plant is arrived to this State, it keeps so, as long as the Season remains wet; nor does it dry up, or wither, till the Sun and Wind dries and parches the Earth; and, by Consequence, deprives it of Nourishment.

I HAVE observed it, in its natural State, to turn up, and bend, usually lengthways; and, it seemed to me, that the two Ends, coming afterwards to meet and join, made a Kind of membranous Bag, or Packet.

IN the Year 1667, Mr. *Duclos* brought to the Academy a clear insipid Water, distill'd from the *Nostock*, which turned white, with a Solution of corrosive Sublimate.

IN 1678, Mr. *Bourdelin* made a more exact Analysis of it; which afforded him a great deal of Phlegm, a considerable Quantity of a volatile Salt, either concrete, or dissolved in the Liquor, and a fetid Oil.

THE

THE Analysis, I have made of it, agrees very well with that of these Gentlemen ; for, at first, I drew from it a clear, tasteless Water, which turned white with the Sublimate, and turned Syrup of Violets green. The other Liquors, I drew from it, confirmed what I have remaked of the first. Lastly, I gained from it a fine, volatile, concrete Salt, chrySTALLized on the Sides of the Recipient ; a volatile, urinous Spirit ; and a foetid Oil. A Lixivium, being made of the Caput Mortuum calcined, afforded but a very little fix'd Salt, and that mix'd with an earthy Matter : It turned a Solution of corrosive Sublimate a little yellowish, and made Syrup of Violets green.

If this Plant be put to ferment of itself, in a close Vessel, it rots and dissolves into a very stinking Liquor ; which, at the End of 20 Days, looks red ; and, at 10 Days more, blue.

I HAVE observed, that these two Sorts of Liquors, even after a considerable Time, were the one acid, the other alcaline. The red Liquor had no Effect at all on the Solution of Sublimate, and reddened Syrup of Violets but a very little : The blue Liquor turned white, with a Solution of Sublimate Corrosive, and made the Syrup of Violets green.

GREAT Power and Vertue is attributed to this *Nostock*. The Common People of Germany use it to make the Hair grow thick. It is thought to be an excellent Remedy for Cancers and Fistula's. A Swiss Physician, having powder'd it, gave two or three Grains of it, to ease inward Pains : The same made Use of it externally for Ulcers.

It is a Part of the Composition called *Spernionium compositum Cnoeffelii pro Principe van Eggenberg* ; the Description of which may be seen in the *German Ephemerides* for the Year 1676, amongst the Secrets of *Cnoeffelius*.

THE

THE Chymists imagine that the *Noftock* contains the universal Spirit. They draw from it a soft Spirit, (*Esprit doux*) to which they attribute great Vertues ; and this they believe to be the radical Dissolver, or *Menſiruum* of Gold.

THEY distill the Water off by the Heat of the Sun only, or of a gentle Fire, otherwise it rises very fast. This Water is reckoned a very gentle, mild Dissolver.

IT is reported that it eases Pains admirably, and cures the most stubborn Ulcers.

Concerning the Burning-Glasses of the Ancients, from the History of the Academie Royale des Sciences, for the Year 1708. With some Remarks. By R I C. WALLER, Esq. &c.

ALTHOUGH the Academy does not propose to make Enquiries after Antiquities, and is rather employed in Discoveries of Matters, as they are at this present, than to know what was formerly thought of them, or what Additions may be still made to the Arts, than what has been already practised ; yet in it there was a considerable Regard made to Mons. de la Hire's Remarks, That *Burning-Glasses were not unknown to the Ancients.*

THAT they knew the Use of Burning Mirrors, or *Specula Uſtoria* by Reflexion, is unquestionable ; since some Historians have related, that *Archimedes* made Use of these for setting on Fire the Enemies Ships, in the Siege of *Syracusa* ; and though they attribute a Power impracticable to them, yet it proves, that at least they were known to them.

BUT

BUT it is certain, these Mirrors were of Metal, and concave, and had their Focus by Reflexion: And it is a common Opinion that the Ancients knew nothing of Burning by Refraction, by convex Glasses.

Mons. de la Hire has found this Invention in a Passage in the *Clouds* of Aristophanes, not strain'd, or far-fetch'd. *Strepsiades*, a stupid old Fellow, tells *Socrates*, That he had found out an excellent Invention not to pay his Debts: The Words are in *Aet* the IIId. *Scene* the 1st. towards the End.

THE French Author having omitted to give them in the Greek, I shall supply that Omission; and the rather, because I am of Opinion there is a Mistake in the French Translation, which I shall observe by and by.

Strepsiades. Ήδη παρεῖ τοῖσι φαρμακοπόλαις τὸν λίθον ταῦτην ἐώρεται τὸν ιχλὴν τὴν διαφανῆ ἀσ' ἦς τὸ πῦρ ἀπτεστο. *Socrates.* Τὴν μάλιστα λέγετε; *Strepsf.* Εγω γε. *Socr.* Φέρε, πί μητ' αὐτόν; *Strepsf.* Εἰ ταῦτην λαβὼν, ἐπότε γεράροιτο οὐδὲν ὁ γερμανιστῶν, Αποτέρω σὰς ἀδει τερψ τὸν μλιού, ταὶ γράμματα ἐπιτίξαιμι τῆς ἔμιντος Δίκης. *Socr.* Σωφῶς γε, νὴ τὸν Χαρίταν. *Strepsf.* Οιμέντος μόνοι μίκην.

I shall give the *Latin* Translation of this Passage, by Nicodemus Frieschilinus, to which I shall add the *French*, and lastly my own.

Strepsf. Vidistin' apud Unguentarios & Aliptas, lapidem illum pulchrum & pellucidum, unde Ignem accendunt? *Socr.* Num Vitrum dicis? *Strepsf.* Utique. *Socr.* Quid cum illo ages? *Strepsf.* Si scriba mibi scribat dicam, Ego procul stans, ad hunc modum ad solem, vitro delevero Literas intentæ mibi Dicæ. *Socr.* Sapienter, ita me Gratiae ament! *Strepsf.* O gestio. Dicam quinque Talentorum esse ex punctam mibi.

Fr.

Fr. Str. As-tu vu chez les Drogistes cette belle Pierre transparente, avec quoi on allume du feu ? Socr. N'est-ce pas du ver que tu veux dire ? Str. Justement. Socr. Et bien, qu'est-ce que tu en feras ? Str. Quand on me donnera une Assgnation, Je prendrai cette Pierre là, & me mettant au soleil, Je ferai fondre de loin toute l'Ecriture de l'Assgnation.

I shall render the Greek Words thus :

Strepſ. Haſt thou ſeen at the Apothecaries that fine transparent ſtone, with which they kindle Fire ? Socr. Doeſt thou ſpeak of the Glass ? Str. Yes : Socr. Bring it : What then ? Str. When the Attorney hath written an Action againſt me, I will take this Glass, and ſtanding at a Distance, in this Manner, againſt the Sun, I will eſface the Letters of my Action. Soc. Cunningly done, by the Graces. Str. O ! How I rejoice, that the five Talent Action againſt me is defaced.

I shall here only obſerve, that this was indeed to be performed by the Rays refracted through a Glas Body, in which I agree, with this Gentleman : Yet, I am of Opinion, it does not come up to a full Proof, that the Ancients knew any more than the Use of Spheres, for collecting the Rays, and not the Way by Lenes, which I take to be a modern Invention ; but of this more hereafter. To proceed then with the Translation.

IT appears plainly, by this Paſſage, that the Writing was graved in the Wax, which covered a more ſolid Body. That the Glas, which did light the Fire, and melted the Wax, was not a Concave; for altho' ſuch a Figure would have its Focus by Reflexion, yet, that being neceſſarily made upwards, would have rendered its Use very improper, and unſit for the common Use of lighting the Fire ;

Fire ; and it would have been necessary to have had the Deed held up in the Air to have effaced the Writing ; which would be an unnatural Supposition, whereas, with a convex Glass, which throws the Rays downwards, they may be directed, where one pleases.

THE Scholiast, upon this Place of *Aristophanes*, says, It was a round, thick Glass, made on purpose for this Use. This they rubb'd with Oil, and heated it, to which they fitted, or brought near, a Match, (for the Greek Word here is equivocal) and after this Manner the Fire was lighted.

I do not well understand what the Oil was for, unless it were to polish the Glass ; but, be that as it will, what is sufficient here, he conceiv'd this Glass to be convex, and that in his Time, much later than *Aristophanes*, they used such Glasses to kindle a Fire.

I have no Design here to make a learned Dissertation, in which it were a Shame to let any Passage of Literature escape. I shall only remark that *Pliny*, in his 36th and 37th Books, speaks of Balls of Glass, and Balls of Chrystal, which, exposed to the Sun, burn'd the Cloaths and the Flesh of sick Persons, which needed Cauterizing. And *Lactantius*, in his Treatise *de Ira Dei*, says, That a Ball of Glass, fill'd with Water, and held in the Sun, would kindle the Fire, even in the greatest cold Weather. Here then we see the Effects of convex Glasses undoubtedly proved.

BUT if they knew that they would burn, how came it to pass that they did not also know they would magnifie Objects ? For it is hard to be imagined, that an Invention so entertaining and useful, and withal, so simple and easy, should ever have been lost, even in the greatest Barbarousness of any Age ; and all History fixes the Origin of magnifying Glasses about the End of the 13th Age,

Age, when the Use of Spectacles began to be discovered. If the Greek or Latin Philosophers had known this Augmentation of Objects, would they not have made Mention of it very frequently in their Writings, and several Metaphors, and Allusions to it, would have been brought into their Language. It is true, there are two or three Passages in *Plautus*, which seem to hint at the Use of Spectacles; which yet, more nearly considered, do not at all prove it. We will not insist upon them to avoid a Literature, to which I am a Stranger.

WHENCE came it then, that the Antients were ignorant of the chief Use of Burning-Glasses? First, The false Ideas, the Philosophers had of Vision, might contribute to it. They thought, that Vision was either caused by an Emanation of I know not what Sort of Substance, which came from our Eyes, and went in Quest of the Objects; or, by little Representations of the Objects, in Miniature, which came from them, and sought out our Eyes: All their Difficulty lay, in which of these two to choose, both equally false; they had no Suspicion of Pencils, of the Rays, nor of our Focus's; and, by consequence, they could see no Agreement between a Burning-Glass and the Manner of Vision, so that the one of these could not lead them to the other. Besides, it seems, that it was with Balls of Glass, solid, or fill'd with Water, that they burnt any thing; and Dioptricks demonstrate, that the Focus of a Sphere of Glass is at the Distance of half the Radius; so that if these Balls, or Spheres, had been six Inches Diameter, which is the most they could be, the Object to be magnified must have been placed at one Inch and half to be perceived to be magnified; and it is natural, and almost necessary, that when any one had look'd thro' these Glasses, he would have look'd

look'd only at distant Objects, which, instead of appearing bigger, wou'd only have looked confus'd. A defined and distinct Augmentation of distinct Objects requires either very large Spheres, (which is impracticable, nor ever put in Use, or of Portions of large Spheres, as is now practised with great Success) which cou'd scarce ever be found out by Chance, nor easy to be invented by Reasoning.

BESIDES, they must have known how to have wrought, and ground their Glasses as we do; and, in all likelihood, the Ancients knew only how to blow their Glafs, to make Vessels of it. It is no strange Matter, therefore, that their Knowledge of *Burning-Glasses* carried them no farther: It is more strange, that from the Use of Spectacles, to the Invention of Telescopes, there should be an Interval of 300 Years. Every Thing goes on slowly with us; and, 'tis possible, we are at this Time on the Brink of some important Discovery, which may be surprising, one Day, that we did not find it out.

THUS ends this ingenious Gentleman's Discourse, to which I shall beg the Freedom to add some few Remarks on the same Subject, or nearly related to it, partly in Confirmation, and partly, as I take it, in clearing the Matter, and setting it in a true Light, without, in the least, pretending to Literature or Criticism.

It seems then to me, in the first Place, that Mons^r. *de la Hire* would insinuate, that the Ancients knew not only Spheres burning at a 4th of the Diameter, but such Burning-Glasses as would have their Effect at a considerable Distance; since he translates the Greek Word *Αποτέλεσμα*, *De loin, je ferai fondre de loin;* as likewise the Latin Word is *Procul*. This Word I rather *English*, *at a Distance;* which Sense, I take it, the Word will more truly

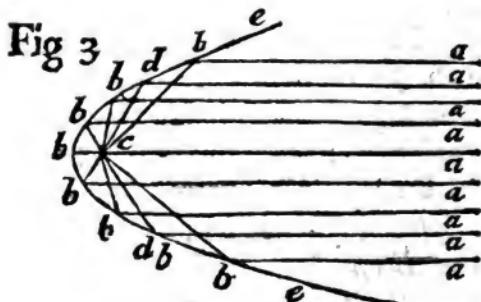
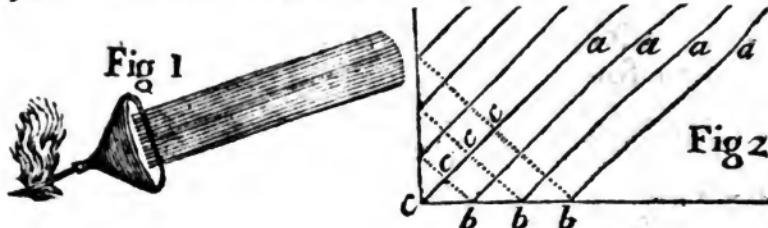
bear in this Place. So that by this Passage, it is not necessary the Glass should burn at any remarkable Distance from the Writing on the Obligation, provided it did not touch it; which I take the Meaning to be here by *'Amoripa, Longius, at a Distance, or farther off.'* So that a Sphere of Glass might do all that was requisite in this Case. Besides, if it should be urg'd that this could not be done, when the Scrivener was present, without his taking Notice of it. I reply, Neither was it: And if it be remarked, that the whole Design of the *Nubes* of *Aristophanes* being only to ridicule *Socrates*, it was proper enough to bring in an old Coxcomb boasting of an Invention for doing what indeed it would not perform; so the old Man, having seen a Fire kindled with a Globe of Glass, never considering the Distance requisite, might foolishly think it would do so at any Distance.

THAT the Ancients had several Ways of kindling the combustible Matter placed on their Altars, without making use of common Fire for that Purpose, might easily be shewn, were it requisite, or to the present Purpose; which it is probable the Priests made use of, to raise the greater Admirati-
on and Devotion in the ignorant and superstitious Beholders. The most solemn was that of the re-kindling the Vestal Fire, when it happen'd to go out.

THAT the sacred *Vestal* Fire was continually kept burning, with great Care, by the *Vestal Virgins*, is certain; and if at any Time it happened to be extinct, the Virgin, to whose Care it was at that Time committed, was severely whipp'd, (*Flagris cæsa Vestalis*) by the *Pontifex Maximus*; which Damage and Loss was not to be repaired, by making use of any common or culinary Fire to re-kindle it. A particular Account how this was done, *Dionysius* somewhere says, he wrote him-
self;

self; which, as *Justus Lipsius* observes, must have been in some of those Books of that Author, that are lost, (*Lips. de Vesta & Vestal. Syntag. cap. 8.*) The same *Lipsius*, out of *Festus*, cites this Passage, *Tabulam felicis materiae tam diu terebrare mos erat, quousque acceptum ignem cribro aeneo Virgo in ædem ferret.* Which Method of setting Wood on Fire is more clearly express'd by *Aristotle*, Lib. 3. *De Cælo.* *Ignem e lignis excutunt, alterum lignorum tanquam terebram, in altero circumvertentes:* Which Way of setting Wood on Fire, by boring it with another pointed Piece of Wood, *Lipsius* says, is still in Use among the Natives of the *West Indies.* This *Terebra*, or Borer, *Theophrastus* says, was often made of Laurel, and the other Piece to be bored of Oak.

Plutarch mentions another Way of re-lighting this Fire. *Si quando extintus ibi sacer Ignis: negant eum fas esse ex alio igne accendi, sed novum parandum eliciendumque ex ipso sole: quod faciunt scaphis sive vasculis, quæ parantur ex latere trigoni rectanguli, quod duo latera aequalia habeat, divergent autem ex circumferentia in unum Centrum. Cum igitur soli opponuntur, ut radii ejus in ipsum centrum cogantur & implacentur, aere attenuato, fomenta levissima & siccissima apponunt, quæ facilime per renixum & reflexionem concipient accensum ignem.* This Passage of *Plutarch's Lipsius* attempts to illustrate, by a Sort of Funnel, whose Sides meet at Right Angles in the Bottom, which he calls the Center of it, and represents the Contrivance by a Figure. (See Fig. 1.) But either *Plutarch* did not well understand the Matter himself; or *Lipsius* has mistaken his Meaning: For a Vessel, so made, will never throw the Rays of the Sun into a Center, or Point; it will indeed reflect the parallel Rays into a Line, (as in Fig. 2.)



where the parallel Rays of the Sun are reflected, into the Line $a\ C$, in the several Points $c\ c\ c$, &c.

P O S S I B L Y this Vessel (if any such was used by the Ancients) was of a parabolic Figure, as (Fig. 3.)

W H I C H reflects all the parallel Rays $a\ b$, $a\ b$, into the Focus at c , and the parabolic Sides of the Vessel appearing, for a great Part, viz. from d to e , very like strait Lines, Plutarch might take them for such, which made him call it a Rectangular Triangle; whereas it was really a parabolic concave Vessel, made by the Section of a Rectangular Cone.

A s to this *Vestal Fire*, there is a Passage related by Dionysius, (Lib. 2.) concerning the Vestal Æmilia something observable. Scilt. *Hæc dicens, & e vese linea fasciam abstrabens, qua cincta erat, dicunt illam post orationem jactasse in aram, eque frigido cinere, quod longe antea fuit absque scintilla, magnam per linum exiisse flamnam, &c.* This Passage shews plainly, that the ancient Priests knew how to raise a Fire, nay, Flame, out of apparently

ingly cold Ashes, since there had been not so much as a Spark of Fire on the Altar for a long Time ; whence, it seems, they then knew the *Phosphorus*, or something of the same Nature, with which the Linnen Fillet was rubb'd over, and which the undiscern'd Warmth of the Ashes set on Fire, and possibly some other Chymical Preparation might be concern'd in producing this Flame ; which, being kept as a Secret among the Priests, might well raise Wonder in the Beholders. They had likewise several earthen Vessels, for the Fire, on the same Altar ; *Et æternos Vestæ focos fictilibus etiamnum vasis contentos, &c.* Valer. lib. 5. cap. 4.

Onuphrius Panvin. de civitate Romana, cap. 29. (Gr. Vol. II. p. 228.) speaking of the Vestal Fire, has these Words ; *Ignem amissum nequaquam decebat ex altero igne sumere ; sed maximis precibus Numen Vestæ placantes, multis sacrificiis novum ex Solis radiis eliciebant, pura & immaculata flamma, ex lagena aqua plena solis splendori opposita, accensa..* *Onuphrius* does not quote his Authority for this Way, by a *Lagena*, as he calls it, placed, as he expresses it, opposite to the Sun's Rays, *Ex lagena aqua plena solis splendori opposita, accensa;* fired by Means of a *Lagena*, fill'd with Water, and placed opposite to the bright Rays. As to what the Figure of the *Lagena* of the Ancients was, I shall give my Thoughts presently ; only first I must observe, that *Onuph. Panvin.* had no clear Notion of what he has here written ; he tells us, that this Vessel (whatever its Shape was) was fill'd with Water ; then its Use must have been to refract, and unite the Rays transmitted thro' it ; for which Reason it was not *opposita splendori solis*, but *interposita*, in the same Manner as Burning-Glasses by Refraction.

As to the Figure of the *Lagena*, I find, by a Passage in *Pliny*, that it had a Neck, *Lib. 28. cap. 11.* where treating of Remedies for a Pain in the Ear, amongst others, he mentions Goat's Urine, &c. heated in this Vessel, the Steam being conveyed hot, thro' its Neck, to the Ear of the Patient, *Urina capri vel tauri aut fullonia vetus calefacta, vapore per lagenæ collum subeunte.* Whence 'tis plain, this Vessel had a Neck, and a large Belly, possibly not unlike our Glafs Bottles, only its Belly was more nearly of a spherical Figure, which rendered it more proper for this Purpose of refracting the Rays into a common Focus. That the Ancients had the Use of Glafs, is undoubted; a Vessel therefore, made of Glafs, of a spherical Figure, such as are now commonly sold at the Glafs-Shops, under the Name of Jewellers Glasses, performs this whole Matter, of setting the dry combustible Fuel on Fire, by the Sun's Rays. Some such Vessels are represented in the ancient Bas-Relieves of Compotations or Banquets.

So that this Passage out of *Panvin* might be added as a farther Proof of what this ingenious Gentleman says, of the Ancients knowing the Use of Burning-Glasses.

HERE I shall observe, that the Ancients made Looking-Glasses, *Specula*, not only of Metal, but of Glafs: *Pliny, Lib. 36. cap. 26.* having before treated of the Art of Glafs-making, adds, *Authores sunt, in India e crystallo fracta fieri, & ob id nullum comparari Indico. Levibus autem aridisque lignis coquitur, addito Cyprio, ac Nitro, maxime Ophirio. Continuis fornacibus, ut æs, liquatur: massæque sunt colore pingui nigricantes, &c. Ex massis rursum funditur in officinis, tingiturque: & aliud flatu figuratur, aliud torno teritur, aliud argenti modo celatur, Sidone quondam iis officinis nobili: siquidem etiam SPECULA excogitaverint.* From which

which Passage it may be gathered, that the Sidonians made reflecting Looking-Glasses of this black semiopaque Glass, and that they knew the Way of grinding Glasses also; as seems to be plainly hinted, by *Torno teritur*. The Glass was ground, or work'd off, by a Turner's Engine, or by turning it into the Figure desired: This, without any Foil, being made of black, or semiopaque Glass, will make a Sort of Burning-Glass, tho' not so good as those foiled on the Back with Quicksilver.

BUT to come to the Passage cited by this Gentleman, concerning Burning-Glasses, out of *Pliny*, Lib. 36. cap. 26. the Words are these: *Est autem caloris impatiens (scilicet. vitrum) ni precedat frigidus liquor: cum addita aqua vitreæ pilæ sole adverso, in tantum excandescant, ut vestes exurant.* Whence, by the Way, 'tis apparent that the Ancients did not know the true Reason why the Balls of Glass, filled with Water, which they made Use of, set on Fire the combustible Matter placed in its Focus, since they supposed that the Glass itself was considerably heated; whereas it is no more heated for this Transmission of the Rays, than if it were of a Plane, or any other Figure.

THE next Place, quoted out of *Pliny*, Lib. 37. cap. 2. by this Gentleman, is this; *Invenio Medicos, quæ sunt urendæ corporum, non aliter utilius id fieri putare, quam Crystallina pila adversis posita solis radiis.* This Use of Crystal Globes, for Cauterizing, is also mentioned by *Matthiolus Dioscorides*. *Diosc.* Lib. 5. cap. 116.

BUT altho' it is evident, from all these Passages, that the Ancients knew that the Rays of the Sun, transmitted either thro' a Sphere of Crystal, or a round Ball of Glass filled with Water, would set any combustible Matter on Fire, at a short Distance, viz. Yet, I presume, this can be no Proof of their ever knowing

the Way of making either plano-convex, or double convex Glass-Lenses, such as are now made, either by their turning or grinding them of two spherical Segments, or by fastening two Portions of spherical-blown Glass Globes, and then filling the Space between them with Water.

So that I am of Opinion that their Knowledge did not reach to the Contrivance of Lenses, as now made; therefore their Burning-Glasses might rather be termed Burning-Spheres, since they were wholly ignorant of the true Cause of Vision, and of the Union of the Rays, by Refraction, into one Focus. Much less were they capable of contriving either Microscopes or Telescopes.

THERE is indeed a Passage quoted by Petrus Borellus, out of Porta, in his Treatise of Natural Magick, (*De vero Telesc. Invent. cap. 1. Porta Lib. 17. cap. 5.*) concerning Ptolomæus, that he could discern Ships approaching, to the Distance of 600 Miles; (*sexcenta millia*) but, as Borelli observes, this Contrivance, if true, remains *inter arcanæ*; and indeed the Convexity of the Earth contradicts such a Distance; for allowing, the most that can be, to the Refraction by the Air, the greatest Distance a Ship can be seen at, by Telescopes, now amounts but to ; so that Ptolomæus, in all Probability, had his Intelligence by the Means of *Specula*, or *Watch Towers*, placed at several intermediate Distances, which, by some Signs, gave Notice to each other, of the Ships and their Number. From all which, and much more that might be alledged, I think it is evident, that Burning-Glasses, of two spherical Segments, were not known to the Ancients. But it is not my Design to enquire into the first Inventor of Telescopes, in this Place, or whether Roger Bacon, as it is very probable, knew the perfect Reason of Vision, and the Construction of Telescopes, long

long before either *Metius, Galileo, or Drebell,* or rather *Joannes Lippestein of Middelburgh in Zealand,* as *Borelli (Cap. 11.) shews* in the forementioned Treatise, about the Year 1609; or his Father, *Zacharias Joannides,* about the Year 1590; but of this enough.

UPON the Whole, I am of Opinion, that the Ancients were wholly ignorant of refracting Burning-Glasses, except Spheres, and therefore agree with this Gentleman, that it is no strange thing that they had neither Telescopes nor Microscopes; both which noble Inventions have discovered new Worlds to the last and present Age.

BUT these Remarks I submit to the more learned Judgment, and Censure, of this illustrious Society.

Mr. WALLER's Account of a Book, intituled, Trattato dell' Apoplessia, &c. Dal Dottor Domenico Mistichelli da Fermo. In Roma 1709.

THIS Treatise is divided into two Books, and each Book into three Sections, which are subdivided into Chapters.

IN a short Preface to the Reader, the Author informs him, that the unusual Number of Persons, who died suddenly at *Rome*, in the Years 1705 and 1706, was the first Motive to his writing this Discourse; to which, a second was his Desire of making known a new Remedy, which his Experience had confirmed very advantageous in this Distemper; to which Publication also, the Sollicitation of his Friends concurred.

THE

THE first Book treats of *Matters relating to the Theory of this Distemper*: In which the first Section gives an Account of the Body anatomically considered, with Respect, more particularly, to *Apoplexies*.

THE five first Chapters treat of the Head, with its Coverings, and Contents, the *Brain*, *Cerebellum*, and *Origin of the Nerves*; in which there is little Difference from other Anatomical Treatises of the like Nature. I shall take Notice of some: He observes, that the *Dura Mater* is furnish'd with very numerous Branches of the Blood-Vessels of the *Carotids* and *Fugulars*; that tho' it seems to be a simple Membrane, yet it may rather be called a *Tendinous Muscle, sui generis*; since, as he says, it has the Force, and performs the Office of a Muscle. It has a Motion of Depression, and Elevation, from the Pulse in the Arteries, which drives the volatile Spirits of the Blood into the small Pipes of the Brain, and those Parts which are the immediate Roots of the Nerves; which volatile Essence, conveyed farther on, and being mix'd with the Blood, are called the *Animal Spirits*, and irradiate the sensitive and motive Parts of the Body.

IN the 6th Chapter, of the *Medulla Oblongata*, he sets down some Particularities observed by himself. The *Medulla Oblongata*, he says, is a Continuation of the callous Substance of the *Brain* and *Cerebellum*, derived from four Heads, which join into one Stalk, of a conical Figure, about three Inches long: This, stripp'd of its Membrane, differs not from the Substance of the Brain. On the lower Part, it has a strait Furrow running up the Middle, on the Outside; it has that cineritious Substance on the Inside, which makes the cortical Part of the Brain. He says, he could never find, in Brutes, or Men, dying of a violent Death, any tubulous,

tubulous, fistular, or fibrous Parts ; but, rather, a soft, mucous, tomentose Body : That he had observed it raw, boiled, and infused, for several Days, in Brandy, Vinegar, and Oil, and always found the same Consistence, only a little dark, or livid, Alteration of the Colour of the outward Part : That being cut transverse, and gently pressed on the Outside, a tomentose, medullary Substance, ouzed out in little Grains, as it were, from so many *Tubuli* ; whence he suspected, that the Fibres, as well those of the *Pia Mater*, which penetrate the Windings, as those of the Membranes, which cover the Ventricles, insinuate into the Substance of the Brain ; and, being prolonged to the *Medulla oblongata*, and *spinal*, form so many *Tubuli* to contain the forementioned tomentose Substance. Again, what is very particular, is the Fibres of the Membranes which encompass the *Medulla* round : Having kept it covered, with its Membranes, 8 or 10 Days in Vinegar, in which they were thicken'd to about the Breadth of the Back of a Knife, he diligently separated the Blood-Vessels, which form a Kind of a Net-work ; and, then, taking off the external Fibres, and coming to the last Covering, he observed, that the Stalk look'd like a braided Tress of Hair. Many small Bundles, or Collections, of strait Fibres, are brought over many transverse ; and many oblique, again, wove over the transverse, and strait ones ; so that, following one Collection of Fibres, you will find it sometimes uppermost, and sometimes undermost in the Brede, till they pass out on the Sides, to form the spinal Nerves on each Side. This, he says, is more observable on that Part, or *Caudex*, of the *Medulla*, which is inwards, or the Fore-Part, than on the Back-Part, next to the *Nucha*, where only some oblique Fibres run over the strait and transverse ones, which seem to come from the Center, to make up, with

with the others, the spinal Nerves. *2dly*, This Texture is only observable in the superficial Part, not wholly stripp'd of its membranous Coat; therefore in that membranous Coat itself: For, when that is quite taken off, there remains only the simple, tomentose, Substance of the Brain; in which, with Signior Campani's Microscopes, he could discover nothing observable. *3dly*, These Fibres which thus concur in Bundles, to form the spinal, lateral, Nerves, at the Place where they pass thro' the Holes of the *Vertebræ*, are bound round, as it were, with a small Ring. *4thly*, He says, this Observation of the Texture may rather be applied to the membranous Fibres which encompass the *Medulla*, than to the *Medulla* itself, as is done by Dr. *Willis*, in his *Anatome Cerebri*.

THE 7th Chapter treats of the Nerves proceeding from the *Medulla oblongata*, and spinal Marrow. In the Enumeration of these, he follows the Order of Dr. *Willis*, reckoning up 10 Pair of Nerves proceeding from the *Medulla oblongata*: Those of the spinal Marrow he distributes according to the Parts they proceed from.

IN the 8th and 9th Chapters he speaks of the Use of the Brain. Here he disagrees from *Willis* and *Malpighi*, that it is a great Gland, for several Reasons; and that it cannot be the Place for the Generation of the animal Spirits: Which he confirms by an Observation of a Child born without a Brain, only it had the *Meninges* filled with a serous Liquor. He says then, that the *Meninges* are an Expansion of the Tunics of the *Carotide* Arteries of the Neck, and jugular Veins; that this Membrane encompasses the whole Brain, the spinal Marrow, and the Nerves: Whence, says he, it may, without Difficulty, be apprehended, that the Spirits, or volatile Essence, of the Blood, carried thro' these Vessels of the *Meninges*, and, by reason

reasōn of their Subtility, brought into the fibrous Interstices of these continued Membranes, (which Membranes also encompass every Fibre of the Muscles in the Body and the Spirits) are, by the Motion of the said Membranes, forced forwards to all the sensitive and moving Parts of the Body. In fine, our Author maintains, that the animal Spirits are the more subtle Parts of the Blood separated from the capillary *Carotide* Arteries in the *Pia Mater*, chiefly by means of the Interstices of the Fibres, of which the Membrane consists; that also along the spinal Marrow, which is but a Continuation of the same Membrane, the same Separations are made; and, that to have a greater Plenty of Spirits in Readiness for Use, for all the animal and voluntary Functions; and that the chief Use of the Mass of the Brain is, by its Softness, Coldness, and Bulk, to distend, and bear up the *Meninges*, and help it in the Separation of this subtile Spirit from the Blood; which he endeavours to confirm by several Reasons and Observations.

THE 10th and 11th Chapters shew, how *Sensation* and *animal Motion* is performed. As to the first, he says, three things are to be considered; the *Objects*, or sensible Bodies, the *Organs*, and the *Soul*: The *Objects*, by their Materiality, or extended Quantity, must either immediately touch the *Sensory*, or mediately impress upon it their Motions, which the Schools call *Species*: Whence all Sensation may be reduced to Touching. This he exemplifies in the Hearing, Seeing, and the rest of the Senses. As for the *Organs*, tho' *Donato Rosetti* makes them 11, yet he is contented with five; to all of which the Nerves arising from the *Medulla oblongata*, conveying the animal Spirits, are continued. That these animal Spirits are corporeal, is evident from a certain Modification which happens either in the soft, nervous,

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Filaments, or in the animal Liquids contained in them, which they communicate *partem post partem* to the *Meninges*, from whence the animal Spirits are derived in the greatest Plenty. The *Anima*, or *Soul*, being immaterial, is not subject to Modifications, or of receiving Impressions from the Spirits or Nerves, which are material. But as *Hippocrates* says, *Qualiacunque patitur corpus, talia videt anima*, which has a Power of comprehending these Impressions, and distends its Powers, and raises the Passions, which it does, or ought to regulate with its Approbation, or Disapprobation. That indeed, without this *Soul*, the Impressions would be made, but they would neither be discern'd, nor any Use made of them.

As to the next Thing; how animal Motions are performed, he says, The Muscles are a Collection of fleshy Fibres; that it is to be observ'd, they are all envelop'd with a Membrane dense, strong and nervous; in which external Membrane all the Nerves terminante with their numerous Ramifications, that it is impossible to separate this Membrane from the contained fleshy Fibres, without breaking innumerable Filaments of the Nerves; so that the animal Spirits pass by these Filaments into all the fleshy Fibres that make up the Belly of the Muscle. By Means of which, the animal Spirits, which are fluid Bodies, enter into, swell, and so contract the Muscle, by drawing the tendinous Parts, that are at each End, nearer together: This he illustrates by a Cable, which, being wetted, is thereby shortened. That when, according to the Empire of the Soul, there is ordered more of these Spirits to one Part, than to another, of the *Dura* and *Pia Mater*, either within the Scull, or along the Canal of the spinal Marrow; then the corresponding Branches of it, on that Side, are acted upon, and the corresponding Muscle

Muscle shortened, and the Member moved accordingly; that this is done independently on the Will, sometimes, and these are called involuntary, or natural, Motions.

AN *Apoplexy* often happening from a Defect in the Heart, in the 12th, and four following Chapters, he considers the *Thorax*, *Pericardium*, and the *Heart*, with its Auricles and Ventricle, its Substance, Use and Motion; in all which, there is nothing different from other Anatomists; only as to the Heart he agrees with Sig. *Giacomo Sircibaldi*, in his *Apollo Bifrons*, that the Substance about the Heart, commonly taken for Fat, is made of the serous *Lympha* contained in the *Pericardium*, brought to that Consistency by the Heat of the Heart, like a Sort of Glue, hardened, and sticking close to the Heart, since it is not melted by Heat, like Fat, and crackles in the Flame of a Candle. As to the Motion of the Heart, he says, indeed, that its *Systole* is caused by the Spirits, conveyed by the Branches of the *par Vagum* to the Membrane that covers it; but it were to be wished he had more particularly explain'd, how this *Contraction* is so regularly and alternately caused and continued. He endeavours to explain it by the alternate Vibrations of the Balance of a Watch, which the circular Motion of the Balance Wheel continues backwards and forwards, by the different Position of the Pallets; so the circular, yet alternate, rushing in of the Blood and Spirits, cause the alternate Motions of the Heart and Pulse. As to the Observation of a Frog's, and some other Creatures Hearts beating, after they are taken out of the Body, he compares that to a Steel Spring, which, being bent one Way, will continue its Vibrations backwards and forwards for some Time, after the first bending Force is removed. In this, I think, he is short.

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THE 17th and 18th Chapters of this Section, describe the Veins and Arteries, with their several Coats and Structures, together with the Nature, Motion, and Use of the Blood. As to which, he says, many Principles of it are discovered, viz. Certain subtle, airy, volatile Particles, discernible by the Plenty of Vapours that arise from it, while it remains hot, when fresh taken out of the Body. 2dly, Salts of divers Figures, observed in the Serum, by the Microscope. 3dly, Several fibrous *Stamina*, or Fibres, observ'd in the thick, or grumous, Part, when wash'd in warm Water. 4thly, Some small red Globules, made of little oval, plane Corpuscles, which, separated, are transparent, but, being joined, appear more or less of a purple Colour. 5thly, Several Particles of Sulphur, which Chymistry procures out of the thick Part, of a yellow, or red Colour. 6thly, Several little *Moleculæ*, derived from the various Combinations of the fore-named Principles. 7thly, A great Proportion of a watery Fluid, serving as a Vehicle to the rest. 8thly, a great Quantity of Chyle, not yet converted into Blood. To this Fluid, or Blood, he gives a threefold Motion; an Agitative, from the different specifick Gravities of the Contents; a Fermentative, and a Circular, from the Action or Pulse of the Heart: All which Motions he applies to the Increase, Nutrition, and Preservation of the Individual.

THE second Section relates to the Theory of an Apoplexy, and is divided into 14 Chapters. I shall only take Notice of what I think most observable. He says, that the Apoplexy, as was remarkable in that at *Rome*, so frequent from the Autumn of 1705, throughout the whole Winter, and Spring following, being a sudden Deprivation of Sense and Motion, it must be granted, that the Parts affected, are either the animal Spirits, or

the Nerves, or both; and since this Stroke is so instantaneous through the whole Body, 'tis reasonable to believe that the Mischief is impress'd on the Principle of all the Nerves that is on the *Meninges*, tho', since there is a continual Circulation, he allows that the Part immediatly affected, in an Appoplectick Fit, may be in the *Thorax*, the Heart itself failing to send a requisite Quantity of Blood to the Brain.

HAVING thus mention'd the Parts affected, he proceeds to consider the Signs of it. These Signs he distinguishes into, Those which shew Persons subject to it; An impendent Evil, or Fit; A real present Fit; and, Those which distinguish this from other Ailments: For which I must refer to the Author; taking Notice only of some Remarks: As, that sometimes in an Apoplectick Fit, the Pulse is full and strong, and without any Féver; and this accompanied with a Snorting in Breathing, and a Relaxation of the Sphincters of the *Anus* and *Urethra*. In the next Place, amongst external, or remote Causes, he reckons Evacuations either suddenly stopp'd, or unusually large, of what Kind soever.

In the 5th Chapter of internal Causes, he enumerates several, some relating to the Brain itself, and others to the Heart.

In the next Chapter, he mentions Apoplexies caused by a Blow on the Head, or Stomach; the first causing an Extravasation of Blood in the capillary Vessels: And here he gives some Instances of sudden Death from a Blow on the Head, especially near the Temples, with the Reason of such sudden Deaths; such as the Loosening the Contact of the Brain from the *Meninges*, Extravasation of the contained Fluids, &c. which must necessarily interrupt the Course of the Spirits.

As to Blows on the Pit of the Stomach proving mortal, he cites a Case in *Hippocrates*, of a Boy

kick'd by a Mule, and agrees with *Willis*, that the outward Coat of the Ventricle, being all nervous, and the Nerves of the *Par Vagum*, brought thither, form, near its Orifice, remarkable *Plexus's*; whence it has a wonderful Communication with the Brain and Heart, and so Convulsions, Syncope's, and the like mortal Syptoms, happen upon a Hurt there.

THE 7th and 8th Chapters, treating of Apoplexies from Hurts on the *Pericranium*, and Fractures of the Skull, have little remarkable, more than is generally known.

IN the 9th Chapter, he observes, that Hurts on one Side of the Head cause a paralytic Affection on the contrary Side. As to this, having observed, that *Hippocrates* has taken Notice of this Case, he explains it by what he had before related of the Nerves, in the *Meninges of the Medulla oblongata*, that they are interwoven and braided, so as those which proceed, at first, from the Left Side Fibres of the *Meninges*, have their Branching out to the Limbs, or other Parts, on the Right Side. He says farther, That the little Rings, which bind round the Nerves, at their Parting from the *Vertebræ*, may be convulsed, and so, stopping the Nerves, cause a Palsey.

THE remaining Chapters of this Section treat of the internal Causes of Apoplexies, the Vitiouſness of the solid Parts, viz. Nerves, Membranes, Tunicles, muscular or tendinous Fibres, and the like, which, he says, proceed, either from their too strong Tension, or from their too great Flaccidity, or Feebleness.

THE first of these may cause a Strangulation, or Stoppage, of the *Canaliculi*, of the Nerves, and instantaneously stop the Heart. This he farther explains in the *Meninges*, and in the *Lymphaticks*, within the Head.

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ON the contrary, too great a Relaxation is as mischievous, from the Parts in that Case failing to send a sufficient Supply of Spirits, to the several Organs of the Body. And, as this Palsey is frequent in the outward Part of the Body, so it may, and does sometimes, seize the Heart, or *Meninges*. This Weakness of the Parts sometimes happens to the Arteries, which he makes the Cause of Aneurisms, the Varices, &c. This Case, generally, is preceded by very long Indispositions, or lingering Distempers.

THE 12th Chapter is concerning *Apoplexies* caused by the Density of the fluid Parts, the Chyle, Blood, Lympha, and *Succus Nervosus*, of all which he treats briefly.

AND, as all these Fluids are, sometimes, too thick, so, on the contrary, they are also, at other Times, too fluid, which is the Subject of his next Chapter. This, he says, he has frequently observed in the Cavities of the Body, especially in the Heads of dead Persons, they being filled with a bloody Serum.

THE last Chapter is of *Apoplexies* from *Narcotic Steams*. Speaking here of *Opium*, (which by the Way he seems not to have a good Account of) he makes the sulphureous and viscous Quality of it to bind, and, as it were, glue up, and so stop the Passages of the Spirits : Whence Sleep, and, if taken too largely, Death follows. He makes the Suffocation by Charcoal, to be from the same Cause, in which he is, without doubt, mistaken, their Effects, and Manner of acting on the Body being quite different.

HERE he observes, that the Wines of *Rome*, when mix'd with Water, will not depurate, unless helped with Flower of Brimstone, which their Vinteners call *Ciambella* (a *Simmel*;) but if they put too much into it, as they are apt to do in re-

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fining either too gross, or thick, Wines, the Nar-
cotic Sulphur, thereby mix'd with the Wine,
proves very mischievous.

The Third SECTION.

*Of the particular Causes producing the frequent
Apoplexies at Rome in 1705-6.*

In order to explain this more satisfactorily, our
Author premises several Lemmata.

Lemma I. Of Respiration and its Necessity.

THE Blood-Vessels in the Lungs, being destitute
of the fleshy Fibres that accompany all the Arteries
of the rest of the Body, are supplied, in this Respect,
by the Spring of the Air admitted into the *Vesiculae* of the Lungs, on which the capillary Blood-
Vessels are ramified; which not only helps forward
its Motion; but carries off, when exhaled, the
noxious Humours from the Blood. Here he men-
tions several other Uses of Respiration: And, in

*The 2d Lemma, treats of the principal Use of
Respiration, The Introduction of an aerial Nitre
into the Blood.*

Here he mentions this Experiment: If you omit
to tie up, very close, the pulmonary Vein, and
Artery, and blow up, by the Windpipe, the Lungs
of any Animal, and then tie up the *Aspera Arteria*;
yet the Air will find a Way out, and the Lungs-
sink: Which, on the contrary, will not happen,
if the Extremities of the pulmonary Vein, and
Artery, are well tied up: Whence he argues a
Communication of the Air with the Blood. He
also observes the Difference of Colour in the Blood,
before, and after, its passing thro' the Lungs: Ob-
serving farther, that our Atmosphere is impregna-
ted with this nitrous Spirit; he adds, that if some
few Drops of the Chymical Spirit of Nitre be
dropp'd on black, cold, and coagulated, grumous,
Blood,

Blood, it will not only render it fluid, but florid, and like arterial Blood.

To this he subjoins, that Nitre, having an expulsive and elastic Power, communicates to the Blood, by Means of Respiration, that which causes its Fermentation, and continued internal Motion; citing Galen (*Lib. de Resp.*) *Aer non ad refrigerandam, sed ad nutriendam vitalem flam-mam, animalibus ineft.*

THE 3d *Lemma* is to shew, that this nitrous aerial Spirit, mix'd with some other Principles in the Blood, compounds, in the Veins and Arteries, a Substance very like the Air which encompasses us.

As to this Point, having observed that our Atmosphere is a Compound of all Sorts of Particles exhaled from Earths, Minerals, Vegetables, Animals, &c. he says, that what pure Part foever may be received into the Blood, yet, in that Blood, it meets with the like Particles conveyed in the Chyle, from the several Foods eaten; whereby, when mix'd therewith, it becomes like the encompassing Air.

BESIDES, finding those Persons, that dwell in marshy Places, subject to ill Habits of Body, he argues, that the Air of such unhealthy Places, some Way or other, gets into the Blood, and that, by the Breath, seems the most likely.

THE 4th *Lemma* is, that the Air, mix'd with the Blood, agrees with, and participates of the Condensation and Rarefaction of the Ambient.

HAVING mention'd the several States of the Air, in respect to Condensation and Rarefaction, and compared its component elastic Particles, to incurvated Steel Springs, always endeavouring to dilate themselves; and observed, that it is the Particles of Air, in Spirit of Wine, in Thermometers, which dilate, or contract, by Heat and Cold: He

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urges, that, for the same Reason, the Air, contained
and intermixed with the several Fluids of the
Body, must also participate with the Alterations
of the Ambient.

HAVING premised these *Lemma's*, in the fifth
Chapter, he treats of *Apoplexies* caused by the Ra-
rity, or Density of the Air, external and internal.

THIS Alteration of the Temperament of the
Air, when to Excess, hinders that due Separation
of the Humours, and more spiritous and useful
Parts from the Chyle and Blood, in the Harmony
of which, Health and Strength consists: Too great
a Condensation, clogging, and thereby hindring
this due Separation; and the Contrary, forcing off
unfit Particles, especially to the Brain and Meninges,
where the Separation of the animal Spirits is made.

FROM these *Lemmata*, our Author, as so many
Corollaries, deduces the Causes of Faintings, or a
Sort of *Apoplexies*, in the too excessive Heats of
the Summer, from a too great Rarefaction. As
on the Contrary, the Fixation of the Fluids, by ex-
cessive condensing Cold. The falling of Fruits
from the Trees, at both these Extreams, &c. con-
firming it.

THE 6th Chapter, being his 5th *Lemma*, is to
shew that the animal Spirits are compounded of a
two-fold volatile Essence, viz. a sulphureous from
the Blood, and a nitrous from the Air.

SINCE, it must be granted, there is in the
Blood a continual Motion and Fermentation of the
several different compounding Principles, it may
easily be allow'd, that there is separated in the
Brain a more fine and subtle Essence, which,
communicated to the Nerves, is what may be call-
ed the animal Spirits, the animal Liquid, or *Sucus Nervosus*.

HE says, as from Wine fermented, an ardent sulphureous Spirit is extracted; so Blood, after its frequent Motions and Fermentations, affords the like sulphureous Spirit to the Brain or Nerves, mix'd with the nitrous Spirit taken out of the Air.

THE 7th Chapter of *Apoplexies*, from the Condensation of the nitrous Spirit, relates this Experiment.

IF, near an unstopp'd Bottle of fresh-drawn Spirit of Nitre, another open Bottle of Spirit of Urine, or Sal Armoniac, be placed, the Steams from the Nitre will be thereby condensed, like a white Smoak, which, instead of evaporating into the Air, falls down on the Table, or Place, where the Bottles stand. Whence he argues, that whenever an urinous Spirit abounds in the Blood, it produces the same Effect in the nitrous of the animal Spirits, and so causes an *Apoplexy*.

THE 8th Chapter of *Apoplexies*, from the Condensation of the sulphureous Part of the animal Spirits.

THIS he explains by rectified Spirit of Wine, coagulating with a small Quantity of the urinous, or Sal Armoniac, Spirit; and whereas he had before asserted Wine and Blood to consist nearly of the same Principles, he hence deduces another Cause of *Apoplexies*.

As to the Objection, that Spirit of Sal Armoniac, Hartshorn, and the like, is given, with Success, in Apoplectic Fits; he says, if such Spirits were immediately mixed with the animal Juice, the Mischief would soon appear; but after passing thro' so many Alterations, as they suffer in the *Viscera*, they do neither Good nor Hurt; and if in a Fit, as it is possible, they do any Good, it is by their violent irritating the Nerves of the Palate and Tongue, and likewise those of the Stomach,

THE 9th Chapter, being the 6th *Lemma*, shews how, from these Principles, new, or second, Principles may be generated in the Blood, and other Humours, which may prove morbid and mischievous.

WHETHER the Blood be composed of Galenic, Chymic, or Democratic Principles, yet it must be granted, that it may, and does receive such Alterations, both in its more fluid and solid Parts, as to cause great Disorders in the Body. Thus, by the Circulation, some Parts are brought together and stopp'd, where they ought not to be; and, by Fermentation, some are raised up, and rendered conspicuous, in Places where they should not.

THIS he exemplifies in Wine, which, according to its Fermentations, receives great Alteration from the Winds, Storms, Thunders, &c. so as to become turbid, and quite alter'd in the Texture of its compounding Parts. So tho' the Blood has not, in it, any visible, fix'd, or tartareous Salts, yet such are often brought together in strumous and schirrous Affections; which, tho' invisible in the Blood, yet are, by the Mechanism of the Body, united and stopp'd, in the Glands most commonly.

THE same may be said of the Bile, the pancreatic Juice, and other Humours; all which, when vitiated, prove noxious to the Body.

THE 10th Chapter of *Apoplexies*, arising from morbid Principles produced within the Body, and there condensed in the solid and fluid Parts.

OUR Author begins this Chapter, with the Experiment of calcined Tartar condensing the Air in damp Places; whence its Oil, improperly so called, *per deliquium*: Alcalizate-Nitre, the white Magnesia, I suppose he means the Pyrites, do the same, &c. The same may happen in the Humours of the Body,

Body, by condensing the more aerial Parts of the Blood into Water, or fixing, into a Sort of Salt, the nitrous Spirit. The alcalizate, acrid, fix'd Particles, he believes, to be what *Hippocrates* called the *Atra Bilis*.

He remarks also, that as Spirit of Nitre, fix'd by Oil of Tartar into a nitrous Salt, dissolves, in warm Water, or damp Air; so the volatile Essence of the animal Spirits, either fix'd into, or condens'd into a Kind of Salt, by some Alchaly either produced, or introduced into the Blood, and easily after dissolved by the warm Serum, breaks the fibrous Texture, and thereby dispirits the Blood; so that it no longer furnishes that ætherial Spirit to the *Genus Nervosum*, which is the Original of all Motion and Sensation.

In the next Chapter he applies what he has before mention'd, to the Case of *Apoplexies*. These Condensations, &c. either sometimes proceeding slowly, in chronical Distempers, or sometimes very quick; and, as it were, in a Moment, the forementioned Alchaly being communicated from one Part of continued Vessels, to another; so that quickly, the Whole becomes broken, disordered, and spoil'd.

This he endeavours to explain, by these Sort of Dews on Shrubs, and the Grafs in Autumn, which look like the finest Spider's Webs; but, upon the least Touch of the Finger, on their Center, they fly away into a single Drop of Dew: So, by a small Touch, as it were, of this noxious Matter, the whole Order and Texture of the animal Spirits become broken, from Head to Foot; and from fine, rare, and delicate; become a thick, gross, and unactive Juice, and the whole animal Machine stopp'd in a Moment.

He adds, that it is not always necessary that a lixivial Alchaly should destroy this volatile Essence; since without any Error, or external Cause, Apoplexies may happen, since, as Galen says, *Eti-
am in sanguine potest generari venenum*: But this usually happens, when the Constitution of the Air contributes to such Distempers.

THE 12th Chapter contains his Conjectures, as to the Causes of the frequent *Apoplexies* at *Rome*, in 1705, and the Beginning of 1706.

OUR Author says, that he makes no Doubt, but that in the many sudden Deaths happening at *Rome*, in the fore-mention'd Time, several might proceed from the Causes set down, in the several Chapters of the second Section; so that all of them cannot properly be called *Apoplexies*: Yet they being so unusually frequent, he judges what he has laid down, in the present Section, had a great Share in producing this Evil.

He proposes therefore to consider of three Matters, in so many Chapters.

The Thirteenth CHAPTER.

Why the forementioned Causes were capable of producing Apoplexies at Rome, more than in other Places.

HERE he takes Notice of the Situation of *Rome*, in the 42d Degree of Latitude, in a large low Plane, divided by the *Tiber*, where the Air being little moved by the Winds, and impregnated with mineral Exhalations, but chiefly with putrid Impurities from the neighbouring stagnant Waters, cannot but be prejudicial to the Health of the Body.

THIS Air, being overcharged with Impurities, becomes thick, so, as at a Distance, to look like a hovering Cloud; wherefore, being so dense, it must press down, or load, more than it should, its elastic

elastic Principle; so that from the 4th and 5th Chapters, it may cause such *Apoplexies* as proceed from a thick Air.

BESIDES, *Rome* lying exposed to the South Winds, is too often mischievously affected by them. Since it is known, by common Observation, that when these Winds prevail, there is a sensible Languishing of the Strength and Spirits; which our Author attributes to the rarifying Heat of the Air, and, by its Dampness, a Dissolution of the Salts; so that there being conveyed to the Nerves an oppressive Quantity of Humidity, it renders them unactive.

THE Tramontane, or North Winds, are also, at some Times, very violent at *Rome*, and in its District, especially in the Winter; these, coming often unexpectedly, alter, of a sudden, the ambient Air, which, communicated to the Air within the Body, renders the Vessels unable to carry the spiritous Essence up to the Brain and Meninges; whence Apoplectic Affections may arise.

Lastly, The mineral Impurities from Vitriol, Alum, and Sulphur, which abound in the District of *Rome*, either taken in with the Air, or Nutriment, vegetable and animal, insinuating into the Humours, may either produce in them an urinous or lixivial, alkalize Essence, either of which may condense the volatile Essence of the animal Spirits. Whence the Inhabitants of *Rome* are more subject to these sudden Deaths, than those of other Countries.

The Fourteenth CHAPTER.

Whence Rome was, at that Time, more than usually subject to Apoplexies.

IN the Summer and Autumn of 1705, the moist hot South Winds blew almost continually, at which Time *Apoplexies* began to be frequent.

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IN the following Spring a very cold Season succeeded, with strong North Winds, with a considerable Frost; each of which stop, or retard, the Motions of the Spirits, which he confirms by two Aphorisms of Hippocrates.

THE Fruits of the Year 1705, were unripe, and the Wines poor, sour, and austere, which since, *Ex iisdem constamus, quibus nutrimur*, must lay the Seeds of future Mischiefs in the *Viscera*, especially in the *Serum*, and other Fluids in the Body. These Salts being, by a continued Fermentation, raised into an urinous Nature, and, by the wet South Winds, dissolv'd, and carried thro' the Body, even to the Head and Meninges; and afterwards, by the cold North Winds, fix'd, in the several Humours, might, by an Excess in either Case, cause a Failure, or Stoppage, of the animal Spirits.

HE believes also, that continual Fermentations may turn these immature Salts into a Kind of lixivial Salts.

HE observed old Men to be more subject to this Distemper, than young, as he supposes from this Reason: The young Men abounding more in a sulphureous Essence, which, when the North Winds bring the nitrous Particles, there being a sufficient Quantity of other, to mix therewith, increases the Spirits; whereas, for Want of that Sulphur in the old, the Blood, by the Nitre, is stagnated, and the few Spirits, they have, stopp'd.

The Fifteenth CHAPTER.

Wherefore since, in Rome, the Causes of this Distemper were universal, yet the Distemper was not so?

FOR the Causes of this Difference, he gives the different Ages, Sexes, Constitutions, Manner of Diet, and Way of Living: Whence, in some, there is such a just Balance and Proportion of Solids

ids and Fluids, of volatile and fix'd Parts, such a due Formation of the Glands, and other excretory Vessels, that there arises a due and regular Fermentation and Circulation of the Blood, and other Fluids in the Body; all which contribute to Health. Whereas, when any of these are faulty, the Evil more readily seizes on the Patient; and especially, if they lay up the Seeds of it, by eating immature Fruits, or drinking sour, austere, Wines.

As a Corollary, he adds, that the ill Temperature and Disposition of the Air and Winds, in those Years, was the occasional Cause; and, as a more remote Cause, he reckons up the unwholesome Food, and bad Wine, then generally taken.

The Sixteenth CHAPTER,

Gives several Remarks on the malignant Fevers, which, at Rome, frequently terminate in Apoplectic Symptoms.

HERE he observes first, that every Summer and Autumn, at *Rome*, and in the neighbouring Campaign, there is an universal malignant Fever, commonly call'd, Fevers from the Air. This Infection is very fatal to Strangers and Travellers, nay, to the Inhabitants themselves, if they come at that Time from a more healthy Place; or, if leaving the City, they go to other more healthy Places, and stay there, or sleep there, and then return Home.

THESE Fevers, he says, when it is little expected, end in a fatal *Apoplexy*.

To account for this, he says, that the Air of different Climates has different Effects, and that it requires some Time, before the internal Air in the Body can be reduced to the Constitution of the ambient; which, while doing, causes Alterations in the several Fermentations. Whence the Fermentation

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mentation, at that Time, is either too violent, or
too remiss. Again, Sleeping, in a different Air
from what we are used to, causes those Separations
which are usually made in Sleep, to be differently
performed from what they used to be.

THE Cause of these, happening chiefly in Sum-
mer and Autumn, is from the Heats then reign-
ing, which cause too great a Rarefaction of the
Humours and Fluids, whence they may more easi-
ly be altered by the noxious Exhalations; all
which entering into the Body by the Breath, or
Food, produce those disorderly Rarefactions, or
Fixations, of the Animal Spirits before treated of;
which happening either at the Beginning, or De-
closion of the Fever, may cause *Apoplectic* Sym-
toms.

THE last Chapter treats of several Phænomena
accompanying *Apoplexies*.

AMONG these he reckons up, Failure of Mo-
tion, Sense, and Speech; Falling down; the Bre-
athing hindered, or violent, and disorderly; a
froathy Foaming at the Mouth; a full Pulse, vi-
brating, and sometimes natural; a Relaxation of
the *Anus* and *Urethra*; the Intellect and Facul-
ties of the Mind (which, without the Nerves, can-
not act) failing, &c. all which he explains, and
concludes his first Book.

The second Book is also divided into three Sections:

*The first of Chirurgical; the second of Medicinal
Methods used in the Cure of this Distemper; and
the third concerning the Diet: Of all which I
shall be but short, having been already too prolix
in the former Part.*

THE first Chapter concerns Chirurgical Opera-
tions in general; and the three next of the Cure
of Blows, or Wounds, on the Head, Fractures of
the

the Skull, and the like; with the Prescriptions of several Ointments, Plasters, Salves, &c.

IN the 5th Chapter he treats of Blood-letting in *Apoplexies*. This he recommends as beneficial, and, in many Cases, necessary, with the Lancet, in the Arm, or Jugulars, and sometimes has been practised in the Forehead; but with due Respect to the Age of the Patient, and other Circumstances.

IN the 6th Chapter, treating of hot Irons, he mentions hot Pans held over the Head, Stupes in Brandy fired upon the shaved Crown of the Head, with other Cauterries applied to the Neck, Arms, Pit of the Stomach, and other Places. But above all, as the most efficacious Remedy, he advises the Application, to the Soles of the Feet, of an Iron heated, less, or more, according to the Exigence of the Patient; of which Iron, and Manner of applying it, he gives a Figure; affirming it the most certain Remedy, which rarely failed of Success. He produces several Authorities for this Practice: And,

IN the next Chapter, he shews the Method of Curing the Burn, after it has rouzed the *Apoplectic* Patient.

THE 8th Chapter concerns Vesicatories, Sina-pismes, and lesser Cauterries, &c.

THE last of this Section mentions Frictions, Ligatures, and Cupping.

THE second Section relates to the Part of the Physician, in this Distemper, which he handles in 14 distinct Chapters, giving particular Directions and Recipe's, as the Case requires.

THE third Section respects the Diet, both of Persons cured, and subject to it; with his Advice as to Preservatives; in all which there is little extraordinary.

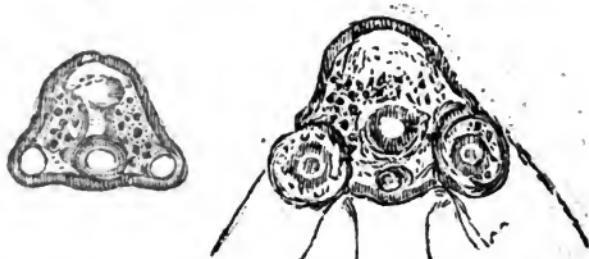
THE Author concludes his whole Work with some remarkable Cases of Persons, chiefly in the Hospitals at *Rome*, either dying, with some Observations on their Dissections, or happily cured, and that, mostly, by the hot Iron applied to the Bottoms of their Feet.

IN the Dissections mentioned by our Author, I find, he opened only the Heads of the dead Persons; taking that Part to be, chiefly, if not only, affected in *Apoplexies*; which, possibly, may be true, as to Distempers properly so called: Tho', on the other Hand, sudden Deaths may proceed from an immediate Stop on the Heart; and, indeed, he observes some had a good and natural Pulse, when at the same Time they lay in an *Apoplectic Fit*.

IN all those who died of Hurts in the Head, he found extravasated Blood, or Matter, or both, on the *Dura Mater*, or between the two *Meninges*, with a copious *Serum*, sometimes in the Ventricles of the Brain.

IN those dying *Apoplectic*, after malignant Fevers, the Blood-Vessels of the *Meninges* were turgid, with a black Blood.

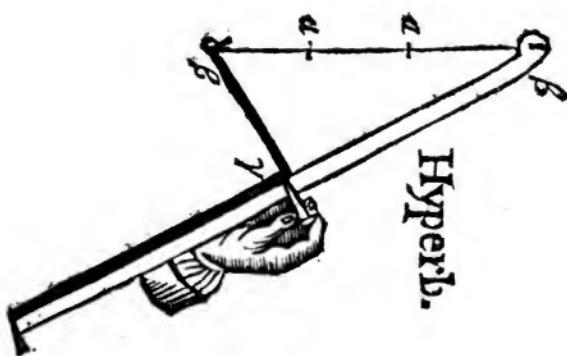
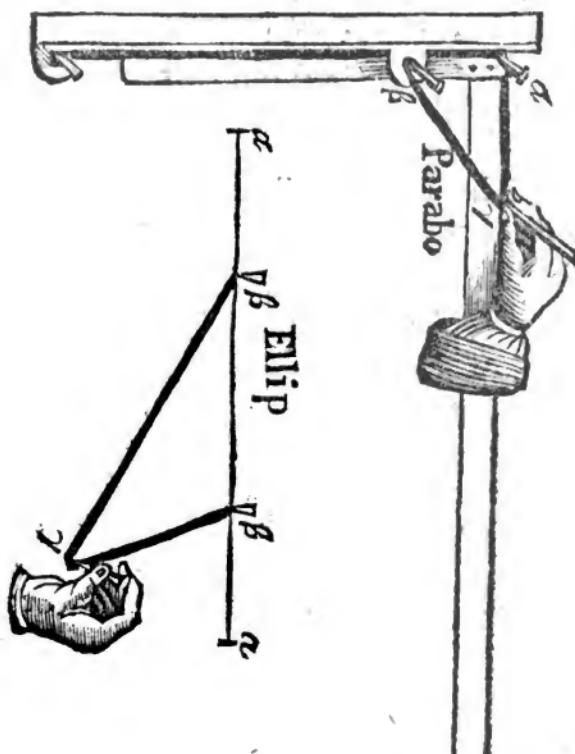
The Pores of the Sensitive Plant.



Altho' I do not find any verbal Account of the Sensitive Plant, that those Figures relate unto, yet I think fit to insert them, because they may probably be of Use to Persons that are minded to enquire into the Mechanism of that uncouth Vegetable.

W. DERHAM.

The Mechanical Way of Drawing Conical Figures.



$\alpha \alpha$ Vertices,
 $\beta \beta$ Foci,
 γ Punctum,

} Sectionis.

Cc

An

*An Extract of a Letter to R. WALLER,
Esq; from Dr. Cotton Mather, dated
Decemb. 1, 1713, at Boston in New-Eng-
land, of a Woolly Substance falling in a
Shower of Snow.*

THO' I have unhappily mislaid the large and well-attested Account of what follows, yet, however, my Memory sufficiently serves me, to assert so much as may afford you a tolerable Satisfaction: Which is, That at a Town in one of our Colonies, called *Fairfield*, in the Depth of the Winter, there fell a *Snow*, as at other Times; but there was a large frozen Spot, (of I have now forgot just how many Acres) which, instead of the *Snow* that lay covered in other Places, was covered with a very considerable Quantity of that *Wooll*, whereof I now tender a Specimen to your Acceptance.

*Mr. WALLER's Relation of petrified Bo-
dies of Men, &c.*

November 12, 1713. Mr. Baker, who had been Consul at Tripoli, &c. gave me this Relation.

A BOUT 40 Days Journey, S. E. from *Tripoli*, and about seven Days from the nearest Sea-Coast, there is a Place called *Ougila*, in which there are found the Bodies of Men, Women, Children, Beasts, and Plants, all petrified, of a hard Stone like Marble: That about 1654, or 5, the *Corsairs* having taken several of the *English* Ships, Admiral *Blake* was sent with a Squadron of Men of War

War to *Tripoli*; from which Place and *Tunis*, he had all the Captives delivered without Ransom; at which Time, the Report of this Discovery of the above-mentioned was new, so that he obliged the Alkade to procure a whole Figure for him, which he promised. But *Blake* not staying long enough there, but failing to *Legborne*, he sent a small Frigat to *Tripoli* to fetch it a-board; in which Frigat one Mr. *Hebden* (then a young Gentleman) went, who told Mr. *Baker*, that he himself saw a Figure of a Man petrified, which was conveyed to *Legborne*, and thence to *England*, and that it was carried to Secretary *Thurlow*.

THE same Mr. *Baker* told me, That when he was at *Tripoli*, he spoke with several *Turks*, who affirmed themselves to have been Eye-Witnesses of the said Petrifications: That, particularly, an Officer that commanded a Garrison of 200 Men, on a Frontier Place, called *Derney*, not many Days Journey from the Place, had promised him to procure a Figure thence; the same affirmed the Relation; that, accordingly, he sent some Spies to find the Place, which, at that Time, they could not, as he sent him Word, it being wholly buried in the Sands, which in that Country are carried in great Clouds; that a strong North Wind blows the Sands off, and by that Means discovers the Place; which, at other Times, is covered by these Sands.

HE farther told me, That this Mr. *Hebden* died about two Years since, a Prisoner in the Fleet, tho' he had been formerly sent to *Moscow* by King *Charles II.* He said, he had procured the Arm of a *Fig-Tree*, as big as his Arm, petrified; whereon the Bark and Wood were plainly visible; the Bark grey, the Wood yellowish, of the true Colour of the Plant; that in the Bark was a Grove, in which were several small Insects like the Lady-

388 Dr. Hook's Answer to some
Cow petrified; that he had presented this Piece of
petrified Wood to my Lord Torrington, in whose
Possession he believes it now is.

Dr. Hook's Answer to some particular
Claims of Mons. Cassini's, in his Original
and Progress of Astronomy.

HAVING lately perused a Discourse of Mons.
Cassini, concerning the Original and Pro-
gress of Astronomy, and of its Use in Geography,
and Navigation, I could not chuse but take No-
tice of several Passages of it, which seem more
particularly to concern this *Honourable Society*;
and the rather, because I do not find that it hath
been mentioned by any hitherto, but suffered to
pass into the World for Authentick, and will be
so concluded by the future learned World, if it
be not otherwise informed of the Errors, or Mi-
stakes, therein contained.

THE first is, concerning the Beginning, and
Original, of the *Royal Society*: Concerning which
he might have been much better informed, if he
had taken Notice of what is said concerning it in
Dr. *Sprat's* History thereof; but that, it seems, did
not so well suit to his Design of making the *French*
to be the first. He makes, then, Mr. *Oldenburg*
to have been the Instrument, who inspired the *Eng-*
lish with a Desire to imitate the *French*, in having
Philosophical Clubs or Meetings; and that this
was the Occasion of founding the *Royal Society*,
and making the *French* the first. I will not say,
that Mr. *Oldenburg* did rather inspire the *French*
to follow the *English*, or, at least, did help them,
and hinder us. But 'tis well known who were
the principal Men that began and promoted that
De-

Design, both in this City, and in *Oxford*; and that a long while before Mr. *Oldenburg* came into *England*. And not only these Philosophick Meetings, were before Mr. *Oldenburg* came from *Paris*; but the Society itself was begun, before he came hither; and those, who then knew Mr. *Oldenburg*, understood well enough, how little he himself knew of Philosophick Matters.

THE next Thing, I take Notice of, is his asserting the *Royal Academy*, at *Paris*, to be the Inventors of many Inventions, and Improvements, of Astronomical Helps, which were invented, and improved here, by some of this *Society*, before that at *Paris* was founded.

THE first Thing, he instances in, is the Pendulum Clock, which, he says, was invented by one of the Members of that *Academy*. I suppose he means Mons. *Chr. Huygens*, because he mentions the Regulation of them by the Cycloid: Now, 'tis well known, that this Person was a Member of the *Royal Society* four or five Years before the *Royal Academy* was founded, which was not till the Year 1666: The *Royal Society* has, therefore, more Right of Claim to that Improvement, than the *Royal Academy*; but, indeed, the Invention was precedent to both, and was made in *Holland*, and from thence sent into *England* about the Year 1659, or 1660.

THE next Thing, he lays Claim to, is the Regulation of Watches, by a Spring applied to the Balance; but that is somewhat more injurious than the former: For, it was not pretended to by Mons. *Zulichem*, till about the Year 1675; whereas it was here invented, before the Year 1660; in which Year, I, and three other Members of this *Society*, had a Grant of a Patent for the Use thereof; and some Years after, when Mons. *Zulichem*

390 Dr. Hook's Answer to some
came to be informed of it, he wrote a Letter a-
gainst it as a Thing not practicable.

THE 3d Thing is about the finding a Standard
for an universal Measure by the Length of a Pendu-
lum vibrating a certain Time. This, I believe, was
first invented, and tried, by Sir Christopher Wren,
some Years before the Beginning of the Society.

BUT that this Length would not be the same,
all over the World, was discovered by me to this
Society, 32 or 33 Years since, as will appear by the
Registers of this Society.

THE 4th Thing, he instances in, is the Im-
provement of Telescopes, both for Length and
Goodness, which was first performed here by Sir
Paul Neile, Sir Christopher Wren, and Dr. Goddard,
who instructed and employed Mr. Reives in the
manual Operation; and, by that Means, it was car-
ried to the Perfection of making Object-Glasses of
60 and 70 Foot long, very good, before any Mention
was made of such being made in France. Some such
Attempts, indeed, had been made in Italy, by Di-
vini and Campani: But upon comparing one of
the best of them, brought hither by Mr. Monconys,
I found, that a Telescope I had then by me,
of Mr. Reives's making, of the same Length with
the Italian, was full as good, if not better; which
Mr. Monconys acknowledged.

A 5th Thing, he instances in, was a Way of using
these Object-Glasses without Tubes. This I pra-
ctised here long before any Mention was made of
its being known beyond Sea, where, I suppose, it
was first used by Mr. Huygens, who hath printed
a little Discourse concerning it; but that was above
20 Years after I had used it here in England.

A 6th Thing is the Application of Clock-Work,
to keep the Glass directed to the Object; but who
contrived this Application, will appear by my Ani-
madversions on the *Machina Cœlestis* of Hevelius.

A 7th Thing, he instances in, is the Application of Telescope Sights to Instruments, which was invented and perfected here long before any such were to be found, or heard of, in France. And Mr. Bullialdus, and several other of the French Astronomers, as well as *Hevelius* in *Dantzick*, and Dr. *Wallis* here, did disapprove of them, after I had published the Use and great Benefit of them, for Sights of Instruments, in my Micrography, in my Attempt to prove the Parallax of the Earth's Orbit, and in my Animadversions; and by the Letters published by *Olhof* for *Hevelius*, it will appear how much the World was then of another Mind.

AN 8th Thing is the Use of a Micrometer, &c.

Concerning which I shall refer to our Philos. Transact. N° 352, where I have given a sufficient Answer to his Claim of the French Gentlemen, by asserting that and other Inventions to Mr. Gascoigne.

W. DERHAM.

It would be too tedious to mention all the Particulars, which he intitles the *Royal Academy* to the Honour of the Invention of, to which, in Truth, they have no just Pretence of Claim. However, I conceive, it might not be improper for some Person to vindicate the right and just Claim of this *Society*, that may stop the Mouths of some malicious Men, who will needs say, that this *Society* hath invented or improved nothing of real Use.

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