PHILOSOPHICAL TRANSACTIONS:

Giving some

ACCOUNT

OF THE

Present Undertakings, Studies and Labours

OF THE

INGENIOUS,

In many

Considerable Parts of the World.

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PHILOSOPHICAL
TRANSACTIONS
GIVEN FOR
ACCOUNT
OF THE
ROYAL
COMMENCEMENT OF THE WORLD
1662...
TO THE
RIGHT HONOURABLE
JOHN
EARL OF CARBERY
PRESIDENT
OF THE
ROYAL SOCIETY, &c.

This Sixteenth VOLUME

OF THE

PHILOSOPHICAL TRANSACTIONS

Is Most Humbly Dedicated

By EDMOND HALLEY.
ADVERTISEMENT.

IT having been found by Experience that several Curious Persons have been and are desirous to receive some Account of what the Learned part of the World are for the present busied a-

(a)
bout, in the examination of experimental and real Knowledge, and what Discoveries they have made in any part thereof. The Royal Society have therefore thought fit to order, that Care be taken for the future, that such Accounts shall be published in these Transactions Monthly, as may answer their expectations: Wherein will be contained not only several Experiments, Invented and tried by divers of their own Body, but also such other useful Discourses or Relations concerning Physical, Mathematical, and Mechanical Theories or Observations as shall be communicated by their Correspondants for that Intent, or shall otherwise be sent to, or collected by the Person that hath engaged himself in this Undertaking. He doth therefore hereby Advertise all such Curious Persons as shall be desirous to promote this Design, by Contributing what shall occur to them that may be useful thereunto; that upon their Communications they shall have such Acknowledgments made them as shall be to their satisfaction.

And whereas divers Books and Treatises of such Philosophical Matters as fall under the Societies Consideration, are published in Foreign Parts, which are seldom to be found till some years after, if at all, to the great damage both of the Authors and the Printers of them, and more especially to the Inquisitive of this Nation: It is therefore desired and hoped that for the future, all such Authors or Publishers, or such Ingenious Gentlemen as shall in their Travels meet with such Books or Tracts, will be pleased to send or lend them to the Undertaker of this Affair, that so an Impartial Account and Extract of them may be communicated to the Curious.

And that upon an extraordinary occasion these Transactions have for some Months last past been omitted, yet that defect will be soon supplied by the speedy Publication of what has occurred since December last, and will be for the future continued at least as punctually as heretofore.

Those that desire to Contribute to the carrying on of this Work, may please to send the Accounts they would have Printed to Mr. H. Hunt at Gresham College, London, for the Secretaries of the Royal Society.
Concerning Gravity, and its Properties,
wherein the Descent of Heavy Bodies, and the Motion of Projects is briefly, but fully handled: Togethe with the Solution of a Problem of great Use in Gun-ner-y. By E. Halley.

Nature amidst the great variety of Problems where- with She exercises the Wits of Philosophical men, scarce affords any one wherein the Effect is more visible, and the Cause more concealed than in those of the Phænomena of Gravity. Before we can go alone, we must learn to defend our selves from the violence of its Impulse, by not trusting the Center of Gravity of our Bodies beyond our reach; and yet the Acutest Philosophers, and the subtilest Enquirers into the Original of this Motion, have been so far from satisfying their Readers, that they themselves seem little to have under stood the Consequences of their own Hypotheses.

Des Cartes his Notion, I must needs confess to be to me Incomprehensible, while he will have the Particles of his Celestial matter, by being reflected on the Surface of the Earth, and so ascending therefrom, to drive down into their places those Terrestrial Bodies they find above them: This is as near as I can gather the scope of the 20, 21, 22, and 23 Sections of the last Book of his Principia Philosophiae; yet neither he, nor any of his Followers can shew how a Body suspended in libero atheæ, shall be carried downwards by a
continual Impulse tending upwards, and acting upon all its parts equally; And besides the obscurity wherewith he expresses himself particularly, Sect. 23. does sufficiently argue according to his own Rules, the confused Idea he had of the thing he wrote.

Others, and among them Dr. Vossius asserts the Cause of the Descent of heavy Bodies to be the Diurnal rotation of the Earth upon its Axis, without considering, that according to the Doctrine of Motion fortified with Demonstration, all Bodies moved in Circle, would recede from the Center of their Motion; whereby the contrary to Gravity would follow, and all loose Bodies would be cast into the Air in a Tangent to the Parallel of Latitude, without the intervention of some other Principle to keep them fast, such as is that of Gravity. Besides the effect of this Principle is throughout the whole Surface of the Glob found nearly equal, and certain Experiment seems to argue it rather less near the Equinoctial, than towards the Poles, which could not be by any means, if the Diurnal rotation of the Earth upon its Axis were the cause of Gravity, for where the Motion was swiftest, the Effect would be most considerable.

Others assign the Pressure of the Atmosphere, to be the Cause of this Tendency towards the Center of the Earth; but unhappily they have mistaken the Cause for the Effect, it being from undoubted Principles plain, that the Atmosphere has no other Pressure but what it derives from its Gravity, and that the Weight of the upper parts of the Air, pressing on the lower parts thereof, do so far bend the Springs of that Elastick Body, as to give it a force equal to the Weight that Compressed it, having of it self no force at all: And supposing it had, it will be very hard to explain the Modus, how that Pressure should occasion the Descent of a Body circumscribed by it, and pressed equally above and below, without some other force to draw, or thrust it downwards. But to demonstrate the contrary of this Opinion, an Experiment was long since shewn before the Royal Society, whereby it appeared
peared that the Atmosphere was so far from being the Cause of Gravity, that the Effects thereof were much more Vigorous where the pressure of the Atmosphere was taken off; for a long Glass-Receiver having a light Down-feather included, being evacuated of Air, the Feather which in the Air would hardly sink, did in vacuo descend with nearly the fame Velocity as if it had been a Stone.

Some think to Illustrate this Descent of Heavy Bodies, by comparing it with the Vertue of the Loadstone; but setting aside the difference there is in the manner of their Attracti-
ons, the Loadstone drawing only in and about its Poles, and the Earth near equally in all parts of its Surface, this Com-
parison avails no more than to explain ignotum per aque ignotum.

Others assign a certain Sympathetical attraction between the Earth and its Parts, whereby they have, as it were, a desire to be united, to be the Cause we enquire after: But this is so far from explaining the Modus, that it is little more, than to tell us in other terms, that heavy bodies descend, because they descend.

This I lay, not that I can pretend to substitute any Solution of this Important Philosophical Problem, that shall more happily explicate the Appearances of Gravity, only it may be serviceable to those with whom the Credit of great Authors sways much, and who too-readily assent in verba magistri, to let them see that their Books are not always infallible: Besides the detection of Errors is the first and surest step towards the discovery of Truth.

Tho' the Efficient Cause of Gravity be so obscure, yet the final Cause thereof is clear enough; for it is by this single Principle that the Earth and all the Celestial Bodies are kept from dissolution: the least of their Particles not being suffered to recede far from their Surfaces, without being immediately brought down again by vertue of this Natural tendency, which for their Preservation, the Infinite Wisdom of their Creator has Ordained to be towards each of their Centers;
nor can the Globes of the Sun and Planets otherwise be destroyed, but by taking from them this power of keeping their parts united.

The Affections or Properties of Gravity, and its manner of acting upon Bodies falling, have been in a great measure discovered, and most of them made out by Mathematical demonstration in this our Century, by the accurate diligence of Galileus, Torricellius, Hugenius, and others, and now lately by our worthy Country-man Mr. Isaac Newton, (who has an incomparable Treatise of Motion almost ready for the Press,) which Properties it may be very material here to enumerate, that they may serve for a Foundation to all those that shall be willing to spend their Thoughts in search of the true Cause of this descent of Bodies.

The first Property is, That by this principle of Gravitation, all Bodies do descend towards a Point, which either is, or else is very near to the Center of Magnitude of the Earth and Sea, about which the Sea forms itself exactly into a Spherical surface, and the Prominences of the Land, considering the Bulk of the whole, differ but indifferently from.

Secondly, That this Point or Center of Gravitation, is fixt within the Earth, or at least has been so, ever since we have any Authentick History: For a Consequence of its Change, tho' never so little, would be the over-flowing of the low Lands on that side of the Globe towards which it approached, and the leaving new Islands bare on the opposite side, from which it receded; but for this Two thousand years it appears, that the low Islands of the Mediterranean Sea (near to which the ancientest Writers lived) have continued much at the same height above the Water, as they now are found; and no Inundations or Recesse of the Sea arguing any such Change, are Recorded in History; excepting the Universal Deluge, which can no better way be accounted for, than by supposing this Center of Gravitation removed for a time, towards the middle of the then inhabited parts of the World; and
and a change of its place, but the two thousandth part of the Radius of this Globe, were sufficient to bury the Tops of the highest Hills under water.

Thirdly, That in all parts of the Surface of the Earth, or rather in all Points equidistant from its Center, the force of Gravity is nearly equal; so that the length of the Pendulum vibrating seconds of time, is found in all parts of the World to be very near the same. 'Tis true at S. Helena in the Latitude of 16 Degrees South, I found that the Pendulum of my Clock which vibrated seconds, needed to be made shorter than it had been in England by a very sensible space, (but which at that time I neglected to observe accurately) before it would keep time; and since the like Observations has been made by the French Observers near the Equinoctial: Yet I dare not affirm that in mine it proceeded from any other Cause, than the great height of my place of Observation above the Surface of the Sea, whereby the Gravity being diminished, the length of the Pendulum vibrating seconds, is proportionally shortened.

Fourthly, That Gravity does equally affect all Bodies, without regard either to their matter, bulk, or figure; so that the Impediment of the Medium being removed, the most compact and most loose, the greatest and smallest Bodies would descend the same spaces in equal times; the truth whereof will appear from the Experiment I before cited. In these two last particulars, is shewn the great difference between Gravity and Magnetism, the one affecting only Iron, and that towards its Poles, the other all Bodies alike in every part. As a Corollary; from hence it will follow, that there is no such thing as positive levity, those things that appear light, being only comparatively so; and whereas several things rise and swim in fluids, 'tis because bulk for bulk, they are not so heavy as those fluids; nor is there any reason why Cork, for instance, should be said to be light because it swims on Water, any more than Iron because it swims on Mercury.

Fifthly, That this power increases as you descend, and de-
decreases as you ascend from the Center, and that in the proportion of the 
Squares of the distances therefrom reciprocally, so as at a double distance to have but a quarter of the force; this property is the principle on which Mr. Newton has made out all the Phenomena of the Celestial Motions, so easily and naturally that its truth is past dispute. Besides that, it is highly rational, that the attractive or gravitating power should exert itself more vigorously in a small Sphere, and weaker in a greater, in proportion as it is contracted or expanded, and if so, seeing that the surfaces of Spheres are as the Squares of their Radii, this power at several distances will be as the Squares of those distances Reciprocally, and then its whole action upon each Spherical Surface, be it great or small will be always equal. And this is evidently the rule of Gravitation towards the Centers of the Sun, Jupiter, Saturn and the Earth, and thence is reasonably inferred, to be the general principle observed by Nature, in all the rest of the Celestial Bodies.

These are the principal affections of Gravity, from which the rules of the fall of Bodies, and the motion of Projects are Mathematically deducible. Mr. Isaac Newton has shewed how to define the spaces of the descent of a Body, let fall from any given hight, down to the Center. Supposing the Gravitation to increase, as in the fifth Property; but considering the smallness of hight, to which any Project can be made ascend, and over how little an Arch of the Globe it can be cast by any of our Engines, we may well enough suppose the Gravity equal throughout, and the descents of Projects in parallel lines, which in truth are towards the Center, the difference being so small as by no means to be discovered in Practice. The Opposition of the Air, 'tis true, is considerable against all light bodies moving through it, as likewise against small ones (of which more hereafter) but in great and ponderous Shot, this Impediment is found by Experience but very small, and may safely be neglected.
Propositions concerning the Descent of heavy Bodies, and the Motion of Projects.

Prop. I. The Velocities of falling Bodies, are proportionate to the times from the beginning of their falls.

This follows, for that the action of Gravity being continual, in every space of time, the falling Body receives a new impulse, equal to what it had before, in the same space of time, received from the same power: For instance, in the first second of time, the falling Body has acquired a Velocity, which in that time would carry it to a certain distance, suppose 32 foot, and were there no new force, would descend at that rate with an equal Motion; but in the next second of time, the same power of Gravity continually acting thereon, superadds a new Velocity equal to the former; so that at the end of two seconds, the Velocity is double to what it was at the end of the first, and after the same manner may it be proved to be triple, at the end of the third second, and so on. Wherefore the Velocities of falling Bodies, are proportionate to the times of their falls, Q. E. D.

Prop. II. The Spaces described by the fall of a Body, are as the Squares of the times, from the beginning of the Fall.

Demonstration. Let A B (Fig. 1. Tab. 1.) represent the time of the fall of a Body, B C perpendicular to A B the Velocity acquired at the end of the fall, and draw the line A C, then divide the line A B representing the time into as many equal parts as you please, as b, b, b, b, &c. and through these points draw the lines b c, b c, b c, &c. parallel to B C, tis manifest that the several lines, b c, represent the several Velocities of the falling Body, in such parts of the time as A b is of A B, by the former proposition. It is evident likewise that the Area A B C is the sum of all the lines b c being taken, according to the method of Indivisibles, infinitely many; so that the
the Area ABC represents the sum of all the Velocities, between none and BC supposed infinitely many; which sum is the space defended in the time represented by AB. And by the same reason the Areas A b c, will represent the spaces descended in the times A b; so then the spaces descended in the times AB, Ab, are as the Areas of the Triangles A B C, A b c, which by the 20th of the 6 of Euclid are as the Squares of their Homologous sides A B, A b, that is to say, of the Times: wherefore the descents of falling Bodies, are as the Squares of the times of their fall, Q.E.D.

Prop. III. The Velocity which a falling Body acquires in any space of time, is double to that, wherewith it would have moved the space descended by an equable motion, in the same time.

Demonstration. Draw the line E C parallel to A B and A E parallel to B C in the same fig. 1. and compleat the Parallelogram A B C E, it is evident that the Area thereof may represent the space, a Body moved equally with the Velocity B C, would describe in the time A B, and the Triangle A B C represents the space described by the fall of a Body, in the same time A B, by the second proposition. Now the Triangle A B C is half of the Parallelogram A B C E, and consequently the space described by the fall, is half what would have been described by an equable Motion with the Velocity B C, in the same time; wherefore the Velocity B C at the end of the fall, is double to that Velocity, which in the time A B, would have described the space fallen, represented by the Triangle A B C, with an equable Motion, Q.E.D.

Prop. IV. All Bodies on or near the surface of the Earth, in their fall, descend 16, as at the end of the first second of time, they have described 16 feet one inch London Measure, and acquired the Velocity of 32 feet two inches in a second.

This is made out from the 25th proposition of the second part of that Excellent Treatise of Mr. Hugenius de Horologio Oscillatorio; wherein he demonstrates the time of the least Vibrations of a Pendulum, to be to the time of the fall of a Body, from
from the height of half the length of the Pendulum, as the Circumference of a Circle to its Diameter; whence as a Corollary it follows, that as the Square of the Diameter to the Square of the Circumference, so half the length of the Pendulum vibrating seconds, to the space described by the fall of a body in a second of time: and the length of the Pendulum vibrating seconds, being found 39,125, or ½ Inches, the descent in a second will be found by the aforesaid Analogy 16 Foot and one Inch, and by the third Proposition, the Velocity will be double thereto; and near to this it hath been found by several Experiments, which by reason of the swiftness of the fall, cannot so exactly determine its quantity. The Demonstration of Hugenius being the Conclusion of a long train of Consequences. I shall for brevity sake omit; and refer you to his Book, where these things are more amply treated of.

From these four Propositions, all Questions concerning the Perpendicular fall of bodies, are easilv solved, and either Time, Height, or Velocity being assigned, one may readily find the other two. From them likewise is the Doctrine of Projects deducible, assuming the two following Axioms; viz. That a body set a moving, will move on continually in a right line with an equable motion, unless some other force or impediment intervene, whereby it is accelerated, or retarded, or deflected.

Secondly, That a Body being agitated by two motions at a time, does by their compounded forces pass through the same points, as it would do, were the two motions divided, and acted successively. As for instance, Suppose a body moved in the Line GF, (Fig.2. Tab.1.) from G to R, and there stopping, by another impulse suppose it moved in a space of time equal to the former, from R towards K, to V. I say, the body shall pass through the point V, tho' these two several forces, acted both in the same time.

Prop. V. The Motion of all Projects is in the Curve of a Parabola: Let the line GRF (in Fig.2.) be the line in which the Project is directed, and in which by the first Axiom it would move
move equal spaces in equal times, were it not deflected downwards by the force of Gravity. Let G B be the Horizontal line, and G C a Perpendicular thereto. Then the line G R F being divided into equal parts, answering to equal spaces of time, let the descents of the Project be laid down in lines parallel to GC, proportioned as the squares of the lines GS, GR, GL, GF, or as the squares of the times, from S to T, from R to V, from L to X, and from F to B, and draw the lines TH, VD, XY, BC parallel to GF; I say the Points T, V, X, B, are Points in the Curve described by the Project, and that that Curve is a Parabola. By the second Axiom they are Points in the Curve; and the parts of the descent GH, GD, GY, GC, to ST, RV, LX, FB, being as the squares of the times (by the second Prop.) that is, as the squares of the Ordinates, HT, DU, YX, BC, equal to GS, GR, GL, GF, the spaces measured in those times; and there being no other Curve but the Parabola, whose parts of the Diameter are as the squares of the Ordinates, it follows that the Curve described by a Project, can be no other than a Parabola: And saying, as RU the descent in any time, to GR or UD the direct motion in the same time, so is UD to a third proportional; that third will be the line called by all Writers of Conicks, the Parameter of the Parabola to the Diameter GC, which is alwaies the same in Projects cast with the same Velocity: And the Velocity being defined by the number of feet moved in a second of time, the Parameter will be found by dividing the square of the Velocity, by 16 feet 1 inch, the fall of a body in the same time.

Lemma.

The Sine of the double of any Arch, is equal to twice the Sine of that Arch into its Co-sine, divided by Radius; and the Versed sine of the double of any Arch is equal to the square of the Sine thereof divided by Radius.

Let the Arch BC (in fig. 3.) be double the Arch BF, and A the Center; draw the Radii AB, AF, AC, and the Chord BDC,
BDC, and let fall BE perpendicular to AC, and the Angle EBC, will be equal to the Angle ABD, and the Triangle BCE, will be like to the Triangle BDA; wherefore it will be as AB to AD, so BC or twice BD; to BE, that is as Radius to Co-sine, so twice Sine, to Sine of the double Arch. And as AB to BD, so twice BD or BC, to EC, that is as Radius to Sine, so twice that Sine to the Versed-sine of the double Arch; which two Analogies resolved into Equations, are the Propositions contained in the Lemma to be proved.

Prop. VI. The Horizontal distances of Projections made with the same Velocity, at several Elevations of the Line of direction, are as the Sines of the doubled Angles of Elevation.

Let GB (fig. 2.) the Horizontal distance be = z, the sine of the Angle of Elevation, FGB, be = s, its Co-sine = c, Radius = r, and the Parameter = p. It will be as c to s; so z to \( \frac{s}{c} = FB = GC \), and by reason of the Parabola \( \frac{ps}{c} \) to the square of CB, or GF,. Now as c to r, so is z to \( \frac{zr}{c} = GF \), and its square \( \frac{zzrr}{cc} \) will be therefore \( \frac{ps}{c} \); which Equation reduced, will be \( \frac{psr}{rr} = z \). But by the former Lemma \( \frac{2sc}{r} \) is equal to the Sine of the double Angle, whereof s is the Sine: wherefore 'twill be as Radius to Sine of double the Angle FGB, so is half the Parameter, to the Horizontal range or distance sought; and at the several Elevations, the ranges are as the Sines of the double Angles of Elevation Q.E.D.

Corollary.

Hence it follows, that half the Parameter is the greatest Random, and that that happens at the Elevation of 45 degrees, the sine of whose double is Radius,. Likewise that the Ranges equally distant above and below 45 are equal, as
are the \textit{fines} of all doubled \textit{Arches}, to the \textit{fines} of their doubled Complements.

\textbf{Prop. VII.} The \textit{Altitudes} of \textit{Projections} made with the same \textit{Velocity}, at several \textit{Elevations}, are as the \textit{versed fines} of the doubled \textit{Angles} of \textit{Elevation}: As \(c\) is to \(s\) :: \(\frac{psc}{rr}\) = \(GB\) to \(\frac{pss}{rr}\) = \(BF\), and \(UK\) = \(RU\) = \(BF\), the \textit{Altitude} of the \textit{Projection} = \(\frac{pss}{4rr}\). Now by the foregoing \textit{Lemma} \(\frac{2ss}{r}\) = to the \textit{versed sine} of the double \textit{Angle}, and therefore it will be as \textit{Radius}, to \textit{versed sine} of double the \textit{Angle} \(FGB\), so an \textit{8th} of \textit{Parameters} to the height of the \textit{Projection} \(VK\); and so these heights at several \textit{Elevations} are as the said \textit{versed sines}, \textit{Q.E.D.}

\textbf{Corollary.}

From hence it is plain, that the greatest \textit{Altitude} of the perpendicular \textit{Projection} is a \textit{4th} of \textit{Parameter}, or half the greatest \textit{Horizontal Range}; the \textit{versed sine} of \(180\) degrees being = \(2r\).

\textbf{Prop. VIII.} The \textit{Lines} \(GF\), or \textit{times} of the flight of an \textit{Object} cast with the same \textit{degree} of \textit{velocity} at different \textit{Elevations}, are as the \textit{sines} of the \textit{Elevations}.

As \(c\) is to \(r\) :: \(so\) is \(\frac{psc}{rr}\) = \(GB\) by the \textit{6 Prop.} to \(\frac{ps}{r}\) = \(GF\), that is as \textit{Radius} to \textit{sine} of \textit{Elevation}, so the \textit{Parameter} to the \textit{line} \(GF\); so the \textit{lines} \(GF\) are as the \textit{sines} of \textit{Elevation}, and the \textit{Times} are proportional to those \textit{Lines}; wherefore the \textit{Times} are as the \textit{Sines} of \textit{Elevation}: \textit{Ergo constat} propositio.

\textbf{Prop. IX.} Problem. A \textit{Projection} being made as you please, having the Distance and Altitude, or \textit{Defcent} of an \textit{Object}, through which the \textit{Project} passes, together with the \textit{Angle} of \textit{Elevation} of the \textit{line} of \textit{Direction}; to find the \textit{Parameter} and \textit{Velocity}, that is (in \textit{Fig. 2.}) having the \textit{Angle} \(FGB\), \(GM\), and \(MX\).

\textbf{Solution.} As \textit{Radius} to \textit{Secant} of \(FGB\), so \(GM\), the \textit{distance} given
given to GL; and as Radius to Tangent of FGB, so GM to LM. Then LM—MX in heights, or + MX in descents; or else MX—ML, if the direction be below the Horizontal-line, is the fall in the time that the direct impulse given in G would have carried the Project from G to L=LX=GY; then by reason of the Parabola; as LX or GY, is to GL or YX, :: so is GL to the Parameter sought. To find the Velocity of the Impulse, by Prop. 2. & 4, find the time in seconds that a body would fall the space LX, and by that dividing the line GL, the Quote will be the Velocity, or space moved in a second sought, which is always a mean proportional between the Parameter and 16 feet 1 inch.

Prop. X. Problem 2. Having the Parameter, Horizontal distance, and height or descent of an Object, to find the Elevations of the line of direction necessary to hit the given Object; that is, having GM, MX, and the greatest Random equal to half the Parameter; to find the Angles FGB.

Let the Tangent of the Angle sought be = t, the Horizontal distance GM = b, the Altitude of the Object MX = h, the Parameter = p, and Radius = r, and it will be,

As r to t, so b to \( \frac{tb}{r} = ML \) and \( \frac{b}{r} + h \) in ascents = LX, and

\[ p \cdot \frac{tb}{r} + ph = GL \text{ quad.} = XY \text{ quad. ratione Parabole;} \]

but

\[ b \cdot \frac{tt}{rr} = GL \text{ quad.} 47. 1. \text{ Euclid.} \]

Wherefore

\[ \frac{p \cdot \frac{tb}{r} + ph}{bb} + \frac{tt}{rr} \]

which Equation transposed, is

\[ \frac{tt}{rr} = \frac{pt + ph}{br} \]

1. this Equation shews the Question to have two Answers, and the Roots thereof are \( t = \frac{p}{r} + \frac{\sqrt{pp + 4pb}}{2bb} \)

\[ \sqrt{pp + 4pb} \]

\[ \frac{4bb}{4bb} \]

1 from which I derive the following Rule.
Divide half the Parameter by the Horizontal distance, and keep the Quote; viz. \( \frac{P}{2b} \) then say, as square of the distance given to the half Parameter, so half Parameter \( \pm \) double height to the square of a Secant \( = \frac{pp + 4pb}{4bb} \)

the Tangent answering to that Secant, will be \( \sqrt{\frac{pp + 4pb}{4bb} - 1} \)
or \( rr \): so then the sum and difference of the afore-found Quote, and this Tangent will be the Roots of the Equation, and the Tangents of the Elevations sought.

Note here, that in Descents, if the Tangent exceed the Quote, as it does when \( ph \) is more than \( bb \), the direction of the lower Elevation will be below the Horizon, and if \( ph = bb \), it must be directed Horizontal, and the Tangent of the upper Elevation will be \( \frac{p}{b} \): Note likewise, that if \( 4bb + 4ph \) in ascents, or \( 4bb - 4ph \) in descents, be equal to \( pp \), there is but one Elevation that can hit the Object, and its Tangent is \( \frac{p}{2b} \) and if \( 4bb + 4ph \) in ascents, or \( 4bb - 4ph \) in descents, do exceed \( pp \), the Object is without the reach of a Project cast with that Velocity, and so the thing impossible.

From this Equation \( 4bb \pm 4ph = pp \) are determined the utmost limits of the reach of any Project, and the Figure assigned, wherein are all the heights upon each Horizontal distance beyond which it cannot pass; for by reduction of that Equation, \( h \) will be found = \( \frac{bb}{p} \) in heights, and \( \frac{b}{p} \) in descents; from whence it follows, that all the Points \( h \) are in the Curve of the Parabola, whose Focus is the Point from whence the Project is cast, and whose Latus rectum, or Parameter ad Axem is = \( p \). Likewise from the same Equation may the least Parameter or Velocity be found capable to reach the Object.
Object proposed; for \( bb = \frac{1}{2} pp \mp ph \) being reduced \( \frac{1}{2} p \) in ascents, \( \frac{1}{2} h \) in descents, which is the Horizontal rang at 45 degrees, that would just reach the Object, and the Elevation requisite will be easily had; for dividing the so found Semi-parameter by the Horizontal distance given \( h \), the Quote into Radius will be the Tangent of the Elevation sought. This Rule may be of good use to all Bombardiers and Gunners, not only that they may use no more Powder than is necessary, to cast their Bombs into the place assigned, but that they may shoot with much more certainty, for that a small Error committed in the Elevation of the Piece, will produce no sensible difference in the fall of the Shot: For which Reasons the French Engineers in their late Sieges have used Morter-pieces inclined constantly to the Elevation of 45, proportioning their Charge of Powder according to the distance of the Object they intend to strike on the Horizon.

And this is all that need to be said concerning this Problem, of Shooting upon Heights and Descents. But if a Geometrical construction thereof be required; I think I have one, that is as easy as any can be expected, which I deduce from the forgoing Analytical Solution, viz. \( \frac{r}{2b} = \frac{p + \sqrt{\frac{1}{4} pp + ph - bb}}{bb} \), and is this. Having made the right Angle LDA, Tab. 1. fig. 4. make DA, DF = p, or greatest Rang, DG = b, the Horizontal distance, and DB DC = h, the Perpendicular height of the Object; and draw GB, and make DE = thereto. Then with the Radius AC and center E sweep an Arch, which if the thing be possible, will Intersect the line AD in H; and the line DH being laid both ways from F will give the points K and L, to which draw the lines GL, GK; I say the Angles LGD, KGD are the Elevations required for hitting the Object B. But note that if B be below the Horizon, its descent DC=DB must be laid from A, so as to have AC = to AD + DC. Note likewise, that if in descents DH be greater than FD, and so K fall below D the Angle.
Angle KGD shall be the depression below the Horizon: Now this Construction so naturally follows from the Equation, that I shall need say no more about it.

Prop. XI. To determine the force or Velocity of a Project, in every point of the Curve it describes.

To do this we need no other praecognita, but only the third Proposition, Viz. that the Velocity of falling Bodies, is double to that which in the same time, would have described the space fallen by an equable motion: For the Velocity of a Project, is compounded of the constant equal Velocity of the impressed motion, and the Velocity of the fall, under a given Angle, viz. the complement of the Elevation: For instance, in Fig. 2, in the time wherein a project would move from G to L, it descends from L to X, and by the third Proposition has acquired a Velocity, which in that time would have carried it by an equable motion from L to Z or twice the descent L X; and drawing the line G Z, I say the Velocity in the point X, compounded of the Velocities G L and L Z under the Angle G L Z, is to the Velocity impressed in the point G, as G Z is to G L; this follows from our second Axiome; and by the 20 and 21. Prop. lib. 1, conic. Midorgii, XO parallel and equal to G Z shall touch the Parabola in the point X. So that the Velocities in the several points, are as the lengths of the Tangents to the Parabola in those points, intercepted between any two Diameters: And these again are as the Secants of the Angles, which those Tangents continued make with the Horizontal line G B. From what is here laid down, may the comparative force of a Shot in any two points of the Curve, be either Geometrically or Arithmetically discovered.

Corollary.

From hence it follows, that the force of a Shot is always least at U, or the Vertex of the Parabola, and that at equal distances therefrom, as at T and X, G and B its force is always equal, and that the least force in U is to that in G and B, as
Radius to the Secant of the Angle of Elevation FG B.

These Propositions considered, there is no question relating to Projects, which by the help of them may not easily be solved; and tho' it be true that most of them are to be met withal, in Galileus, Torricellius and others, who have taken them from those Authors, yet their Books being Foreign, and not easy to come by, and their Demonstrations long and difficult, I thought it not amiss to give the whole Doctrine here in English, with such short Analytical Proof of my own, as might be sufficient to evince their Truth.

The Tenth Proposition contains a Problem, untouched by Torricellius, which is of the greatest use in Gunnery, and for the sake of which this Discourse was principally intended; It was first solved by Mr. Anderson, in his Book of the Genuine use and effects of the Gunn, printed in the Year 1674; but his solution required so much calculation, that it put me upon search, whether it might not be done more easily, and thereupon in the Year 1678 I found out the rule I now publish, and from it the Geometrical Construction: Since which time there has a large Treatise of this Subject Entitled, L'art de jeter les Bombes, been published in France by Monsieur Blondel, wherein he gives the Solutions of this Problem by Messieurs Bout, Romer and de la Hire; But none of them being the same with mine, or in my Opinion more easy, and most of them more Operose, and besides mine finding the Tangent, which generally determines the Angle better than its Sine, I thought my self obliged to print it for the use of all such, as desire to be informed in the Mathematical part of the Art of Gunnery.

Now these rules were rigidly true, were it not, as I said before, for the Opposition of the Medium, whereby not only the direct imprest Motion is continually retarded, by likewise the increase of the Velocity of the fall, so that the spaces described thereby, are not exactly as the squares of the times: But what this Opposition of the Air is, against several Velocities, Bulks, and Weights, is not so easy to determine. This Certain
certain that the weight of Air, to that of Water, is nearly as 1 to 800, whence the weight thereof, to that of any Project is given; tis very likely, that to the same Velocity, and Magnitude, but of different matter, the Opposition should be reciprocally as the weights of the shott; as likewise that to shott of the same Velocity and matter, but of different Sizes, it should be as the Diameters reciprocally: whence generally the Opposition to shott with the same Velocity, but of differing Diameters, and Materials, should be as their Specifick Gravities into their Diameters reciprocally; but whether the Opposition, to differing Velocities of the same shott, be as the Squares of those Velocities, or as the Velocities themselves, or otherwise, is yet a harder Question. However it be, tis certain, that in large shott of Mettal, whose weight many Thousand times Surpassest of that of the Air, and whose force is very great, in proportion to the Surface wherewith they press thereon; this Opposition is scarce discernable: For by Several Experiments made with all Care and Circumspection with a Morterpeice Extraordinary well fixt to the Earth on purpose, which carried a Solid Bras Shott of 4½ Inches Diameter, and of about 14 Pound weight, the Ranges above and below 45 Degrees were found nearly equal; if there were any difference, the under Ranges went rather the farthest, but those differences were usually less than the Errors committed in ordinary Practice, by the unequal Goodness and Dryness of the same sort of Powder, by the Unfitness of the Shott to the Bore, and by the Loosness of the Carriage. In a Smaller Bras-Shott of about an Inch and half Diameter, cast by a Crofs-Bow which ranged it, at most about 400 foot, the Force being much more Equal than in the Morterpeice, this difference was found more Curiously, and Constantly and most Evidently, the under Ranges out went the upper. From which Trials I conclude, that altho' in small and light Shott, the Opposition of the Air, ought and must be accounted for; yet in Shooting of Great and Weighty Bombs, there need be very little or no allowance made; and to these Rules may be
be put in Practice to all Intents and Purposes, as if this Impediment were absolutely Removed.

An Account of an Experiment shewn before the Royal Society, of Shooting by the Rarefaction of the Air:
By Dr. D. Papin, R.S S.

Whereas ordinary Wind-Guns do their Effect by the Compression of the Air. Ottho Gericke hath found a new Sort that shoots by Rarefaction; and he hath Published that device at large in his Book about Pneumatick Experiments, but he doth not express how strong was the Effect. I have therefore had the Curiosity to try it myself by another Contrivance, which I take to be better than his: First, because I can make a Rarefaction much more perfect than he could do. Secondly, because his Device could not be used but for Guns of a small bore; but my way may be apply'd to the biggest bore that can be made by Workmen: So that one might by this means throw up vast Weights to a great distance.

A A is a Pipe very equal from one end to the other.
B B a small Pipe solder'd to a Hole near the end of the Pipe A A, and apply'd to the Plate of the Pneumatick Engine.

C C C C some kind of Stool to bear up the hinder part of the Pipe A A.
D a piece of Lead fitted to the bore of the pipe A A.

The pipe A A is to be shut at both ends by Valves outwardly apply'd, and so the said pipe A A, though never so big, may be exhausted of Air by means of the Pneumatick Engine: Which done, the Valve towards D must be suddenly open'd, so that the whole pressure of the Atmosphere acting upon the Lead D may drive it along the pipe A A with such
such a swiftness, that it will be able to carry it to a great distance: And because such a Valve shutting a great hole would prove very difficult to be opened, when the pipe AA is of a great Bore, the aperture towards D may be left much smaller than the pipe; the swiftness of the Air being so great, that even through a pretty small aperture, it presses the lead D as freely almost as if the whole Bore was quite open.

Having prepared a Barrel carrying a lead of 2 ounces, the Experiment was shewn before the Royal Society, and the Effect was found very considerable, the force being little less than that of the Wind-Gun by compression; the same experiment being afterwards repeated with a longer Barrel, 'twas found that the length in this way of shooting was very little, if any advantage.

Part of a LETTER from Dr. Salomon Reisel, Chief Physician to the Duke of Wirtemburg, about an extraordinary Tincture given to a Stone: Stuttgadice, Febr. 12o. 1686.

A Urifaber Stuttgardianus, qui & gemmis & Metallicis typis nummorum cudendorum infulpendis artificiosus est, nomine Christophorus Muller, Anno 1685, aurum aqua regis solutum, oleo Tartari præcipitatum atque edulcoratum, quod aurum fulminans dicunt, dum in scutella, quam Materellam vocant, ex lapide Chalcedonico coloris unici pellucidi onychini seu Cornei, vitro pro fusione præparato rubro mixtum, & aqua fontana imbutum tereret, ad facienda Encausta seu smalta; de quibus Anton. Nerius vertente Andrea Fisiio, egit lib. 6. Artis Vitrarie; invenit iterato tertium eodem labore: quod color pulveris istius puniceus, qui per dies aliquot succatus in vasculo manferat, quousque inter te-
rendum etiam ad marginem effluxit, reliquis tamen puris
hinc inde spatii Onychini coloris, durissimam hanc gem-
man, quae limam spernit, ita profunde penetraverit, non
tantum in feucella, sed & ipfo ptililo, & distincterit maculis
atque circulis fat ordinate ductis, ut color hic neque simplici
aqua, neque lixivia, vel acriori alio liquore potuerit deleri,
& quidem fine politura elegantioris detrimento.

Talis itaque tintura per repetitas trituras dicti pulveris
tentata denuo aliquoties, in similis coloris alio Vasculo, na-
que vero apparuit postea ut antea nunquam. Sed hoc impi-
nis circa tiontem hujus vafculi observandum est, quod
secundum texturam gemmæ, tam nudo quam armato oculo,
in trunka interna, & fincera externa parte vasis, notentur fi-
bræ feu ductus circulares, juxta quos, bracteis suci lapidei
novi per intervalla impositis, in ejusmodi molem excreviss
credendum est; uti Bezoar alicue lapides laminis super ac-
crescentibus augmentur, & ligna, in quorum ultimorum trun-
cos, circuli feu annuli designant suci annui numerum & in
crementa: adeo ut hic, purpureus ille color lineis pallidiori-
bus & obscurioribus, prout vel densiores vel rariores poros,
mollioem vel duriorem texturam offendit, circulares ambi-
tus circa verticem aliquem, veluti circa medullam feu cor,
ut appellant, aut granum aut paleam in aliis lapidibus & lig-
nis, signaverit; intermissis quoque hinc inde maculis & spa-
tis obscurioribus. Veluti Illustri. Boyle, Specim. de. Orig. &
Virt. Gemmarum, §. 1. pag. 22, 23, in Adamante & Granat-
is acies & commiurias tenuium bractearum, aut planorum
observavit; quod granum artificialis feu planam texturam
non dissimilem sflfiliati ligni vocant.

Jam vero tingi posse quoque Marmora & Alabastra & Of-
fa per lixiviam & acres succos, hinc inde scriptum est: quod
fortassis & de Gemmis sperandum est, quando Rob. Boyle Cit.
§. 2. pag. 123. ex iis tinturam manifestam extrafam esse
scritit, alibi, p. 43. & 190. per vapores minerales tiinetos esse
crysallos petrosos, atque pag. 45. ipsum Sapphirum per va-
pores subterraneos.

Cum
A CATALOGUE of Simple and Mixt Colours, with a Specimen of each Colour prefixt to its proper Name: By R. WALLER, Fellow of the Royal Society.

Having sometime since seen a TABLE of the Simple Colours made use of in Limning and Painting, Printed in the Year 1680, at Stockh lm; I have here endeavoured to give a more Philosophical, and useful one by the addition of some mixt Colours: Not that I pretend to give the Shades of all the mixt Colours, which were indeed infinite as the Compositions and Proportions of them may be unlimited; but I have mixt each of the Simple Yellows and Reds with each of the simple Blews, and these Mixtures give most of the mean Colours, viz. Greens, Purples, &c. To know what each of these mixt Colours is compounded of, you need but look to the Top of the Table directly over the Colour enquired after, where you may find the One Ingredient, and at the Side in the
the fame Row, the other. As the P.pinnajay-green is made of Blew Bice and Cambodia, an equal weight of each. I chose Weight rather than Measure, because the heavier Colours have generally the more Body, and therefore come nearest to an Equality that way. I have added the Latin, Greek, French, and English Names that I knew, which the more skilful Reader may supply where wanting. I propose to my self that this Table will be of some Use and advantage in the describing of the Colours of Natural Bodies, which may be done by this Table, and represented more nearly to the Reader provided with one of the fame Tables, with less ambiguity, I think, than is usual: A Standard of Colours being yet a thing wanting in Philosophy. Thus to describe a Plant, it may be seen which of the simple or mixt Colours comes nearest to it, and then the Word affixt to that Colour may be made use of, which the Reader, if desirous, may look in his Table, and find together with the Pattern thereof.

The Table of Colours is to be Inserted after this Leaf, which ought to be done with a Guard and a White-leaf between after the Book is bound, lest otherwise the Colours by beating stick together.
A short Description of the Simple Colours specified in this Table.

1. Spanish White made of Chalk and Alum burnt together.

2. I take the Lapis Armenius to be the blew Bice fold in the Shops, for it is light and friable; formerly brought out of Armenia, now from the Silver Mines of Germany, called Melochites, in high Dutch Berghley.

3. Ultramarine is made of the bleuest lapis Lazuli, which is freest from Gold-veins, by Calcination; the method of preparing it being too large for this place, may be seen in Doctor Merret’s ingenious Notes upon Nerii’s Art of Glass, lib. 7.

4. Smalt is made of Zaffer and Pot-ash, calcined together in a Glass-furnace. Dr. Merret ib.

5. Litmse, or Litmos, I suppose the Juice of a Plant.

6. Indigo said by Pliny to be brought from India: a kind of Mud adhering to the Froath about Reeds, and that when tryed with a Coal, the true burns with a Purple-flame, and smells of the Sea: Linseheten says, it is called Anil, that it grows in Canavia, and is a Plant like Rosemary, which is gathered and dryed, then wetted with fair Water, and beaten to a Mud; this Operation being repeated, it is dryed and fitted for use, cap. 69.

7. Indian Ink, its Use known to Pliny, tho’ not its Composition; which is yet undiscovered, except it should be burnt Rice, as hath been thought.

So much for the Blues at the Head of our Table; the Yellows and Reds made use of, are these that follow.

1. Ceruse is the Dust of Lead made by a vaporous Calcination; Pliny writes thus of it in the 34. lib. cap. 18. Ceruse, or Phymuthum is made in the Plummer’s Shops; of small Plates
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<td>Cerussa</td>
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<td>Mastic</td>
<td>Lime</td>
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<td>Crista Pamba</td>
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<td>Ochra</td>
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<td>Turigummonium</td>
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<td>Umberia</td>
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<td>Mix</td>
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<td>Minium</td>
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<td>Co'du</td>
<td>Bluer.</td>
<td>Ethiopia.</td>
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<td>Ochra rusta</td>
<td>Ruff</td>
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<td>Puller.</td>
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<td>Cinnabaris</td>
<td>Min.</td>
<td>Drua</td>
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<td>Cassia</td>
<td>Gocc</td>
<td>Purpur.</td>
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<td>Canxia</td>
<td>Co'ci</td>
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<td>Sacc</td>
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<td>Sanguis Draconis</td>
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<td>Rubrica</td>
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<tr>
<td>Candida Flavescens</td>
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<td>Montanum</td>
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<td>Cyprium</td>
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<td>Luteus</td>
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<td>Tnctus</td>
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<td>Color later</td>
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Note: The table lists various types of colors and their corresponding names in Latin.

- **Candida Flavescens**: A type of brown color
- **Montanum**: A type of green color
- **Cyprium**: A type of blue color
- **Smalt**: A type of yellow color
- **Luteus**: A type of orange color
- **Tnctus**: A type of red color
- **Cerulius**: A type of blue color
- **Color later**: A type of blue color

Each color is accompanied by a description of its appearance and classification.
Plates of Lead laid upon a Vessel of very strong Vinegar, what falls into the Vinegar is taken out, and dried in the Sun: and in the 35 Book, Chap. 6. he says it was made at Rome of burnt Marble-flint quench'd in Vinegar.

2. Masticot is a kind of improper Calx of Tin.

3. Gutta Gambia, or Cambodia, the inspissated Juice of a Plant, not well known, it comes from both the Indies. Some think it the Juice of Euphorbium; others Scammony, or Tithmal; others Ricinus: others refer it to the greater Catapuntia, Esula, or the Flowers of the Indian Ricinus, and will have it coloured with Turmeric: as Scroder.

4. Oker a kind of Natural Earth, there are two sorts thereof, the one Native formerly brought out of Attica, now from Dacia and Hungaria, and from many places of England, especially in the Forrest of Dean: The other a factitious substance of Lead burnt and quench'd in Vinegar. In Pliny's time it was made of Rubrica, or Reddle burnt.

5. Orpiment, a fat inflammable Mineral, justly ranked amongst Poisons for its extream Corrosive quality. Pliny says it was dug up in Syria on the Surface of the Earth; and that the Emperor Caligula had hopes of getting Gold out of it; wherefore he caused 14 Pounds of it to be tried, which afforded him very good Gold, but in so small a Proportion, that he lost by the trial.

6. Umber is a Native Earth.

7. Red-lead, a Colour unknown to the Antients, made of Litharge or burnt Lead by a Reverberatory Calcination, or of Ceruse put in a Platter over the Fire, which must be continually stirred till it has acquired a Red-lead colour. Dr. Charlton de Foss.

8. Burnt Oker is the common yellow Oker burnt in the open fire.

9. Cinnabar or Vermillion. There are two sorts; Native or the Minium of the Ancients, which is the Mineral that yields Quicksilver; whereof, and of Sulphur it chiefly consists,
it is found in the Mines of Istria. This Colour was among the Ancient Romans used to sacred Purposes, and on Festivals Jupiter's Face was painted therewith, as likewise the Bodies of those that entered in Triumph. The factitious Cinnabar is that which we now use; and is made by a sublimation of Mercury and Sulfur.

10. Carmin made of Cochineel.

11. Lake, thought to be an Arabick word: It is made of Flocks dyed, or shavings of Scarlet-cloth, or of the Cochineel Insect, or else of Kermes-berrys, their Tincture being extracted with a Lye of Pot-ashes, and then precipitated with a Solution of Rock-alum. After the same manner a Lake may be made of any Plant or Flower; a more exact Information touching this matter, may be had in Mr. Boyle's Treatise of Colours, Part. 3. Exp. 49. and Dr. Merret's Notes on Neri's Art of Glass. lib. 7: There is also another sort of Lake made of Gum-iac, by extracting its Tincture with Trine. Dr. Merret, ibidem.

12. Sanguis Draconis is the Gum of a Tree which looks like dried Blood, 'tis brought out of several places in the East Indies; and the Tree which produces it is very well described in the Hortus Malabaricus.

13. English Reddle or Ruddle, is found in many places of England, amongst the rest near Witney in Oxford-shire. Dr. Plot's Hist. of Ox. c. 3.

14. Lamp-black, by Pliny thus described: It is made of the Soot of Rosin or Pitch burnt, Houses being built on purpose for it, that keep in the Smoak. Its Use is in Writing-books, lib. 35. cap. 6.
In usum Exterorum visum est Praefatuum silam hanc atque Catalogum Colorum Latinitate donare.

Cum aliquando viderim Nomenclaturam Colorum simplicium Trilinguam Stockholmiæ editam per D. St. Brenner; mihi in mentem venit opus me praefaturum Genio, ac fini Regis Societatis, nec absonum, nec inutil, si talis, non modo Simplicium, verum etiam Mixtorum Colorum Tabulae conficiendæ modum exegitare potuerim: magis autem fore gratum si cuique Vocabulo Specimen Coloris apponi possit; quod Amice Lector hic tandem effectum vides.


Ad usum vero hujusce quod attinet, non leviusculum hinc enaturum confido: reftat enim hucusque quid Desideratum nempe jucta Colorum statera. Jam si quis Plantarum, vel Animalium Integumentum describere velit, ope hujus Tabulae minimo Labore, fine uta Ambige, vel Ambiguitate rem conficet, idemque genuinis quasi depictum coloribus, Lectoris eadem instructi Tabula oculis subjiciet. Exempli gratia, Gentianelle flós colore est azurino, exterius in saligneum vergente, hujusque planta folia prope Herbei sunt coloris.

Hoc quale cunque Tentamen in meliorem partem accipias, studioque nostro tibi subserviendi fruaris feliciter, & faveas candide.

Vale.
Sequitur Pigmentorum Simplicium in hac Tabula exhibitorum Descriptio alia qualis.

1. *Andidum Hispanicum* fit ex *Creta alba* et *Alumine* in Crucibulo simul calcinatis.


   *Indicum*, Authore *Plinio* ex *India* provenit, constans limo quodam arundinum spumæ adhærescente; probatur carbone, sincerum enim reddit flamman excellentis purpuræ; ac dum fumat Odorem Maris redolet, 1.35.c.6.


   Hodie vero in insula *Jamaica* et alibi in *Americanis nostris* Coloniiis copiose provenit, ac ad hunc ferme modum preparatur.

7. *Atramentum Sinicum* vel *Indicum Plinio*, cui ignotum erat ex quo constabat; neque etiam nobis plane innotuit quid sit: a quibusdam vero creditur *Oriza usta*.

   Hoc
Hoc sufficiat descriptioni Cæruleorum ad Caput Tabule positorum, jam Pauca de Luteis & Rubris subjiciam.

1. **Cerussa est Åæugo Plumbi per Calcinationem vapore-sam. Dios. l.5. c.103. De hac ita Plinius; Cerussa vel Psmry-thium fit ex laminis Plumbi tenuissimis super vas aceri afferrimi impositis, atque ita diffillantibus iiis, quod in vas decidit, ad folem succatur, liib. 34. cap. 18. Idem tectatur aliud genus Rome factum, cremato silice Marmoro & restricto aceto, l.35. c.6.

2. **Masticot est Calx quaedam impropria sic dicta ex Spanno confecta. Helm.de Lithi. c. 1.

3. **Gutta Gambe, succus infpiatus Plantæ minus notæ; ex India utraq; venit, juxta quoddam Euphorbi, alios Ricini vel Tithinali; vel Scammonii succus est. Sunt qui ad Esulam, & Caraputiam majorem, vel ad flores Ricini Indi originem ejus referunt, colorisque ex Curcuma conciliatum volunt. Serod. ib. l.4.c.4. §.405.

4. **Ochra, Terra species; duplex autem habetur, Nativa, quæ apud nos multis in locis reperitur, præsertim in Salto de Dean. Factiti a altera ex Plumbo adusto & in aceto extincto, facta vero est tempore Plini ex Calculata Rubrica: Plin. l.35. c.6.


6. **Umbria Terra est Nativa.

7. **Minium factitium, ignotum veteribus; Fit ex plumbo per calcinationem reverberatorii; vel ex Cerussa in Patina super ignem posita, ac continue Rudicula agitata, donec colorem Minii acquisiverit. Dr. Charlton de fossil.

8. **Ochra usua, Ochra est nativa lutea nudo igne adusta.

9. **Cinna-
9. Cinnabar is Græcis Milto, duplex est; Nativa, Minium Veterum: minera vero est e qua excoquitur Hydrargyrum, quæq; ex eo et Sulphure plurimum constat. copiose provenit in Mercurii fodinis Istriensibus. Color hic apud Veteres Romanos in sacros usus adhibebatur, eq; Jovis simulachri faciem diebus festis illinere solebant, ut & Triumphantium corpora: Plinio veteres citante l.33.c.7. Ubi dicit Romam folummodo ex Hispania adventum fuisse. Altera Factitia ac nobis uita tata, fit ex Mercurio cum sulphure sublimato. Scrod. l.3.c.15.

10. Carmin fit ex Coccinella.


12. Sanguis Draconis, lachryma arboris cujusdam infar sanguinis Exiccati concreta; Ex India orientali advehitur, et arbore e qua Lachryma hæc exudat accurate descriptur in Hortu Malabarico.


The Learned Author of this Treatise, has with a great deal of Industry and Judgment, Collected the several Testimonies both Ancient and Modern, Sacred and Profane, that may give any light into the discovery of the Ancient Jewish Weights and Measures: In the doing whereof he relies chiefly upon the Tryals of Mr. Greaves, whose Integrity was never yet questioned, and who, with his own hands compared our English Standard Foot with the several Foreign Measures, our Author has occasion to use: The Book consists of Four Chapters, whereof the first by way of Preface, gives an account of the Method proper to be used in this Discovery. The second proves by many Arguments the likelihood that the Jewish Ammah or Cubit, was the same with the present Egyptian Cubit; to do which, he alledges that the usual Rise of Nile, necessary for the fertilizing of Egypt, was in the days of Herodotus, as well as now, about 16 Cubits; whence he concludes, that the old Cubit of Egypt is not altered, but the Divisions on the Nilometrium are the same as in all Antiquity: Also that the constant necessity of Surveying their Lands, by reason the Annual over-flowing does Efface their Land-marks, obliged them to observe a constant Standard to avoid confusion. Next he alledges this Cubit not to have been altered by any Conquest; the Babylonian Cubit of Five Palms being shorter, and that of Six being the same; that their next Conquerors the Greeks and Romans, have their Cubit considerably shorter, and that the Turks their present
present Masters have not introduced theirs, which is much longer, as appears by Mr. Greaves. Lastly, He proves out of Greaves, that the side of the Great Pyramide, and the length of the Tomb therein, are measured by an even Number of such Egyptian Cubits; wherefore he concludes they were so designed at first; viz. the Side of the Pyramide to be 380 Cubits, and the length of the Tomb just Four, which carries with it a great shew of probability. This done, he proves the Jewish Cubit, the same with the Egyptian Cubit, by several probable Arguments; among which the chief seems to be, That the whole Nation of the Jews had been for so many years Subjects of Egypt, and carried undoubtedly away with them their Weights and Measures: and there is no Testimony or Reason to prove that the Jews have since altered them. Hence he concludes the Old Scripture Cubit 21; 9 Inches English fere, equal to what Mr. Greaves found the modern Egyptian Cubit: and so makes a Table of all the other Measures, whose proportions to the Cubit are agreed upon.

The third Chapter treats of the Epfa, and the other Measures of Capacity, endeavouring to prove the Content of Epha, equal to 4 of the Ardeb, or Cube of the Egyptian Cubit; that is, Seven Gallons and half, and half Pint Circiter, or very near the Cube of a Foot English, and containing just 1000 Ounces Averdupoize of Water; for the which he produces such Authorities, and compares them so well together, that he has almost put it out of doubt; giving at last a Table of the Contents of all the other Scripture-Measures of Capacity, having a known relation to the Epha.

The fourth Chapter treats of the Weights and Copies mentioned in Scripture; and having by Tryal as well as Authority found the Weight of Shekel just half the Roman Ounce, equal to the half Ounce Averdupoize, he determines its value 2 s. 4 d. ; and thence derives the value of the Gold and Silver Talent, weighing 3000 Shekels. Lastly, He recommends for a Universal Standard, the length of the Pendulum vibrating
ting Seconds, to be the Hour and Yard, which he says is 3 Foot 3/4 Inches English, following therein the Ingenious Mr. Hugen's the first Proposer thereof. By the way, he takes notice of the Harmony that is between the Measures and Weights thus stated; for having the Egyptian Cubit given, the sixth part of its Cube is the Epha, the tenth thereof Homer, the tenth of that Cotyla, the tenth of which is an Ounce Aver-
drop in Water, whose half is exactly the Weight of Shekel. The whole Book being made up of very rare Remarks, is well worth the perusal of the Curious Reader.

Note. That the Learned Dr. Edward Bernard in his late Account of Weights and Measures, agrees nearly in the Capacity of Epha, with what Dr. Cumberland has determined; for he makes the Cube of the English Foot to contain 76 l. Troy of Spring-water, and the Epha, or rather Bath to contain 75 such Pounds, so that it is a Pound less than the Cube of a Foot English, which Dr. Cumberland has stated about 12 Ounces of Water more than the said Cube: And whereas Dr. Bernard says, the Epha contains 9 Gallons, 'tis a plain mistake of the Printer, of 9 for 7; for the Cube of a Foot, which is by his own account greater than Epha, scarce holds 7 Gallons and half, such as by Statute are to contain 23½ Cube Inches. As to the Value of Shekel, Dr. Bernard says, that none but Bishop Usher ever made it so little as 2 s. 5 d., which yet Doctor Cumberland has reduced to 2 s. 4 d. ;

Ephemeris ad Annun a Nativitate Domini 1686, ad Longitudinem Urbis Londinensis; ex Novis Hypothesibus ex- accissime supputata, & Regie Societati dicitata, Londini in Octavo. Impensis Gulielmi Cooper.

There being at this time a great want of Ephemerides of any tolerable exactness, several of our Astronomers were persuaded to undertake the Calculation of one for this present
present Year, which they have done from Tables of their own, whose Numbers, by many years observation, have been found to answer with great preciency to the Celestial Motions, the *Moon* only excepted; whose Motion, by reason of her manifold Inequalities, not being yet reduced to the Nicety of the rest of the *Planets*, 'twas thought needless to do any more than reduce her *Tycho*ick place in *Argol*, to our *Meridian*, and Compute the true *Latitudes*. The several Persons concerned have promised a Continuation thereof for some years to come, which will make it valuable to all Lovers of *Astronomy*.

Imprimatur,

May 15, 1686.

S. PEPTS. R. S. Pr.

LONDON,
Printed by J. Strater, and are to be sold by Sam. Smith, at the Sign of the Prince's Arms in St. Paul's Church-yard.
The Roman Abacus Out of Marcus Victorius

The Chinese Abacus from the Chinese Dictionary containing 9 places or degrees.
PHILOSOPHICAL
TRANSACTIONS.

For March and April 1686.

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The Preface. An Account of a Voyage made by the Emperor of China into Corea and the Eastern Tartary in the Year 1682: Containing many Curious Observations and Discoveries, of the height of Mountains. Declination of the Compass, and of the Latitudes and Distances of several Places, through which he passed. A Relation of a second Voyage of the said Emperor into the Western Tartary containing an exact Account of the Country Government, Manners, and Customs of these People, and several Observations concerning the Miraculous Wall, and the Prodigious Height of some Mountains. An Explanation necessary to justify the Geography supposed in these Accounts. Some Observations and Conjectures concerning the Character and Language of the Chinese, Made by R. H. Fellow of the Royal Society, together with the Characters and Method of their Numbers, and the Letters and Strokes out of which, both the Radical and also the Compounded and Decomposed Characters are constructed: with a Specimen of three Varieties of Characters or ways of Writing, made use of by them, The Figure of the Roman Abacus, together with that of the Chinese now commonly made use of for the performing of all Arithmetical operations necessary for Trade.
THE

PREFACE.

Artary, and the North-East of China, being parts of Asia, the least known and hitherto the most fabulously described, I conceiv'd it would not be unpleasing to the Curious in England, to be furnished with the Translation of two Letters published lately at Paris, which give a considerable Information concerning the present State of them. The Publisher Dedicated them to the French King, and affirms them to be the Letters of the Famous Father Verbiest, who is one of the 3 Fathers (viz. Ludovicus Buglius, Gabriel Magellanus, and Ferdinandus Verbiest) that were left at Pekin to Solicite the cause of Christianity, and who by his great Skill in Mathematick Learning obtained access to that Emperour, and thereby many Favours for himself and the other Missionaries; As appears by a Book Printed in the Chinesè and Latine Character in Quam Cheu the Metropolis of the Province of Quam tum in China Anno 1671.

But one Reason more of Printing this Translate, was to manifest by Experience, the great Use of Mathematical Knowledge, which, by these, you will perceive highly esteemed in Countries where 'tis more difficult to be obtained then here, so that when no other means could procure entrance upon the skirts of that vast Empire of China, this alone has got admittance into the Metropolis of the whole Empire, nay, into the Palace and Presence of the Emperour, with the practical parts of which knowledge, you will here find Him delighted and even captivated; And that this Learned Father, judges it the most effectual means to insinuate into the Minds also, of the most rude and ignorant (of all other things and parts of the World, but what their own Country affords) in order to propagate the Christian Religion. I shall not now add as a Confirmation of this Opinion; what to this effect we have long since beca
been informed of by the Historical Relations about China, but only take notice that besides this use, these Letters will give another, viz. Several Curious Mathematical and Physical Observations there made by the Author, who it seems well understood what would be beneficial to Europe as well at pleasing to the Chinese. To men so equalised with Mathematical knowledge, we owe the Discovery, of the before, unknown parts of the World, and from such we are to hope for the perfection of that knowledge, and the Discovery of the rest. I have upon this occasion added some inquiries concerning the Literature of that Country, they are but conjectures, grounded upon the perusal of some of their Books. A full Discovery is not pretended, however I hope they may serve as hints and incitements to others, who have better ability and other advantages to compleat it. We have hitherto not been admitted to the Skirts, but this Discovery when perfected, will lay open to us an Empire of Learning, hitherto only fabulously described; This will admit us to converse with the best and greatest of that Empire, that either are or ever have been; This will Discover a new Indian Mine and Treasure, and make a new Trade to bring it hither, which may not be unworthy, the consideration of our Honourable East-Indian-Company, As well as of several Learnd Men, who have leisure, and other opportunities to make further Progress in this Inquiry: To promote which, if these find acceptance, I shall add some further observations, together with the publication of one piece of their Philosophy, which is printed in their own Character, with the pronunciation and interpretation in Latine; which may supply a fit Subject for the Curious to practice upon, and give a taste of the Philosophy and of the manner of Expression in that Remote Part of the World. To these I have added the figure of the Roman Abacus. Which question left was the Ground of the signification of figures according to places. As also that of the Chinese in the Dictionary of the Court Language, differing from that of Martinius described in the first Decad of his Chinese History, 1st. in that the Dignity of the places here ascend from the Left to the Right; contrary to what he says of his; and 2ly. In that this has one bead only for the fifth or 6th. And his hath two;
ERRATA.

Page 56 line 22 for about read above. P. 64. l. 23. r. Obelisks.
A Voyage of the Emperor of China into the Eastern Tartary, Anno. 1682.

The Emperor of China made a Voyage into the Eastern Tartary, in the beginning of this Year 1682, after having appeased (by the Death of three Rebellious Kings) a Revolt, formed in some Provinces of the Empire: One of those revolted Princes was strangled in the Province, of which he had made himself Master: The second being brought to Pekin, with the Principal Heads of his Faction, was cut in Pieces in the sight of the whole Court: The most Considerable among the Mandarins, acting with their own hands in this sad Execution, to Revenge upon this Rebel the Death of their Parents, which he had caused to be cruelly murdered.

The third, which was the most Considerable, (and indeed the Chief of all the Revolts) had by a voluntary Death prevented his deserved Punishment, and so put an end to a Warr, which had lasted for seven Years.

The Peace having been settled, by the Re-establishing in the Empire and all the Provinces, the Peaceable Enjoyment of their Ancient Liberties: The Emperor departed the 23d. of March, to go into the Province of Iesotung, the Country of his Ancestors, with a Deligné of visiting their Sepulchres, and (after having honoured them) with the usual Ceremonies, instructing him Journey into the Eastern Tartary: This Journey was about 1100 Miles, from Pekin to the end of it.

The Emperour took with him his eldest Son, a young Prince of ten years old, which had already been declared Heir of the Empire. The three principal Queens went also in this Journey, each in their guilded Chariot; the principal
pal Kings also which compose this Empire, were accompanying with all the Grandees of the Court: And the most considerable Mandarines of all the Orders, who having all a very great Train of Attendants, and very numerous Equipage, made a Court about the Emperour of more than 70000 Persons.

It was his Will that I should accompany him in this Journey, and that I should be always near him, to the end I might make in his Presence, the Observations, necessary for knowing the disposition of the Heavens, the elevation of the Pole, the magnetical Declinations of every Place, and for measuring with Mathematical Instruments, the height of the Mountains, and the distances of Places: He was well pleased also to be informed of what concerned Meteors, and many other Physical and Mathematical Matters.

In so much, that he gave Order to an Officer to carry upon Horses such Instruments as I should have occasion to make use of, and recommended me to the Prince his Unkle, who is also his Father in Law, and the second Person of the State; he is called by a Chinese Name, which signifies an Associate of the Empire: He gave Charge to him to cause all things to be provided for me which were necessary for this Journey, which this Prince performed with a very particular goodness, causing me to lodge always in his own Tent, and to eat at his Table.

The Emperour ordered that they should give me Horses of his own Stables, to the end I might the more easily change in riding, and some of those were of them he himself had rid, which is a mark of very extraordinary distinction. In this Journey we always went toward the North-east: From Pekin to the Province of Leao tum, the way being about 300 miles is pretty equal: In the Province it self of Leao tum, it is about 490 miles, but much more unequal by reason of the Mountains; from the Frontier of this Province to the City of Ula, or the River which the Tartars call Songoro, and the Chinoise Sumhoa, the way (which is about 400 miles
miles) is very difficult, being crossed sometimes by Mountains extremely steep, sometimes by Valleys of extraordinary depth, and through Desert Plains; where in for two or three days march we met with nothing. The Mountains of this Country are covered on the East side with great Oakes and old Forests which have not been cut for some Ages.

All the Country which is beyond the Province of Leaotum is exceeding desert where nothing is to be seen on all sides but Mountains and Valleys, and Denys of Bears, Tigres and other Devouring beasts, you can scarce find a house, but only some poor Reed butts, upon the sides of some brooks, and streams. All the Citys and Burrow-towns which I have seen in the Province of Leaotum, and which are in very great numbers are entirely ruined: One can see nothing through the whole Country but old ruined Walls with Rubbell, Bricks and Stones. In the out-skirts of these Citys there have been of late some few houses built, but without any order. Some of them made of Earth, others of the Rubbish of the old Buildings, the most part of them covered with straw or thatch, and but few with tyles. There is now not the least footsteps remaining of a great number of Towns and Villages which were here before the Warr. Because the petty King of the Tartars, who began to kindle this Warr having but a very small Army, caufed the Inhabitants of those places to take Armes, which places he forthwith destroyed, that he might take from his Soldiers the hopes of ever returning again to their own Homes.

The Capital City of Leaotum, which is called Xin-Yam, is a City very fair and pretty intire, it has as yet the Remaines of an antient Palace. It is (for as much as I was able to remark by divers Observations) of the Latitude of 41 degrees 56 minutes that is to say, two degrees above Pekin, tho' hitherto both the Europeans and the Chinese have given that City the Latitude of 41 degrees. There is in that City no declination of the Magnetick Needle, as I have found by many reiterated Observations. The City of
which was almost the very extremity or our journey, lyes in 44 degrees and 20 minutes. The compass there declines from the South to the West one degree 40 minutes.

But to resume the prosecution of our journey, from Pekin to this Extremity towards the East there is made a new Way, by which the Emperour can commodiously March with his Horse, and the Queens in their Chariots. This Way is about 10 foot broad, and as even and streight as could possibly be made; it is extended above 1000 miles, it has a little Raising on each side of about a foot high, every where equal and perfectly Parallel to one another; and this Way was as neat especially when the Weather was fair, as a Floor where the Husbandmen beat out their Corn in the Field, there were also certaine Persons along this way, who only took care to smooth and cleanse it. The Christians have no where so great care of Sweeping their Streets and publick Places where the holy Sacrament is to pass in the Processions; as these Infidels have of cleaning the Ways, where their Kings and their Queens are to palls, every time they go out of their Palaces.

There was made for their Return a way like the former, they plained or levelled the Mountains as far as they were able, they raised Bridges over the Rivers, and for ornamenting them, they had extended on each side of them a fort of Mats upon which they had painted divers Figures of Animals, which had the same effect with Tapestry, Hangings, with which the Streets are usually hung in Procession.

The Emperour did very seldom make use of this Way, being almost always in Hunting; And when he accompanied the Queens he only Rode by the side of it, to the end that the great number of Horses which were in the Train that followed should not spoile it: He ordinarily marched at the Head of this kind of Army. The Queens followed Immediately in their Chariots, with their Train and their Equipage; they notwithstanding left some space between the Kings and themselves. After these marched the Kings, the Grandees of the
the Court and the Mandarines, every one according to his Rank, behind these an infinity of Attendants, and other people on Horse-back brought up the Rere-guard.

As there was not one City upon all this way, that could either lodge so great a Multitude, or furnish them with Provisions; and that the greatest part of their Journey was through a Country very little inhabited, so they were necessitated to carry along with them all things that were necessary for the Journey, and even Provisions of Victuals for three Monthes.

Upon this Account there were sent before by the ways which were made on each side of the Emperours Way, an Infinity of Waggons, Camels, Horses, and Mules for to carry the Baggage: Besides these the Emperour, the Kings and almost all the Grandees of the Court, had great numbers of Horses led, for the use of changing from time to time. I do not here reckon the droves of Beefs, Sheep, and other Cattel, which they were obliged to have with them. And though this great Multitude of Men, Horses, and Drovess, passed by a way at a good distance from that of the Emperour, yet it raised so horrible a dust, that we always seemed to march in a cloud, and thence found it difficult to distinguish those that marched 15 or 20 paces from us.

The March was so well regulated, that this Army incamped every night upon the sides of some River or Brook. 'Twas for this Reason that they caused the Tents and the Baggage necessary for this Incamping to set out very early in the Morning; and the Quarter-masters upon their first arrival marked the Ground most proper for the placing of the Emperors Tent, of the Queens, of the Kings, of the Grandees, of the Court, of the Mandarines, each according to his Dignity; and according to the Dignity he had in the Chinese Militia, which is divided into eight orders or into eight Standards.

In the space of three moneths we passed about 1000 miles, advancing towards the North-east, and about as many
in our returne: In fine we arrived at Kam-Hay, which is a
Fort situate between the South Sea and the Mountaine of
the North: It is there where is the beginning of that so
much celeberate Wall, and which seperates the Province
of Leao-tum from that of Pekely; from whence it is extended
very farre on the side of the North over the tops of the highest
Mountains. When we entred this Province, the Empe-
roure, the Kings, and the Grandees of the Court, quitte
the great way of which we have hitherto spoken, to take
that of the Mountains of the North, which are extended
without interruption towards the North-East: There some
dayes were passe in Hunting, which was performed in this
manner.

The Emperour chose 3000 men of his Life-guard, armed
with Arrows and Javellings, and dispersed them some on
this side some on that; so that they possesse themselves of a
great circuite about the Montains, which they invironed on
all parts, which made a kind of Circle whose Diamiter was
at least 3000 paces; then marching to draw nearer together
with equal progress and without quitting their range, what
ever Obstacles they found in way (the Emperour having
joyned with them severall of the Captains, and of the Gran-
dees of the Court, for the better keeping of their Order)
they Reduced this great Circle to another much lesse, which
had about 300 paces in the Diamiter: So that all the Beasts
which had been stayed within the first, found themselves
taken in this last as in a Net: for that every one setting his
feet upon the ground, they locked themselves together so
closely, that they left no meshing place for them to make
their escape by. Then they Pursued them so Vigorously in
this little space, that the poor creatures tired with the vi-
olence of their Coursing, came and fell down at the feet of
their Chasers, and suffered themselves to be taken without
trouble. I saw taken in this manner two or three hundred
Hares in lesse then one day, without counting an Infinite of
Wolves and Foxes. I have seen the same thing divers times
done
done in that part of Tartary, which is on the other side of the Province of Leao-tum, where I remember to have seen, amongst others, more than 1000 Deer so pent up by these fort of Netts, which came to cast themselves into the hands of the Hunters, having found no passage to save themselves by: they kill’d also Bears, Bores, and more than 60 Tigres, but these are taken by other means, and with other weapons.

The Emperor willd that I should be present at all these different Huntings, and he recommended to his Father in Law, in a most obliging manner the having a particular care of me, and of giving charge that I should not be exposed to any danger in the Hunting of the Tigers, and the other fierce Beasts; I was the only Person of all the Mandarines who was without Arms, and so near to the Emperor, though I made light of the Fatigue during the time we were on our Journey, I found my self so wearied every evening when I got to my Tent, that I was not able to support my self; and I should have dispensed with my self divers times from following the Emperor, if my friends had not counsel’d me to the contrary, and if I had not fear’d that he would have taken it ill if he should have perceived it.

After having passed about 400 miles in Huuting daily after this manner, we arrived at last at Xyn-Lam, the capital City of the Province, where we stayed four days.

The Inhabitants of Coree came to present to the Emperor a Sea-calf which they had taken, the Emperor caused me to see it, and asked whither our European Books had spoken any thing of this Fish; I told him we had a Book in our Library at Pekin which had explain’d the Nature of it, and dispatch’d presently a Currier to our Fathers at Pekin, who brought it me in a few days. The Emperor was pleased to see that what was sayd of this Fish in this Book, was agreeable to this which he had seen, and caused it to be carried back
back again to Pekin to be carefully preserved.

During the stay which we made in this City, the Emperor with the Queens went to visit the Sepulchers of his Ancestors, which are not very far distant, from whence he sent them back to Xyn-Tam, to continue his own Journey into the Eastern Tartary.

After several days of Marching and Hunting, he arrived at Kirin, which is distant from Xyn-Tam 400 miles: This City is built along the great River Senigoro, which takes its source from the Mountain Cham-pe, distant 400 miles towards the South: This Mountain so famous in the East for having been the Antient Seat of our Tartars, is always covered with Snow, from whence it had its Name, because Cham-pe signifies the white Mountaine.

So soon as the Emperor saw it, he alighted from his Horse and fell on his knees on the bank of the River, and bowed himself three times to the Ground to Salute it: After which, lie caused himself to be carried upon a Glorious Throne of Gold, and so made his entry into the City: All the people ran in a throng before him, testifying by their Acclamations the Joy they had to see him. This Prince took great pleasure in those Testimonies of their Affection, and that he might give them some Marks of his being very sensible of it, he was pleased to suffer himself to be fed by all, and forbid his Guards to hinder the people from approaching him, as they used to do at Pekin.

They make in this City Barks of a very particular manner: The Inhabitants keep always a great number of them ready fitten to Repulse the Muscovites, who come often into this River, to dispute the fishing of Pearls. The Emperor Reposed himself two days, after which he Descended upon the River with some Lords, accompanied with more than 100 Boates, till he arrived at the City of Ula, which is the fairest of all this Country, and which at other times hath been the Seat of the Empire of the Tartars.

A little below this City, which is at most about 32 miles and
from Kirin, the River is very full of a certain fish which resemble near enough the Plaice of Europe: and 'twas principally for the taking the Divertisment of Fishing, that the Emperor went to Ula; but the Rains coming on so suddenly, swelled the River so much, that all their Nets were broken and carried away, by the great Flood of those land Waters. The Emperor notwithstanding stayed 5 or 6 days at Ula; but seeing the Rains were not at all discontinued, he was obliged to come back to Kirin, without having enjoined the Pleasure of Fishing: as we ascended the River, the Bark wherein I was with the Emperors Father in Law, was so indamaged by the agitation of the Waves, that we were constrained to go a Shore, and mount a Chariot drawn by one Oxe, which carried us very slowly to Kirin, the Rains not at all ceasing during our Journey.

In the Evening when the Emperor was entertained upon all these Adventures, he said Laughing, the Fish have cheated us; at length, after we had stayed two dayes at Kirin, the Rains began to Diminish, and we re-took our way towards Leao-tum. I cannot here express the pains and Fatigues these had caused us to undergo, during the whole course of this Journey, by reason of the ways which the Rains had spoiled, and rendered almost Impossible: we went without staying over the Mountains and over the Vallies, and we could not pass but with extream Danger, the Brooks and Rivers which were swelled by the Floods and Inundations which ran from all parts: the Bridges were either overthrown by the Violence of the Currents, or all covered by the great overflowing of the Waters. There were made in divers Places great Collections of Water, and of Mudd, that it was almost impossible to be drawn out of it. The Horses, Cammels, and other Beasts of Burthen, which carried the Baggage could not advance, but remained sticking in the Mudd of the Marshes, or Dyed of tiring upon the Ways. The Men were not at all less in commodified, and all were enfeebled for want of Victuals, and of Refresh-
freshments necessary for so great a Journey: Many of the Horsemen were obliged, either to lead their Horses on Foot, who were no longer able to carry them, or to rest in the midst of the Fields to suffer them to take Breath: And though the Quarter-masters and the Harbingers, spared not their Pains, nor for Wood (which they cut on all sides) to fill with Faggots all the bad Passages: Yet notwithstanding after the Horses and Chariots, which took the Van early in the morning had quite passed, it was Impossible to pass after them: The Emperor himself, with his Son, and all the great Lords of the Court, were obliged more than once, to foot it over the Mud, and the Marshes, fearing to expose themselves to greater danger, if they should have passed them on Horse-back.

When they came to Bridges, or those other obstructions all the Army stayed: And as soon as the Emperor was passed, with some of the most considerable Persons, all the rest came together in a Throng, and every one striving to pass first, many were tumbled over into the Water: Others taking ways more about, found them more Dangerous, falling into Sloughs and Bogs, out of which they could not Recover themselves. In fine, there were so many Inconveniencies to be met with, in all the Ways of Eastern Tartary, that the old Officers who had followed the Court above 30 years, said they had never suffered so much in any Journey.

It was on those Occasions, that the Emperor more than once, gave me the Marks of a Respect altogether particular: the first day that we put our selves in the way for returning, we were stayed in the evening, by a Torrent so great and Rapid, that 'twas impossible to Ford it: The Emperor having by chance found a little Boat, which could not hold above 4 Persons at most, passed first with his Sons, and some of the Principal Kings followed: All the other Princes, Lords, and Mandarin, which the rest of the Army attended, (in the mean while) with Impatience the return of the Boate, to carry them to the other side of the Torrent, because the night ap-
proceeded, and the Tents had long before passed: But the Emperor being come back to us in such another Boat as the former, demanded aloud where I was; and his Father in Law having presented me to him, he added, let him come in and Cross over with us: So we were the only persons that passed with the Emperor; and all the rest stayed on the Bank, where they must pass the night under the open Heaven. The same thing hapned the next day, almost in the same manner. The Emperor at Noon meeting with a like Rapid Torrent, gave order that the Boats should be made use of for Transporting the Tents, Packs, and other Baggage till the Evening, then willed that I should pass alone with him and some few of his Attendants, having left on the other side all the Great Lords, who were necessitated to pass the Night there: The Emperors Father in Law himself, having asked if he should not pass with me, since I lodged in his Tent and eat at his Table; this Prince answered him, that he should stay, and he himself would take Order to give me what was necessary.

After we had past, the Emperor sitting on the Bank-side, made me sit by him, with the two Sons of the two Petty Western Kings, and the first Colao of Tartary, whom he distinguished on all Occasions.

As the night was fair, and the Heavens very clear; he willed me to Name in the Chinese and European Languages, all the Constellations that then appeared above the Horizon, and he himself first named all those he already knew; then unfolding a small Map of the Heavens, which I had some years since presented him, he put himself upon inquiring the Hour of the Night, by the Stars in the Meridian: Pleading himself to shew to all, the Knowledge he had acquired in these Sciences. All the Marks of his Favours which he so often gave me, even to the leading me to eat from his own Table; these marks I lay were for Publick, and so Extraordinary; that the two Uncles of the Emperor, who bore the Titles of Associates of the Empire, being on their return to Pekin,
Pekin, said that when the Emperor had some Regret or appeared somewhat Sad, he would Resume his ordinary Gaiety upon the sight of me.

I arrived at Pekin in perfect Health the 9th day of June very late, though divers were detained in the way by Distempers, or were returned from their Journy, Hurt and Lamed.

I say nothing of what we did for Religion in this Journy, having Reserved that for a particular Relation, by which it will appear, that by the Grace of our Lord, the Favours we received at the Court of China, produced considerable Fruits for the Church, and did not take away the Cross from the Missionaries.

I shall here add the Tartarean Names, and the distance of every Place through which we passed in the Eastern Tartary, from the Capital of the Province of Leao-tum even to Kirm, according to the order of Days which we spent in this Progress. A Topographick Chart may be made and inserted into the Map of the Province of Leao-tum, to be found in the Atlas of Father Martin Martinus, by changing only the Latitudes according to the heights of the Pole, which we have before Specified.

I shall add one thing more which I Understood from the Inhabitants of Ula, to wit, that Ninorita (which is a Place much Renowned in those Parts) is distant from Ula 700 Chinese Stadia (each of which is 360 Geometrical Paces.) And that Imbarking at Ninorita upon the great River Helum, into which the Songoro, and some other more considerable Rivers are discharged, and following the course of the River, which runs towards the North-East, or somewhat more to the North, they arrive in 40 days Journy at the Eastern Sea, which is (as I believe) the Streight of Armen: I was told this by the General of the Militia which is at Kirm, and who had performed this Voyage himself.
The Distances of the Places, through which we passed in the Eastern Tartary.

The first Day we passed from Xyn-Yam, the Capital of the Province of Lead-tum, and we arrived at Seac-Lysto, so the place is called in the Chinese Language. 95. stadia.
The 2d. day we arrived at Cha-cay Angha.—85. stadia.
The 3d. day at another Torrent of the same Name. 70. stadia.
The 4th. at Kiangbuchen. 50. stadia.
The 5th. at Feytiri. 80. stadia.
The 6th. at the Torrent of Seipery. 60. stadia.
The 7th. at the Torrent of Ciam. 60. stadia.
The 8th. at Courou. 50. stadia.
The 9th. at the Burrow of Safe. 40. stadia.
The 10th. at Quaranny Pyra. 40. stadia.
The 11th. at Elten eme Ambayaga. 70. stadia.
The 12th. at Ypatan. 58. stadia.
The 13th. at Suayen ny Pyra. 60. stadia.
The 14th. at Ylmen. 70. stadia.
The 15th. at Seuten. 70. stadia.
The 16th. at the City of Kirin. 70. stadia.

All this Course being 1028 Chinese Stadia, contains 369 miles (each) of 1000 Geometrical Paces; the Chinese Stadium containing as I mentioned before 360 Geometrical Paces.
A Voyage of the Emperor of China, into the Western Tartary, in the Year, 1683.

The Emperor this Year, which is the 30th. of his Age, made a Voyage into the western Tartary, together with the Queen his Grand-mother, which they call the Queen Mother, he departed the 16. of July, in the Company of more than 60000 Men, and 100000 Horse. He positively resolved, that I, with one of the two Fathers that were at the Court of Pekin, the Choice of which he left to me, should follow him. I chose Father Philip Grimaldi; because he is the most known, and because he perfectly understood the Mathematicks.

Several Reasons prevailed with the Emperor to Enterprise this Journey. The first was, that he might keep his Militia during the Peace as well as in the Wars, in continual Exercise; and for this Reason it was, that after he had establish'd a firm Peace in all the Quarters of this so vast an Empire; he recalled his best Troops hither out of every Province, and resolved in his Council to make every Year Expeditions of this kind; in several Seasons, that by hunting of Deer, Bores, Bears, and Tigres, they might learn to overcome the Enemies of the Empire, or at least to prevent the cooling of their Courage, or the degenerating from their Pristine Valour, by the Luxury of China, in a too long Repose.

In effect these kinds of Hunting had more of the Show of a Military Expedition, then of one for Divertisement, as I have already noted; The Emperor took in his Train, 100000 Horse, and above 60000 Men, all armed with Arrows and Cimiters, divided into Companies and Marching
ng in Battell-Array after their Colours, with the sound of Drums and Trumpets: During their Hunting, they entirely invested the Mountains and Forrests, as if they had been Cities which they designed to Beleaguer; following in this, the manner of Hunting used by the eastern Tartary, of which I have spoken in my last Letter. This Army had its Vaunt-guard and Rear-guard, and its Main Body, its Right Wing and left Wing, was commanded by so many Generals and petty Kings. There were spent more than Seventy days before they were on their March, in bringing together all the Ammunitions of the Army upon the Waggon, upon the Camels, upon the Horses, and upon the Mules, by reason of the Incommodious Ways. For in all the western Tartary (I call it western) not with relation to China, which Lyeth in Respect of it westward it itself, but with respect of the Eastern Tartary) there is nothing to be found but Mountains, Rocks, and Vallyes, there are neither Cities, Towns, nor Villages, nor so much as any Houses. The Inhabitants Lodge under Tents, pitched on all sides in the open Feilds. They are for the most part Graziers, and transport their Tents from one Vally to another, according as the Pastures are better. There they Pasture their Beefs, their Horses, and their Camels, they breed no Hoggs, nor any of those other Animals, which else where are fed in the Villages, as Poultry and Geese. But only of such as the Herbs, which an uncultivated Land doth Naturally produce, will serve to sustain. They pass their Life either in Hunting, or doing nothing. And as they neither Sow nor cultivate the Earth, so they make no Harvest. They Live upon Milk, Cheese, and Flesh, and have a sort of Wine, not much unlike our Aqua-vitæ; with which they make their Feasts, and are often Drunk. In short they care for nought from Morning to Night, but to Drink and Eat; like the Beasts, and Drovers which they Feed.

They are not without their Preists, which they call Lamas, for whome they have a singular Veneration, in which they differ from the Oriental Tartars; the most part of whom
whome have no Religion, nor do they belieue any God. For the rest both of the one and the other are Slaves, and wholly depend upon the will of their Masters, whose Religion and Manners they Blindly follow: Like in this to their Doves, who go where they are Lead, and not where they ought to go.

This part of Tartary, Lyes without the Prodigious Wall of China about 1000 Chinese Stadia, that is to say more than 300 European Miles, and extends from the North-east towards the north.

The Emperor Rides on Horse-back, in the Head of his Army through these Desert Places, & these Steep Mountains, and far from great Roads, exposed all the day to the Scorchings of the Sun, to the Rains, and to all the Injuries of the Air. Many of these which had been in the last Warr, assured me, that they had not suffered so much during all that, as during this Hunting. In so much that the Emperor, whose principal Aim it was, to give his Forces a Breathing, performed effectually what he pretended.

The second Reason he had of undertaking this Journey, was that he might keep the western Tartars in their Duty, and to Prevent any punhitious Designs, that might be formed against the States.

It was for this that he entred their Country with so great an Army, and with so great Preparations for Warr. Having carryed along several great Gunns, that he might cause them to be Discharged from time to time into the Vallies, and by the Noyle and Fire which issued out of the Mouths of those Dragons, which served to ornament them, he might cast a Dread upon the Rout.

Besides this great Retinue, he would yet be accompanied with all the Marks of Grandure, with which he was environned at the Court at Pequin. To wit, with a Multitude of Drums, Trumpets, Timbals, and other Musical Instruments, which formed Conforts During his sitting at Table, when he entred the Pallace, or when he went out. He caused all these
to march with him, that he might by this outward Pomp Astonish these Barbarous People, to strike them with a Fear and Respect of his Empirial Majesty.

For the Empire of China never had any Enemies more to be feared than these Western Tartars; which beginning on the East of China encompass it with an almost Infinite of people, and keep it as it were continually beleagured on the North and West sides thereof; and 'twas to make a Bulwork against their Incursions, that a Chinese Emperor in Antient times caused this great Wall to be Built, which separates China from their Country. I have passed it severall times, and have considered it very attentively. And I can say without Hyperbolizing, that all the seven Wonders of the World put together, are not comparable to this worke. And all that Fame has spread concerning it among the Europeans, is far short of what I my self have seen.

Two things have more especially caus’d my Admiration. The first is, that in this long extent from the East to the West, it passeth in several places not only through vall clampanes, but also above the tops of exceeding high Mountains, upon which it is raised by little, & little, and Fortified at certaine Intervals with great Towers; not distant the one from the other more then two flight shot. At our return I had the curiosity to measure the hight of it in one place by means of an Instrument, and I found that it was in that place 1037 Geometrical feet above the Horizon; in such sort that it is hard to comprehend how 'twas possible to Elevate this Enormous Bulwork to the hight we saw it, in places dry and full of Mountains, whence they must be oblig’d to bring from a great distance with Incredible Labour, the Water, Brick, Morter, and all the Materials necessary for so great a Work.

The second thing that Surprised me was that this Wall is not continued upon the same Line, but bent in divers places following the Situation of the Mountains, in such manner that instead of one Wall, one may say that there are three,
three, which Inviron all this great Part of China.

After all, The Monarch which in our Dayes hath Re-united the Chinese and the Tartars, under one and the same Government, has done some things more for the advantage of the Security of China, than the Chinese Emperor that Built the long Wall. For after having Reduced the Western Tartars, partly by Artifice, partly by Force of Armes: He has Obleiged them to go and remaine at 300 Miles Distance from the Wall of China; and in this place he Distributes to them Lands and Pastures, whilst he has given their Country to other Tartars, his Subjects which have their Habitation there at present: Notwithstanding which these Western Tartars are so Powerful, that if they should agree together, they might make themselves Masters of all China, and of the Eastern Tartary, Even in the face of the Oriental Tartars.

I have said, that the Tartarian Monarch that Conquered China, used an expedient for Subduing the Western Tartars. For one of his first Cares was to engage to his Interest by his Royal Bounties, and by Demonstration of a Singular Affection, the Lamas (or Preists) these Men having a great Repute about all those of their Nation, easily persuad'd them to Submit to the Government of so great a Prince, and 'tis in consideration of this Service done to the Estate, that the present Emperor looks upon these Lamas with a Favourable Eye, that he bestows Presents on them; and that he makes use of them to keep the Tartars in the Obedience which they owe him: Tho' at the Botom he hath nothing but Dis-esteem for their Persons, and looks upon them as a Sort of Ignorant Fellows, which have not the least Tincture of the Sciences or Commendable Arts, in which without doubt this Prince shews a Wise Policy, in so Disguising his true Sentiments, by these Exterior Marks of Esteem and Goodwil.

He has Divided this Vastly extended Country into 48 Provinces, who have Submitted and are Tributary to him. From
From whence it comes to pass, that the Emperor that Reigns at present in China, and in the one and the other Tartary, may justly be called the Greatest and most Powerful Monark of Asia, having so many vast Estates under him, without being any where interrupted by the Territory of any Forrein Prince, and he alone being as the Soule which gives Motion to all the Members of so vast a Body.

For after he had charged himself with the Government, he did not at all intrust the Care to any of the Colaos, nor to any of the great Men of his Court. He has not at all suffered, that the Evnucks of the Palace, or any of his Pages, or any of the young Lords that have been Raised by him, should dispose of the least thing in his House, or should Regulate any thing of themselves: which appears very extraordinary; especially if we examine what Customes his Predicessors were wont to use.

He Chastises with wonderful Equity the Great Ones as well as the Inferiors; he Deprives them of their Charges, and makes them descend from the Rank they held, Proportioning always the Penalty to the Heinousness of their Fault. He takes Cognisance of the Affairs which are transacted in the Royal Councel, and in the other Tribunals, even to the causing them to Render to him, an exact account of the Judgments there given. In one word, he of himself Disposes and Orders all things; and 'tis by reason of the Absolute Authority which he hath thus acquired, that the greatest Lords of the Court, and Persons of the highest Quality in the Empire; even the Princes of the Blood, never appear in his Presence, but with a Profound Respect.

But to what remains, the Lamas or Tartarian Preists, of whom we have spoken, are not only respected by the People, but also by the Lords and Princes of their Nation, who for Politick Ends testify to them a great deale of Freindship: This makes us fear that the Christian Religion, will not find so easy an Entrance into the Western Tartary. They are also very powerful upon the Mind of the Queen
Mother, who is of their Country, and who is at Present Threescore and Ten Years Old; they are wont to tell her, that the Sect (of which she makes Profession) has no more declared Enemy then us. And 'tis a kind of Miracle, or at least an extraordinary Protection of God, that notwithstanding this, the Emperor, who has very much Regard and Respect for her, has not hitherto ceased to heap on us Graces and Honours, considering us after an other manner than the Lamas.

During the Journy, as the Princes and the chief Officers of the Army went often times to the Queen to attend at her Court; and that we also were advertised to do so likewise: We were willing first to consult a Person of the Court, who loved us very much, and who spake for us to the Emperor in our Affairs. This Lord having entered the Princes Tent, told him what had passed, and presently coming out again: The Emperor (said he to us) has given me to understand, that 'tis not at all necessary for you to attend the Queen as others do; which made us to apprehend enough, that this Princess did not Favour us.

The 3d. Reason which the Emperor had for making this Journy, was for his Health: because he knew by Experience long enough, that when he is too long at Pekin without going abroad, he cannot avoid his being attacked by several Distempers, which he prevents by means of these long Progresses. For during the whole time he never sees any Woman; and that which is more surprizing, there appears not any one in all this Great Army, except those which are of the Retinue of the Queen Mother: 'Tis yet also a Novelty that she has accompanied the King this Year, it having not been practised above once, when he took with him the three Queens as far as the Capital City of the Province of Leapotum, to visit the Sepulchres of their Ancestors.

The Emperor and the Queen Mother pretend moreover by this Journy, to avoid the excessive Heats which are in
Petin, in the Summer during the Dog-days. For in this Part of Tartary, there Reigns during the Moneths of July and August so cold a Wind, especially in the Night, that 'tis necessary to put on thick Cloths and Furs. The Reason that may be assigned for this so extraordinary Cold, is that this Region is very much elevated and full of Mountains. There is one amongst the rest, upon which we continually ascended, for the Space of 5 or 6 Dayes March. The Emperor being desirous to know, how much it surmounted the Plains of Pekin, Distant about 300 Miles; at our Return (after having measured the Height of above a Hundred Mountains that lay in our Road) we found that it had 3000 Geometrical Paff of Elevation, above the Sea that nearest approached Pekin.

The Salt-Peter also with which these Countrys abound, may contribute to this great Cold, which is so Violent, that in Digging the Earth to 3 or 4 foot deep, there are fetched out Clods all Frozen and pieces of Ice.

Divers of the Petty Kings of the Western Tartary, came from all Sides for 300 Miles; and some for 500 Miles, together with their Children, to Salute the Emperor. These Princes, who for the most part know none but their own Natural Language, which is very different from that of the Eastern Tartary: took Regard of us, with Aspects and Gestures of a Goodness very particular. There were some amongst them, who had made a Journey to Pekin to see the Court, and who had seen our Church.

One or two days before we arrived at the Mountain which was the boundary of our Journey, we met a Petty King very aged, who returned from accompanying the Emperor, he seeing us stayed with all his Retinue, and enquired by his Interpreter, which of us was called Nauboaij, one of our Servants having made a Signe that it was I; this Prince accosted me with a great deal of Civility, and told me that for a long time he had known my Name, and that he had desired to know me. He spoke also to Father Grimaldi, with
with the same Marks of Affection. The favourable Entertainment he gave us in this Rendezvous, gave some Reason to hope that our Religion might find an easy Entrance to those Princes, particularly if care be taken to infuse into the Minds of those Princes, by the Means of the Mathematicks: Which if there should at any time be a Designe to penetrate into their Country: The most sure way for divers Reasons, (which I have not the Leisure to Explain here) will be to begin the Entrance with the other Tartars more Remote, which are not at all Subjects of this Empire, from whom we may pass on to these, advancing by little and little towards China.

During the whole Journey, the Emperor has continued to give us singular Tokens of his Good Will, shewing us Favours in the Sight of his Army, which he shewed to none besides.

One time meeting us in a great Vally, where we were measuring the height and the distance of some Mountains, he made a Stay with the whole Court, and calling to us from a great distance, he demanded of us in the Chinese Language, Hao-mo? that is to say, are you well in Health? And then asked us several Questions in the Tartarean Language, concerning the height of those Mountains, to which I answered also in the same Language; after which turning to the Lords that were about him, he discoursed with them concerning us in very obliging Expressions, as I learned the same Night from the Prince his Uncle, who was then by his side.

He testified also his Affection to us, by causing often meat to be carryed to our Tents from his own Table, willing also that on some Occasions we should eat in his; and every time he did us this Honour, he had a Regard to our Days of Abstinence, and of Fasting, sending us only such Meats as we could use.

The eldest Son of the Emperor after the Example of his Father, gave us Marks also of his Bounty, for having been con-
constrained to stay more than 10 days, by reason of a Fall from his Horse, by which he was hurt in his right Shoulder; and one part of the Army in which we were, having attended, whilst the Emperor with the other continued his Hunting, he was not wanting in sending to us daily, and sometimes twice a day during this space, Food from his own Table. In fine, we lookt on all these Favours of the Royal Family, as the Effects of a particular Providence which watched over us, and over Christianity, for which we had so much the more occasion to thank God, for that the Affection of the Emperor, was never so constantly shewn to the Grandees of the Empire, nor to the Princes of the Blood.

As to what relates to the other Particularities of our Journey, they are like to those which happened to us the last Year, in the Journey to the Eastern Tartary, which I have fully describ'd in my last Letter; that is to say, that we made use of the Emperors Horses, and of his Litters, that we lodged in the Tents, and eat at the Table of the Prince his Uncle, to whom he had particularly recommended us.

During more than 600 miles, which we had pass'd in going and returning, (for we did not return by the same Road) he caused to be made a great High-way cross the Mountains and the Vallies, for the Queen Mother, who went in a Chariot; he caused also an infinite of Bridges to be made over the Torrents, as also the Rocks to be cut, and the Points of the Mountains, with incredible Pains and Expences. Father Grimaldi shall describe the other particulars in his Letter.

As to the benefit which the Religion may draw from our Journey, I have spoken elsewhere; it sufficeth to say that the Emperor, to whose Will we cannot make the least resistance, without exposing all this mission to a manifest Danger, has ordered us to follow him. I ceased not however to speak twice to that Lord of the Court, who is our
particular, Friend, to excuse us for the time to come, from these long Journies, and especially me, who am not of an Age fit for it: I tried to obtain at least that they would be contented to take only one of us; the Letters of our Fathers were daily brought us during the Journcy, and I had the convenience of writing to them, by means of the Curriers which continually went to and came from the Royal City. I write all this in haste, that I may continue to give you an Account of our Affairs.

An Explanation, necessary to justify the Geography supposed in these Letters.

It may seem wonderful, that the Author of these Letters makes mention, in his former, of a kind of War between the Oriental Tartars and the Moscovites, notwithstanding the extream distance, these People appear to be from one another in our Geographical Charts; but those who know how much the Moscovites have extended the Bounds of the Empire along the Tartarian Sea, will judge the thing less difficult; besides those who have seen these Countries, have made Discoveries much differing from those which our Geographers have informed us of hitherto. Very lately Monsieur D’Arcy, who commands one of the Kings Ships, in the Fleet of Monsieur Le Marechal d’Estrees, informed us, that having served in Poland, and having been made Governor of a Place towards Moscovy, the Moscovite Ambassadors in their returne having passed by him, and being by him, treated in such a manner as put them into a very good Humor; one of them shewed him a Chart of the Countries between Moscovy and China: and told him, that from 3 Citys which he shewed him, whose Names were Lopla, Abajinko, Nerginsko, all 3 under the Government of the great Dukes, tho’ Situated in the great Tartary, there was a Way to Pekin, which
which was not more than 25 or 30 days Journey. This Map it seems must be kept very Secret in Muscovy: for the next day the Muscovite was in dispair, for having given it, saying that if it should be known he should come to great Dammage. The Officer being come back since into France, has given a Copy to the King, and another to Monsieur Le Marquis de Seignelay. To confirme this it may be added, what a French Man has writ from Muscovy within this two Monthes, that they are actually Raising Troops, to go to War with the Chinese.

Some Observations, and Conjectures Concerning the Chinese Characters. Made by R. H. R. S. S.

Whether there ever were any Language Natural, I dispute not: But that there have been, are and may be artificial Languages 'tis nor difficult to prove. The Chinese Court Language is said to be of this kind, invented and Spoken by the Literati and Mandarins throughout the whole Empire of China, differing from all the other Languages spoken in it, and I conjecture it to be nothing els but the names of the Characters by which they write and express their meaning, Arbitrarily Imposed by them, as we in Europe set names to Arithmetical Figures, not as we pronounce words written with a Literal Character. This I Judge by comparing the Characters with the Names, Monosyllables or Words they Pronounce and Read them with. Nor do they ascends above a Monosyllabical Name tho' the Character be composed of many single Characters, each of which hath its proper Sense and Monosyllabical Name, And though the meaning of each Character, be an ingredient in the Notion of that compounded Character.

I might give an instance also in the Artificial Language,
invented by the Late Reverend Bishop of Chester, Dr. Wilkins, which in all the accomplishments of Language doth excel any one yet extant; to which is also annexed a real Character, Legible into that or any other Language Spoken. By which Language the Character and every additional Mark is effable, and yet the Character is not Litteral but Real, which is more curious and useful than the Chinese way. Great pity it is that Discourse is not published in Latin, that the Learned of Europe, may think of further Improving it, and bringing it to Use.

But whatever we may judge of Language, tis past dispute that Writing was ever Artificial, how Antiently ever it were in Use, and was the Invention of some thinking and Studious Men. Tis also evident that there have been various ways thought of for Expressing Significancy, according to the several Genii of the Persons that were the Inventors. As may be guessed by the Egyptian Hieroglyphicks; the Chinese Characters, the Mexican Chronology, and the Literal Characters of several Nations, each of which seem to proceed upon differing methods, and from differing thoughts of Invention.

Which of these ways is the most Antient, is hard to Prove. The Egyptian Mummies and Obleisks prove a great Antiquity of the Hieroglyphicks, but yet the Chinese Chronology (if to be credited) outstrips the Egyptian in pretence to Antiquity. For the Chinese make Fohi the first King of China to be the Inventer of their Character; And account him to have Lived 2950 Years before the time of Christ, during all which time they pretend to have a certaine and written account in their Books: But their account of the times preceding, they esteem more Hypothetical and Fabulous; depending chiefly upon Fiction and Oral Tradition: As you will easily beleive, when you understand how many years they make it since the Creation of the World to the present year 1686, which by the account thereof in Mr. Graves his translation of Vlug. Beig. will be found to be no less than eighty eight millions fix hundred and forty thousand one
one hundred and two Solar Years, there having been run out since the Creation 8864 Ven. of Years (every Ven. containing ten thousand such Years) and of the present Ven. this Year 1686 is the 102d. Which account is abundantly more extravagant than the Egyptian: But this need not invalidate their History since Fohi; by which it appears that their Character was Invented before the time of Moses about 1400 Years, and even before Menes the first King of Egypt about 500 Years. So that the Chinese Invention of Writing or Characters, seems to be the most Antient of that kind. And the Book Tekim said to be written by Fohi, the most Antient Book.

These accounts made me the more desirous to understand somewhat of the Reality and Truth, of what is related concerning the Knowledge of Literature and Manual Arts, which these people of China are said to have possessed so long a time in so great Perfection, and without Alteration from the Primitive Institution, especially upon the account of their Art of Printing, which gave a hint to the Inventors of that admirable and most useful of all Inventions (for the Common Wealth of Learning) the way of Printing here in Europe. For Paulus Fouius affirms that the first Occasion of that Invention in Germany, was a Germane Merchant, who returning out of China into his own Country, Related what he had observed concerning the Practice of it as used in that Country. And tho' the Chinese way, be wholly differing as to the method of composing, from what was Invented and Perfected here: Yet such an intimation was enough to an Ingenious Artist to improve the first Con- trivance, and make it more accomodate to the Literal way of Writing with us: And as our way may possibly be now brought to the greatest Perfection for exactness and expedi- tion, so without doubt must be their way of Printing any thing just as it is written. Since I find, that they can Ingrave their Stamps for a sheet, as soon as one of our Composers can set and correct a sheet of our Literal Character, and when so done
done one Man alone will print off 1500 Sheets in one day. And though tis generally believed to be much the same with our Wooden Cuts for Printing, yet from some Observations I have made, I believe it to be much another way; of which I shall hereafter say more when I describe their other Arts of Pottery, Staining, Varnishing, &c.

By a Chinese Manuscript, out of which I transcribed the Lords Prayer in the Year 1666 (when it was lost) I found that the Pronuntiations had no Affinity with the strokes of the Character. Whence I conceived it was either a numeral Character consisting of Numbers, or else a real Character, but not a Literal, unless it were a Litteral Character of some other Language than that by which it was Pronounced, whose pronuntiation is lost though the Significancy be retained, as if one should Read what is written in Hebrew into the Latine or Roman Language, In Principio Creavit instead of Brasit bra. or Beresith Bara according to the Masoreths.

Since that time I procured from China a Dictionary of the Court Language, (as I found it written upon by the person that sent it me from thence) But this whole Book (which I found was Printed) consisted only of the Chinese Characters without any interpretation, or Pronuntiation, however by the help of the pictures of that, and a Chinese Almanack, I quickly found out their Characters for numbers and their way of Numeration, together with the Figure and use of their Abacus or counting Board, for performing the Operations of Arithmetick, which I find pretty near to agree with that of the Antient Romans (A Description and Picture of which is given by Ursinus, Pignorius and Vellerus) save only that, instead of pins and sliding Groves of the Romane, the Chinese Abacus hath Strings or Wires and Beads, to slide upon them; and that, instead of four pins for Digits or Unites, the Chinese hath 5 beades: So that it may seem to argue that the Chinese abacus was designed for a Duodecimal Progression: Whereas that of the Romans was designed for the Decimal.
One thing is remarkable in the Chinese, that I find the places in the abacus to lie horizontal, and their first place to be that next the left hand, which I judge was also the first in their old way of reading, much the same with ours, though their other characters are erected (as I shall by and by shew) from the posture of Writing and Reading, which I conjecture they did at first make use of, and what does yet further agree with this conjecture, is Remarkable in the newly mentioned Treatise of Vlug Beig. That whereas the way of Writing and Reading used by the Arabs, was from the right to the left, the first place or the place of Units in their Numeration, was that next the right Hand; and so came first to be read, as did that of China, who as I conceive read the contrary way, from the left to the right.

It appears therefore by this remark that we received this way of expressing Numbers from the Arabians, for that we keep the same posture or position of places with them, though our progression in Writing and Reading be the contrary way. And though we now Read them also in the order they are set, twenty one, twenty two, thirty six, forty eight, &c. yet we retain also the other way of Pronouncing, viz, one and twenty, two and twenty, six and thirty, eight and forty, &c.

Now as the Chinese and Roman Abacus do much agree have only that they proceed contrary ways, so doth their way of expressing Numbers by Letters or Marks, one stroke or line signifying one, two lines, two, three lines, three, a cross ten, two crosses, twenty, three crosses thirty, and so onwards to a hundred, which they expressed by a square mark, and a cross with a stroke added for a thousand, as will appear by the Table annexed. And though the Characters are not all the same; yet the order & method of one agrees very near with that of the other, especially if I may be allowed my supposition, that the Primitive way of Writing and Reading with the Chinese was Horizontal, and like the Greek and Latine or European way. Now that there are prop
Figures or Characters, is manifest from this, that they have also word Characters for every Number. And they can (in the same manner as the Romans could) express a Number by their numeral Characters or Marks, and by their Litteral or word Characters; for as one single stroke signifies one or the first, so does the Character (in the plate marked with E) signify the same thing, that is one or the first.

Having thus discovered their Characters for Numbers, and their way of Numeration, I was next desirous to understand something concerning their Language and Character.

Upon Perusing all the Accounts I could meet with in Books, I found very little satisfaction as to what I principally inquired after, which was first concerning the Method of the Character, whether it consisted of a certain Number of Marks Methodically disposed like Letters in a Literal, or like Numbers in a Numeral, or like Radicals in Composite & Decomposite Derivations; 'tis said to be Legible into a great many Languages considerabliy different one from another, but how this is effected is not related, only 'tis said that the marks are of the Nature of our Arithmetical Figures, (which are become almost Universal at least to us here in Europe,) and secondly, concerning the Number of these Characters, to which I found as little satisfaction, for, by some Relations I found that there were 120000, by others 80000 and by others 60000. And that a man must be able to remember to Write and Read at least 8000, or 10000 before he will be able to express his meaning thereby, & that it is the business of a Mans whole Life to be thoroughly understanding in the whole Character; seeming to intimation that the Characters are Immethodical, and there are as many Primitive Characters as Words. Others tell us of various kinds of Characters which have been in use in several Ages. The first they say were Hieroglyphical like the Egyptian or Mexican consisting of the Pictures of Animals & Vegetables. But that the last are made up of Lines & Points, that they have no such thing as Letters or Sylla-
Syllables, but every distinct word & notion has a distinct Character, & that all are primitive or in composit, So that if Calepinus Dictionary were to be translated into the Chinese, 'twere necessary to have as many distinct Radical Characters as there are words therein to be found, which accounts do seem to insinuate that this Character is the most Difficult, & the most perplexed piece of Learning in the World, & depends wholly upon the strength of the memory in retaining the form & signification of a perplexed scrawl. But whether they who gave us these accounts did do it knowingly, is much to be doubted, my own observations, at least, make me think otherwise. I have not yet been able to procure sufficient helps to Inform my self of the whole Art of Writing and Reading the Chinese Character, and I fear the Relations I have hitherto met with concerning it, were written by such as did not well understand it, however from such helps as I had, what I collected or do conjecture, I shall here relate. The best help I had, was the Perusal of some Books Printed in China, with the Pronunciation and Signification of the Character in Latine Letters. By these Books then I observed, First, that every one of their Characters whether consisting of more or fewer strokes or marks, were comprised within a certain square space, which is proportion'd according to the bigness of the size or manner of Writing, they designe there to make use of, not that the whole Square is filled with every Character, but that no part of that Character does exceed the Limits of that Square, so that though the Character have but one stroke it takes as much room in the line as another that hath 20 or 30 several marks, so that their Characters are most exactly ranged in Rank and File, not unlike our Numbers in Arithmatick. Notwithstanding, which I find they do vary the bigness of the Character upon several Occasions, as in the Titles of Books, in the Titles of the Chapters or Sections, in the Comments Explications or Notes, and upon several other occasions of Variety, which they do at Pleasure with their Pencil, as we use variety of Letters in the Printing of a Book. The Titles
Titles of Books are generally in very large Characters, 6 or 8 times as big as those of the Book, the Explication notes, of the Signets, the contents usually twice as big, and the like variety on several other occasions. I have met with also three several kinds of Characters, the most usual is the fixed or set square form. The second sort is the Running hand in which the orders of the Courts are written by their Secretaries, of which I have seen 3 or 4 kinds, in which the Pencil is never taken off till the whole Character be Finished, and sometimes 2 or 3 are all written without break. The third seems to be some what like the flourishing great Letters used by Scriveners at the beginning of Deeds, and by the Germans in the beginning of Chapters and Sections. They are compounded of the same strokes as the set Character, but modulated and shaped a little otherwise to make them appear the more beautiful & regular. A Specimen of each of these three are in the plate. This third is made use of for Epitaphs and other Inscriptims on Buildings or Monuments. These 3 sorts I may call the three general kinds of writing, but there is to be found an almost infinite variety of forms, which men use. This will be the more easy to be believed, when we consider that the Printed Characters are exactly the same with the written. in so much that every variety in each stroke, line or point, that is or can be made with the Pencil, is perfectly expressed in the Impression, and the forme mode, or hand, as we call it of every Writer is exhibited so curiously, that I think it hardly possible to be performed after the way of wooden Cutts as Authors affirm it is, but must be done after the Method of our Copper cutts, printed by a Roule-press, which the way of expressing the Running or Court-hand, does, I conceive most evidently demonstrate, and from divers Circumstances, I could evidently make appear from the Book it self, which I cannot so well express in writing. Their Paper is generally very thin and fine, and very transparent, but brown, so that what ever is Written or Printed on it, is almost as Legible on
on the back, as on the foreside which is of great use in the cutting of their stamps. And thence they never write or print on both sides of the same leaf but only on one, and to make the leaf appear printed on both sides they double the sheet with the printed sides outwards, and putting the folded part forward, they sew, bind or stitch together, all these sheets by the cut edges, and upon whole sheets instead of single leaves; just in the same manner as the plate annexed to this discourse is printed. They begin the book on the top of the right hand side of the page that is next the right hand, and they read downwards to the bottom, then begin the next line towards the left hand at the top, and so read to the bottom, and so proceed to the end of the book. But this I suppose not to be the primitive or first way of writing or reading. The Title of the Book is set first upon a whole Leaf, usually of a thicker Paper; and some Title is likewise written upon the folding or edge of every Sheet, where is set also the Number of the Book, and the number of the Sheet, half of which appears on one side, and half on the other side of the fold.

As to the Character itself, (I find by all the books and writings I have yet met with of that kind,) that each of them is made up of a certain number of strokes, lines, or marks, which are very distinct from each other in their shape and position, and by reason that these are single strokes, and as I conceive uncompounded, I think they may be called the Letters, Elements, or Particles, out of which the more compounded Characters are constructed or contexted. These are the first kind of which there are but a very few. And I think those I have described in the 13th line of the Plate are all.

Two, three, four, or more of these joined together in a certain order and contexture (in the doing of which there is a great Regularity and order observed, which is not varied from, and all within the regular square space) I conceive do make Syllables or Primitive Radical Characters.

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each of which have a primitive single or distinct notion or
signification as well as found, which is made much use of
in the more compounded Characters or Words. Of this
kind I take the Figures of the Numbers to be: If at least
they are not single Letters like the way of expressing Num.
bers in the Hebrew Greek Arabick, &c, Languages, for though
there may be two or three of the single strokes joynd toge-
ther into a compound Character, it hinderers not, but that
it may still signify a Letter, as in the Greek Α.Α.Δ.Ι.Ρ.Τ. In
the Runick; where every Letter hath one upright line and
some other additional marks: In the Roman I.L.F.E.O.Q.V.
Y: Or it may signify a Syllable as in the Ethiopick, and in the
Hanscrot, and Sanscrit Languages and Characters: The first
of which being the Brackmans Character we find in P. Kir.
cher’s China Illustrata, described by P. Roth who studied it 7
Years; and the second (being a Literal Character ufed over
all India by the Merchants) I have seen in a Transcript,
brought lately out of India by a very Worthy Gentleman
who lived there many Years, and had the curiosity to cause
to be tranferibed and tranflated alfo into English, A Dic-
tionary of their Language in their own Character: who did
me the favour to let me perufe it.

In which Characters or ways of Writing a Vowel is al-
ways joynd with a Confonant into one compound Character
to make it effable. And then the single stroaks may be ta-
ken for single Ineffable Letters as are the Confonants, and
the Composition of two or three (of which one at leaft may
be a Vowel) will make Syllables.

Of this kind, there are not fo many in the whole Chinese
Character, but that it will be easy enough to affigne each a
proper Monasyllable which shall only have one or two Con-
fonants, and one or two Vowels: That is the Confonants
together and not separate, either both behind the Vowel or
Vowels, if it be a diphthong or both after it or them.
Of this kind, I understand there are about 500, probably 8x8x8, or 512. I could enumerate a great many, and give you also the name or words by which they are pronounced as also their signification, but (as I said before) first, I conceive the present Chinese Language to have no affinity at all with the Character, the true primitive, or first Language, or Pronunciation of it, having been lost. And secondly, I want some further help to make a full and compleat Discovery: what I have learnt from the Book of 萬 I shall give the next opportunity; which will explain the reason of the multiplication of 8, and the order and method of places in the Letter or word Square.

The third sort of Characters, is a decompounded sort being made up of two three or more of those of the second kind, diminish proportionably in their size, either as to their length, or breadth, or both, from what they have in the same Writing when they are single and fill up the whole Letter Square or Words Square. For there being several of them to be crowded together within the same Square, according as there are more in number, so they are always more squeezed together. In this Decompound sort, there is a Regular order observed in the placing of the several Characters of the 2d sort; there being some that are always on the Left side, some always on the Right, some at the top, some at the bottom. Of which I doubt not but that they have a certain Regular Method, which had we Dictionaries, explained would be easie enough to be Discovered.

This method alone of crowding together all the Characters (how many ever go to make up the decompound Character) into one square (which is of the same size for the most Simple and for the most Compound) seems to be the great Singularity, by which the Chinese Characters differ from those of all the rest of the World. And this I conceive has been the Reason why all People, and possibly even the very Chinese themselves have, and do believe it to be a Real and not a Literal Character: For if the Primitive Lan-
guage, or Pronunciation of the Characters be lost (as I conceive it is) and that the disposition, order, method, texture, or manner of placing the more Simple in the more Compounded Characters be also lost, forgotten, or not understood; then the whole Characters becomes a Real and not a Litteral Character: And an Immethodical one to such as want a method, that must be learnt by rote and depend wholly upon the strength of the Memory to retain it. But I conceive it might be at first either a Litteral Character, and so the whole square Character was composed of so many distinct Letters or Syllables, which composed the word signified thereby; And so there might be a regular order of placing these Letters in the Character. That is, that the whole square being divided into so many parts, there was a Rule which was the first 2d, 3d, and 4th place; so that there being placed in those the several Letters that made up the word, according to the order they had in the word, it was easy by that Rule to Decipher the said Character, and thence to finde the word and the Signification, As Regularly as if the Letters had been written one after another, as most other Litteral Characters we know are at this day written.

Or Secondly, it might be a Real Character consisting of divers Marks or Letters, that expressed so many simple Notions, several of which joyned together might make up the more compounded Characters, of which I have added some examples in the Plate which may be also made Litteral and Pronouncable, tho' that consideration were not made use of when they were first invented. What things I have Observed in my Chinese Books that seem to respect this method, I will give more particular of by the next opportunity, by Printing a Specimew of the Book Te-kim which explicat-ed by these Notions will I conceive appear more Intelligible, than by the accounts we find given of it by the Chinese commentators, and those that have translated them into Latine, who seem not to have understood the true design thereof: for both
both the Chinese and European Commentators affir it to be a Conjuring Book, or a Book to tell Fortunes by, and to be made use of by the Chinese for that purpose; whereas by the small Specimen I have seen of it, I conceive it to contain the whole Ground, Rule or Grammar, of their Character, Language and Philosophy, and that by the understanding of it, the Foundation and Rule of their Language and Character, may be without much difficulty Deciphered and Understood.

The present use of this Character, I conceive to be differing from what it was at first, both as to the position of Writing and Reading it, and as to the Expression and Pronunciation thereof.

For the way of Writing and Reading it, I conceive might at first be exactly the same with that of the Greeks, Romans, English, and all other European Nations, and also the Ethiopic and Coptick. That is, they began at the the top of the Page towards the left Hand, and so proceeded towards the right in the Horizontall Line to the end of it, and then began at the left end of the next line under the first and proceeded with that in the same manner, and so with the next under that and all the remaining. Continuing to Write the words of the line towards the right Hand, and the lines of the Page one under another till the whole Discourse were compleated, joyning leaf to leaf one under another, after the same manner as the Roules are at present Writ, and as the Volumina were of the Antients. And to make the parts of the Volume to be the more easily to be come at, without the trouble of Rouling and unrrouling as the Ancient Romans did, and we do with our Roules they contrived to fold them, like the folds of a Fan, forwards and backward: and so stitching them together, that the written sides might lye outwards, and open freely one from another, and the fair sides might meet together. It came to make the present form of their book, which being laid as we generally place our books before us, they seem to begin at the top of the page on the Right-hand, and to proceed to the bottom, and then at the top
top of the next line towards the Left-hand, and descend as in the former; proceeding in this order with all the rest, which way must needs be very inconvenient for writing, however they may use their Pencil differing from our Pen. Though there be a way of Writing, from the top to the bottom of the Page, which is very convenient for Writing the Syriack, as also for Writing Latine, English, or Greek where the Writing is to be used for cutting the stamps of Wood, or Graving of Copper Plates with the same Character for Printing, in which Cases the Letters must be written backwards.

Secondly, as to the Pronunciation of this Character, by the Court Language, or by any other now used, I conceive it to be wholly differing from that of a Litteral Character; that is from being pronounced or spoken according to the Marks or Figures thereof, whether they be simple or compounded and made up of Simple Characters (though there are some instances of affinity in Characters and Words.) The reason of which differing pronunciation I conceive may have proceeded, partly from the loss of the Primitive Language, for which it was made, partly from a most inconvenient affectation of Monosyllabical Words, in this Court Language, to help the poverty of which, they are fain to make one Syllable to signify many differing Notions, to do which they have introduced a kind of Musical toning or accenting of each of them, and that not single, but compound of two or three tones to each signification of every one of these Monosyllables: Partly from the using of this way of Writing, by divers Nations of Differing Languages, who minding only the Figure and Signification, Read it into their own Mother Tongues, as we in Europe do Arithmetical Figures: and partly, also from the omission of most Grammatical Distinctions, the same Character serving for Substantive and Adjective, Singular and Plural, in all Cases, (save only they have some Characters for Particles as of and to in English) for the Verb in all Tenses, and numbers, &c.
for the Abstract and the concrete Signification, and for
divers Metaphorical; if at least the Interpretation I have
met with in the Books I have perused be exact: Partly,
also from the Syntax of them, it being necessary to con-
sider the whole Sentence to Discover which Part of
Speech each Character is of, in that Sentence, wherein the
order and positions of the Characters to one another, for
which they have Rules, hath its Signification: And lastly,
from the loss of the very Notion of a Literal Character,
whence for the Expressing of Proper Names, they are fain
to make use of several Characters, whose sounds or words
come nearest to the sounds of the Syllables of that Name,
as in the Plate tan_joy van. for Adam_joyan.

Now, though I conceive this Character is not Effable
properly as a Literal Character by any of their present Lan-
guages; And though possibly it might be at first a Real
Character, that is each of them compounded of such strokes
or marks as by their Figures Positions and Numbers in the
Square, denoted the several Philosophical Ingredients, that
made up the Notion of the whole Character, as the book
Ye Kim seems to shew by giving Rules as I conceive for the
Order and Significancy of places in the Square, &c. Yet I think
it not difficult to make it a Litteral or at least a Syllabical
Character, and Legible into a Language somewhat after the
manner of the Universal Character I mention'd before. And
tho' this would not be the Primitive Language for which it
was made, yet for the present uses of it (the chiefest of
which is the assisting and refreshing the memory, and helping
the imagination by proper sounds) it might be as good:
wherein the single Characters might be Monosyllables and
the compounded disyllables trisyllables, &c. According to
the Number and Order of Simple Characters in the Square
of the Compounded. And I am apt to think that the pre-
sent pronunciation of Languages, as of Hebrew Syriack
Arabic Greek and Latine or any other Language that has been
fo long written, may be as much differing from what it was 2000 Years since, as an Arbitrary one now invented, and grounded on the Letters, might possibly be. And such an Arbitrary pronunciation if generally agreed upon might serve As well for a help to learn the Signification of words, or Word Combinations of Characters, as if we now knew the exact Primitive Pronounciations, as Critically as the Masorethes are said to have done that of the Hebrew; and possibly also Much Better, for that by such a one a great many Irregularities and Difficulties of Pronunciation (which are to be found in all Languages now spoken) might be omitted, and the whole made exactly Regular and easy, as might be shown in the Hebrew and Greek, and especially in the Arabick, whose difficulties are sufficiently manifested by Alphabetum Arabicurn, Printed at Rome 1592. Now as by such a Language the Character might be made Effable without Musical Tones or Difficult Aspirations, so had we Dictionaries of the Signification of the Characters, we might as soon learn the Chinese Character, as we can Latine, or any other Language to be Learnt by Book, and not by Speaking.

IMPRIMATUR,

John Hoskyns Vice P. R. S.
July 17th 1686.

Printed by J. Streeter, and are to be sold by Sam. Smith at the Sign of the Prince's Arms in St. Paul's Churchyard.
Ob dé quattuor Interiorum Satellitum Saturni cum Anse omnium maxime diducet conspicitur.
Satellitum Saturni diductae conspiciuntur

Fig. 3
PHILOSOPHICAL
TRANSACTIONS

May the 25th. 1686.

THE CONTENTS.

1. An Account of an Engine that Consumes Smoak, shown lately at St. Germans Fair in Paris; Communicated by Mr. Justell. R.S.S. 2. An Extract of the Journals des Scevans of April. 22st. N. 1686, giving an account of two new Satellites of Saturn, discovered lately by Mr. Caffini, at the Royal Observatory at Paris. 3. Two Astronomical Observations of the Eclipses of the Planet Jupiter by the Moon, in March and April last, made at London. 4. A Discourse on the Problem, why bodies dissolved in Menstrua specifically lighter than themselves swim therein, by Mr. Will. Molineux, of Dublin R. S. S. with some Reflections thereon by Mr. T. M. 5. A Letter from Dr. Sigismond Konig, Physician of Bern in Switzerland, to the R. Society, being a continuation of the History of his Patient Margaret Lower; whereof an account is given in the third Philosophical Collection, of Decemb. 10. 1681. 6. A Discourse of the Rule of the decrease of the height of the Mercury in the Barometer, according as places are elevated above the surface of the Earth, with an attempt to discover the true reason of the Rising and Falling of the Mercury upon change of Weather. Accounts of Books. 1. A free enquiry into the Vulgarly received notion of Nature, by the Honourable R. Boyle Esq; Printed by J. Taylor at the Globe in St. Pauls Church-Yard. A. 1686. in Octavo. 2. Traite du Mouvement des eaux, & des autres Corps fluides par feu Mr. Mariotte. A Paris, Anno 1686. in Octavo.
To burn all sorts of Wood in the middle of a Room without making any Smoak, is a thing so extraordinary, that all those that have heard of it, as well Philosophers as others, have asserted it impossible: but Mr. Dalme Engineer, professing his discoveries, has found out a Machine, which tho very little and portable, consumes all the Smoak of all sorts of Wood whatsoever, and that so, that the most curious eye cannot discover it in the Room, nor the nose smell it, although the Fire be perfectly open. This has given such satisfaction to all that have seen it, and to the King himself, that he has caused the Experiment to be made several times before him.

This Engine is made after the manner represented in Fig. 1, and is composed of several hoops of hammer’d Iron of about 4 or 5 inches diameter, which shut one into the other: It stands upright in the middle of the Room, upon a sort of Trench made on purpose. A is the place where the Fire is made, where if you put little pieces of Wood, it will not make the least Smoak, neither at A nor B, over which you cannot hold your hand within half a foot, there comes out so great a heat, that if you take one of these pieces of Wood, out of the Fire at A, it smoaks presently, but ceases immediately so soon as it is cast in the Fire again. The most fatid things, as is a Coal-keet in Cats-pjfs, which sinks abominably when taken out of the Fire, notwithstanding in this Engine makes not the least ill scent. The same did Red-Herrings brailed thereon; on the other side all perfumes are lost in it, and Incense makes no smell at all, when burnt therein. We have since learnt, that this is not shewn, but when the Fire at A is well kindled, and the Tunnel B D very hot, so that the Air that feeds the Fire cannot come that way, but must all pass in upon the open Fire, whereby the Smoak and Flame is all forced inwards, and must pass through the heap of burning Coals in the Furnace, A, in which passage the parts thereof are so dispersed and refined, that they become inoffensive both to the Eye and Nose.

The Variety of wonderful Discoveries, which have been made this Century in the Heavens, since the invention of the Telescope, and the great Utility that may possibly be drawn therefrom, for perfecting natural Knowledge, and the Arts necessary to the Commerce and Society of Mankind, has incited Astronomers more strictly to Examine, if there were not yet something considerable, that had not been hitherto perceived.

The diligence of those that have gone before, having left only the most difficult and obscure Objects to discover, these Satellites of Saturn which are eminently so, by reason of their Smallness and great Distance from the Sun and Earth, have fallen to the share of Sign. Cassini; who being furnished with Telescopes of an extraordinary length and goodness, has been able to see deeper into the Heavens, than those that have hitherto attempted. Mr. Hugens indeed found out one of them, viz. the fourth and biggest about thirty Years since, and made out the Theory of the Ring or Anse of Saturn till then unknown; but it seems there remained yet four others to discover. The middlemost and outermost, or third and fifth Sign. Cassini discovered in the years 1671, 72 and 73, an account whereof is to be seen at large in Number 92 of these Transactions; the two innermost were reserved to this present time for the same Observer, having now lately gotten yet better Telescopes. The account he gives of these Discoveries is as follows.

The
The Distance and Period of the first Satellite.

The first or innermost Satellite of Saturn, by the Observations hitherto made, is never distant from his Ring, above two thirds of the apparent length of the same Ring, which we take for the measure of the distances of these Satellites: and it makes one Revolution about him, in one day, 21 hours and 19 minutes. Wherefore in less than two days it makes two Conjunctions with Saturn, the one in the upper part of his Orbe, and the other in the lower part; and the Ring taking up the greatest part of the Diameter of the Circle, wherein this Satellite makes its Revolution, these Conjunctions are of a long continuance, in respect of the whole Revolution, it being 8 hours and half in passing the length of the Ring, which at present hides it every day for so long time; and longer too, because it is very hard to be distinguished, when it is very near the Ring.

This happens particularly for these two or three years, when the Position of the Ring, in respect of the Earth, being very Oblique, it appears very narrow; and the Circle of this Satellite's Orb being nearly in the same plain with it, they appear very close together. In the following years when the Ring and the Orbs of these Satellites shall be more open, there will be a greater distance in Latitude between this Satellite and the Ring, and it may be seen both above and below the Angle, which at present cannot be.

These Conjunctions of so long duration happening often at the times most proper to observe Saturn, have frequently hindered the seeing of this Satellite; and particularly before we had found the Rules of its Motion, so as to be able to prepare to observe it, at the times when it was far from its Conjunction. And seeing one Conjunction begins 14 hours after another is finished, and that each lasts 8 hours and half; whenever we hapned to observe after the beginning of a Conjunction, and continued the following days to observe about
about the same hour, there would be 9 or 10 days wherein this Satellite could not at all be seen, for this only reason: and if the course of the Observations were interrupted by ill Weather or any other cause, it has been above 20 or 22 dayes before it could be seen again: So it hapned soon after the first discovery thereof, the which has for this cause been incomparably more difficult to make, than any other hitherto made.

The Distance and Period of the second Satellite.

The second or penintime Satellite of Saturn, according to the Observations hitherto made, is but three quarters of the length of his Ring distant therefrom, and makes his Revolution about him in 2 days, 17 hours and 43 minutes.

There seldom passes a day wherein it is not joyned to Saturn, either in the upper or lower part of its Orb. The Conjunctions or times wherein it passes the whole length of the Ring, last 8 hours; and 25 hours after one ends another begins. By reason that at first it could not be distinguished, when it was not at a good distance from the Ring, and before we had found out the Rules of its Motion, to foresee the times proper to observe it, we were several days without seeing it. Afterwards it was discovered one day to the Eastward, the next day to the Westward, and the third or fourth day at the same hour, it was again in Conjunction with Saturn: and so because the first for several days together could not be seen at the same hour, it often hapned that neither the one nor the other was Visible, and when one began to appear, it was uncertain which of the two it was, both of them shewing themselves alternately, on day on the East side, and the next day on the West side.

This distinction was still more difficult, for that the difference of their Elongations is so little, that for the most part the second Satellite is found within the limits of the Elong-
longations of the first, which likewise made it hard to determine their Degressions. It was not without a great number of choise Observations, that it was concluded that the proportion of the digression of the second, to that of the first, counting both from the Center of Saturn, is as 22 to 17.

The Rule of the Proportion, that is between the Distan

ces and the times of their Periods.

The time wherein the second Satellite makes its Revolution, is to the time wherein the first makes its, is as 24\frac{1}{2} to 17, which is a greater Proportion by half a Degree than that of the Distances, viz. 22 to 17. This is that very same Proportion which Kepler observs, between the Distances & Periods of the primary Planets, and which we have found between the other Satellites of Saturn, upon our former discovery, and is verified in the Satellites of Jupiter. There is nothing that better shews the admirable Harmony of the particular Systems, with the great Systeme of the World.

The Number of the Conjunctions, of these Satellites with Saturn.

Of all the Satellites that are, there are no two so near placed to their primary Planet, as these two Satellites of Saturn, and which taken both together make so great a number of Conjunctions with their Planet in the same space of time; for there are in all no less than 653 in a year, whereas the two first Satellites of Jupiter make, one with another, but 617; the first of Saturn's, makes its Revolution in 3 hours longer time than the first of Jupiters, but Saturn's second has its Period 9 hours and half shorter than Jupiter's second Satellite.
The Glasses used to make these Discoveries.

The Distance of these two Planets, which is almost Infinite in respect of their Magnitude, had kept them yet much longer concealed, if we had not for this purpose made use of Glasses of extraordinary Force. They were first of all seen in March Anno 1684, by two excellent Object Glasses of 100 and 136 feet, and afterwards by two others of 90 and 70 feet, all made by Sigr. Campani and sent from Rome to the Royal Observatory by the Kings order, after the discovery of the third and first Satellites, which had been made by others of his Glasses of 47 and 34 feet. We made use of them without Tubes, by a more simple contrivance than those proposed either before or since. We have since seen all these Satellites with that of 34 feet, and continued to observe them with Glasses of Mr. Borelli of 40 and 70 feet, and by those which Mr. Arrouquel hath lately made, of 80, 155 and 220 feet. It was easy for us to see these two Satellites by these different sorts of Glasses, after having found the Rules of their Motion, whereby we might with more particular attention look upon the places where they ought to be.

We placed these great Glasses sometimes upon the Observatory, sometimes upon great Masts, sometimes upon the Tower of Wood, which his Majesty has caused to be brought for this purpose from Marly, upon the Terras of the Observatory. Lastly we put them in a Tube raised upon a support made like a Ladder with three leggs, which had all the success we desired.

After having distinguished these 2 Satellites from the first Stars, from the other Satellites of Saturn, and from each other, and found the periods of their Motion, we have established Epochs from Observations, as near as we could to the Conjunctions.
Radices or Epochæ of their Motions.

The first Satellite was observed 45 degrees distant from its Perigee, moving towards the West, March 11th 1686 ft N. at 10 h. 40 min. at night, and returned to the same position on the 14th. of April at the same hour.

The second was 36 degrees distant from the Perigee to the West, the 30th of March 1686 ft. N. at 8 of the clock in the evening.

A Comparison of the Revolutions of Saturns Satellites with Jupiters.

It were too much at this time, to give all we have observed of the other Satellites, but we cannot miss comparing the Periods of the Satellites of Saturn with those of Jupiter, after the following manner, by which it appears that the Satellites of Saturn in the same order, perform their Revolutions in less time, than those of Jupiter, that answer to them; except the first, as may be seen in this Table.

<table>
<thead>
<tr>
<th>Day</th>
<th>Hour</th>
<th>Min.</th>
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<tr>
<td>The first Satellite of Jupiter revolves in</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>The first Satellite of Saturn in</td>
<td>1</td>
<td>21</td>
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<tr>
<td>The second of Saturn in</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>The second of Jupiter in</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>The third of Saturn in</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>The third of Jupiter in</td>
<td>7</td>
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<td>The fourth of Saturn in</td>
<td>15</td>
<td>23</td>
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<tr>
<td>The fourth of Jupiter in</td>
<td>16</td>
<td>18</td>
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<tr>
<td>The fifth of Saturn in</td>
<td>79</td>
<td>21</td>
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There are the particulars of the Discovery, whereby the admirable Analogy and Uniformity of the parts of the Universe are most evident, and the Infinite Wisdom and Power of the Creator is demonstrated to the Contemplative. In the Conclusion, the Discoverer considers that the Ancient Astronomers, having translated the Names of their Heroes among the Stars, those Names have continued down to us unchanged, notwithstanding the endeavour of following Ages to alter them; and that Galileo, after their Example, had honoured the House of the Medici with the discovery of the Satellites of Jupiter, made by him under the Protection of Cosmus II; which Stars will be always known by the Name of Sidera Medicea. Wherefore he concludes that the Satellites of Saturn, being much more exalted and more difficult to discover, are not unworthy to bear the Name of Louis le Grand, under whose Reign and in whole Observatory the same have been detected, which therefore he calls Sidera Lodoicea, not doubting but to have perpetuated the Name of that King, by a Monument much more lasting than those of Brass and Marble, which shall be erected to his Memory.

In our Figure we have omitted the Orbe of the outer Satellite, that to the rest might not be crowded, but its distance to that of Hugenius's, is as Cube Root of 2.5 or 2.925 to 1.

Two Astronomical Observations of the Eclipses of the Planet Jupiter, by the Moon in March and April last, made at London.

The Lipfick Ephemerides of Mr. Godfrid Kirck, giving notice of these Occultations, they were thought of too great consequence to be neglected, if the weather proved fair. The first hapned March 31st. at night, and was attended with a most Serene Sky, no Clouds any where appearing, wherefore Mr. Hook and E. Halley undertook the Observation in Gresham
Grejham Colledge, which succeeded as follows. Having taken some good Notes for the rectifying the Pendulum Clock, they expected the rising of the Moon, so much the rather, for that it was doubtful, whether the Planet would be eclipsed at the Rising or no, for tho' Kirk's Ephemerides made the Immer-

sion at 9 h. 46 m. at Lipfick; that is at London 8 h. 54 m. yet his Jupiter's place being 13 m. too low, it was plain that the Occultation would be very near the Horizon of London. Accordingly at 9 h. 26 m. the under Limb of the Moon, was just risen over Shooters Hill, and soon after Jupiter appeared near the Eastern Limb of the Moon, within a few Minutes of being eclipsed.

9 h. 33 m. As near as could be guessed, was the Time of the central Immerison, which was very difficult to be ob-

served, by reason of the Asperity of the Moons Limb, which undulated and sparcled very much, as it appeared through the Vapours near the Horizon, so that the contact of the Limbs could with no certainty be determined: The Ingrel's happened much about the length of the Spot, called by He-

velius palus Mareotis, to the North of the said Spot, or about the 124th. Degree of the outer Limb of his Selenography, nearly in the same Latitude with the Moons Center.

10 h. 30 m. The Western Edg of Jupiter began to emerg out of the dark Limb of the Moon.

10 h. 31 m. 20 s. The whole disk of Jupiter was entire, so that he was about a minute and a third in coming out from behind the Moon, whereby the Diameter of this Planet may be determined.

The Emerison was exactly in a right Line with the Moons Center, and the Northern Part of Palus Maroeotis, or about the 324th degree of the inner Limb of the Selenogra-

phick Table of Hevelius.

The other Occultation hapned May the 28th. Mane, or Astronomically, the 27th after mid-night; the preceding Night was cloudy dark Weather; so that there was no enc-

ouragement to set up for it; however by good hap, both
Immerfion and Emerson were observed.

The Immersion was seen at Totteridge (which place is about 9 Miles from London, and nearly 25 seconds of time to the Westwards thereof) by Mr. Edward Haines, a Member of the R. Society, well versed in this sort of Observation: who between a gap of the Clouds observed the Contact of the Moon's limb and Jupiter's, at 15h. 3½ min. the Clouds closing again permitted him to observe no more; however, from this we may conclude the Central Immersion at London, to have been 15h. 4½ min.

The Emerson was observed at London by E. Halley, to fall out at 15h. 49 min; for at 15h. 50 min. Jupiter was all out, and the limbs so little separated, that he judged, that a minute before, the center of Jupiter had been upon the Moon's edg: The point of the Emerson was over against the Southern part of the spot, called by Hevelius Insula Macro, or at the 342d division of the inner limb of his Map of the Moon.

What has been observed of these two Occultations elsewhere, would be very acceptable to the R. Society; such sort of Observations, if accurate, being of singular use to determine the Longitudes of Places, especially those that are far remote; for which purpose all Curious Persons furnished with Instruments and Skill in Astronomical matters, are desired to let slip none of these opportunityes, which may be of so great benefit to Geography.
A Discourse on this PROBLEM;

Why Bodies dissolved in Menstrua Specifically lighter than themselves, swim therein.

By Mr. WILLIAM MOLYNEUX, of Dublin. Member of the Royal Society.

The Liberty of Philosophing being now universally

Granted between all men, I am sure that a difference
in Opinion will be no breach of affection between two entirely Loveing Brothers: And therefore I shall take the freedom to Propose my Own thoughts in a matter wherein my Brother Mr. Thomas Molyneux hath Appeard publickly in the

Novelles de la Republique des Lettres, Mois d' Aout 1684. Art 4. and Mois de Janvier 1685. Art 7. The Problem proposed is, Why Bodies dissolv'd float in Liquors lighter than themselves; as for Example: Mercury dissolv'd in strong Spirit of Niter swims therein, tho' each small Particle of Mercury, be far heayyer than 10 much of the Liquor whose place it occupies. This, says he, cannot be solv'd by the prime Law of Hydrostaticks, which is, that a Body which in an equal Quantity is heayvyer then a like quantity of Liquor, sinks in that Liquor; thus a Cubick Inch of Iron being heayvier then a Cubick Inch of Aqua-Fortis, and each Particle (how small soever) of Iron being heayvier then a like Particle of Aqua-Fortis; Iron being put into Aqua-Fortis should sink, and yet we find, that Iron being dissolv'd in a convenient Quantity of Aqua-Fortis floats therein, and does not fall to the Bottom. The Reason which my Brother gives for this is, that the Internal Motion of the Parts of the Liquor, does keep up the Particles of the dissolv'd Solid, for they being
so very Minute, are Movable by the leaft Force imaginable, and the Action of the Particles of the *Menstrum*, is sufficient to drive the Atomes of the dissolved solid Body from place to place; and consequently, notwithstanding their Gravity, they do not sink in the Liquor lighter than themselves. As a Proof of this in the 7th. Article of Janvier 1685; he offers an Experiment known in Chymistry, that a *Menstrum* over a digesting Fire (as the Chymist speaks) will dissolve a greater Quantity of a Body put into it, than when it is off the Fire, and if it be taken off the Fire, and suffered to cool, a great Portion will precipitate of that which was perfectly dissolved, whilst the *Menstrum* continued hot. For, says he, the Particles of the *Menstrum* acquire a more violent agitation by the Fire, and are therefore able to raise and keep up a greater Quantity of the dissolved Body, or hereby they are able to Resist a greater Gravity.

It has been objected against this Notion, that the common Experiment of precipitation, by mixing an *Alkaly* with an *Acid* seems to contradict this; for thereby the Fluidity of the *Menstrum* is not taken away, and consequently, the internal Agitation of its Parts is not diminished, and yet thereupon, the Particles of the dissolved Body precipitate all to the Bottom. To this he answers in the forecited Article of January, that all Mixtures of different Liquors introduce in each a different Conformation of Pores, and therefore the Infusion of a new Liquor, drives the insensible Parts of the dissolved Body from their Places, and forces them to strike against each other, and cling together, and so becoming more big and heavyer than formerly, the internal Agitation of the Liquor is no longer able to move and sustain them, and consequently they fall to the Bottom.

This, as fairly and shortly as I can propose it, is his Sentiment of this Phenomenon.
But I conceive, an other Account may be given of this Appearance, and that the foresaid Law of Hydrostaticks is a little deficient. Tis true indeed, if we consider only the specific Gravity of a Liquor, and the specific Gravity of a solid Particle floating therein, the forementioned Rule is exact; but in sinking there is requisite a separation of the Parts of the Liquor by the sinking Body; and there being a natural Inclination in the Parts of all Liquors to Union arising from an Agreement or Congruity of their Parts, there is a resistance therein to any thing that separates this Conjunction: Now unless a Body have weight enough to overcome this Congruity or Union of Parts, such a Body will float in a Liquor specifically lighter then it self. But that a heavy Body, as Mercury or Iron may have its Parts reduced to that Minuteness, that their Gravity or Tendency downwards, is not strong enough to separate the Cohesion or Union of the Parts of a Liquor, will be manifest, if we consider, that the Resistance made by the Medium to a falling Body, is according to the Superficies of the Body; but as the Body decreases in Bulk, its Superficies does not proportionably decrease, thus a Sphere of an Inch Diameter, has not eight times less Superficies than a Sphere of two Inches Diameter, tho' it have eight times less Bulk, and consequently passing through a Medium, as suppose Air or Water, the Sphere of an Inch Diameter is, proportionably to its Bulk, more resisted, than a Sphere of two Inches Diameter in proportion to its Bulk, and hence it will come to pass, that at last a Body may be reduced to that Minuteness, that its Gravity pressing downwards (which is according to its Bulk) may be less than the resistance of the Medium, which operates on the Surface of the Body; seeing as I sayd before, the Superficies of Bodys do not decrease so fast as their Bulks, these decreasing in a Triplicate, but those in a Duplicate Ratio of the Bodies Diameters.

This Account does not at all oppose the Experiment of a Menstruum over the Fire, being able to dissolve or sustain
a greater Quantity of a heavy Body; for the Reason of this, as ’tis given by my Brother, does not Contradict my Notion. The Account likewise, that he gives of Chymical Precipitation agrees very well with what I propose: So that of these I shall say no more.

But because in the beginning of my Discourse, I say that the forementioned Law of Hydrostaticks is a little defective, I desire to explain myself a little further in that Point. In Weights falling through the Air, were Gravity only consider'd, the Proportions of their Descents would be exactly as Galileo has Demonstrated; but it is allow'd by all, that the Resistance of the Air, not being consider'd in those Demonstrations, they are not Mathematically true in Practice, but that Really there is something of that Proportion hindered by the Air's Resistance. Now, what is this less than to say, that the Resistance of the Air takes off some of the Operation of Gravity, or is able to withstand or oppose part of its Action? And if so, what shall we say were an Iron Sphere let through a Medium of Water? Surely the Proportions of its descents would be much more disturbed herein, as Water is much more Solid and difficult to be separated or passed through than Air, and consequently we must needs Grant, that more of the Operation of Gravity, is taken off or Resisted by this Opposition of the Water, than that of the Air. And if so, Surely there may be a certain degree of Gravity, that may be quite taken off by the Resistance of the Water: Were a Pistol Bullet let fall through the Air, it would Descend imperceptibly nigh the Proportions that Galileo has assigned, but were a single grain of Sand so let fall, it would be much hindered in its Course, and the half of this Grain would be more obstructed; what shall we then say of the ten thousandth part, or of a part the ten thousand millionth of this, and again of the Infinite Subdivisions of that, till at last we come to a part that would be wholly resisted, or kept up; such
such as I conceive the Minute particles of a Body dissolved in a Menstruum.

On this account 'tis I say, that the forementioned Principle of Hydrostaticks is a little defective; for it considers not the Natural Congruity of the Parts of a Liquor, whereby they desire, as 't were, to unite and keep together, just as we see two Drops of Water on a Dry Board being brought together do jump and Coalesce, and therefore Liquors have an innate power of Resisting a certain degree of force that would separate them; such as I suppose the degree of Gravity, in the most Minute Particles of a Body dissolved in a Menstruum.

The forementioned Rule holds true to the most nice Sense in Great Bodys, but in those that are by many Millions of Divisions Smaller, it seems to fails.

This in short is my Conjecture in this matter, which I propose, as my Brother did his, with all submission imaginable, and thereby to give occasion to others to enquire into the Causes of this appearance, rather then to publish my own sentiments as the undoubted solution thereof.

But this I must acknowledg, that the Internall motion of the parts of a Liquor seems so very agreeable to truth, and explicates so many Phenomena easily and plainly, that I would not be thought to deny it. Neither would I be thought wholly to Reject my Brothers solution of this Problem; for certainly that Motion (what soever it is) in a Menstruum, which is able to Dissolve such a solid Body as Iron, that is, which is able to disturb the close and strong Cohe- sion of the Parts of Iron, may very well be suppos'd sufficient to disturb or keep up these parts from resting in the Bottom of the Vessell, wherein the solution was made; And certainly no better account can possibly be given of such solutions, than by supposing such an Internall motion in the Parts of the Menstruum infinuating themselves into the solid body, and loofening its Parts. And tho' it may be object-ed, that in the Parts of Water there may be suppos'd as Viol-
lent an Internall motion, as in the Parts of *Aqua-Fortis*, and yet we see Water will not dissolve Iron, as *Aqua-Fortis* does, and Common Bees-Wax is disturbed by neither of them, I leave the Nice enquiry after this point to others, *viz.*, What kind of Motion and peculiar Conformation of parts is requisite both in the *Menstruum* and in the Dissolved Body, that a solution may result from their Commixture.

**Some Reflections on the foregoing Paper by Mr. T. M.**

What my Brother has laid down in this Discourse, I think does most undeniably evince that the received Law of *Hydrostaticks* is somewhat defective. For Liquors, tho’ they are Fluid yet they are Bodys, and therefore consist of parts united; which Union tho’ it be easily destroy’d, yet of necessity it requires some degree of Force for the effecting it; nor is it more manifest, if rightly considered, that a Flint requires Force for the separation of its parts, than that Fluids do for theirs. But however, I imagine, this Property ought not to be rely’d upon as the sole Cause of this Appearance, to which my Brother has apply’d it; nay perhaps does not so much as concur the least in the producing this effect; my Reason in short is this: whatever is of sufficient Power to raise the minute Particles of a *Heavy Body* in a light Fluid, is certainly a sufficient cause to keep them in that state: now my Supposition may give some account of this, what my Brother says, never can; for he must necessarily suppose them first raised; and then he gives the reason of their not sinking: Whereas ’tis not to be questioned but that that Force which raised them, is the same that keeps them from falling to the bottom.

But these Conjectures (for I esteeme them no more) I leave to the Consideration of those that desire to enquire further into this Matter.
A Letter of Dr. Sigismond Konig, Phyftian of Bern in Switzerland, to the Royal Society, being a continuation of the History of his Patient Margaret Lower; an Account whereof is given in the third Philosophical Collection, of December 10th. 1681.

Ilustres Nobilissimi doctissimiq; Viri.

Acito temporagressu diffugiunt, nullos; sono Annus vertitur, vite emblematam quibus mensuramur, incitamurq; ea, qua aliquos boni esse possunt, ne sero suspendamus: moti unde, licet aedus immaturum fructum decerpere, Historiamq; de petrificata nostra, (cujus obitum inane expectavimus) continuare, quam occultare malluimus; ne aut Phenomini haecennis nihil contingisse, aut non observasse putemur. Videmus enim hinc et inde Historiam istam grate acceptam, varijs prælis mandatam, sed non equaliter ad sensum verborum transitam vel examinatam esse; plurimosq; doctos hoc, et si paucas, ob casus infrequentiam, admirari, progressum monere, quosdam vero ad sortilegia, vel inter istas species referre, quæ fidem occultam; fallant: Assentierer forsuan, nisi summus naturæ Author in hac prins imperescutabilis sapis recluderebrig; physicisq; scrutinio ad redundantem Nominis sui Gloriam rimanda concederet: In hoc dum laboramus Clarissimorum Virorum desiderium nos non impeturos, sed favorem excitaturos speramus.

Ab eo quo Historiam secunda Calendarum Octobris Anni Seculi octogesi primi pertexit, agra nostra moderate vixit; satq; bene; naturæ functionibus (ut ante relatum) in excipiendis & exercendis occupatis, ad decimam octavan Anni octogesimi secuni-
di mensis Augusti, qua torqueri, nauseâ, et singultu alsi; tamen vomitu, agitari capit: dato cardiaeco cum spiritu nitri dulci ad vigesimam nonam dicti mensis cesserunt symptomata: hac vero superioris & inferioris ventris cruciatibus summis angii, in latera volvi, respiratione impediri, Hysterico Paroxysmo infestari, cum ruâbus, cordis palpitatione & oscitatione visa; Occurrebatur Anodynis & Antispasmodicis (omnia hysteribus, quorum usum aegra ob intestinalis motus inversionem valde, horrebat.) succedebant expansiones & jactationes artuum, motus convulsivi totius abdominis, constrictio musculorum laryngis & fasciæ cum Aphonía, tandem; parturientis dolor sibi alto se dictans, quo contræs omnibus membriis, alvo dejectus insequenti, trigesima, calculum Fig. tertiae cruore conpersum, cujus emitum sequens altera die rario minores longe, cum hemorrhoidali fluxu, dilaceratis vasibus: posthaec infar puerpera habita, jaàculis restaurata, remedii sublevata convuluit, intraq; septimanae paucas, resoluta jam quasi natura, ad actiones obuendas vires collegit.

Hec rerum tristis facies & vicissitudo, hic aegra status, ab ultimis prateritorum tolerabilior, in dolorificum versus: Calculi non tantum majoris ponderis sed & durioris substantiae, valdeq; angulos, nec singulis digestionibus, sed velut in quadam matrice maturecentes abrupti pelluntur, tertia quarta se septimana inferne nec ulterius superne excluduntur: Abous prius libera demum adstringi incipit, & una alterave a constrictione die lapidem parturit: Urinam e vesica reddit paucam, potui in quantitate non respondentem, variam, pluralium crassam & turbidam, quae raro supprimitur, suppressam emingendo antecedat calculus fabe magnitudine majoris, angulosus, cateris; per omnia similis: Et quod antebac per intervalla, num quotidie contingit, mane dum urinandi motus urget, quantitate aliqua fluente per vesicam prius, nullo vel exiguo intervallo, altera vomitu decedit ad uncias tres vel quatuor, exsudationem coloris, consistentia, odoris urinosis; & ex agra relatione, multis fara cum nausea, saporis; quæcunque claribus in spagyrico examine apparuere. Timet abdomen nec solum ut ante in sinistro hypochondrio durities, lapidum; allidentium sonitus, sed in tota ventris aëstra regione aliquando profundius ob musculorum laxitatem sentitur, magnumq; dolorum circa hypogastrum queritur. Appetit cibum

N
ve modo, qui ex radice Glycyrrhizae graminis & hordei usus est, perq; vices aliquid vini tenuioris conceditur. Dormiendo subsultat: Fluunt mensae rarius & parcius nec tamen desintant: Pulsum habet & languidum, & celerem, & profundum, & interceptum, pro variis symptomatibus variantem: Respiratio liberior, non valida sed sensu vix perceptibilis: Menteq; plus nunquam movetur: Tandem duodecima Decembri Anni ultimo elapsi, til i dextra Gan- grana ad palma latitudinem correpta, scarificatione caterisq; necessariis curata, nunc Angina notha, ob tonsurarum inflammationem: premitur, plurimumq; arteriosi sanguinis e faucibus fluitt, majoris forsan excernendi lapidis prodromus: revulsionem per phlebotomiam in pede & clysma tentatam secuta fuit, vigesima Februarii, de- jectio facum naturalium per inferiora; vigesima tertia vero & de- jectio faculent & reiectio per fauces oleos & clysmanis substantia, cum setore absq; lapillis, unde imminens suffocationis metus abi- nere jussit.

Hic Casus rarus & mirus varia ingenia suscitavit: Naturam enim fortilegia abhorreare cujusque; Philosophi sententia est; ipsam vero a limite & communi experimenta in agra nostra plu- rimum recessisse, si quis antebac proposita Phanomena in dubium vocavit, nunc specimina credat: Majorum siquidem morborum arguentum existit gravium symptomatum consursum, quae seorsim sumpta, etr explicata singula leviora videantur, jencta vero ob motus varietatem ardue pugnant.

Calculos in humano corpore, ad Macrocsmi leges, ex principiis activis, vinculo salino, cum matrice terra & phlegmate, diversomode concrecere docet Analysis; Inq; glandulosis partibus corporisq; ductibus generari nihil ignoti, quod gravissimi Authores testantur, sa- fraq; observatione constat, prater renum vesicaq; calculos, anno seculi septuagesimo septimo, Catarin: Scertenleib pueullam, excre- tis tussiendo plurimus lapillis tophaceis, in Nosocomio nostro Physi occubuisse; E contra Sábulö multaq; pituita gypsea in intestinis concreta varie dejecta, Catarinam Blaferam Anno octogesimo in eodem hospitio integre restitutam esse; Virum Ampl. D. Joh.W. majoris Senatorii ordinis, arthriticum mense Julio Anni octogesi- mi tertii, utroq; uretere calculis obstruöto, ab impedita mitio, dicera
decima & septima morbi die, non juvantibus variis seris vacuatio-
nibus, Phlebotomis & Lithoutripticis, Apoplexia obijisse; quos
lapides, alterius longe a nostra aerote substantiae, nulloq; acido spi-
ritu ob oleosam impragnationem solubiles, extraxi; Ren sinifter natu-
rali duplo, dexter vero triplo major, dilatatis tunici, multo sero
tumide scatebant, plurimis obherentibus lapillis ruffis, esperis, cum
ex ureretibus seuti essent apice rotundo, forsan levigato in ductu,
& forma glandis quercus minoris: Nuperisq; e tensillis pulleae
Maris Haffneriae ad triginta duo tophos secuit Civitatis hujus
Chirurgus expertissimus D. Albertus Baurenkoningius: Insuper
a Clarissimo vesiero Dn. Doctore Sclareo Historiam communicata
de calculis felleis rare magnitudinis pro angustia ductus cholido-
chj: Et alia filij Ebræi cuiusdam undecem Amorum Weinhemii
in Palatinatu degentis, lapillos diversi generis, immo silices, per
virgam anumq; externentis, ab Urbis Heidelbergæ Secretario
Cl. D. Zweifelio mihi perscripta.

Verum cum similia visu, resipfa plurimum dissimilia sint; ut
Naturæ Cariofis obiectationem aliquam, generiq; humano solatii-
um fructumve praetemus, accuratissiq; loquamur, Physico exami-
ni calculos hocce subjecimus.

1. Solvendo: Sic spiritus Sulphuris, Vitrioli, Acetiq; assus,
aliquem effusus, aliquem effervescendi motum incipit, imprimis in ijs qui ven-
triculo excreti, rarioris texture, friabiliorisq; substantiæ sunt;
secutius, acidis suis particularis inflexos poros ingressis, subsistit,
nullamq; solutionem perficit.
Salis Armoniaci Spiritus ne quicquam movet, & omni modo ten-
tatus, veluti homogenius subiecto suo, conquiescit.
Sed Nitrofus Achilles cum ida desfruendo subegit.

2. Distillando per retortam: Oesophago excreti Salis Vo-
latilis cum spiritu & Phlegmate paucum, terra plurimum, Salis-
que fixi fere nihil; Postiores alvo redditi, cum ijs ex vesica
ejusdem figure & substantiae, plus Volatilis, cum paucum ad gustum
subacio phlegmate, sed spiritu urinofo forti, modicum fixi salis ac
plurimum terræ habebant. Calculorum horum uncinæ ex exhibe-
runt Capitis mortui unciæ quinque; cum drachmis duabus, & ex
his salis liquivos vix scrupulum cum dimidio phlegmatis cum

spiritu
spiritu et immiso sale volatili drachmas quin[g, & semis, adhe-
rente quodam portione recipientis lateribus: Hic liquor junctim
sumptus, addito spiritus vini Alkohisati quanto, in Alembdro ex-
iguo caloris gradu sublimatus, depositus in Capite salis volatilis u-
roso scrupulos duos & semis. Olei nihil conceptum nisi volatil-
lium fluorem salium coreferre velimus.

3. Precipitando. Liquor distillatus spiritus Vitriolli addi-
tamento in rubram tinctorum vertitur, tandemq; crassior evadens
quodammodo secedit in fundum; Affulsus vero idem spiritus a di-
stillatione residuo capiti mortuo, aut sali inde elixiwiato, non
aliam quam cum sale & oleo Tartari impetuosam effervescetiam
excitat.

Sic Lapides nostri constant plurima Terra, Sale Vol.exigno,acido
perpanco, quod sale spiritus, Urinoso infraetum & edulcoratum
esse, spiritus Armoniaci ejsdem natura demonstrat, acidorum
partibus immixtus eae retundendo & implicando in dulcem Sapo-
rem cogit, post non resclubiles.

Exin concludimus salium lisiuioforum naturam a salis Tartari
non recedere in agra nostra; & reperta matrice, incorporandi
subjecto, accedente acido, motum (effervescentia aliqua pragens-
fa) invicem siti, inque calculos hosce coire; prout Vitrioli spi-
ritus particulis suis acutissimis & flexilibus (unde oleofus tangi-
tur) sal Tartari penetrando quidem destruit, sed destruetum in
sui naturum aliter colligando cogit: In hisce calculis, ut jam ad
suam crasine dispositionis, nil praesitit; verum sal fixum, igne sublatis
implicandi spiritibus, in suam naturam reduxit, ex qua coagulam
cogit.

E contra, Nitrispiritus acidus quidem, sed ob subtilissimi sa[lis
conjunctionem particulis rigidioribus, penetrantissimis, inseparabi-
liuis constans, non tantum una qualitate cuneta solwebat, sed & al-
tera reunionem impediebat; cum particula hujus rigidiores, in actu
continua, sese fleterre, saliaq; divisa in alienam naturam combi-
nare non valuerint.

Spiritus vero salis Armoniaci urinosus, salibus istis volatilibus
confmilis, exque fixis productus, illa non modo quieta reliquit, sed
& hae ut gremium suum amplexus.

Hinc
Hinc longe alia calculorum horum generandi ratio & locus quam eorum qui abs renibus excluduntur; cum hi e particularis seri rigidioribus, vel ad pororum renalium relationem crassioribus, sensim obherentiuis esq; obliteratebibus contescentur; lubrica quidem aqua flexibilius particularis decidat, salia vero sero inconstantia volatilia insensibiliter reticulo huius implicitur, tandemq; in lapideam duritiam accrescant; Quod prius communi experientia constans exhibet senes, quibus crassiores homores, minusq; meabilis meatus contingent, in hunc affectum valde pronos; Posterioris distillationis firmatur; etenim imminendo ejusmodi calculos donec collum angustum retortae ingrediantur, pro dit spiritus urinofus cum sale volatili multo & aliquo oleo, remanentq; in fundo retorte non commota figura lapidum, qua in cineres commovendo decidunt, quae vero rursus assuso distillato liquore in calculos conjunguntur: ex quibus salis volatilis copia & implicandis modus in his optime constat.

Qualiter vero & ubi in agra nostra generentur lapilli & tephi Tartarei (ea in vivis) vix esset hujus loci & temporis divinare, nisi ratione aliquid concedendum foret. Vestcas sub epidermide limpio sero flagrantibus, ibiq; ob impediteam cuticule transpirationem obstruens; glandularum subcutaneorum poros; denegantes refluxum collecto, sanguini pellenti non vero quieto ortum debent; cum hic a tempore quod coagulari visus est, nusquam amplas siccitavit, & secus motui contrario esset: Mordax vero lancinansq; humoris qualitas atq; inspissatio singularis, acidi in corpore predominantis argumentum; cjuus rimari naturam difficile, cum levissima additione vel detractione motuve, humores alterentur, ut ex chylo sanguis, ex sero lympha, ex a qua forti regia generentur, aliisve naturalibus cernere evidens est. Qui humores in receptaculis suis glandulosis, ut locis natalitiis, varie & perversim alterati tantas coagulationes efficient, cum stagnantes exhalato Alkali spirituoso inspissantur & aescent; hanc secus ac analogum sanguinis vinum, quod evanidis sulphuris particularis quibus acida incorporate herebant, velicitis bis, in aorem verititur: Ex certe dulcis acidisq; ratio non alia est, quam diversimoda major minorve acutarum partium cum aliis commixtio, actiug;
retardatio, ut in saccharo, melle, &c. Hinc sanguis, et si tandem inspissatus, tamen dulcis lingue occurrit: immo pro tactus ratione magis minusq; seriunt, parva inter titillationem & dolorem distantia.

Merito ergo glandule praerimis inferioris ventris, seri lymphatice (vel pituita in hoc acide) receptacula & ergastula, in vitio occurrant, quo humor, jam heterogeneus ductibus suis, band exoneratus, atq; e pancreate in duodenum longo intervallo non solutus, acidior esset: Hinc prior hisce pra. utero attribuenda mali labes, (cum naturaliter absq; impregnatione, mensum suppressio ante Anos senebris, nulla contingat) quae in hoc corpore primos effectus latentes ederit, unde refragnans sanguis majorem corruptionem, majorq; turbas fovebat; non enim subordinate causa pugnans.

Subita vero vesicarum evanescentia ad remedia resolventia volatilia commode referitur, quibus obstruciones universi referant nitiramur; factum unde ut una cum meatibus glandulosis patefactis non modo refluxus resoluto humori datus, sed & magnum pituita receptaculum pancreas, impetu in intestina & abhinc massam chyli viscosam, indeq; sanguinis universam, humorem contentum acidum effuderit, sicq; diaphesin pravam hucusq; continentam induerit: Qui Chylus juxta principia sua alias vix statui potest, agra adhuc in sanis magno aquarum potui ad juvenilium viscerum estuantium calorem supprimendum dedita; Aquis et si in hac urbe saluberrimis in subjecto capaci evidentem causam non detrahimus, ex qua consequens obstruatio ductum glandularumque concurrantia potuit: Quantum vero vel an contribuat bilis in petrificatione haec vix invenire est, cum haec aliter ac nostri calculi sale lixivioso redundet.

Hinc ventriculus, intestina, glandula primarij generationis loci, quamvis & in vesica secundario procreentur: Latex quippe urinojus prima digestiojus vitio ita inquinatus, secunde excrementum, multo acido, saleq; & crasso phlegmate imbutus, in vesica stagnans, in coagulum invicem accedentibus particularis aptis coivit; unde & mucus & calculi absque alterius rei accessu vel dissipationis ope.

Qua-
Quatenus vero ante, slices exiguos variæque cæmenta evomuerit, cum abhinc vomito nihil excreverit, causa delitescit in corpore; aqüarum tanen pro ratione subjici occupati diversa, diversa est lapides producendi & incorporandi vis.

Pondus specimina probant, non enim desistente agendi vi in subjecto disposition, effectus continuantur, ut decem haec tens libras superavint.

Aliena a podagricorum tophis substantiae primos, ventriculo excretos, rarioris compactura, Aer non ut salia humectando, cum minima haberent, in fluorem, sed rariores minusq; firmiter simplexos angulos movendo insensibiliter contritos in pollinem reedit; quem-admodum in vitriolo albo, lignis corruptis exsucis, alis quae ad aere contingere videmus; contra vero vini spiritus rectificatus raros poros facillime intrans, nec aere instar vibrans, fibrillas quietas sustinebat.

Motus naturam esse renitente objecto circulare vermiculariter at retrograde in nostro subjecto, patet, majoribus lapillis ad angusti portam intra exitum Ilii & præcipiitum Coli circa Cæcum obharen-tibus, reæctis orbicularibus musculosis intestinorum libris, peristaltici motus inversionem contingisse, causam vero tam violentam ut calculum, facile valvulam aut ineptam everfisse, aut plane dictum esse.

Hoc ostio patente, quid ni stimulata intestina Clysmata sursum absque excrementis durissimis rejecerint? cum foëbala videans in colicis adeo indurata cellulis inhaerere, tandem ad album descendere, ut vix coctione solvi, multoque minus Clysmate dilui posset; Æque quidem mirum haec contingisse & etiamnum contingere infartis ducibus crassioribus lapillis, verum ad horum figura variae et spectantes, eos non ad intestinorum cavitatem conformari, sed ubi; laterali, immo in aliquibus per ipsa.qhibus perforan-tur foramina chylo descensum & clysmatibus ascensum concedere.

Urinoi laeticis coloris varie immutari, substantiamque alterari pro accedentis vel deficientis ratione quemvis dies docet; Caro uel vero pellucida contra naturae ordinem succedentis cum tempore aliqua est perquirenda ratio; illis enim magis minusque bile saturatis in-tenditur.
tenditur vel remittitur tinctura, aut admixtis variis heterogeneis, vel spiritibus exhalatis incrasfatur, inque opacam & virulentam vertitur urina.

Cujus collecte excretionem impediébat mucus in vesica, ejus col-lum glatinans, tantam vero osto libraram quantitatem vesica capere incapa-x, nisi non natu-rem extensionem ei concedamus; qualem in puella sub finem anni septuagesimi secundi Johanna Heuscheria observavi; ad quam ut ascitiam accer-is, quarenti causas, obtigit inflammatio colli vesica, Anodyna & post Cathete-rem applicare jussi, unde incredibilis totius quantitas libras novem superans, sub stidente ventre, continuo fluxit, ipsaque convalescit.
Urinas vero non tam in vesica quam reibus, vaferque ceteris re-dundare superius exemplum Dn. I. W. declarat.

Eventire unde potuit ut excedens hujus laticis urinofi quantitas apertis Coeliace ostiolis in cavitatem ventriculi exudatur; verum propius observantibus constat, urina non redundante ejusmodi fieri vacationem, plurimum purum, aliquando vero quibusdam chyli giborung; particulis mixtam; Nec si quis antecedentem historiam serio examinabat, ne quique excretiones ante primas egra ingestum, multo minus hac usque datum intelliget, quod urinosum saporem induere valuerit; Nec lacte semper redundans vasa sanguisera eructare cogit: Inde ex ipsius rei contingentibus veris aliquid contra nature leges in hoc corpoe contingere, conscire licet, fors anque continuata calculorum generationis aliqua causa petenda, cum ventriculus nova saburra perverfoq; fermento humorum quotidie tenetur; securum jam jam remediis alteratus esser: Memor quidem exempli quod mihi contigit, Anno 1677. in Eva Zubera annorum quadraginta cive urbis hujus, quae enimu partus violento, vesica urina diöenta, fetus exitu valide compressa, haæ; violenta causa aperto uracho, urina per umbilicum integro puerperio majorem portionem exoneravit, demum consolidato hoc, naturaliter fluxit; Ast a naturalibus & manifestis ad non natu-ralia occultâ hæc evit dissolendum non est.

Abstinente Thema Lentulus nofiter ad divum Jacobum pri-mum, Regem Angliae Potentissimum pertractavit, ignota tum transpirationis hujusq; principii circulationis causa varie ratioci-natus
natus; sed ad hanc reflectentes, hominem respirare adq; substantia deperdite restauracionem resici. Ars statica docet plus insensibiliter e corpore excerni transpirando quam per omnes excretorias vias sensibiliter excludi.

Ut vir robustus in actione permanens octo librarum, potu ciboq; singulis diebus saturatus, tres tantum vel in summum quatuor lib. manifestis in excrementis deponat, saepe tamen digestione amplius non penderet quam cibum ante sumtum: Hinc coctionum energia omnia immittit inq; spiritus tandem resolvit, & transpirationis, in solutione morborum insensibili & hecticorum devorata substantia, veritas consistit; qua non ob epidermis constipationem procedente, non opus erat reflexione; secus aer inspirari ad spiritum vitalium reflexionem debuit, ut expirari posset, sicq; in motu manere; qui ipse aer inspiratus, incassatus, in vasis in serum versus, urinandi materiam tempore abstinenti e commodam preebuit, ut hydropicos sepulcrum cernimus solo aere, aquosis suis particulars, in crescere.

Hec sunt, Excellentissimi Domini, quae olim desideratis, exigua quidem, nisi favore vestro, digna ad majora videantur. Plura hærorum Calculorum specimina doctis praecelatis amicisq; viris in rei testimonium mittere voluimus, ut si aliquid cum tempore observari velit, hortari dignentur; Incliti enim Senatus nostri Amplissimi mandato, pro Clementia sua in miseros, egra nostra publico loco sustentatur et observatur, cautumq; est ne mortua ante exactam eviscerationem sepeliatur, quo publico ex ipsius laudissimo desiderio aliquid boni redundare posset.

Dabam Berne in Helvetiis ultima Feb. 1686.

Sigism. Konig, M. D.
Incl. Rpl. Ph.

Horum Calculorum specimina duo una misit Cl. D. König, quorum figuras juxta magnitudine accurate exhibent Fig. 3 & 4. R. Societas rei novitate permota, voluit eos spagyricos examini subjicere, administrante Chymico excellentissimo D. D. Slareo. Eventum e Transactione proxime edenda scies.
A Discourse of the Rule of the decrease of the bight of the Mercury in the Barometer, according as places are Elevated above the Surface of the Earth, with an attempt to discover the true reason of the Rising and Falling of the Mercury, upon change of Weather.

By EDM. HALLEY.

The Elastick property of the Air have been long since made out, by Experiments before the R. Society and else where; and the Resistance of its Spring is found to be nearly equal to the Weight or Force that compresses it; as also, that the spaces the same Air occupies, under differing Pressures are Reciprocally as those Pressures: it has been shown likewise by undoubted Experiment, that the Specifick Gravity of the Air, near the Earths Surface to that of Water, was once as 1 to 840, again as 1 to 852, and a third time, in a very large Vessel holding ten Gallons, as 1 to 860; all which, considering the difficulty of the Experiment agree well enough, the Mercury standing at all those times about 29 Inches; but by reason twas Summer Weather and consequently the Air rarified when all these were tryed, we may without sensible Error say in round Numbers, that the Barometer standing at 30 Inches, and in a mean state of Heat and Cold, the Specifick Gravity of the Air to Water, is as 1 to 800: By the like Tryals the weight of Mercury to Water, is as 13 ½ to 1, or very near it, so that the weight of Mercury to Air, is as 10800 to 1, and a Cylinder of Air of 10800 Inches or 900 Feet, is equal to an Inch of Mercury, and were the Air of an equal density like Water, the whole Atmosphere would be no more than 5, 1 Miles high, and in the Ascent of every 900 feet the Barometer would sink an Inch. But the expansion of the Air increasing in the same proportion as the incumbent weight of the Atmosphere decreases, that is as the Mercury in the Barometer sinks, the upper parts of the Air are much more rarified than the lower, and
and each space answering to an Inch of Quicksilver grows greater and greater, so that the Atmosphere must be extended to a much greater height. Now upon these principles, to determine the height of the Mercury at any assigned height in the Air, and e contra having the height of the Mercury given, to find the height of the place where the Barometer stands, are Problems not more difficult than Curious; and which I thus resolve.

The expansions of the Air being Reciprocally as the heights of the Mercury, it is evident, that by the help of the Curve of the Hyperbola and its Asymptotes the said expansions may be expounded to any given height of the Mercury: For by the 65th prop. lib. 2. Conic. Mydorgii, the Rectangles AB CE, AKGE, ALDE, &c. (in fig. 5.) are always equal, and consequently the sides CB, KG, LD, &c. are reciprocally as the sides, AB, AK, AL, &c. If then the lines AB, AK, AL, be supposed equal to the heights of the Mercury, or the pressures of the Atmosphere, the lines CB, KG, LD, answering thereto, will be as the Expansions of the Air under those pressures, or the bulks that the same quantity of Air will occupy; which Expansions being taken infinitely many, and infinitely little, (according to the method of Indivisibles) their summe will give the spaces of Air between the several heights of the Barometer; that is to say the summe of all the lines between CB and KG, or the Area C BKG, will be proportioned to the distance or space intercepted between the Levels of two places in the Air, where the Mercury would stand at the heights represented by the lines AB, AK; so then the spaces of Air answering to equal parts of Mercury in the Barometer, are as the Areas CBKG, GKL D, DLFM, &c. These Areas again are, by the Demonstration of Gregory of St. Vincent, proportionate to the Logarithms of the numbers expressing the Rationes of AK to AB, of AL to AK, of AM to AL, &c. So then by the common Table of Logarithms, the height of any place in the Atmosphere, having any assigned height of the Mercury, may most
easily be found: For the line CB in the Hyperbola, whereof the Areas design the Tabular Logarithms, being $0, 0.0144765$; it will be, as $0, 0.0144765$, to the difference of the Logarithms of 30, and any other lesser Number, 10 900 feet or the space answering to an Inch of Mercury, if the Air were equally press with 30 Inches of Mercury and every where alike, to the height of the Barometer in the Air, where it will stand at that lesser Number of Inches: And by the converse of this proportion may the height of the Mercury be found, having the Altitude of the place given. From these Rules I derived the following Tables.

### A Table shewing the Altitude, to given heights of the Mercury.

<table>
<thead>
<tr>
<th>Inch</th>
<th>Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>29.5</td>
<td>915</td>
</tr>
<tr>
<td>28.5</td>
<td>1862</td>
</tr>
<tr>
<td>27.5</td>
<td>2844</td>
</tr>
<tr>
<td>26.5</td>
<td>3863</td>
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<td>25.5</td>
<td>4922</td>
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</tr>
<tr>
<td>0,1</td>
<td>29 mil. or 154000</td>
</tr>
<tr>
<td>0,01</td>
<td>41 mil. 216169</td>
</tr>
<tr>
<td>0,001</td>
<td>53 mil. 278338</td>
</tr>
</tbody>
</table>

### A Table shewing the heights of the Mercury, at given Altitudes.

<table>
<thead>
<tr>
<th>Feet</th>
<th>Inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>30,00</td>
</tr>
<tr>
<td>1000</td>
<td>28,91</td>
</tr>
<tr>
<td>2000</td>
<td>27,86</td>
</tr>
<tr>
<td>3000</td>
<td>26,85</td>
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<tr>
<td>4000</td>
<td>25,87</td>
</tr>
<tr>
<td>5000 feet</td>
<td>24,93</td>
</tr>
<tr>
<td>1 mile</td>
<td>24,57</td>
</tr>
<tr>
<td>2</td>
<td>20,29</td>
</tr>
<tr>
<td>3</td>
<td>16,68</td>
</tr>
<tr>
<td>4</td>
<td>13,72</td>
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<td>5</td>
<td>11,28</td>
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<td>10</td>
<td>4,24</td>
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<td>15</td>
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<td>0,95</td>
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<tr>
<td>30</td>
<td>0,08</td>
</tr>
<tr>
<td>40</td>
<td>0,012</td>
</tr>
</tbody>
</table>

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

This seems confirmed from the Observations of the Crepusculum, which is observed commonly to begin and end when the Sun is about 18 degrees below the Horizon; for supposing the Air to reflect light from its most rarified parts, and that as long as the Sun illuminates any of its Atoms, they are visible to an Eye not intercepted by the Curvity of the Earth, it will follow from Fig. 5. that the proportion of the height of the whole Air, to the Semidiameter of the Earth, is much about, as 1 to 90, or as the excess of the Secant of about 8½ degrees to Radius: For if E be the Eye of the Observer, S a place where the Sun sets at the end of twilight in E, and the Arch ECS, or TCA be found 18 degrees, the excess of the Secant of half thereof ECH, would be the height of the Air viz. GH: But the beam of the Sun ASH, and the visual Ray EH do each of them suffer a Refraction of about 32 or 33 minutes, whereby being bent inwards from H towards G, the height of the Air need not be so great as if they went afoot; and having from the Angle ECS taken the double Refraction of the Horizontal Ray, the half of the remainder will be 8½ degrees circiter, whose Secant being 10½ it follows that as 10000 to 111, so the Semidiameter of the Earth supposed 4000 miles, to 44,4 miles; which will be the height of the whole Air, if the places E, S, whose Visible portions of the Atmosphere ERZH, and SHKB just touch one the other, be 18 degrees afounder.

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

Hitherto I have only considered the Air and Atmosphere, as one unaltered body, as having constantly at the Earth's surface the 800th part of the weight of Water, and being capable of rarefaction and condensation in infinitum; neither of which Hypotheses are rigidly true: for here in England, tis notoriously known, that the weight of the whole Atmosphere is various, being counterpoised sometimes by 28½ inches of Mercury, and at other times by no less than 30; so that the under parts being pressed by about a 15th part, less weight, the specific gravity of the Air upon that score will sometimes be a 15th part lighter than another; Besides heat and cold does very considerably dilate and contract the Air, and consequently alter its gravity, to which add the mixture of effluvia or streams rising from allmost all Bodies, which assimilating into the form of Air are kept suspended therein, as Salts dissolved in Liquors or Mettles in corroding Menstrua, which bodies being all of them very much Heavier than Air, their particles by their admixture must needs encrease the weight of that Air they lie incorporated withal, after the same manner as melted Salts do augment the Specific Gravity of Water. The other consideration is that the Rarefaction and Condensation of the Air is not precisely according to the proportion here laid down, for the experiment very nearly agrees thereto, as may be seen in the 58th Chapter of Mr. Hooks Micrographie, yet are the Condensations not possible beyond certain degrees, for being compressed into an 800th part of the space it takes up here, its consistence would be equally dense with that of Water, which yeilds not to any force whatsoever, as hath been found
found by several experiments tryed here, and at Florence, by the Academia del Cimento. Nor can the Rarefaction proceed in infinitum; for supposing the Spring whereby it delates it self, occasioned by what texture of parts you please, yet must there be a determinate magnitude of the natural state of each particle, as we see it is in Wool and the like, whose bodies being compressible into a very small space, have yet a determinate bulk which they cannot exceed, when freed from all manner of pressure.

These objections being true do disturb the Geometrical accuracy of these conclusions, drawn from the specific gravity of the Air observed at any time; but the method here shewn will compute by a like calculation, the heights of the quicksilver, and the rarefactions of the Air from any assigned height of the Barometer at the Earths Surface, and any specific gravity given. As to the Condensation and Rarefaction by heat and cold, and the various mixture of Aqueous and other Vapours, these two objections seem generally to compensate each other, for when the Air is rarified by heat the Vapours are raised most copiously, so that tho' the Air properly so called, be expanded and consequently lighter, yet the interstices thereof being crowded full of Vapours of much heavier matters, bulk for bulk the weight of the Compositum may continue much the same; at least a most Curious experiment made by the Ingenious Mr. John Cawwell of Oxford upon the top of Snowdon hill in Caernarvan-Shire, seems to prove that the first inches of Mercury have their portions of Air near enough to what I now determine; for the height of the hill being 1240 yards or very near it, he found the Mercury to have subsided to 25.6 inch. or 4 inch. below the mean Altitude thereof at the level of the Sea, (which is a greater difference than has been found in any of our former Experiments,) and the space answering to 4 inch. by my calculation should be 1288 yards; and it agrees as well with the Observations in the Appendix to Mr. Pascals Book, de l'Equilibre des Liqueurs, made on the high hill in
Auvergne, call’d le puy de Domme. So that the Rarefaction and Vapours seem not to have altered considerably, the Gravity of the under parts of the Air; and much above the height where these Experiments were made, do few Vapours ascend, and the cold is such that the Snow lies continually, so that for the more elevated parts of the Sphere of Air there is much less reason to doubt.

But now we have had occasion to mention the difference there is between the height of the Mercury at one time, from the height thereof at another, it may not be unacceptable to offer at some reasons for the said difference, which, at least to my self, seem to have some appearance of truth; first then tis undoubtedly demonstrable that the height of the Cylinder of Mercury, is equal to the weight of the whole incumbent Air, and consequently that that whole is sometimes a fifteenth more than at other times, which cannot otherwise be, but by the access of new matter when tis heavy, and its diminution when tis light; that Hypothesis therefore that shews how the Air shall be increased or diminished, in any particular place, will give a reason for the greater and lesser height of the Mercury in the Baroscope: but to direct us in the choice of the several causes, which may be assigned for the encrease and decrease of the Air, twill not be unnecessary to enumerate some of the principle observations made upon the Barometer, most whereof are sufficiently known already to all those that are curious in these matters.

The first is, that in calm weather when the Air is inclined to Rain, the Mercury is commonly low.

2. That in Serene good settled weather the Mercury is generally high.

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

4. That ceteris paribus the greatest heights of the Mercury are found upon Easterly and North-easterly winds.

5. That in calm frosty weather the Mercury generally stands high.
6. That after very great stormes of Wind, when the Quicksilver has been low, it generally rises again very fast.

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

8. That within the Tropicks and near them, those accounts wee have had from others, and my own Observation at St. Helena make very little or no variation of the hight of the Mercury in all weathers: Now that Theory that can well account for all these Appearances, will in all probability approach nearer the true Cause of the Barometers variations, than any thing hitherto offered; and such an one I am bold to believe, is that which I here lay down, with submission to better Judgments.

I conceive that the principal Cause of the rise and fall of the Mercury, is from the Variable Winds, which are found in the Temperate Zones, and whose great unconstancy here in England is most notorious: I shall not at present inquire into the Cause of its uncertainty, but the matter of Fact being most undoubted, the Legitimate Consequences thereof must be allowed me; let it proceed from what it will.

A Second Cause is the uncertain Exhalation and Precipitation of the Vapours, lodging in the Air, whereby it comes to be at one time much more crowded, than at another, and consequently heavier; but this latter in a great measure depends upon the former. Now from these Principles, I shall endeavour to Explicate the several Phenomena of the Barometer, taking them in the same Order, I layd them down.

1. Why in Calm Weather, the Air being inclined to Rain, the Mercury is commonly low? I Answer that, the Mercury's being low, enclines it to Rain, for the Air being light, the Vapours are no longer supported thereby, being become specifically heavier than the Medium wherein they floated; so that they descend towards the Earth, and in their fall meeting with other aqueous Particles, they incorporate together and forme little drops of Rain; but the Mercury's being
ing at one time lower than at another, is the effect of two contrary Winds blowing from the place where the Barometer stands; whereby the Air of that place is carried both ways from it, and consequently the incumbent Cylinder of Air is diminished, and accordingly the Mercury sinks; as for instance, if in the German Ocean it should blow a gale of Westerly Wind, and at the same time an Easterly Wind in the Irish Sea; or if in France it should blow a Southerly Wind, and in Scotland a Northern; it must be granted me that that part of the Atmosphere impendent over England, would thereby be exhausted and attenuated, and the Mercury would subside, and the Vapours which before floated in those parts of the Air of equal Gravity with themselves, would sink to the Earth.

2. Why in Serene good settled Weather the Mercury is generally high? To this I answer, That the greater height of the Barometer, is occasioned by two contrary Winds blowing towards the place of Observation, whereby the Air of other places is brought thither and accumulated; so that the incumbent Cylinder of Air being encreased both in height and weight, the Mercury pressed thereby must needs rise and stand high, as long as the Winds continue so to blow; and then the Air being specifically heavier, the Vapours are better kept suspended, so that they have no inclination to Precipitate and fall down in drops, which is the reason of the Serene good Weather, which attends the greater heights of the Mercury.

3. Why upon very great Winds or Storms though accompanied with no Rain, the Mercury sinks lowest of all, with relation to the point of the Compass upon which the Wind blows. This is caused by the very rapid motion of the Air in these Storms; for the Tract or Region of the Earths Surface wherein these Winds rage, not extending all round the Globe, that flagrant Air which is left behind, as likewise that on the sides, cannot come in so fast as to supply the Evacuation made by so swift a Current, so that the Air must necessarily be atte-
nuated when & where the said Winds continue to blow, and that more or less according to their Violence; Add to which that the *Horizontal* motion of the *Air* being so quick as it is, may in all probability take off some part of the perpendicular pressure thereof: and the great agitation of its particles, is the reason why the Vapours are dissipated and do not condense into drops, so as to form Rain, otherwise the natural consequence of the *Air* rarefaction.

4. *Why ceteris paribus the Mercury stands highest upon an Easterly or North-easterly Wind.* This happens because that, in the great *Atlantic* Ocean on this side the 35th degree of North Latitude, the Westerly and South-Westerly Winds, blow almost always *Trade*, so that whenever here the Wind comes up at East and North-East, 'tis sure to be checked by a contrary Gale, as soon as it reaches the Ocean; wherefore according to what is made out in our second Remark, the Air must needs be heaped over this Island; and consequently the *Mercury* must stand high, as often as these Winds blow. This holds true in this Country, but is not a general rule for others, where the Winds are under different Circumstances: and I have sometimes seen the *Mercury* here as low as 29 Inches, upon an Easterly Wind, but then it blew exceeding hard, and so comes to be accounted for by what was observed upon the 3d. Remark.

5. *Why in calm frosty weather the Mercury generally stands high.* The cause hereof is, as I conceive that it seldom freezes but when the Winds came out of the Northern and North-Eastern Quarters, or at least, unless those Winds blow at no great distance of, for the Northern parts of Germany, Denmark, Sweden, Norway, and all that tract from whence North-Eastern Winds come, are subject to almost continual Frost all the Winter; & thereby the lower Air is very much condensed, and in that State is brought hitherwards by those Winds, and being accumulated by the Opposition of the Westerly Wind blowing in the Ocean, the *Mercury* must needs
needs be preft to a more than ordinary hight, and as a concurring cause, the shrinking of the lower parts of the Air into letter room by cold, must needs cause a descent of the upper parts of the Atmosphere to reduce the cavity made by this contraction to an Aequilibrium.

6. Why after very great Storms of Wind, when the Mercury has been very low, it generally rises again very fast. This I have frequently observed, and once found it rifen an Inch and half in less than fix hours, after a long continued Storm of South-West Wind. This seems to be occasioned by the sudden accession of new Air to supply the great Evacuation which such continued Storms make thereof, in those places where they happen (as in the third remark) and by the Recoile of the Air, after the force ceases that impell'd it; and the reason why the Mercury rises so fast, is because the Air being very much rarified beyond its mean density, the neighbouring Air runs in the more swiftly to bring it to an Aequilibrium, as we see water runs the faster for having a great declivity.

7. Why in more Northerly Places the Variations of the Baroscope are greater than in the more Southerly; The truth of the matter of fact is proved from observations made at Clermont and Paris compared with others, made at Stholm, as may be seen in the Appendix to Mr. Pascals book before cited. The reason I conjecture to be, that the more Northerly parts have usally greater Storms of Wind than the more Southerly, whereby the Mercury should sink lower, in that extream; and then the Northerly Winds bringing the Condensed and Ponderous Air from the Neighbourhood of the Pole, and that again being checked by a Southerly Wind, at no great distance, and so heaped, must of necessity make the Mercury in such case stand higher, in the other extream.

8. And Lastly, Why near the Equinoctial as at Barbadoes and St. Helena, there is very little or no Variation of the height of the Barometer. This Remark above all others, Confirms the Hypothesis of the Variable Winds being the cause of these
these Variations of the height of the Mercury, for in the places above named, there is always an easy Gale of Wind blowing nearly upon the same point, viz, E.N.E. at Barbadoes and E.S.E at St. Helena; so that there being no contrary Currents of the Air, to exhaust or accumulate it, the Atmosphere continues much in the same State: However upon Hurricanes, the most Violent of Storms, the Mercury has been observed very low, but this is but for once in two or three years, and it soon recovers its settled state of about 29 \frac{3}{4} Inches. I doubt not but the same thing is in the East Coast of Africa and in India, where the Monsoons or Winds are Trade for half the year one way, and half the year another; only 'tis probable, that there may something worth noting happen, about the times of the Change or shifting of the Winds, which might be obtained if any body had the curiosity to keep the Barometer at our Factories in India.

I doubt not but this Doctrine will find some Opposers, and that one principal Objection will be, That I suppose the Air sometimes to move from those parts where it is already evacuated below the Equilibrium, and sometimes again towards those parts, where it is condensed and crowded above the mean state, which may be thought contradictory to the laws of Staticks and the rules of the Equilibrium of Fluids. But those that shall consider how, when once an Impetus is given to a fluid body, it is capable of mounting above its level, and checking others that have a contrary tendency to descend by their own gravity, will no longer regard this as a material Obstacle; but will rather conclude, that the Great Analogy there is between the rising and falling of the Water upon the Flux and Reflux of the Sea, and this of the accumulating and extenuating the Air, is a great Argument for the truth of this Hypothesis. For as the Sea, over against the Coast of Essex, riles and swells by the meeting of the two contrary Tides of Flood, whereof the one comes from the S. W. along the Chanel of England, and the other from
the North;) and on the contrary sinks below its level upon the retreat of the Water both ways, in the Tide of Ebb; so it is very probable, that the Air may ebb and flow, after the same manner; but by reason of the diversity of Causes, whereby the Air may be set in moving, the times of these fluxes and refluxes thereof, are purely casual and not reducible to any Rule, as are the Motions of the Sea, depending wholly upon the regular course of the Moon. The next Transaction shall give an Historical Relation of those Winds which are found to have any thing of Constancy, and shall endeavour to assign the Causes thereof.


This is not without reason, that the renowned Author of this Treatise wonders that none have written concerning Nature herself, and yet so many have so largely treated of the Works of Nature. But this will seem less strange to him that considers for how many Ages the whole Learned World has been devoted to the Peripatetic Principles of Matter and Form, and with how blind an obedience the Doctrine of Aristotle hath been universally received and maintained; For the vulgar Notion of Nature, concurring with the Peripatetic, having been generally admitted, all men thought it unsafe to oppugn the opinion of the multitude, and at the same time to call in question the authority of those reputed for Learning; subjecting their own judgments, by a servile resignation unworthy the name of a Philosopher to the Dogmes of others. This seems to be the chief, if not the only cause of the propagation
tion of Errors, as well in Philosophy, as in other matters of more concern, as Religion and Divine Worship: but these not being the present scope of our Author, he in this excellent and learned Essay shews, that in Philosophical Inquiries, the vulgarly received Notion of Nature hath given great occasion of Error, being admitted without a due examination.

The whole is divided into eight Sections, the scope of which is briefly as follows:

In the first Section, after having premised something of the manner of conception in the rational soul, our Author, with his usual acuteness, answers two Objections, shewing, that it is neither ungrateful nor blameable, for a Son of Nature to oppugn Nature, after this manner: likewise, that there is sometimes a necessity to recede from the common opinion of men.

The second Section reckons up the several vulgar acceptations of the word Nature, and then substitutes in their places, other Words and Expressions more suitable to the true notion of Nature.

The third, examines the Aristotelian definition of Nature, and proves it obscure, intricate and affording no light, whereby to explain other things; which done, our Noble Author sets forth the reason why he endeavour to avoid the frequent use of this word Nature.

The fourth Section, in the first place, examines several Axioms concerning Nature, whereby she is described after the vulgar apprehension; and then lays down a much better description of her, after a most learned dissertation concerning the several forms of speech relating thereto: Here our Author distinguishes Nature into general, which he calls Cosmical Mechanism, and particular, which he names Individual Mechanism. In the conclusion is shewn the original of Polytheism, and how Nature came to be a made Goddess by the Antients.
The first proposes the Reasons whereby our Author was persuaded to reject the received Notion of Nature; as first, that such a Notion has no sufficient proof to establish it; that it is unnecessary, obscure and unintelligible, that it is dangerous to Religion in general, and consequently to the Christian, and that it is contradicted by the daily observation of several Phenomena, &c.

The sixth discusses the Arguments in behalf of Nature, drawn from the common content of Mankind; from the endeavour observable in Bodies to maintain their Natural state; from the distinction of Motion into Natural and Violent; from the Crises of Diseases, &c.

The seventh Section, with the usual clearness and subtility of our Author, expounds, according to the Doctrine here laid down, the several received Axioms or Attributes of Nature; among others these two, Natura Vacuum Horret, and Natura est Morborum Medicatrix, are largely and most accurately handled.

The eighth and last Section shews, that Nature, according to the vulgar Acceptation, is not a real, but an imaginary Being; and conformable to the Doctrine of this Treatise, a new and peculiar Hypothesis of Divine Providence is proposed; In the end, the Advantages and Utility of the whole are briefly touched upon.

This Book having been designed by the Ingenious Mr. Mariotte, and by him in a great Measure completed at his Death; has had the good Fortune to receive the last hand from Mr. De la Hire, whose great abilities in the Mathematicks, are too well known to need mention in this place. The whole is divided into five Parts, and each Part again into Discourses or Chapters; the first Part contains 3 Discourses, whereof the first is about the several Properties of fluid Bodies, as their Glaciation, Evaporation, Dilatation upon Heat, and admission of the Air into their Pores, &c. The 2d. is about the Original of Fountains, which he deduces from the Rains that fall, and sink into the Earth, till they meet with a Clayey or Rocky Soyl, which being not able to pass, they run alongst, till they find their way out into the Air, where they become Fountains. And to prove the quantity of Rain Water, sufficient to furnish the Rivers, he shews by Experiment that there falls in the Countries about the Fountains of the Seine, at least 7 times as much Water, as the said River evacuates. The 3d. is about the Origine and Cause of Winds, of which he assigns 3 general and 4 particular Causes, the first of the general, is the Diurnal Motion of the Earth; the second is the Condensation and Rarefaction of the Air, caused by the heat of the Sunn. The 3d. is from the Moons respect to her Apogaeon or Perigaeon, whereby she sometimes rises from, other times descends towards the Earth. The particular causes are, 1st. the extraordinary rising of the Vapours and Exhalations out of certain places of the Earth.
2d. The fall of great Rains and Hails. 3d. The great Quantity of nitrous and Sulphureous Exhalations in Earthquakes.

4th. The Soudain melting of Snow in the High Mountains; and from these several causes combined, he thinks he can account for all the Phenomena of Winds, particularly the Trade Winds between the Tropicks, called by him Vents Ali-zez, but in so doing he seems not sufficiently informed in their History: In this Discourse are several curious Remarques, and Observations touching the Course, Propagation, &c. of the Wind.

The second Part Treats of the Equilibrium of Fluids; the first Discourse demonstrating from the Principles of Mechanicks, how Fluids counterpoise one another's weight, and giving the Rules of the Doctrine of floating Bodies: The second Discourse shews the Nature of the Elasticity of Air and Flame, and how their Spring is counterpoised by weight. The third Discourse Treats of the Equipollence of a Fluid Body to a stroak or shock; shewing the Rules of the force of Jets d'eau, from several heights of the Reservoir, and differing Diameters of the Bore of the Pipe; giving in the end an account of the comparative force of Wind and Water-mills, with the manner of computing them; together with a Description of 3 or 4 sorts of Mills with Horizontal Sails, and the Authors Opinion thereupon.

The third Part Treats of the Measure of running and spouting Waters; in the 1st. Discourse, are produced several experiments to find the quantity of Water passing through a Bore of an Inch Diameter, just under the Surface of the Water, which at length is concluded to be 14 Paris Pints in a Minute, or 72 muides in a natural Day: where by the way, notice is taken of the length of the Pendulum vibrating seconds, in parts near the Equinoctial, having been found at Cayenne a tenth, and at the Isle of Goree, near Cape Verde, an eighth of an Inch shorter, than at Paris, of which the Cause is proposed to proceed from the diurnal Motion of the Earth.
The second Discourse shews by Experiment that the quantity of Water expended by a jet d'eau of the same Diameter of Bore, but at different heights of the reservoir, are in a subduple proportion of these heights; and it being found that at the height of 1 foot, a jet d'eau of 1/4 of an Inch Diameter, evacuate 14 Paris Pints, or 14 parts of 35 of the Paris Cube Foot in a Minute, thence is concluded the expence of Water at any other height of the Reservatory through the same Bore.

The third Discourse shews that the quantity evacuated by different Bores at the same height of the Reservatory, are as the Squares of the Diameters of the Bores, the which is proved both Mathematically and Experimentally: The fourth Discourse shews the manner of finding the quantity of Water which a River or an Aqueduct furnishes, which is illustrated by the Example of the Seine at Paris.

The fourth Part Treats of the height to which the Water of Fountains rises, and its first Discourse, shews that the jets d'eau never rise so high as their Reservoirs, but always fall short thereof, by spaces which are in duplicate Proportion of the heights they rise to, which is proved by several Experiments: The next thing inquired after is the best sort of Ajutages or Spouts for jets d'eau, affirming from Experiment, that an even polished round hole in the end of the Pipe, gives a higher jet than either a Cylindrick or Conical Ajutage, of which yet the latter is the better. Lastly 'tis made out, that very great heights of Reservoir are altogether useless, the Water being by its great Velocity dispersed into small drops and its force lost, so that the height of the jet is not proportionably increased: A second Discourse of this Part handles the Amplitudes or Distances of Oblique jets, according to the Doctrine of Galileo and Torricelli, and concludes with a Geometrical way of finding the height of the Reservatory by the Horizontal Stream issuing out of a Hole bored in the side of the Pipe.
The first and last Part treats of the Pipes that are to convey Water, and of the Strength necessary thereunto, and consists of 3 Discourses, the first whereof shews the size of Pipes requisite for the several expences of Water, proving that in small Pipes emptying the same Water, the Water running faster, has more friction and is consequently more retarded; to avoid which this Rule is given, that the Squares of the Diameters of the Pipes be as the quantity of Water to be expended, in which case the Water will run in all alike fast, and the friction be the same; and when a great Pipe branches into several smaller, distributed to differing Jets, the square of the Diameter of the main Pipe must be proportioned to the sum of all the Expences of its Branches; and for a Foundation of a Calculus of the most commodious size of Pipes, it is laid down that for a Reservatory of 52 foot high, whole Adjutage is half in Inch Diameter, the Pipe ought to be 3 Inches Diameter. The second Discourse Treats of the strength of Pipes requisite for bearing the weight of the Water, where are several pretty Experiments of the resistence of Solides. The last of all gives a method of distributing Water by Pipes into a City, and shews how those Pipes are to be cleansed from Mud, by leaving Apertures to let out the Water in those places where the pipes lie lowest; and from Air, by the like Apertures left on the tops of those eminences where the Pipes pass.

N.B. That the Paris foot Measure is to the London foot as 1279, to 1200, viz. 79 Centismes of an Inch greater; so that to reduce the Experiments here produced, tis to be noted that 14 Paris Pints, or 14 parts of 35 of the Cube of the Paris foot, is equal to 3 gall. 5 pints, or 29 pints London Measure; and so much was evacuated in a minute through a Bore of a Paris Inch diameter, just under the Surface of the Water; but a Bore of a London Inch so placed, will pass but 3 gall. 1 ½ pint or 25 7/10 pints our Measure in a minute at which rate near 73 Hogsheads will run through such a Bore in a Day. The
The same Quantity of Water will by the Experiment of our Author, furnish a jet d'eau of the diameter of a quarter of a London Inch, when the Reservatory is at the height of 13 French feet, or 13. f. 10 1/2 Inch. English; and the Expences of Fountains of the same Bore, being as the Square Roots of the heights of the Reservatory, 4932 gall. or 78 Hogsheads will furnish a jet of 16 foot high, with a Quarter of an Inch Bore. Generally the Rule is, that the Expences of all Fountains, are as the Square Roots of the heights of their Reservatories, into the Squares of their Bores, and according to what is delivered in the 5th. Part of this Book, the Squares of the Diameters of the Pipes must be proportioned thereto.

IMPRIMATUR,

John Hoskyns Vice P. R. S.
July 17th 1686.

Printed by J. Streeter, and are to be sold by Sam. Smith at the Sign of the Prince's Arms in St. Paul's Church-yard.
PHILOSOPHICAL
TRANSACTIONS.

June the 26. 1686.

THE CONTENTS

1. An Essay towards an Universal Alphabet, together with a farther essay concerning an Universal Primer, to which is added a Specimen of a new Character fitted to the said Alphabet by Fr. L. Reg. Soc. S.

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5. An Extract of a Letter written from Aramont in Languedoc near Avignon, giving a Relation of an Extraordinary Swarm of Grafshoppers in those parts, communicated by Mr. Justell. Reg. Soc. S.
Having observed a great difficulty in truly writing what is pronounced, or truly pronouncing what is written, either in our own or foreign Languages, by the Ordinary Alphabets now in use, arising either from the want of some Letters, or the differing Pronunciation of the same Character or Letter in differing Languages, and the irregularities of its various Sounds in any one Language; I saw a necessity of some such expedient as I have here attempted, viz. An Universal Alphabet, which should contain an Enumeration of all such single Sounds or Letters as are used in any Language, which I have endeavoured by examining all those Languages, which hitherto I have considered: Altho’ this my attempt be not new, but what before by others hath been attempted, yet I hope what herein I have done will not be unuseful.

The Benefits of such a Collection being perfect.

1. Children from their first beginning, being taught and accustomed to the true Expression of all these single Sounds or Letters, will without difficulty be brought to pronounce truly and readily any Language how seemingly difficult so ever
ever; for the pretended difficulty to some Persons of Pronouncing some Letters, is only that they have not been accustomed to pronounce them, either single or in conjunction with others: and this difficulty is chiefly in Persons come to Age.

2. It will enable any one, accustomed to the true Pronunciation of this Alphabet, truly to describe the Pronunciation of any Language whatever, that shall in his hearing be distinctly pronounced; so as another also accustomed to this Alphabet, altho’ he before never had heard this Language pronounced, shall notwithstanding at first sight of such Writing, be able so truly to pronounce it, that it shall (if at all) very little differ from the Original Pronunciation. Whereas by the use of the common Alphabets, if any strange Language be written, another that’s a stranger to that Language, shall never be able truly to pronounce such Writing, as it should be, or was by the Writer intended, nor even the Writer himself sometime after that he hath forgotten what Sound he designed to describe.

3. It will also be useful to perpetuate the true Sounds of any Language, and serve as a Standard thereof to after-Ages: For if all the single Sounds expressable, be here characterized. And that no one Character have more than one Sound, nor any one Sound be expressed by more than one Character; it cannot fall out that any Character should be falsely pronounced, but it will soon be discovered; for this false Sound he giveth it, must be the true Sound of some other Letter of this Alphabet: and so none can Erre herein, but he that wilfully or carelessly will do it.

In this Collection I proceed according to these Rules.

1. That no true single Sound can be truly described or expressed by the Conjunction of any two or more other single Sounds, Viz. If a Vowel, by the Conjunction of
of other single Vowels, or if a Consonant, by the Conjunction of other single Consonants.

2. That whatever Sound cannot be expressed or described, but by the Conjunction of two or more single Sounds, is no single but a compounded Sound.

3. That in every composition of single Sounds, the particular single Sounds which make up that Composition, ought to be truly and clearly discerned in the Sound of the Composition, otherwise it cannot be truly said to be a Composition, and composed of such single Sounds.

The Single Sounds

Usually named Letters, are commonly distinguished into Vowels and Consonants. Vowels are such as are singly expressable, as a, e, o, &c. Consonants are such as cannot singly be expressed without the Conjunction of a Vowel, as b, d, f, g, &c.

Of Vowels

The whole number of them are these 14 following, to which, for the better discerning of their Sounds, I have annexed so many words wherein they are expressed, all English but three, Viz. the 7, 8, 12, because no English words occurred to my Memory, wherein they are expressed.

1 a as tall
2 a — tallow
3 a — tale
4 e — tell
5 ea — teal
6 i — till
7 u — dure French
8 ui — muis Lowdutch
9 y — tile
10 o — tone
11 u — tunne
12 u — une French
13 oo — tool
14 ou — tould

The
These are the Vowels, each of which are long and short.
Short as in the words; God, Man, Sin.
Long as in Ball, Demand, Seen, &c.

Of Diphthongs

A Diphthong in the ordinary use of the Word signifies a Compound of two Vowels, but those in ordinary so named, are most of them nothing but only single Vowels, as ea, oo, ou, eo, ai, in the Words teal, tool, tould, people, main, &c. That these are but single Sounds will appear, if we consider the Sounds of the Vowels singly, that make those supposed Compositions, and then whether those Sounds in Composition will make out the true Sound required; so as both of them may be clearly discerned in these pretended Compounds. For instance; in ea in Teal.

Consider the Sound of e in the Word sent, or in the Word scene; and a in the Word ball, or in the Word and, or in the Word tale, and then whether e, in either of the two Sounds going before, and a in either of the three Sounds following joyned together, will make out the true Sound of ea in the Word teal, if not, then is it a single Sound; thus, if you proceed to examine all the other, you will I doubt not find the same event, and I believe the true Diphthongs and Triphthongs of the Greeks were no other but a true expression of the single Vowels they joyned together, but in so short a time, as both or all three were express'd in the time that ordinarily one single Vowel was express'd.
Of Consonants.

The whole number of Consonants are these undermentioned, as nigh as I could collect, by examining all the Languages I am acquainted with, or have heard express'd, and I think but few; if any, single Consonants have escaped my Notice, all which in this following Table I have ranged in 11 Files, and 6 Ranks.

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The First File containeth three Consonants, the Second six, the Third and Fourth ten, the Fifth and Sixth four the seventh two, the remaining four each one, in all twenty nine Consonants.

The second Rank in each File contains Derivatives [so I shall name them] in relation to the First Rank, or their Primitives, all alike in kind, so also all the Derivatives in the Third Fourth and Fifth Ranks, whereby their Sounds will be the better comprehended.

Those
Those places filled by two strokes (=) signify that Sounds may be express'd by the same posture of the Mouth with their Primitives, answering in kind to those in the same Rank wherein they stand, but they would be so like in pronunciation to some others in the Table, that the difference would be too nice for common discernment, and also for that I have not observed them used in any Language I have heard express'd by a perfect Mouth, I thought it needless to characterize them.

As those of the Fourth and Fifth Rank in the First File are like those of the Fourth and Fifth Rank in the Fifth File, & those of the First, Second, & Third Ranks in the Fifth File, are like those of the same Ranks in the First File, so those of the First, Second, Third Ranks in the Sixth File, are like those of the same Ranks in the Second File.

Some of these above-mentioned twenty-nine single Consonants, are vulgarly supposed compounded, as th, ch, sh, gn, ng, &c. But if you consider the Sound of each single Consonant in the Composition apart, and then the Conjunction of them in that order, so as the single Sounds may be clearly discerned in the Composition, you will never make the Sounds required, and if neither by this nor by any other Conjunction the required sound can be made out, it must be a single and no compound Sound.

Whereas these single sounds, vulgarly described as Compounds, ought to have single Characters and Secondly, that some of the single Characters have in the same Language a different Sound, as c in the Words, can, mice; g in the Words George, Game, &c. and also a different Sound in different Languages, as I Consonant differently express'd in several Languages, as in English, Low Dutch, French, Spanish: and Thirdly, that some single Sounds are differently characterized in the same Language, as the Sound of / in same, and c in mice; (the same Sound by two different Characters;) so also c in can, and k in kind the same, &c. and the same also in different Languages, as ch in the French Word chose, and sh in the Word shall, the same, &c. It will be impos-
ible in the use of the present Characters or Alphabets, to add those wanting, and to correct and limit the Sound of others in use; thereby to constitute a perfect Alphabet, because people so long accustomed, or habituated to such corrupt and differing Expressions of the present Characters, will be always subject on the sight of the old, to give them those Sounds they have been used to, and to spell words according to their old and corrupt Custom, whatsoever Rules shall be set to the contrary; and therefore there will be a necessity of a whole new Set of Characters, both of Vowels, and Consonants.

Hitherto I have endeavoured to make a Collection of all the single Vowels and Consonants, which are used in any Language; in which, if I have not collected all those that are, yet in the method I have used therein, I hope I have attained higher to it, than any other Collection extant. I have likewise shown the necessity of a new Set of Literal Characters, & such a one is this I here propose; First the Set of Consonantal Characters, are to be seen in the top of Page (137) being ranged in the same method & order with those in the foregoing Table. The first Rank in every file are those I name Radical Characters, the other succeeding Ranks have each a distinguishing Characteristical Addition to distinguish them one from another, which causeth some complication; but yet I judged it necessary to express the same in the Character, the more regularly to sort them into Classes, and to express the derivation of Letters of the same Organ, the one from the other.

The Set of Vocal Characters is likewise in the same Page with the Consonants; in writing they are to be placed over the Consonants, which they follow in Expression; and whereas some Syllables begin with a Vowel, place the 12th Consonantal Character, answering to the Hebrew, Aleph; and over the same place the Vowel beginning such a Syllable.

This Character may seem somewhat to oblige for dispatch in ordinary Writing, but the reader will be
the fame with that now used, and I only designed it for
that purpose, but for the Pen, others more convenient may
be invented.

To distinguish the long Vowel from the short, add a
prick to the Vocal Character.

The 9.11.12.13.14th. vocal Characters, are (for want of
single strokes) compounded of the first and second.

The Diphthongues truly such (as I have before noted in
the first Part) may be made by the Conjunction of the
Single Vocal Characters in the order as they follow, and
will be easily distinguished from the 5 foregoing compound-
ed Characters of the single Vowels, because there will not
lightly occur any Diphthongs compounded of the first two
Vowels.

The Accent may be a thwart line under the Syllable
that is to be accented.

The 4 Marks of pauses ordinarily used, namely , ; , , may be continued.

The Characters signifying the various Modes of Expression
may be these following, and ought to be placed at the be-
ginning and end of every Sentence requiring it.

[ ] Explication. [ ] [ ] Interrogation.

( ) Parenthesis. ! ! Wonder.

A Second Essay concerning the Universal Primer.

As the present Alphabets are imperfect, (as in the foregoing Essay is declared,) so are also the Primers or first Books, wherein Children and others are Taught to Spell and Read, first in not having a perfect Alphabet. Secondly, in not being digested in such a Method as is fit and proper to teach them, as they ought to be taught, for the usual way of teaching to spell, is to dismember every syllable (of more than one Letter) into many Syllables, by expressing every Letter apart, and Syllabically, and the Consonants with such a Vowel as they are ordinarily named with, and then requiring them to join these Syllables into one word, but how preposterous this method is, one instance for all will manifest, suppose the monosyllable Brand be to be spell’d, they will teach them thus to dismember it Bee, er, a, en, dee, and then require them to join these into one Syllable, which it is impossible to do, and they must be necessitated as they have begun, to express this one Syllable by five Syllables, which was not designed, whereas they should teach them to express every Syllable entire at first sight, without dismembering it. And to do this, they must proceed gradually, first beginning with the most simple Syllables, and so by degrees proceeding to the more difficult and Compound, till they can readily pronounce a whole Syllable at first sight, even the most difficult that are.

To that end, let all the Primers be thus contrived; at the top of the leaf, let all the Vowels be placed singly in order as they follow in one Rank, and under the same place, Syllables, first, of one Vowel and one Consonant, following it throughout all the Variations; then of one Consonant and one Vowel following, 2dly, of two Consonants before, and one Vowel following through throughout the Variations, 3dly, of one Vowel and three or four Consonants
sonants following. And of three Consonants going before, and one Vowel following. 4thly of one, two or three Consonants going before a Vowel, and one two, three, or four Consonants following. 5thly, of some Syllables with Diphthong or Triphthongs. For Instance,

a e i o u &c.
ab. eb. ib. ob. ub. &c.
ad. ed. id. od. ud. &c.
ba. be. bi. bo. bu. &c.
ald. eld. ild. old. uld. &c.
dra. dre. dri. dro. dru. &c.
balm. belm. bilm. bolm. bulm. &c.

After this place, a number of words of two, three, or four Syllables, from the more easy to the most difficult expressions, without heed to their Significations.

Further let there follow some words of several Syllables, with the Accent Various placed, as on the first, second, third, &c.

Let there be two or three small Discourses writ with this Alphabet, in so many several Languages, with the Accent rightly placed, and truly distinguished by their pauses. And thus you have a perfect Primer for the Design.

Of teaching with this Primer.

First, begin to teach them the true sound of all the Vowels singly, then proceed to the following single Syllables, beginning with the easiest of Expression, and so proceed on gradually to the most difficult, and then to the words of more Syllables, and lastly, to the use of the Accent and Pauses when the learner hath past all these, you may exercise him in the reading of the following Discourses, and therein let
him exactly observe the Accent and the Pauses, and hitherto it will not be Material, whether the Syllables be significant or not, or whether they understand the small discourses or no, for hitherto we suppose them by this instruction, only capable of Reading or uttering exactly whatsoever is written in this Alphabet and Character, in what Language forever, which is the design of this Primer.

And to gain a greater readiness and habit herein, teach them to write truly what they hear distinctly expressed, according to this Alphabet, proceeding therein gradually as before, and rightly to place the Accent and Pauses, and also the use of the Signs of the different modes of speaking.

In Teaching, Observe these necessary Rules.

1. Proceed leisurely and orderly. Suffer them not to pass by any mispronunciation uncorrected, from the beginning to the end, cause them so oft to repeat a wrong pronunciation, till with your assistance they pronounce it truly, allowing for the natural defects in the Speech of some persons, the younger will learn these pronunciations more easily, but the elder may attain them also, although with more difficulty.

2. Suffer them at no hand in spelling, to dismember any Syllable by repeating the Letters singly, but that they pronounce them whole as they find them.

Think not this method tedious, the end will crown and reward the labour, and what the learner hath thus attained and habituated himself to, will remain with him all his life time.

This new Primer will without change except in the Title, be the same for all Nations and Languages.

The following Page gives the Alphabet and Character mentioned in this Discourse, with the Lords Prayer in English, written therein as a Specimen.
# The Universall Alphabet

## The Table of Consonants

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## The Table of Vowels

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## The Lords Prayer in English

*...*
Some further Remarks on the Instrument proposed by an Anonymous French Author, for effecting a perpetual Motion, an account whereof is given in No. 177 of these Transactions, by Dr. Papin. M.D.: R.S.S.

Having seen in the Journal des Scavans of May 13th. and in the Nouvelles de la République des Lettres of the Month of June, that the Author of the Perpetual Motion is not satisfied, but doth endeavour to answer the Objection that I propounded against his contrivance, in the Philosophical Transactions of the Month of December, 1685. I find I must explain myself more at large than I did in that Paper; but I beg his pardon if I say nothing concerning the new disposition, which he says might be given to his Engine: My want of time makes me avoid new matters of dispute, and I think it enough for me, if I do but shew that his first Description can never succeed.

I am very sorry, that this Author took so much trouble in trying his Bellows with several Liquors, as Oyl, Mercury, Water. I thought I had said nothing, that might make him believe, that I did in the least question the truth, which he intended to prove against me by those Experiments; and without any trials I am fully enough convinced, that the Mercury in his Engine must follow the laws of the equilibrium of fluid Bodies: But the consequence which he draws from that Principle, seems to me very groundless; for altho' the lowest part of the Bellows be press'd by the weight of 40 inches of Mercury, it doth not follow, that all the parts which are situated higher must bear the same pressure: To the quite contrary, it is plain that the upper part having no Mercury above it bears none at all; the parts that lye in the middle near the Axes of the Bellows, bear but 20 inches, and so all the rest must bear more or less, according as they lye higher or lower: It is evident therefore, that there are a
as many parts that bear less then 20 inches, as there are that bear more, and the increase of pressure following an Arithmetical Progression, it is undeniable, that all these pressures added together, will do no more than one uniform pressure, that would be equal to 20 inches every where.

Having thus found the quantity of pressure caused by the Mercury within the Bellows, we must remember that the pressure of the Atmosphere within the same Bellows, is equivalent but to 5 inches, as I observed in my first Paper, vid. Philosophical Transaction No. 177, pag. 1241: So that we find that the inward pressure is equivalent but to 25 inches of Mercury in all. Now the pressure of the Atmosphere upon the outside is every where equal to 27 inches; from whence it appears that the pressure without is stronger than the pressure within, and so I had reason to say, that the Bellows standing upright, must rather shut than open.

I did not think to have given this Computation so at large, but I have been necessitated to do it, (as I said in the beginning,) since my first Paper was not sufficient to make me be understood by the Author of the Perpetual Motion, however, I will be careful to save the time of the Reader as much as I can; and although I might observe some other things in his Description, that will increase the difficulty of opening the Bellows, I forbore to speak of them; and I will stick only to that which is most material, and makes his Perpetual Motion to be altogether impossible.

As for the Argument the Author draws from comparing his Engine to an ordinary Siphon; I do beseech him to consider what a difference there is between a Siphon that lets the water run down at the bottom, and his Engine, that should gather up the heavy liquor into the highest part of the instrument, and I do not question but he will acknowledge the weakness of this Argument.
A short Examen of the Stones sent the R. Society from Berne, whereof an account is given in the last Trans-
action: By Frederick Slare M.D.R.S.Soc.

Those that have made Experiments in Hydrostaticks, do find all pure Metals to have Specifick and peculiar
Gravities to themselves, and those very differing one from
another. From this hint I formerly endeavoured to disco-
very the Nature of the Calculus Humanus (which I found to
have no attributes that are proper to a real Stone) and bring-
ing them to a Hydrostatical Test, I found them very differing
in their specifick Gravity, and very remote from an equal
proportion to their bulke of common Stone, when weigh-
ed in Water. After the same manner in order to the better
inquiry into the Nature of this Helvetian Concretion, I made
it my first attempt to compare it with its Relative Pondus
to Water, having first of all satisfyed my self that there is a
certaine Term of Gravity that all true and genuine Stones
( the which are a sort of Natural Vitrifications ) do meet in
or arrive at: That is, that there is a Standard of Gravity so
competent to all real Stones, that where they decline from
this Standard, we have good reason to question those Concre-
tions, whether they are Stones or no. The Standard of
Gravity for real Stones I find to be generally about two to
one of the common Fluid, that is the bulke of the former, to
answer double the bulke of the latter, and a little more. In
our Examen of this Concretion, this Stone was very hard and
seemingly heavy, but being brought to the Hydrostatical
Tryptal, it was very Spungy, for when it lay under Water,
there palled a good while before I could clear it of the lurk-
ing bubbles, so that it grew heaver, from time to time as
the bubbles were expeld, and at last arrived near the Stan-
dard of a true Stony Concretion, or rather somewhat beyond

This
This Stone sent us for thirteen Dramms, must either have been Averdupois, or else is wasted something, for I found it only to weigh

| In the Air | 12 dr. | 36 gr. |
| In Water   | 6 dr.  | 48 gr. |

The difference betwixt the weight of this Stone so called, in the Air and in Water comes to

\[
\begin{align*}
\text{In the Air} & \quad 12 \text{ dr.} - 36 \text{ gr.} \\
\text{In Water} & \quad 6 \text{ dr.} - 48 \text{ gr.}
\end{align*}
\]

The proportion betwixt this Concrete and Water, proves to be as 756 to 348, or as two and somewhat more than a sixth to one. This extraordinary Pondus or Gravity makes the matter of a greater consideration, and worthy our further Inquiry whether there be not some Metallick Ingredient in it.

Whilst I was making these Tryals, I was willing to compare this matter with common Chalk, which I found specifically lighter, bearing only the proportion to Water of 521 to 292, considerably short of that of 2 to 1. Shells and Tectaceous Bodies do very near agree with this matter; which takes off the former opinion that this Patient, had perhaps devoured Wall, Lime, and such like Tectaceous Matter, from whence the Stone might receive its original: For this being broken into pieces, will not so easily cement again into so compact a Body as it was formerly of, as we see in Whiteing that is lighter than Chalk: Wherefore this being vastly heavier than Chalk, can scarce be thought a Concretion of such a matter.

I then compared it with petrified Water, being an Icecle that was broken off a Grotto, where the petrifying Spring did furnish enough. This came very near the Gravity of our Rarity, and the usual weight of ordinary Stones; a piece that weighed five drams out of the Water, discovered its weight to bear the proportion of 403 to 184, or 756 to 345 to that of Water. This Anomalous Substance being so near the weight of our petrified Water, would almost incline
cline a Man to believe it real Stone, and the rather, because we are informed the Patient Drank much Water. Moreover, the following Experiments upon this matter, do seem to give proof of its being rather of the ordinary Stony Constitution, than of that which is proper to Animal Concretions. For Instance, we first of all poured upon it ordinary Vinegar, and it presently wrought upon it with a hissing noise, as it did on the petrified Water when powder'd. We poured on it Spirit of Vitriol, and that also wrought upon it and dissolved it, but let it fall again, as Aqua-fortis does Tinn when it has corroded it; which is agreeable to the Relators' Account.

But I do not find he used Spirit of Salt, for this wrought upon it very vigorously, and presently dissolved it, and kept so without any Precipitation.

These Experiments do all of them distinguish this Concret (whatever it be) from the ordinary Animal Ones, as the Stone in the Bladder, Kidney, the Tophi, &c. for these will not be dissolved, or in the least corroded by any of the mentioned Acids: The Spirit of Nitre be a general Menstruum, that dissolves them all readily.

There are some things yet very strange, which make this Case peculiar: Namely that those Stones which are generated in the habit of the Body, I mean in the very serous part of the Blood, and those that passed the Bladder have just the same Nature, with those that are extra habitum, even those evacuated ex Stomacho and ex Ano: for one as well as the other will be presently corroded, by so mild an Acid as plaine Vinegar.

The Relator in his Analysis of these Stones, gives an Account of so great a quantity of Volatile and fixed Salt obtained by his distillation, that those trying do necessarily make it an Animal Substance; which Experiment so far failed us, that I am not satisfied as to the matter of Fact.

Thus we must at present leave the Discovery imperfect, for according to the Description the Case is very Singular; espe-
especially as to those Concretions generated extra Habitum in the Stomack and Guts: That thefe should abound with Volatile Salt is strange, I have tryed the Bezoar Stone said to be generated in the Stomacks of fome Animals, and could obtain no Volatile Salts from that Substance; though it herein agree with this Substance, that it is easily wrought on by many Acids.

A Short Review.

We need not much doubt, though it be not mentioned, that those cragged and large Stones, were ejected per Anum, for the Oesophagus could not possibly pass them.

The Stone in the Kidney is often fo foff, that it answers the Cylindrical Figure of the Ureter, but these are much harder, and do not in any measure comply with the Conftriction of the Bowels.

We may in fome measure queftion that principle, or rather Hypothefis of Acidum, our Correfpondent trusts to, for the Combination or Coagulation of the Humors in the Body, in order to this Petrifaction; it being fuppofed not proved.

We may also queftion whether the fift or Alcalizate Salt, found in the Caput Mortum after Distillation, were really pre-exiftent in that forme in the Blood, or other Humors, and not rather a product of the Fire.

It may not be impertinent to inquire after fome metallick particles, whether they may not be an Ingredient in this ponderous Stone, especially since Dr. Lifter has found them in much lighter Concretions, as thofe of the Kidneys are. For though we find them not in this unprepared Stone, yet after Reverberation or a ftrong Calcination, many bodies have detected an Iron Contexture. The Marchafite it felf, though very pregnant with Iron, fhou’d it not, till it has been calcined: which fhall be done with fome of the remainder, after the Tryall by Distillation.
To deviate a little, though not from a Proposition made before the *Royal Society*, which was to endeavour what we could, to reduce bodys to such setled Standards, as might somewhat represent their Natures, and free us from false and confused Conceptions of *Things*, or give us an account of some bodies, whose Natures we are doubtful of. In a small Treatise of the *Calculus Humanus*, I found reason to complain of the Imposition of our Senses upon our Conceptions in calling that a Stone by its external appearance, when it has no real properties of a Stone. I have also, in this, Reason to except against *Chalke*, (commonly taken for a Stone,) for being brought to the *Hydrostatical Examen*, (if that may be allowed as a Standard;) it wants much of the true Conistency of a Stone, as the Calculation mentioned does manifest. For it wants much of that weight, which real Stones are proved to have in Water, and it may perhaps be better reckon'd amongst *Boles* than *Stones*. I found this true, not only in Chalk, but various other bodies taken for granted to be Stones at large: some of which are nearer *Earths* than *Stones*; others have nothing but *Earth* and *Sulphur* and *Metall*, and yet must be called Stones, (as all *Marchasites* are.) Of these the former, (namely the *Boles*) many of them fall short of our Standard, others are more ponderous and so exceed our Standard, whereas true *Stones* though differing much in hardness, whether Pebbles, Flints, petrified Waters, &c. do answer the same Standard of Specific gravity that a Diamond does. But that these natural bodies should as exactly agree, as Metalls do, when they are by art separated from all *Heterogeneity*, cannot be expected in Compound Bodies, though I doubt not but much use may be made of it by those that are more accurate:
A further Tryal of the said Stones by Chymicall distillation. By the same.

We brought this Stone to a gros powder, and conveyed it into a coated Retort, which coated Retort was kept for some Hours in a naked Fire, so hot that the Glafs melted.

The quantity we put into the retort amounted to half an ounce, twenty Graines. The liquor that came over seems scarce to afford 3 or 4 drops, which looks like Spirit of Harts-horn rectified, and smells much like the same: which plainly discovers it an Animal substance though it affords much less than the Calculus Humanus does: and by consequence gives us a much larger proportion of Caput Mortuum or Residuum in the Retort. All which is very consistent with the nature of the Stone, for its Specific Gravity was much heavier than the Stones are, we usually find in the Humane body; and therefore the parts may be supposed more fix'd, or to consist of fewer volatile parts, such as are carried over by Distillation.

We weigh'd the Remainder in the Retort and it came to three Drams and fifty Graines; Ten Graines of which seem'd to hang about the neck of the Retort in the form of a dirty hard baked Oyl. The other 20 Graines are partly gone off in Vapour through the Lute, and what we find in the Receiver in a liquid form.

We tryed part of this Caput mortuum by applying Mr. Haaks strong Magnet, to enquire whether it contained any Iron Particles, but did not find any would adhere. However there remains yet one Tryal to be made, and that is to give it a much stronger Reverberation in the Fire, and then to see whether some Particles will not prove Martial, which may be done at another season.

TWO
Two Observations of the last Eclipse November 30th last, made at Nuremberg; the one by Mr. G. C. Eimmart, the other by Mr. J. Ph. Wurtzelbaur: Communicated by Mr. Theodore Haak R. S. S.

This Eclipse of the Moon was the more remarkable, for that it fell out very near the Apogeeon of the Moon, and was nearly central; so that the duration was as great as possible. But so it hapned, that neither at London, nor Greenwich, nor Paris, it could be seen by reason of thick Clouds, for the whole time intercepting the light of the Moon: The only Account we have received is already published, from Letters of the Famous Mr. Hevelius of Dantzick, in Num. 178 of these Transactions: And now these two from Nuremberg, made by the Industrious Observers Mr. Eimmart and Mr. Wurtzelbaur.

The Observation of Mr. Eimmart was as follows.

9h. 19. min. the Penumbra was very obscure, and the beginning of the Eclipse was at hand.

9h. 23m. 30s. the Eclipse was begun, the quantity almost half a digit, and the distance between the cusps was about 42 degrees of the Moon's limb, and Palus Mareotis was just all Eclipsed; hence we may conclude the beginning about 9h. 21m. 30s.

10h. 23m. 30s. as near as I can collect from the Observators words, was the time of the total Immersion into the shaddow; to verifie which, the Azimuth of the Moon's center was observed to the East, 41 gr. 48 m. 2 min. 12 sec. of time after the said Immersion.

12h. 13min, or 10m. 13 sec. before the Culmination of the right shoulder of Orion, was the Emersion or first appearance of the Moon out of the total Darkness.

13h. 14min. was the just end of the Eclipse, being 2m. 20 sec. before the Culmination of Sirius or the great Dogg.

Whence
Whence the middle of this Eclipse should have hapned at 11h. 18min. P. M. at Nuremberg: the total duration 3h. 52min. 30sec. and the total darkness 1h. 49m. 30s.

The Meridian Altitude of the Moon's upper limb was observed 63gr. 23m. 50sec. and the Moon's apparent Diameter while totally Eclipsed was found 30m. 7sec.

The other Observer Mr. Wurtzelbaur made use of the Pendulum Clock, corrected by Altitudes. According to his Observation.

9h. 23m. 30sec. was the beginning of the Eclipse, at about 119 degrees of the limb of the Moon in Hevelius's Selenography.

9h. 24m. 50sec. Palus Mareotis was all covered.

10h. 25m. 20sec. The Total Immersion; about the 299th degree of the limb of the Moon.

12h. 11m. 30sec. The Moon began to Emerge out of the shadow, about the 112th degree of her limb.

13h. 14m. 30sec. The End of the Eclipse about the 295th degree of the limb.

By these Observations the middle of the Eclipse ought to have been about 11h. 19m. P. M. at Nuremberg, differing but one minute from Mr. Eimmarts Observation. The duration will be 3h. 51min. and the total Darkness 1h. 46m. The Longitude of Nuremberg has been formerly stated 11 degrees from London, & since found to be so by Observations of the last Eclipse of the Sun July 2d 1684, which made it 44 1/2 min. of time. So that the middle of this Eclipse at London should have been 10h. 34 1/2m. which from the Observation of Mr. Hevelius had been formerly concluded 10h. 35m.

An Extract of a Letter written from Aramont in Languedoc near Avignon, giving an account of an extraordinary swarm of Grasshoppers in those parts; communicated by Mr. Juftell R. S. S.

Since you demand of me a Relation of the Grass-hoppers that have eaten up our Harvest the last Year, and which give
give us so much trouble to destroy them this, I will do what I at present can to satisfy you. These Insects are undoubtedly of a peculiar species, although to look on them, they appear in nothing different from the common sort, but they take their flight like Birds, which is particular to them. They are much about an Inch in length, of a Grey Colour; The last Year the Earth in some places was covered 4 fingers thick with them in the morning before the heat of the Sun was considerable, but as soon as it begun to be hot, they took wing and fell upon the Corn, eating up both leaf and ear, and that with such expedition, by reason of their great number, that in three hours they would devour the Corn of a whole field, which you will hardly conceive unless you had seen it, after which they again took wing and their swarms were so thick, that they covered the Sun like a Cloud, and were whole hours in passing. They flew against the Wind, and went over the Castle which is very high, and seas’d upon another field of Corn which they destroyed like the former. After having eaten up the Corn, they fell upon the Vines, the Pulte, the Willows and even the Hemp notwithstanding its great bitterness. Afterwards about the end of August they ceased flying, and copulated, and the Female stuck her tayle into the hard Earth where the cast a foam, and made therewith in the ground, a hole as big as that of a Goosè quill, and about an Inch long, wherein the laid her Eggs, which are much of the size of Miller feed, there would be sometimes 50 of these Eggs in a hole, which are so covered over with the same Earth that the Water does not get in. After this all these Insects died and flunk very much. They begun this Year to hatch in the Month of April, and some there are, that are not yet hatch-ed. In March, we thought upon destroying their Eggs which lye not above a fingers breadth in the Earth, and we took of them 180 Quintals being 9 Tuns: it had been well if we had thought of this expedient sooner. Since their hatching they have taken above 15 Tuns of the young Grass-hoppers
hoppers which are not yet bigger than flyes. There are yet a multitude that have escaped us because they are in the Corn which is too forward to be gone into, without spoiling it. They have undone the People of our parts, who had no Harvest the last Year, and it will cost above 3000 Livers to destroy them this year. They have taken them in Abundance in the Neighbouring Villages. If this care had not been taken, there would have been enough of them to have eaten up the Corn of the whole Province.

Whereas in the last Transaction an Historical Account was promised of the Trade Winds, the Patience of the Reader is entreated till the next; for by reason of the Absence of a Person extraordinarily knowing in this Matter, whose Information was thought necessary, the said Account could not as yet be perfected.

Erratum in Num. 181. Pag. 112. l. 6. r. a Northerly Wind, and in Scotland a Southerly.

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THE CONTENTS.

1st. An Extract of two Essays in Political Arithmetick concerning the comparative Magnitudes, People, and Wealth of the Cities of London and Paris, tending to prove that at this day the City of London is the most considerable upon the face of the Earth. by Sr. William Petty Knight. R. S. S.

2. An Historical Account of the Trade Winds and Monsoons, observable in the Seas between and near the Tropicks, with an attempt to assign the Physical Cause of the said Winds, by E. Halley.


4. An uncommon Inscription lately found on a very great Basis of a Pillar, dug up at Rome; with an Interpretation of the same, by the Learned Dr. Vossius.

5. Several Observations of the Eclipse of Jupiter by the Moon on March the 31st. 1686. St. Vet. (whereof some account has already been given in Transaction. No. 181.) viz. of Mr. Cassini at Paris, of P. Boufa at Avignon, of Mr. Zimmerman and M. Wurtzelbauer at Nurenbarg.

6. A Letter of the famous M. Hefvelius, Couful of Dantzick to the R. Society, containing his Observation of the same Eclipse at Dantzick.

An Extract of two Essays in Political Arithmetick concerning the comparative Magnitudes, &c. of London and Paris, by Sr. Wm. Petty Knt. R.S.S.

The excellent Author of these two Essays, has in several former of the same Nature made it appear that Mathematical Reasoning, is not only applicable to Lines and Numbers, but affords the best means of Judging in all the concerns of humane Life. In the present he endeavours to prove London, as it now is, the most considerable City now in being, by shewing it much to exceed Paris, (which not only the French but foreigners have asserted to be the chief City of Europe.) both in People, Housing, and Wealth: The first by comparing the Bills of Mortality, whereby he finds that the People of London are as many as those of Paris and Rouen put together. The second by comparing the number of Houses, which by the Chimney-Books are found above 80000 in London, whereas a great Author among the French, (who seldom fails to magnifie their own things,) reckons but 50000 Houses in Paris. As to the third, to wit the Wealth, he conceives that there is yet a much greater disproportion, there being no comparison between them for Trade, and besides a good argument drawn from the Law-Suites of both places, he concludes from the Paris bills of Mortality, that two 5ths of the People of Paris are so poor that they chuse rather to die in Hospitals, than lie sick at their own Charges; and that a third of the whole People of that City, die out of the most wretched Hospitall of L'Hôtel Dieu; whereas at London there dies scarce one in fiftie in our Hospitalls. Hereupon in the second Essay, our Author extends his Charity to those poor wretches, shewing how by a reasonable expence, 3000 persons might be then saved per Annum, who die for want of good accommodation. The whole is so close writ, that it will not bare Epitomizing, wherefore I rather recommend it to the Curious who cannot but be satisfied therewith.
An exact Relation of the constant and Periodical Winds, observable in several Tracts of the Ocean, is a part of Natural History not less desirable and useful, than it is difficult to obtain, and it's Phenomena hard to explicate: I am not Ignorant that several Writers have undertaken this subject, and although Vareninus (Lib. I. Chap. XXI. Geo. Gen) seems to have endeavoured after the best information from Voigers, yet cannot his accounts be admitted for accurate, by those that shall attentively consider and compare them together; and some of them are most evident mistakes; which, as near as I can, I shall attempt to rectify, having had the opportunity of conversing with Navigators acquainted with all parts of India, and having lived a considerable time between the Tropicks, and there made my own remarks.

The substance of what I have collected is briefly as follows.

The Universal Ocean may most properly be divided into three parts. viz. 1. The Atlantick and Ethiopick Sea: 2. The Indian Ocean: 3. The Great South Sea or the Pacifick Ocean; and tho' these Seas do all communicate by the South, yet as to our present purpose of the Trade Winds, they are sufficiently separated by the interposition of great tracts of Land; the first lying between Africa and America, the second between Africa, and the Indian Islands and Hollandia Nova; and the last, between the Philippine Isles, China, Japan and Hollandia Nova on the West, and the Coast of America on the East. Now following this natural division of the Seas, so will we divide our History into three parts, in the same order.
I. In the Atlantic and Ethiopic Seas, between the Tropicks, there is a general Easterly Wind, all the Year long, without any considerable variation, excepting that it is subject to be deflected therefrom, some few points of the Compass towards the North or South, according to the position of the place. The Observations which have been made of these deflections, are the following.

1. That near the coast of Africa, as soon as you have passed the Canary Isles you are sure to meet a fresh Gale of N.E. Wind about the Latitude of 28. degrees North, which seldom comes to the Eastwards of the E.N.E. or passes the N.N.E. This Wind accompanies those bound to the Southward, to the Latitude of 10 North, and about 100. Leagues from the Guinea Coast, where till the 4th. degree of North Latitude, they fall into calmes and Tornadoes, of which more hereafter.

2. That those bound to the Caribbe Isles, find, as they approach the American side, that the aforesaid North-East Wind, becomes still more and more Easterly, so as sometimes to be East, sometimes East by South, but yet most commonly to the Northward of the East a point or two; seldom more. 'tis likewise observed, that the strength of these Winds does gradually decrease, as you faile to the Westwards.

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

4. That from the Latitude of 4 degrees North, to the aforesaid limits on the South side of the Equator, the Winds are generally and perpetually between the South and East, and most commonly between the South-East and East, observing al-
always this Rule, that on the African side they are more Southerly, on the Braslian more Easterly, so as to become almost due East, the little deflection they have being still to the Southwards. In this part of the Ocean it has been my fortune to pass a full year, in an employment that obliged me to regard more than ordinary the Weather, and I found the Winds constantly about the South-East, the most usual point $S E b E$; when it was Easterly it generally blew hard, and was gloomy, dark, and sometimes rainy weather; if it came to the Southwards it was generally Serene, and a small gale next to a Calme, but this not very common. But I never saw it to the Westwards of the South, or Northwards of the East.

5. That the season of the Year has some small effect on these Trade Winds, for that when the Sun is considerable to the Northwards of the Equator, the South-East Winds, especially in the straight of this Ocean (if I may so call it) between Brasile and the Coast of Guinea, do vary a point or two to the Southwards, and the North-East become more Easterly; and on the contrary when the Sun is towards the Tropic of $w$, the South-Eastly Winds become more Easterly, and the North-easterly Winds on this side the Line were more to the Northwards.

6. That as there is no general Rule that admits not of some exception, so there is in this Ocean a tract of Sea wherein the Southerly and S. West Winds are perpetual, viz. all along the Coast of Guinea, for above 500 Leagues together, from Sierra Leone to the Isle of St. Thomas; for the South-East Trade-Wind having passed the Line, and approaching the Coast of Guinea within 80 or 10 Leagues inclines towards the shore, and becomes S. S. E. and by degrees, as you come nearer, it varies about to South, S. S. West, and in with the land Southerly, and sometimes West South-West; which variation is better expressed in the Map annexed, than it can well be in words. These are the Winds, which are observed on this coast when it blows true

U2
true, but there are frequent Calms, Violent suddain Gults called Tornado's, from all points of the compas, and sometimes unwholsome foggy Easterly Winds called Hermitaas by the Natives, which to often infest the Navigation of these parts.

7. That to the Northwards of the Line, between 4 and 10 degrees of Latitude, and between the Meridians of Cape Virde, and of the Easternmost Islands that bear that name, there is a tract of Sea wherein it were improper to say there is any Trade Wind, or yet a Variable; for it seems condemned to perpetual Calms, attended with terrible Thunder and Lightning, and Rains so frequent, that our Navigators from thence call this part of the Sea the Rains: the little Winds that are, be only some suddain uncertain Gults, of very little continuance and less extent; so that sometimes each hour you shall have a different Gale, which dies away into a Calme before another succeed; and in a fleet of Shipps in fight of one another, each shall have the Wind from a several point of the Compass; with these weak Bries Shipps are obliged to make the best of their way to the Southward through the aforesaid six degrees, wherein it is reported some have been detained whole months for want of Wind.

From the three last observables is shown the reason of two notable occurrences in the East-India and Guinea Navigations. The one is, why notwithstanding the narrowest part of the Sea between Guinea and Brasil be about 500 leagues over, yet Shipps bound to the Southward sometimes, especially in the months of July and August, find a great difficulty to pass it. This happens because of the South-east Winds; at that time of the year commonly extending some degrees beyond the ordinary limit of 4 degrees North Lat. and withall they come so much Southerly, as to be sometimes South; sometimes a point or two to the West; there remains then only to plie to Wind-ward, and if on the one side they stand away W. S. W. they gain the Wind still more and more Easterly, but there is danger of not weathering the Brasilian shore, or at least the shoals upon that Coast. But
But if upon the other tack they go away E. S. E., they fall into the neighborhood of the Coast of Guinea, from which there is no departing without running Easterly, as far as the Isle of St. Thomas, which is the constant practice of all the Guinea Ships, and which may seem very strange without the consideration of the sixth remark, which shews the reason of it. For being in with the Coast, the Wind blows generally at S. W. and W. S. W., with which Winds they cannot go to the Northward for the Land, and on the other tack they can lie no nearer the Wind than S. S. E. or South; with these courses they run off the shore, but in so doing they always find the Winds more and more contrary; so that when near the shore they could lie South; at a greater distance they can make their way no better than S. E. and afterwards E. S. E., with which courses they fetch commonly the Island of St. Thomas and Cape Lopez, where finding the Winds to the Eastward of the South, they keep them favourable by running away to the Westward in the South Lat. of 3 or 4 degrees, where the S. E. Winds are perpetual.

For the sake of these general Winds, all those that use the West-Indian Trade, even those bound to Virginia, count it their best course to get as soon as they can, to the Southwards, that so they may be certain of a fair and fresh gale to run before it to the Westwards; and for the same reason those homewards bound from America, endeavour to gain the Latitude of 30 degrees, as soon as possible, where they first find the Winds begin to be Variable; though the most ordinary Winds in the Northern part of the Atlantick Ocean come from between the South and West.

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

What is here said, is to be understood of the Sea Winds at some distance from the Land; for upon and near the shores, the Land and Sea Brizes are almost everywhere sensible; and the great Variety which happens in their Periods, Force, and Direction, from the situation of the Mountains, Valleys, and Woods, and from the various texture of the Soil, more or less capable of retaining and reflecting Heat, and of exhaling or condensing Vapours is such, that it were an endless task, to endeavour to account for them.

II. In the Indian Ocean, the Winds are partly General, as in the Æthiopick Ocean, partly Periodical, that is half the Year they blow one way, and the other half near upon the opposite points; and these points and times of shifting are different in different parts of this Ocean; the limits of each tract of Sea, subject to the same change or Monsoon, are certainly very hard to determine, but the diligence I have used to be rightly informed, and the care I have taken therein, has in a great measure surmounted that difficulty, and I am persuaded that the following particulars may be relied upon.

1. That between the Latitudes of ten Degrees and thirty Degrees South, between Madagascar and Hollandia Nova, the General Trade Wind about the S. E. by E. is found to blow all the Year long, to all intents and purposes after the same manner as in the same Latitudes in the Æthiopick Ocean, as it is described in the 4th. Remark aforesaid.

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

3. That to the Northward of 3 Degrees South Latitude, over the whole Arabian or Indian-Sea and Gulph of Bengal, from Sumatra to the Coast of Africa, there is another Monsoon, blowing from October to April upon the North East Points; but in the other half Year, from April to October, upon the opposite Points of S. W. and W.S.W. and that with rather more force than the other, accompanied with dark, rainy weather, whereas the N. E. blows clear; 'tis likewise to be noted, that the Winds are not so constant, either in strength or point, in the Gulph of Bengal, as they are in the Indian-Sea, where a certain steady Gale scarce ever fails. 'Tis also remarkable, that the S. W. Winds in these Seas are generally more Southerly on the African side, more Westerly on the Indian.

4. That as an Appendix to the last described Monsoon, there is a Tract of Sea to the Southward of the Equator, subject to the same changes of the Winds, viz. near the African-Coast, between it and the Island Madagascar or St. Lawrence, and from thence Northwards as far as the Line: wherein from April to October there is found a constant fresh S. S. W. Wind, which as you go more Northerly, becomes still more and more Westerly, so as to fall in with the W. S. W. Winds, mentioned before, in those Months of the Year to be certain to the Northward of the Equator: What Winds blow in these Seas, for the other half Year, from October to April, I have not yet been able to obtain to my full satisfaction, for that our Navigators always return from India without Madagascar, and so are little acquainted in this matter; the Account has been given me is only this, that the Winds are much Easterly hereabouts, and as often to the North of the true East as to the Southwards thereof.

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

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

7. That these contrary Winds do not shift all at once, but in some places the time of the change is attended with Calms, in others with variable Winds; and it is particularly remarkable, that the End of the Westerly Monsoon on the Coast of Coromandel, and the two last Months of the Southerly Monsoon in the Seas of China, are very subject to be tempestuous: The violence of these storms is such, that they seem to be of the nature of the West-India Hurricanes, and render the Navigation of these parts
parts very unsafe about that time of the Year. These Tempests are by our Seamen usually termed, The breaking up of the Monsoons.

By reason of the shifting of these Winds, all those that fail in these Seas, are obliged to observe the seasons proper for their Voyages, and so doing they fail not of a fair wind and speedy passage; but if so be they chance to out-stay their time, till the contrary Monsoon set in, as it frequently happens, they are forced to give over the hopes of accomplishing their intended Voyages, and either return to the port from whence they came, or else put in to some other Harbour, there to spend the time till the Winds shall come favourable.

III. The third Ocean called Mare Pacificum, whose extent is equal to that of the other two, (it being from the West Coast of America to the Philippine Islands, not less than 150 degrees of Longitude,) is that which is least known to our own or the neighbour Nations; that Navigation that there is on it, is by the Spaniards who go yearly from the Coast of new Spain to the Manilla's, but that but by one beaten track; so that I cannot be so particular here as in the other two. What the Spanish Authors say of the Winds they find in their Courses, and what is confirmed by the old Accounts of Drake and Candaish, and since by Schooten, who sailed the whole breadth of this Sea in the Southern Latitude of 15 or 16 degrees, is, that there is a great conformity between the Winds of this Sea, and those of the Atlantick and Ethiopick; that is to say, that to the Northwards of the Equator, the predominant Wind is between the East and North-East, and to the Southwards thereof there is a constant steady gale between the East and South-East, and that on both sides the Line with so much continence, that they scarce ever need to attend the Sails, and strength, that it is rare to fail of crossing this vast Ocean in ten weeks time, which is about 130 miles per diem; besides, as laid that Stormes and Tempests are never known in these parts: So that here is the ve-
ry best of Sailing; no want of a fresh fair Wind, and yet no danger of having too much: Wherefore some have thought it might be as short a Voyage to Japan and China, to go by the Streights of Magellan, is by the Cape of Good-hope.

The limits of these General Winds are also much the same as in the Atlantick Sea, viz. about the 30th. degree of Latitude on both sides; for the Spaniards homewards bound from the Manilhas, alwaies take the advantage of the Southerly Monsoon, blowing there in the Summer months, and run up to the Northwards of that Latitude, as high as Japan, before they meet with variable Winds, to shape their course to the Eastwards. And Schooten and others that have gone about by the Magellan Streights, have found the limits of of S. E. Winds, much about the same Latitude to the Southwards; besides a further Analogie between the Winds of this Ocean, and the Ethiopick, appears in that, upon the Coast of Peru, they are always much Southerly, like as they are found near the Shores of Angola.

Thus far matter of Fact, wherein if the information I have received be not in all parts Accurate, it has not been for want of inquiry from those I conceived best able to instruct me; and I shall take it for a very great kindness if any Master of a Ship, or other person, well informed of the Nature of the Winds, in any of the aforementioned parts of the World, shall please to communicate their Observations thereupon; that so what I have here collected may be either confirmed or amended, or by the addition of some material Circumstances enlarged. It is not the work of one, nor of few, but of a multitude of Observers, to bring together the experience requisite to compose a perfect and compleat History of these Winds; however I am not much doubtful that I have erred in, or omitted any of the principal Observables, whatever lesser particulars may have escaped my knowledge.

To help the conception of the reader in a matter of so much difficulty, I believed it necessary to adjouyn a Scheme, shew-
Shewing at one view all the various Tracts and Courses of these Winds; whereby 'tis possible the thing may be better understood, than by any verbal description whatsoever.

The limits of these several Tracts, are designed every where by prickt lines, as well in the Atlantick and Æthiopick, where they are the boundaries of the Trade and Variable Winds, as in the Indian Ocean, where they also shew the extent of the several Monfons. I could think of no better way to design the course of the Winds on the Mapp, than by drawing rows of stroaks in the same line that a Ship would move going always before it; the sharp end of each little stroak pointing out that part of the Horizon, from whence the Wind continually comes; and where there are Monfons the rows of the stroaks run alternately backwards and forwards, by which means they are thicker there than elsewhere. As to the great South Sea, considering its vast extent, and the little Variety there is in its Winds, and the great Analogy between them, and those of the Atlantick and Æthiopick Oceans, besides that the greatest part thereof is wholly unknown to us; I thought it unnecessary to lengthen the Mapp therewith.

In the foregoing History are contained several Problems, that Merit well the consideration of our acutest Naturalists, both by reason of the constancy of the effect, and of the immense extent thereof; near half the surface of the Globe being concerned. The chief of these Problems are. 1. Why these Winds are perpetually from the East in the Atlantick and Æthiopick, as likewise in the Pacifick Ocean, between the Latitudes of 30 North and South. 2. Why the said Winds extend no farther with Constancy than to the Latitudes of 30dg. 3. Why there should be a constant South-westerly Wind, upon and near the Coast of Guinea. 4. Why in the North part of the Indian Ocean the Winds, which for one half year do agree with those of the other two Oceans, should change in the other half Year, and blow from the opposite Points; whilst the Southern part of that Ocean followes the...
General Rule, and has perpetual Winds about S. E. 5. Why in these General Trade-Winds it should be always true, that to the Northward of the Equator it is inclined to the Northwards of the East; and in South Latitudes, to the Southward thereof. 6. Why in the Seas of China there should be so great an Inclination from the East to the North, more than elsewhere; with many more, which it would be much easier to propose than Answer.

But least I should seem to propose to others, difficulties which I have not thought worth my own time and Paines, take here the result of an earnest endeavour after the true reason of the aforesaid Phenomena, wherein if I am not able to account for all particulars, yet 'tis hoped the thoughts I have spent thereon, will not be judged wholly lost, by the curious in Natural Inquiries.

Wind is most properly defined to be the Stream or Current of the Air, and where such Current is perpetual and fixt in its course, 'tis necessary that it proceed from a permanent unintermitting Cause. Wherefore some have been inclined to propose the diurnal Rotation of the Earth upon its Axis, by which, as the Globe turns Eastwards, the loose and fluid particles of the Air, being so exceeding light as they be, are left behind, so that in respect of the Earth's surface they move Westwards, and become a Constant Easterly Wind. This opinion seems confirmed, for that these Winds are found only near the Equinoctial, in those Parallels of Latitude where the diurnal Motion is swiftest; and I should readily assent to it, if the constant Calms in the Atlantic Sea, near the Equator; the Westerly Winds near the Coast of Guiny; and the Periodical Westerly Monsoons under the Equator in the Indian Seas, did not declare the insufficiency of that Hypothesis. Besides the Air being kept to the Earth by the principle of Gravity, would acquire the same degree of Velocity that the Earth's surface moves with, as well in respect of the diurnal Rotation, as of the Annual about the Sun, which is about thirty times swifter.

It
It remains therefore to substitute some other cause, capa-
pable of producing a like constant effect, not liable to the
same Objections, but agreeable to the known properties of
the Elements of Air and Water, and the laws of the Motion
of fluid Bodies. Such an one is, I conceive, the Action of the
Suns Beams upon the Air and Water, as he passes every day
over the Oceans, considered together with the Nature of the
Soyl, and Scituation of the adjoyning Continents: I say
therefore, first that according to the Laws of Staticks, the
Air which is less rarified or expanded by heat, and conse-
quently more ponderous, must have a Motion towards those
parts thereof, which are more rarified, and less ponderous, to
bring it to an Equilibrium; and secondly, that the pre-
fence of the Sun continually shifting to the Westwards, that
part towards which the Air tends, by reason of the Rari-
faction made by his greatest Meridian Heat, is with him car-
rried Westward, and consequently the tendency of the whole
Body of the lower Air is that way.

Thus a general Easterly Wind is formed, which being
impressed upon all the Air of a vast Ocean, the parts impel
one the other, and so keep moving till the next return of the
Sun, whereby so much of the Motion as was lost, is again
restored, and thus the Easterly wind is made perpetual.

From the same Principle it follows, that this Easterly
Wind should on the North Side of the Equator, be to the
Northwards of the East, and in South Latitudes to the
Southwards thereof; for near the Line, the Air is much
more rarified, than at a greater distance from it; because
of the Sun twice in a year Vertical, and at no time distant
above 23dg. and a half, at which distance the heat, being as
the Sine of the Angle of Incidence, is but little short of that
of the perpendicular Ray. Whereas under the Tropicks,
though the Sun stay long Vertical, yet he is as long 47dg. off;
which is a kind of Winter, wherein the Air so cools, as that
the Summer Heat cannot warm it to the same Degree with
that under the Equator. Wherefore the Air to the North-
Towards and Southwards, being less rarified than that in the middle, it follows, that from both sides it ought to tend towards the Equator: This Motion compounded with the former Easterly Wind answers all the Phænomena of the general Trade Winds, which if the whole surface of the Globe were Sea, would undoubtedly blow all round the World, as they are found to do in the Atlantic and Ethiopick Oceans.

But seeing that so great Continents do interpose and break the continuity of the Oceans, regard must be had to the Nature of the Soil, and the position of the high Mountains, which I suppose the two principal Causes of the several Variations of the Winds, from the former general Rule: for if a Country lying near the Sun, prove to be flat, sandy, low Land, such as the Deserts of Libya are usually reported to be, the heat occasioned by the reflection of the Sun's Beams, and the retention thereof in the Sand, is incredible to those that have not felt it; whereby the Air being exceedingly rarified, it is necessary that this cooler and more dense Air should run thitherwards to restore the Equilibrium: This I take to be the cause, why near the Coaft of Guinea the Wind always sets in upon the Land, blowing Westerly instead of Easterly, there being sufficient reason to believe, that the Inland Parts of Africa are prodigiously hot, since the Northern borders thereof were so intemperate, as to give the Ancients cause to conclude, that all beyond the Tropic was made inhabitable by excess of heat: From the same cause it happens, that there are so constant Calms in that part of the Ocean, called the Raines. (described in the 7th. Remark on the Atlantick Sea) for this Tract being placed in the middle, between the Westerly Winds blowing on the Coast Guinea, and the Easterly Trade-Winds, blowing to the Westwards thereof, the tendency of the Air here, is indifferent to either, and so stands in Equilibrio between both; and the weight of the incumbent Atmosphere being diminished by the continual contrary Winds blowing from hence, is the reason that
that the Air here holds not the copious Vapour it receives, but lets it fall in so frequent Rains.

But as the cool and dense Air, by reason of its greater Gravity, presses upon the hot and rarified, 'tis demonstrative that this latter must ascend in a continued Stream as fast as it Rarifies, and that being ascended, it must disperse it self to preserve the Equilibrium; that is, by a contrary Current, the upper Air must move from those parts where the greatest Heat is. So by a kind of Circulation, the North-East Trade Wind below, will be attended with a South Westerly above, and the South Easterly with a North West Wind above; that this is more than a bare conjecture, the almost instantaneous change of the Wind to the opposite Point, which is frequently found in passing the limits of the Trade Winds, seems to assure us; but that which above all confirms this Hypothesis is the Phenomenon of the Monsoons, 'by this means most easily solved, and without it hardly explicable.

Supposing therefore such a Circulation as above, tis to be considered that to the Northward of the Indian Ocean there is every where Land within the usual limit of the Latitude of 30. viz. Arabia, Persia, India &c. which for the same reason as the Mediterranean Parts of Africa, are subject to unsufferable heats when the Sun is to the North, passing nearly Vertical; but yet are temperate enough when the Sun is removed towards the other Tropic; because of a ridge of Mountains at some distance within the Land, said to be frequently in Winter covered with Snow, over which the Air, as it passes, must needs be much chilled. Hence it comes to pass, that the Air coming according to the general Rule, out of the N. E. in the Indian Seas, is sometimes hotter, sometimes colder, than that which by this Circulation is returned out of the S. W. and by consequence, sometimes the under Current or Wind is from the N. E. sometimes from the S. W.

That
That this has no other cause, is clear from the times wherein these Winds set in: viz. in April, when the Sun begins to warm those Countries to the North, the S. W. Monsoon begins, and blows during the Heats till Oct ber; when the Sun being retired, and all things growing cooler Northward, and the Heat increasing to the South, the North-East Winds enter and blow all the winter till April again. And it is undoubtedly from the same Principle that to the Southwards of the Equator, in part of the Indian Ocean, the North-West Winds succeed the South-East, when the Sun draws near the Tropick of Capricorn; but I must confess, that in this latter occurs a difficulty, not well to be accounted for, which is, why this Change of the Monsoons should be any more in this Ocean, than in the same Latitudes in the Æthiopick, where there is no thing more certain than a S. E. Wind all the Year.

'Tis likewise very hard to conceive why the limits of the Trade Wind should be fixt, about the thirtieth degree of Latitude all round the Globe; and that they should so seldom transgress or fall short of those bounds; as also that in the Indian Sea, only the Northern Part should be subject to the changeable Monsoons, and in the Southern there be a constant S. E.

These are particulars that merit to be considered more at Large, and furnish a sufficient Subject for a just Volume; which will be a very commendable Task for such, who being used to Philosophick Contemplation, shall have leisure to apply their serious thoughts about it.

In the Journal des Scavans for Munday the 17th. of September 1685. pag. 466. Amst. Edition, we find this passage. As Perspectives of one Convex-glass make Objects appear Upright, which those of two Convex-glasses invert, and again those of three rectify; so it should seem that those of four ought to invert: And yet Experience shews us that Objects appear upright through these glasses. The Singularity of this Phenomenon obliges all Skilful in Dioptricks to inquire the reason thereof, but hitherto they have found none. Mr. Regis, who applies himself particularly to this part of Natural Philosophy, believes that he has hit upon the Reason, and makes us hope that he will suddenly Publish it.

Thus far the Journal, but it does not tell us whose remark this is, though I am apt to believe 'twas written by Mr. Regis himself, to the Publisher of the Journal.

To me this Phenomenon appears very easily explicable, from the consideration of placing Glasses in a Tube. Which is thus; after the Object-glass, the Eye-glass is placed so much distant (towards the Eye) from the Focus of the Object-glass as is the Focus of the Eye-glass; then the middle Eye-glass is placed so much distant from the Focus of the first Eye-glass, as is the Focus of this middle Eye-glass; lastly the nearest Eye-glass is placed so much distant from the Focus of this middle Eye-glass, as is the Focus of this nearest Eye-glass; and the Eye looking through them all is placed in the Focus of this nearest Eye-glass.

I say therefore first, that one single Convex-glass, cannot properly be said by itself to shew Objects erect or reverse, but in respect of placing of the Eye that looks through it. For if the Eye that looks through such a single Convex-glass X...
be placed nigher thereto, then the Glasses Focus, the Objects are erect, if the Eye be placed just in the Focus, the Objects are neither erect nor reversed, but all in confusion between both; and if the Eye be placed further from the Glasses than the Focus, the Objects are reversed. I mean here distant Objects, the Rays flowing from any point whereof may be counted to come parallel towards the Object-glass, for such Objects we are to consider when we speak of looking thro' Telescopes.

This being laid down, I assert. Secondly, that the Object-glass of a Telescope reverses the Object, both to the Eye-glass and the Eye, that looks through it: For the Eye-glass is placed farther from the Object-glass than is the Focus of the Object-glass. But the Eye-glass does nothing towards the Rectification or Reversion; the Eye being placed just in it's Focus. Thus we see that the Reveraling of Objects in a Telescope of two Convex-glasses proceeds wholly from the Object-glass and its position, and the Eye-glass has nothing to do in the Affaire; for were the Eye it self in the place of the Eye-glass it would see the Objects inverted thro' the single Object-glass.

I come now to consider the second Eye-glass placed after the first Eye-glass. (the first Eye-glass being that next the Object-glass) And here it is manifest that placing this as it ought in a Telescope, if we place our Eye nearer to this middle Eye-glass than it's Focus, the Eye sees the Objects inverted and confused: Place the Eye in the Focus, it sees the Objects all in confusion, neither erect nor reversed; for here again there is a distinct Representation of the Objects to be received on a piece of Paper, as in the Focus of the Object-glass; and the Eye being placed at any time at this place (which is usually called the Distinct-Base) sees all in confusion. But then let the Eye be placed farther from this middle Glass than its Focus (for so is the third or immediate Eye-glass, it being always distant from the middle Eye-glass, the Aggregate of both their Foci) it perceives the Objects erect and confused.

Last-
Lastly, the third or immediate Eye-glasses does nothing towards the erecting or reversing the Species, which it receives erect from the middle Eye-glasses; no more than in a Telescope of two Convex-glasses, the Eye-glasses does to the Species it receives from the Object-glass, as we have shewn before. The reason that this last or immediate Eye-glass has nothing to do in the erecting or reversing the Species is the same as in a Telescope of two Convex-glasses, viz. the Eye is placed in its Focus, and therefore sees the Species as 'tis represented in the Distinct Base; that is, the Species is inverted in the Distinct Base of the Object-glass, and therefore a single Convex Eye-glass brings it to the Eye inverted; but in the Distinct-Base of the middle or second Eye-glass the Species is erect, and therefore the third or immediate Eye-glass brings it to the Eye erect.

Wherefore we are to consider the Telescope consisting of an Object-glass and three Eye-glasses, as two Telescopes, each consisting of two Convex-glasses. The first consists of the Object-glass and first Eye-glass, and this inverts the Species; that is, the Species is inverted in the Distinct-Base of the Object-glass, and so brought into the Eye. The second Telescope consists of the two immediate Eye-glasses, and this erects what the former inverted, that is, the Species in the Distinct-Base of the middle Eye-glass is erect, and is so brought into the Eye by the Eye-glass; the Eye-glasses themselves in neither case having anything to do with the erecting or inverting, but merely in representing in the same posture the Species immediately before them.

The French Problem therefore should not have broken a Telescope of four Convex-glasses into four pieces, but into two, and the case would have been plain; whereas by breaking it into four Perspective-Glasses, they attribute that to two of them, which neither of them does, viz. inverting and erecting.

Therefore I say lastly, that one Convex-glass as posited in a Telescope inverts, the second (that is the first Eye-glass) \( X_2 \) does
does nothing towards erecting or reversing, but represents the Image as it is in the Distinct-Bafe of the Object-glass before it, that is, inverted. The third Glass erects, or rather restores what was before inverted. The fourth represents the Image as it receives it from the Distinct-Bafe of the third, that is, erect. And this I think a sufficient Solution of this Problem.

An uncommon Inscription lately found on a very great Basis of a Pillar, dug up at Rome; with an Interpretation of the same by the learned Dr. Vossius.

This Inscription was sent by that excellent Philosopher and Mathematician Mr. Adrian Auzout, who copied it from the Stone, to Mr. Wulfel, who was pleased to communicate it to the Royal Society, together with the Sentiments of Dr. Vossius therupon, of which the Reader may Judge.

The Inscription is three fold upon three sides of the Basis, and as follows.

P. SVFENATI. P. F. PAL. MYRONI
EQVITI. ROMANO. DECV
RIALI. SCRIBARVM. AEDILI
VM. CVRVLIVM. LVPERCO. LAVRENTI
LAVINATI. FRETRIACO. NEAPOLI. ANTI
NOITON. ET. EVNOSTIDON. DE
CVRIONI. III, VIRO. ALBA
NI.
NI. LONGANI. BOVILLEN
SES. DECVRIONES OB ME
RITA. EIVS. L. D. D. D

P. SVFENATI. P. F.
PAL. SEVERO. SEMPRO
NIANO. DECVRIALI
SCRIBARVM. AEDILIVM. CVRV
LIVM. FRETRIACO. NEAPOLI. EV.
NOSTIDON. DECVRIONI. ET
SA. ERDOTI. APOLL.
NIS. ALBANI. LONGA.
NI. BOVILLENSES. DE
CVRIONES. OB. MERI
TA. SVFENATIS. HER.
METIS. PATRIS. EIVS
L. D. D. D.

P. SVFENATI. P. F. -- --
MYRONI.
EQUITI. ROMANO. DEC--
An Extract of the Letter of Dr. Vossius to Mr. Iustel upon the Subject of this Inscription.

Several Observations of the Eclipse of Jupiter by the Moon on March the 31th. 1686. St.Vet. whereof some account has already been given in Transaction No. 181.

The most accurate Observation of this Eclipse we have received, is that of Mr. Caffini, made in the Royal Observatory at Paris, published in the Journal des Scavans of the 10th of June last, the substance whereof is as follows.

April 10th. St. N. Vesperi Mr. Caffini, assisted by other Astronomers, attended upon this Occultation with Telescopes of 21 and 70 foot, while one was deputed to take the Altitudes of 4 to verify the time.

At 9h. 31m. 6sec. 4 was in a perpendicular falling on the Limb of the > over against the Northern Part of the spot Grimaldi (Marcotis) near to Riccioli (stag. Miris) and was distant from the Limb about four times as much as the said spot.
tb. 4" m. 21 sec. v touched the circumference of \( \varpi \), which undulated by reason of the Vapours near the Horizon.

9. 41. 20. he quite disappeared in the inequalities of the \( \varpi \)s Limb, the total Immerfion might be some seconds later.

So the central immersion was at tb. 40 m. 51 sec.

v entered over against that part of Grimaldi next Riccioli. The Vapours of the Horizon hindered the Observation of the Immerfions of the Satellites, but not their Emerfions, for

At 10h. 30m. 2 sec. the outermost Satellite which preceded \( \nu \), appeared over against the middle of the Caspian Spot (pal. Meotis) through which the section of Light and Darkness passed, and made nearly an equilateral Triangle with the Extremities of that spot.

At 10h. 40 m. 24 sec. the first Limb of \( \nu \) began to come out of the dark side of the \( \varpi \), over against the North part of the Caspian spot, about Cleomedes, (ad montes Riph eos)

At 10h. 40 m. 56 sec. the center of \( \nu \) did emerge. It was difficult to distinguish the moment when \( \nu \)'s disk was fully clear, but at 10h. 41 m. 36 sec. the Eclipse was certainly past.

At the Emerfion of the Center, the Altitude of \( \nu \) was

11d. 31 m.

At 10h. 42 m. 49 sec. the second Satellite, being the nearest of the three that followed the Planet, emerged.

At 10h. 45 m. 1 sec. the innermost Satellite, being near its greatest Elongation, emerged.

At 10h. 50 m. 40 sec. the third or penextimus Satellites, being likewise near its greatest Elongation, began to appear over against the Northern Edge of the Caspian Spot.

At 11h. 45 m. the Diameter of the \( \varpi \) was 32 m. 27 sec. and according to the calculus of Mr. Cassini, her parallax was 6 min.

Together with this Observation is joined that of R. P. Bonfa. made at Avignon who observed the central immersion at 9h. 42 m. 12 sec. and the central Emerfion at 10h. 45 m. 2 sec. over
over against the Southern part of the Caspian Spot.

The same P. Bonfa has also observed at Avignon the other Eclipse of the same Planet, April 28th. & the same place. The Immersion of the Center happened at 3h. 37m. 23s. on the East side of the Spot Xenophanes. The Emersion was at 4h. 28m. 22s. between Seneca and Berosus, according to Riccioli, or ad montes Alanos Hevelii, a little to the Northward of the Palus Meotis. This occultation could not be observed at Paris by reason of Clouds.

Another printed Paper about the Eclipse of March 31st, is since come to hand from Nureburg, where it was observed part, by Mr. Iac Zimmerman, and by Mr. Wurtzelbauer, the substance of whose Observations is as follows.

At 10h. 19m. 56s. Mr. Zimmerman observed the first contact of the Limbs of \( \gamma \) and the \( \beta \), and at 10h. 20m. 47s. \( \gamma \) was all eclipsed.

At 11h. 22m. 51s. \( \gamma \) was wholly clear from the Eclipse.

The Immersion was about the 117th, the Emersion at the 321st Degree of the Limb, in the Chart of Hevelius.

At 11h. 31m. 06s. the third Satellite of \( \gamma \) emerged. These times were collected from the Culminations of fixed Stars, and the Vibrations of a Pendulum.

The Relation of the other Observer Mr. Wurtzelbauer is to this purpose.

At 10h. 20m. 50s. \( \gamma \) applied to the Limb of the \( \beta \), over against the local paludosa Insula Circinna.

At 10h. 22m. 00s. he appeared about half eclipsed.

At 10h. 22m. 30s. he was wholly hid.

At 11h. 19m. 45s. \( \gamma \) began to Emerge.

At 11h. 21m. 20s. he was quite free from the interposition of the \( \beta \). The point of the Emersion was somewhat to the North of the Palus Meotis.

No Spot in the \( \beta \) was so near the apparent magnitude of \( \gamma \)'s disk as the Insula Besbicus Hevelii.

At 11h. 40m. 02s. the Altitude of Procyon was 8gr. 37m. whence the Pendulum Clock, which had been set by Altitudes
The Account we have but now lately received from the famous Mr. Hevelius from Dantzig, of these same Eclipses, is contained in this following Discourse addressed in a Letter from the Observer to the R. Society.

Occultatio Jovis Anno 1686, die 10 April. st. n. vespert., observata Gedani a Joh. Hevelio.

A Dun Observationem summa alacritate accessi, non obstante invaletudine mea, cum Coelum fere undec; effet serenum, nisi quod circa Horizontem, ubi Luna atq; Jupiter exoriri debebant, vapores quidam atq; nubeculae exifferent. Inprimis ex eo maximopere fui excitatus, quod hujus generis Observationes, Occultationes nempe Jovis admodum raro contingat, sed adhuc rarius ex voto observantur. Me quod attinet, scias, mi Lectorem, etiam si huc usq; per 56 annos Rebus Coelestibus pro meo modulo operam dederim, atq; nullam Observationem alicujus momenti, (absit gloriola) lubens neglexerim, haud feliciorem fuisse quam quod in hunc usq; diem spatio 30 circiter annum, non nisi tres tales Jovis Eclipses rite deprehendere & annotare potuerim: utpote primam Anno 1646, die 24 Decemb. vespert., sed tantummodo ejus finem: secundam, Anno 1679, die 5 Junii ante meridiem de die, quo tempore res omnis felicius succedit; tertiam hoc Anno currente 1686 die 10 April. vespert.

Quam Observationem, mi Astrophile, prout peragi potuit, a me nunc benevole accipias, rogo. Quæ vero obtenta, arq; annotata fuerunt, ex subseuente Tabella & Observationis Typo patebunt. Omnium primo nonnullas Altitudines Solis, & Aræturi Quadrante singula minuta commonstrante observavi, ad corrigendum Horologium ambulatorium aliquanto tardius incedens. Deinde, exoriente atq; ex nu-
nubeculis circa Horizontem vagabundis erumpente Luna ac Jove, nonnullas Distantias a limbo Lunæ orientali cepi, ca
tione, qua tum licuit meliori. Inter alia autem notandum occurrî, quod hæcce Occultatio non Luna omnino ex-
istent e plena, sed altera die circiter post ipsum Plenilunium 
vesperi acciderit; & quidem eodem tempore (quod permi-
rum sane accidit, & est casus, quals haud facile unquam 
continget) eadem; facie, ut illa Occultatio Anni 1646 
die 24 Decemb. vesperi visâ est; quo tempore Luna jam ad 
biduum pariter decreverat, & fine dubio eandem Librationem 
etiam exhibuit, quam in hac nostra ultima Observatione. 
Nam Sectio Luminis atq; umbræ plane fuit eadem, & per 
eadem maculas transit (quod satis admirari nequeo) num-
mirum ad Lacum Hyperboreum majorem & minorem, tum 
ad montes Ripheos, per paludem Mætidiem, per Lacum 
majorem maris Caspîi, & finum ejus inferiorem ad Montem 
Nerofum.

E contrario, Jovis Occultatio Anno 1679 a me habita, 
plane exiti diversa, quidem illa non circa Plenilunium, sed 
Novilunium accidit, tertia circiter die ante Conjonctionem 
ipsam, adeo ut phasis tantummodo parvula decrecens con-
spectat fun; instar Phæos meæ Lunæ cornutæ decrementis, sub 
Numerio 37, in mea Selenographia, pag. 422 conspicac: 
transfibrat enim per finum Apollinis, per locâ paludosa Insula 
Cercinnæ, Mare Syrticum, Montem Cataraëtes, & partem 
inferiorem Sin. Sirbonis, montemq; Lion: prout ex ipso 
schemate dixi Occultationis An. 1679, in Anno meo Clima-
terico pag. 38. clare luet.

Postquam ita q; initio, ut supra dicebam, nonnullas Distantias 
Jovis a limbo Lunæ Orientali cepam, atq; Jupiter magis 
magisq; Lunæ appropinquaret, omni diligentia invigilavi, 
ut non solum quam accuratissime ipsum momentum tem-
poris annotalem, quando Jupiter prius Limbo suo occidu-
o illum Lunæ orientalem attingeret, sed etiam quando dimidius, nec non quando omnino totus esset tectus. Hac 
etenim recte scire Astronomia plurimum interest; præferi-

Y 2
tim, cum a nemine Observatorum huc usq; nondum, quantum sciem, adhuc fit deprehensâ. An in hac Observatione a quopiam sint annotata, adhuc me latet; tempus tamen docebit.

Me quod attinet, hæc omnia ex voto obtinui, non solum circa initium, sed etiam circa finem hujus Occultationis, sic ut ipsum momentum temporis rursus prima apparitionis Jovis occasum versus, ad Sectionem Luminis & Umbrae, nec non cum dimidius, ut & totus appareret, exactusime deprehendere potuerim. His acquisitis Diametrum Lunæ optimo Micrometro, atq; Telescopio duodecim circiter pedum investigavi, pariter unam aut alteram Jovis Distantiam a confinio Lucis & umbrae, a parte scilicet Lunæ occidentali, pro majori confirmatione reliquarum Observationum, sicuti ex annexa Tabella atq; Observationis Typo elucet: quæ præmittenda esse duxi, antequam ad alia non nulla bene notanda me conferam.

Eclipsis Jovis Observata GEDANI a Joh. Hevelio
Anno æae Christ. 1686. die 10 April. Vesp. st. n.

<table>
<thead>
<tr>
<th>Horologi. ambulator.</th>
<th>Altitudines Gr. M. S.</th>
<th>Tempus ex capte rectum H. M. S.</th>
<th>Altitud.cor</th>
</tr>
</thead>
<tbody>
<tr>
<td>H. M. S.</td>
<td>Altitudo Solis.</td>
<td>13 47 o</td>
<td>5 11 43</td>
</tr>
<tr>
<td>5 10 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 12 30</td>
<td>Altitudo Solis.</td>
<td>13 28 c</td>
<td>5 13 55</td>
</tr>
<tr>
<td>5 17 4</td>
<td>Altitudo Solis.</td>
<td>12 41 c</td>
<td>5 19 21</td>
</tr>
<tr>
<td>5 23 50</td>
<td>Altitudo Solis.</td>
<td>11 46 c</td>
<td>5 25 43</td>
</tr>
<tr>
<td>8 7 1</td>
<td>Altitudo Arcturi.</td>
<td>29 55 c</td>
<td>8 12 50</td>
</tr>
<tr>
<td>8 11 15</td>
<td>Altitudo Arcturi.</td>
<td>30 32 o</td>
<td>8 17 4</td>
</tr>
<tr>
<td>8 15 1</td>
<td>Altitudo Arcturi.</td>
<td>30 59 c</td>
<td>8 20 51</td>
</tr>
<tr>
<td>Luna oritur</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 44 50</td>
<td>Jupiter ob nubes &amp; vapores citius haud conspectus; distabant tum ab Ins. Cer-</td>
<td>9 24 0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>cinna 43 circit. minut.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 52 50</td>
<td></td>
</tr>
<tr>
<td>H. M. S.</td>
<td>Jovis distantia erat tanta, quanta distantia M. Sinai a Palude Maræotide.</td>
<td></td>
<td></td>
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<td>----------</td>
<td>------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 21 30</td>
<td>Jovis distantia erat fere aequalis distantiae inter M. Aëtnam &amp; M. Porphyritem.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 40 35</td>
<td>Jovis limbus a limbo distabat tanto interstitio, quanto Pal. Maræotis a limbo.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 51 30</td>
<td>Jovis limbus a limbo suo tangere incipiebat Lune limbum, atq; sic initium Occultationis Dimidius Jupiter occultabatur. (accidit.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 56 9</td>
<td>Totus Jupiter omnino a tectus.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 56 54</td>
<td>Occultatio Comitis Jovis ultimi ad M. Alabastrinum accidit. Duo tantummodo Comites a parte orientali conspecti sunt.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 8 31</td>
<td>Altitudo Lyæ.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 15 44</td>
<td>Infusa Besbicus &amp; Rhodus repercibantur sub eodem perpendicularicio, id quod ad 35gr. circ. a Linea &gt; verticali re-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 19 0</td>
<td>Altitudo Lyæ. (movebatur)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 21 37</td>
<td>Altitudo Lyæ.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 24 57</td>
<td>Altitudo Lyæ.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 38 15</td>
<td>Emerfions initium Jovis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 39 0</td>
<td>Dimidius Jupiter emergebat.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 39 45</td>
<td>Totus Jupiter apparebat.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 1 30</td>
<td>Diameter Lune Micrometro observata erat 31m. c.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 54 10</td>
<td>Distantia Jovis a confinio Lucis &amp; Umbrae erat aequalis distantiae M. Aetna a M. Porphyrite.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 57 20</td>
<td>Distantia Jovis a confinio Lucis &amp; Umbrae elongabatur intervallo inter Infusam Besbic. &amp; M. Aëtnam. Et comes v remotissimus a Jove tantum aberat, quantum ipse comes a dicto confinio Lucis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 6 9</td>
<td>Altitudo Lyæ.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 9 18</td>
<td>Eadem Altitudo denuo.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 13 30</td>
<td>Altitudo Lunae.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Primo liquidum est ex ipsa Observatione & occultationis Schemate, quod orbis, seu Linea Jovis itineraria, per Montem Alabastrinum, per M. Christi, M. Carpathes, infra M. Macrocemnios, & per Lacum Hyperborium inferiorem incellerit. Secundo, quod Insula Besbica & Insula Rho-
dus sub uno eodemq; perpendicular, tempore occultationis, hora circiter 1 m. 30 extiterit; sic ut 35 gradus Lunæ limbi culminaverit. Intravit itaq; Jupiter limbus Lunæ illuminatum circa 61 gradum, a linea scilicet perpendiculari Nonagefimi atq; puncto Zenith, ortum versus; exivit vero circa 31 gradum a dita linea perpendiculari Nonagefimi occafum versus, ad limbum Lunæ obscuratum. Proin-
de Linea Jovis itineraria fuit subtenfa 104 fere graduem, attenta videlicet parte Lunæ Boreali.

Præterea etiam maxime notatu dignum, quod ex hac ob-
ervatione Diametrum Jovis exquisite elicer potuerim, & quidem hac ratione: cognita nimirum tota duratione Oc-
cultationis 42m. 6s. atq; data simul Diametro Lunari 31m.
protinus innotescit, ex illa temporis mora, cum scilicet Ju-
piter limbo suo primum Lunæ limbum attingeret, & cum
totus occultaretur (id quod factum est spatio temporis
1m. 30s.) Diameter Jovis 51m. 42s.

Et tantæ Magnitudinis extitit etiam Diameter Jovis 50
circiter secund. quoties illam per maculas Lunæ dimensus
sum: uti ex parte secunda Machinæ nostræ coelestis suo
loco patet. Quod autem Anno 1679. die 5 Jun. cum fi-
milem Jovis Eclipsim observarem, longe ea extiterit minor,
nimirum tantum 30m. 53s. Id ex eo evenisse puto, quod
Observatio illa, tempore diurno, splendente Sole fuent ob-
servata; quo radii Stellarum & Planetarum adventitii ma-
gis a Luce Solis absterguntur, quam tempore nocturno,
nocte obscura. Quod si autem quæras, quamnam Dia-
metrum apparentem veriorem existimem ? scias illam, quam
Anno 1679, 5 Jun. de die, sole splendente observavi. Non
quidem ex eo quod non æque diligenter hanc quam illam
determinaverim; sed quod tempore nocturno, radii adven-
titii
Iitii magis obtent, sicuti diximus, quam tempore diurno. An vero rexe Judicium meum expono, futuræ Observatio-
nes, dummodo accuratissime peragentur, docebunt.

Postremo Corollarii loco, adhuc adjiciam Tabellam, calcu-
culum hujus occultationis Jovis, ex diversorum Auctorum,
videlicet Keppleri, Lansbergii, Bullialdi, Riccioli & Wingii
Tabulis exhibentem; ut sub uno statim intuitu quilibet
habeat in quantum ab ipsa Observatione & ipsa cælo dic-
tæ Tabulæ discedunt. Invenies non tantum in plurimis
integris Minutis, sed ad septem horam, imo integram nonnu-
llas a vero exorbitare; sic ut Rerum Coelestium Cultores
abunde adhuc habeant, quod quaerant, castigant.

Calculus ad Horizontem Gedanensem.

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<tbody>
<tr>
<td></td>
<td>H. M. S.</td>
<td>H. M. S. H.</td>
<td>M. S.</td>
<td>H. M. S. H.</td>
<td>M. S.</td>
<td>H. M. S. H.</td>
</tr>
<tr>
<td>Initio.</td>
<td>11 7 9</td>
<td>10 31 5</td>
<td>12 15 25</td>
<td>10 38 21</td>
<td>10 47 9</td>
<td>10 18 4</td>
</tr>
<tr>
<td>Immersio.</td>
<td>11 8 39</td>
<td>10 33 17</td>
<td>12 18 46</td>
<td>10 40 41</td>
<td>10 49 41</td>
<td>10 18 8</td>
</tr>
<tr>
<td>Emerito.</td>
<td>11 49 15</td>
<td>11 17 45</td>
<td>13 1 26</td>
<td>11 21 43</td>
<td>11 47 13</td>
<td>11 23 20</td>
</tr>
<tr>
<td>Finis.</td>
<td>11 50 45</td>
<td>11 19 57</td>
<td>13 4 47</td>
<td>11 24 3</td>
<td>11 49 45</td>
<td>11 23 24</td>
</tr>
<tr>
<td>Duratio.</td>
<td>0 42 60</td>
<td>0 48 520</td>
<td>49 220</td>
<td>45 421</td>
<td>2 36 1</td>
<td>5 20</td>
</tr>
<tr>
<td>Semid.</td>
<td>0 15 300</td>
<td>16 120</td>
<td>17 520</td>
<td>16 520</td>
<td>16 130</td>
<td>16 32</td>
</tr>
</tbody>
</table>

Quibus finio, & Te, Benigne Astrophile, bene valere
jubeo, rogans, ut qualem qualem hancce Observationiunculam
boni confitas, donec quædam praestantiora in Lúcem pro-
deant. &c.

Præsum quam hæce literas obsignarem, in manus meas inci-
derunt paucula illa, quæ de conjunctione Lunæ & Jovis
posteriori, die 8 Maj. St. N. mane, a me fuerunt anno-
tata. Jdeirco & ea volui, licet nullius sint ponderis, vobis
communicare.
Primo, observata est Altitudo Areaturi, pro corrigendo tempore; deinde 'quasdam Distantias determinavi, ea intentione, me forte adhuc posse, ante ipsum occasum horum siderum, minimum, initium Occultationis deprehendere; sed spe frustratus sum. Nam citius circa Horizontem & Lunam & Jovem Nubeculæ exceperunt, atq; paulo post obitus horum Planetarum omnino incidit.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>H. M. S.</td>
<td>Dantisci Anno 1686. die 8 Maj.</td>
<td>St. N. mane.</td>
</tr>
<tr>
<td>3 23 20</td>
<td>Altitudo Areaturi.</td>
<td>3 16 0</td>
</tr>
<tr>
<td>3 24 25</td>
<td>Eadem Altitudo.</td>
<td>3 4 0</td>
</tr>
<tr>
<td>3 44 30</td>
<td>Jupiter a limbo : dißtabat majori ad-</td>
<td>3 41 30</td>
</tr>
<tr>
<td></td>
<td>huc intervallo quam M. Sinai a M.</td>
<td></td>
</tr>
<tr>
<td>3 47 0</td>
<td>Jovis distantia erat tanta, quanta M.</td>
<td>3 44 0</td>
</tr>
<tr>
<td></td>
<td>Porphyritidis a Byzantio.</td>
<td></td>
</tr>
<tr>
<td>3 52 0</td>
<td>Jovis a limbo Lune distantia erat æqualis</td>
<td>3 49 0</td>
</tr>
<tr>
<td></td>
<td>distantiae Insulae Sardiniæ &amp; Paludis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maræotidis.</td>
<td></td>
</tr>
<tr>
<td>3 59 0</td>
<td>Jupiter a limbo Lune paulo plus distabat</td>
<td>3 56 0</td>
</tr>
<tr>
<td></td>
<td>quam Pal. Maræotis ab Ætna.</td>
<td></td>
</tr>
<tr>
<td>4 16 40</td>
<td>Distantia Jovis a limbo Lune a quabatur</td>
<td>4 13 40</td>
</tr>
<tr>
<td></td>
<td>fere distantiae M. Porphyritidis ab</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insula Cercinna.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Planetarum Occasus factus est.</td>
<td>4 17 0</td>
</tr>
</tbody>
</table>

Adeo ut nihil quicquam de ipsa Occultatione nobis hic, Gedani in conspectum venerit; quibus valete iterum iterumq; quam felicissime.

**Johannes Hevelius**.

The great use of drawing the Tangents of Curve Lines, has made the most famous amongst the Modern Mathematicians endeavor to find out General Methods of finding the Tangents of Curve Lines, as may be seen from the several ways invented by Des Cartes, Monsieur Fermat, Sluissen, Dr. Barrow, Dr. Wallis, Tschurmebuys, and Leibnitzius; but as yet none has attempted to invert this problem generally, that is, having the Tangent to find the Curve Line whose tangent it is. Therefore the Author of this Treatise perceiving that the doing of this would give a General Method of determining the Quadrature of any Curvilinear space, has laid down a rule for inverting Sluissen his method mentioned in the *Philosophick Transactions* Num. 90. He has illustrated his Method of Quadratures by several Figures which have been already confidered by Geometers. As for the Circle & Hyperbola, he asserts that their indefinite Quadratures are impossible, and therefore in these & such like cases, he expresses the Area by an infinite Series, which is easily done by his Method, except the Series consist of irrational terms, for in these he has recourse to Leibnitzius his method of finding Tangents, where the Calculation will be more tedious. By his resolving the Area of the Hyperbola into an infinite series, he comes to the same expression with that of N. Mercator. And in measuring the Zone of a Circle, his expression falls in with that invented by Mr. Isaac Newton, as Mr. David Gregory relates in his Treatise. He has subjoined a Method of measuring the Curve Superficies made by the rotation of any Curve upon its Axis; with a small Animadversion on the Method of Quadratures, published in the *Acta Lipsiensia Eruditorum* of October, 1688.

Since the Publication of this Treatise, the Author is pleased to make the following Addition.
Additio ad Methodum Figurarum Quadraturas Determinandi. Autore Johanne Craige.

Voniam omnium Figurarum Quadrature ex perfecta nostri primi problematis Solutione determinantur; propterea utile judicabam nonnulla addere, quae solutionem meam non modo plenius illustrant sed omnino perficiunt: non adeo tamen sunt obscura, quin facile quisquam in istiusmodi rebus versatus, ex his quae jam exposui, omnia suppleere possit. Problema sic se habet. Data expressione Analytica lineae inter ordinatum & Curva perpendicularem designata, Invenire equationem naturam illius Curva definientem. Hoc problema tres casus includit. 1. Cum expressione istius lineae talis est, qualis a vulgaribus tangentium Methodis exhibetur. 2. Cum ad simpliciorem reducitur, facta divisione numeratoris & denominatoris per communem simplicem divisorem. 3. Cum expressione fit simplicissima, dividendo per divisorem compositum. Duos priores casus Regula, prout eam explicui, universaliter comprehendit; superer est tantum ut ostendam quo pacto tertium pariter casum comprehendat.

Postquam expression data per y multiplicatur, apponuntur omnes termini qui sub maximo continentur (Terminorum magnitudinem & dimensionibus quantitatis & mensurans) & connectantur signo affirmativo vel negativo, prout libuerit; adequentur omnibus illi termini (prius in coefficientes incognitas multiplicati) Quadrato quantitatis per x designate: erit; inde resultans equatione quaestia, vel quaestam includet; & determinationes coefficientium terminos equationem constituentes a reliquis distinguant.
Sit in apposito schemate abscissa \( AM = y \), ordinata \( MC = z \), & curva \( ACE \) proprietas \( z^2 = \frac{a_2 y^2 + y^4}{p^2} \) & invenienda sit quadratura. Area a lineis rectis & illa curva comprehens. Querenda est alia curva \( AGH \), in qua \( PM = \sqrt{a_2 y^2 + y^4} = z \); ubi \( PG \) curva quaedae perpendicularis, & \( MG = x \) illius ordinatam denotat. Cumq; hæc expressio lineæ \( PM \) in \( y \) multiplicata continent secundum quantitatis \( y \) dimensionem, ideo apponò omnes terminos sub illa sexta dimensione contentos, unde resultans equatio est:

\[
\frac{na_6 + ma_5 y + la_4 y^2 + ha_3 y^3 + ka_2 y^4 + gay_5 + fy_6}{p^2} = x_4.
\]

Ex hæc equatione invenio valorem lineæ \( PM \) quem comparo cum valore dato, unde

\[
PM = \frac{ma_5 + 2la_4 y + 3ha_3 y^2 + 4ka_2 y^3 + 5gay_4 + 6fy_5}{4p\sqrt{na_6 + ma_5 y + la_4 y^2 + ha_3 y^3 + ka_2 y^4 + gay_5 + fy_6}} = \sqrt{a_2 y^2 + y^4} \text{ auferuntur fractiones & Signa radicalis, & determinentur coefficientes } n, m, l \text{ &c.} \text{ (ut in prob. 2 tractatus nostris) rejectis ills quorum determinationes absurdam involvunt: & cetera, in quibus nihil tale contingit; equationem constituent. Sic in exemplo proposto, erit } f = \frac{4}{9}, k = \frac{12}{9}, l = \frac{12}{9}, n = \frac{4}{9}. \text{ Sed dum } g \text{ determino, invenio } 240g = 144g, \text{ quod absurdam involvit; & sic pro } h \text{ comparatio erit } 16h = 16h \text{ unde nullus illius valor, & pro } m \text{ erit } 48m = 144m, \text{ quod itidem est absurdam: quapropter termini a quantitatis } g, h, m \text{ affecti ad equationem non pertinebunt; unde reliqui litteris } n, l, k, f \text{ affecti equationem naturam Curva definitem constituen. Sc. } \frac{4a_6 + 12a_4 y^2 + 12a_2 y^4 + 4y_6}{9p^2} = x_4,
Sit Curva Linea ACE talis proprietatibus \( z^2 = qy^2 + y^3 \) & inventienda sit Quadratura spatii AMC. Querenda est Curva AGH in qua sit PM = \( \sqrt{qy^2 + y^3} \) = Z & quoniam hic valor in y multiplicatus continet quattuor quantitatis y dimensionem, apponantur omnes termini sub illa quinta dimensione, & aequatur quadrato quantitatis per x designata; unde aequatio resultans est.

\[ \text{AMC} = \sqrt{16q5 - 4q3y2 - 4q2y3 + 4qy4 + 4y5} = x4 \text{ adeoq.} \]

\[ \text{AMC} = \sqrt{16q5 - 4q3y2 - 4q2y3 + 4qy4 + 4y5} = x4 \text{ adeoq.} \]

Exem. 3. Invenienda sit Quadratura spatii AMC, definita natura Curvae ACE hac aequatione \( z^2 = \frac{3a}{4y + 4a} \). Queratur alia Curva AGH, in qua PM = \( \sqrt{\frac{a3}{4y + 4a}} \) = Z. Ex premisis constat aequationem primam fore

\[ \text{AMC} = \sqrt{16a3y + 2a2y + 16a5} = x4 \]

Quibus substititis, erit aequatio \( \frac{16a3y + 2a2y + 16a5}{4y + 4a} = x4 \).

\[ \text{AMC} = \sqrt{a3y + 4a4} \text{ adeoq.} \]

Notatur dignissimum est, hae tres (seu infinitas alias) Quadraturas abscisse AM (seu y) non convenire. Quoniam in eiusmodi...
modi Figuris, simplicissima Area ex expresso huic portioni non respondet; attamen Quadratura abscissa conveniens exinde parvo labore deducitur. Ut in Exem: 3. ubi Area est \( \sqrt{a_3y+a_4} \); fiat \( y = 0 \), & erit Area \( \sqrt{a_4} = a_2 \), & subducatur hoc ex generali, proveniet Quadratura portionis abscissa respondentis, sc. \( \sqrt{a_3y + a_4 - a_2} \). Quam observationiunculam mihi primus significavit Vir celeberrimus D. Isaacus Newton.

Tentetur jam idem processus in Circulo ACE, cujus diameter sit \( r \), ac proinde \( Z = \sqrt{ry-y^2} \), Quaerenda est Curva AGH in qua \( PM = \sqrt{ry-y^2-z} \), sed ex dictis constat equationem primam fore \( nr_4+mr_3y+hr_2y^2+hry^3-kx^4=x^4 \); & singulare coefficientium determinationes erunt impossibiles; adeoque nulla datur Curva AGH in qua \( PM = \sqrt{ry-y^2} \), ac proinde Circuli Quadratura indefinita est impossibilis. Fieri tamen potest ut sit aliqua hujiusmodi Curva AGH, sed ex earum numero, quas post Cartesium Mechanicas Geometræ communiter appellant; sed quia harum usus non libenter admittunt Mathematici, praestat hujiusmodi Quadraturas per series infinitas exhibere.

Benevole Lectore

Ob inopiam Typorum Numerantium minusculorum, qui ad designandos quantitatum potestates supra Symbola dexterum apponi solent, festinante prælo, Typographus paulo majoribus usus est in eadem linea immediate sequentibus; ubicunque itaque offendoris a3, vel x2, &c. cubum vel quadratum, &c. e quantitate, cui suffigitur numeros intelligas.
LONDON,
Printed by Joseph Streater, and are to be sold by Samuel Smith, at the Princes Arms in St. Paul's Church Yard.
PHILOSOPHICAL
TRANSACTIONS.

For the Month of October, 1686.

THE CONTENTS.

1st. A N Account of the Course of the Tides at the Port of Dublin in Ireland; communicated in a Letter to the Publisher, from Mr. William Molineux Esq. R.S.S. with a Remark thereupon. (2.) A Demonstration of the Velocity wherewith the Air rushes into an exhausted Receiver, lately produced before the R. Society by Dr. D.Papin, Reg. Soc. S. (3) An Extract of a Letter from Mr. J. Flamsteed Astr. Reg. and Reg. Soc. S. giving his Calculation of the Eclipses of Jupiter's Satellites, for the Year 1687, together with a Table of the Parallaxes of the Orb, and an Ephemeris of Jupiter's Geocentric Place for the same Year; to which is added an Observation of the Eclipse of the Moon Novemb. 30th. 1685, made at Lisbon; and Mr. Flamsteed's own Observation of the Eclipse of Jupiter by the Moon on the 31th. of March last. Accounts of Books, (1) The Natural History of Stafford-Shire, By Robert Plot LL.D. Keeper of the Ashmolean Museum, and Professor of Chymistry in the University of Oxford. (2) Sciothericum Telescopicum or a new Contrivance of adapting a Telescope to an Horizontal Dial, for observing the Moment of Time by Day or Night, by Will. Molineux Esq. R. S. S. Printed at Dublin, Anno 1686. 4to.
An Account of the Course of the Tides in the Port of Dublin in Ireland, communicated in a Letter to the Publisher, from William Molineux Esq. R. S. S. with a remark thereon.

At the Barr of Dublin, on the New and Full Moons, a South-South-East Moon makes high Water, that is, at half an hour after Ten.

At Rings-End at Three Quarters after Ten.
At the Custom-House at Dublin at Eleaven.

On the Quarter Days.

High Water on the Barr at five of the Clock.
At Rings-End at a Quarter past Five.
At the Custom House half an hour past Five.

A Southerly Wind between S. S. E. and S. S. W. blowing fresh makes it flow near half an hour longer than its usual Course.

N. B. that this observation makes the Tides, upon the Quarter Moons, come in later, in respect of the Moons Southing, than upon new and full Moons, by half an hour: whereas in the River of Thames, as high as London, the Quarter Moons make high Water above an hour an Quarter sooner, in that respect, than the New and Full; as may be seen by the accurate Tide Tables of Mr. Flamsteed: but it is from hence Evident that the same Tables are not applicable to the Sea-Ports; where there is not the same reason for the Anticipation of the Nepe Tides upon the Quarter Moons. The cause of this Phenomenon seems to be, that the Impulse of the Ocean in the Quarter Moons is not so Vigorous as in the New and Full; nor the Motion of the Waters so quick: (as is evident by daily experience) whence it comes to pass that in the open Sea, and in Ports upon the Sea-Coast, as this of Dublin, the high Water time falls out later, than when the motion is more rapid in the New and Full; but on the con
contrary, in Rivers, at any considerable distance from the Sea, the resistance of the weight of the fresh Water, which is kept suspended during the time of the Flood, is longer overcome by the more potent Impetus in the New and Full, than by the weaker in the Quadratures: and from hence this difference should be still more and more considerable as the Fort is farther removed from the Sea.

A Demonstration of the Velocity wherewith the Air rushes into an Exhausted Receiver, lately produced before the R. Society by Dr. D. Papin. Reg. Soc. S.

There being several Occasions wherein it would be useful to know the Velocity of the Air, according to the several pressures that may drive it; The Royal Academy at Paris hath attempted by some Tryals to attain that Knowledge, and by means of a Bladder, which they did sometimes fill up with Water, and sometimes with Air; they found that (although the Weight to squeeze out these Liquors, and the hole to let them out were the same) nevertheless, the Bladder when full of Air, could be empty’d in the 25th part of the time that was required to squeeze out the Water of the same Bladder: from thence they concluded that the swiftness of the Air is 25 times greater than that of water, when both these liquors bare the same pressure. This Experiment was very well thought on, and might serve till a better should be found out; but those Gentlemen could not but know, that this was not Perfect: The Reason is that the Air yieldeth much, and so the Bladder being fill’d with it, will become pretty flatt, as soon as a considerable weight is laid upon it. It is plain therefore that the weight bearing upon a large space doth not press every part with the same force as it would do, if the Bladder did for a while remain Plump, as it doth when full of water: moreover, the water it left being heavy in the Bladder, makes some pressure: so that
that it appears, that the pressure in this experiment was not quite so great upon the Air as upon the water: I have therefore thought of another way, which I think better, to come to the said Knowledge; and I do humbly submit it to the R. Society.

My way is grounded upon this Hydrostatical Principle, that liquors have a strength to ascend as high as their source is; and although the reslence of the Medium doth always hinder Leits d'eau in the open Air from reaching quite so high, nevertheless the liquor at its first spouting out, hath the necessary swiftness to come to that height.

**Proposition. I.**

From this Principle may easily be deduced this Proposition, that of two differing liquor's driven by the same pressure, that which is in specie lighter must ascend higher than that which is heauier, and their heighths will be reciprocally in the same reason as their specifick gravity's are. Thus, Quicksilver being 13 times and a half heauier than water, bears as much pressure when its spring is one foot above the spout hole, as water doth when it's spring is 13 foot and a half high, and the heighth to which Mercury shall ascend will be 13 times and a half lesser than the heighth to which water shall be driven by those equall pressures.

**Proposition. II.**

From the foregoing Proposition another may easily be deduced, viz. That of differing liquors being the same pressure those that are lighter in specie must acquire a greater swiftness, and their differing Velocity's are to one another as the roots of the specifick Gravity's of the sayd liquor's. For we have seen Prop. 1. that the heighth's to be attain'd are in the same reason as the specifick gravity's; Now Galileus, Hugenius, and others have demonstrated that the Velocities
city's of bodies are to one another as the square roots of the heigths to which they may ascend: and so in this occasion they are also as the roots of the specific Gravity's.

If therefore we would know what is the Velocity of Air being driven by any degree of pressure whatsoever, we ought but to find what would be the velocity of water under the same pressure: and then take the square roots of the specific gravitys of these two liquor's; because as much as the square root of the specific Gravity of Water, doth exceed the square Root of the specific Gravity of Air; so much in proportion will the velocity of Air exceed the velocity of water. For example, when I would compute what should be the swiftness of a bullet shot by the Pneumackick Engine, as hath been described in Philosophical Transactions, Num. 179.

I should first compute what was the velocity of the Air itself that drove the Bullet: I did therefore take notice that in this occasion the Air bares a pressure much about the same as that of water when it's spring is 32 foot high: now such water would spout out with a sufficient velocity to ascend 32 foot perpendicular, and therefore, according to the rules and observation of Galileus, Halley and others, such water hath the velocity of 45 foot in a second. It remains therefore but to know the proportion of the gravity of Air to that of Water: and we have found it not to be always the same; because the height, the heat, and the moisture of the Atmosphere are variable: nevertheless we may say in general that the reason between the specific gravitys of water and Air is much about 840 to 1. Taking then their square roots, as I have sayd above, which roots are 29 and 1, we may conclude that the velocity of Air must exceed that of water by 29 times: and so multiplying 45, the velocity of water, by 29, we shall find that the velocity of the Air driven by the whole pressure of the Atmosphere, is about 1305 foot in a second.
An Extract of a Letter from Mr. J. Flamsteed Astr. Reg. and Reg. Soc. S. giving his calculation of the Eclipses of Jupiter's Satellites for the Year 1687. Together with a Table of the Parallaxes of the Orb, and an Ephemeris of Jupiter's Geocentric Place for the same Year: to which is added an Observation of the Eclipse of the Moon, Novemb. 30, 1685. made at Lisbon, and Mr. Flamsteed's own Observation of the Eclipse of Jupiter by the Moon on March 31st. past.

I give you here a Catalogue of all the Eclipses of Jupiter's Satellites, for the ensuing year 1687, and together with it 2 Tables, one of his Geocentric places, the other of the Parallaxes of his Orbit to every day in the said Year. This is the 4th. Catalogue I have got published in the Transactions. With the 1st. printed Dec. 1683. Num. 154. I shewed their uses, and how by their help the difference of Longitude, betwixt any two places on the Earth, where they should be observed, might be determined. And I taught a Method of finding out within what space on our Globe any of them would be observable: This was done in English for the use of our Country-men. Next Year in December 1684. I repeated those Directions in Latin Num. 165. pag. 760. for the benefit of Forreigners. In the two Transactions of Decem. 85. Num. 177 and 178, with the Catalogue of Eclipses I described a small Instrument, and shewed by the help of it, the said Catalogue, and the Tables of Jupiter's Geocentric places and Parallaxes, the appearances of the Satellites at any time within the compass of that Year might be discovered and delineated; if therefore the Reader desire to be informed concerning the use of the Catalogue and Tables herewith printed
ed, he may repair to the above-mentioned Transactions. I shall only add.

That whereas for the two Years last past, the 4th. Satellit has not been Eclipsed. As this Year enters, it begins to fall into y's shadow, and that its Eclipses will again be observable for the 4 next Yeares. The first that happens Feb. 2. in the Morning will be well worth the attention of the Curious; in that its duration is the shortest of any that follow it this Year; both the Ingresse and Emission are Visible with us, as are all those in the Catalogue which are alike marked with an Asterisk (*), which if they shall be exactly observed, may serve to determine the place of the Node of the orbit of y's Satellites, and its Inclination to the orbit of y, by comparing the observation either with such as we have already obtained, or as may be made hereafter.

In my last observations, the Eclipses of the 2d and 3d. Satellit have anticipated my Calculations something more than I expected in so short a time; of which I thought it convenient to acquaint the Reader, that hee may attend them one quarter of an hour earlier than the times noted in the Catalogue. In 2 or 3 years more we may expect opportunities of observations, which will afford us such a correction for the error, that the Numbers shall fail no more in them, than in the 1st. whose Eclipses have not yet differed above 3 minutes from the Calculation.

I give you further herewith an observation of the Lunar Eclipse November 30, 1685, made at Lisbon by my kind Friend Mr. Henry Jacobs: and another of my own of the Occultation of y by the Moon, March the 3th. this Year 1685: of which you have published several foreign observations already.

Tab.
### Tabula Parallaxium Jovis

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in diem quemlibet Anni. 1687.
Defectus Lunaris Ulissipponæ a Do. Jacobeo Observato Nov: 30. 1686.

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<td>Martii 31</td>
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<td>vs limbus tangebat limbum Luna lucidum, Mareotidis diametrum a termino ejus boreo.</td>
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<td>Totus tegit erat. Quantum per vaiores horizonis &amp; undulationem limbi valde turbidam, licuit conjectur.</td>
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<td>Differentia declinationum limbi Luna vere Aufrini &amp; loci Ingressus, Tubo ped. 8</td>
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<td>&amp; Micrometro 1546 = 12 m. 42 sec.</td>
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<td>Jovis particula emergerat, et regione Boreali limbi Mareotidis.</td>
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<td>Jupiter torus liber.</td>
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<td>Differentia declinationum centri Jovis, &amp; limbi Luna Aufrini 3436 = 28 m. 15 s.</td>
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<td>Lunæ Diameter 3906 = 32 m. 07 s.</td>
<td>Reper. 3915 = 32 m. 11 s.</td>
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Accounts of Books. The Natural History of Staffordshire.
By Robert Plott L. L. D. Keeper of the Ashmolean Museum and Professor of Chymistry in the University of Oxford.

Here is very little need to take notice of the Method of this Work since it is drawn up according to the pattern laid down in the Natural History of Oxfordshire written some years since by our Author. He begins with the Heavens and Air, giving account of those uniuall Meteors, which have sometimes appeared in this Countrey; such are the Solar Rainbow observed by Mr. Wolverstan Dec. 4. 1680, which appeared at first about the Azimuth of Two, two hours before the Sun, and thro the thin diaphanous clouds was mistaken for another Sun, but soon after exhibited the Usual colour of a Solar Rainbow: as also several Lunar Iris's, and very severe Winter Tempefts. Here he takes an occasion to deduce the caufe of the circles in Grass called commonly Fairy Walkes, which he doth not think do owe their caufe to the Field Conventicles of Demons and Witches nor to the subterraneous Courses of Moles and Ants, but rather to percussions made by Lightnings, which breaking out of the clouds in Concave Cones have made Circles on the ground conterminous to the Rims of those Cones, and according as the Cones breakeing forth from the clouds have had a greater or lesfer inclination to the Horizon, and so have either touched with all the Base, or only dipt with the Lower part, have made Circles, or Quadrants, or Sextants &c. Here likewise he relates the wonderfull Raines, which have brought Frogs, whose Generation cannot (says he) be referred to the Ordinary way by seed. Cap. I.

He then comes to treat of Waters and the Texture of Ambient Air, the Conservatory of all the Exhalations, which are perpetually forced by the suns heat out of the Earth; as
also of the wonderfull Intermittent Springs observed up and
down in this country, which leads him to the Examination
of the causes of the Rise of Springs and Wells, of which
the World has had a Relation some time since, when we
gave an Account of Dr. Plott's Latine Book De Origine
Fontium, the Reasons whereof are here again at large repeated
in English. Afterwards he particularly enumerates what
Fountaines are Medicinal, as those at Willowbridge; what
abound in Salt, as the Brine Pitts at Weston, which tho' inferior to those in Worcestershire and Cheshire by reason of the
weaknesse of the Liquor, yet after a tedious process to
Crystalife the Salt, become very useful to the whole Coun-
trey; and lastly, what are for Colour, or Taff, or any other
Accident, remarkable, as a Well between Over and Nether
Tene, which in Autumn sends up a great Quantity of small
Bones of Frogs, which creeping into those Caverns, whence
the Springs come, are killed by the cold; and the acidity of
the water corroding the flesh, those Bones are driven up and
carried away by the streame of the Fountain. Cap. II.

From Waters our Author passes to Earths and Minerals:
Of the first of which the Number is very great, especially
of fine Clays for Pottery-Ware and Bricks: But the Coale-
Workes with the Iron-Mines most deserve our considera-
tion. The Coale-Mines are very accurately described, both
as to their Inclining Position, or Dipping under the surface
of the Earth, and as to their several differences in goodness
and usefulness, such as those of Cannal, with which the Choice
of Litchfield Cathedral is paved; those of Wednesbury most
fit for Culinary Fires, &c. Upon this occasion the Nature
of Damps is examined, which are resolved into the stagna-
tion of the Air contained within the Rifts of the Coale,
that are emptied of the running Water (which in Virgin-
Mines always fills the Rifts, and keeps them from this stagnating Air) by the Soughes made for that purpose; or which
sometimes are occasioned by working so deep, as that there-
by the Intervention of the upper Air is wholly stoppt.
Cap. III.
Before we come to the Iron-stones, our Author considers those great Quarries of Marble, Alabaster, and other useful stones dispersed up and down the Country; all which he supposes to be made by a Petrification upon the meeting of the solutions of Aced and Alkaliform salts, which compound transparent, opaque, and semi-opaque stones, as they are mixed with sulphures or Earths of different finenesses. He considers Pebles and Firestones by themselves, as wherein the Sulphur is predominant; and therefore are they easily Calcinable. When he comes to the Iron-workes he explains the way how their Fornaces are built, how they melt their Iron-stone, how the goodness is discernable, and the like. As for the Copper-mines tried by Sr. Rich. Fleetwood, they would turn to no Account.

Other stones have been sometimes found in Staffordshire, which have had a determinate Form, as the Asteria of a Pentagonall surface, with Rayes issuing from the Center, and to each angular point. These are either such as resemble Animals or some of their Parts: so one was found like a Pullets heart, others like most Tefaceous Fisbes, which have been long thought to be petrifyed Shells, tho some Naturalists are persuaded to the contrary; or else such as are like Vegetables, whereof in mineral stones and Oares there is great Variety. Gold Oare hath resembled Branches of Trees, and Wormius had a piece of Silver Oare exactly like a Vine; which Figures are ordinary in Bohemia as Balbinus informs us, and when he afterwards speaks of the Entrochi and Trochite he explains very curiously several Figures not taken notice of by Mr. Beaumont. Cap. 5.

Next he comes to Plants, tho there he owns little can be added to what Mr. Ray had found in his accurate Catalogue of English Plants, yet he found some few omitted by him, as a sort of Cup-Moffe with Scarlat Heads, and some Fungi tho the Fungus Phalloides is described, and a Cott annexed in the 2d. Edit. of Mr. Rayes Catalogue ] together with some few Trees, which Mr. Ray took for strang-
ers to our soil, as the Firrs, which Dr. Plott seemes to thinke are Natives here, which he grounds upon the great Numbers that have bin digged up in the Mosses, and can by no means be allowed to have bin under ground ever since the Flood; but were rather Trees, which being felled and not presentely used, gathered and kept in the Rain Water, which in time bred there a Marsh, and being buried in earth by those frequent Deterations from the adjoyning Hills, in time were so far covered, as we now fee them. Some Trees he finds of wonderfull Growth in this Country, as the Wiche-Elme cutt down in Sr. Harvey Baggot's Park, that weighed near 100 Tuns: and that this may not be thought incredible, all the Demensions are set down with Attestations of Workmen and of Sr. Harvey himself. Cap. 6.

Under Brutes, our Author comprehends all irrational living Creatures: amongst birds he takes notice of a Swan with Red Leggs, and a sort of Columbus or Ducke not described by Mr. Willughby. the Pewet-Catching in Norbury Pond, with their way of Living, and their affection to the Family of the Skrymsheers is exactly described. Of Insects he describes a water Eruxa, a white Earwig and several more. He found amongst Fishes a Mustela Fluviatiles, with yellow spots, not observed by Naturalists. Speaking of Eels, he observes many which goe from one Pond to another in search of Provender, and then shews by the concurrent suffrage of Natural Historians, that it is no such strang thing; as is not also the finding of Toades in Trees and stones, whereof many instances are produced, which principally says our Author comes from a Toades being enclosed in a narrow Rift in winter, which afterwards closing too hard imprisons them there, without killing them; Toades having little blood, and very viscous juices, require not much perspiration. In discouring of sheepp, he solves the Problem why the Testicles and Horns se mutuo ponunt ac tollunt, because those excrementitious juices which form hair, horns & wouoll are more vigorously thrown out in Males than in Females,
and in those when uncastrated, than when guelt; All a long, many Monsters and Lusus naturæ are described, and many cut in Brasse. Cap. 7.

The Next Chap. is of men and women. And first he speaks of a man in Stafford-shire who married being 108 years of Age, and had a child extremely like him; next of a woman who had a Monstrous Birth, with a Bagg filled with Grinader-Teeth, and very hairy: of another woman who was brought a-bed without Knowing she was with child. [This Dr. Plot lays is a case he never before met with, but it may be confirmed by the like instance of a young Woman, the wife of Philip Barker junr. of Wrentham in the County of Suffolk, who was also brought to bed of her second child, a lusty Boy, last Year, without any suspicion of being with child; for about three days or a week before, she took Physick for a Tympany, which the good Women of her acquaintance persuaded her she was troubled with.] Then our Author speaks of Famous men born in the County, as Arch Bishop Sheldon, Mr. Ashmole &c. And afterwards of those who are otherwise memorable for odd & occasional things, as the Boy of Bilson, who counterfeited being bewitched (where our Author takes occasion to differ very materially from the old Relations); Mary Foster who recovering of a Fright, slept 14 days and nights: Several deaf men who could understand what was said by the motion of the speakers Lips: then he mentions others eminent for Piety, particularly in building Churches, as Mr. Chetwind who built a noble Church at Ingestre, and others whose deliverances from dangers are very remarkable, as our Late Dread Sovereign K. Charles the seconds Preservation by Coll.Lane &c. Afterwards when he comes to speake of the Corporation of Masons he fully confutes the Fabulous Accounts, they give of their Charter Privileges; the rise whereof they date from St. Amphibalus alias S. Albans Cloake: he concludes with a numerous Catalogue of men and women, who have lived to an Extraordinary Age. Cap. 8.
In the next Chap.our Author treates of the most curious things relating to Arts in this County, such as in Water-Workes is the Jack turned by water falling upon a Wheel after the manner of an Overshott Mill. So in Agriculture he examines all sorts of Compost, wherewith they improve their Ground, as Marles, Lime-stones, Effe or Turf burnt to Ashes, and Turfes and Dung. He shewes what Land requires any Particular Compost; and what increase, when well manured, they usually produce. From Husbandry he passeth to Buildings, where he describes the Cathedral at Litchfield, and upon account of its declination from East to-wards N. he discourses of the reasons that enduced Pagans and Christians to build their Temples, E. & W. He curiously describes the staircase to the steeple of the Collegiate-Church at Tamworth, which is made with two Cochleas winding one within the other round the same Cylinder, so that one may ascend in one Cochlea, and another in the other, unseen by each other: One Cochlea opening to the Church-yard and the other in the Church. He then tells of those curious Iron Works, Locks, Boxes, Spurs &c. for which Wolverhampton in particular, and this whole County in General is so much admired by strangers. Amongst other things he describes that remarkable Bridle for Scolds used in some parts of the County, which put into their mouths hinders their speakeing, and effectually shames them, whilst they are carried over the whole Town where they live, thus Gagged.

Cap. 9.

The Antiquities in this County are either British, Roman, Saxon, Danish or Norman. Near Wrottesley there is a Ditch 4 Miles in Circumference, cross which there are to be seen Remainders of Streets, and here and there Foundations that seem to be of British Original; as also those Instruments of Stone like Darts and Arrow Heads, used by the Britans, which are here sometimes seen up and down. The Principal Roman Monuments are, Watling-street, and Icknild-street, which cross each other in this County, on which were the Stages where the
they lodged their Troops; as Etofetum, now Wall, and Pen-
nocraatum now Stretton. In the Saxon time we find Litchfield
railed by Wphere K. of the Mercians to the Honour of St.
Ciadda; Wphere Castle at Berry-bank has yet some Ruines
which are visible: Tamworth was K. Offa's Seat; and Wul-
verhampton, or Wulphrumes-Hampton, called so from Wulphrune
Wife to Althelm Duke of Northampton in K. Edgar's Reign,
was by her endow'd with a Deanary and Prebends; and fe-
veral Lows or sepulchral Hillocks, railed by the Saxons are to
be seen up and down, Marks of those Bloody Engagements
between them and the Danes. There are no Danish Anti-
quity, more remarkable than their wooden Almanacks, still
in use in Denmark and Staffordshire; one of which used in
this County, our Author accurately describes, and explains its
deviations from those now made in Normey. Lastly he
clears many Customs and Tenures brought in by the Nor-
mans, as the Chusing the King of the Minstrels, and the Bull-
running (instituted by John of Gaunt) at Tulbury, the claiming
of the Gammon of Bacon at Whitchnower, and several others.
Cap. X:

2. SCIOTERICUM TELESCOPICUM or a new Con-
trivance of adapting a Telescope to a Hori%ontall Diall,
for observing the moment of Time by Day or Night. by
Will: Molineux Esq. R. S. S. Dublin. 1686 in 4to.

T HE Author dividing his Book into XI Chapters, he
first declares the Ufe & Advantage of this new Contri-
vance, which he conceives so great, that since the first men-
tion of Dials, he hath not heard of a more plain and easy addi-
tion for their advancement; especially, when the Observation
of the exact moment of time is so necessary, that neither
Geography, Navigation, or Astronomy can be brought to per-
fection, nor the Longitude or the Truth of Astronomical Tables
Tables fully discovered. The Methods which commonly are used for observing the Moment of Time, are either by Dials, or by taking the Suns Altitude by day, or that of Stars by night; or by observing the Altitude and Azimuth of the Sun or Stars; or by the Transits of the Sun or Stars through the Meridian, or the coming of some Circumpolar Stars in the same Vertical with the Pole-Star. All which Methods are attended with many inconveniences and difficulties, the which our Author believeth his Way will avoid; at least the most material ones, which commonly arise in the Practise. For whereas Dials must be very large, if there shall be any division for Minutes made discernable, so the uncertainty of the Shadow cast from a large Gnomon renders them useless for niceness, when also their service is only by Day, and when the Sun shineth. All which hindrances are taken off by this new contrivance of our Author, where also there is no need of any Calculation of Oblique Spherical Triangles, all being done by a plain and simple Observation, and by the Addition and Subtraction of two or three small Numbers; and that to such exactness, that not a quarter of a Minute, or 15 Seconds shall be wanting, performable also both by day or night. Describing therefore his Instrument in the 3d. Chap. he tells, that the Contrivance consisteth in making a very large Horizontal Dial, adapted to the Latitude of the place where the Observation is to be made, capable of receiving divisions into minutes; and parts of a minute, fitted with a large, strong, and double Gnomon: He calls that a double Gnomon, that casts the Morning Shadow from its Western Edge, and the after-noon Shadow from its Eastern Edge, and the Noon-shadow by its thickness. This Dial is to be furnished with two pair of Sights or Rulers, one is to serve in the Morning, or for Stars on the Eastern side of the Meridian, the other to serve in the Afternoon, or for Stars on the Western side of the Meridian. Each of these consists of two moveable Rulers; one he calls the Horizontal Ruler, the other the Gnomonick, or Stile-Ruler. These two Rulers must be
be so adapted that their two Edges, which are next to the Gnomon, may be perpetually in the same Plane with their correspondent edge of the Gnomon. On the Stile-Ruler he puts Telescopical Sights, with Cross-hairs in their due place. This Instrument is represented by a large Scheme annexed to the end of the Book. How every part of this Instrument must be framed, and the Stile-Nut and Ruler-Joyn composed, is at large described in the 4th. Chapter. As for Telescopick Sights, and their true adjusting; he tells Chap. 5. how to put in the Mensurator, or to place the intersection of the Cross-Hairs, so that they may stand neither too high nor too low, nor too much to the right or left Hand, which else would produce Errors in the Azimuths and Altitudes: also for making the Line of Sight or Collimation parallel to the sides of the Ruler, he applyeth two Pins, which will serve in the same manner for finding the Declination of the Magnet, whereas the Ways proposed by Mr. Huyghens and Sturmus, seem to be defective. The way of letting the Dial to his true Position, is explained in the 6th. Chap. where he tells that two things are requisite, first that the plain of the Dial be in an exact Horizontal Posture, by accurate Levels; and secondly, that the Meridian, or 12 a Clock-Line, be exactly towards South and North; for that being 12 minutes of a Degree ill placed, will make a Dial err a minute of Time, in the Latitude of 53 Degrees: and for this Reason he sheweth Chap. 7. how to find the Meridian Line by his Instrument, in taking several equal Altitudes of the Sun in the fore and afternoon, and having drawn the Azimuths thereto, the Bisection of the included Angles, will shew the true Meridian Line, which also may be found after the same manner at night by the Stars. But coming finally in the 8th. Chap. to the manner of observing the Time, after the Dial is justly levelled and flated; he shews it to be done by looking at the Sun through the Telescopick or Stile Ruler, and bringing the Mensurator upon the Sun's Center; and then the Horizontal Ruler shall cut the hour, minute, and part of a minute.
nute most exactly in the Dial. By the same Telecopical Sight, the motion of the Sun will be perceived so quick and nice, that two beats of a Second-Pendulum may be determined, and the time of the day or night to 3, 5, or 7 Seconds discerned. The way of using this Dial on the Stars by Night is much the same, only that for these are requisite certain Tables (put at the end of the Book) of the Sun and Stars temporary Right-Ascensions: For in looking at the Star through the Telecopick-Ruler, the Horizontal-Ruler cuts the Stars horary distance from the Meridian, to which adding the Stars Right Ascension, and from the sum subtracting the Sun's Right Ascension, the remainder gives the Hour, Minute, and Second of the Night; and by this Method inverted, the Author thinketh the Right Ascension of any Star may be easily had. The way to calculate the Sun's and Stars Ascensions, he declareth in the 9th. Chap. and also Chap 10, the Equation of Time, upon supposition of the equability of the Earth's Revolutions; he shows also by a Calculus how to correct the length of the Pendulum of a Clock, and giveth in the 11th. and last Chap. Tables of the Circumpolar Stars their Calculation and Uses.

L O N D O N,
Printed by Joseph Streater, and are to be sold by Samuel Smith, at the Princes Arms in St. Paul Church Yard.
For the Months of November and December 1686.

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A Table shewing the time of High Water on the Coasts, and in the Ports of France, upon the day of the New and Full Moon. Taken from the French Ephemerides called La Connoissance des Temps for the Year 1687.

On the Coast of Gascony and Guienne.
At 3 h. at the Mouth of Garonne, and the Isle of Rée.
At 3 ¼ h. at St. John de Luz, at Bayonne, and Menissan.
At 3 ¼ h. at Royan, Brouage and Rochelle.
At 3 h. on the Coast of Poitou.
At 3 ½ h. at Ollonne and Beauvoir.

On the Coast of Brittany.
At 1 ½ h. at Bell Isle.
At 3 h. at the mouth of the Loire, at Garande, Morbihan, Blavet, and Concarneau.
At 3 ½ h. at Apenars, Vannes, and Auray.
At 2 ½ h. at Apenmark, Audierne, the Race of Fontenay, and Le Conquet.
At 2 ¼ h. at Brest, and at Cape de Four.
At 4 h. at St. Paul de Leon.
At 4 ½ h. at Port Blanc.
At 6 h. at St. Malo and Cancale.

On the Coast of Normandy.
At 7 h. at Granville, and Barneville.
At 8 h. at Cherbourg and Barfleur.
At 9 h. at Caen and Honfleur, at the Mouth of the Seine, and at Havre de Grace.
At 9½ h. at Fesca and St. Valeri.
At 10¾ h. at Rouen, Dieppe, and Treport.

On the Coast of Picardie.
At 11 h. at the Mouth of the Somme, at Estaple, Boulogne, and Ambleteuse.
At 11 h. at Calais.
At 12 h. at Dunkirk, Newport and Ostend.
The Verbal Process upon the Discovery of an Antient Sepulchre, In the Village of Cocherel upon the River Eure in France.

In the yeare 1685. the 11th. day of July, Wee Olivier Estienne an Advocate in Parliament, subdelegated by Monseigneur de Marillac, Concellour of State in ordinary, having the conduct of the workes that are making upon the River of Eure below the Village of Passy, Doe Certifye to all present and to come, that upon the petition of Messire Robert, Prevoft of Cocherel, Knight and Lord of the Mannour of the upper and lower Cocherel, wee have this day come to the sayd town of Cocherel, having with us several Witnesses, and from thence to a piece of Land of the sayd Mannour of upper Cocherel called les Hautberges, upon the top of a rising Ground expos'd on all sides to the Sun, a little declining from South to West: Where being come the sayd Lord of the Mannour of Cocherel did remonstrate unto us, that having occasion for a considerable quantity of Free-Stone for the reedification of the gate or Sluice for boates of the Mills of Cocherel, and which hee is to repaire by the Kings order, hee had for that purpose cauls'd two great Sones, which appeared in this place above ground onely as two Limits or Bounds, the one about a foot and the other about 8 or 9 Inches to be further uncovered, and they had been found to bee 6 foot heigh, and about a foot and a half thick; marked in the figure of the Sepulchre A and B; the bredth of the one marked A of three foot; and the other marked B of two foot and a half, set end ways by one another; and they had further observed in making this discovery, that it was an Antient Sepulchre, shut only on three sides, viz. at one end at the head by the two Stones already mentioned; on the right side by a Stone placed edg-ways upon its thickness of about 14 Inches, and being above 5 foot
foot and a half long, and about 3 foot broad, touching in a Right Angle the Stone marked B at the head; and at the feet another Stone was set, it was marked D, of the same thickness of the precedent, and about 4 foot square; all these Stones were cemented together with Morter made of the Chalk or Marle taken out of the same hole, and mingled with little Stones or Gravel.

That in this Sepulchre were found the Bones of about twenty Bodies of Men, of the ordinary Stature, between 5 foot and a half, and 6 foot, except two Youths of about 15 or 16 Years old; all these Bodies lay extended North and South, the Arms along the Bodies, and the Heads all placed along the two Stones A. B. In the Right Angle there were two Bodies separated from two others by the Stone E, of about a foot thick, 4 foot broad, and 5 foot and a half long, that lay in the manner of a Tomb Stone upon the two Bodies underneath. All these heads had very fair found Teeth in them, and the Cranium and other Bones of the Head, were much stronger and thicker than those of ordinary Heads; which argues them to have been of strong well constitution'd Men; amongst them all there was not any Womans Head.

In proceeding still to examine the Sepulchre, we did observe, that at the same distance from the Superficies of the Earth, and from those Bodies thus buried, there was three little earthen Pots, of about 4 Inches Diameter, and between 4 and 5 Inches high, of a black Earth as soft as Wax; which could not be separated from the other Earth without breaking them, and the pieces being come into the open Air turn'd of a greyish Colour and grew hard. These Pots were full of Wood Coals and Ashes, which were not much examined.

All these large Stones of the Sepulchre were rough, and had not been cut, but seem'd to have been fetcht from a Neighbouring Quarry, which is about 400 foot off, upon the same Hill.
We observed besides, that in the place where were laid the two Heads of the Bodies, that lay upon the Tomb-Stone there were found two Stones: The one whereof was about 6 Inches long, and some 15 Lines broad in its broadest place, and about 4 Lines thick; fram'd like the head of a Pike, very sharp and cutting at both ends and on the sides; it was a yellow Flint, of which the best Fire-lock Stones are made, being almost as hard as an *Agat*. The other Stone, which was likewise under one of these Heads, was shap'd like the head of an Axe, about 4 Inches long, and 3 Inches broad, having a hole at the narrowest end, and about 6 Lines thick, very sharp and of a greenish Stone, spotted with white spots as hard as *Agat*: the *French* Lapidaries call it *Pierre de Jade*, or the *Nephretick* Stone.

Under the two Heads which were under the Tomb-Stone there were also found two other Stones; the one much of the same Nature with that first described, but something longer, and the sharp end a little dull'd. The other was likewise in the shape of an Axe Head, very sharp and cutting, of about 3 Inches long and 2 and a half broad, and 6 Lines thick, with a hole in it at the narrow end: The Stone was of a dark green Colour, which the Lapidaries call, *Oriental Serpentine*.

On the left side of the Sepulchre which was open, there were sixteen Bodies in the same Situation as the first, placed North and South, their Heads along the great Stone A, and the Arms extended along the Bodies, the Bones all entire, though they appeared very Antient, and after two Days lying in the Air fell all to Dust.

All the Bones of these heads, as has been said before, were very thick, there was one that had been pierced by some blow, and Nature had repaired the Wound; within, the hole was round as having been made by some sharp round Weapon, which argued likewise the wounded to have been a Souldier. Under every one of these heads, there was a little Stone: Two were round, one of a reddish colour, of about
an inch thick, having a hole at each end, which lessened and grew narrower towards the middle. Another of a Chestnut colour and about the bigness of a Chestnut, made in the shape of a Coat-button, with a hole clean through it, but roughly polished and hard, seeming on one side to have suffered by the fire.

There were likewise two other little Stones, which according to probability were under the Heads of the young Bodies; whereof one was about two inches long and eight lines broad and two lines thick, pretty sharp at the broader end, and having a hole at the narrow end: it is thought to be of the same Pierre de Jade, green and white, but tis nothing so hard as the first.

The other Stone was about 17 lines long, and 8 broad; two lines thick, somewhat sharp at the broad end, and having two holes at the narrow end, the one bigger than the other: tis thought to be of a white Marble or Alabaster.

There were moreover found under these Heads three Stones, whereof two were of a grey Pible, such as we find by the Sea side, shaped like Axes Heads, sharp and polished, about four or five inches long and four broad at the broadest end; about an inch and a half at the narrowest, and in the middle about an inch thick. These Stones were by their narrow end to be put into a piece of Staggs Horn fitted to receive them, as appeared by several pieces found in this Sepulcher, which had an oval hollow at the end to receive one of these Stones; these pieces were about six inches long, and had a hole at the other end, by which they might be fastened to a longer stick.

The Third Stone was of the shape of the precedent, but of a black Pible like a Flint, of which this Country is very full; and it was besides remark'd that the pieces of Staggs Horn were worn at the end, and polished upon some Stone, but not cut with Iron.

Under all the other Heads there were ten little Stones like black flint, one under each Head, cut all in the same shape.
there, smooth on one side and sharp on the other; tis thought they might use them as Knives.

There was likewise found in the same place under one of the Heads a Stone, which within was of black flint, having the outside of a white substance, as that sort of Stone uses to be, this had two Eminences like Teeth, which we took to be Natural, and not Artificial. All these Stones thus placed under their heads shewed that they had them in great Esteem.

Amongst these dead Bodies has been also found some Bones sharpened, to put at the end of a Stick, or at the end of an Arrow; one was of the smaller Bone of a Horse's Legg, and the other was made of the sharp end of the Andouilleres of a Staggs Horn.

Amongst all these Stones there, has been found no sort of Inscription, Sculpture or Character either in rilievo or otherwise, which might oblige us to think that these Men had any knowledge of Christianity; but rather that they had some Idolatrous Superstition, as these Stones seemed to Indicate. Wherefore we thought fit to declare to the said Lord of the Mannour of Cocherel, that he might without Scruple use these Stones for what use he thought fit.

Since the Expedition of the present verbal proces, there having been further digging on the left side of this Sepulcher, it has been discovered that the bottom of the Sepulcher was raised, and not so deep by a foot and a half as that part where the Bodies were buryed. And it is perceivable that in this place several Bodies have been burnt, whose Ashes and burnt Bones have been thrown confusedly into this hole: and tis observable that all along the Sepulcher, there is a veine of Coales and Ashes, which runs about two foot below the superficies of the Earth, and all these Ashes, and Bones are under this Bedd of Coales and Ashes which are so salt and, urgent that they make one freeze; and when these Bones are handled they produce a tingling in ones finger ends, as if one had handled the sharpest Salt-Peter.

There
There has not been time yet to finish entirely this discovery by digging into the Earth that has been put into this Sepulcher, which was dug on purpose in the Chalke to bury these Bodies, and likewise the Ashes and Bones of those others that were Burnt. So that it seems difficult how to reconcile the two Cerimonies of Burying and Burning. Except we should say that there has been a fight in this place between the Gaules and some barbarous Nation, who had Invaded them; that the Gaules have burn't their dead, and sacrificed to the mnes of them their Prisoners taken in Warr, whom they buried with the Cerimonies proper to those Barbarians, the thickness of whose Sculls shew that they went bare-headed; and their Armes shew that they had not the use either of Iron or Brass to make Arms of, but using such as Nature afforded first, as some Indian Nations do now.

There remains now to guess, by these Stones and what Antiquities we have left in History, who these Barbarians should be, and at what time this Sepulcher might be made.

The Sepulchres and Monuments of the Dead having been in all times held sacred, and it being looked upon as a piaculum to remove or deface them: Mr. de Cocherel having discovered this but now described, thought it his duty to inquire into the Condition thereof, as not being willing, without Legal Authority, to disturb the Bones of those there interred: This was the occasion of this Verbal Process, which for the Novelty of the thing, was thought fit to be Published in the form of Law, as it was communicated by Mr. Juftell. Reg. Soc. S. who has promised to procure, if possible, the Figures of the Arms of Stone found in the said Sepulchre, which in some following Transaction shall be given.
An Extract of a Letter Written from Rome, dated the 16th. of November last, to Signior Sarotti, concerning a Discovery made upon the Inundation of the Tevere. Translated out of the Italian.

I believe you have already heard how the Inundation of our River has done several considerable Mischiefs about this City, spoiling several fine Houses, and very large Aqueducts, by breaking down their conduits, &c. It has in several Places, (especially without this City) by breaking the Ground, discovered Vaults unknown before, great part of them full of earthen Urnes, and Sepulchers, but of no great consideration, by the Inscriptions they had upon them: Only in a Place within two Miles of this City, where there was some great antient Ruines, the Water having pierced a strong thick Wall which joined to a great Country Palace, and passing under the same, broke out at a corner of an Aqueduct by the said House, where there was found a small Vault of an Oval Figure, in which there was a Stone Sepulcher pretty large, with the following Inscription P. M. R. C. cum Uxore. and more, which could not be discerned; By this same there was a great earthen Urne shut up very close, which being opened, there came out such a strong Smoake, that it made the Man that was by it almost giddy; the Smell was like Bitumen, but being quickly dispersed, they found in the bottom of the said Urne an earthen Pot made up as a Lamp, full of a Materia Oleosa, which by degrees, as the cold Air got into it, grew hard.

Several persons suppose this to be one of those perpetual Lamps that the Antients mention: For my part, I cannot give yet my Judgment; but after that the business shall be better examined, I shall give you a further Account of it; intending to go myself to see it, because the Gentleman in whose Palace it was found is my good Friend.
A Relation of a petrified Glandula Pinealis, lately found in the Dissection of a Brain: Communicated by Sr. Edmond King Knt. M. D. and Reg. Soc. S.

Mr. ROBERT BACON, Master of Arts, of Corpus Christi Colledge in Oxford, a Pious Learned Man, above 75 Years of Age, was formerly employed in Transcribing and Publishing the posthumous Works of Dr. Robert Gell; he had been before a Preacher at Bussleton, near Bristol, and afterwards in the Town of Windsor; he was Sanguine, and cheerful in his natural Temper.

About 12 Years since, his Friends observed that at his return home from walking, he would bend double to his right Side, insomuch that he would be ready to fall, and has been brought home in Coaches and Sedans, yet was always temperate, and never observed to be disordered with Drink in his Life.

He would often say, that he feared Fatuity, or Distracti- on, and would pray that God would keep him in his right Mind.

His Appetite to all sorts of Food in his latter Years inclined to Canine, and his Thirst very great.

He often complained of pain in his Bowels.

He was always desirous to have his Head rubb'd many times in the day, and this too was of late Years.

His Urine of late Years, and Excrement came away always involuntary at Bed, Board, &c. of which he did not seem at all to be sensible.

Of late he would always hang down his Head in a prone sleeping Posture; and his Head was very hot: he did sweat very much every night, and wet his Linnen extraordinarily.

And in the whole his rational Faculties seemed to be quite lost, for a great while before he dyed; for he would usually take
take up Tongues, Fire-shovel, Brooms (many times alltogether) to walk by, though he had a Staff of his own; he would also hale the Chairs about the House and up the Stairs, and grasp at any thing with his hands; he would often tumble on the ground, and seldom rise without help; he did rather creep along by Walls and Chairs than go, though formerly he went very upright; of late it was 2 or 3 Folks Work to support him to his Bed; he would put 2 or 3 Hatts at a time upon his Head like an Antick, he would many times strike those that attended him, yet at Intervals would say to his Daughter, *Pray thee be reconciled to me,* or words to that Effect.

I hearing of these things before this Gentleman dyed, desired that I might open his Head, and examine the Brain to see what I could find or observe therein extraordinary, that might occasion so great a Change as was in him some Years before his Death.

He dyed of a Fever, November the 4th. 1686, about 6 in the Evening.

**Nov. 6th. 1686.**

Upon Dissecting the Body of Mr. Robert Bacon aforesaid; We found in the lowest Venter as followeth.

The Liver indifferently well coloured and firm.
The Spleen firm and good, but shrivill’d.
The Stomack firm, large, and strong.
The Intestines all well coloured.
The Omentum whole but ill coloured.
The Pancreas very firm and good.
The Mesenterie well enough.
The right Kidney found, with a few small stones.
The left Kidney two parts of three wasted, and some...
course Gravel, but both Kidneys very fatt.

The Bladder of Gall fill'd with one Stone only, and that no bigger than a long Nutmeg.

The Bladder of Urine found, but some little course Gravel and small Stones in it.

The middle Venter being opened; the Lungs were well enough, only by the stagnation of Blood discolor'd, and fill'd in several places with Icorous Spumy Matter.

The Heart strong and Vigorous as I have seen.

The Pericardium very thin, and too tender, and too little Water in it; very little Blood in the Ventricles: No adhesion of his Lungs to his Ribbs.

The Auricles of his Heart perfectly found and strong, as of any found Man of 20 Years old; those and the strength of the Muscles of the Heart I admir'd

The Head being opened,

The Dura Mater extremly hard, thin and white, a slender Imboydery of Vessels.

The Pia Mater all full of seeming turgid Glands, and a great distention of Lymphæduets full of coagulated Lympha.

The substance of the Brain loose and shrunk, very white, very little of the cineritious Colour to be seen.

The Corpus Callosum very flaccid more than ordinary.

The whole Body of the Brain was shrunk about a third part.

Between the two Meninges of the Brain, was near a pint of extravasated Serum, that must needs oppress the Brain very much.

The Ventricles of the Brain full of Serum.

The Plexus Choroides extremly large, in length as well as breadth and thickness.

The Nates and Testes very small, and shrunk.

The Thalami Nervorum Opticorum plump and fair. The
The Corpora Striata large and fair, full of large Striae as I have seen.

The Glandula Pinealis firm and fair, well colour’d to look on, of the exact Figure, and ordinary size: Feeling of it, and finding it harder than ordinary (and talking to a Gentleman then present of Des Cartes his Opinion, that it was the Seat of the Soul) I preff it, and found in it a Stone in a film, or rather a petrified Gland in a film; I took out the Stone, and kept it as a great Raritie; I do not remember I ever heard of such a thing before, I am sure of all the Brains I have dissected (and I may say I have dissected more than an hundred) I never saw such a one.

The Glandula Pituitaria was half wafted, that part that was left was very hard and brittle, had not the Tone of a true Gland, nor substance, according to my Observations, unless of a vitiated Gland.

The Cerebellum seem’d well enough, and all down the Cauda Medulla oblongata.

The other parts of the Brain unmentioned had nothing remarkable, nor have I time now to Philosophize upon the Remarques to be made upon the above-named Observations.

Before he became so mopish, he would say he felt a certain kind of fierceness within him, which (it is probable) made him to utter some kind of Vocifération when he was displeased at any thing.

Remedies were applied to all these Distempers for several Years, both inward and outward; outward as in Plaisters, Cerates, opening the Jugular, &c. inward as Cardiacks, Cephalicks, and Febrifuges, &c.

Thus having told you Matter of Fact, attested by his own Relations, (who were Eye-Witnesses of it) I leave these my Observations upon the Dissection of his Body to the Consideration of the more Curious and Inquisitive.

Edm. King.

November the 6th.

1686.
A Correct TIDE-TABLE, shewing the true times of the High-Waters at London-Bridge to every Day in the Year 1687: By J. Flamsteed Math. R. & R. S. S.

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Initium ob interpositas Nubes præcise determinare hand licuit, ideoq; incertius pon

Eclipsin incepit ad 9 h. 25 m. vel

H. M. S

Umbra ad Paludem Maraotim 9 15 00

Palus Maraotis tecta 9 27 00 *

Mons Sinai Tegitur 9 38 20

Mons Thamnes Tectus 9 40 20 *

Mons Audus Tegitur 9 46 30 *

Mons Neptunus Tectus 10 1 20 *

Umbra ad Montem Sipylum 10 8 00 *

Insula Circinna teginitur 10 14 00 *

Ad Montem Didymum 10 15 10 *

Mons Didymus teginitur 10 16 40

Emergit M. Audus 10 18 20 *

Umbra ad paludem Maraotim. 10 20 10

Emergit Maraotis 10 23 00

Ad Montem Sinai 10 48 30

Emergit Sinai 10 52 00

Finis Eclipsis 12 4 00

Notanda.

Tempora sunt Horologii Oscillatorii ad Stellas fixas rectificati.

Que Afterismo Notatur Observationes, per biantes Nubes captae sunt, adeoq; accuratas haberii nolo.

Quantitatem hujus Eclipsis sex poto Digitorum.

Calculum quod spectat, in Initio determinando, Ephermeridas Gallica (La Connoissance des Temps) ad veritatem propius accedunt quam Anglice (Societati Regiae dicata) Idem enim initium
Initium ponunt ad 9h. 31m. ha vero ad 9h. 38m. Meridianorum habitus respectu.

In assignandis autem Medio, Fine, Quantitate & Duratione Ephemerides Anglice Gallicas sunt accuriores; Finis enim ab Anglicis ponitur ad 12h. 14m. a Gallicis vero ad 12h. 29m. Quantitas ab illis supputata sex fere Digitorum; ab his 7 Dig.

Further Assertion of the Propositions concerning the Magnitude, &c. of London, contained in two Essays in Political Arithmetick; mentioned in Philos. Transact. Numb. 183; together with a Vindication of the said Essays from the Objections of some Learned Persons of the French Nation, by Sr. W. Petty Knt. R.S.S.

1. It could not be expected that an Assertion of London being bigger than Paris and Rome, or than Paris and Rome put together, and bigger than any City of the World, should escape uncontradicted, and 'tis expected that I (if continuing in that Perwation) should make some Reply to these contradictions.

2. I begin with the Ingenious Author of the Novelles de la Republique des Lettres, who faith, that Reyin Persia is far bigger than London; for that in the 6th Century of Christianity (I suppose An. 550.) It had 15000, or rather 44 thousand Moschees or Mahometan Temples. To which I reply, that I hope this Objector is but in jest, for that Mahomet was not borne till about the Year 570, and had no Mosche still about 50 Years after.

3. The next is the excellent Monsieur Auzout from Rome, who is content, that London, Westminster, and Southwark with the contiguous Housing, may have as many People as Paris and its Suburbs; and but faintly denyeth, that all the Housing within the Bills, may have almost as many People as Paris and Rome, but faith, that several Parishes infected

G g
into these Bills, are distant from, and not contiguous with London, and that Grant so understood it.

4. To which (as his main, if not only Objection) we answer. 1st. That the London Bills appear in Grant's Book to have been, since the Year 1636, as they now are. 2. That about 50 Years since, 3 or 4 Parishes formerly distant, were joyn'd, by interposed Buildings, to the Bulk of the City, and therefore then inserted into the Bills. 3. That since 50 Years the whole Buildings being more than double, have perfected that Union, so as there is no House within the said Bills, from which one may not call to some other House. 4. All this is confirm'd by Authority of the King and City, and so long Custom. 5. That there are but three Parishes under any Colour of this Exception, which are scarce a two and fiftieth part of the whole.

5. Upon sight of Monsieur Auzout's large Letter, I made Remarques upon every Paragraph thereof, but suppressing it (because it lookt like a War against one with whom I intended none, whereas in truth it was but a reconciling Explication of some Doubts, and therefore) I have chosen the shorter and sweeter way of answering Monsieur Auzout, as followeth, viz.

Concerning the Number of People in London, as also in Paris, Roven, and Rome, viz.

Monsieur Auzout alleageth an authentick Register, that there are 23223 Houses in Paris, wherein do live above 80 thousand Families, and therefore supposing 3½ Families to live in every of the said Houses one with another; the Number of Families will be 81280; and Monsieur Auzout also allowing 6 Heads to each Family, the utmost Number of People in Paris, according to Mr. Auzout's Opinion, will be.

The
The Medium of the Paris Burials was allowed by Monsieur Auzout to be 1,887, and that there dyed 3506 unnecessarily out of L'Hotel Dieu, wherefore deducting the said last Number, the neat Standard for Burials at Paris, will be 16381, so as the Number of People there, allowing but one to Dye out of 30 (which is more advantageous to Paris than Monsieur Auzout's Opinion of one to Dye out of 25) the Number of People at Paris will be 491430; more than by Monsieur Auzout's last mentioned Accompt.

The Medium of the said two Paris Accompts is—488055.

The Medium of the London Burials is 22217, which Multiplied by 30 (as hath been done for Paris) the Number of the people there will bee.

The Number of Houses at London appears by the Register to bee 105315. Whereunto adding a 10th part or 10531, as the least Number of double Families, that can bee supposed in London, the total of Families will be 115346, and allowing 6 Heads for each Family, as was done for Paris, the total of the People at London will be.

The Medium of the 2 last London Accounts is 695718.

The People of Paris according to the above-laid Account is 488055.

Of Rome according to Monsieur Auzout's utmost Demand, 80000. 693055.

Of Rome according to his own Report thereof, 125000.

G g 2 So
So as there are more People at London, than at Paris, Rouen, and Rome by

Memorandum, that the Parishes of Islington, Newington, and Hackney, for which only there is any Colour of Non-contiguity, is not a two and fiftieth part of what is contained in the Bills of Mortality; and consequently London without them, hath more People than Paris and Rouen put together, by

Several other Estimates, Viz.

I. That London alone is equal to Paris, Rouen, and Rome, as aforesaid.
II. That London, Bristol, and Dublin are equal to Paris, Amsterdam, and Venice.
III. That London alone is to Amsterdam, Venice, and Rouen, as 7 to 4.
IV. That London and Bristol are equal to any four Cities of France.
V. That Dublin is probably equal to the second best City, of any Kingdom or State in Chrifteendome.
VI. That London, for ought appears, is the greatest City of the World, but manifestly the greatest Emporium.
A Description of an Invention, whereby the Divisions of
the Barometer may be enlarged in any given pro-
portions; produced before the Royall Society, by Mr. Robert

Since the discovery of the Alterations, that are in these
parts of the World, in the weight of the Atmosphere,
by the means of the Torricellian Tube, there has been seve-
ral contrivances thought on, to make the more minute va-
riations in the Airs presfure sensible.

And first, the Wheel-Barometer was invented and Publish-
ed by Mr. Hook, Anno 1665, in his Micrography: (where it is
described at large) but this did not answer fully the design-
ed exactness, both for that the Mercury being apt to stick
against the sides of the Glass, would rise and fall per saltum,
all at once, and because it is very difficult to adjust the Ball
and Thread and other apparatus of this Instrument, as also
that it is exceeding apt to be out of order, for which reason
it is at present almost wholly laid aside.

Upon this in June 1668 (as appears on the Journal
of the Royal Society) he bethought himself of an other de-
vice to do the same thing, which was to encrease the divi-
sions by putting coloured Spirit of Wine, or some other Liquor
not capable of Freezing, on the Mercury, which Liquor was
made to rise as the Mercury fell, and fall as it rose, in a narrow
Cane, so as to make the utmost limits about two foot asun-
der. This Invention was afterwards in the Year 1673 Publish-
ed in France by Mr. Hubin, who neatly performed the
Glass-work; but the Cane being necessarily small and apt
to be obstructed with bubbles, (whereby the intercourse
of the outward Air would be intercepted) and besides the
utmoost limits of rise and fall scarce reaching two foot and a
half, Mr. Hook was not yet satisfied, till he had found out
the means of encreasing the Divisions of the Barometer ad libitum, by a way free from such Objections, which finally he produced before the R. Society at their meeting on Feb. 3d, 1685 ft. vet. The contrivance whereof is this.

Figure I. Tab. II. Represents the Glass of this Baroscope: the Cylinder A may be of what Diameter you please, the bigger the better, but it need not be above 2 inches long, the Cane A D must be so long, that the upper part of the Cylinder B may be 29 Inches + such a part of the height of the other Cane B C, as the weight or specific Gravity of the Liquor that is to fill that Cane is to the specific Gravity of Mercury, below the line a b in the Cylinder A. The third Cylinder C may be as high as you please above the Cylinder B, but is most conveniently made, so as the square of the Diameter of the Cane B C be to the square of the Diameter of the Cylinders B or C, (which must be exactly equall) as the rise of the Mercury in the Cylinder B, is to the whole Length of the Cane B C: for in this case there will be nothing Superfluous, but the divisions enlarged to the utmost advantage.

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

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

The effect of this Baroscope will be, that when the Atmosphere is heavy, and the Mercury raised high in the Cylinder A, and retired out of B, the Spirit of Wine will descend into the Cylinder B, and the Oyle of Turpentine will fill the Cane, so as to make the partition of the two Liquors near the Cylinder B. But on the contrary when the Air is light, the Mercury will sink in A and rise in B, so as to drive the Spirit of Wine into the Cane, and the Oyle of Turpentine into the Cylinder C, so that the section of the 2 Liquors will be near C, and the Variation of the height of the Mercury will be en-
larged into almost the length of the Cane, without that the Counter-pressure from the Liquors will be in the least altered, the height and weight of the Incumbent Cylinders being always the same.

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

Thus is a remedy found out for the defects and inconveniences of the Barometers hitherto produced, and an Instrument discovered, which like a new Sense, will most nicely shew those alterations in the Air, which without it would by no means be perceptible, and of which undoubtedly very great uses might be made in order towards a perfect Meteorologe, which, without some such help as this, can hardly arrive at any great point of certainty.

But I forbear to say more about it, least (by omission of some material circumstance) I should prejudice the Ingenious Author of this discovery, who has promised to publish a more particular account thereof; what is here said being only intended to assert the Right of the first Invention of this Useful and Subtile Instrument to its proper Author, from the pretensions of all others.

This Author is one of those unhappy Geometricians, who without having acquired a through Understanding of the Principles, have yet thought themselves able to master the abstrusest Difficulties in this nice Mathematical Science, where the least oversight or mistake subverts the whole superstructure. Hence it is, that the true Quadrature of the Circle here pretended to, is lost upon the same Rock with those many others, which the less knowing and more opinionated of their own Skill have produced, in this and the last Century: But briefly to shew wherein the Paralogism of our Author consists, we must first lay down the construction, whereby he pretends to do the Business: In Tab. 2. Fig. 2. let $f k z k$ be a Circle, $f a z$ the Diameter, $a$ the Center, $k z k$ an equilateral Triangle inscribed, $B b$ a line equal to the three sides of that Triangle, and dividing the Arch $f k$ equally in $i$, the line $i e$ will be half the side of a Hexagon inscribed, which side taken 6 times, is the line $e E = $to the circumference of the Hexagon; and dividing the Arch $i f$ in $h$, the side $h d$ is half the side of the Dodecagon inscribed, and $D d = 24$ $h d$ is the circumference of the Dodecagon; and proceeding after the same manner, the circumferences of Polygons of 24, 48, 96 sides, &c. may be found, approaching still nearer and nearer to the circumference of the Circle, which at length will be equal to the line $f F$ in the Tangent; but how to find the Point $F$ is all the Skill: Here our Author tells us, that the Points $B E D F$ are all in the Arch of a Circle, whose center is in the line $H h$.
fz continued; but to contract his Work into a little compass, he assures us that it is all one, if instead of the whole circumferences Bb, Ee, Dd, Ff he take the lines b q, e p, d o, f m, each a third part of its correspondent; and that in this case too, the Circle whose Center is L, taken in the Diameter fz continued, shall pass through the Points o, p, q and interfe& the Tangent Ff in the Point m, so as to leave fm = to a third of the circumference of the Circle; which supposition being proved to be groundless and erroneous, all the consequences drawn from thence must be fo too. If our Author had but considered what the intermediate Points of the Curve between o & p, p & q, q & t ought to express, he could not but have discovered the fallacy himself, for the lines o d, p e, q b are each proportioned to fm, as the lines k b, i e, h d to their respective Arches k f, i f, h f, and so of all the rest between o and m. This would have taught him, that the Curve he has occasion to use, did universally express the Proportion of the Arches to their Sines, by that of the line fm to its respective ordinates; that it was a sort of Linea Quadratrix, to be reckoned among the Linea Geometrica Irrationales, or such whose relation between the parts of the Diameter and the Ordinates, are not generally expressible by any one Equation; that this Curve did interfe& the Circle in the middle of the Arch k x, and continge it in the point x. This Curve will be better understood in Fig. 3, where it is drawn as it ought, and wherein the proportion of the line fm to the lines q b, is as any Arch k f is to its Sine k b. Tis evident, that this Curve is not the Circle mopqt in Fig. 2, yet ’tis not apparent but that a Circle passing through the point m, may interfe& it in several points, as o p q: (but to supposie it to pass through all the extremities of the circumferences of the infinite Polygons between the Circle and Triangle, or their thirds, is to make it coincident with that Curve.) It remains therefore to shew, that the Circle passing through p and q, whose center is in the Line fz, does not pass
pass through the point \( o \), which from the following Considerations will be made evident.

First let it be required, by the extremities of the lines \( a, b, c \), or \( h, g, f \) (in Fig. 4), parallel one to another and \( d, e \), or \( k, l \), given as parts or segments of the Axis or Diameter of the Figure, to determine what curvity passeth through their extremities, according to the conditions of the five Conical Sections.

First if it be found that \( \frac{b - a}{c} + \frac{a - a}{d} + \frac{c - a}{e} = \frac{cc - aa}{de + ee} \) is equal to \( r = \frac{c - a}{dd + ee} \), then it is the Characteristic of a Circle, the Lines \( a, b, c \) being disposed in an uniform increasing order.

But if \( c \) the biggest stands in the middle, than \( \frac{cc - aa}{de + ee} \) will show the same. If the Lines \( d, e \) be segments of a line drawn parallel to the Axis, then transposing and ordering the foregoing Equations, Rules also may be found accordingly. If \( \frac{c - b}{d} = \frac{e - c}{d} \), then the Line passing through the Extremities is right:

If \( \frac{cc - bb}{ee + dd} = \frac{cc - bb}{ee + dd} \), then a Parabola is designed. The Characteristic of an Hyperbola or Ellipse differs not from that of a Circle, but only by a Relation to the inequality of the Axes, and the alteration of the Signs + and −.

Secondly, out of \( a, b, c, d \), or \( b, c, e \), lines given, that stand in the Arch of a Circle, to find the Distance from the Center = to \( m \), or \( m + e \), and to determine the Radius. There is a little variety in the case, when the given lines are in the same Quadrant or other wise: but there being only occasion for this first Case, the Rule is this, \( \frac{cc - bb}{2e} + \frac{1}{2}e = e + m \): And

\[
\sqrt{\frac{ccc - 2ccbb + bbb}{4ee} + \frac{1}{2}ee + \frac{1}{2}bb + \frac{1}{2}cc} = \text{Radius}
\]

Thirdly, in a Circle, having \( a, b, d \) and \( e \), to find \( c \): The
Equation is \( \frac{b^2 e - a^2 e}{d} - de - e^2 + b^2 = c^2 \). Fourthly: To inscribe Polygones in a continual double Progression within a Circle, many different Rules may be given: the following will serve, which is the same with that, how to find the subtenfe of an Arch, out of the subtenfe of a double Arch. The Rule is thus; \( 2 R^2 - \sqrt{4 R^4 - A^2 R^2} = B^2 \); Supposing \( A \) to be the Chord of a double Arch, and \( B \) of a single Arch. From hence it is easily deduced, that \( \sqrt{3} R^2 \) being the side of an equilateral Triangle inscribed, the side of a Hexagon will be \( \sqrt{6} R \) of the Dodecagon \( \sqrt{\frac{1}{2}} R^2 - \sqrt{\frac{1}{3}} R^2 \); and so for the rest. Now reducing according to these Equations the Lines to Numbers, it will be found that in Fig. 2 Tab. 2

\[
\begin{align*}
bg &= 173205,08 & ab &= 50000,00 \\
ep &= 200000,00 & eb &= 36602,54 & fm &= 209439,51 \\
do &= 207055,23 & de &= 9990,04 \\

\end{align*}
\]

But supposing, as our Author will have it, that \( do \) stands in the same Circle with \( bg \) and \( ep \), it follows that the Square of \( do = 422658679 \) &c. whereas it should have been equal to \( 428718707 \) &c. Square of \( do \) in the Table. The Square of the Tangent \( fm \) is also a great deal too small, and the whole Quadrature to little: All which make it appear, that the Glory of Lewis the Great is not (as this Book pretends) much advanced by the Achievements of this Author; who would have done well, in a Matter that so little needed it, to have forborne to make use of the sacred Words of our Saviour, Math. 11th. 25th.
This is a second Relation of the Voiage and Embassy of the French to the King of Siam in the Year 1685, and being a more particular Account than the former, an extract of this, 'twas thought, might suffice for both: That was composed by le Chevalier Chaumont the Embassadour, and now this by le Pere Tachart Jesuite, who was one of six Fathers of his Order, that went with the Embassadour, as Missionaries to China. The whole being much interspersed with matters of Religion and Ceremony, I shall only take notice of such things as relate to Arts and Sciences, and particularly of the Astronomical Observations made at the Cape of Good Hope and at Siam; whereby the Longitudes of those places are stated: following herein the Author's method.

He divides his Treatise into six Books, whereof the first contains the Voiage from Brest to the Cape of Good-Hope. Here he gives the reasons and motives of sending this Embassy, as likewise the six Jesuites who are Mathematicians and by the Kings Letters Patents are so styled; Their Instructions being, besides their Spiritual Function, to prosecute the business of the Royal Academie of Paris (of which they are admitted Members) by accurately observing the curious things in Art and Nature, and particularly to make Observations for discovering the Longitudes of the Places where they pass; for which purpose they are well provided with Instruments. They failed from Brest on the third of March st. n. and arrived at the Cape of Good Hope the last day of May, taking notice by the way of the several remarkable things in that Voiage, which are here too well known to need repeating; But mentioning the faultiness and rectification of the Southern Constellations, our Author is not willing to take notice of what has been done in that matter by a member of
of the Royal Society of London, tho' his Catalogue of those Stars hath been translated from Latine into French and Printed at Paris, and an Account thereof is in the Journal des Scavans of Aug. 7. & Sep. 4. 1679; but speaks of it as a thing not done, wishing they had had the opportunity to augment the Science of Astronomy, by observing them themselves.

The second Book is entituled the Voyage from the Cape of Good Hope to the Island Java; but is chiefly taken up with the description of the Colonie of the Hollanders there, the Natives, and the Astronomical Observations they made there during their stay, by which they have determined the Longitude of the Cape of Good Hope 18 degrees to the East of Paris: (but here we must begg leave to make a Remark) He mentions 7 several Nations of the Natives, viz. the Hotentots, whom he describes at larg, the Namaquaas, (of these two there are the Figures) the Ubiquaas, the Souriquaas, Ilaquaaas, Soussquaas and the Odiquaas: and here he relates a Voyage made in the Year 1685, as far as the Tropick, by the Governour of the Cape, Mr. Vanderstell; who is said to have found about the Latitude of 27 degrees and about 10 or 12 leagues from the shore, a Nation of Natives that are very Mulical, who have long Hair flowing on their shoulders, some of the Men as White as Europeans, and their Women Naturally very White, but they Blacken themselves to please their Husbands: This Nation seems to have much more Intelligence than their Neighbours, but some circumstances seem to argue it Fabulous.

Here are likewise the Figures of a Stagg with Horns like a Goat, of the Zembra, the Sea Cony, the Cerastes or Horned Serpent, the Camelion, and two sorts of uncommon Lizards, whereof one is made to have 2 fair Crofles on his back. Speaking of Elephants he says he was told by creditable persons, that they had seen the foot steps of Elephants two foot and half diameter, and that there are Rhinocerotes there as bigg as ordinary Elephants, but, by I know not what mistake, he makes the Rhinocerot a two horned Animal. The Voi-
age from the Cape to Java (in sight whereof they arrived Aug. 5th. St. n.) containes nothing very Extraordinary.

The third Book is the Voyage from Java to the Kingdom of Siam: which is chiefly taken up with what occurred at Bantam and Batavia, and at their arrival on the Coast of Siam, here are represented the Roads of Bantam and Batavia, together with the Plan of the City and Fortress of Batavia.

The fourth Book describes the Entry and Audience of the French Embassador at the Court of Siam, who, as they say, was received with more Honour and Respect than was ever yet shewn to any Embassador whatever; and that even those of Persia, the Mogul and the Tartar Emperor of China, (tho’ his neighbour, and by much the most Potent Monarch of the Universe) present themselves before the King of Siam on their Knees, whereas Mr. Chaumont the French Embassador made his harangue, sitting with his Hat on his Head. Here are described the Baloon or Barges of State which are used at Siam, which are of a very odd Figure, as of Serpents or Sea-Horses, but which by their sharpness and number of Oars are of an incredible Swiftness: here likewise ’tis related, that the old White Elephant of the King of Siam is near upon 300 Years Old; as also that there are Tumblers there, of an extraordinary Agility, as that they would stand upon one Foot on the top of a Bamboo of 80 or 100 Foot high, and then turn themselves, and stand on their Heads thereon, and afterwards hang, by the Chin only, on the top of the same, and then descend by a Ladder down right, with an incredible Swiftness, working their Bodies all the while through the Rounds of the Ladder.

The fifth Book is entituled the Return of the Voyage of Siam, and first relates several notable Shews presented to entertain the Embassador; as the fight of two Elephants, who were only suffered to twit each others Teeth, as Bulls do their Horns; the fight of an Elephant and a Tiger or rather a Panther, according to the description, and the manner of catching the wild
wild Elephants, by alluring them into an inclosure by the means of a Female tame Elephant, and the like. Next are related several Observations of the variation of the Magnetic Needle, which was found towards the end of the Year 1685, to be about half a degree West, at Louvo near Siam; as likewise the Observation of an Eclipse of the Moon on the 10th. December st. n. post medium noctem, made at a place near Louvo called Thlee-Poussonne, in the presence of the King. It began about 15h. 20m. the Total Darkness at 16h. 23m. 45s. the Emerson or end of Total Darkness at 18h. 2m. 36s. or rather, as is there said, at 18h. 10m. 25s. whereby the Longitude of this place is found 98 degrees and half from Paris, and about 6h. 45m. to the East of London, as may be seen by comparing this Observation with the Observations thereof made at Dantzig, Nurenburg and Lisbon, Published in Philos. Transact. Num. 178, 182 and 184. And whereas tis here said that some Charts have made the Longitude of Siam above 20 degrees more than it is, tis to be understood only of the Charts of Sanson, which in this particular are the worst extant: But that this Correction is just, we are fully satisfied, by the like errors in those parts, discovered and published in the Philosoph. Collect. of Feb. 1683, and in Philos. Trans. of June 1683. The relation of the homeward-bound Voyage (which was of about 6 Months) is short and contains very few considerable Remarks.

The sixth and last Book is of the manners and Religion of the Siammers, where is a short description of the Kingdom and Capital City of Siam: Next the habits of the People, and their use of Betel, Arek, and Tea is described, as likewise the Root Ginseng so much esteemed in the East, with its Vertues and Uses. As to the Religion of this people, which is here described at large, I shall say little to it, as not falling under our Argument, only one principal point therein is the Metempsychofs of Pythagoras and the Bramines, and they hold the Eternity of the World, but on the contrary they suppose God Mortal, Corporeal and produced in time: their present God they call Sommonokhodom.
A Remark concerning the Longitude of the Cape of Good Hope.

IN the second Book of this Voyage are related two Observations of the Satellites of Jupiter, capable, if well made, to ascertain the Longitude of the Cape of Good Hope. The first was there made June 2d. f. n. 1685, when at 11h. 29m. 20s. the first or innermost Satellite touched the Western edge of Jupiter and at 11h. 30m. 50s. it appeared no more: this Observation is said to be made with an excellent Telescope of twelve Foot: The other was on June 4th. following f. n. when the Emersion of the same Satellite was observed at 9h. 37m. 40s. from which latter is concluded, that the Longitude of the Cape is 18 gr. to the East of Paris, for that the said Emersion, according to the Calculus of Sigr. Cassini, in the Meridian of Paris ought to have happen'd at 8h. 26m. This same Emersion is computed by Mr. Flamsteed at 8h. 19m. at London, that is, 3 m. later than by Sigr. Cassini; and considering that neither is verified by Observation in Europe, the Longitude hence deduced is doubtful at least 3 minutes, if this had been the only Observation: But the former being considered will yet show that there is a much greater Doubt still remaining: For from certain Astronomical Principles the Parallax of the Orb, or Difference between the Place of Jupiter seen from the Sun and Earth was, at the Time of the first Observation, 9gr. 19m. which Arch that Satellite moves in 1h. 6m. and the utmost Duration of an Eclipse thereof in this Position of Jupiter being scarce 2h. 20m. (as appears by the accurate Observations of Mr. Cassini and Mr. Flamsteed) it will follow, that from the Immersion behind Jupiter's Western Edg, to the Emersion out of the Shadow, there could not be full 3h. 26m. wherefore the Emersion out of the Shadow, on June 2d. ought, according to the Time of the Immersion, to be at 14h. 56m. at latest, at the Cape; which by Mr. Flamsteed's Calculus was at London 13h. 51m. or according to Sigr. Cassini at 11h.
13h. 58m. at Paris. Hence the Longitude of the Cape will be found but 14 Degrees and half at most to the East of Paris; so that these 2 Observations will differ in the Result about a quarter of an Hour; which is a little too much. However there are some Reasons that seem to argue for this latter Longitude rather than the former; for it is much easier to observe what becomes of a luminous Object that appears, than to wait upon the first Appearance of a Star Eclipsed: and it is probable that the Satellite might, in the latter Time, be several Minutes Emerged out of the Shadow, when they might first perceive it; but they could not but see the Application to the Body of Jupiter in the former, if we may suppose their Telescopes so good as they are said to be: And that the Cape of Good Hope is not more than an Hour to the East of Paris, is proved by the constant Consent of our Navigators, who find by their Reckonings that the Island of St. Helena is about 22 or 23 Degrees of Longitude to the Westward of the Cape; (and that Sailing both backward and forwards is the same, which takes away the Objection of Currents) now by accurate Observations made at St. Helena, and compared with others made in Europe at the same Time, the Longitude of that Isle is certainly about 8 ½ Degrees to the West of Paris: It follows therefore that the Cape cannot be much more than 14 or 15 Degrees to the East of Paris; and undoubtedly it must be less than 18, for 3 Degrees is much too great an Error to be committed in so short a Distance Sailing.
PHILOSOPHICAL TRANSACTIONS

For the Months of January, February and March, 1687.

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I. Historia Plantarum, species haecen us editas aliasque in- 
super multas noviter inventas & descriptas complectens, &c. 
Autore Joanne Rajo e Societate Regia. Tomus primus. Lon-
dini, 1686. Fol. Apud Henricum Faithorne R. S. Typo-
graphum; ad Insigne Rosse in Cæmeterio D. Pauli.

II. Philosophiae Naturalis Principia Mathematica, Autore 
If. Newton, Trin. Coll. Cantab. Soc. Matheficos Profef-
fore Lucafiano & Societatis Regalis Sodali. Londini. 4to. 
Proflat apud plures Bibliopolas.

An Account of a Comet seen at Lipfick, Sept. 1686. 
taken from the Lipfick Acta Eruditorum for the 
Month of November last.

That Comets are so frequently seen of late above 
what has been formerly observed, happens rather 
from the diligence and number of those that now apply 
themselves to the study of the Coelestial Motions, than 
from any casual concourse of those Bodies. That this is 
so, may be concluded from the five Comets, that in less 
than six years time have been seen to traverse the Heavens, 
of which yet only the two first (viz. those of 1681 and 
1682) by reason of their long tailes were generally regarded. 
That that appeared in July and August 1683, was 
not, as I can hear, any where observed in France. That 
that appeared in June 1684 was no where else taken no-
tice of but at Rome: and now this of September 1686, we 
have no other account of, than this from Lipfick. The truth 
is, that where Comets are deftitute of a tayle and appear 
only like an obscure hazie Star, as those of 1683 and 1684 
did, they that first discover them had need be well ac-
quainted
quainted with the Constellations (which few People are,)
and must look over the Heavens designedly with great at-
tention, notwithstanding all which 'tis possible for such
obscure Stars to pass by unseen.

This Comet was observed at Lipjich by the diligent and
accurate Mr. Kirck; in whose Ephemerides for this year
there is likewise a brief account thereof; He saw it only
twice, viz. on the 8th. and 9th. of September 1686.
and observed it as follows.

Sept. 8. 4h mane about day-break, he found the Comet
in the Constellation of Leo, to the right hand of the Lu-
cida in Lumbis α (as is conceived, for the Latin Copy is
defective in this place) and resembling that Star in colour
and magnitude, with a thin and short taile extended up-
right. Over the Comet in the same vertical was the Star
α of Bayer, or 21 Tychoni, distant therefrom by the Mi-
crometer, exactly a degree; and a Line drawn from the lu-
cida in lumbis α to the Comet passed much about half a
degree to the right hand of the said θ Leonis. The distance
of the Comet from Regulus taken by a Radius was about
17 gr. The next Morning, Sept. 9. the Comet appeared
again obscure and more difficult to observe than before,
by reason of the day-light: however, at 3h 58m the di-
fance thereof from θ α was found by the Micrometer
2°. 23½m. and at 4h 40m. again 2 gr. 25½m. To veri-
fie the Times, the Altitude of the Lucida in Lumbis α was
Observed 11 gr. 10min. at 4h. 08m. mane. A right Line
drawn by the Comet and the said θ Leonis towards β Le-
onis, or the Lucida Colli, left that Star a little to the right
hand. The following days being Cloudy no more could
be Observed.

This Comet was seen by a Countryman, who first gave
notice thereof, from the 6t to the 12th of September; the re-
sult of whose Observations is, that the Comet was direct
in motion, that it moved about 1½ degree per diem, and
that it seemed rather to decrease in Latitude. On the 7th
of
of Septemb. it was about 24 min. distant from θ Leonis, but its bearing therefrom is not set down. From other parts it is said to have been seen from the first of September, but nothing observed.

N. B. That this Star θ Leonis was then in 9 gr. 2 min. of w with North Latitude 9 gr. 41½ min. Whence at the time of the first Observation it may be concluded that the Comet was in 9 gr. 55 of w with North Latitude 9° 15 min. And at the second Observation the Longitude of the Comet will be found about 11 gr. 20 min. in w, with much the same North Latitude as before.

These Observations being so few, do scarce suffice to conclude anything concerning the preceding or consequent motions of this Comet, which being near the Sun and still approaching him was soon lost in his Beams. It may however serve one day, when the Theory of Comets shall attain its perfection, to confirm an Hypothesis, and help to ascertain the number of these Heterogeneous Planets, whose frequency makes it more than probable that they have their periodical returns, tho hitherto unknown. And that the Prophecy of Seneca [*Erit qui demonstraret aliquando in quibus Cometae partibus errent; cur tam seduisti a reliquis, quot qualisque sint,*] is not wholly to be despaired of, will soon appear, from the accurate Theory of the Comet of 1682, to be found in the incomparable Treatise of M. Isaac Newton, an account whereof is given at the end of this Transaktion.
Part of a Letter written in Latin to Thomas Gale, S. T. D. Secret. Reg. Soc. from Carniola, by Mr. John Weichard Valvasor liber Baro; containing the Method of casting Statues in Metal; together with an Invention of his for making such cast Statues of an extraordinary thinness, beyond any thing hitherto known or practised.

I send you likewise my Method of casting Statues in Metal, in obedience to the Commands of the Royal Society; it is as follows. First, I form out of good Clay, that will endure the Fire, and not crack either in drying or burning, such a Figure or Statue as I desire to cast; when this is well dry, I make, all over the Figure, little holes of no great depth (but both size and depth proportionate to the bigness of the Statue) into which I let small pieces of Metal, and with some of the same Clay fix them firmly in the holes; the use of these bits of Metal, marked in Figure I. a, a, a, a, a, is to keep the Core and Mould from touching one the other, or falling together when the Wax runs out; and that they may remain constantly in the same fixt Posture. This done, I scrape away with some proper Instrument as much of the Clay in thickness as I design for the thickness of my Statue, and then laying it in a Furnace, I burn the Core till it be red-hot. (by the Core I mean always the Statue first made in Clay.) When it is cold I rub the Core all over with that sort of Earth or colour, which our German Potters use, to colour the jointns of the Tiles when they sett Stoves of Tiles or (Kachel-Ofens;) This Colour resembles much that which the French call Plomb de mer (Black Lead) which
which is used to design on Paper, and easily wipes out with Bread, but it is not the same: this colour I mix with Water, and daub all over the Core, because the Metal is found to run freely upon it. There are other Substances proper for this purpose, but I have always made use of this, especially for thin Statues. This done, I lay on upon the Core as much yellow Wax mixed with Pitch or Rosin as will make the thickness of the intended Statue, which I form in the Wax with all the exactness possible.

Here note, that the Particles of Metal mentioned to be set into the Core, to keep it at a distance from the Mold must be so set as to fall in with the surface of the Wax exactly: and that the reason of mixing Pitch or Rosin with the Wax is, because that when it is burnt out, it makes a great smoke, and that smoke adhering to the Mold occasions the Metal to run more freely: as I have experienced it.

Next I put all over upon the surface of this Statue of Wax, little pieces of Wax which I call the little channels; in the Figure marked c. c. c. c. c. (all which must be contrived so as to enter into the great Channels d. d. d.) This done, I cover the Core and wax all over with the same sort of Clay, that will endure the Fire without cracking; and so I have my Concave Statue or Mould made. Upon this I lay the great Channels marked d. d. d. both upright and transverse, formed likewise in Wax, and placed according to Judgment, so as best to receive the ends of the little Channels c. c. c. c. c. for the more easie distribution of the Metal. These great Channels must all meet at the top of the Statue, so as to come out by one hole, as at E, where the Metal is to be poured in; it is also necessary to have a Channel or two to let out the Air as the Metal enters, as those marked f. f: and there must be a hole or two left at the foot, as g. g, where the great Channels and waxen Statue joyn; and whereat, when the Mould is burnt, the wax as well of the Statue as of the Channels may run out. The great Channels being thus placed, the Mould
must be again laid over with the same sort of Clay. (I use constantly to bind about the Mould with Iron Wire and then lay on more Clay) and when this Mould is well dry, then I heat it red hot; as I did before the Core, so now both together.

The first time I practiced this method, I burnt both Core and Mould together, and all the small bits of Metal melted, so that, though it chanced to succeed well, yet I was in great danger of miscarriage; and ever since I burn the Core first, that so there may not need so strong a fire to burn the Mould: but for small manageable Statues of not above a foot or two high, they may be both burnt together, and there is no need of the holes g. g., but the Mould may be inverted, and the Wax run out by the Channels f. f. and E.

The Mould being thus burnt, I stop with the same Clay the two holes g. g. and then I bury it in a pit, and proceed as is usual in casting of Bells and the like, but care must be taken that the Metal be very well in fusion.

If it be a small Statue not above a foot or two high, whose Mould may be managed in ones hands; then I make me a concave Statue of Wax, of the thickness I desire, and then place upon it all those great and lesser Channels, as afore; which done I put it all together, into a liquid substance made of Plaister and Tile or Brick dust tempered with water; but I doubt not but the way of casting in Plaister is well known in London, and therefore shall not need to write it.

If the Statue be intended very thin, then I take Copper, and when it is well in fusion, I mix with it a good quantity of Zinc, without observing any certain proportion of weight; the more Zinc the better the Metal runs. I have sometimes for small and thin Statues put in above a third part of Zinc. now Zinc is a certain Mineral Substance like Marcasite or Bismuth, in French du Zinc; without it our work would not succeed if it be very thin, and
I have found by experience that this Mineral makes the Metal run most freely, and gives it a fair golden Colour.

The Statue being cast, I take off the Mould and cut off all the little Channels; all which both great and small are filled with Metal, which may be kept for further use: In these there is much more Metal than in the whole Statue; for if the Statue be very thin, there must be more and bigger Channels; and so the cheaper the the Statue the more weighty the Channels and the more Metal remaining.

To know the quantity of Metal requisite for my intended work, I take a lump of the same mixture of Wax and Pitch, with which I make the Mould of my Statue; and having weighed it, I make a Mould upon it, and cast in the same a lump of Mettle of the same size; which I weigh and thereby compute the proportion of the weight of the Mettle and Wax; then observing how many pounds of Wax I use about the Figure and Channels, I can calculate to a small matter how much Metal I need to melt.

This is my manner of casting Statues very thin, and which always succeeded happily with me. Hitherto I have cast no Statue above nine foot high, but I doubt not but I could, by the same methods, cast one of any biggerness desired. And when we shall be more at ease from our ill neighbour the Turk, I will cast at one fusion the Statue of our Emperour Leopold. I. setting on Horseback, much greater than the life; I have been already in treaty about the charges thereof with the States of this Country; and if these Turkish troubles had not come upon us, it had been now finished. &c.

The
The Answer of Dr. Papin to several Objections made by Mr. Nuis against his Engine for raising Water by the rarefaction of the Air, whereof a description is given in No. 178. of these Transactions.

Having seen in the Nouvelles de la Republ. des Lettres of the Month of December last, some difficulties which Mr. Nuis doth find in my new way for raising Water, published in the Philosophical Transactions of the month of January; I am obliged to answer them as clearly as I can in these short notes.

In his first Objection he faith, that it would be a very hard matter to hinder but some Receipctacles would come to be fill'd too much: So that the water filling also the pipes C D D would hinder the effect of the Engin. To this I answer that it being necessary to let out the water of the highest Receipctacle, I thought it might be conceived that the water may also be let out of the inferior Receipctacles by inserting into each of them a crooked pipe, reaching a pretty way downwards, and having its lower aperture shut up with a valve; whereby the water might run out when the Receipctacle should be fill'd to a certain height: and so I did not judge it needful to prevent this Objection.

The second Difficulty, which I had very well foreseen (as it is plain in my first explication) lyeth in the great quantity of Air to be rarefied: So that Mr. Nuis, by his computation, doth find that the Pump's should every one contain 84 cubick feet of rarefied Air to raise water at 1200 feet distance. To this I may answer, first that I have not positively promised a good success but for Windsor and St. Germain; but when I spoke of Versailles I used the word perhaps, thereby shewing that before any one should go about such a great undertaking he should reflect upon it.
it more than I would then do, not having occasion for such work: but since I have seen Mr. Nuis his Objeetion, I have been Obliged in order to answer him to make the following computation.

Let the distance as he supposeth be 12000 foot, and the Capacity of each Receptacle be about one half of a cubick foot: I might make the wheel with the Axis to make their revolution in one minute of time, and so order all things that the Air under the ascending plugs might come to be rared to such a degree, that by its Elasticity it might not counterpoise more than 7 foot of water: but at the same time the Air in the Receptacles A A, B B, would even in its great dilatation be able to counterpoise 17 foot: so it is plain that the Air will be driven from the Receptacles into the Pumps by a strength equivalent to ten foot of water: Now if we compute after the method publish'd in the Transact. of the month of Oct. last, what should be the Velocity of the Air driven by such a pressure: we shall find that the said Velocity will be about 740 foot in a second. So that in half a minute, during which the plug goeth up, this Air might pass above 22000 foot, although it were not rarified at all; but being rarified, as we do suppose it to be, it might go a great deal further.

I must now take notice that according to the Honourable Mr. Boyle's Experiments quoted by Mr. Nuis, the Rarification of the Air is much less than he takes it to be: For the Water contain'd in the Pipe N O. is so far from causing the Air to fill up a space four times bigger, that it will not extend itself to a space once bigger than before; considering therefore the Velocity of the Air and the small dilatation it doth suffer, if any one will take the trouble to compute, he will find that if the Pumps have in Diameter the Diagonal of a Square Foot, and the same heighth: and if the small Tubes of communication be made of 3 part of an Inch in Diameter, so that being 12000 Foot long, they may contain about one cubick Foot of Air.
Air, that would be more than sufficient to make the necessary Rarefaction in the Receptacles: And thus much might answer Mr. Nuis his Objection.

But for the good success of the Engine it is not enough to make the Air pass from the Receptacles into the Pumps, it must also return from the Pumps into the Receptacles: Now for this intent it would be necessary to set the Receptacles but five Foot above one another; so to drive the Water up the Pipe NO, it would be enough that the Air in the Receptacle B should press with a strength equivalent to 23 Foot of Water: For it is plain that 5 Foot in the Pipe NO, together with a pressure equivalent to 17 Foot which I have supposed to be in the upper Receptacle A, will make but 22 Foot in all: and therefore 23 Foot pressing in the Receptacle B must prevail and cause the Water to ascend: now the pressure in the Receptacle being but 23 Foot, and the Air in the Pump returning to its ordinary pressure, which is about 33 Foot; it is plain that the Air going back to the Receptacle will be driven by a strength equivalent to 10 Foot, as well as it had been in coming from the Receptacle towards the Pump: and so the bigness assigned for the communication-Pipes will also prove more than sufficient to this effect.

From what I have been saying it is plain, that in great distances there should be made as many Pumps as Receptacles, as I had propounded in the first explication of my Engine: and for to raise Water but 60 Foot high, there should be required 13 or 14 Receptacles and as many Pumps of the bigness aforesaid. Some people may take this for a great difficulty. But I answer that in this Engine this is not so much as it seems at first; because the pressure being all from without, there is no need of any great strength to resist it, and so the Metal for the Pumps will cost but little: there may also be found occasions where to make so good use of them, that such an Engine as I have described would in a years time save labour enough to pay for
for many Pumps, since it might every hour raise about 1800 pounds of Water to the height of 60 Foot: Mean while I don't pretend to have given here the best proportion for the bigness of every part of the Engine; but it may be, by altering the Capacity of the Pumps, of the Pipes, or of the Receptacles, a much more considerable effect might be produced: but I'll leave this to be lookt after by those that may have occasion for it; and for my part I content my self having shewn the truth of what I had at first, though but doubtfully, propounded: For the River Seine, where it is nearest to Versailles, not being above 20000 Foot distant, it is easie to see that, to supply this increase of distance, we might lessen at pleasure the capacity of the Receptacles, or increase the capacity of the Pumps and of the Pipes, or cause the wheel to spend more time in its revolution: 'tis true the Engine would produce less effect, but upon a great River the number of the Engines might be multiplied, and vast quantitys of Water still be raised. I shall therefore, to prevent new difficulties, add only this: that as well as in the Receptacles I have a way to prevent the overflowing with Water; so in the Pumps I might also prevent the overfilling with Air, by making a Valve that should open as soon as the Air in the Pump should be more compress'd than the outward Air: So the Air getting in through any pores would constantly be let out.

As for the third objection wherein Mr. Nuis says that it doth not appear how the Water in our Engine may, by Rarefication, ascend higher than 32 Foot. I answer that the Water doth not at any time ascend higher than from a lower Receptacle into the next upper Receptacle, which height is but 12 Foot: So that it is plain enough that the pressure of the Air may be sufficient to drive it up. It is indifferent whether it be by Rarefaction or otherwise that the Water comes into the Receptacle A; it is enough that the Water is there, and that the Air presses upon
upon it with such a strength as will prevail against all that opposeth it, as I have shewn above.

To the fourth Difficulty I answer: That although the use of the Pipes be meerly for the conveying of Air: They may nevertheless easily be fill'd with Water when need requires, and so the defects in them may as well be found out as in the Pipes that are used for the conveying of Water. This is all I may answer at present, and I shall make an end with assuring Mr. Nuis that i'le make use of his advice when ever he will be pleased to give it me.

An answer of the same to the Author of the perpetual Motion.

In the last papers I published in Phil. Transact. N. 184 against this perpetual Motion described in N. 177. I intreated the Author to permit me to say nothing as to what alterations he might make in his Engine; resolv- ing to leave it to others to shew him that upon that principle all he can do signifies nothing. But I find since, in the Nouvelles de la Republ: for December last, that he still persists to urge some new contrivances, which being added he conceives his Engine must succeed. To this I answer that I undertook only to shew that his first device would fail, which yet I should scarce have done, if I had thought a dispute of this nature could have lasted so long. To come therefore to the point, where he faith that this Engine may well succeed without alteration, because he hath tryed with Liquors put into Bellows immersed in Water: I again say that I grant him the truth of the Experiments, but deny the consequences he would draw
draw from them, I have already given the reasons of my different, which this Gentleman is not pleased to understand. But to end all controversies he may please to consult Mr. Perrault, de la Hire, or any other at Paris well known to be skilled in Hydraulicks: and I doubt not but he will find them of the same opinion with Mr. Boyle, Mr. Hook and other knowing persons here, who all agree that our Author is in this matter under a mistake.


Ingruente Eclipsi, ad corrigendum Horologium Oscillatorium cepit aliquot Altitudines Pollucis. viz.

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<tr>
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<td>H. m. s.</td>
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<td>12 06 10</td>
<td>Alt. Pollucis 28 35</td>
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<td>11 18 00</td>
<td>limbus tangebat anSam occid. ni</td>
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<td>Immerfio centri ni paulo infra Palu-</td>
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<td>11 19 00</td>
<td>Fem Saturnus omnino latuit.</td>
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<td>Altiduo centri Solis</td>
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<td>Emerfio ob nubes videri non potuit.</td>
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ADis-
A Discourse concerning the Measure of the Airs resistance to Bodies moved in it. By the Learned John Wallis S. T. D. & R. S. Soc.

1. That the Air (and the like of any other Medium) doth considerably give resistance to Bodies moved in it; (and doth thereby abate their Celerity and Force:) is generally admitted. And Experience doth attest it: For otherwise, a Cannon Bullet projected Horizontally, should (supposing the Celerity and Force undiminished) strike as hard against a perpendicular Wall, erected at a great distance, as near at hand: which we find it doth not.

2. But at what Rate, or in what Proportion, such resistance is; and (consequently, at what Rate the Celerity and Force is continually diminished) seems not to have been so well examined. Whence it is, that the Motion of a Project (excluding this Consideration) is commonly reputed to describe a Parabolick Line; as arising from an Uniform or equal Celerity in the Line of Projection, and a Celerity uniformly accelerated in the Line of Descent:

3. In order to the computation hereof; I first premise this Lemma, (as the most rational that doth occur for my first footing,) That (supposing other things equal) the resistance is proportional to the Celerity. For in a double Celerity, there is to be removed (in the same time) twice as much Air, (which is a double Impediment) in a treble, thrice as much; and so in other Proportions.

4. Suppose we then the Force impressed (and consequently the Celerity, if there were no resistance) as \(1\); the resistance as \(r\). (which must be less than the Force, or else the Force would not prevail over the Impediment, to create a Motion.) And therefore the effective Force at a first Moment, is to be reputed as \(1 - r\): That is, so much as
the Force impressed, is more than the Impediment or Resistance.

5. Be it as \( i - r \) to \( i \); so \( i \) to \( m \). (which \( m \) is therefore greater than \( i \).)

6. And therefore the effective Force (and consequently the Celerity) as to a first Moment, is to be \( \frac{1}{m} \) of what it would be, had there been no resistance.

7. This \( \frac{1}{m} \) is also the remaining Force after such first Moment; and this remaining Force is (for the same Reason) to be proportionally abated as to a second Moment: that is we are to take \( \frac{1}{m} \) thereof, that is \( \frac{1}{mm} \) of the impressed Force. And for a third Moment (at equal distance of time) \( \frac{1}{mmm} \); for a fourth \( \frac{1}{m^4} \); and so onward infinitely.

8. Because the length dispatched (in equal times) is proportional to the Celerities; the Lines of Motion (answering to those equal Times) are to be as \( \frac{1}{m}, \frac{1}{m^2}, \frac{1}{m^3}, \frac{1}{m^4}, \&c. \) of what they would have been, in the same Times, had there been no resistance.

9. This therefore is a Geometrical Progression; and (because of \( m \) greater than \( i \)) continually decreasing.

10. This decreasing Progression infinitely continued (determining in the same point of Rest, where the Motion is supposed to expire) is yet of a Finite Magnitude; and equal to \( m - i \) of what it would have been in so much Time, if there had been no resistance. As is demonstrated in my Algebra, Chap. 95. Prop. 8. For (as I have elsewhere demonstrated) the Sum or Aggregate of a Geometrical Progression is \( \frac{VR - A}{R - 1} \) (supposing \( V \) the greatest term, \( A \) the least, and \( R \) the common multiplier.) That is \( \frac{VR}{R - 1} - \frac{A}{R - 1} \). Now in the present Case, (supposing the Progression infinitely continued) the least term \( A \), be-
becomes infinitely small, or \(= 0\). And consequently \(\frac{A}{R - 1}\) doth also vanish, and thereby the Aggregate becomes
\[
\frac{VR}{R - 1}.
\]
That is
\[
\text{(as will appear by dividing } VR \text{ by } R - 1;)
\]
\[
VR + \frac{VR}{R} + \frac{VR}{R^2} + \frac{VR}{R^3} + \&c. = \frac{VR}{R - 1};
\]
(supposing the Progression to begin at } \(V = 1\). That is
\[
\text{(dividing all by } R, \text{ that } \text{the Progression may begin}
\]
at
\[
\frac{V}{R} = \frac{1}{m};
\]
\[
\frac{VR}{R - 1} = \frac{V}{R} + \frac{V}{R^2} + \frac{V}{R^3} + \&c.
\]
That is, in our present Case (because of \(V = 1, R = m:\))
\[
\frac{V}{R^3} + \&c. = m - 1.
\]
That is, (putting \(n = m - 1\)) \(n\) of what it would have been if there had been no resistance.

11. This infinite Progression is fitly expressed by an ordinate in the exterior Hyperbola, parallel to one of the Asymptotes; and the several Member of that, by the several Members of this, cut in continual Proportion. As is there demonstrated at \textit{Prop. 15}. For let \(SH\) (\textit{vid. Fig. III.}) be an Hyperbola between the Asymptotes \(AB, AF\): And let the ordinate \(DH\) (in the exterior Hyperbola, parallel to \(AF\)) represent the impressed force undiminished; or the Line to be described in such time, by a Celerity answerable to such undiminished force. And let \(BS\) (a like ordinate) be \(m\) thereof; which therefore, being less than \(DH\)
DH (as being equal to a Part of it) will be further than it from AF. In AB (which I put = 1) let Bd be such a Part thereof, as is BS of DH. Now because (as is well known) all the inscribed Parallelograms, in the exterior Hyperbola, AS, AH, &c. are equal; and therefore their sides reciprocal: Therefore as $A d = 1 - \frac{i}{m}$ (supposing Bd to be taken, from B toward A,) to $A B = 1$, (or as $m - 1$ to $m$:) so is BS 

$$\frac{1}{m} DH, \text{ to } dh, \text{ which } m - 1 \text{ to } \frac{1}{m}$$

is therefore equal to $\frac{1}{m - 1}$ of DH; that is (as will appear by dividing 1, by $m - 1$,) to $\frac{1}{m} + \frac{1}{m^2} + \frac{1}{m^3} + &c.$ of DH.

Or if Bd be taken beyond B; then as $A d = 1 + m$, to $AB = 1$, or as $m + 1$ to $m$, so is $\frac{1}{m} DH$ to $dh$, which is therefore equal to $m + 1$ of DH; that is (as will appear by like dividing of 1 by $m + 1$;) = to

$$\frac{1}{m - 1} + \frac{1}{m^2} - &c. \text{ of } \frac{1}{m} DH.$$

12. Let such ordinate dh, or (equal to it in the Asymptote) AF, be so divided in L, M, N &c. (by perpendiculars cutting the Hyperbola in l, m, n, &c.) as that FL, LM, MN be as $\frac{1}{m}, \frac{1}{mm}, \frac{1}{m^3}$ &c. That is, so continually decreasing, as that each antecedent be to its consequent, as 1 to m, or as m to 1. See Fig. IV.

13. This is done by taking AF, AL, AN, &c. in such proportion. For, of continual proportionals the differences are also continually proportional, and in the same pro-
proportion. For let \( A, B, C, D, \&c. \) be such proportionals; and their differences \( a, b, c, \&c. \) That is \( A - B = a, B - C = b, C - D = c, \&c. \)

Then, because \( A, B, C, D, \&c. \) are in continual proportion;
That is \( A : B :: B : C :: C : D :: \&c. \)
And dividing \( A - B : B - C :: C - D :: \&c. \)
That is \( a : b :: b : c :: d : D :: \&c. \)
And alternately \( a : b : c : d : \&c. :: B : C : D : \&c. :: A : B : C: \&c. \)
That is, in continual proportion as \( A \) to \( B, \) or as \( \frac{m}{n} \) to \( 1. \)

14. This being done; the Hyperbolick spaces \( FL, LM, MN, \&c. \) are equal. As is demonstrated by Gregory San-

15. So that \( FL, LM, MN, \&c. \) may fitly represent equal times, in which are dispatched unequal lengths, re-
presented by \( FL, LM, MN, \&c. \)

16. And because they are in number infinite (tho

17. The spaces \( FL, FM, FN, \&c. \) are therefore as Log-

18. Because \( FL, LM, MN, \&c. \) are as \( m, mm, m^2, \&c \) (infinitely) terminated at \( A; \) therefore (by \( \frac{1}{m} \)) their

19. If therefore we take, as \( \frac{1}{m} \) to \( n, \) so \( AF \) to \( DH; \) this

20. And if such \( DH \) be supposed to be divided into e-

These answer to those (as many) parts unequal in \( FA, \)

or \( h d. \)
21. But, what is the proportion of \( r \) to \( i \), or (which depends on it) of \( i - r \) to \( i \), or \( i \) to \( m \); remains to be inquired by experiment.

22. If the progression be not infinitely continued; but end (suppose) at \( N \), and its least term be \( A = MN \); then, out of \( \frac{V}{R - 1} = \frac{1}{m} + \frac{1}{mm} + \frac{1}{m^3} \), &c. is to be subducted

\[
\frac{A}{R - 1} \quad (\text{as at } \frac{7}{10}) \text{ that is } (\text{as by division will appear})
\]

\[
\frac{A}{R} + \frac{A}{R^2} + \frac{A}{R^3} &c. \text{ That is } (\text{in our present case}) \frac{a}{m} + \frac{a}{mm} + \frac{a}{m^3} &c. \text{ And so the Aggregate will be } \frac{1 - a}{m} + \frac{1 - a}{mm} + \frac{1 - a}{m^3} &c. = \frac{1 - a}{n}.
\]

And thus as to the line of Projection, in which (excluding the resistance) the motion is reputed uniform; dispatching equal lengths in equal times. Consider we next the line of Descent.

23. In the Descent of Heavy Bodies, it is supposed, that to each moment of time, there is superadded a new Impulse of Gravity to what was before: And each of these, excluding the consideration of the Airs resistance, to proceed equally (from their several beginnings) through the succeeding moments. As (in the erect lines)

\[
1 \ 1 \ 1 \ &c. \ 1 \ 1 \ 1 \ &c. \ 1 \ &c. \ \text{and so continually as in the line of Projection.}
\]

24. Hence ariseth (in the transverse lines) \( 1 \ 1 \ 1 \) for the first moment \( r \), for the second \( i + r \), \( 1 \ 1 \ 1 \ 1 \) for the third \( i + r + i \), and so forth, in \( A-\)arithmetical progression: As are the Ordinates in a Triangle, at equal distance.

25. And such are the continual increments of the Diameter, or of the ordinates in the exterior Parabola, answering to the interior Ordinates, or Segments of the Tangent
gent, equally increasing. As is known, and commonly admitted.

26. If we take-in the consideration of the Airs resistence; we are then for each of these equal progressions, to substitute a decreasing progression Geometrical; in like manner (and for the same reasons) as in the line of Projection.

27. Hence ariseth, for the first moment \( \frac{m}{m} \); for the second \( \frac{m^2}{m} \); for the third \( \frac{m^3}{m} \) &c. And such is therefore the Descent of a heavy Body falling by its own weight. The several impulses of Gravity being supposed equal.

28. That is (in the figure of \( \| 12 \)) as \( FL, FM, FN, \) &c, in the line of Descent, answering to \( FL, LM, MN, \) &c. in the line of Projection.

29. But though the Progressions for the line of Projection, are like to each of those many in the line of Descent: it is not to be thence inferred, that therefore \( \frac{m}{m} \) in the one, is equal to \( \frac{m}{m} \) in the other: But in the line of Projection (suppose \( \frac{1}{m} \) \( f \) (such a part of the force impressed, and a celerity answerable:) in the line of Descent, \( \frac{1}{m} g \) (such a part of the Impulse of Gravity.)

30. Those for the line of Descent (of the same Body) are all equal, each to other: Because \( g \) (the new Impulse of Gravity) in each moment is supposed to be the same.

31. But what is the proportion of \( f \) to \( g \) (that of the force impressed, to the Impulse of Gravity in each Body) remains to be enquired by Experiment.

32. This proportion being found as to one known force; the same is thence known as to any other force \( Mm \) (who's
[276]

(who's proportion to this is given) in the same uniform Medium.

33. And this being known as to one Medium; the same is thence known as to any other Medium, the proportion of who's resistance to that of this is known.

34. If a heavy body be projected downward in a perpendicular line; it descends therefore at the rate \( m, m^2, m^3, \&c. \) of \( f \) (the impressed force) increased by \( m, m + m^2, m + m^2 + m^3 \ &c. \) of \( g \) the impulse of Gravity : (by \[ 27 \& 7. \) Because both forces are here united.

35. If in a perpendicular projection upwards; it ascends in the rate of the former, abated by that of the latter. Because here the impulse of Gravity is contrary to the force impressed.

36. When therefore this latter (continually increasing) becomes equal to that former (continually decreasing) it then cealeth to ascend; and doth thenceforth descend at the rate wherein the latter continually exceeds the former.

37. In an Horizontal or Oblique projection: If to a Tangent who's increments are as \( FL, LM, MN, \&c. \) that is as \( \frac{1}{m} f, \&c. \) be fitted Ordinates (at a given angle) who's increments are as \( FL, FM, FN, \&c. \) that is as \( \frac{1}{m} g, \&c. \) The Curve answering to the compound of these Motions, is that wherein the Project is to move.

38. This Curve (being hitherto without a name) may be called Linea Projectorum; the line of Projects, or things projected; which resembles a Parabola deformed.

39. The Celerity and Tendency, as to each point of this line, is determined by a Tangent at that Point.

40. And that against which it makes the greatest stroke or
41. If the Projection (at \( \text{II} 27. \)) be not infinitely continued, but terminate (suppose) at \( N \), so that the last term in the first Column or Series erect be \( a \); and consequently in the second, \( ma \); in the third, \( m^2a \), &c. (each Series having one term fewer than that before it:) then for the same reasons as at \( \text{II} 22. \) the Aggregates of the several Columns (or erect Series) will be \( \frac{1-a}{n} \), \( \frac{1-ma}{n} \), \( \frac{1-mm^2a}{n} \), and so forth, till (the multiple of \( a \) becoming \( =1 \)) the progression expire.

42. Now all the abatements here, \( a \), \( ma \), \( mm^2a \), &c. are the same with the terms of the first Column taken backward. For \( a \) is the last, \( ma \) the next before it; and so of the rest.

43. And the Aggregate of all the Numerators is so many times 1 as is the number of terms (suppose \( t \),) wanting the first Column; that is \( t - \frac{1-a}{n} \), or \( \frac{nt-1+a}{n} \); and this again divided by the common denominator \( n \), becomes \( \frac{nt-1+a}{nn} \). And therefore \( \frac{nt-1+a}{nn} g \), is the line of descent by its own Gravity.

44. If therefore this be added to a projecting force downward in a perpendicular; or subducted from such projecting force upward; that is, to or from \( \frac{1-a}{n} f \): The Defcent in the first case will be \( \frac{1-a}{n} f + \frac{nt-1+a}{nn} g \); and the Ascent in the other case \( \frac{1-a}{n} f - \frac{nt-1+a}{nn} g \). And in this latter case, when the ablative part becomes equal to the positive part, the Ascent is at the highest: and thence-
thenceforth (the ablative part exceeding the positive) it will descend.

45. In an Horizontal or Oblique projection; having taken \( \frac{1-a}{n} \) in the line of Projection, and thence (at the Angle given) \( \frac{nt-1+a}{nn} \) \( g \) in the line of Descent; the point in the Curve answering to these, is the place of the Project answering to that moment.

46. I am aware of some Objections to be made, whether to some points of the Process, or to some of the Suppositions. But I saw not well how to wave it, without making the Computation much more perplexed. And in a matter so nice, and which must depend upon Physical Observations, t’will be hard to attain such accuracy as not to stand in need of some allowances.

47. Somewhat might have been further added to direct the Experiments suggested at \( \| 21 \) and 31. But that may be done at leisure, after deliberation had, which way to attempt the Experiment.

48. The like is to be said of the different resistance which different Bodies may meet with in the same Medium, according to their different Gravities (extensively or intensively considered) and their different figures and Positions in Motion. Whereof we have hitherto taken no account; but supposed them, as to all these, to be alike and equal.

Post-script.

49. The computation in \( \| 41, 42, 43 \), may (if that be also desired) be thus represented by Lines and Spaces. The Ablatives \( a, ma, mma, \&c. \) (being the same with the first Column taken backward) are fitly represented by the segments of \( NF \) (beginning at \( N \)) in Figure IV. and V. and therefore by Parallelograms on these Bases, assuming the common hight of \( Fh \), or \( NQ \): the Aggregate of which is
is $Nh$, or $FQ$. And, so many times 1, by so many equal spaces, on the same Bases, between the same Parallels terminated at the Hyperbola: The Aggregate of which is $hFNQn$. From whence if we subduct the Aggregate of Ablatives $FQ$; the remaining trilinear $hQn$, represents the Descent.

50. If to this of Gravity, be joyned a projecting Force; which is to the impulse of Gravity as $hK$ to $hF$ (be it greater, less, or equal) taken in the same line: the same parallels determine proportional Parallelograms, whose Aggregate is $KQ$.

51. And therefore if this be a Perpendicular Projection downwards; then $hKn$ (the summe of this with the former) represents the Descent.

52. If it be a Perpendicular upwards; then the difference of these two represents the Motion: which so long as $KQ$ is the greater, is Ascendent: but Descendent when $hQn$ becomes greater: and it is then at the highest when they be equal.

53. If the Projection be not in the same Perpendicular, (but Horizontal, or Oblique) then $KQ$ represents the Tangent of the Curve; and $hQn$ the Ordinates to that Tangent, at the given Angle.

54. But the Computation before given I take to be of better use than this representation in Figure. Because in such Mathematical enquiries, I choose to separate (as much as may be) what purely concerns Proportions; and consider it abstractly from lines or other matter where-with it is incumbered.

As to the question proposed; whether the resistance of the Medium do not always take off such a proportional part of the force moving through it, as is the Specifick Gravity of the Medium to that of the Body moved in it: (for, if so, it will save us the trouble of Observation.)

I think this can by no means be admitted. For there be many other things of consideration herein, beside the Inten-
tensive Gravity (or, as some call it, the Specifick Gravity) of the Medium.

A viscous Medium shall more resist, than one more fluid, though of like Intensive Gravity.

And a sharp Arrow shall bore his way more easily through the Medium, than a blunt headed Bolt, though of equal weight, and like intensive Gravity.

And the same Pyramide with the Point, than with the Base forward.

And many other like varieties, intended in my ¶ 43.

But this I think may be admitted, namely, That different Mediums, equally liquid, (and other circumstances alike,) do in such proportion resist, as is their Intensive Gravity. Because there is, in such Proportion, a heavier object to be removed, by the same Force. Which is one of the things to which ¶ 33. refers.

And again: The heavier Project once in motion, (being equally swift, and all other circumstances alike,) moves through the same Medium in such proportion more strongly, as is its Intensive Gravity. For now the Force is in such proportion greater, for the removal of the same resistance. And this part of what my ¶ 32. insinuates.

But where there is a complication of these considerations one with another, and with many other circumstances whereof each is severally to be considered: there must be respect had to all of them.
Part of a Letter from Mr. William Cole of Bristol to the Publisher, about the Grains resembling Wheat which fell lately in Wiltshire.

This City and Country round about, is filled with Reports of Raining Wheat about Warminster, and other Places within Six or Eight Miles of it, and many believe it; I have procured several Parcels of it, and carefully examined them, and find it to be the seeds of Ivy-Berries, which from Towers and Churches, Chimneys, Walls and high Buildings, were lately by very fierce Tempefts of Wind and Hail, driven away from the holes, chinks and other parts where Birds had brought them, especially Sterlings and Choughs: It were to little purpose to tell you the prodigious Stories which have been made of it; among many others, it was confidently affirmed (and backt by several, who affirmed they had seen it) that those Grains were found in the Hail, as Seeds in Comfits: I do here acquaint you with it (upon Notice I had of some who have sent several Parcels of it to your Society, with strange Relations of it) to the end you may inform them of the Truth; For I have by all the ways I can Imagine examined and compared them with the Seeds of Ivy Berries, by the taft, smell, size, and Figure; with the assistance of Magnifying Glasses, viewing them in both the superficial and inward Parts. This perhaps they may have discovered before this comes to their Hands, if they desire farther Satisfaction concerning it, I shall be ready to serve them, &c.

William Cole.
An Extract of a Letter written by Mr. Veay Physician at Tholouse to Mr. de St. Ussans, concerning a very extraordinary Hermaphrodite in that City. Communicated by Dr. Aghionby. Reg. Soc. S.

J' aime Monsieur, vous faire part d'une chose fort extraordinaire, qui m'est arrivée il y a quelques jours dans l'Hôpital S. Jacques, au quartier des femmes, ou je suis de tour pendant ce semestre. On apporta une servante malade Hermaphrodite. Elle est du lieu de Pourdiac à sept lieues de Tholouse. Elle a été baptisée en qualité de fille, sous le nom de Marguerite. Son père est pauvre homme de Pourdiac, qu'on appelle Malaufe. Elle est âgée de 21 à 22 ans, ayant bien la mine externe d'une fille, mais les marques réelles d'un homme bien puissant. Son visage est féminin & assez agréable, la gorge bien jolie, & les mamelles aussi bien faites qu'on les puisse désirer à une fille, les fesses & les cuisses grandes comme aux femmes, les parties bouteuses tout comme celles d'une femme, mais elle n'est percée que de la profondeur de deux petits travers de doigts ; et au milieu de cette fente, il pend un membre viril d'une grosseur fort considérable, & qui dans l'cérection luy fournit au dehors d'environ huit pouces. Ce membre est bien formé, hormis qu'il n'a point de prépuce, & qu'il n'est pas accompagné de testicules apparents. L'urine & la semence en sortent comme aux hommes, & ce qu'il y a de particulier, c'est que le sang menstrual coule aussi par ce même conduit de la Verge.

J'aurois eu de la peine a le croire, si je ne l'avois vu moi-même, & examiné fort exactement dans le temps que ses menstrues couloit, lesquelles luy survenaient presque tous les mois assez régulièrement, ne passant gueres deux mois de temps sans les avoir ; mais presque toujours avec de grandes douleurs & une tension au bas ventre qui marque une espece d'inflammation dans ces parties.
J'ai fait voir cela a plusieurs de nos médecins, & après avoir consulté Messieurs les Vicaires Généraux, nous luy avons fait prendre un habit d'homme, sous le nom d' Arnaud Malaufe; & on va présentement luy faire apprendre quelque métier. Il n'y avait pas a hésiter la dessus, parce que notre Hermaphrodite peut fort bien faire la fonction d'homme, & point du tout celle de femme.

J'ay cru vous faire plaisir de vous écrire ce fait, qui commence deja d'etre public dans cette ville, mais qui est bien rare, & bien extraordinaire.

Tholosé
Decemb. 4. 1686.

Accounts of B. O. O. K. S.


The excellent Author of this great Work, is so well known for his incomparable Skill in the Botanick Science, and other Parts of useful Learning, that it will be needless to say any thing of him. The Forreign Journals having given Accounts of this Book have prevented the mentioning of many particulars, but they only speaking in general, and per saltum, neglecting the Divisions, Subdivisions, and the Method; I shall therefore only confine my self to those Particulars.

The First Tome contains 18 Books, to which are premised a Botanick Lexicon, or Interpretation of Terms of Art;
together with an Account of most of the Writers that have handled the Subject of Plants. The first Book treats of Plants in general; as of their Roots, Stalks, Sap, Juices, their Motions, and Differences; of Gems or Buds, Leaves, Flowers, Fruits, Seeds, Clavicles or Climbers, Prickles, their Varieties, and Vegetations; of Sowing, Propagating, Cultivating, Grafting, or Inoculating; of the Transmutation of Plants, their Statures or Magnitudes, their Ages or Duration, their Faculties, Tafts, and Uses, their Places, and Divisions; of Collecting, Drying, and Preserving them, their Chymical Analysis, and their Diseases.

The 2d. Book begins with Particulars, as the imperfect Plants, such as seem to have no Flower or Seed; these are either Submarine; as the Corals, Sponges, Alga's, Wracks, &c. or Terrestrial, as the Mushrooms, and barren Mosses. Or Subterraneous, as the Truffles; some of the Fungi and Mosses, have visible Seeds: These are all subdivided into subordinate Genera, as the Mushrooms according to their Lamella, Plates, Brims, and Caps; and as they are noxious, or esculent; or grow upon Trees.

The 3d. Book contains the Capillary or Acaulose Herbs, which bear their very minute Seeds on the backs of their Leaves, that are conspicuous by the Microscope: These are subdivided according to their Leaves, as they are whole, entire and undivided; or variously cut, laciniated, pinnate, and ramose. Of this Kind are the Ferns, the Spleenworts, Polypodies, Maiden-Hairs, &c. which have nothing like a Flower.

The 4th. Treats of such Herbs as have an imperfect or flaminoeous Flower, commonly call'd Apetalose, because it is not composed of Petala or tender fugacious coloured Leaves; only of a Calyx or Cup, of Stamina or Capillaments of Styles. These are subdivided, I. into such whose Fruits are not contiguous to their Flowers; as in Hops, Hemp, Nettles, Spinache, Mercury, Palma Christi, the American Phy-
Physick - Nut, &c. II. Into such that have a triquetrous, or triangular Seed, as the Docks, Sorrels, Arsmarts, Knot-grass, Snake-weeds. III. Into those that have round, compressed, and otherwise figured Seeds, as the Pond-Weeds, Orraches, Sea-Purslane, the Blites, the Amaranth, the Beets, some Kalis, &c.

The 5th. Book begins with those that have a perfect planifolious Flower, or tender coloured Petala, or Leaves, that make up a compound Flower: these are, I. either lactescent, milky, and pappose, containing their Seeds in a lanugo or downy Substance; as the Lettuces, Sow-thistles, Succorys, Hawk-weeds, Mouse-ears, Dandelyons, Scorzonera's, or Viper-grass, Goats-beard, &c. II. Such as have solid Seeds without any pappus or lanugo; as Endive, Nipple-wort, and some Succorys; these are lactescent.

The 6th. Book contains the Herbs that are not Milky, and yet bear their Seeds in a downy or pappose Substance, succeding the Flowers; these have either radiated, discose, and flat Flowers; as Colts-foot, the Conyza's or Fleabanes, Elecampane, the Star-worts, the Leopards Banes, the Golden Rods, the Stachys, the Jacobna's or Ragworts; or else the Flower is disposed into a Thrysus or Spike, as in the Petasitis or Butter-bur.

The 7th. Is of the capitate Herbs, whose Flowers are fistular, and whose Seeds are included in a Squamose Calyx or cup, conglobated into a Head, fill'd with a Pappus: of this Kind are the Blew-bottles, Saw-wort, the Jacoba's or Knapweeds, the great Centory, the great Burr-dock, and most of the Thistles, which are subdivided according to their Heads, Flowers, Prickles, Spots, Consistence of their Leaves, &c.

The 8th. Comprehends the Corymbiferous, that are not Pappose, these have either a radiated, or a naked Flower, and are subdivided according to the Colours of the Barbula and Discus, and from the Figures the Flowers make; of this Tribe are the Sun-flowers, the Chrysanthemum's and Marigolds, the Tarrows, Daisies, Feverfew, the Lavender-cot-
tons, the Tanseys, Wormwoods, Southernwoods, Mugworts, Scabious, Teasels, Eringo, the Globe-thistle, &c.

The 9th. Treats of the Umbelliferous Herbs, to which are premised some Herbs that are a little a Kin to the Umbelli, only they have a single Seed succeeding each Flower; whereas the true Umbelli have two; of the first Kind are many Valerians, the Sea Lavenders, the Marvel of Peru, Agrimony, Burnet, Meadow-Rue, Fumitory, &c. The genuine Umbelli have Pentapetalous Flowers, to each of which succeed two naked Seeds joined together; these are put under so many sub-divisions, according to the various Figures of their Seeds, and Leaves; of this Umbelliferous Family are the Parsneps, the Fennels, the Angelica's, the Cumin's Parsys, Hemlocks, Smallage, Aniseed, Caraways, the Carrots, Coriander, &c. all which are very nicely distinguished, and variously sub-divided.

The 10th. Contains the Stellate Herbs, whose Leaves like a radiated Star embrace the Stalk; their Flowers are Monopetalous, tho' divided or cut into four Segments, or coloured Leaves; to each Flower there generally succeeds two Seeds; of this Kind are the Madders, the Crossworts, the Ladies Bed-straw, the Wood-roots, the Cleavers or Goose-grass, &c. The second Section of this Book, comprehends the Asperifolious Herbs, whose Flowers are Monopetalous, and generally reflected at the end like a Scorpions Tail, yet cut into five Margines or Segments; to every one of these Flowers succeed for the most part four Seeds; of this Kind are the Pulmonaria Maculosa, or Sage of Jerusalem, the Hounds-Tongues, Borage, Bugloss, Alkanet, the Heliotropes, or Turnfoles, the Grumils, Scorpion-grass, Comfrey, the Honey-Worts, &c.

The 11th. is of the Verticillate Herbs, so called from the Flowers embracing the stalk like a whirl, or wherle, the Leaves are generally placed together exactly opposite on the Stalk, the Flowers are Monopetalous, labiataed for the most part or galeated; to each Flower succeeds 4 Seeds, which
which the Calyx or Perianthium serves instead of a Vessel; these are subdivided according to their substance and duration, as they are Lignous, Fruticose, Perennial, and Herbaceous. Of this tribe are the Sages, the Lavenders, Rosemary, the Hysops, the Savoury’s, Thymes, Poleymountain, the Germanders, the Mints, Penneroyalls, Vervain, the Majorans, Basil, the Clarys, Betony, Marrubiums, Lamiums, Sideritis, Ground-Ivy, Baulm, Calamint, Ground-pine, Bugle, &c.

The 12th. Comprehends those Herbs, to each of whose Flowers succeed more than 4 naked Seeds, whose number is indefinite, they being Polysperous; here we may note that Mr. Ray takes those for naked Seeds whose Follicules or Covers (if they seem to have any) are not cast off, but fall with the Seeds from the mother Plant, being not separable from them. Of this family are the Hepatica’s, the Ranunculi, the lesser Celandine, some Mallowes and Althea’s, Aven’s, Strawberries, Cinquefoils, Tormentill, &c. The second Section of this Book is of such Herbs as have many naked Seeds, and a Flower without any Perianthium or Calyx, as the Traveller’s-joy, and some Climbers, Dropwort, Meadow-sweet, the Anemones, Pasque-flowers: Those of the former Section having Perianthia or Cups about their Flowers.

The 13th. Is of the Pomiferous, and Bacciferous Herbs, these are distinguished by the Magnitude, and Skins of their Fruits; the Flowers are naked, Monopetalous, divided into many Margines or Segments, placed on the top of the Fruit like a Corolla or Umbilicus. Of this kind are the Gourds, the Pompions, the Coloquintida, the Citruls, Melons, Cucumbers, the Passion-flowers, &c. China, Bryony, Solomon’s-seals, Solanum’s or Nightshades, Mandrakes, Capsicum’s or Guinea pepper, Sparagus, Lillies of the Vallie, &c.

The 14th. Contains the Multifiliquose or corniculated Herbs, which after each Flower bear many Pods or horned Seed Vessels. Of this kind are some Sedums or Houseleeks,
Leeks, Orpines, Peonys, black Hellebore, some Althea's, Monks-hoods, Columbines, Larks-spur's.

The 15th. Is of such Herbs as have a uniform Monopetalous Flower, and besides the Calyx of the Flower have a distinct and proper Seed Vessel, such as are the Henbanes, the Tobacco's, the Gentians, the Convolvuli or Bind-weeds, the Bell-flowers, Throatworts, Rampions, Stramonium's or Thorn Apples: The other Section is of the deform'd Monopetalous Herbs, both of which are subdivided according to the Figures and Valves of the feminal Vessels, of this last kind are the Butterworts, the Toad-flax or Linaria, Birthworts, Figworts, Foxgloves, Cock-combs or Rattles, Eye-brights, Cow-wheats, &c.

The 16th. Treats of such Herbs as have a uniform Tetrapetalous or four leav'd Flower with a deciduous quadrifolious Calyx or Perianthium, to which succeed long or broad Seed Vessels, or short ones: the first are Siliquose, the other Capsular; of these kinds are the Stock-gilliflowers, the Wallflowers, Toothworts, Rockets, Mustards, Cabbages, Colliflowers, Turneps, Radishes, Cresses, Scurvigrasses, &c. all which are subdivided according to their various Pods, and Capsula's. To these are subjoyn'd many Anomalous tetrapetalous Herbs, or rather Monopetalous, their Flowers being laciniated or cut into 4 parts; of this latter kind are some Veronica's or Speedwells, some Chickweeds, Brooklimes, Poppies, some Lysimachia or Willow-herbs, Rues, the Spurges, Plantaines, &c. these make the 17th. Book.

The 18th. and last Book of the first Tome comprehends the Legumes or Papilionaceous Herbs, whose Flower somehow represents a Butterfly with expanded wings, and is properly a deform'd Monopetalous Flower, tho' laciniated into 4 unequal Segments. These are divided I. into such Legumes as climb, and run up sticks, or perches, as the Kidney Beans, Pease, Tares, Vetches, Lentills, &c. II. into such as have no claspers, and doe not climb, neither are trifoliated, these are subdivided into many subordinate genera.
genera, according as their Pods are simple and erect, as in Lupines, Beans, common Liquorice, Goats-Rue; or echinate and monospermous, as in Cocks-head; or propendent, as in the Orobis, Astragoli or Heath-Pease, Chiches; or as their Coeds are included or hid in Bottles, or Vehicles, as in the Anthyllis; or joyned, as in some Colutea’s, Ferrum equinum, Ornithopodium or Birds-foot; or double, containing a double Series of Seeds, as in the Tragacanths, &c. The III. general division is into such Legumes as are trifoliated, which are variously subdivided, according as their heads are thicker or thinner spicated; or their Pods hid in the Calyx, or appear out of it, or are longer, shorter, intorted or cochleated; of these kinds are all the Trefoils, Hares-foot, Melilots, Fenugreek, Anonis or Rest-Harrows Saintfoin or Medick-Fodder, the Medica’s or Snail Trefoils, the Lotus which are almost Pentaphyllous, or five leaved Legumes, the Cytisi or shrub Trefoils; to these are subjoined many anomalous siliquose Herbs, very near a kine to the Papilionaceous; as several Fumitories, Acacia’s, Mimosa’s or sensitive Plants.

So much for the general Method of this Book; as for the subdivisions of each tribe, they are so numerous and very nice, that I could not trace and set them down in this account for want of room and words: therefore the Reader is referred for them to Mr. Ray himself, who discovers in every part a vast Memory, a quick Apprehension, a clear Judgment, and a long Experience.

Before we leave this Work it may be necessary to note, that all the Plants confusedly dispersed up and down in Books, are collected and Methodically digested in it, together with many new ones never before published; in the History of each Plant Mr. Ray observes this excellent Order, first he gives the Etymologies, then the Characteristic Notes of distinction, the best Synonymous Names, descriptions of all the parts, the times and places of Growth, and the uses as well Medicinal as Mechanical.
The second and last Tome is already far advanced in the Press, above 100 Sheets being work't off, and the whole will certainly be finished and published by the end of this Summer; this Volume will contain the Pentapetalous and Polypetalous Herbs, the Bulbs and those a kin to them, the Culmiferous and Graminifolious, as the Corns, Grasses, Reeds, Rushes, &c. After which follows the Anomalous or disorderly tribe of Herbs; and then the Dendrology or History of Trees and Shrubs begins, all which will be digested in a new and most natural Method; there will also be a very large Appendix. As soon as this Volume is published a particular account shall be given of it; in the mean time a short general Specimen of the Dendrology may be inserted, containing only a few of the principal heads.

First Mr. Ray divides the Trees into such as have caudicem simplicem non ramosum, and such as have caudicem ramosum: the first have a simple Stemme without any Branches, and produce but one great Gemma or Bud; the second that are ramose, are first distinguished into such as have florem a fructu disjunctum seu remotum, and such as have florem Fructui contiguum: of the first sort some have the Flower remote from the Fruit in the same Plant, and some totis Plantis sejunctum. Of such as have also the Flower contiguous to the Fruit, some have it summo Fructui insidentem, and others imo Fructui adnascentem; of the first of these (which have for the most part a Corolla or Umbilicus on the top of the Fruit) some contain their seed in Pericarpio seu pulpa humida, others in materia Sicciore. Each of these may be divided according to the number of the Seeds which the Fruit contains, into those that have Fructum monococcum, dicoccum, tricoccum, tetracoccum, pentacoccum, and polycoccum; after the same manner also may the other sort which have Florem imo Fructui adnascentem be divided: there will be many other Heads, of which at large and in particular when the Work comes forth.
seos Professore Lucassiano, & Societatis Regalis
Sodali. 4to. Londini. Prostat apud phures Bibliopolas.

This incomparable Author having at length been pre-
vailed upon to appear in publick, has in this Trea-
tise given a most notable instance of the extent of the pow-
ers of the Mind; and has at once shewn what are the
Principles of Natural Philosophy, and so far derived from
them their consequences, that he seems to have exhausted
his Argument, and left little to be done by those that shall
succeed him. His great skill in the old and new Geome-
try, helped by his own improvements of the latter, (I
mean his method of infinite Series) has enabled him to
master those Problems, which for their difficulty would
have still lain unresolved, had one less qualified than him-
sell attempted them.

This Treatise is divided into three Books, whereof the
two first are entituled de Motu Corporum, the third de Sy-
stemate Mundii.

The first begins with definitions of the Terms made use
of, and distinguishes Time, Space, Place and Motion into
absolute and relative, real and apparent, Mathe-
matical and vulgar: shewing the necessity of such distin-
tion. To these definitions are subjoined, the Laws of
Motion, with several Corollaries therefrom; as concerning
the composition and resolution of any direct force out of,
or into any oblique forces, (whereby the powers of all
sorts of Mechanical Engines are demonstrated:) the Laws
of the reflection of Bodies in Motion after their Collision: and the like.

These necessary Præcognitâ being delivered, our Author proceeds to consider the Curves generated by the composition of a direct impressed motion with a gravitation or tendency towards a Center; and having demonstrated that in all cases the Areas at the Center, described by a revolving Body, are proportional to the Times; he shews how from the Curve described, to find the Law or Rule of the decrease or increase of the Tendency or Centripetal forces (as he calls it) in differing distances from the Center. Of this there are several examples: as if the Curve described be a Circle passing through the Center of tendency; then the force or tendency towards that Center is in all points as the fifth power or squared-cube of the distance therefrom reciprocally. If in the proportional Spiral, reciprocally as the cube of the distance. If in an Ellipse about the Center thereof directly as the distance. If in any of the Conic Sections about the Focus thereof; then he demonstrates that the VisCentripeta, or tendency towards that Focus, is in all places reciprocally as the square of the distance therefrom; and that according to the Velocity of the impressed Motion, the Curve described is an Hyperbola; if the Body moved be swift to a certain degree than a Parabola; if slower an Ellipse or Circle in one case. From this sort of tendency or gravitation it follows likewise that the squares of the Times of the periodical Revolutions are as the Cubes of the Radii or Transverse Axes, of the Ellipses. All which being found to agree with the Phenomena of the Celestial Motions, as discovered by the great Sagacity and Diligence of Kepler, our Author extends himself upon the consequences of this sort of Vis centripeta; shewing how to find the Conic Section which a Bodie shall describe when cast with any velocity in a given Line, supposing the quantity of the said force known: and laying down several neat constructions to determine
termine the Orbs, either from the Focus given and two points or Tangents; or without it by five points or Tangents or any number of Points and Tangents making together five. Then he shews how from the Time given to find the Point in a given Orb answering thereto; which he performs accurately in the Parabola, and by concise approximations comes as near as he pleases in the Ellipse and Hyperbola; all which are Problems of the highest concern in Astronomy. Next he lays down the Rules of the perpendicular descent of Bodies towards the Center, particularly in the case where the tendency thereto is reciprocally as the square of the distance; and generally in all other cases, supposing a general quadrature of Curve lines: upon which supposition likewise he delivers a general method of discovering the Orbs described by a Body moving in such a tendency towards a Center, increasing or decreasing in any given relation to the distance from the Center; and then with great subtlety he determines in all cases the Motion of the Apsides (or of the Points of greatest distance from the Center in all these Curves, in such Orbs as are nearly Circular. Shewing the Apsides fixt, if the tendency be reciprocally as the square of the distance; direct in Motion in any Ratio between the Square and the Cube and retrograde; if under the Square; which Motion he determines exactly from the Rule of the increase or decrease of the Vis Centripeta.

Next the Motion of bodies in given Surfaces is considered, as likewise the Oscillatory Motion of Pendules, where is shewn how to make a Pendulum Vibrate always in equal times, tho' the center or point of tendency be never so near; to which, the Demonstration of Mr. Hugens de Cycloide is but a Corollary. And in another Proposition is shewn the Velocity in each Point, and the time spent in each part of the Arch described by the Vibrating Body. After this the Effects of two or more Bodies, towards each of which there is a tendency, is considered; and 'tis made out that two Bodies, so drawing or attracting each other, describe

about
about the common center of Gravity, Curve Lines, like to
those they seem to describe about one another. And of
three Bodies, attracting each other, reciprocally as the
Square of the distance between their Centers, the various
Consequences are considered and laid down, in several Co-
rollaries of great use in explicating the Phenomena of the
Moons Motions, the Flux and Reflux of the Sea, the Pre-
ceision of the Equinoctial Points; and the like.

This done our Author with his usual Acuteness pro-
ceeds to examine into the Causes of this Tendency or cen-
tripetal Force, which from undoubted Arguments is
shown to be in all the great Bodies of the Universe. Here
he finds that if a Sphere be composed of an infinity of At-
toms, each of which have a Conatus accedendi ad invicem,
which decreases in duplicate Proportion of the Distance
between them; then the whole Congeries shall have the
like tendency towards its Center, decreasing, in Spaces
without it, in duplicate Proportion of the Distances from
the Center; and decreasing, within its Surface, as the di-
stance from the Center directly; so as to be greatest on
the Surface, and nothing at the Center: and tho' this
might suffice, yet to compleat the Argument, there is laid
down a Method to determine the forces of Globes com-
posed of Particles whose Tendencies to each other do de-
crease in any other Ratio of the Distances: Which Specu-
lation is carryed on likewise to other Bodies not Spherical,
whether finite or indeterminate. Lastly is proposed a
Method of explaining the Refractions and Reflections of
transparent Bodies from the same Principles; and several
Problems solved of the greatest Concern in the Art of Di-
optricks.

Hitherto our Author has considered the Effects of com-
pound Motions in Medii non resistentibus, or wherein a
Body once in Motion would move equably in a direct Line,
if not diverted by a supervening Attraction or tendency
toward some other Body. Here is demonstrated what
would be the consequence of a resistance from a Medium, either in the simple or duplicate Ratio of the Velocity, or else between both: and to compleat this Argument is laid down a general Method of determining the density of the Medium in all places, which, with a uniform Gravity tending perpendicularly to the plain of the Horizon, shall make a Project move in any curve Line assigned; which is the 10th. Prop. Lib. II. Then the circular Motion of Bodies in resisting Media is determined, and 'tis shown under what Laws of decrease of Density, the Circle will become a proportional Spiral. Next the density and compression of Fluids is considered, and the Doctrine of Hydrostàticks demonstrated; and here 'tis proposed to the Contemplation of Natural Philosophers, whether the surprizing Phenomena of the Elasticity of the Air and some other Fluids may not arise from their being composed of Particles which fly each other; which being rather a Physical than Mathematical Inquiry, our Author forbears to Discuss.

Next the Opposition of the Medium and its Effects on the Vibrations of the Pendulum is considered, which is followed by an Inquiry into the Rules of the Opposition to Bodies, as their Bulk, Shape, or Density may be varied: Here with great exactness is an Account given of several Experiments tried with Pendula, in order to verify the foregoing Speculation, and to determine the quantity of the Airs Opposition to Bodies moving in it.

From hence is proceeded to the undulation of Fluids, the Laws whereof are here laid down, and by them the Motion and Propagation of Light and Sound are explained. The last Section of this Book is concerning the Circular Motion of Fluids, wherein the Nature of their Vertical Motions is considered, and from thence the Cartesian Doctrine of the Vortices of the Celestial Matter carrying with them the Planets about the Sun, is proved to be altogether impossible.
The III. and last Book is entituled *de Systemate Mundi*, wherein the Demonstrations of the two former Books are applied to the Explication of the principal Phenomena of Nature: Here the verity of the Hypothesis of Kepler is demonstrated; and a full Resolution given to all the difficulties that occur in the Astronomical Science; they being nothing else but the necessary consequences of the Sun, Earth, Moon, and Planets, having all of them a gravitation or tendency towards their Centers proportionate to the Quantity of Matter in each of them, and whose Force abates in duplicate proportion of the Distance reciprocally. Here likewise are indisputably solved the Appearances of the Tides, or Flux and Reflux of the Sea; and the Spheroidical Figure of the Earth and Jupiter determined, (from which the precession of the Equinoxes, or rotation of the Earth's Axis is made out,) together with the retrocession of the Moons Nodes, the Quantity and inequalities of whose Motion are here exactly stated a priori: Lastly the Theory of the Motion of Comets is attempted with such success, that in an Example of the great Comet which appeared in 1680, the Motion thereof is computed as exactly as we can pretend to give the places of the primary Planets; and a general Method is here laid down to state and determine the Trajectoriae of Comets, by an easy Geometrical Construction; upon supposition that those Curves are Parabolick, or so near it that the Parabola may serve without sensible Error; tho' it be more probable, said our Author, that these Orbs are Elliptical, and that after long periods Comets may return again. But such Ellipses are by Reason of the immense distance of the Foci, and smallness of the Latus Rectum, in the Parts near the Sun where Comets appear, not easily distinguished from the Curve of the Parabola: as is proved by the Example produced.

The whole Book is interspersed with Lemma's of General use in Geometry, and several new Methods applied, which
which are well worth the considering; and it may be justly said, that so many and so valuable Philosophical Truths, as are herein discovered and put past Dispute, were never yet owing to the Capacity and Industry of any one Man.

ADVERTISEMENT;

Whereas the Publication of these Transactions has for some months last past been interrupted; The Reader is desired to take notice that the care of the Edition of this Book of Mr. Newton having lain wholly upon the Publisher (wherein he conceives he hath been more serviceable to the Commonwealth of Learning) and for some other pressing reasons, they could not be got ready in due time; but now they will again be continued as formerly, and come out regularly, either of three sheets, or five with a Cutt; according as Materials shall occur.

LONDON,

Printed by J. Streater, and are to be sold by Samuel Smith at the Princes Arms in St. Paul's Church-yard.
The CONTENTS.

A Receipt to Cure Mad Doggs, or Men or Beasts Bitten by Mad Doggs. Communicated to the R. Society by Mr. Rob. Gourdon Knt. R. S. Soc. by his Majesties Command. (2.) A Letter of Monfieur Caffini to the Publisher, setting his Corrections of the Theory of the five Satellites of Saturn: With Tables of the Motions of those Satellites, adapted to the Meridian of London and the Julian Account. (3) An Account of several curious Observations and Experiments concerning the growth of Trees; made by Thomas Brotherton of Hey in the County of Lancaster Esq. Brought in and Read before the R. Society, by Mr. Robert Hook Fellow of the said Society. (4) A Discourse concerning the Apparent Magnitude of the Sun and Moon; or the Apparent Distance of 2 Stars when near the Horizon, and when higher elevated; by William Molineux of Dublin Esq. Reg. Soc, Socius. (5.) The Sentiments of the Reverend and Learned Dr. John Wallis R. S. Soc. upon the aforesaid Appearance. Communicated in Letter to the Publisher. Account of a Book. A Continuation of the New Digester of Bones: Its Improvements and new Uses, that hath applied to, both at Sea and Land: Together with some improvements and new Uses of the Air Pump, tryed both in England and Italy. By D. Papin M. D. & R. S. Soc.
A Receipt to cure Mad Dogs; or Men or Beasts bitten by Mad Dogs: Communicated to the Royal Society, by Sr. Rob. Gourdon. By His MAJESTIES Command.

& A

Grimony Roots, Primrose Roots, Dragon Roots
Single Peony Roots, the Leaves of Box, of each a Handful; the Starr of the Earth two Handfuls; the black of Crabs Claws prepared, Venice Treacle, of each one Ounce; all these are to be beaten and bruised together, and boiled in about a Gallon of Milk, till the half be boiled away; then put it into a Bottle, unstrained and give of it, about 3 or 4 Spoon-fuls at a time, to the Dog or Beast, three Mornings together before new and full Moon.

Observe, that it will be necessary the day before you administer the Medicine, to take away a little Blood.

Some of these Roots and Herbs, being difficult to be gotten in the Winter, they may be gathered in their Season, and being dried, and well powdered, may be give mixt with the Crabs Claws, and Venice Treacle, with Sallet Yl or Butter, and it will do as well.

If it be for Men or Women that are bitten with Mad Dogs; take the same Ingredients in the same Quantities and the Roots and Herbs being bruised altogether, with the Crabs Claws and Venice Treacle; let them be infuse warm in two Quarts of strong White Wine, for at least 12 Hours. This being strained, the Party bitten is to take about a quarter of a Pint Evening and Morning, three Days before the new and full Moon; it may be sweetned either with Sugar or some Cordial Syrup.

N.B. The Plant in this Receipt called, Starr of the Earth and which is the chief Ingredient, is known among the Botanists, by the Name of Sesamoides Salamantica, Parkiníni, five Lychnis viscosa floré muscoso, Cap. Bauhini. Anglico Spanish Catch-fle. It grows plentifully about Thetford, an about the Mills near New-Market. Vide Raîii Catalogum Plantarum Angl. e, & Hisl. Plant. Tom. II. inter Lychnides.
A Letter of Monsieur Cassini to the Publisher, giving his Corrections of the Theory of the five Satellites of Saturn; With Tables of the Motions of those Satellites, adapted to the Meridian of London, and the Julian Account.

Ce que j'ay escrit jusqu'à présent sur les nouvelles découvertes, que j'ay faites depuis quelque temps dans le Ciel, est si peu de chose, que je ne l'ay pas jugé digne d'être présenté à la Société Royale.

Je n'eus pas plus tôt donné au Journal la découverte des deux nouveaux Satellites de Saturne, que je vis qu'il y avait quelque chose à éclaircir, touchant leur distances, & la durée de leur conjonctions.

La distance du premier Satellite au centre de Saturne m'a paru variable, & son mouvement sensiblement inégal, plus vifte, en ce temps, dans le demi-cercle occidental, que dans l'oriental. J'ay dernièrement déterminé sa moyenne distance de $\frac{3}{12}$ du diametre de l'anneau de Saturne, son mouvement journalier de 6 fig. 10 d. 41'. 31''. Ainsi si son mouvement estoit égal, la durée de sa conjonction avec Saturne, c'est à dire, tout le temps qu'il met a parcourir son anneau, seroit de 7 h. 46'. Elle m'a paru plus grande par les observations immediates, mais il est à remarquer que je n'ay jusqu'à présent pu voir ce Satellite plus près de Saturne, que d'un Quart d'un Anse.

J'ay calculé l'Époque de son mouvement, pour le dernier Decembre 1685, a midi au meridien de Paris en $41^\circ$ 24 d. 50'.

La distance du second Satellite du centre de Saturne m'a paru plus uniforme. J'ay déterminé d'un diametre de l'anneau & $\frac{1}{2}$. Son mouvement paroit aussi plus égal. J'ay calculé le journalier de 4 fig. 11 d. 31'. 30''. Ainsi la durée de sa conjonction deuroit êstre de 8 h. 36'. Je n'ay pas non plus vu jusqu'à présent ce Satellite plus proche de l'anneau de Saturne que d' $\frac{1}{4}$ d'un anse. Comme ce Satellite se voit de la plus part du temps dedans les confins de la distance du Premier, auquel il est égal en grandeur, & semblable dans la color, la difficulté de distinguer l'un de l'autre a été extreme, de sorte que sans une affiditude particulière aux observations, & sans une grande multitude de combinaisons je n'en serois pas venu a bout.

P.p
J'ay déterminé l'Epoque de ce Satellite pour le 31 Decembre 1685, à midi, en \( \frac{9}{10} \) h. 10'.

La distance du Troisième du centre de Saturne paroît d'un diamètre de l'anneau \( \frac{1}{3} \). Son mouvement journalier 2 fig. 18. d. 41'. 50". Ainsi sa conjonction doit durer 10 heures. L'époque de son mouvement pour le midi du dernier de l'année 1685, \( \frac{9}{10} \) d. 39'.

La distance du Quatrième Satellite au centre de Saturne paroît de 4 diamètres de l'anneau. Son mouvement journalier de 22 d. 34'. 38". La durée de sa conjonction 15 h. 6'. L'époque de son mouvement au même temps & lieu que les autres en \( \frac{1}{10} \) 18 d. 1'.

La distance du cinquième Satellite au centre de Saturne paroit de 12 diamètres de l'anneau. Son mouvement journalier de 4 d. 32'. 17". Ses conjonctions durent 24 heures. L'époque de son mouvement au même temps & lieu en \( \times \) 18 d. 51'. Sur ces principes on peut construire les Tables, & les Ephemerides.

Voicy, Monsieur, en deux pages le resultat d'un Travail très long & très pénible, que je vous prie de communiquer à la Société Royale, la suppliant de l'agréer, & d'attribuer au perfond respect, que je luy dois, la réserve que j'ay eue de ne luy presenter que des choses bien digérées, &c.


Cassini

For the sake of the Curious in Astronomical Matters, and to help them to know where to look for these obscure little Stars, it was thought fit to deduce from the Elements delivered in this Letter, the following Tables, serving to compute easily their Places at any time assigned.

Tabula
Tabula Motus Medii Intimi Satellitis
Saturni, a Cassino Detecti Anno 1686.

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In Anno Bisextili post Februariurn adde unum die motumque ei com- pentem.
### Tabula Motus Medii penintimi Satellitis
Saturni, a Cassino Detecti Anno 1686.

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Tabula Motus Medii Satellitis Saturni

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In Anno Bissextili post Februarium adde unum die, motumque competen-
Tabula Motus Medii penextimi Satellitis
Saturni, ab Hugenio inventi Anno 1655.

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| 24               | 7.17.00         | 15               |
| 25               | 8.9.35          | 16               |
| 26               | 9.2.92          | 17               |
| 27               | 9.24.44         | 18               |
| 28               | 10.17.18        | 19               |

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In Anno Bisextili post Februarium adde unum diem, motumque competentem.
As to the Use of these Tables, it is supposed that the Reader is so much versed in Astronomical Calculation, as to know how to compute by them, they being in the usual Form; if not, there is sufficient direction given in the Correction of Hugens's Satellite, to be found in Numb. 145. of these Transactions. I shall only add, That the Proportion of the Squares of the times of the Periods, to the Cubes of the Distances, (which is proposed as probable by Kepler, but now demonstratively found true by Mr. Newton,) gives us nicely the Proportion of the Distances of these Planets from the Center of Saturn; and supposing the Satellite of Hugens four Diameters of Saturn's Ring distant from him, we shall find by the Periods, the Distances, as follows.

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<tr>
<td>Intimi</td>
<td>1 21 18½</td>
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<td>2 17 41½</td>
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<td>Medii</td>
<td>4 13 47½</td>
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<td>Penextimi</td>
<td>15 22 41</td>
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<td>Extimi</td>
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These Distances may be used, as more accurate than those obtained by Observation, which yet differ but little therefrom. The outermost Satellite being so far distant, cannot fail of being seen every greatest Elongation. This present Year 1687, it will be in its greatest occidental distance July 24. again Octob. 12. and Jan. 2. 1688. and on the Oriental Side on Sept. 3. 1687. Nov. 23. and about the middle of Feb. 1688. at which Times all those that are furnished with good Telescopes may satisifie themselves of the Truth of these Discoveries.

Those that desire a fuller Account of this Matter, may find it in N. 92. N. 145. N. 181. of these Transactions.
An Account of several curious Observations and Experiments, concerning the Growth of Trees; made by Thomas Brotherton, of Hey, in the County of Lancaster, Esq. Brought in and Read before the R. S. by R. H, Fellow of the said Society.

The Experiments and Observations, were made at Hey, in the County of Lancaster.

The first Experiment was made in the Year 1671, upon a Crab Tree, about four Inches in Diameter; it was hacked round with a Hatchet, so as to cut pretty deep into the Wood, besides the cutting off of the Bark, for about four Inches wide. After which it was the same Year observed to increase above the said hacking very considerably, and to shoot in length of Wood, about one Foot; the next Year it increased considerably, and shot in length about nine Inches: But the third Year it dyed to the very Root.

Much the like was observed in another, part of whose Bark was eaten off by a Canker, that the lower part stood, without increasing, and by degrees the Wood rotted and mortified; but the upper part increased to the 3d. year when it Dyed also.

Most of the following Experiments, were tryed on the Abies or Scotch-Firr, and on the black Poplar with white Bark, and on Hazel and Ald Trees.

A Scotch-Firr of three Years growth, having a Ring of the Bark cut off, of the breadth of three Inches, near the bottom of the Stem or Stalk, below the uppermost Knot or Joyn, was observed to grow and shoot out its Top, about Q.9 half
half a Yard; and the Parts all about the Ring, to increase very much in thickness the same Year the Section was made, and to increase in thickness much more than it would have done if the Section had not been made: but all that part of the Stock, between the the said Ring and the Knot next below it, increased not at all; but that part which was below the next Knot increased somewhat, yet not so much as if the said Ring of the Bark, had not been cut off. The 2d. Year it also increased considerably, but not so much as the first; but, the third Year it died. The Branch that was here produced, had the Ring cut off from it, Apr. the 1st. 1686, and the part above the Section increased, and grew till the 17th. of October following, when it was cut off from the Tree. In this space of time the part below the Ring increased not at all, but stood at a stay; but the part about the Ring shot out a new Joynt, between a Foot and half a Yard, and increased in thickness for the whole length of it, and in all its parts twice as much as it would have done, if it had not been Cut, as was apparent by a like Branch on the opposite side of the Knot, which was not cut or barked round in the same manner: The Bark also of the part above the Section, swelled, or grew downwards over the woody part, (which was bare) above half an Inch in breadth.

The usual time for making this Section, was either in March or the beginning of April.

Tryal was made upon some young Trees cutting a helical swath of the Bark, a bout half an inch in breadth, by leaving a like helical swath of Bark to communicate between the upper and under part; in this Tryal, the difference of growth succeeded not, but the remaining swath of the Bark swelled downwards, and by the end of the Year, covered the bared part of the Wood.

The like event almost followed, upon making an indented Section round, of about half an Inch in breadth; the uper
uper Bark quickly swelling downward, and joyning again with the lower.

It was also observabel, that as the upper Bark grew downwards; so it increased also in thickness, whereas the Bark below the Section thickned not at all.

Several of those Bows, which were about one Inch in Diameter, and had increased, as above the Summer before were observed to out live the great Frost, and to receive no considerable Damage; whereas many others otherwise ordered, were killed by it, as will appear by and by, more particularly.

In the first Fig. is represented a Scotch Firr of three Years growth (it shooting forth every Year, both from the Body, and the Branches a new Joynit and circumambient Sprouts, to a determinate length) barked with three Rings, of about 1½ Inch broad, each about the middle of the Internodia or parts of the Stock between the Joynits, at c b, & a; this in one Year increased and shot forth branchings, as in the second Fig. that is the Stock at a, which was about the bigness of a Quill, below the Ring to the next Joynit continued of the same bigness, but above the Ring it increased and grew to the bigness of ones Finger, and from the new Joynit at e shot out new Limbs and Stock about a quarter of a Yard, which was somewhat bigger, than if there had been no Ring made. Next the Branches f f increased likewise proportionably, by swelling in bigness, and from a new Joynit shooting out new Body and Limbs, as the Top or Body; and the Body of the Tree below the Joynit b to the Ring b, increased more than if the Ring had not been made; but the part of the Stock below the Ring to the next Joynit, increased not at all. The like shooting forth and increasing, was observed in the 2d. Limbs Joynit and Stock below it g g. i to e, between which and k, it increased not.

The like also succeeded in the lower Branches l l, and Joynit k, and in the Stock d, below the Joynit k.
Fig. the 3d. Represents a young Scotch Firr of two Years old, on one of the lowermost Branches of, was made a Ring Section between the Body and first Knot of the Limb. The following Year, that part of the Limb above the Ring, increased twice or thrice as much as the corresponding parts of the other Limbs, from the same Knot, as a, which increased as if there had been no Section made at B, but the part below b to the Body, increased not at all.

Fig. 5 represents a young Hazel cut into the Body with a deep gash, and the parts of the Body above and below cleft upwards and downwards, and the Splinters a and b, by wedges kept off from touching each other, or the rest of the Body. These the following Year were observed to be in the State represented in the 6th. Fig. that is the Splinter a above the gash, was grown very much, but the Splinter b below, stood at a stay and grew not, but the rest of the Body at c, grew as if there had been no gash made.

Fig. 7 Represents a like gash made just above the lowermost Knot; and the parts splinter’d or cleft and wedged off from each other, and from the Body as before, but there is left a Branch upon the lower Splinter to see what will be the State thereof the next Year, or in October next. When’tis probable by the other Experiments the lower Splinter and Branch upon it, will be found to have grown and increased as the Splinter in the former Experiment did above the gash; though not in the same Proportion.

Fig. 8 Represents four young Poplar Trees, A, B, C, D, all of equal bigness, growth, situation, and foliage as near as could be found; these were ordered as is represented in the 9th. Fig. that is A had all its branches and top cut off, B had all its branches pruned off, but it was left with a small Head at the top. C had the branches cut about half way, and those of the upper half left growing. D was left grow-
growing without being at all pruned or lopped; the event was expected.

The success was found to be thus A in the following Years shot out many Twigs round about, but the Body increased but little in height or bigness. B shot out likewise many Twigs where it had been pruned, and the top branches and top also increased considerably, and the Body also increased much more in height and bigness than did the former A. C increased yet much more in all its parts than B. But D increased in Limbs, Height, and Bigness most of all; swelling in bigness, and stretching in height and spreading in its Boughs much more than C; and in about 10 Years, was more than four times as bigg as A.

The same worthy Person also observed, that all the Poplars that had been pruned, dyed in the great Frost 1684; in so much, that of 25 that were so ordered, he observed 19 of them to be killed by it, and the remaining to be very weak and hardly able to recover, and increased very little in the following Years. These Poplars were about 30 Foot high, and had only a small Head left at the top unloped, of about 4 or 5 Foot, and were pruned, the Spring before the great Frost. He observed also, that divers of those which had been pruned two Summers before the Frost, were killed by it: But none of those which had not been pruned at all, were hurt by it. He took Notice also, both in Lancashire and Cheshire, that Trees of 60 Foot in height, that had been pruned, and had only a small Top left, were also killed by thesaid Frost; whereas those Trees of the same Kind and Height, which stood near to them, but had not been pruned, continued to flourish, and suffered no harm thereby. Several of those Branches of about an Inch Diameter, and Trees that had been barked round, as above, the Spring before the great Frost, out lived the violence of the same, and the preceding Winter.

Where
Where these prunings had been tried upon Trees 20 Foot high; the difference of their Increase, was sensible the following Summer, but in 7 or 8 Years time, the difference is prodigious; the un-pruned Trees growing several times bigger than the pruned, both in Body and Branches, even to Admiration.

He hath often observed, also that when the top Branches would shoot out and grow 2 Foot, or more, in length; the lower Branches would not shoot above 4 Inches. And further, that in the Branches of the Scotch Fir, the Joynts above the Rings barked round, would increase and grow much bigger in 3 Years, than they would in 5 Years, if the said Rings were not cut off.

The same Person upon Discoursing some, other particular Inquiries about the Spreading and Increase of the Roots, assured me, that he had observed a very large Pinafter about two Foot and an half in Diameter, and of a heighth proportionable (viz: of about 20 Yards; the lowest Boughs of which, were about 30 Foot above the Ground) did spread and flourisht on every side a like, though it had no Root at all towards three quarters of its Situation, but only toward one quarter, into which it spread its Roots very far and large; divers of them reaching about 70 or 80 Foot from the Body of the Tree. The Reason of which spreading was occasioned by its being planted just within the square Angle of the Corner of a deep thick and strong Stone Wall, which was a kind of Bauking or Wharfing against a River that ran by it: This Tree I say, tho' it had nourishment only from one quarter of four to its Roots, yet did the same flourish and spread equally on every side.

Upon Consideration of these and divers other Observations, and Experiments Mr. Brotherton is of Opinion.

1. That the Sap (most of it if not all) ascends in the Vessels of the lignous part of the Tree, and not in the Cortical Part, nor between the Cortical and Lignous parts.

2. That
2. That the Increase and Growth of a Tree in thickness is by the descent of the Sap, and not by the ascent; and if there were no descent, a Tree would Increase but very little, if at all.

3. That there is a continual Circulation of the Sap all the Summer Season, and during such time as the Sap is stirring, and not a Descent at Michaelmas, only as some have held.

To me it seems very probable, that the Bodies of Plants, as well as those of moving Animals, are nourished and increased by a double Food; the one an impregnated Water, and the other an impregnated Air, and that without a convenient supply of these two, the Vegetable cannot subsist, at least not increase. These do mutually mix and coalesce, and parts of the Air convert to Water, and parts of Water convert to Air. As some of this latter are rarified and freed from their Chains and become Spiritual and Airy, so others of the fore-mentioned, are cloggeth and fettered and become debased. To this purpose all Plants as well as Animals, have a twofold kind of Roots, one that branches and spreads into the Earth, and another that spreads and shoots into the Air, both Kinds of Roots serve to receive and carry their proper Nourishment to the Body of the Plant, and both serve also to convey and carry off the useless Recrements; useless I mean any further within the Body of the Plant, though useful to it when they are separated, and without it, the one for Seasoning the Earth and Water wherein it is planted, and the other for seasoning and preparing the Air, the Method of which I have elsewhere explained.
Concerning the Apparent Magnitude of the Sun and Moon, or the Apparent Distance of two Stars, when near the Horizon, and when Higher elevated.

I do not design so much to establish any thing of my own that may be satisfactory in solving this admirable appearance, as to detect the errors of those that have offered a solution thereof, and have come short (as I conceive) of being satisfactory; that thereby I may again set the minds of philosophers on work, and rouse them up to enquire a new after this surprising phenomenon. That I may do this the more effectually, I shall briefly declare the matter of fact and then proceed to the reason thereof, given by several, and to their confutations.

First therefore it is well known that the mean apparent magnitude of the Moon is \(30^\circ 30^\prime\). We will take it Numero Rotundo to be 30, that is, an Arch of a great circle in the Heavens of 30 minutes is covered by her diameter, and this we'll suppose to be her apparent diameter, at a full Moon in the midst of Winter, and when she's in the Meridian, and at her greatest Northern Latitude and consequently the utmost that she can be elevated in our horizon; tis as well known also that when she is in this posture, being looked upon by the naked eye she appears (that we may accommodate all to sensible measures) to be Magnitudinis Pedalis, about a foot broad. But the same Moon being looked upon just as she rises, she appears to be three or four foot broad, and yet if with
an Instrument we take her Diameter, both in one posture and the other, we shall find that still she shall be but 30 Minutes; the several ways of trying this I will not mention, they being as various as are the Methods of taking the Moons apparent Diameter, common enough amongst the Astronomers; neither will I insist upon the truth of the Matter of Fact, for that I think cannot reasonably be questioned, after so many trys and so many experiments thereof, faithfully recorded by undoubted witnesses; and it would be very unreasonable to imagine that so many Authors should rack their Brains for solving an appearance, wherein they were not certain of the matter of Fact. But because of Nullius in Verba, I can assert that I have accurately tried it myself, and I have so found it: one of the ways I proceeded was thus, I took a very good Telescope of about 6 foot long, in the inward Focus of whose Eye-Glass I apply'd a very fine Lattice made of the single hairs of a Mans Head; then Looking with this at the Moon when she was just Risen and Looked Extraordinarily big, I observed what Number of the squares of the Lattice were Occupied by her body; then observing her again, when more elevated and free from all Extravagant greatness, I still found the same squares of the Lattice possess'd by her. This way is Equivalent to that now more used, of taking her Diameter by Mr. Townlvs Micro-meters: but I have also tried and found the same thing by an Accurate Sextant, taking the distance of the Moons Opposite Limbs.

Now this Phenomenon affords two things to be considered, first why the Moon (I still name the Moon as being an Object more adapted for our sight, for the same thing holds in the Sun) should seem bigger about the Horizon, then when more elevated; and secondly, she appearing bigger, how it comes to pass, that her Diameter being taken, it is no greater then when she appears less. But the Disquisition concerning this latter being likely to
Comprehend the former, I shall not divide my discourse into two Branches, but proceed in the Method Proposed. Only I desire it may be noted, that I suppose the Horizontal and Meridional Moon to be found both of the same Angle, whereas in truth the Meridional Moon (tho appearing less) shall be found of the greater Angle: which increaseth the Wonder: But this proceeding from the different distances that one and t’other is looked at (the Meridional Moon being nigher us by almost a Semidiameter of the Earth) and consequently easily solved that way; I have therefore chosen to put between them a plain equality, for avoiding Confusion and Intricacy in Discourse.

Wherefore let us hear what the Ingenious of these latter days can say to this appearance. And first we find the Celebrated Des-Cartes attributing this appearance rather to a deceived Judgment than to any Natural Affectation of the Organ or Medium of sense; for the Moon (says he) being nigh the Horizon, we have a better opportunity and advantage of making an Estimate of her, by comparing her with the various objects that incur the sight, in its way towards her; so that tho we imagine she looks bigger yet this a meer Deceipt: for we only think so, because she seems nigher the tops of Trees or Chimneys or Houses or a space of Ground, to which we can compare her, and Estimate her thereby; but when we bring her to the Test of an Instrument that cannot be deluded or Imposed upon by these appearances, then we find our Estimate wrong, and our Sences deceived. These thoughts, my-thinks, are much below the Accustomed Accuracy of the Noble Des-Cartes; for certainly, if it be so, I may at any time increase the apparent Bigness of the Moon, tho in the Meridian; for it would be only by getting behind a Clutter of Chimneys, a Ridg of a Hill, or the top of Houses, and comparing her to them in that posture, as well as in the Horizon: besides if the Moon be look’d at just as she is Rising from an Horizon determined by a smooth Sea, and which has no more Vari-
Variety of Objects to compare her to, then the Pure Air; yet she will seem bigg, as if lookt at over the Rugged top of an uneven town or Rockey Country. Moreover, all Variety of adjoyning objects may be taken off, by looking through an empty Tube, and yet the deluded imagination is not at all helped thereby. I come next to the solution hereof given by the Famous Thomas Hobbs: and for this we shall stand in need of the first Fig. wherein says he, let the Point G be the Center of the Earth, and F the Eye on the surface of the Earth; on the same Center G, let there be struck the two Arches, E H determining the Atmosphere, and AD to Represent that blew surface in which we imagine the fixed Stars: and let FD be the Horizon. Divide the Arch AD into three equal parts by the lines BF, CF; it is manifest that the Angle AFB is greater than the Angle BFC, and this again greater than the Angle CFD. Wherefore says he, to make the Angle CFD equal to the Angle CFB, the Arch CD must be greater than the Arch CB; and consequently, that the Moon may in the Horizon appear under the same Angle as when Elevated, she must cover a greater Arch, and therefore seem greater; that is the Moon in the Meridian appearing under the Angle BFC, that she may appear under an equal Angle in the Horizon, as suppose CFD, tis necessary that Arch CD should be greater than CB; and consequently the shee appear to subtend a greater Arch when in the Horizon then when Elevated, yet shee appears under the same Angle. And all this without Refraction. The Geometry of this Figure is most certainly true and demonstrable. At this I quarrel not; but it makes no more in our present Difficulty then if nothing had been said: for the Philosopher has here made a Figure of his own, and from thence he Argues as confidently, as if Nature would accommodate herself to his Scheme, and he not obliged to Accommodate his Scheme to Nature; for here he has made the Circle GF representing the Earth very large.
in proportion to the Circle $AD$; and then indeed taking the Point $F$ in the Earth's surface, and by lines from thence dividing the Angle $AFD$ into what ever equal parts, the Intercepted Arches $AB$, $BC$, $CD$ shall be unequal. But if he had considered, that the Earth is as it were a point in respect of the Sphere of the fix'd Stars, nay the very Annual Orbit of the Earth is almost if not altogether imperceptible (saving the truth of Mr. Hooks Attempt) he would have found that the Lines $FB$, $FC$, $FD$, must be all conceived as drawn from the point $G$, and then equal Angles will intercept equal Arches, and equal Arches equal Angles: and so it happens (at least beyond the Possibility of discovery of sense) to the Eye on the surface of the Earth. And besides he should have considered, that all Observations Astronomical are performed as from the Center of the Earth, and therefore it is that they keep such a stir about Parallax; so that his drawing his lines so far from $G$ as $F$ is, and to another concentrick Circle so nigh as $AD$, deceived him in this Point.

The Famous Gassendus has written 4 large Epistles on this Subject, the substance of all which is, that the Moon being nigh the Horizon and looked at through a more Foggy Air, casts a weaker Light, and consequently forces not the Eye so much as when brighter; and therefore the Pupil does more inlarge itself thereby transmitting a larger Projection on the Retina. In this Opinion I doe find he is not alone, for in the Journalls des Savans, this disquisition being again revived by a French Abbe, He therein follows this Sentiment of Gassendus; it was first Published in the 2d Conference presented to the Dauphin in August 1672, but by Reason of an Objection moved by Father Pardye, it was fain to be republished with some additions and amendments in Octob. 1672. The addition was, that this Contracting and enlarging of the Pupil causeth a different shape in the Eye; an open Pupil making the Crystalline flatter, and the Eye longer, and the narrower Pupil short-
ning the Eye, and making the Crystalline more convex, the first attends our looking at Objects which are Remote or which we think so; the latter accompanies the viewing Objects nigh at hand. Likewise an open Pupil and flat Crystalline attends Objects of a more Sedate Light, whilst Objects of more forcible Rays require a greater Convexity, and narrow Pupil. From these Positions the Abbe endeavoured to give an account of our Phenomenon, as follows. When the Moon is nigh the Horizon, by comparison with interposed Objects, we are apt to imagine her much farther from us than when more Elevated, and therefore (says he) we order our Eyes as for viewing an Object farther from us, that is, we somthing enlarge the Pupil, and thereby make the Crystalline more flat: moreover the Duskiness of the Moon in that posture does not so much strain the light; and consequently the Pupil will be more large, and the Crystalline more flat: hence a larger Image shall be projected on the Fund of the Eye, and therefore the Moon shall appear larger. And this disposition of the Eye that Magnifies her, Magnifies also the divisions of our forementioned Lattice, and consequently shee by her Body shall possess no more of the divisions, then when shee seems less. These two forementioned accidents, viz. the Moons Imaginary distance and Duskiness, gradually vanishing as shee rises, a different Species is hereby introduced in the Eye, and consequently shee seems gradually less and less, till again shee approaches nigh the Horizon. These two Opinions of Gassendus and the Abbe being so nigh a kin, I shall consider them both together, and first I assert that a wider or narrower Aperture increases not, neither diminishes the projection on the Retina. I know Honoratus Faber in his Synopsis Optica endeavours to prove the clear contrary to this my Assertion, and that after this manner. Fig. II A B is an Object; E F the greater aperture of the Pupil, admitting the projection K I on the Retina, whereas the lesser aperture
Aperture $CD$ admits only the projection $GH$; but $GH$ is less than $KI$, wherefore a lesser Aperture diminishes the projection. I admire that any Man that undertook (as *Honoratus Faber*) to write of Opticks more accurately then all that went before him, should be guilty of so very gross an Error; and I do more admire that the Celebrated *Gassendus*, and with him the Noble *Hevelius* should be of the same Opinion: for tho' the foresaid Figure and Demonstration hold most certainly true in direct projections, as in a dark Room with a plain Hole; yet it will not hold in Projections made by Refraction, as it is in those on the *Retina* in the Eye, by means of the *Crystalline* and other Coats and Humours of the Eye. For a Demonstration of this observe the *third Fig.* wherein lett $AB$ be a Remote Object, and $EF$ the *Crystalline* at its large aperture, projecting the Image $IM$ on the *Retina*. Let then $CD$ be the lesser Aperture of the *Pupil* before the *Crystalline*: I say the Image $IM$ shall be projected as large as before, for the Cone of Rays $EAF$ consists partly of the Cone of Rays $CAD$, therefore where the former $EAF$ is projected, the latter $CAD$; as being a part of the former, shall be projected also. So that no more is effected by this narrow Aperture, but that the sides of the Radiating Cones are intercepted, and consequently the Point $I$ shall be affected with less light, but it shall still be in the same place: what is said of that Cone and that Point may be said of all other Cones and other Points of the Object. From hence appears first, the Invalidity of the Account given of the Moons appearance by *Gassendus* from this Reason; 2ly. The Reason appears why a Telescope's greater or lesser Aperture, makes no difference in the Angle it receives: for imagine $EF$ to be an *Object-Glafs* of a Telescope, and it's plain: 3ly. 'Tis Evident why a greater or less Aperture on a Telescope should make the Objects appear Lighter or Darker, for thereby more or less Rays are admitted to determine on the Projection of each Point. But all this
by the by. And this is sufficient for a Confutation of Gassendus and Faber; But our forementioned Abbe superadds to a greater or lesser Aperture of the Pupill, as a necessary Consequent, a greater and lesser Convexity of the Crystalline, as also a lengthening and shortening the Tube of the Eye. And this I must confess would do something if we find it true in our Case; and this let us try. First says he the Duskiness of the Moon nigh the Horizon admits the Pupill to enlarge itself, the Crystalline to flatten, and the Eye to lengthen: but what if we change our Object, and instead of the Moon take the Distance between some of the fixt Stars; (as suppose those of Orions Girdle,) we shall find the same Phenomenon in them, and yet I hope neither he nor Gassendus will Assert, that they at one time strain the Eye more than at another, or that at any time their fulgur strains the Eye at all; if he do, let him take Stars of the lesser Magnitudes, nay even those that can but just be perceived, and then he will be convinced. Or let him consider whether this will hold in looking at the Sun through very dark Glasses, which render the Sight thereof as inoffensive to the Eye, as that of a green Field; but perhaps he will then say that this other Reason holds which is by that the greater Imaginary distance at which we think the Moon near the Horizon, than when more elevated, makes us Contemplate her as if really she was so, viz. with ample Pupills, &c. but this I have sufficiently overthrown in my Remarks against Descartes: therefore I pass it over, only subjoyning that if there were any thing in this Surmise, 'tis thinks the Horizontal Moon should be fancied nigher to us than farther from us; for if we are for trying Natural thoughts, let us take Children to determine the Matter, who are apt to think, that could they go to the edg of that space that bounds their Sight, they should be able (as they call it) to touch the Sky; and consequently the Moon seems then rather nigher to us than farther from us.

After
After I had writ thus far I accidentally cast my Eye upon Riccioli's Treatise of Refraction, at the end of his 2d Volume of the Almagest, Lib. 10. Sect. 6, cap. 1. Quest. 13, wherein he speaks of our present Difficulty; But to my wonder I find him Assert, that he and Father Grimaldi had often taken the Horizontal Sun and Moons Diameters by a Sextant, when to the naked Eye they appeared very large; (Grimaldus directing his Sight to the left edg, and Ricciolus to the right,) and that even by the Instrument they always found the Diameters greater than when more elevated, the Sun often subtending an Angle of almost a Degree, and frequently 45 Minutes, the Moon also 38 or 40 Minutes. This is down right contrary to the matter of Fact, which I have before alleged, and directly repugnant to the matter of Fact asserted by the French Abbe in the forecited Journal. Whether of us be in the right I leave to Accurate Experiment to determine, and submit the whole to the Decision of the Illustrious Royal Society. Only give me leave to add one word against Riccioli, for had his Experiments been Accurately prosecuted, he should have tryed them when the Horizontal Moon had look'd ten times more large in Diameter than ordinary; and then if it be true, that even by an Instrument she will be found proportionally broader than really, she should subtend an Angle of 300 Minutes, or 5 Degrees: for very often I have seen the Moon when she appeared 10 times broader than ordinary, which the small addition of 8 or 10 Minutes to her usual Diameter will never Cause.

Lastly as an Apology for my reviving this disquisition to that Noble Company of English Philosophers, I shall only intimate the words of the forementioned Abbe's Letter. *Pour la Raison de cette Apparence, & de la tromperie de nos Sens, je la tiens plus Difficile a trouver, que les plus grands Equations d'Algebre, & quand vous y aurez bien pense,** vous m'Obligerez de m'en dire vos tre Sentement, &c.
After which I have only to subscribe my self an unworthy Member, and an humble Servant and Adminder of that Illustrious Company.

Dublin
March 10th. 84.

William Molyneux.

The Sentiments of the Reverend and Learned Dr. John Wallis R. S. Soc. upon the aforesaid Appearance, communicated in a Letter to the Publisher.

As to the last Inquiry (concerning which, you say, the Royal Society would be glad to know my Opinion;) about the apparent Magnitude of the Sun near the Horizon, greater than when considerably high:

The Inquiry is Ancient: And, I remember, I discoursed it near forty Years ago with Mr. Foster, then Professor of Astronomy in Gresham College. Who did then assure me (from his own Observation, I suppose; for I have never examined it myself,) that the apparent Magnitude taken by Instrument (however the Fancy may apprehend it;) is not greater at the Horizon, than when higher. And Mr. Cafwell (when your Letter was communicated to our company here;) affirmed the same.

And (though I have not myself made the Observation;) I do not doubt but the thing is so. For it is agreed: That Refraction near the Horizon, though (as to appearance:) it alter the Altitude of the thing seen; yet it alters not the Azimuth at all.

And it must needs be so. For, since this equally respects all points of the Horizon; let the Refraction be what
what it will, the whole Horizon can be but a Circle: So that there is no room for the breadth of a thing (as to the Angle at the Eye) to be made greater, what ever its Tallness may (the Refraction not equally affecting all parts in the Circles of Altitude.) Nor is there any reason why this should rather thrust the other, than that the other thrust this, out of place.

Whereas, in the Altitude, it is otherwise: For while what is near the Horizon is enlarged, that which is further off is thereby contracted: which as to the Azimuth or Horizontal Position cannot be.

In Spectacles indeed it is otherwise: for they represent the Object every way enlarged: and do thereby hide the adjacent parts. But in Refraction by Vapours, supposing all parts of the Horizon equally affected by them, one part cannot be expanded in breadth (whatever it may be as to the hight) without thrusting out an other (for the whole Horizon can be but a Circle) and, why one part rather than another?

Unless we would say (as perhaps we may, if there shall appear a necessity for it) That the Rays of a lucid Body do expand themselves every way to the prejudice of the parts adjacent, by covering them.

But supposing (which I am apt to believe, till the contrary shall be evinced by Experiment) that the Sun or Moon's apparent Diameter taken by Instrument near the Horizon, is the same as taken in a higher Position, (I mean, its Horizontal Diameter, or that parallel to the Horizon; for the erect Diameter, in a Circle Perpendicular to the Horizon, may by the Refraction be varied, and thereby made, not greater, but less than, when higher: as hath been noted in the Name of Sol Ellipticus at the Horizon.) supposing, I say, that the Sun's apparent Diameter Horizontal, taken by Instrument, is the same near the Horizon, as in a higher Position, I take its Imaginary greatness which is fancied near the Horizon, to be only a deception.
tion of the Eye; or rather the Imagination from the 
Eye.

For sure it is, that the Imagination doth not estimate 
the greatness of the Object seen, only by the Angle which 
it makes at the Eye; but, by this compared with the sup-
poed distance.

True it is that, *Ceteris paribus*, we judge that to be the 
greater Object, which makes at the Eye the greater An-
gle: But not so if apprehended at different Distances.

For if through a Casement (or lesser aperture) we see 
a House at 100 Yards distance; this House (though seen 
under a less Angle) doth not to us seem less than the Case-
ment through which we see it, (or this greater than 
that, because it makes at the Eye the greater Angle:) 
But the Imagination makes a comparative Estimate from 
the Angle and Distance joyntly considered.

So that, of two things seen under the same or equal 
Angles, if to one of them there be ought which gives the 
apprehension of a greater Distance, that to the Imagi-
nation will appear greater.

Now sure it is, that one great advantage for Estimat-
ing of a thing seen, is, from the variety of intermediate 
Objects between the Eye and the thing seen. For then 
the Imagination must allow room for all these things.

Hence it is that if we see a thing over two Hills, between 
which there lies a great Valley unseen, it will appear much 
 nearer than if we see the Valley also: and it will appear as 
just beyond the first Hill. And if we move forward to the 
top of the nearest Hill (that so the Valley may be seen) it 
will then appear much further than before it did.

And on this account it is, that the Sun setting, ap-
pears to us as if it were but just beyond the utmost of 
our visible *Horizon*; because all between that and the 
Sun is not seen. And, upon the same account, the Hea-
ven itself seems Contiguous to the visible *Horizon*.

Now when the Sun or Moon is near the *Horizon*, there
is a prospect of Hills, and Vallyes, and Plaines, and Woods, and Rivers, and variety of Fields, and Inclofures; between it and us; which present to our Imagination a great Distance capable of receiving all these. Or, if it so chance that (in some Position) these Intermediates are not actually seen: Yet having been accustomed to see them, the Memory suggests to us a view as large as is the Vifible Horizon.

But when the Sun or Moon is in a higher Position; we see nothing between us and them (unless perhaps some Clouds) and therefore nothing to present to our Imagination so great a Distance as the other is.

And therefore, though both be seen under the fame Angle, they do not appear (to the Imagination) of the fame bignefs, because not both fanned at the fame Difiances: But that near the Horizon is judged bigger (be-cause fuppofed farther off) than the fame when at a greater Altitude.

'Tis true, that as to small and middling Difiances (beside this Estimate from Intermediates) the Eye hath a means within it felf to make some Estimate of the Dif-ance. As, when we already know the bignefs of a thing feen, to which we have been accustomed; as a Man, a Tree, a Houfe, or the like: If fuch thing appear to us under a small Angle, and indiftinct, and faintly coloured; the Imagination doth allow fuch Difiance, as to make fuch a thing fo to appear. And, if this, through a Pro-fpective Glass, be represented to us under a bigger Angle, and more distinct: It is accordingly apprehended as fo much nearer.

But the case is otherwife, when we do not, by the known bignefs, judge the Difiance; but, by the suppo-fed Difiance, judge of the bignefs; as in the Case before us.

And accordingly, different Persons, according to diffe- rent fanned Difiances, judge very differently. As, if two Stars be fuffled to Ignorant Persons, and you ask how far
they seem to be asunder: one perhaps will say, a Foot; another, a Yard, or more: And one shall say, The Sun appears to him as big as a Bushel; another, as big as a Holland Cheefe: Each estimating according to the fancied Distance.

Again; in our two Eyes (when the Object is seen by both) there is yet another means of Estimating how far off it is. (And it is this by which we judge of Distances.) Namely, there are, from the same Object, two different visual Cones, terminated at the two Eyes: Whose two Axes contain, at the Object, different Angles, according to different Distances: An acuter Angle at a great Distance, and more obtuse when nearer.

Now, that such Object may be seen by both Eyes, clearly; it is requisite that the Eyes be put into such a Position, as that the Sight of each Eye receive the respective Axe at right Angles. Which requires a different Position of the two Eyes, according to the different Distance of the Object.

As will manifestly appear; if we look, with attention, on a Finger (or other small Object) at two or three Inches distance from the Eye; and then upon another like Object at three or four Yards beyond it: (and this alternately several times.) For 'twill be manifest, that while we look intently on the one, we do not see the other (or but confusedly) though both be just before us. And, as we change our view, from the one to the other, we manifestly feel a Motion of the Eyes (by their Muscles) from one posture to another.

And according to the different Posture in the Eyes, requisite to a clear Vision by both, we estimate the Distance of the Object from us.

And hence it is, that they who have lost the Sight of one Eye, are at a great disadvantage, as to estimating Distances, from what they could do while they had the use of both.

But
But now when the Distance grows so great, as that the Position of these visual Axes become Parallel, or so near to Parallel, as not to be distinguishable from it: This advantage is lost, and we can thenceforth only conclude, that it is far off; but not how far.

Hence it is, that our view can make no distinction of the Moons Distance, from that of the other Planets, or even of the fixed Stars: But they seem to us as equally remote from us; though we otherwise know their Distances from us to be vastly different. Because the Parallax (as I may so call it) from the different Position of the two Eyes, is quite lost, and undiscernable, in Distances much less than the least of these.

And so, of the fixed Stars amongst themselves: Which, though they seem equally remote from us; many (for ought we know) be at Distances vastly different. Nor can we tell, which of them is nearest: (unless perhaps we may reasonably guess, those to be nearest, which seem biggest.) Because, here not only the Parallax from the Distance of the two Eyes; and that from the Earths Semidiameter; but even that from the Semidiameter of the Earths great Orb, is quite lost; and none remaining, whereby to estimate their Distance from us.

But (to return to our case in hand;) though as to small Distances, we may make some estimate from the known Magnitude of the Object: And, as to middling distances, from the Parallax (as I may call it) arising from the interval of the two Eyes: Yet even this latter will hardly reach beyond, if so far as the visible Horizon: and all beyond it, is lost.

So that, there being nothing left to assist the fancy in estimating so great a distance, but only the intermediate Objects: Where these intermediates appear to the Eye, (as, when the Sun or Moon are near the Horizon:) the distance is fancied greater, than where they appear not, (as when farther from it;) and consequently (though both
both under the same or equal Angles) that near the Horizon is fancied the greater. And this I judge to be the true reason of that appearance.

You will excuse (I hope) what excursion I have made; because though some of them might have been spared, as to the present case; yet they are not impertinent to the Business of Vision; and the estimate to be thence made, of Magnitudes and Distances, by the Imagination.

The Sun's Eclipse May 1st. was here observed about \( \frac{1}{2} \) a Digit; between one and two a Clock after noon.

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Account of a BOOK.

A Continuation of the New Digester of Bones: It's Improvements and new Uses it hath been applied to, both at Sea and Land.
Together with some Improvements and new Uses of the Ayre Pump, tryed both in England and Italy.

By D. Papin M. D. Fellow of the Royal Society.

This Treatise is divided into three Sections; the first contains the Improvements made by the Author on the Digester; with the new Uses it hath been apply'd to. First is given the Description of that which he had made for His Majesty King Charles the 2d. of blessed Memory; and he doth not think (considering the alterations whereby this exceeds the first Invention) that any thing better can be made for such things, as must be stew'd in their own Juices: But for other things that must be boil'd with Water, as Pulte, Gellies, &c. He gives the Description of another Engine, which he finds to be, for seven Rea-
Reasons, preferable to the other; so as that a small Engine of this Fashion, if it holds but 6 or 7 Pounds of Water, will be enough to make 150 Pounds of Gelly in 24 Hours, and will not consume above 11 Pounds of Charcoal. He doth afterwards relate the new Uses this Engine hath been applied to, but for brevities sake, I will mention but one that seems to be very considerable. He hath tried, that Bones being as much salted as Bones can be, if they be left to soak in Sea Water, as they do for the Meat at Sea, they will be fit to make fresh Gelly several times: so that all the Bones that are thrown away as useless in long Voyages, may henceforth serve to make a Food wholsomer and better, than the Meat itself. The Author doth afterwards relate, how these Gellies may be applied for the preserving of Summer Fruits: Upon this he alledged many Experiments, which give him Occasion to make several Observations; as for Example, he faith that Strawberries that are brought up by Art in the latter Season, have much less Spirits, than those that ripen in the Spring of the Year: So that some Strawberries which he had thus shut up in the Month of October, became very lower in 3 Months time; whereas other Strawberries which he shut up in the Month of June, having been kept 8 Months, were not lower at all, but had given a Vinous Taff to the Gelly: He doth afterwards impart his Way for making and clarifying Gellies, which hath given him Occasion to contrive two Engines for filtrating quickly, and a contrivance how to make Evaporations quicker, and with less Fire than they use to be done, and these are very plainly described in the Book. He gives also the description of an Engine for distilling per descezium in several degrees of Rarefaction and Condenzation of Air; and he gives an Account of some Experiments which he hath already made with this Instrument, from whence it appears, that in some Cases the Condenzation of the Air will be of great advantage for a quick Distillation.
In the second Section are explain'd the Improvements made by the Author, on the Pneumatiek Engine; and he doth not think, that ever any hath been so good as his: he gives a full Description of it, and takes Notice of all that contributes to its exactness; and he relates some Experiments that he hath made to prove his Assertion: He doth by the by, Answer Mr. Bernoulli, who hath written something against the Honourable Mr. Boile, about the weighing of the Air in a Bladder; and afterwards he comes to the new Ufes this Engine hath lately been apply'd to; whereof I will mention but this, that seems to be of great Moment, because without any Sugar or any other alteration, than what can be made by a little boilings, he can preserve great Quantities of Fruit with their Taff: The Way is this; he shuts up the Fruits in Glass Vessels exhausted of the Air, and then puts the Vessel thus exhausted in hot Water, and lets it stand there for some while; and that is enough to keep the Fruit from the Fermentation, which otherwise would undoubtedly happen: Yet it is observable, that this is not generally true: but that it is good to have several ways for the preserving of Fruit: Rasberries, for Example, that keep in Gelly better than any other Fruit, cannot be preserved although they be heated in vacuo. Such or the like Observations are annexed to almost every Experiment, at the latter end of this Section, the Author answers such Objections as may be brought against the real usefulness of these Engines; whereupon he describes a Way how to exhaust the Air very speedily out of great Vessels, to be kept thus exhausted as long as we please.

The third Section gives a Relation of what hath been done in two Years time, in Mr. Sarrotti's Academy at Venice; which had some Relation to the Matter treated of in this Book: There may be seen several new and curious Experiments about Matters of Moment: But I shall only relate two of them, from whence the reader may judge of.
of the rest; the first is, that two equal pieces of Iron were put at the same time into two equal Quantities of Aqua-fortis, the one in vacuo, and the other in the open Air; and being afterwards taken out at the same time; it was found that the Iron in the open Air, had been 16 times more dissolved than the Iron in vacuo.

The second Experiment is, that two equal Quantities of Roses were put into two Instruments for Distillations, like one another; but the one was exhausted of Air, and the other was full; the Distillation was abundantly greater and quicker in the evacuated Instrument, than in the other, although they were both heated by the same warm Water; it was also observable, that the Rose Water distilled in vacuo did congeal, which doth not happen in ordinary Distillations: So it is plain, that in some Circumstances, the Vacuum helps Distillations; as well as in the first Section it was seen, that in other Circumstances the compression of Air is more advantageous. In this whole Section are intermixed the reasonings of the Academy, about the Matters in hand, and two Discourses made in the Academy, by Sigr. Ambrofio Sarrotti in the beginning of each Year: So the Reader may here be diverted as well as instructed in the Operations of Nature. It may be laid in short, that it is rare to see a Book, that in so small a Volume doth contain so many things recommendable, both for Usefulness and Novelty; but no Wonder, since it is owing to the Instructions and Directions of the R. S. as the Author acknowledgeth in his Epistle, which he inscribeth to my Lord of Carbery, President of that Illustrious Company. Nevertheless, the better to convince those that would question either the Truth, or the Usefulness of the Contents of his Book; the Author engageth to let People see them try'd once a Week, and he appoints a certain Time and Place for that Purpose.

PHILOSOPHICAL
TRANSACTIONS

For the Months of July and August 1687.

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Observations of what did præternaturally occur in the opening of the Body of Mr. Smith of Highgate July 8th. 1687. Communicated by that learned Physitian Dr. Edward Tyson Reg. Soc. Soc.

In the first place dividing the Abdomen, immediately upon Incision made into the Peritoneum, we discovered the Bladder very Schirrous and thick, viz. \(\frac{4}{10}\) of an Inch; of a Præternatural Figure, and distended to the bigness of a Child’s Head: And at the entrance of the Ureters on each side were two Protuberances, of the bigness of a Hens Egg each; the Ureters were of the largeness of the small Guts in Children, so that they could easily admit two fingers into their Cavity. They were both repleat with Urine or a serous matter; which upon pressure did easily regurgitate into the Kidneys, but would not pass at all into the Bladder. The Kidneys were of their Natural bigness and Figure, but so emaciated that they were rather large Baggs than of a fleshy Substance; The Cavity of the Pelvis being so large as to contain above 3 ounces of Water: But to return to the Bladder; therein upon Apertion we discovered a very strange sort of Cystes or Bags, of the exact Figure of Eggs, of several dimensions, some larger than Goose Eggs, others as big as Hen Eggs, to the number of twelve in all; and about eight of them whole and repleat with a Limpid Serum: The Coats of these Bladders were some of them considerably thick, others very thin and tender; all of them loose and free without the least adhæsion, either to one another or to the Coat of the Bladder. There was little or no Urine in the Bladder but what
what was contained in these Bags. Nor could we imagine that this miserable Patient could possibly make any Water, but what happened upon the breach of some of these Watery Tumours, when the Bladder was crowded beyond its dimensions; for that the passage by the Ureters into the Bladder was impervious: And though the Ureters were full of Serum, yet could none be forced into the Cavity of the Bladder.

This Liquor contained in these Baggs, we did conjecture to be of the Nutritious juice of the Body; and upon tryal of boyling a small quantity of it, we found it thicken and come to the consistence of a stiff and glutinous Gelly. These Vesicula were undoubtedly formed from the tenacity of the matter between the Membranes of the Bladder, in its oblique passage through them; for that being so glutinous, it was here detained till its Superficies were condensed into a firm Coat, and so by the coming of more matter was forced into the Cavity of the Bladder. This I suppose, from our finding two of these Ova in a distinct Sinus from the rest, between the Coats of the Bladder, at the entrance of each Ureter.

The Liver we found very large and hard, of the Colour and Substance of a boyled one. It adhered to the Peritoneum on the external part, and by its vast bigness had so straitned the Thorax, that there was very little room for the Lungs.

The Lungs we found of a livid Colour, adhering close to the Pleura on the right side; upon Incision we found them wholly repleat with a Purulent matter, and a Stone of the bigness of a Cherry-Stone in one Lobe.

Dividing the Pericardium we found a Fungous Substance covering the Heart all over; and Fibres from it, that ran to the Pericardium in a great number; so that they were by these Fibres every where united.

The Heart was very large, the right Auricle and Ventricle were one large undivided Cavity, and therein a large Polypus;
Polypus, which run up the descending Branch of the Vena Cava to the very Jugular, another Part was distributed to the Pulmonary Artery.

In the left Ventricle was another Polypus not so large as the former: it had two Branches, one in the Pulmonary Vein, another in the Arteria Magna, or Aorta.

One of the Vesicula being opened had a large cluster of small Ova as big as Grapes, all replete with Liquor: All the rest contained nothing but Serum.

A Relation of an extraordinary effect of the power of Imagination: Communicated by Mr. Edward Smith, Secretary to the Philosophical Society at Dublin, as it was brought before that Company, by Mr. St. George Alt. R. Soc. S. who had seen the thing.

One Elizabeth Dooly of the County of Kilkenny was aged 13 Years in January last: Her Mother being with Child of her was frightened by a Cow as she milked it, thrown down and hit on her Temple, within an eighth of an Inch of her Eye, by the Cows Teat. This Child has exactly in that place, a piece of Flesh resembling a Cows Teat, about 3 Inches and half in length: ’Tis very red, has a Bone in the midst about half the length of it; tis perforated and the Weeps through it; when the Laughs it wrinkles up and contracts to two thirds of its length, and it grows in proportion to the rest of her Body. She is as sensible there as in any other part. This is lookt upon to be as strange an instance of the strength of Imagination as can be produced.
De Constructione Problematum Solidorum, five
Æquationum tertiaræ vel quartae Potestatis, unica
data Parabola ac Circulo efficienda; dissertat-

Quo pacto æquationes omnes Cubum vel Quadrato-quadratum quantitatis incognitae involventes, ope Parabolæ
cujuscumq.; datae & Circuli, construere possint, clare tradit ac Li-
quido demonstrat præclarus ille Cartesius in Lib. III. Geome-
triae sua: sed primum jubet secundum æquationis terminum, si
adverterit, tollere, ac deinde reducere æquationis Radices regula
ibidem exposita elicere. Cum vero operatio ista nimis laborio-
sa videatur, nonnullis viisum est constructionem similem etiam
absc.; utra prævia reductione comminisci; inter quos Franciscus
a Schooten Methodum valde faciæm ac simplicissimam pro con-
struendis Cubicis quomodolibet affectis prodidisset, si modo ex-
posito principio unde regulam derivaret, Lectoris memoriae,
quam plurimis ac intricatis cautelibus obrut, melius studiisse.
Nuper vero Vir Cl. D. Thomas Baker nosbras, integro
libello de constructionibus hujce conscripto, non solum Cubicas
sed etiam Biocadraticas omnes cujuscumq.; generis unica generali
regula complexus est, eamq.; demonstrationibus ac Exemplis per
omnes causas abunde satis illustravit; nec non sub finem modum
proponit unde regular ista generalis investigari possit: Haud ta-
men illum ipsum offendit, cujus ope (ut suspicor) Clavem jam
Geometricam Catholicam obtinuit, vel saltem multo facilius
obtinere potuit. Cumq; perplexis cautelibus de signis &—
Regula hujus D. Bakeri non minus obnoxia fit quam illa
Schooteni, ut vix absente libro constructiones illas quis tuto
peragat; baud injucundum nec Tyronibus incommodum fore vi-
fum est, utiusq; fundamentum exponere, ac simul emendata methodo, in re tam difficili, lucem quantum valeam afferre.

Construictio quam tradit Cartesius, quaeq; facillime radices aequationum omnium Cubicarum vel biquadraticarum, ubi defect secundus terminus, eruit, ut nota supponi potest; attamen cum cardo sit a quo subsequentia pendent, ne dissertatiuncula bae capite truncata videatur, ex illius Geometria dehumptam plaeuit Regulam adjungere, pauculis nonnullis in melius uti reor transpositis.

Deficiente secundo termino omnes aequationes Cubicae reducuntur ad hanc formam $z^3 \cdot a p z. a a q. = o$, ac Biquadraticae ad hanc $z^4 \cdot a p z z. a a q z. a^3 r = o$. (ubi a designat Latus rectum Parabolae cujusvis datae, quam in Constructione adhibere licet.) vel sumendo a pro Unitate, ad hanc $z^3 \cdot p z. q = o$, vel ad hanc $z^4 \cdot p z z z. q z. r = o$.

Jam data Parabola F-AG cujus Axis sit AC-DKL ac latus rectum a vel r, fiat AC ejus dimidium ac collocetur semper a vertice A versus interiora figurae: dein sumatur CD = $\frac{1}{2}$ p in linea illa AC continuata versus C si in aequatione fuerit $- p$, vel versus alteram partem si babeatur $+ p$. Porro e punto D, aut ex puncto C si non babeatur quantitas p, erigenda est ad axem perpendicularis DE aequalis $\frac{1}{2}$ q, dextror- sum quidem si fuerit $- q$, ad alterum vero axis latus si fuerit $+ q$; ac Circulus centro E radio AE descriptus, si aequatio fuerit tantum Cubica, Parabolam tot punctis F & G intersecabit quot versus habet Radices, quarum quidem affirmativae ut GK erunt
erunt ad dextram Axis partem, Negativae ut F L ad finitram.

Abst si Aequatio Biquadratica fuerit, augeri vel minui debet Circuli Radius AE, addendo si fuerit + r, vel subducendo, si sit
+ r, ex ejus quadrato rectangulum a r, seu contentum sub Late-
re recto & quantitate data r; id quod nullo fere negotio efficitur
Geometrico. Hujus vero Circuli intersectiones cum Parabola
omnes veras Biquadraticae Aequationis radices dimissis ad Ax-
em perpendiculis exhibebunt; Affirmativas quidem ad dextram
Axis, Negatives vero ad finitram. Totius demonstrationem
Cartesio ejus inventori relinquo.

Notandum hic me operam dare ut semper habeantur Radices
affirmatiae ad dextrum Axis latus, ut evitetur confusio a plu-
ribus cautionibus, quarum causa minime evidens est; necessario
oritur.

His praemissis, ut aditus pateat ad constructionem etiam earum
aequationum ubi reperitur terminus secundus, consideranda venit
regula pro tollendo termino secundo, ac reducenda aequatione ad
aliam quae modo praeedente construi posset. Omnes vero hujus
classis aequationes cubice ad banc formam $z^3 \cdot b z z \cdot a a q = o$, vel ad banc $z^3 \cdot b z z \cdot a a q = o$. Biquadraticae vero
ad banc $z^4 \cdot b z z \cdot a p z z \cdot a a q z = o$, vel $z^4 \cdot b z z \cdot a a q z = o$ vel deniq; ad banc $z^4 \cdot b z z \cdot a^3 r = o$, vel $a^3 r = o$ reduci possent; e
quibus omnibus, prout signis + & − diversimode connectur,
ingens oritur varietas; unde Regula generalis omnibus inservi-
ens obscura ac maxime difficilis redditur, nisi modo quo sub-
jungimus illustriata nodis extricato tractetur.

Tollitur in Biquadraticis secundus terminus, ponendo $x = z-
+ \frac{1}{4} b, \text{ si fuerit } + b$ in aequatione, vel $x = z - \frac{1}{4} b, \text{ si fuerit }-
+ b$: binc $x = - \frac{1}{4} b$ in prima casu, & $+ \frac{1}{3} b$ in altero aequatur
z; & in aequatione quavis proposta, substituta loco z quantitate
aequali, prohibit nova æquatio termino secundo carens, cujus ra-
dices omnes x data differentia $\frac{1}{3} b$ vel excedunt vel deficiunt a
radice quæsita z: Cum vero in rebus istiusmodi plus exempla
quam præcepta valere solent, proponatur una vel altera æquatio
Construenda.

U u 2

Exem.
Exemp. I.

\[ z^4 + b z^3 = a p z z - a a q z + a a r = o. \]

**Sit** \[ x - \frac{1}{4} b = z \]

**Et erit**

\[ xx = \frac{1}{2} b x + \frac{1}{16} b b = z \]

\[ xxx = \frac{1}{2} x x b + \frac{1}{16} x b b = \frac{1}{4} b b b = z^3 \]

\& \[ x^4 - b x^3 + \frac{3}{2} b b x x - \frac{1}{16} b^3 x = \frac{1}{4} b^4 = z^4. \]

**Hinc.**

\[ x^4 - b x^3 + \frac{3}{2} b b x x - \frac{1}{16} b^3 b x + \frac{1}{256} b^4 = z^4 \]

\[ + b x^3 - \frac{3}{2} b b x x + \frac{1}{16} b b b x - \frac{1}{4} b^4 = + b z^3 \]

\[ - a p x x + \frac{1}{2} a p b x - \frac{1}{16} a p b b = - a p z z \]

\[ - a a q x + \frac{1}{4} a a q b = - a a q z \]

\[ + a a a r \]

Harum omnium summa fit æquatio nova secundo termino carens, quæq; proinde juxta regulam Cartesianam confulri posuit, sumendo loco \( \frac{1}{2} p \) dimidium coefficientis termini tertii per a seve Latus rectum divisi, hoc est \( \frac{3}{16} \frac{b b}{a} - \frac{1}{2} p \); ac Loco \( \frac{1}{2} q \), dimidium coefficientis termini quarti per a a divisi, seve \( + \frac{1}{16} \frac{b b b}{a} \)

\[ + \frac{1}{4} \frac{p b}{a} - \frac{1}{2} q. \]

Cujus partes signo \( + \) notatæ sinistrae sunt ab Axi, signo \( - \) notatæ dextrorūm collocandæ sunt, ut habeatur centrum Circuli ad constructionem requisiti, ac cujus intersectiones cum Parabola, dimissis in axem perpendicularis, radices omnes veras x designet, affirmativas quidem ad dextram axis, negativas vero ad sinißram. Cum vero \( x - \frac{1}{4} b = z \), ducendo linea Axi parallela, ad dextrum eus latus \& ad distantiam \( \frac{1}{4} b \), perpendiculari illa ad banc parallela terminata designabunt omnes radices questas \( z \), affirmativas ad dextram, negativas vero ad sinißram. Radium circuli quod attinet, habetur ille addendo partes negativas ac auferendo partes affirmativas termini quinti per a a divisi, e quadrato lineæ \( A E \), a centro invento \( E \) ad Ver-
Verticem Parabolae A ducta : id quod maxima ex parte efficitur
acquies loco lineae AE lineam EO, quae ad O intersectionem
Parabolae ac parallela predicta terminatur; ejus enim quadrat-
um omnes termini quinti partes ex ablatione termini secundi
equationis nova ingesta complectitur (uti facile probabitur:) ac
res stat sufficiente ut ipsius E O quadratum augeatur, si in equa-
tione habeatur − r, vel minutatur si sit + r, additione vel sub-
ductione rectanguli ar, unde conflatur quadratum Radii Circuli
questi.

Hac est methodus investigandi regulam centralem Dni Bake-
ti omnibus cautusbus libera ac satis facilis; ac sola differentia
ex eo provenit, quod ego justa Axem, ille vero justa Axe pa-
paralleledam circuli ejusdem centrum determinat; quodg; ego sem-
per radices affirmativas ex Axis dextro latere invenio, quas ille
nunc dextro nunc sinistro constituat.

Equationes cubicas quod attinet, ea reduci debent ad Biqua-
draticas, antiquum eadem regula generali construi possit; id
quod sit ducendo equationem propositam in radicem sumam z, unde
provenit equatio Biquadratic a qua deficit terminus ultimus, fui-
r: quapropter sublato secundo termino & invento centro E, linea
E O est radius Circuli; cum scilicet a r sit = 0, & in nova a-
quatione totus terminus quintus ex ipsa ablatione termi ini secun-
di oriatur. Construenda sit hac equatione.

Exemp. II.

z^4 − b z^3 + a p z + a a q = 0: Quo ducita in z sit
z^4 − b z^3 + a p z + a a q z = 0

Ad tollendum secundum terminum ponatur x + b = z, & sit
x^4 + b x^3 + a b b x x + a b^3 x + b^4 = + z^4
− b x^3 − a b b x x − a b^3 x − b^4 = − b z^3
+ a p x + a b p x + a b p b = + a p z
+ a a q x + a a q b = + a a q z

In hac nova Aequatione, tertii termini semecofficiens per a.
divisa, viz. = − \frac{3 b b}{16 a} + \frac{p}{2 p}, loco \frac{p}{2} usurpanda est; ac coeffi-

W w. scientis
scientis termini quarti dimidium, divisum per a a Lateris recta-quadratum, viz. \[ \frac{b b b}{16 a a} + \frac{p b}{4 a} + \frac{1}{4} q, \] visum ipsus \( \frac{1}{4} q \) in constructione Cartesii subit; unde centrum E determinatur. Deinde ducta Axi parallela ad distantiam \( \frac{1}{4} b \) ad sinistrum ejus latus \( (b x + \frac{1}{4} b = z) \) cujus intersectio cum Parabola sit O; circulus centro E, Radio E O. descripsus Parabolam secet vel tangat in tot punctis quot aequatio verus habet radices: quae quidem radices \( z \) sunt perpendicula de punctis illis in Axi parallela demissa; ad dextram quidem Affirmativa, Negativa ad sinistram.

Si in aequatione desuerit terminus tertius vel quartus vel u-
terp, in investiganda regula centrali nulla omnino observanda est methodus differentia, sed deficiente quantitate \( p \) vel \( q \), de- erunt partes illae linearum C D ac D E ex quantitate illa aliquo modo deducta, ac procedendum est cum reliquis coefficientibus termini tertii et quarti in aequatione nova, sicut in premisissis exemplis praescriptum est.

Hactenus Cl. Bakeri methodum generali pertransvimus, qua quidem nulla alia facilior ac paratior expectanda est, assumpta ad constructionem sive Parabola, sive alia quavis linea curva, cum sic spe aequatio ad Biquadraticam ascendet. Etenim dum hae scribo mihi occurrerit regulae Centralis. Effectio Geometrica prae ter omnem sem expedita, ac harum rerum Curiosis abunde satisfactura.

Descripta Parabola NAM, cujus vertex A, Axis ABC ac latus rectum a, reducatur aequatio ad hanc formam \( z^4 + b z^2 + a p z + a q = 0 \) vel ad hanc \( z^4 + b z^2 + a p z + a q = 0 \) cubicarum tantum fuerit: dein ad distantiam BD = \( \frac{1}{4} b \) ducatur linea DH Axi parallela, ad sinistram quidem \( z \) fuerit \( -b \), ad dextram \( z + b \), parabolae occurrente in puncto D; de quo dimittatur perpendiculum in axem BD. In linea AB con-
tinuata versus B fiat BK = \( \frac{1}{2} a \), & ducatur linea DK utriusque interminata. Porro si KC = 2. AB in Axi semper ultra K continuato; ac si habeatur quantitas \( p \) signo \( - \) affecta, versus easdem partes etiam sumatur CE = \( \frac{1}{3} p \), vel in contrarias,
si habeatur \( p \), ac e puncto E erigatur Axi perpendiculam \( EF \) (vel epuncto \( C \) si fuerit quantitas \( p \)) linea \( DK \), si opus est contiunata, occurren in puncto \( F \); quod quidem circuli requisit centrum est, si fuerit quantitas \( q \); Assi si habeatur \( q \), sumenda est in \( FE \), si opus est continuata, linea \( FG = \frac{1}{2}q \), sinistrorum quidem si fuerit \( q \), dextrorum \( s - q \) collocanda: Et punctum \( G \) erit centrum circuli ad constructionem propostam idonei; eujufq; Radius, si fuerit quantitas \( r \), hoc est si tantum cubica fuerit, erit linea \( GD \); eujus quadratum in Biquadricis augendum est, si fuerit \( -r \), vel minusendum \( s + r \) additio et subductione rectanguli sub \( r \) et latere recto. Descripsit sic Circulo, ab intersectionibus ejus cum Parabola demissis in lineam \( DH \) perpendiculis, quae ad sinistrum sunt; ut \( NO \), radices equationis negativas semper designant, quae ad dextram ut \( ML \) affirmativas.

Aliter ac paulo simplicius \( A \) Equationes cubicae juxta Schooten Regulam constructur, quas etiam radices ad Axiem referuntur: quoniam vero ipse inventor nec modum inventi nec demonstrationem invente expostit, non abs re erit eujusdem fundamentum hic adiicere, simul atq; Efectionem Geometricam considerarem reddere, atq; cationibus quibus implicatur extricare.

Hec Regula derivat ex eo quod omnis equation Cubicae reduci possit ad Biquadricam, in qua deficit terminus secundus: Hoc sit ducendo equationem propostam in \( z - b = 0 \), si fuerit \( +b \).
aequatione, vel in $z + b = 0$, si fuerit $-b$; $\&$ aequatio nova producta easdem habebit radices cum Cubica, atq; insuper alteram ipsi $-b$ aequalem, si fuerit $-b$ in aequatione; vel contra.

Proponatur construenda $z^3 - z^2 b + a p z + a a q = 0$.

Hec dexta in $z + b fit$ $z^4 - z^3 b + a p z^2 + a a q z$

Hic deficit secundus terminus, $ac$ coefficientis tertii $-b + a p$

dat $\frac{b b}{2 a} + \frac{1}{2} p$ loco $\frac{1}{2} p$ vel CD in Constructione Cartesii,

$\&$ ex dimidio coefficientis termini quarti fit $+\frac{1}{2} q + \frac{b p}{2 a}$ loco $\frac{1}{2} q$ vel DE usurpanda; adeoq; determinatur centrum circuli qus-

$fit$ atq; ob datam unam $ex$ radicibus aequationis nova, viz. $-v + b$, dabitur etiam punctum in circumferentia, $id$ est Rad-

ius ejus. Deniq; descripto circulo, ab intersectioni us ejus cum Parabola demissa in Axem perpendicular aequationis radices exhi-

bebunt, affirmativas $\&$ negatives, eadem leges ac supra.

Investigatur autem centrum Circuli constructione perquam facili, exterisq; omnibus in Cubis preferenda. Descripta Par-

bole A MD sit vertex A, atq; Axis

AF: ad distantiam ipsi

b aequalem ducatur Axi

parallela DK, ad dex-

tram si fuerit $+b$ in a-

equatione, ad sinistrum si

$-b$, que Parabole oc-

currat in punto D. Cen-

tris D $\&$ A descriptur

radius aequalibus arcus oc-

culiti utrinqu; se$e$ inter-

secantes, ac per sectio-

num puncta ducatur linea

interminata BC, que

medio lineae suppositae AD

perpendiculariter insitiat,

$&$ Axi occurrat in puncto E. Ab E, inferne quidem si in aequa-

tione habeatur $-p$, vel superne versus A si fuerit $+p$, pon-

tur
tur \( EF = \frac{1}{2} \); \& ex \( F \) (vel ex \( E \) si defuerit \( p \)) educatur perpendiculum \( FG \), lineae \( BC \) occurrents in puncto \( G \); \& in \( GF \) producta fiat \( GH = \frac{1}{2} q \), dextrorsum quidem si in equatione habeatur \( -q \), aliter sinistrorum, applicanda: ac punctum \( H \) erit centrum quaestionum, HD vero circuli \( \text{Radius} \), qui demissis in axem perpendiculis ab intersectionibus suis cum \( \text{Parabola} \), ut \( LM \), \( \text{Radices omnes} \), ut \( \text{prima} \), commonstrabit. Quomodo vero constructio hae ex praemissis consequatur, per se satis eadem est, nec opus est ut in eadem demonstranda diutius immorer.

Ne in his edendis frustrancam navasse operam, \& ex aliorum inventis gloriam captare videar, consulat Lector Cl. Bakeri librum Anno 1684 Londini editum, \& quae de hoc Argumento scripta a Schooten in Commentario suo in Librum III. Geometricae Cartesiana. Brevi concesso otio tractatuum alium de numero Radicem in hujusmodi equationibus, earumq; limitibus, ex contemplatione Constructioe omnium precedentium, aggredi ac in lucem proferre statu.
A Letter of Mr. De la Hire of the Royal Academy of the Sciences at Paris, concerning a new sort of Magnetical Compass, with several curious Magnetical Experiments.

You know Sr. that there is nothing which creates so much trouble in long Voiages on the Sea, as the Variation of the Magneticall Needle, both because this Variation is different in differing places, and because in the same place it changes considerably in process of time. It seems that if wee had exact Observations of the irregularities of this Variation, made all over the Earth, and at a considerable interval of time, one might discover some Period of this Motion, and establish a System which might be of great use in Navigation. But seeing our oldest Observations were made but about a hundred Years since, and in some particular places only, they only serve to let us know, that if there be a regular Motion, it must needs be very slow: So that we can conclude nothing certain for the time to come from all that has been hitherto Observed. This is not because of any difficulty that there is in ascertaining this variation by Observation, since it is found to Change but few Minutes in a Year; but too much reliance must not be upon the Observations of Pilotes, by reason of the grofs Errors which it is not easy for them to prevent. For it often happens that near the place where the Compass is, there is much Iron, which draws the Needle, and causes it to shew a point on the Horizon much different from what it would, were it farther from the iron; which makes it be thought that there is a considerable Variation where perhaps there is none at
at all. And it may so happen that in the same place where the Year before an Observation was made, if in the next, the Iron Instruments be found otherwise placed than they were the time before, either in the same Shipp or another, the Needle will shew a Variation much differing from that found the first time. And this sort of Caution not being Observed at Sea may be cause of very great Errors in the Observations of the Needles Variation tho' not affecting the Course of the Vessel. For the Needle being drawn after a certain manner will constantly observe the same situation in respect of the North, provided the Iron round about it be not stirrd: And you shall not faile to steer true upon any point of the Compass, if this false Variation be observed after the usual Manner by the Amplitudes of the Sun. We cannot therefore hope to be secure of any thing from the Observations we have at present, and especially from those made at Sea, which are the most considerable. This put me upon finding out some means independent from Observations to discover the Variation at Sea; but having considered that several learned Men of this age had proposed divers ways of making Magnetical Needles, which should not be subject to Variation, and that all these propositions had had no effect; I judged that after all that they had done by means of the Loadstone, it was not to be hoped to draw any farther advantage from it; since the Stone itself, as far as might be guessed from the Experiments hitherto made, was subject to the same Variation:

I had quite given over this Enquirie, when there accidentally fell into my hands a Terrella or Spherical Loadstone, of three Inches Diameter; with which being minded to make some Experiments, with a little Needle whose foot might easily be placed upon the Stone, I soon Observed that which hath been already noted by several, viz. that this Globe of Magnet caused the Needle to have the same changes which are found in the Compass in different
rent parts of the World, as well in respect of the direction towards the two Poles, as of the Inclination towards that which is next it: and upon trial I satisfied my self that it was not possible to find the Point where the Needle would stand indifferently in any position, (which Point would have exactly shewed me the Pole of the Stone) but that the Needle however placed, always directed it self some one way. I determined by this means, as well as I could, the Point called the South Pole; but I was much surprized to find it 18 Degrees distant from a Cross deep engraven on the Stone, which according to all appearance had heretofore been the Pole of this Stone, as it had been Observed by him that Cut it. This change of the Poles of this Stone having revived my former thoughts concerning the Variation of the Needle, I believed that if it were true that the Poles of the Magnetical Vertue changed in the Loadstone, as we see they change in the Earth, one might derive great advantages therefrom as to the Variations of the Magnetical Needle. For if this change of these Poles in the Load-stone were certain, and that it was Analogous to the change of the Poles of the Magnetique Vertue in the Earth, it is not to be doubted but a Terrella, being suspend'd at liberty, would remain immoveable, and that one point thereof would regard the Pole of the World, which might be called the true Pole of the Stone, whilst the Poles of its Vertue would pass successively from one part to another, after the same manner as they change in the Earth.

After having well considered this Hypothesis, and having cleared up some doubts which I had, concerning the Position of the Stone at the time when its pole had formerly been determined; I concluded that this former Pole was distant from the point I call the true Pole, thirteen Degrees towards the East, in the place where it had been marked (and which is unknown to me) since that at this time in this Country the Needle Varies about five Degrees Westward.
Upon this Hypothesis, which I know not that any one else has yet thought upon, I have invented a new sort of Needle for the Compass, which may have the same alterations as a Sphæricall Load-stone, and at the same time the same conveniencies as the ordinary Needle hath.

I caused a Ring of three Inches diameter to be made of Steel Wire; from which there went three Radii of very fine Brass-wire meeting at the Center in a Cap perfectly like that of an ordinary Compass, that so this Circle might rest on a Pin in its Center, and be at full liberty to turn round, its Center being fixt. This done I gave the Magneticall touch to this Steel Ring, by applying indifferently to a Point thereof one of the Poles of a strong Load-stone, and the other Pole of the Stone to the opposite Point, to give the greater Vertue to the Ring. Then I observed that the Ring was strongly Magneticall, and that the Point called the South Pole did readily turn it self towards the North, and after several Vibrations flopped there; and that it had also the same inclination towards the Pole which is found in Needles after they have been touched: Lastly I fixed upon the Ring a small Fleur de Lis of Brass, in the Point which exactly respected the North, the Ring being first well settled.

If the Poles of the Magnetick Vertue change in the Load-stone after the same manner as they do on the Earth; it seems likely that the same thing should happen to this Ring, and that one Point thereof should always exactly respect the North. But to informe my self if a Steel Ring had the same effects as a Terrella, I made the following Experiment. Having touched a Steel Ring, and having laid it on a Paper, I strewed the filings of Steel upon it; and then gently shaking the Paper, I saw that the direction of the Magneticall matter passed directly cross the Ring from one Pole to the other, and that there were two Vortices on the sides, as it is observed in the Sphæricall Magnet; which seems very surprizing: For
according to the ordinary Hypothesis of the Magnet, the Magnetical Vertue passing more easily in the Steel than in the Air, should runn on both sides of the Pole round the Ring, and only form a Pole opposite to the first. But I was further confirmed in this Opinion by applying a flatt and pointed piece of Iron, like the blade of a Knife, to a Load-stone, so as the point of the Iron reached beyond the Stone; and having afterwards presented this point to the Magnetical Ring, I observed that different Points of this Ring did apply to the Point of the Iron, according as the several parts thereof had been applied to the Stone: which happens not in the Magnetical Needle, for that always presents one of its ends to the Point of the Iron, being not disposed, by reason of its length, to receive the Magnetical matter in all the parts thereof analogous to those of the Stone. It must only be noted that in an irregular Stone the Magnetical Vertue appears stronger towards the Angles than in the other parts, which may cause some irregularity in this Experiment, if it be tried with a Stone that is very uneven.

These Experiments gave me the Curiosity of making another, by touching two Semi-circles of Steel. Having joyned the two ends touched by the same Poles, I observed by the Steel-dust the same effect as in the Ring. But having joyned the ends differently touched; I found that immediately the two half-rings run together and stuck to each other; and by the Steel-dust arrowed on Paper I observed, that there were four Vortices, one in the middle of each Semi-circle, and one at each of the places where they were joyned, and that the two latter were less than the others and much stronger. I saw likewise that there were four Poles, each of which was within a Vortex, and that each retained in its Semi-circle the Vertue of the ends of the half Rings.

I would trie, after having touched a Steel-Wire that was straight, to make a Ring thereof; but I found that it had quite
quite lost its Virtue: which cannot be attributed to the junction of the Poles, since they ought to stick together, according to the other Experiments which have been made; but only to this that hath been already noted, that when a Magnetical Virgula is a little bent, it loseth its Virtue, which cannot happen but from the alteration of the Pores of the Steel.

I farther remarked that a Ring of Steel having been touched does for a long time retain its Virtue, although it be put in a position contrary to its Poles. And this Experiment is confirmed by another much more considerable: Which is, that a Ring of Steel having been touched with a strong Load-Stone, cannot without difficulty receive a contrary touch from a Magnet less strong than the first; but that in time by little and little it resumes its former Virtue, much as we see Magnets do, which being applied to another Stone, by the Poles of the same denomination, lose their first Virtue and take a contrary; which they afterwards lose by degrees, to reassert their first.

After I had presented this new Systeme of the Magnet to the Academy, there were made some Experiments upon a Terrella of much the same diameter with mine, but whose Poles were not diametrically opposite; and upon a half-Globe very much bigger than the Terrella. Wee could find in them no considerable difference or alteration of Poles: Yet because of some circumstances, the Company thought fit that some Experiments should be made with this sort of Compasses.

If some of these compasses were carried into very remote parts, where it is known that the Magnetical Needle has a great Variation; one might be certain in little time whether this Hypothesis hold or no, and whether we may expect from it those advantages, which I have concluded from the supposed immobility of a Terrella hung at liberty.
It remains only to explain after what manner these circular Needles may be touched a new, when it is perceived that they have lost their first Vigour. According to this Hypothesis, it is evident that if the Circle be not touched in the point that answers to that of the Stone, with regard to its Variation, the little Fleur de Lis which marked the true North, may decline a little from it; and the difficulty of finding the corresponding points on the Ring and the Stone, would cause that the touch of the Circle could not be refreshed, without taking great care and first observing the Meridian line. But to avoid all these difficulties, you need only apply the Poles of the Stone to the Ring; and the Ring, which is suspended upon its pivot, will turn so as the Point answering to the Pole of the Virtue of the Stone which is applied to it, will come as near to it as possible. In so much that without touching the one or the other, the Ring, will not fail to receive very much force. The same may be done at the opposite Pole.

I doubt not but you are curious enough to see if the poles do change in the Terrella, when you shall meet with one fit for this Experiment. There might several other things be noted upon this Subject, and it were to be wished that some other particular observations might be made as opportunity shall offer; but unless curiosities of this nature fall into the hands of such as have a great love for the advancement of the Sciences, it is not to be hoped that we shall have any certain information in a matter so nice, &c.

Paris
April. 26, 1687.

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This Letter having been produced and Read before the Royal Society, it was Ordered that the Terrella, which has been in their Repository these 25 Years, the
the gift of their Royal founder King Charles the Second, should be examined, to see if there be any sensible alteration in the Poles thereof: And upon tryal it was found that the Points which are marked thereon with crosses, were as near as could be discerned the true Poles of the Stone; notwithstanding that the Variation has changed at London full 4 Degrees since this Terrella has been in the Societies Custody; and perhaps many more since it was marked: and had there been a change in the Poles of the Load-stone analogous thereto, it must needs have been perceived in this, whose Diameter is about $4\frac{1}{2}$ Inches. However to put this matter past dispute, care was taken to find out exactly and mark the Poles of the Society's great Load-stone, the Sphere of whose Activity is above 9 Foot Radius, and whose Poles are 13 Inches asunder, whereby if this Translation of the Poles be real, it cannot fail of being made very sensible in future times. As to the supposition that the Points in which the Iron hath received the Magnetical Vertue may change place, after the same manner as the Poles of the Earths Magnetisme are observed to do; tho' it was lookt upon as an ingenious hint and worth prosecution, yet some of the Company, well skill'd in Magneticks were of opinion, rather that such a Circular Needle would librate on its Center, so as to respect the Magnetical Meridian with the Points that had at first received the touch, than that the Ring remaining immovable, the directive Vertue should be transferred therein from place to place, either by length of time, or by transporting this Compass into those parts where the Variation of the Needle is considerably different.
A Relation of the great effects of a new sort of Burning Speculum lately made in Germany: taken from the Acta Eruditorum of the Month of January last: being a Letter from the Inventor to the Authors of that Journal.

Of the concave burning Speculum which I lately caused to be made in Lübeck, take this following Account.

The like thereof hath not yet been made, that I know of, for in Magnitude it exceeds even that great one which they shew as a Sight at Paris, and whose measure I took when I was there, by about three eights of a Lanthorn Ell. The outer Circle of mine is near three such Ells in Diameter, and is made of a Copper Plate scarce twice so thick as the back of an ordinary Knife; and may therefore be easily removed from place to place, and ordered for use; whereas those which I have yet seen that are large, and capable of producing considerable effects, being Cast thick of a Mixt Mettal, are because of their bulk and weight, less Tractable. The workmanship of this Speculum, which in one of the other sort, of this Magnitude, would be an immense Labour, may by the contrivances I have invented, be easily and in little time performed by one Man.

The Polish thereof is very good, and represents by distinct reflections all those appearances which arise from the concave Figure thereof; representing a Dwarf like a Gyant, or the Head or other part of a prodigious Magnitude. The Eye being placed nearer the Speculum than is the Focus thereof, all Objects are seen within it, in an
an erect Posture, and as at a great distance; but the Eye being farther off than the Focus, all things appear inverted and without the Speculum: And because the Focus is two Ells off, it is pleasant to see Objects distinctly as it were hanging in the Air; and if a Sword be drawn against the Speculum, a Spectator not used to such Optical Delusions, would be apt to be Frighted, Imagining a Pass to be made at his Face.

The Force of this Speculum in Burning is such, that even Chymists, who best know the power of Fire, will hardly credit it, unless they see it with their own Eyes. For (1) a piece of Wood put into the Focus Flames in a Moment, so as a fresh Wind can hardly put it out. (2) Water applied in an earthen Vessel presently Boyles, so as to Boyle an Egg, and the Vessel being held there some time, the Water evaporates all away. (3) A piece of Tin or Lead three Inches thick, as soon as it is put into the Focus, melts away in drops, and held there a little time is in a perfect Fluor, so as in two or three Minutes to be quite pierced through. (4) A plate of Iron or Steel placed in the Focus immediately is seen to be red hot on the backside; and soon after a hole is Burnt through; I have made three such holes in a plate, in six Minutes time. (5) Copper, Silver and the like applied to the Focus melt, which I have tryed with several forts of Coin; among the rest with a Rix Dollar, and the same hapned to it as to the aforesaid Iron Plate in 5 or 6 Minutes. (6) Things not apt to melt as Stones, Brick and the like, soon become red hot like Iron. (7) Slate at first is red hot, but in a few Minutes turns into a fine sort of black Glass, of which if any part be taken in the Tongues and drawn out, it runs into Glass threads. (8) Tiles which had suffered the most intense Heat of Fire, in a little time melt down into a yellow Glass; as do. (9) Pot-threads, not only well burnt at first, but much used in the Fire, into a blackish-yellow Glass. (10) Pumice-Stone said to be that
of burning Mountains, in this Solar Fire, melts into a white transparent Glass. (ix) A piece of a very strong Crucible put in the Focus, in 8 Minutes was melted into a Glass. (x) I have likewise seen Bones turned into a kind of Opake Glass, and a clod of Earth into a yellow or greenish Glass.

It is to be noted that I made these Experiments in the latter end of August and September, when the Sun has not the same Force as when he is about the Summer Solstice; at which time I promise myself yet more wonderful effects; tho' from hence it is evident, that there is no other Fire in Nature of the like Force and Efficacy.

I might add several other things well worth Notice, but shall only give you this one. I tried what effect the Beams of the full Moon, concentrated with this Speculum, would have, at the time when she was at her greatest Altitude; but there was not found any degree of Heat, tho' the Light was not a little increased.

This passage of the Lipsick Journall was produced at one of the meetings of the Royal Society by Mr. Hook, as seconding a proposal he had some Years since made to them concerning the same thing. He supposed that if such a Speculum were made of many Foot diameter, its effects must needs be prodigious; and might be of great use in perfecting the Art of Paints or Factitious Jewells, which require the most intense degree of Heat, to bring them to an exact mixture. He conceives such an one might be made very large for a small Price, being hammered out of a Copper Plate, and tinned over with a mixture of Tin, Lead and Tin-glass, which is found to bear a very good Polish.

LONDON

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PHILOSOPHICAL
TRANSACTIONS.

For the Months of September and October, 1687.

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An Account of some Saxon Coys found in Suffolk; Communicated by Sir P. S. R. S. Soc.

In May 1687, at Honendon nigh Clare in Suffolk, the Sexton, as he was digging a Grave in the Church-yard, met with a Skull; and near it his Spade broke a Yellow Earthen Pot, wherein were many Silver pieces of Saxon Mony, some of which I have seen, and endeavoured to read the Inscriptions, which are so various, that there are scarce two alike, tho' they are generally of the same bignefs, viz. of a Groat, and about the same weight. I ghes this variety of Inscriptions ariseth from the many Masters of the Mint who were appointed to coyn Mony in several Places, and who might each of them have a different Stamp: and I find this Conjecture of mine countenanced by a Passage in K. Æthelstan's Laws, Printed by Lambard.

Cantuariae Monetarii VII Sunto, quorum quidem IV Regis, II Praefuli ac unus Cænobiarchæ deservito. In Civitate Roffensi tres sint, Regii duo, tertius Episcopi. Londini VIII. Vintoniae VI. In vico Lewisio II. In vico Haslingo I. Ciceftria I. Hamtonæ II. Exceflriæ II. Werham II. Schaftsburiae II. Ad aliumque oppidum Monetarius unus efto.

To confirm my Opinion, That the several Masters of the Mint made different Reverses, I have observed great variety in Henry III. Coyn, viz.

NICOLE CV LVND.
WILLEM CV LVND.
WILLEM CV CINT. Canterbury quarter.
RICHARD CV GLOV.

These Names being probably the Masters of the Mint's, the Laws as to the Mints being not altered. 1 Hen. VI. Cap. 1. The King's Council might assign Mony to be Coyned in as many Places as they will. (a)

But now in France, tho' there be Mints in several Cities, yet there is no difference in the Inscriptions, only a Letter of the
the Alphabet, to signify where the Mony is stamp'd; as A for Paris, &c.

These Saxon Monies were Denarii, or Pennies; for Greaves, of the Denarius, p. 17. says, In Ethelred's time it was the 20th part of the silver Ounce Troy, and bigger than three of our present Pennies; and our Goldsmiths weigh by this Penny-weight or 24 Grains. Five of the Saxon Pennies made a Shilling, and (as Lambard's Glossary says) therefore 48 of those Shillings made a Pound, and 240 Pennies made a Pound, which is the present Proportion of our Penny and Pound, tho' the intrinsic value be about three to one different.

I cannot yet meet with any satisfactory Reason, why this Mony should be thus buried; tho' very probably it was upon a superstitious Account: I shall only offer a bare Conjecture of mine; There were, they say, between 200 and 300 pieces found in the Grave; and if 240, i.e. l l, then the Deceased might order so many to be buried with him, as a kind of Expiation for having privately killed a Dane of servile Condition; for in Ethelred's Law there is this Penalty, Servilis conditionis Dacum si Anglus morte affecerit, integrum solvito Libram. If more or less was found, it might answer another Mulet enjoined by the Saxon Laws for killing or maiming some Person of another Quality. Or the aestimatio capitis might be laid in the Grave with the Person that was killed.

Those who believe they were Peter-Pence, Rome-Scot, Rome Peob, or Hearth-Penny, I think are under a Mistake; for that Mony was collected every Year, and carry'd out of the Nation. Nor it cannot be the Soul Scot mentioned in Canute's Laws, (but first required by the Council or Parliament at Eanham in Ethelred's time) to be paid at the opening of the Grave, (whence Sir Henry Spelman, De Sepulcrud, thinks the Fee demanded for the Office of Burial is derived) for it is not likely that Fee or Soul-Scot paid to the Priest did amount to the Sum found in this Grave; and it is more unlikely that the Priest should so easily part with his Mony, by burying it.

I shall, as well as I can, give you the Inscriptions on those I
On some of these Monies there are very odd Saxon Characters, which are not drawn here very exactly. It would be a useful piece of Learning to have an Alphabet of the several Characters or Shapes of Letters observed in antient MSS. Coyns, and Monuments of Stone, &c. and there might be added an Explanation of Words abbreviated, as in these Monies \[\text{\textbullet} \ \Pi, \ \Pi \] for M; &c.

Some Pieces are diminished in their Weight, by lying long under ground, and several of them coloured Green. (e)

Spanheimius, in his Dissertations de Numismatis, tells us of the way of Writing Letters backwards, In Antiquissimis aliquot Graecorum Numismatis, in quibus \(\text{ΣΑΛΗΙ} \) pro \(\text{ΘΕΑΣ}; \) \(\text{ΝΟΙΑΤΕΙΗΣ} \) pro \(\text{ΣΕΤΕΣΤΑΙΝ}, \) &c. alias id genus Phoenicum more finisitursum non semel scripta leguntur. Eandem quoque scripturae rationem in Antiquis aliquot Gothorum Saxis adnotavit Antiquitatus patris restaurator Olaus Wormius.

This

| 1 | \( \AEDELTAN \) RE+ | \{ P, NE \} |
| 2 | \( \AEDELTAN \) RE+ | \{ FEHO \} |
| 3 | \( \AEDELTAN \) RE+ | \{ LANDC \} |
| 4 | \( \AEDELTAN \) RE+ | \{ VEHOL \} |
| 5 | \( \AEDELTAN \) RE+ | \{ STEL \} |
| 6 | \( \AEDELTAN \) RE+ | \{ ANV \} |
| 7 | \( \AEDELTAN \) RE+ | \{ AREM \} |
| 8 | \( \AEDELTAN \) RE+ | \{ ONETA \} |
| 9 | \( \AEDELTAN \) RE+ | \{ DICTVS \} |
| 10 | \( \AEDELTAN \) RE+ | \{ MAN \} |
| 11 | \( \AEDELTAN \) RE+ | \{ LANO \} |
| 12 | \( \AEDELTAN \) RE+ | \{ ETA \} |

\( 24 \text{ gr.} \)

\( 16 \text{ gr.} \)

\( 10 \text{ gr.} \)

\( 8 \text{ gr.} \)

\( 6 \text{ gr.} \)

\( 5 \text{ gr.} \)

\( 4 \text{ gr.} \)

\( 3 \frac{1}{2} \text{ gr.} \)

\( 2 \text{ gr.} \)
The same Reverie with the last.

This Reverie is written round the +, whereas most of the Reveries are not so; but there are two Lines of Letters with three Crosses between 'em.

The little o in some of these Monies is periodical.

These following Reveries are written round the +

The ℹ is a very clear Character, and stands for a Letter that is not defaced.

But I find Gronovius may be corrected in what he writes in the Addenda to the same Treatise by this Reverso; Dubium non est (says he) si Saxonibus Anglis debetur ea *Vox*, *Sterling*, in monumentis illorum repertam iri. — constat inter omnes ante Normannorum ingressum in Angliam, non reperiri mentionem hujus *Vocabuli*; cum ipso Gulielmo primo legit, *Sterlings*, &c. appellatos, ergo debetur ea *Vox* in Anglia. Yet I believe what he writes just before, *Denariis* autem nomen etiam *Sterlinges* fuisse, in Continente quæ Normanni imperabant, offendunt duo rescripta Pontificum Romanorum in Decretò Gregorii; and he might well have added, That the Normans borrowed of the Franks that *Word* *Sterling*, as well as descriptionem *Libræ per solidos denariosque*. But it may be, when Gronovius writ, no *Coyn* or Monument of Antiquity was then discovered in England that mentioned *Sterling* before William I. whose Name brings to my mind, that a his *Coyn* *P* is put for *W.* (n)

Sir Henry Spelman, in his Glossary, speaks of *Sterling* and *Denarius* to be the same; and he directs to the Statute made An. 1302, 31 Edw.I. wherein the *Penny* is called *Sterling*, and the weight of the *Sterling* is 32 Grains of dried *Wheat*; (and I have weighed 32 Grains of *Wheat*, and they are equal to 24 Grains *Troy*-weight, which is our *Saxon* *Penny,*;) And Ann. 1496, 12 Hen. VII. Cap. 5, there is another Statute wherein the *Sterling* is of the same weight.

I am credibly inform'd, some of *Egbert's* and *Ethelbert's* *Coyn* were found amongst them: Those I law, were *Æthelstan's*, who began his Reign about the Year 925. *Edmund Etheling's* his Brother, (for I take, the *Edmunds* to be his) who began his Reign 9405. *Edred*, another Brother, who began his Reign 946.

I hope others more skilful in Antiquities, and that have better advantage by our Records and ancient Histories, will give a clearer Interpretation of the *Words, Characters*, and other Circumstances relating to these and other *Saxon Monies.*
In the Church-yard at Foulsham in Norfolk, there is a Tomb-stone with this Inscription, which some of the Learned in these Curiosities may perhaps explain.

On one side  \text{AK COL LOC}  \\
At one end  \text{000}  \\
On the other side  \text{EDE DESWIA} \\
On the other end  \text{BOG}

\textbf{Remarks upon the foregoing Observations by W. W. Reg. Soc. Soc.}

\textbf{(a) This Law was in force till Henry VII. who, first, that I can find, quartered the Arms of England and France in his common silver Coyms, on their Reveries: This his Successors have since followed; before they writ, Civit. London; Civitas Cantuarie, Villa Calesiae. The want of knowing this Custom, has caused some Learned Men to mistake some Coyms of Edward IV. with Civitas Norvic. on the Reverse, for Medals stamped in memory of Kett's Insurrection, by Edward VI. Golden Medals, in memory of great Actions, are of ancient use amongst us; witness that golden Coym of Edward III. where a Shield, with the Arms of England and France over a Ship, is stamped, to shew his Title to the Kingdom of France, which he then claimed; yet this can hardly be shewn in silver Coyms which then passed for current Money: that seems to have been peculiar to the Greeks and Romans, except some Instances in these two last Ages.}

The single Exception of Edward III. who quarter'd England and France in his Mony, doth not weaken my Assertion, since it was extraordinary, as a more publick Proclamation of the Justice of that Title, which he set on foot against Philip de Valois.

\textbf{(b) This Reverse is to be read PENE FEHO; i.e. Penny} mony, a Duplication usual amongst the Saxons; to afterwards

Sterling-
Sterling-money. Febo, or Feoh, is a common word for mony.

St. Mark xii. 41. ğa 7α ve ḍe 7læn9 ongen 7ene 7ollfreamol, 7 gerea7 hu  biện hynə peoh; Then set Jesus over against the Treasury, and saw the People put in mony.

(c) LAND WEHO; This was coined in memory of a land tax, raised by Æthelstan, to support his wars against the Danes and Scots; against whom, especially the Scots, he was always victorious. Our writers (Ingulph. Hist. Croyland, p. 29.) say that he killed Constantine King of the Scots, with five more Kings at the same time; but the chronicle of Mailrofe, written by the Abbot of Dunkraine, a Scottish man, says only, Regem Scottorum Constantium prælio vicit, & fugavit; (ad An. 926. p. 147.) And this is the only Æthelstan who was ever King of England: There was another Æthelstan King of Kent only, Son to Egbert, who beat the Danes at Sandwich in Ann. 852.

The variety of Letters in these reverses is remarkable. The last word in these two reverses is manifestly to be read alike, yet the form of the Letters is vastly different. This variety arose from the multitude of Mints, which did not all type themselves up to one stamp, nor to the same letters.

AREM (d) This I should read REGIA MONETA, to distinguish it from the Bishops or Abbots, for it was probably coined at Canterbury; A, I take to be a mint master's mark.

(e) Tho' these coigns, as far as I can judge, are as good silver as any current with us, if not better; yet since what alloy is in them is of brass, I am apt to think, that the acid steam in a long series of ages arising from the humane bodies, might corrode so far into the metal, as to raise some little verdigrise upon the surface of the coigns; to which that greenness is to be imputed.

(f) Probably this Albericus was a nobleman, and they might have had the jus monetae as well as Bishops and Abbots; but I must confess I cannot make that out clearly. H before G is an usual transposition; so HCLOTHARIUS, H.LUDOVICUS. This
(g) This I read IVE MONETA, or IVE Money, that is, Mony coyned at St. Ives in Huntingdonshire. The H, as also Π, both used for M, are remarkable. Bouteroüe, in his Disquisitions on the old French Monies, gives us some Gallick Epitaphs from which he draws an Alphabet of the old Gauls: in that, H and Π are used for M; so that possibly the Britains might likewise use them: it is manifest they are not Saxon Letters; and I see no Absurdity to allow the Saxons to have borrow'd them from the Britains, and to have used them amongst their own Capitals. There is a Coyn in Tab. 3. Coyn 14. of the Collection prefixed before Ælfréd's Life, which has two other of those Gallick Letters of which Bouteroüe has given us an Alphabet. The Coyn is:

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</RUTA> BERILL-
ÆLFRED + + +
</FIRKA> ÄLEDM-
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The ϝ and E are S and F in his Alphabet; and I am apt to think, that that Inversion of Letters in these Saxon Monies, as Æ for M, Π for Π,E for F, took its rise from them; for in this Alphabet we have Δ and θ for D; ϝ, Z, Z, for S; however, this will evince, in some measure, the Practice of such Inversions, which made some Learned Men take them for Runic, Gothic, or indeed for any Characters with which they were little acquainted.

(h) This and the Reverse of the 11, are to be read alike, tho' they were coyned at different Places, as appears from the variety of the Letters.

(i) Π which is used here for M, is frequently used in that Collection of Saxon Coyns prefixed to Ælfréd's Life.

(k) This Gotaé monæ, or Gods Mony, was the Peter-Pence which was collected yearly, and sent to Rome. Ina, one of the Kings of the Mercians, first gave it: thence it was constantly paid
paid afterwards, tho' now and then intermitted in the heat of the Danish Wars, I suppose this Coyn came out of an Ecclesiastical Mint.

(l) The true Original of Sterling is Starry. The Common People observing the Crosses upon the Coyns, which looked like so many Stars, called them Sterlings, Starry pieces. Ling is an adjective Termination in the Saxon Language; so in time, the Word became Substantive, and was used promiscuously for Penny.

(m) The 19 and 21 Reverses are to be read alike, tho' possibly they might be made from different Stamps. The Letters in both (for neither are very clear) will mutually explain each other. I read it MACHECH HONE, or Malmesbury Money: The £, which is an entire Letter, seems to have been taken from the square £, or B.

(n) This P was the old Saxon ṁ or W; so it was Willem, not Pillem. The Saxon Character, which was full and plain, gave rise to that small beautiful Character which we usually call the Roman Letter. The ancient Romans, for ought as yet appears to the contrary, wrote all with one uniform Character, sometimes greater and sometimes less, of the same Figure with the great Letters in our Alphabet. This they took from the Greeks; and it is usual in all the Alphabets of the Oriental Nations. The three Inscriptions in Gruter, (pag. 185. 3. p. 652. 2. p. 882. 7.) only prove that they had our small t, p, b, h, for we have no Hints in our MSS. of any others. After them succeeded the Francick or Merovingian Character, entirely left off in transcribing Books after Charlemagne. The Notaries kept it longer; only by making it longer, they brought it to something like the Italica, to which it possibly gave rise. The Specimens in Mabillon's fourth Book de re Diplomatica, will put this past doubt. All this while the Saxon Character was used in England, whose Alphabet is evidently the same with the small Roman, except some Letters which expressed Sounds proper to their Language, as ṁ, ṁ, ḋ: wherefore when Alcuinus (Scholar to Egbert Arch-bishop of York;) went over into France
France to Charles the Great, and afterwards sent for Books out of Egbert’s Library, as may be gathered from William of Malmesbury, he introduced that fine way of Writing, which immediately took place with all but the Publick Notaries. Mabillon owns the thing in effect, tho’ he dissembles the Original: Prima stirpe extinctâ, Carolus M. Literas expolire capiit, aut certe jam tantissum expolitum Scripturâ genus à Merovinginco in elegantiorum formam commutavit, quæ in eadem formam evasit, quæ haecnum minuti Romani Charâcteris nomen retinet. (Lib. i. Cap. ii. num. io.) And if this Change was not wrought in a moment, because the Transcribers us’d to the old Merovingian hand conform’d it to the new, as much as they could, yet that wore off by degrees: so Mabillon, que [Carolina Scriptura] principio nonnihil Merovingici Charâcteris habebat intermittum; at subinde politior effecta, in eadem formâm, &c. Mabillon acknowledges, that Alcuin introduced the modern Punctuation into the French MSS. and Records, which he learned from the Saxons, particularly [•••] for a full Period, as is manifest to all that shall look into the Saxon MSS, or printed Books in imitation of them.

Besides, all our Latin MSS. in England, ’till some time after the Conquest, were writ in the Saxon Character. So Archbishop Parker published Asserius Menevensis: and there are several Latin MSS. in the University Library of Cambridge, written in the Saxon Character. And it is no wonder that those Letters which expressed Sounds not used in the Roman Tongue, should be left out by the French Transcribers, who at the same time might use Saxon Copies: so that it is not strange Wossus should be mistaken, when he thought Ω and Θ were from the Greek Ω and Θ, who did not consider them to be both Runic Letters, which were introduced upon a particular occasion, by Chilperic, who took them from the Visigoths in Spain, as Wormius (de Literaturâ Runicâ) has probably proved from Gregorius Turonensis and a Constitution of the same Chilperic printed in Goldælius: yet I will not deny but Theodore, or some other of those Greeks, who in that Age had so great
great Intercourse with England, might introduce some Greek Letters to express those Sounds which they had not in their own Language; from hence they were carried into France, with the rest of the Saxon Alphabet, and so into Italy; which Mabillon also in effect acknowledges when he says, Hanc tamen Scripturae formam non Franci a Romanis, qui Langobardi-cis passim Elementis tune utebantur, sed a Franciis Romani accepisse videntur. But it would take up too much time here to discourse of the Original of the Saxon Character, and whence those Agreements between it and the pure Merovingian and Lombard Characters might at first arise; and perhaps the thing it self does not deserve any farther enquiry.

An Estimate of the Quantity of Vapour raised out of the Sea by the warmth of the Sun; derived from an Experiment shown before the Royal Society, at one of their late Meetings: by E. Halley.

That the quantity of aqueous Vapours contained in the Medium of the Air, is very considerable, seems most evident from the great Rains and Snows which are sometimes observed to fall, to that degree, that the Water thus discharged out of the Interstices of the Particles of Air, is in weight a very sensible part of the incumbent Atmosphere: but in what proportion these Vapours rise, which are the Sources not only of Rains, but also of Springs or Fountains (as I design to prove) has not, that I know of, been any where well examined, tho' it seem to be one of the most necessary Ingredients of a real and Philosophical Meteorology; and as such, to deserve the consideration of this Honourable Society. I thought it might not be unacceptable, to attempt, by Experiment to determine the quantity of the Evaporations of Water, as far as they arise from Heat; which, upon Tryal, succeeded as follows.

We
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We took a Pan of Water, about 4 inches deep, and 7 inches \(\frac{5}{6}\) diameter, in which we placed a Thermometer, and by means of a Pan of Coals, we brought the Water to the same degree of heat which is observed to be that of the Air in our hottest Summers; the Thermometer nicely shewing it. This done, we affixed the Pan of Water, with the Thermometer in it, to one end of the Beam of the Scales, and exactly counterpoised it with weights in the other Scale; and by the application or removal of the Pan of Coals, we found it very easy to maintain the Water in the same degree of Heat precisely. Doing thus, we found the weight of the Water sensibly to decrease; and at the end of two hours we observed that there wanted half an ounce Troy, all but 7 grains, or 233 grains of Water, which in that time had gone off in Vapour; tho' one could hardly perceive it smok, and the Water were not sensibly warm. This Quantity in so short a time seemed very considerable, being little less than 6 ounces in 24 hours from so small a Surface as a Circle of 8 Inches diameter. To reduce this Experiment to an exact Calculus and determine the thickness of the skin of Water that had so evaporated, I assume the Experiment alluded by Dr. Edward Bernard to have been made in the Oxford Society, viz. That the Cube foot, English, of Water weighs exactly 76 pounds Troy; this divided by 1728, the number of inches in a foot will give 2\(\frac{3}{3}\)\(\frac{1}{3}\) grains, or \(\frac{1}{2}\) ounce 13\(\frac{1}{3}\) grains for the weight of a Cube inch of Water; wherefore the weight of 233 grains is \(\frac{53}{36}\) or \(\frac{35}{38}\) of 35 parts of 3\(\frac{1}{2}\) of a Cube inch of Water. Now the Area of the Circle, whose Diameter is 7 \(\frac{5}{6}\) inches, is 49 square inches; by which dividing the quantity of Water evaporated, viz. \(\frac{3}{5}\) of an inch, the Quote \(\frac{53}{36}\) or \(\frac{35}{38}\) shews that the thickness of the Water evaporated, was the 53d part of an Inch: but we will suppose it only the sixtieth part, for the facility of Calculation. If therefore Water as warm as the Air in Summer, exhales the thickness of a 60 part of an inch in two hours from its whole Surface, in twelve hours it will exhale the \(\frac{1}{10}\) of an inch; which quantity, will be found abundantly sufficient to serve for all the Rains,

Springs.
Springs and Dews, and account for the Caspian Seas being always at a stand, neither wasting nor overflowing; as likewise for the Current laid to set always in, at the Streights of Gibraltar, tho those Mediterranean Seas receive so many and so considerable Rivers.

To estimate the quantity of Water arising in Vapour out of the Sea, I think I ought to consider it only for the time the Sun is up, for that the Dews return in the Night, as much if not more, Vapours than are then emitted; and in Summer the Days being longer than twelve hours, this excess is balanced by the weaker Action of the Sun, especially when rising, before the Water be warmed: so that if I allow \( \frac{1}{10} \) of an inch of the Surface of the Sea to be raised per diem in Vapours, it may not be an improbable Conjecture.

Upon this Supposition, every 10 square Inches of the Surface of the Water yields in Vapour per diem a Cube inch of Water; and each square foot half a Wine pint; every space of 4 foot square, a Gallon; a mile square, 6914 Tons; a square Degree, supposed of 69 English miles, will evaporate 33 Millions of Tons: and if the Mediterranean be estimated at 40 Degrees long and 4 broad, Allowances being made for the Places where it is broader by those where it is narrower, (and I am sure I guess at the least,) there will be 160 square Degrees of Sea; and consequently, the whole Mediterranean must lose in Vapour, in a Summers-day, at least 5280 Millions of Tons. And this quantity of Vapour, tho very great, is as little as can be concluded from the Experiment produced: And yet there remains another Cause, which cannot be reduced to Rule, I mean the Winds, whereby the Surface of the Water is lick'd up sometimes faster than it exhales by the heat of the Sun; as is well known to those that have considered those drying Winds which blow sometimes.

To estimate the quantity of Water the Mediterranean Sea receives from the Rivers that fall into it, is a very hard task, unless one had the opportunity to measure their Channels and Velocity; and therefore we can only do it by allowing more than
than enough; that is, by assuming these Rivers greater than in all probability they be, and then comparing the quantity of Water voided by the *Thames*, with that of those Rivers whose Water we desire to compute.

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

To calculate the Water of the *Thames*, I assume that at Kingston Bridge, where the Flood never reaches, and the Water always runs down, the breadth of the Channel is 100 Yards, and its depth 3, it being reduced to an equality; (in both which Suppositions I am sure I take with the most.) Hence the Profil of the Water in this Place is 300 square Yards: this multiplied by 48 miles, (which I allow the Water to run in 24 hours, at 2 miles an hour) or 84480 Yards, gives $25344000$ Cubick Yards of Water to be evacuated every day; that is, $20300000$ Tons *per diem*; and I doubt not but in the excess of my measures of the Channel of the River, I have made more than sufficient allowance for the Waters of the *Brent*, the *Wandel*, the *Lea*, and *Darwent*, which are all worth notice, that fall into the *Thames* below Kingston.

Now if each of the aforesaid 9 Rivers yield 10 times as much Water as the *Thames* doth, ’twill follow that each of them yields but 203 millions of Tons *per diem*, and the whole 9 but 1827 millions of Tons in a day; which is but little more than 2 of what is proved to be raised in Vapour out of the Mediterranean in 12 hours time. Now what becomes of this Vapour when raised, and how it comes to pass that the Current always sets in at the mouth of the Streights of Gibraltar, is intended; with leave, for a farther Entertain-
tainment of this Honourable Company: in the mean time, it it needful to advertife the Reader, that in making the Ex-
periment herein mentioned, the Water used, had been falted
to the fame degree as is the common Sea-water, by the Solu-
tion of about a 40th part of Salt.

Observationes nonnullæ Eclipfeos Nuperæ Solaris,
Maii 1. St. vet. diversis in locis habitæ, accum Re-
giâ Societate Communicatae.

HÆC Eclipfs, etiam contermina; quantitatis fuerit, ac
nudis oculis non omnino percipi potuerit, tamen ad ac-
curatam determinationem Parallaxis & Latitudinis Lunæ maxi-
me idonea videtur. Quapropter quas haœtemus obtinere potimus
observationes cape Leœor Benevole.

Londini seorsim observantibus Hookio & Halleio, Initii
momentum, cœlo licet puriffimo, ob obliquam incidentiam Lunæ,
debite definire non licuit. Sed hora 1. 16', jam cepta erat Eclip-
sis satis notabiliter: circa 1. 40'. prope medium Eclipfis, Chorda
partis Eclipfæ, sive inter cornua, inventa est 9'. 30'. cui respon-
det arcus 36 gr. in diametro vero non nisi 1'. 30". Finis consen
tus utriusque observatoris contigit accurate hora 2. 3'. 00.

Grenovici in Observatorio Regio Flamsteedius eadem de cau-
sa Initium non vidit, finem vero determinavit 2. 4'. 15". Me-
dio Eclipfis sive maximâ obscuratione, Chorda partis Eclipfæ
erat 9'. 54".

Apud Totteridge prope Londinum versus Corum, finem videt
Dominus Haines, Reg. Soc. Soc. ad 2. 2'. Quantitatem vero
Maximam dimidii Digitæ, ab Austro.

In Insula Barbada, ad Oppidum Bridge-Town, sub Lat. 12 gr.
58'. Finem habuit Dominus Frank 1'. 30". temporis ante quam So-
is Altitudo fuit 31 gr. 47'. ad ortum, hoc est hora 7. 56'. 45".
A. M. Quantitatem Maximam estimatione definit duorum digi-
torum ab Austro.

Norim.
Norimbergæ eandem Eclipsem observavit J. P. Wurtzelbaur.
Initium quidem accurate ad 1 h. 58' ½; circa medium, sc. ad 2 h.
36' ½ quantitatem maximam duorum dig. precise; Finem vero ad
3 h. 18'. 33'"

Ulmae Sueviae, observavit Honoldus Initium ad 1 h. 48' 5
Quantitatem maximam 2 ½ dig. Finem vero ad 3 h. 16'.
Lipsiae, observatore Kirchii, Eclipsem jam satis notabilis ad horam 2 h. 20'. 10''. ad 2 h. 47' ½ digiti 1 ½ circiter. Finis vero incidunt precise in 3 h. 15'.

Vratissavae Silesiae denique observavit D. G. Schultzius
Maximam obscurationem, paulo citius quam 3 h. 12' ½ sua 1 ½
dig. Finem vero hora 3 h. 37'.

In omnibus hujusmodi observationibus momentum Finis multo tuitius determinatur; itaque huic potius fidendum est, præsertim in Eclipsibus parvis, ubi ob incidentiam maxime obliquam die barent quasi in Contaetu Luminaria.

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Memoirs for a Natural History of Animals; containing the Anatomical Descriptions of several Creatures, dissected by the Royal Academy of Sciences at Paris; Englished by Alexander Pitfield, Esquire, R. S. Soc. To which is added, An Account of the Measure of a Degree of a great Circle of the Earth: Published by the same Academy, and Englished by Richard Waller, Esquire, R. S. Secr.

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His Book, containing the Anatomical Observations of 28 Species of Animals, and about 70 Individuals, was published in two very large Folio's by the Royal Academy at Paris, and owned by them, as their united Labours, as they are a Body. The Difficulty of procuring Copies of the French Edition, few of the Learned having ever seen the Book, tho' printed some Years since, was no small Inducement, as the Translators say, to their Undertaking.
Waving what may be said as to their Preface, and of the first 12 Species of Animals; viz. two Lyons and a Lyoness, a Camelion, a Dromedary, a Bear, five Gazella's or Antilopes, a Chat Pard, a Sea-Fox, a Casfor, an Otter, two Civet Cats, an Elke, and a Coati mondi, of all which, a large Account has been already given by Mr. Oldenbourg in his Philosophical Transactions, Numb. 49. & 124. to which I refer the Reader; I shall proceed to give some Account of the sixteen remaining Species; all which were published in the Second Volume of the French Edition.

The Thirteenth Species then is the Sea-Calf, which, from Rondeletius, they observe to be of two kinds, the larger from the Ocean, the less from the Mediterranean, of which sort this was. That which is most extraordinary in it, was the Epiglottis, much larger than in other Animals; its Ventricle like an Intestine: it had all the Organs for Secretion of Urine, and the Kidneys seemed composed of several Glands, each provided with a particular Pelvis: it had Lungs like other Amphibious Animals; and the foramen Ovale giving Passage to the Blood from the Cava to the Aorta. It had the Cristalline more convex before, which is not common; and several Particularities in the Formation of the Eye favouring the Opinion of the Reception of the Visual Species on the Retina.

The Fourteenth, the Barbary Cow, an Animal somewhat resembling a Deer: it had but two Teats, four Ventricles like other ruminating Animals, a very large Cæcum, and no distinct Lobes in the Liver. It was in several Particulars like the common Cow.

The Fifteenth is the Cormorant, wherein the shortness of the Legs is remarkable, and structure of the Feet for Swimming with one Foot while the other holds the Prey: the largeness of the Oesophagus: want of the two Cæcums, found in most Birds: the Kidneys separated from the other Viscera by a particular Membrane: the Tongue and Eye very small, this Water-Fowl being to feel for its Food under the Water, rather than discover it from afar.

The
The Sixteenth, the Chamois or Rupicapra, in whose Ventricle a Ball was found; whence they take occasion to discourse of the Balls found in the Stomachs of Creatures, as Cows, Horses, &c. and observe that they are compos’d of lignous Fibro and not Hair, as is usually thought: besides several other Observables, the Cornua uteri were very long and winding; the Heart had a Callous Apophysis, &c.

The Seventeenth and Eighteenth are the Porcupine and Hedg-hog, a comparison being made between these two Animals. They observe the external Ear of the Porcupine to be like a Mans; the end of the Tongue armed as it were with Teeth; the Skin provided with an extraordinary Muscle for Ejaculation of the Quills. Of these they dissected six. In comparing the Hedg-hog with them, they describe the Musculus carnosis, which serves to bring the Head round into the Breech like a Foot ball; whereas in the Porcupines the Cæcum was very large; in the Hedg-hog there was none at all; the Epididymis, in the Porcupine, was separate from the Testis; in the Hedg-hog united to it; in the Hedg-hog they observed a large Crystaline filling almost the whole Globe of the Eye.

The Nineteenth are four Monkeys; where they in general observe, that this Animal more resembles Man in his outward shape than inward Formation of the Parts, which in many things are like a Dog; the genital Parts of the Male like neither; of the Female much like Woman; the Anfractuosities of the Brain like Mans, but the Processus mammillares were hard and membranous, which they are not in Man: they conclude with a comparison of the Muscles, which very much resemble those of Men.

The Twentieth is the Stag of Canada and Sardinian Hinde. In the Stag, the length of the Intestines is observable, being in all 96 feet; and indeed, generally all grazing Animals have long Guts. In the Hinde, the four Ventricles were more distinguishable than in the Stag; the Cornua uteri long and winding, as in the Chamois: in the Trunks of the Jugulars were found 16 Valves, which were in situation contrary to the Cir-
ulation of the Blood. In the Carotides were observed several transverse incisures.

The Twenty first, ten Pintadoes; where, after a full description of the outward Form, they describe several Parts like the common Hen; the Pancreas wanting: the Bladders in the lower Belly were raised by blowing into the aspera Arteria, whence they hint at the use of Respiration.

The Twenty second, three Eagles: after having discoursed of the six kinds of Eagles, according to Aristotle and Pliny; they observe, That the Intestines, after the usual manner of voracious Animals, were slender and short, as also the Kidneys; some had the Cæcum, others none: the Globe of the Eye was large, and the Cornea very prominent. In this Subject they first discovered that the Spinal Marrow in the middle of the Back was divided in two, with a Ventricle like those in the Brain betwixt: this was afterwards found common to all Birds.

The Twenty third, two Indian Cockes, not our Turky Cocks. They were both Males: in one there was two Pancreas’s, with three Cholidoci, and two Pancreatici ductus into the Intestine: in the other was but one Pancreas, and a single ductus: the Intestines were 12 feet long, and Cæcum fix: the Aspera Arteria made a fold in the Craw bone, after a most particular manner.

The Twenty Fourth, six Bustards; in which the Craw was scarce distinguishable from the OEso phagus, and furnished with a great number of Glands most conspicuous in this, but to be found in most Birds: a particular description of the Gizzard follows, and of a third Cæcum near the Retum or the Burfa Fabritii: between the Cornea and Sclerotica a cartilaginous Circle was observed. They end with the discovery of a black Purfe in the Eyes of Birds.

The Twenty fifth, fix Demoiselles of Numidia, a kind of Crane, in which they found the Liver very large, and without Gall-bladder in some Subjects. In the Female a kind of Gland besides the Ovary, resembling the Testicles of the Male. Amongst other Observables, the Structure of the Wind-pipe was very unusual, entering with a winding into the Bone of the
the Sternum: at its Union with the Lungs it had a kind of Larynx: the Punctum Lachrymale in the Eye was double, &c.

The Twenty sixth, eight Ostriches, in which they very largely discourse of the make of the Feathers of Birds, and joyning of the Fibres of each Feather to one another; a great part of which, seems to have been taken out of Mr. Hook's ingenious Book of Microscopical Observations, tho' they have not thought fit to own it. The Foot of this Animal seems contrived for a speedy Course, in which its Wings are of great use: the different length of the Intestines is observable, in some being 50, whereas in another they were but 29 feet; the Cæcum, which was double, was wreath'd like a Screw, and the inside of the Colon provided with Valves or semilunar leaves, like Membranes. At the extremity of the Rectum was found a Bladder filled with Urine. In this Description they discourse largely of the Ureters and genital Parts of Birds, as likewise of the Lungs, and its Divisions or Diaphragmes, and its Communication with the Bladders containing the Ventricle and Intestines: together with the manner and use of Breathing in Birds, explaining it by a pair of double Bellows, &c.

The Twenty seventh, the Caffowar, a Bird but lately known to the Europeans: it has no Quills nor Feathers for flying, and indeed but short Wings: that which was most unusual was the want of a muscular Gizzard, tho' a granivorous Animal; which might in some sort be supplied by the number of Ventricles. In this Subject they more particularly insist on the Muscles of the Thorax necessary for Respiration, and a curious description of the Parts of the internal Eye lid in Birds, as to its Mechanism and Use.

The Twenty eighth. They conclude these Discourses with that of a very large Land Tortois, being four foot and \( \frac{1}{2} \) from the extremity of the Head to the Tail. Amongst the Internal Parts, the Structure of the Urine Bladder is very curious for its exterior Tunicle being membranous: the inside was strengthened with an infinite number of muscular Fibres, not unlike those in the Ventricles of the Hearts of Animals. This Contrivance seems
feems necessary for the pressing out of the Urine in this Animal, which has an unyielding Belly, not capable of Compression; nor was the formation of the Heart less observant: it had three Ventricles communicating with each other by holes in the Septum: the Vena Cava had two Branches into two of the Ventricles, which likewise received Blood from two Vena pulmonares to be transmitted to the Aorta, &c. Having been already too large, I shall pass by what was observed of the extraordinary Structure of the Lungs, with a Discourse of the Lungs of Animals in general, which they reduce to three sorts; treating next of Respiration, together with an Experiment of blowing up the Lungs of a Dog with a pair of B. llows; but I shall refer, as to the other Particulars in this and the former Anatomical Discourses, to the Book itself, very well deserving the Perusal of all Persons curious in Anatomy and Chirurgery, containing many useful Remarks and natural Discoveries, of which this is but a very imperfect Account.

I shall say nothing of the Measure of the Earth added to the end of this Edition, a very full Account having been given of it in the Philos. Trans. Numb. 112. to which I refer the Reader: only the Translators thought fit to annex it, the Curiousness of its Subject, and exceeding Scarcity, being sufficient to recommend it to this Learned and Inquisitive Age.

Confucius Sinarum Philosophus, sive Scientia Sinensis Latine exposta, Studio & Operá Patrum Societatis FESU, &c. Adjëta est Tabula Chronologica Sinicæ Monarchiae ab hujus exordio ad hæc usque tempora.

THE famed Chinese Philosopher CUM-FU-CU, or as we call him Confucius, being in so great esteem in his own Nation, and having never yet appeared in an European Dress, cannot but be gratefully received by the Curious, especially since the Version is perform-
ed by very ancient Missionaries sufficiently accomplished in the knowledge of the Chinese Character, and at the Command (as is said) of the King of France.

The Subject of this Book being foreign to our purpose, as consisting chiefly of Moral and Political Precepts and Apophthegms of the Philosopher, I shall not enlarge thereon; only to recommend it, the Translators assure, That the Memory of the Author is still precious in China; and that in respect to him, his Posterity, after above 2200 Years, enjoys certain great Privileges never granted but to the Royal Family; is exempt from all Taxes; and whosoever is advanced to the Degree of Doctor, gives, as a mark of his Respect to the great Confucius, some Present to the eldest of his Family, who is now 68 Generations removed from him.

As to the time when Confucius lived, 'tis here precisely set down from the Chinese Annals: He was born Anno 551, ante Christum, and lived 73 Years; so that he was contemporary with the most ancient Greek Philosophers, and not long after Pythagoras, flourishing about the time of Tarquiniius Superbus, and the first Consulats, when Darius Hyphasis held the Persian Empire. He is said to be descended of a Branch of one of the most ancient Royal Families, which might not a little contribute to gain Respect and Credit to his Writings.

But what may not improperly find place here, is, the Chinese Chronology, whereof such wonderful Relations have been brought into Europe: This Matter the Author of this Part of the Book, P. Couplet, seems well to have examined, and to have lifted the credible from the fabulous. They begin their Account with the Years of the Reign of King Fobi, who was the Founder of their Empire, about the Year before Christ 2952; rejecting, as ill grounded, and not to be believed, all that some Authors have said of the Times before, and following therein the Opinion of the best reputed Chinese Historians. This Fobi is said to have reigned 115 Years, and to have invented the Character now in use in China, and his Successor Ximinum is made to govern 140 Years: These two Kings are by our Author, by reason of some manifest Fables in their History, reputed doubtful; wherefore they, as from a more certain Era, choose to begin their Annals with the third King Hoam-ti, and the Year before Christ 1697. This Hoam-ti is said to have instituted the Sexagenary Cycles or Periods of 60 Years, according to which this Chronology is adjusted, and for want of which, or the like, our Account of Time, both Sacred and Profane, is subject to too great Uncertainties; the Years of the Reigns of Kings, where the Months and Days are neglected, introducing great Errors in length of time, which
which by this method are prevented. Since this Institution, there are
now 73 Periods elapsed, and the 74 is current; in which time they ac-
count that there has been 234 Kings of China, sprung from no less
than 22 several Royal Families; the King now reigning being the
second of the Race of the Tartars, who within these 50 Years have
throughly subjected China.

In this Chronology are set down the beginnings of each King's
Reign, with a short Character of the Prince, and the principal of his
Acts, with the most notable Contingencies of his time: amongst the
reft, severall Eclipses of great Antiquity are recorded, whereby this
account may be examined.

The third King, Chuen-hio, is said to be the Author of the Chinese
Kalendar, and to have appointed the beginning of the Year to be
on the New-Moon next the beginning of the Spring, which the Chi-
inese account to be when the Sun is in $^5$ gr. of Aquarius: this Account
is now in use, tho' instituted 2500 Years before Christ. About 700
Years after, the King Chin-tam reduced the beginning of the Year
to the Winter Solstice; but the former was restored about 100 Years
before Christ, and still continues.

The Years of this Account are Luni-Solar, or consisting of 12 Lunar
Months, half of 30 days, and the rest of 29 days, with the Intercalati-
on of 7 mon. in 19 years; so that 7 years in each Cycle have 13 mon.
This Distribution of mon. was ordained by K. Tso, above 2300 years
ante Christum, and is, if rightly intercalated, a more exact measure of
the Celestial Motions than our Julian Account or old Style, for that
fails a day in 131 years, whereas this Account of the Chinese (which
is nearly the same with the Jewish) fails but a day in 225 years, or 4
days in 900 years; but since their method of Intercalation is not here
expounded, I shall not say more in a matter of such Uncertainty.

'Tis here said, that the famous Wall of China, extending above 400
Leagues, was begun by King Xi-Hoam-ti about the year ante Chr. 210.
to hinder the Incursions of the Tartars, which in all Ages have infe-
ted this Country. The following Cycles are more amply described,
and towards the End, the Transactions of the Roman Missionaries are
inserted, with a brief account of that great Revolution in China, by
the entire Conquest of that Kingdom by the Tartars. This Chrono-
logy ends with the year of Christ 1683, being the last of the 73d
Cycle, since the King Hoamt; and contains in all 4380 years.

'Twill be needless to advert, that this Account places the begin-
ing of the Chinese Empire long before the Deluge, according to the
Holy Scriptures; wherefore if this be to be wholly rejected, as fab-
ulous; or if not, how it is to be reconciled with the sacred Chronology,
belongs more properly to the Disquisition of the Divines.
The CONTENTS.

(1.) De Sestertio Dissertatiuncula, sub finem Voluminis Quartorum Opusculorum Celeberrimi D. D. Isaaci Barrow, S. S. Theologiae Professoris, nuper edita, cum Tabula valorum Nummi Romani in moneta nostra Angliae exhibente. Quam ob eximum ejus usum in legendis veteribus ex loco quodammodo impropiohue transferre visum est.

(2.) De Numero Radicum in Equationibus Solidis ac Biquadraticis, quin tertiarum quarternorum, earumjv limitibus, ex contemplatione intersectionum Circuli & Parabolae datæ in Constructionibus hujusmodi equationum tractatus.

Author E. Halley.

(3.) An Account of some Observations lately made at Nurenburg, by Mr. P. Wurtzel-baur, shewing that the Latitude of that Place, has continued without sensible alteration for 200 Years last past; as likewise the Obliquity of the Ecliptick; by comparing them with what was observed by Bernard Walter, in the Year 1487: Being a Discourse read before the ROYAL SOCIETY, in one of their late Meetings.
Assendus pecuniam Gallicam confert cum multiplis sester-
tii nummi: Supponit autem denarium, Sestertii quadrup-
plum, sub primorum Cæsarii temporibus octavam uncix par-
tem æquasse pondere: quam hypothesin aliquatenus redarguit
nostr Gravius: (De Den. pag. 96, & 113.) probat enim sub
illis, qui Vespasiano priores imperarunt Cæsarii, varium &
inconstans denarii pondus extitisse; majus scilicet & minus al-
ternatum, fecund tamen decrevendo, ita ut ab Augusto ad Vespas-
anum decreverit a septima parte uncia ad partem octavam; in
quo ferme statu persistit a Vespasiano ad Alexandrum Severum.

Unde conseqüi videtur ad lectionem veterum autborum magis
conducere, ut moderni nummi cum Consulari denario (recentiore
nimirum) comparentur, tum quoniam is statu certique ponderis
fuit (uncia septimam partem adequant) tum quia tempus, quo
in usu fuit, plerisque comprehendit poetas & historicos nobili-
iores, tum quia verisimilis est praecipuos autores ad bunc potius
resexisse, quam ad Cæsarii illum mutabilem & nullo certo
pondere definitur. Pag. 119.

Denarium vero Consulari nostr Gravius (Pag. 61. 94, &c.)
ex appenfis multi denarii, ex eorundem cum alii aurés argen-
tesique nummis (Romanis, Hebrais, Grecis, Persicis, &c.)
collatione, & ex Vespasianeii congii mensura deducit cum LXII
granis Anglicis æquiponderare. (Pag. 81.) Unde cum denarius
nostr octo grana pendat, Consularis iste denarius valebit septem
denarios nostris cum tribus quartis. At denarius Cæsareus,
uncia pondus habens, pendet 54 ½ grana, valebitque denarios
6 3/5.

Breerwoodus autem denarium Consulari (¾ uncia penden-
tem) estimat denarii nostris 8 ¼; & Cæsareum (¼ uncia) dena-
riis 7 ½: quæ magna est a Gravio discrepantia. Sed is non vi-
detur Romana pondera cum nostris accurate contulisse.
In eo quoque graviter errare videtur idem Breerwoodus, quod Caesareum denarium Attica drachma putat aequalem: cum huic potius aquetur denarius Consularis; imo quem exquisitus rem penstante Attica drachma etiam Consularem denarium (tanto majorem Caesareo) 5 granis Anglicis exsuperet, ut luculente probat Gravius. Pag. 72.

Consultius itaque visum est a Gravio adseritis proportionibus adhære; Et cum Consulari nummo pecunias nostras conferre. Quibus ex suppositis adjuncta tabella computatur.

Tabula valorem Nummi Romani in moneta nostra Angliae exhibens.

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De Numero Radicum in Equationibus Solidis ac Biquadraticis, sive tertiae ac quartae potestatis, earumq; limitibus, tractatus Authore E. Halley.

C U M in tractatu, quem nuper publici juris feci in actis bisce Philosphicis, Num. 188; Methodum aperuissem, qua Problemata solida utcunq; affecta minimo negotio, unica data Parabola & Circulo, simplicissime construi possint; sub finem nibi sefe obtulit contemplatio jucunda satis, nemen ex bis Constructionibus Numerum radicum in quavis Equatione, earumq; Limites ac signa facile consequi ac determinari: quocirca fidem dedi me brevi de hac materia dissertatiunculam aliquam scripturum, in qua si non Principibus, saltem secunda classis Geometris, me non ingratum nec inutile praesitum omnino persuasum habui.

Propius vero insipienti nibi cometum est, me imprudentem inter ardua Geometrica illapsum, ac jam iis tractandis designantum, quibus olim laboravere Viri illustres Harriottus nostras, ac Cartesius; in quibus pari fato utriq; Paralogismum, (forfan in eorum scriptis Geometricis unicum) diverso tamen modo, admisere; uti post bac probatum: sed quandoq; bonus dormitat. Quae propter agnita rei tum difficultate tum praefantia, totis viribus incumbere statui, ne promissis exequendis impar crederer, ac ne Geometrica pars tam eximia, tamq; parum culta, diutius tenebris involuta lateret; sed ope nostra lucide bis paucis exposta daretur.

Imprimis vero Lectorem monitum velim, quod dum bis legendi operand dat, oportet pradictam dissertationem Num. 188. editam, ad manum habere, ac Constructiones ibidem traditas probe collere; quia quæ sequuntur ab illis maxima e parte pendent, quas tamen hic repetere vix integrum est.
Ex Cartesio & ex ibi dictis constat, tam in Cubicis quam in Biquadraticis aequationibus, radices exponi posse demittendo perpendicula in Axes, datamve diametrum Parabolae data, ab interseccionibus Curvæ illius cum Circulo. Cumq; Circulus Parabolæ secans, vel in quatuor vel duoibus punctis eam intersecare necessè est, constat in Biquadraticis vel duas vel quatuor radices veras, Affirmativas vel Negativas, semper haberi; uti etiam si forte Circulus illam tangat, quo in casu aequalitas duarum radicum ejusdem signi concluditur. In Cubicis autem, quoniam una ex intersecionibus ad Constructionem requiritur, non nisi una vel tres reliqua radices designant unam vel tres; uti in Casu contactus, unde constat duas aequales reperiri Radicis, Problemæ, unde resultat aequatio revera planum esse.

Cubica itaq; omnes quomodo cunctæ, affecta una vel triplici radicis explicabiles sunt, utiq; semper possibles, nempe si radices Negativas pro veris admiseris: sic Biquadratica, quarum terminus ultimus æsigno—affecta est, duabus vel quatuor. Ast si habeatur + r in aequatione, eaq; tanta sit, ut r, G D aq; a r, (vide fig. pag. 341.) minor sit quam ut Circulus, eo Radio ac centro G descriptus, Parabolam contingere in aliquo puncto possit, aequatio data omnino impossibilis est, nec ullæ Radicæ Negativa vel Affirmativa explicabilis: Sed de his plura in sequentibus.

Quoniam vero tanta intercedit differentia inter casus Cubicarum & Biquadraticarum, ut simul comprehendì nequeant; primæ Cubicas deinde alteras tractabimus. Cubica vero infinitis Circulis in data Parabola construuntur, Biquadratica autem unico tantum (saltem bis methodis): id adeo quia ponendo z—e five indeterminata aliqua, aequalem nihilò, aequatio Cubica reducitur ad Biquadraticam easdem radices cum Cubica habentem, atq; insuper aliam ipsi e aequalè, unde fit ut tot Circulis diversis construï possit Cubica, quot imaginari velis quantitates e, id est infinitis. Inter has vero Constructiones illæ, quam dedi (pag. 342.) longè facilem est. Huic tamen non multum cedit alia, quæ ad enucleationem Numeri Radicum, earumque limitum
tum magis accommodata videtur, quae; ortum trabit ex ablatione secundi termini, ponendo modo vulgari $x = z + \text{vel—tertia parte Coefficientis termini secundi. Hac autem est. Data Parabola ABY (Fig. I.) ejusq; Vertice A, axe AL & Latiere recto a, reducatur aquatio ad formam consequatur, viz. $z^2 + b z + a a q = o$. Deinde ad distantiam $b$ ducatur Axi parallela BK, dextrorsum quidem si fuerit $+ b$, aliter sinistrorsum, Parabola occurrens in B; ac lineæ suppositæ AB erigatur perpendicularis utrinque interminata DP, axi occurrens in puncto G. De B in Axem demitte perpendicularum BC, & ipsi AC fiat GE semper æqualis, ac versus inferiord ponatur. Ab E fiat EH = $p$, sursum quidem, si in aequatione fuerit $+ p$, deorsum vero $- p$, ac e puncto H (vel ex E si defuerit quantitas $p$) educatur perpendicularum HQ interminatae DP occurrens in puncto O. Denique in lineæ HQ interminata, fiat $OR = q$, ab O dextrorsum si fuerit $- q$, sinistrorsum $+ q$, collocanda: ac Circulus centro R, radio RA descriptus, tot punctis secabit Parabolam, aut aequatio proposita veras habet radices; e.gq, erat perpendiculara $Z Y$ a punctis intersectionum $Y$ in axi parallelam BK demissa; quarum quæ ad dextram lineæ BK Affirmativa sunt, ad sinistram Negativa.

Hujus Constructionis commoditas in eo consistit, quod circulo per Verticem transeunt peragitur, perinde ac si defusisset secundus Terminus; ideoq, ad Radicum Numerum determinandum, sufficit Locis five Lineæ Curva proprietates perspectas habere, qua spatia discriminat, ubi si ponatur centrum Circuli qui per Parabolæ Verticem transeat, circumferentia ejus vel uno vel tribus aliis punctis eam secabit; hoc est Lineæ curva, in quam incidunt centra omnium Circulorum per verticem transeuntium ac deinde Parabolam tangens, naturam definire.

Locus autem ille est Parabolæ, quam cum Cl. Wallisio semicubicalem appellare licet, five-in qua Cubi applicatorum ad Axem sunt inter se ut Quadrata portionum Axis. Cujus Latus rectum est $\frac{27}{8}$ Lateris recti datae Parabole, Vertex vero punctum V (Fig. I.) existente AV dimidium lateris recti ejusdem Parabolæ. Hoc est, si ponatur Unitas pro latere recto datae Parabola, C C C 2
bola, \( \frac{s}{27} \) cubi ordinatim applicata aquabuntur quadrato partis diametri, five cubus \( \frac{1}{2} \) V H quadrato ex HR, si scil. R sit centrum circuli qui per verticem Parabola transeat eamq; deinde contingat; Hac est Curva illa quam primus mortalium Nellius Noferas recta data aequalem demonstravit, eaq; occasione apud Principes Geometrarum dudum celebris; ejusq; proprietates Cl. Wallisius sub finem Libri de Cissoidc, & Hugenius prop. 8 & 9 de linearum Curvarum evolutione, aliiq; acri ingenio discipi- vere, Quorum scripta consultat Lectur. Hac Curva utrinq; ab Axe Parabolae descripta, viz. V NL, V PX, spatium completi- tur, in quo si ponatur centrum Circuli, qui per verticem A transeat, intersecabit ille Parabolum in tribus aliis punctis; Spa- tia vero ab Axe remotiora centra praebeat circulis non nisi uno prater verticem puncto Parabolam secantibus.

His probe intellectis jam ad determinandum Radicem numer- um accingimur: Ac primum deficiat secundus terminus; sitque: Latus rectum \( \frac{1}{1} \), vel AV = \( \frac{1}{1} \); In constructione V H est \( \frac{1}{1} \) p, HR vero \( \frac{1}{1} \) q; cumq; si fuerit + p, ab V versus superiora ponendo sit \( \frac{1}{1} \) p, centrum circuli extra spatium LVX semper con- sistitur; ideoq; una tantum radice explicabils est, affirmativa si \( \frac{1}{1} \) q, negativa \( \frac{1}{1} \) q: qua quidem radices Cardani Regulis investigantur. Si vero fuerit \( \frac{1}{1} \) p, VH = \( \frac{1}{1} \) q inferne poni- tur, ac fieri potest ut HR cadat inter Axem & Curvam VX vel VL, si scilicet Cubus ex \( \frac{1}{1} \) V H, five ex \( \frac{1}{1} \) p, major si quam quadratum ex \( \frac{1}{1} \) q, five \( \frac{1}{1} \) p p p major quam \( \frac{1}{1} \) q q, quo in casu tres dantur radices, dux Negativa, si fuerit \( \frac{1}{1} \) q, ac una Affir- mativa earum summa aequalis; vel \( \frac{1}{1} \) q, dux Affirmative unaq; Negativa. Quod si \( \frac{1}{1} \) p p p minor sit quam \( \frac{1}{1} \) q q, una tantum reperitur Radix, Affirmativa si \( \frac{1}{1} \) q, negativa si \( \frac{1}{1} \) q. Atq; hac passim docentur ab iis qui hanc Geometriæ par- tem tractarunt.

Jam afsint omnes termini, ac primum proponatur, Exempli causa, aequatio hæc \( z' - z^2 b + z^3 p = q = 0 \) cui etiam Figuram I. adaptavimus. In hujus constructione BC = \( \frac{1}{1} \) b, VG = \( \frac{1}{1} \) AC = \( \frac{1}{1} \) bb, VE = \( \frac{1}{1} \) bb, VH = bb = \( \frac{1}{1} \) p, GH = bb = \( \frac{1}{1} \) p vel \( \frac{1}{1} \) p = \( \frac{1}{1} \) bb, bine HO = \( \frac{1}{1} \) b' = \( \frac{1}{1} \) b p vel \( \frac{1}{1} \) b p = \( \frac{1}{1} \) b', atq; HR five distan-
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tia Centri circuli R ab Axe, est semper differentia inter \( \frac{b}{b} \)
\& \( \frac{1}{b} \) b; quae si \( \neq \) quantur, centrum cadit in Axe; si \( \frac{b}{b} \)
major sit quam \( \frac{1}{b} \) b; \( \frac{1}{q} \) ad finisprim Axis, sin minor ad dex-
tram. Si ita\( \text{q} \); Cubi ex \( \frac{V}{V} \), (hoc est \( \frac{q}{b} = \frac{1}{b} \) q
nominemus d) Latus quadratum sive \( \sqrt{d \cdot d} \), majus sit quam
\( HR \), sive differentia inter \( \frac{1}{b} \) b; \( \frac{1}{q} \) \& \( \frac{1}{b} \) p; reperitur cen-
trum \( R \) intra spatum \( NP^2 \), Paraboloidibus \( VFX \), \( VNL \)
ae recta intermitata \( DNP \) circumscripsum: ac proinde circu-
lus Parabolam secabit in tribus punctis \( Y, Y, Y \), ad dextram li-
nea BK sitis, atq\( ; \) adeo aquatio tres habet radices Affirmati-
vae. Centro vero extra boc spatum \( NVP \) constructo, non ni-
fi una radice Affirmativa explicari potest. Hic obiter notam-
dum rec\( \text{t} \)am \( DP \) Paraboloidem \( VFX \) tangere in puncto \( P \), ex-
istentem \( EP \) \( \frac{1}{b} \) b; alteram vero \( VNL \) secare in puncto \( N \),
ita ut demisso in axem Perpendiculo \( NF \), \( VF \) sit pars quarta
ipsum \( EV \) sive \( \frac{1}{b} \) bb, \( NF \) vero \( \frac{1}{b} \) b. \( VV \) autem, quae e
puncto \( V \) axi perpendiculariter ere\( \text{c} \)a linea \( DP \) occurrit in
\( W \), aequalis est \( \frac{1}{b} \) bbb sive \( EP \).

Hinc tuto concluditur si in equatione vel \( p \) major sit quam
\( \frac{1}{b} \) b, vel \( q \) major quam \( \frac{1}{b} \) b; non nisi unam eamq\( ; \) affirmati-
vam radicem reperiri; Fallit itaq\( \text{q} \); Regula Cartesii (Edit.
Amst. 1659 pag. 70) ubi tot veras dari radices quot sunt in
equatione mutationes signorum + & - pronunciat, frustra e-
tiam in Commentariis Suis Sphalma hoc excusante Schootenio;
Fingi enim possunt infinites plures equationes pr\( \text{e} \)cedentis formu-
læ tres signorum mutationes habentis, que unam tantum quem
que tres habeant radices. Propositio etiam quinta Sectionis
quinta Artis Analyticae Harriottii Noftri, uti Prob. 18 Nume-
rosæ Pote\( \text{s} \)t. Resol. Vietæ, \( \text{vix satis firma est, cum ex limitati-
onibus quas ibi possuerint, toti parallelogrammo \( PIV \) W id con-
veniat, quod soli spatio \( NVP \) am comptere probaminus, boc
est ut centrum pr\( \text{a} \)beat circulo tribus aliis punctis pr\( \text{a} \)ter vert-
icem Parabolam se\( \text{c} \)ante.

Quantitatis autem \( q \), sive terminus ult., datis \( b \) \& \( p \), ea legi
ut \( p \) minor sit quam \( \frac{1}{b} \) bb, accuracie limitatur ex pr\( \text{e} \)cedente equatione
\( \sqrt{d \cdot d} = \frac{1}{b} \) b; \( \frac{1}{q} \) \& \( \frac{1}{b} \) p; cum scil. Circulus Parabo-

D d d
iam contingat. Itaq; \( \frac{1}{2} q \) minor esse debet quam \( \frac{1}{2} b \ p - \frac{1}{2} b' \) \( \sqrt[3]{d} d d; \) at si \( p \) major fuerit quam \( \frac{1}{2} b \), majorem etiam esse o- 
portet \( \frac{1}{2} q \) quam \( \frac{1}{2} b \ p - \frac{1}{2} b' \) \( \sqrt[3]{d} \) ne cadat centrum in spati-
olo N V W. Atq; his conditionibus aequatio semper triplici 
radice explicabilis erit, aliter non nisi una. Semper vero, five 
tres five una, Affirmativa sunt, ob positionem centri \( R \) ad dext-
tram lineæ \( D \). 

Atq; hic est casus maxime difficilis, ita ut quincunq; premissa 
bene callet sequentia facili negatio intelliget. Detur jam a-
quatio \( z' - b z' + p z + q = 0 \). Hic ut tres habeantur ra-
dices, oportet centrum circuli allicubi intra spatiwm \( P N \Delta \), 
rectis \( P N, P \Delta \) & curva Paraboloidis \( N \Delta \) definitum, reperi-
ri; quapropter cum \( E F \) sit \( \frac{1}{2} b \ b, \) \( p \) minor esse debet quam \( \frac{1}{2} b b; \) 
jam ad determinationem quantitatis \( q, \) existente \( d = \frac{1}{2} b b - \frac{1}{2} p \) 
ut antea, \( \sqrt[3]{d} d d + \frac{1}{2} b b - b p \) semper major esse debet 
quam \( \frac{1}{2} q, \) ut constitutur centrum circuli in spatio prædicio 
\( P N \Delta \); quod cum sit aequatio talis duas habet radices Affirm-
avas ac unam negativam. Si vero \( p \) major est quam \( \frac{1}{2} b b, \) eul \( \frac{1}{2} q \) 
major quam \( \sqrt[3]{d} d d + \frac{1}{2} b b b - b b p, \) non nisi una eaq; ne-
gativa radice explicabilis est.

Proponatur jam aequatio \( z' - b z' - p z - q = 0 \). Ut hac 
aequatio tres habeat Radices, oportet centrum circuli allicubi inven-
iri in spatio indefinito, inter rectam \( D P D \) & curvam Para-
boloidis \( P X \); hic quantitas \( p \) non est obnoxia limitationibus, 
\( \frac{1}{2} q \) vero semper minor esse debet quam \( \sqrt[3]{d} d d - \frac{1}{2} b b b - b p, \) post-
to \( d = \frac{1}{2} b b + \frac{1}{2} p \); Hoc patcio duas dantur Radices Negativæ, 
ae una Affirmativa; aliter vero \( \frac{1}{2} q \) major sit quam \( \sqrt[3]{d} d d - 
\frac{1}{2} b b b - b b p, \) unica tantum Affirmativa exponi potest.

Quarto loco sit aequatio \( z' - b z' + p z + q = 0, \) qua duas 
Affirmativas habet Radices ac unam Negativam si centrum circ-
uli reperiatur in spatio indefinito inter rectas \( P \Delta, P D \) ac cur-
vam Paraboloidis \( \Delta L \); hoc est, (posto \( d = \frac{1}{2} b b + \frac{1}{2} p), \) si \( \frac{1}{2} q \) 
major sit quam \( \sqrt[3]{d} d d + \frac{1}{2} b b b + b p; \) si vero \( \frac{1}{2} q \) major 
hac quantitate fuerit, una tantum Negativa ineat radix.

Quatvor autem aequationes reliqua, in quibus habetur \( + b, \) quo-
ad limitationem Numeri Radicum non different a prædictis, \( b \) sign-
nulla vero omnino Affirmativa. Sic in $z^2 + bz + p z + q = 0$ duas sunt Negativae & una Affirmativa, si $p$ minor sit quam $\frac{3}{7} b$, et $q$ minor quam $\sqrt{d} + \frac{1}{7} b$; quemadmodum in $z^2 - b z^2 + p z + q = 0$ duas erant Affirmativae & una Negativa; excedentibus autem leges praestiptas $p$ vel $q$, una tantum hic est radix Affirmativa, qui ibi Negativa erat. Pari modo in $z^3 + b z^2 - p z + q = 0$ vel duas sunt Affirm. ac una Neg. vel una Negativa tantum. Deniq, sidem de causis in aequatione $z^2 + b z^2 - p z - q$ duas sunt Negativae & una Affirm. vel una Affirm. tantum, quibus in aequatione $z^3 - b z^3 - p z + q$ duas erant Affirm. & una Negativa, vel una Negativa tantum, nempe proinde $\frac{3}{7} q$ major vel minor fuerit quam $\sqrt{d} + \frac{1}{7} b + \frac{3}{7} b p$.

Si defuerit terminus tertius, hoc $p z$, centrum $R$ semper cadit in linea $P E \Delta$, quocircum si fuerit $z^3 - b z^3$. * $- q$ vel $z^3 + b z^3$. * $+ q$, una tantum esse potest radix, si $b$ Affirmativa, $b + b$ Negativa. At si fuerit $z^3 - b z^3$. * $+ q$ vel $z^3 + b z^3$. * $- q$, duas possunt esse Affirmativae ac una Negativa in priore, vel una Affirm. & una Neg. in posteriori, cadente centro in linea $P \Delta$ inter $P$ ac $\Delta$, hoc est si $\frac{3}{7} q$ minor, sit quam $\frac{1}{7} b$; fin major fuerit, una tantum Negativa in priore, vel una Affirm. in posteriori datur potest.

Hactenus numerum radicum in Cubicis aequationibus plenius afferuntur, resit ut nonnulla adjiciam de quantitate radicum. Hic primum notandum quod omnis aequatio tres habens radices ope Tabula Sinuum, Trisectione scilicet anguli, satis expedite resolvi possit; ponendo scil. $\sqrt{3bb - \frac{3}{7} p}$ vel $\sqrt{4d}$, si fuerit $+ p$, in aequatione, vel $\sqrt{3bb + \frac{3}{7} p}$, si $- p$, pro Radio Circuli; Angulum vero trissecandum qui Sinum habeat in Tabula Sinuum $\frac{3}{7} b^3 + \frac{3}{7} b p + \frac{3}{7} q$: Invento hoc angulo, Sinus $\sqrt{d d d}$ d d 2. ter-
tertia partis ejus, ut & Sinus tertia partis compl. ad Semicirculum, eorumq; summa, ex Tabula Sinuum dabuntur. Hi vero Sinus in Radium \( \sqrt{\frac{3}{2}b \cdot b + \frac{1}{3}p} \) ducendi sunt, & babebuntur quantitates (\( y \land, y \land, y \land, y \land \) in Fig.) quarum \( \sqrt{\frac{3}{2}b} \) vel summa vel differentia, prout casus postulat, veras radices \( \text{Equatio-} \)nis exhibebunt. Hac omnia ex inventis Cartesii derivantur: Ut vero casus omnes quantum fieri possit breviter complectar, disco quod centro \( R \), in prima \( \text{equationum formula, cadente in spatio} \ V \ G \ P \); sectiones d\( u \) e \( Y \), \( Y \), cadunt inter \( A \) & \( B \), ac proinde utraq; ex minoribus radicibus minor est quam \( \frac{1}{3}b \), tertia autem \& major semper superat \( \frac{1}{3}b \), superatur vera a \( b \). Quod si cadat in \( \text{spatio} \ G \ N \ V \), d\( u \) e mai\( o \)res sunt quam \( \frac{1}{3}b \), minores vero quam \( \frac{1}{3}b \), tertia vero est \( b \) — duabus alteris, ac proinde minor quam \( \frac{1}{3}b \): sed adhibita limitatione quantitatis \( p \), æqualis-ribus terminis radicis includuntur. Maxima enim radicis \( p \) minor est quam \( \sqrt{\frac{3}{2}b \cdot p + \frac{1}{3}b} \), major vero quam \( \sqrt{\frac{3}{2}b \cdot b - \frac{1}{3}p} \); at cum \( \frac{1}{3}b \cdot b \) minor est quam \( p \), limes ille fit \( \sqrt{\frac{3}{2}b \cdot b - \frac{1}{3}p} + \frac{1}{3}b \). Radix media semper minor est quam \( \sqrt{\frac{3}{2}b \cdot b - \frac{1}{3}p} + \frac{1}{3}b \); major vero quam \( \frac{1}{3}b - \sqrt{\frac{3}{2}b \cdot b - \frac{1}{3}p} \); hunc vero limitem non-quantum excedit radix minima, sed cum quantitate \( q \) evanescit.

In secunda formula praescriptis legibus d\( u \) e sunt affirmative ac una negativa, ac cadente centro in \( \text{spatio} \ G P E \) altera ex affirmative \& minor est, altera minor quam \( \frac{1}{3}b \), major vero non excedit \( b \). Negativa autem major non esse potest quam \( \sqrt{\frac{3}{2}bb - \frac{1}{3}b} \), est autem differentia ipsius \( b \) \& summa Affirmativae. Centro autem in \( \text{spatio} \ G P E \ D \) posito, utraq; Affirmativa major est quam \( \frac{1}{3}b \), minor vero quam \( \sqrt{\frac{3}{2}bb + \frac{1}{3}b} \), Negativa vero semper minor est quam \( \frac{1}{3}b \). Limites autem propriores ex data \( p \) evada- dunt, radicis quidem maxima Affirmativa \( \sqrt{\frac{3}{2}b \cdot b - \frac{1}{3}p + \frac{1}{3}b} \), qua semper minor est, ut \& major quam \( \sqrt{\frac{3}{2}bb - \frac{1}{3}p + \frac{1}{3}b} \); hoc tamen limite minor est altera Affirmativa, quae cum quantitate \( q \) minuitur: Negativa vero semper minor est quam \( \sqrt{\frac{3}{2}bb - \frac{1}{3}p - \frac{1}{3}b} \), ac deficiente quantitate \( q \) evanescit.

In tertia formula d\( u \) e Negat. sunt ac una Affirmativa: in hac, ut &
ut & in quarta, Radices non limitantur a quantitate. Affer-
mativa vero semper minor est quam $\sqrt{\frac{1}{3}b b + \frac{1}{3}p + \frac{1}{3}b}$, ma-
jor tamen quam $\sqrt{p + \frac{1}{3}b b + \frac{1}{3}b}$; maxima vero ex Nega-
tivis semper major est quam $\sqrt{\frac{1}{3}b b + \frac{1}{3}p - \frac{1}{3}b}$, minor vero
quam $\sqrt{p + \frac{1}{3}b b - \frac{1}{3}b}$. Minor autem ex Negativis semper
minuitur cum minuta quantitate q.

In quarta formula, cadente centro intra spatium $L \Delta P D$, si
due sint Affirmativa ac una Negativa, maxima ex Affirma-
tivis major esse nequit quam $\sqrt{p + \frac{1}{3}b b + \frac{1}{3}b}$, nec minor quam
$\sqrt{\frac{1}{3}b b + \frac{1}{3}p + \frac{1}{3}b}$; minor vero radix ab hoc limite minuitur,
minuta quantitate q. Negativa autem minor est quam
$\sqrt{\frac{1}{3}b b + \frac{1}{3}p - \frac{1}{3}b}$; major vero quam $\sqrt{p + \frac{1}{3}b b - \frac{1}{3}b}$.

Notandum vero hoc radices Negativas ubiq\', signo Affirmati-
vo notari, quia ha sunt radices Affirmativa quatuor aequationum
illarum, in quibus habitur + b, ac q signo contrario notatur; ut
supra monu. Horum omnium demonstratio ex eo consequitur,
quod ubicung; centrum circuli R incidit in Lineas Curvas
V P X vel V A L, circumferentia ejus Parabolam tangit in
puncto, cujus distantia ab axe est $\sqrt{\frac{1}{3}V H}$, eamq; secat ex al-
tera Axis parte, ad distantiam 2 $\sqrt{\frac{1}{3}V H}$; cum vero centrum
cadit in lineam $D P D$, altera ex radicibus fit =0, ac proinde
Cubica reducitur ad Quadraticam, sive ad $z^2 - b z + p = 0$ cu-
jus radices limites designant ubi evanescit quantitas q: ac quo
minor est q, eo propius ad bas limites accedunt radices. Qua-
dratica est etiam cum centrum cadit in Axe; hoc est, cum $\frac{1}{3}q =
\frac{1}{3}b p - \frac{1}{3}b$ in prima formula; vel $\frac{1}{3}q = \frac{1}{3}b b - \frac{1}{3}b$ in
secunda; in tertia impossibile est; at in quarta cum $\frac{1}{3}q =
\frac{1}{3}b b + \frac{1}{3}b p$; quo in casu minor ex Radicibus Affir-
mativis est $\frac{1}{3}b$, major $\sqrt{\frac{1}{3}b b + p + \frac{1}{3}b}$; Negativa vero $\sqrt{\frac{1}{3}b b + p}
- \frac{1}{3}b$. In prima, Radices sunt $\frac{1}{3}b & \sqrt{\frac{1}{3}b b + p + \frac{1}{3}b}$; In
secunda vero formula, $\frac{1}{3}b & \sqrt{\frac{1}{3}b b - p + \frac{1}{3}b}$ sunt Affirmati-
va: Negativa autem $\sqrt{\frac{1}{3}b b - p - \frac{1}{3}b}$.

Atq\', hoc in Cubicis sufficere posse videntur; ob eximum ve-
ro Usum Methodi, qua ope Tabula Sinuum radices harum aequati-
E e e

onum
onum inveniuntur, placuit unum vel alterum exemplum adjungere, ut praxis illius compendium inde innotescat. Proponatur
Equatio \( z \cdot z - 39 \cdot z + 479 \cdot z - 1881 = 0 \); quarum
tur radices \( z \). \( \sqrt{\frac{1}{3} b \cdot b - \frac{1}{3} p} = \sqrt{9 \frac{1}{3}} = \sqrt{d} \), cujus duplex \( \sqrt{37 \frac{1}{3}} \)
radius est Circuli; \( \sqrt{\frac{1}{3} b \cdot b + \frac{1}{3} p} = \frac{2197}{940} \).

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facia divizione ope Logarithmorum, Log. \( 9.9251560 \), cujus respon
det, Angulus \( 57^\circ \) 19m. \( 11^\circ \); Hujus tertia pars \( 19^\circ \) 6m. \( 24^\circ \).
\& complemen ti \( 40^\circ \) 5m. \( 36^\circ \). Sinus dant Log. \( 9.514983 \).
\& \( 9.816011 \), qui duce i in Rad. \( \sqrt{37 \frac{1}{3}} \) producunt \( Y \) \& \( Y \) \&
Log. \( 0.301030 \) = 2 \& Log. \( 0.601059 \) = 4, tertia vero \( Y \) \&
equalis est eorum summa five 6. Ideoq; radices sunt \( 13-4=9 \).
\& \( 13-2=11 \ \& \ 13+6=19 \), ex quibus singulis conflatur praeita
equatio. Ubi Notandum duas minores radices non excedere
\( \frac{1}{3} b \) vel \( 13 \), quia centrum \( R \) in constructione cadit ad dextram
Axis; id est \( \frac{1}{3} b \) minor est quam \( \frac{1}{7} b^1 + \frac{1}{7} q \).

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Exemplum alterum sit \( x^3 - 15x^2 - 229x - 525 = 0 \).
\& quarantur radices. \( \sqrt{\frac{1}{3} b \cdot b + \frac{1}{3} p} = \sqrt{101\frac{1}{4}} = \sqrt{d} \), \& Ra-
dius Circuli \( \sqrt{405\frac{3}{4}} \). \( \frac{1}{2} b^3 + \frac{3}{5} b \cdot p + \frac{3}{5} q \) \( 125 + 572\frac{2}{3} + 262\frac{2}{3} \)

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\[ \frac{960}{101\frac{1}{4}} \sqrt{101\frac{1}{4}} = \text{Sinui Tabularis Arcus, cujus Log.} \ 9.9736426 \].
\& Arcus ipse \( 70^\circ \) 14m. \( 22^\circ \). buxus pars tertia est \( 23^\circ \) \( 24^\circ \).
\& \( 47\frac{7}{8} \). \& complemen ti \( 36.35.12\frac{1}{4} \); quorum Sinus Log.
sunt \( 9.599183 \ & 9.775275 \), quibus addito Log. \( \sqrt{405\frac{3}{4}} \) sunt
Log. \( 0.903089 \ = 8 \ & \ Log. \ 1.079181 \ = 12 \, \& \ eorum summa
= 20. Hinc concluditur \( 20 + \frac{1}{3} b \) vel \( 25 \) equari radici Affirmative, \& 8 \ & 12 \ & \( \frac{1}{3} b \) five 3 \ & 7 Negativis. Quod si quinquies
fuit \( x^3 + 15x^2 \) \( - 229x + 525 = 0,3 \ & \ 7 \) fuisent Affirmative; \( 25 \) vero Negativa. Caetera autem Cubica unica
 tantum Radice explicabiles juxta Regulas Cardani resolven-
dae sunt, postquam demptus fuerit secundus terminus; nec vi-
deo quo paefo minori calculo hoc negotium peragii possit. At si
desideretur radix haec in Quantitatibus \( b, p, q \) expressa, dico
eam
eam esse in prima formula, $\frac{1}{3}b + vel = \text{summa vel differentia}\n$ Raticum Cubicarum ex $\sqrt[3]{qq - \frac{1}{6} p^2 + \frac{1}{7} b^2 - \frac{1}{8} bpq + \frac{1}{7} p' + \frac{1}{7} b' + \frac{1}{7} q - \frac{1}{8} bp}$: viz. $+\frac{1}{7} b' + \frac{1}{6} q$ major sit quam $\frac{1}{8} bp$, aliter — Summa vero quoties $\frac{1}{5} b$ major est quam $p$; sin minor fuerit $\frac{1}{5} b$, differentia. Inq; ceteris formulis radix semper conflatex ex iiisdem elementis, variatis tamen signis $+ \&$, ut facile percipiet qui velit experiri.

Ope vero Tabulæ Logarithmicae Sinuum Versorum Radices ha fatis prompte inveniuntur; nempe fi Coefficientes Numeri sint Surdi vel fractionis, ac radices Numeris ineffabiles; ut plerunque sint. Hac autem est Regula: In prima ac secunda formula, fi $\frac{1}{5} b$ minor sit quam $p$, sit $\frac{1}{5} p - \frac{1}{5} b = d$, & posta differentia inter $\frac{1}{5} b p \& \frac{1}{5} b' + \frac{1}{5} q$, hoc est HR, in prima, ac inter $\frac{1}{5} b p + \frac{1}{5} q \& \frac{1}{5} b'$, in secunda, pro Radio; inveniatur angulus cujus Tangens est $d \sqrt{d}$. Deinde ut Cosinus hujus anguli, ad ejusdem Sinum versum: ita differentia pro Radio habita, ad quantum; cujus Latus cubicum trisecando Logarithmum habebitur: ac diviso $\frac{1}{5} p - \frac{1}{5} b$ per hoc Latus Cub. e Quoto subducatur Divisor: Residuum erit quantitas $X \&$, in Fig. I. Hujus Residui ac $\frac{1}{5} b$ summa, fi centrum cadit ad dextram Axis, aliter differentia earundem, Radix erit quæstis. Quod si $\frac{1}{5} b$ major sit quam $p$, posito HR pro Radio, sit $d \sqrt{d}$ five distantia Paraboloidis ab Axe, Sinus Arcus cujusdem; Hujus Sinus versus ducatur in Radium, five $\frac{1}{5} b p - \frac{1}{7} b' + \frac{1}{7} q$, ac triseclo produci Logarithmum, habebitur ejus Latus Cubicum, per quod dividatur $\frac{1}{5} b - \frac{1}{5} p$. dico Quotie ac divisoris summam eadem Lege additam vel ablatam ex $\frac{1}{5} b$, Radicum quæstis exhibere. Ac par est ratio in tertia ac quarta formulis, nisi quod $\frac{1}{7} b b b + \frac{1}{7} b p + \frac{1}{7} q$ pro Radio assumenda est, ac $\frac{1}{5} b b + \frac{1}{5} p$ in $\sqrt{\frac{1}{5} b b + \frac{1}{5} p}$ five $d \sqrt{d}$ pro Sinu: Sed hac præcepta exemplis fortasse melius percipientur.

Sit aquatio Cubica $zzz = 17 zzz + 54 z = 350$, ac quadratur Radix z: Hic $\frac{1}{5} b$ major est quam $p$, sed $q$ major est quam Cubus ex $\frac{1}{5} b$, ideoq; una tantum Affirmativa Radice explicabilis est. Fan $\frac{18}{9} - \frac{54}{3}$ est $d$, ac $\frac{17}{9} \sqrt{\frac{17}{9}}$ pro Sinu habenda est, ad Radium $\frac{49}{13} + 175 = 153$, hoc est $\frac{107}{27}$: E e e 2 Arcus
Arcus vero competens fit 15gr. 31m. 49s. Hujus Sinus Versi Log. 8.5362376. additus Log. Radii 2.3695913. dat. 0.8457-889. cujus tertia pars 0.2819276. est Log. Radicis Cubica 1.91394, quo divisore diviso \( \frac{17}{3} \) sive d. fit Quotus 7.37281; Quotis ac divisoris summa, auxia additione \( \frac{3}{3} \), fit Radix qua-fita, nempe 14.9534, &c.

Exactis Cubicis Biquadraticas jam aggrediamur; Hæ sem-per vel nullam, vel duas, vel quatuor Radices veras habent, quærum determinatio partim a Coefficientibus, partim a signo & magnitudine numeri absoluti dati, pendet; Harum omnium Constructionem generalem (in No. 188. Pag. 341) satis con-cinnam prodidi, quam Lectorem jam vidisse supponitur; Figuram tamen eo spectantem (Fig. II.) huc transferre visum est. In Con-
structione equationis \( z^4 - b z^3 + p z^2 - q z + r = 0 \), fit
BD = \( \frac{1}{6} \)b, AB = \( \frac{1}{6} \)b b, BK = \( \frac{3}{2} \), sive dimidio Lateris recti,
KC = 2 AB = \( \frac{1}{6} \)bb. KE = \( \frac{1}{6} \)b - \( \frac{1}{6} \)p, AE = \( \frac{3}{6} \)b b - \( \frac{3}{6} \)p
FE = \( \frac{1}{6} \)b, ac EG = \( \frac{1}{6} \)b b - \( \frac{1}{6} \)b p + \( \frac{1}{6} \)q; quo facto
Circulus centro G, Radio \( \sqrt{GD^3} - r \), interfecabit Parabolam
vel nullo, duobus aut quatuor punctis, quæ perpendicularis in line-
am DH, Radices omnes z exhibent. Ut autem quatuor sunt,
evidens est centrum circuli alicubi constitui debere intra spati-
um, de cujus puncto quovis tria perpendiculara in Curvam Para-
bola demitti possint; atq; simul radium minorem esse maximo ex illis perpendicularibus, majorem vero medió. Quod si centrum
constituatur extra boc spatium, ut non nisi una perpendicularis
in Parabolam demitti possit, qua major fit radius; vel si minor fit
media ex tribus perpend. major vero quam minima ex illis, due
tantum possunt esse radices; nulla vero omnino datur, quoties
radius \( \sqrt{GD^3} - r \) minor est minima ex tribus, vel una illa,
quoties una tantum est.

Jam quale spatium hoc fit, quibusq; limitibus discernitur,
ac quibus conditionibus radius Circuli minor vel major fit pre-
dictis perpendicularibus, nobis restat inquirendum; ac primum
quo facto perpendicularis in Parabolam demitti possit ostenden-
dum est.

Sit A
Sit ABC Parabola, AE Axis ejus, AV (Fig. III.) semi-Latus reëturn, G punctum de quo demittenda est perpendicularis: Ducatur Axe perpend. GE, ac bisectatur VE in F, & ereëta perpend. FH ad idem Axis Latus, fiat FH = ¼ GE; dico quod Circulus, Centro H, radio HA discriptus, Parabolam intersecabit in punctis tribus vel uno Z; ad qua duëla reêta GZ Curva Parabolica perpendiculariter insitunt.

Ut autem tres sint hujusmodi intersecutiones, oportet centrum circuli H ita collocari, ut sit intra spatium Paraboloidibus (in Fig. I.) inclusum; hoc est ut FH minus quam \( \sqrt{\frac{8}{7}} VF \) sive \( FH^2 \) minus quam cubus ex \( \frac{1}{7} UF \); atq; adeo GE = 4FH minor erit quam \( 4 \sqrt{\frac{8}{7}} VF \) sive \( 4 \sqrt{\frac{1}{7}} VE \), hoc est quadratum ex GE minor erit quam \( \frac{15}{7} VE \). Coincidunt itaq; hi limites cum Paraboloidibus duas ejusdem generis cum iis quibus in Cubicus usi sumus, sed quorum Latus reëturn duplo minor est; viz. \( \frac{17}{16} \) Lateris reëti Parabola, hoc est \( \frac{17}{8} ipsius AV \): ideoq; ea ipsa est linea Curva cujus evolutione generatur Parabola, sic demonstrante Hugenio; quamq; semper contingit linea DF, (Fig. II.) que Parabola perpendiculariter insitit in puncto D. Punërum autem P, sive in quo contingit recta DF Paraboloidem, centrum est Circuli, qui radio DP descriptus cum Parabola in puncto D coincidit, sive ejusdem Curvitatis est; ut per se satis constat.

Descriptis itaq; hujusmodi Paraboloidibus VXO, VN\( \Delta \) (Fig. II.) utrinqu\, ab Axe\, perspicuum est quod, nisi centrum Circuli constitutatur intra hos limites, non possit ille pluribus quam duobus in punctis Parabolam intersecare: unde determinare licet quibus sub conditionibus Coefficientes terminorum intermediorum coercentur, in equationibus Biquadraticis, ut habeantur quatuor radices. Ac prima fronte clarum est p majorem esse non potesse quam \( \frac{1}{b} b \) (sic. in formulis ubi babetur + p) nec q quam \( \frac{1}{6} b \). Generaliter vero \( \frac{1}{6} b + \frac{4}{p} b + \frac{9}{q} \), id est distantia centri ab Axe EG, minor esse debet quam BH = \( 4 \sqrt{\frac{1}{7}} VE \), hoc est (ob VE = \( \frac{15}{7} b \) b + p) quam \( \frac{1}{6} b \)

\( \frac{1}{6} p \sqrt{\frac{1}{6} b} + 2 + p \); signis + & — in dubio reliquis, ut secundum equatio nis cujusvis naturam variari possint; quem admodum
admodum in Cubicis superius ostensum est; ac nollem deditum in dicentibus singula particulatim remanere vol-uptatem ac exercitationem praevere.

Termini autem ultimi r limitatio eadem facile inveniri nequit; id adeo, quia Problema sit Solidum, in Curvam Parabolae demittere perpendiculararem, quodq, non sine solutio a- quationis Cubicæ resolvi possit. Itaq, prima loco deficiat secun- dus terminus, vel si adsuerit, tollatur, ut aequatio habeat formu- lam 2. x. p z. q. z. r. = 0. Ac si fuerit — r, semper dubius vel quatuor Radicibus explicari potest; ut autem quatuor sint, o- portet centrum circuli intra Paraboloides prædictas constitui, five ut fit — p, ac q q minus quam \( \frac{2}{9} p \) five cubo ex \( 3 \). Deinde habeantur radices aequationis hujus y. * * p y. \( \frac{1}{9} q = 0, \) quantitatibus p & q iisdem signis annexis quibus in Biquadra- tica. Ha autem Radices auxilio Tabulae Plouum satis expedite inveniuntur. Inventis autem tribus illis y, (qua sunt ordi- natis applicatae ad Axem Parabolae, de punctis ubi incident per- pendicula in Curvam ejus, scil. Z Y in Fig. III.) p y y — 3 y e x minore y, quantitatem maximam r designabit, si fuerit — r; qua si minor fuerit r, aequatio quatuor habebit radices, aliter du- as. Ast si fuerit — r, oportebit eam minorem esse quam 3 y — p y y ex media y, nam si major sit, non nisi duas habere potebatur radices, saltem si minor sit r quam 3 y — p y y ex maxima y. Hac vero si major sit, nulla omnino radice vera explicabilis est aequa- tio. Hi vero iidem limites aliter designantur ex quantitate q, scil. q y — y in primo casu, y — q y in secundo, ac y + q y in tertio.

Fieri autem potebatur ut duæ minores quantitates y non longe diffirent ab invicem, unde eventit quod utraq; ex perpendiculara- ribus major sit quam restra G A, scil. cum q q majus sit quam \( \frac{1}{9} p \), minus vero quam \( \frac{2}{9} p \); cadente centro intra spatum Pa- raboloidibus utriusq; Figuræ I & II interjedunt. Hoc in ca- su, si fuerit + r, non nisi duas possunt esse radices, existente y + q y ex maxima y, major quàm r, aliter nulla. At si \( q y — y \) ex minima y, major fuerit quàm r signo— notata, r vero major quàm \( q y — y \) ex media y, tunc habeantur quatuor ra- dices
dices; at duæ tantum sì vel major priore vel minor posteriore inventa sit r.

Si vero in æquatione fuerit + p, vel sì sit — p & q q major fuerit quam \( \frac{5}{2} p' \), æquatio y'. * 1 p y' uq unica tantum explicatur radice y; hoc est una tantum perpendicularis de centro Circuli demittit potest: unde certo concluditur duas tantum radices haberi posse in æquatione data, quarum summa, sì fuerit — r, cum quantitate r augetur; at sì habeatur + r, obtenta quantitate y, quantitas illa r minor esse debet quam y' + q y; nam sì ea major sit, æquatio proposita absurda & impossibilis est.

Longum & superfluum est tot omnes hujus census æquationes percurnere, cum ex jam diēris attendenti satis evidens sit, quæ Negativæ, quæ Affirmativæ sunt; atq; quod Radicum barum Limites ex quantitatibus inventis y petantur. In exemplum vero, quod cuivis in ceteris imitati licet, proponuntur indagandi limites fīve conditiones, sub quibus in Àequatione Biquadricata 4 Radices Affirm. dari possint. Hoc autem fit quoties centrum circuli G ponitur in spatio UPK, (Fig. II.) ac simul habeatur + r sive Circuli radius minor quam GD: Unde patet, æquationem de qua agitur hujus esse formula z' — b z' + p z' — q z + r = 0; p vero majorem esse non posse quam b b, nec \( \frac{4}{p} b \) hoc in casu, quam \( \frac{1}{2} b' + \frac{1}{2} q \); deinde opus est ut \( \frac{4}{p} b - \frac{p}{4} \) in \( \sqrt{\frac{1}{2} b b - \frac{p}{4} b} \) major sit quam \( \frac{1}{6} b' + \frac{1}{2} q - \frac{5}{4} p b \); & ex his limitibus certo constabit centrum intra spatium UPK inventi. Ut vero definitur quantitas r, solvenda primum est Cubica y'. * — \( \frac{1}{6} b' - \frac{p}{4} y = \frac{1}{12} b' + \frac{1}{2} q - \frac{3}{4} p b \); S habeuntur puncta, in quæ perpendiculares de centro in Curvam Parabolæ cadunt.

Inventis autem tribus valoribus hujus y, r minor esse debet quam \( \frac{1}{5} b' + \frac{1}{4} b q - \frac{1}{2} b b p + 3 y' + \frac{1}{2} b' y y + p y y \) ex media y, major vero quam \( \frac{1}{16} b' + \frac{1}{2} b q - \frac{1}{6} b b p + 3 y' - \frac{1}{2} b' y y + p y y \) ex minima y. Hos vero limites si excedat r, non nisi duæ Radices haberi possunt. Deniq; sì \( \frac{1}{2} b' + \frac{2}{5} b p - \frac{1}{6} b b p + 3 y' - \frac{1}{6} b b y y + p y y \) ex maxima y, minor fuerit quam r, æquatio proposita impossibilis est.

Accidit
Accidit etiam ut quatuor sint Affirmativae, cum Centrum G constituitur in spatiolo VTS; duèta scil. RTS perpendiculari in medium suppositae lineæ AD: Hoc autem sit cum p major est quam \( \frac{1}{2} b \) b, ac \( \frac{3}{8} b \) b \( \sqrt{\frac{1}{2} b} \) b \( \frac{3}{8} p \) major quam \( \frac{3}{4} b \) b \( \frac{3}{8} b \) b \( \frac{3}{8} q \). Quo in caelo semper duæ, aliquando tres ex Radicibus sint maiiores quam \( \frac{3}{4} b \).

Notandum vero hic limitem illum ex minima y producunt, aliquando negativum fieri, sive minorem nibilum; quoties scil. maxima ex tribus perpendiculararibus major est quam GD. (Fig. II.) Hoc si acciderit quantitas \( + x \) a limite prescripto ex media y, in nihilum minuit potest. Defectus vero limitis ex minima y monstrat quanta possit esse \( - r \) in aequatione, si habeantur tres radices Affirmativae ac una Negativa; quam si exceedingat, non nisi duæ, altera Affirmativa, altera Negativa, dari possunt. Hoc autem omnia demonstrantur ex eo quod prædicti limites quantitatis \( r \), sint differentiae Quadratorem lineæ GD & perpendicularium in Curvam Parabolæ.

Ob perplexas vero cautions, quas parit in aequationibus hisce signorum diversitas, præsentat semper secundum terminum tollere, ac deinde juxta praecipua jam tradita radicum numerum ac signa inquirere; præsertim si quantitates illæ y non multum dierunt ab invicem. Ex quatuor autem bisce radicibus Affirmatis, duas semper sunt minores quam \( \frac{3}{4} b \), duas vero maiores; nempe si DG minor sit quam AG, sive \( \frac{3}{4} p b \) quam \( \frac{3}{4} b \) + q. Tres autem minores sunt quam \( \frac{3}{4} b \), quoties perpendicularis media, sive ex media y inventa, major est quam AG, sive \( \frac{3}{4} b \) b major quam \( 3y \) \( - p \) y y ex eadem media y; Quarta vero & maxima radix major est quam maxima y + \( \frac{3}{4} b \); aequatur autem differentiae ipsius b & summa cæterarum trium radicum, ideoq; minor est b. Sed jam Manum de Tabula; Fortassì illi qui naturam Parabolæ penitus perspectam habent, majori compendio hac omnia perager e valebunt; at si quantitates ha omnes b. p. q. & r, absq; resoluzione Cubica aequationis rite determinari possint, non sine causa ambiguitur; quæcunq; enim aequationibus planis hac in re sunt, non vero limites, sed approximationes tantum exhibent.

An Account
An Account of some Observations lately made at Nurenburg by Mr. P. Wurtzelbaur, shewing that the Latitude of that Place has continued without sensible alteration for 200 Years last past; as likewise the Obliquity of the Ecliptick; by comparing them with what was observed by Bernard Walther in the Year 1487, being a Discourse read before the Royal Society in one of our late Meetings.

Whether the Poles and Axis of the Earth be really fixt in the Globe, or subject to be transferred from place to place is an old Enquiry, though now lately revived by Mr. Hook in his ingenious essays upon the great mutations and Catastrophies which in all appearance have hapned to the Earth's Surface. A necessary consequence of such a translation of the Poles would be the change of the Latitudes of places, which would encrease in those Regions towards which the Poles approach, and decrease in those from which they recede: and under the Meridian 90 degrees removed from that in which the Poles shift, the Latitudes continuing the same, the Meridian Line would only alter; but no two places considerably differing in Latitude can be supposed, wherein if there be any sensible motion of the Poles, it shall not be perceived by the alteration of the Latitude of one or both of them.

The accurate Mr. Wurtzelbaur, has lately furnished us with the means of examining this Hypothesis by observation, having sent us the Meridian Altitudes of the Sun taken at Nurenburg about the two Solstices in the Year 1686. June the 10th. he found the Meridian Altitude of \( \odot \) 64gr. 2m. 20s. and the next Day 64gr. 2m. 25s. and on December 14° 3 days after the Solstice, wherein the Sun was got two minutes higher, he found the Meridian Altitude 17gr. 9m. 1cs.
wherefore the solstitial Altitude was 17gr. 7m. 10s. These
heights were taken by an Instrument of 6 foot Radius of
Brails; and the skill and diligence of the observer is not to be
doubted.

To compare with these I find among Bernard Walthers ob-
servations made in the same City of Nurenburg, two hundred
Years before, viz. in the Year 1487, that the Meridian Alt-
titude of the Sun in the summer Solstice was observed by
the Parallactick instrument of Ptolomy, whereby the Chord of
the Sun's distance from the Zenith was observed 44890 parts
of 100000 Radius; the same being confirmed by the con-
currence of the observations of several Years both before and
after. The arch answering to this Chord gives the Sun's di-
stance from the Zenith 25gr. 56m. 30s. and consequently
the Meridian Altitude its Complement to a Quadrant, 64gr.
3m. 30s. Again, the same Year 1487, the Chord of the Meri-
dian distance of 0 from the Zenith, on the day of the Winter
solstice was found 118790, confirmed likewise by many sub-
frequent observations; the arch answering to this Chord is
72gr. 52m. 40s. and its complement 17gr. 7m. 20s. the Me-
ridian height of the Sun in the Winter solstice.

Hence it appears that the solstitial hights were very near-
ly the same at Nurenburg 200 Years ago as now they are, that
of the Summer solstice being but one minute differing, the
other only 10s. both which may possibly arise from the de-
fects of the Instruments of these observers, being made with
plaine sights; but what I shall necessarily conclude from
hence is, that if there be such a motion of the Poles, it is
either very slow, or else nearly at right angles to the Meri-
dian of Nurenburg; in which latter case the Latitudes of
places about Tunking, Siam, Malacca and Java on the one
side, and in our American plantations of New-England, Vir-
ginia, Jamaica &c. on the other, ought to change fastest;
but I have never yet heard of any such thing by any of our
Navigators; whence if there be such a change of the Earths
Poles, it must necessarily require a long time to become sensible.

Besides
Besides, from these Observations it appears that the obliquity of the Ecliptick has continued unaltered for these 200 Years last past, that is to say, that the Angle which the Earth's Axis makes with the plane of the Ecliptick or Orb wherein she moves annually round the Sun, has been without sensible Change in all that time; which will be very hard to conceive, if we allow a translation of the Earth's Poles; for the direction of the Axis being perfectly at Liberty, it must be purely casual, if it so hit, that after such change, it make the same Angle with the Ecliptick as before.

A farther argument of this slowness of the change of the Poles is the Latitude of Alexandria, the habitation of those Famous Astronomers of antiquity Eratosthenes, Timocharis, Hipparchus and Ptolemy, and for that reason it may be concluded that this of all the Latitudes the ancients has left us, ought to be one of the most correct. This by Ptolemy is said to be 30 gr. 58 m. North, (which he uses in all his computations in his Almegist, and seems derived from the proportion of the Gnomon to its Equinoctial shadow, as 5 to 3) but in his Geography, 31 gr. just. In the Year 1638 the curious and Ingenious Mr. Greaves, when he went to visit the Egyptian Pyramides, of which he has given so good an account, did with a sufficient Instrument observe the Latitude of Alexandria, and found it 31 gr. 4 m. or 6 minutes more than it is reputed by Ptolemy, and before him by Eratosthenes; so that in about 2000 Years the Latitude of Alexandria has altered only a few minutes, and so few that the accuracy of the observations of the ancients may well be questioned: But both being granted, this motion will amount to no more than a degree in 2000 Years.

This is said not with intent to invalidate what Mr. Hook hath from so good grounds advanced, viz. that the Ball of the Earth, at least the fluids thereof, being necessarily of the Figure of a Sphæroides prolatus, or flat Oval, whose shortest diameter is the Axis, and greatest Circle the Equinoctial; if the Poles be supposed changed, the Equinoctial will be so too;
too; and consequently the Water must rise and cover those parts from which the Poles recede, and fall off and leave bare those places towards which the Poles approach. By this means it may be accounted for, how such strange marine things are found on the tops of hills, and so deep underground; and scarce any other way. But from these and the like observations it will follow, that if these inundations are produced by any regular motion of the Poles, it would require a prodigious number of Ages to effect those changes we may be certain have been. Besides, if the access and recess of the Sea were after such a gradual manner, as when produced by such an easy translation of the Poles, as can by observation be admitted, those Inundations could never be fatal to the Inhabitants, for that they would always give notice of their Coming, so that the People might provide for their safety. But the Holy Scriptures and Pagan Tradition do unanimously agree, that the last great Deluge was brought to pass in a few days, with no previous notice, so that the account we have thereof, could not by this Hypothesis be made out, without the supposition of a great and sudden alteration in the Poles of the Earths diurnal Revolution; for which whether we should have recourse to the Intelligent powers that first impress this whirling motion on the Ball, or leave it to be performed naturally, by the casual Choc of some transient body, such as a Comet or the like, whereby the former Axis might be lost and a new Revolution produced, differing both in time and position from the old; I shall not undertake to dispute: such a supposition would include likewise a change of the length of the Year and Eccentricity of the Earths Orb; for which yet we have no sort of Authority.

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for the Month of December, 1687.

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Cum Uso Tabularum, &c. Authore Ph. de la Hire, Regio
Mathémos Profeffore, &c. 4to. Parisiis, 1687. (7.) The
Report of the Parish-Clerks of London, made to His Majefty,
of the Number of Chriftenings and Burials, in the Years 1686,
and 1687. (8.) An Index to the Sixteenth Volume of the
Philosophical Transaftions.

h h h
An Account of the diseases of Dogs, and several Receipts for the Cure of their Madness, and of those bitten by them. Extracted from the Papers of Sr. Theodore Mayern, and Communicated to the Royal Society by Sir Theodore de Vaux Knt, and R. Soc. S.

Dogs are Subject to these several sorts of Madness or rather diseases. (1) The Hot Madness which is incurable without hope. They fly upon every thing and can hold out but 4 days (2) the Running Madness which is likewise incurable. They fly only upon Dogs, and that by Fits, and may sometimes hold out 9 months (3) La Rage Mae which is a disease that lies in the Blood (4) The Falling Madness which seizes on the Head, and is as a sort of Epilepsie (5) The Blasting or Withering; this lies in the Bowells which shrink up exceedingly (6) The Sleepie Disease, which comes from little worms in the mouth of the Stomach: These Dogs die sleeping. (7) The Rheumatick Disease. This swells the Head very much and makes the Eye yellow.

These five latter are not properly Madness but other diseases. In them the Dogs will not eat, nor at any time when they are sick, but in these five they live 8 or 9 days without hurting any body, and then die of Hunger. The two first are caught by the breath of Dogs being together as is the Plague among Men, the latter are likewise Contagious but Curable.
A Never failing Remedy for the Bite of a Mad Dog.
by Sr. Theodore Mayern.

Take *Virginia Snake-Root* and Flowers of *St. John’s Wort* gathered in their prime, equal parts of each, let them be made into very fine Powder. The Dose is from a Scruple to a Dram, to be taken in any sort of Decoction prepared with Specificks. To a Horse give 2 Dr. to a Dog from one to 1½ Dr. This before the ninth day after the Bite.

Another Receipt for the same, taken from
D. Mathias Hulsboos.

Take Leaves of *Rue* pickt from the stalks and bruised, 6 Oun. *London Treacle* (or which is better *Venice Treacle*) Garlick Pild and bruised, and fine filings of *Tin*, each 4 Oun. put them into 4l. of Canal or good *White Wine*, or in case of a nice or hot constitution, into the same quantity of strong and well-workt Ale, in an Earthen vessel well stop’t. Then let there be made a digestion or gentle boiling thereof in Baalneo, for 4 hours, shuffing in the steam, then press it and strain it.

The dose is from two to three Ounces (and in some Person’s more) to be taken every Morning for 9 days. The Party bitten must fast for three hours after it, and the dreggs that remain after expression must be bound upon the wound received, renewing it every 24 hours. *N. B.* That the ninth day after the bite must not be let slip, before this medicine be taken, leaft the Poyson seate the Blood too Strongly. It must be given cold, or at least only a little aired. A Double Quantity may be given to a Beast soon after the Bite.

This Remedy I have given many times by Sr. Theodore Mayerns direction, and I never found it to faile.

*Theodore De Vaux.*

Another
Another approved Remedy.

Pluck the feathers from the breech of an Old Cock, and apply it bare to the Bite, and do this upon each of the Wounds. If the Dog were Mad, the Cock will swell and die, and the Person bitten will do well; but if the Cock dies not, the Dog was not Mad. If the Wounds be very small, it is requisite to open them with a Lancett.

Another Process of Sr. Theodore Mayerns.

Let the Party be Nine times Plunged in the Sea, while he is fasting, as soon as may be after the Bite. Let the Bitten Part be washed with a Lie of the Ashes of Oke-Wood and Urine, and apply a Caraplatme of London Treacle, Allaria or Hedge Garlicke, Rue and Salt.

Take dried Rue and Scorodium each 2 Dr. Virginia Snake-Root 1½ Dr. Flowers of St. Johns wort 3 Dr. fine filings of Tinn and Garlic cut small, each 4 Dr. London Treacle 1 Ounce. Let them be all beaten and exactly mixed together, adding Syrup of Lemon Pils as much as suffices to make it into an Electuary; Divide this into Nine equal parts to be taken every day one, drinking after it a small draught of Good strong Ale. Let him walk upon it and not dine till 4 hours after.

Use as little of the aforesaid Syrup of Lemon Pils as may be: and if that be not at hand, a Syrup made of Malaga-wine, adding as much Sugar as it can dissolve, may serve the turn.

Make up of this Electuary 4½ Ounces at a time, that so the Dose may be half an Ounce.

This Lake was by the Ancients called *Lugea Palus*, by the moderns *Lacus Lugens*, tho at present its Latin name be *Lacus Circnescensis*, in high Dutch *Zirknizer-see*, and in our *Carniolan* tongue *Zirknisko Jesero*. Why it was so called of old is unknown or very uncertain; but the original of the present name is more sure, it being derived from the adjacent town of *Cirknits*: and that had its name, from a Chappel of the *Virgin Mary*, which at first stood alone, but now the town is built round it. This Chappel was no great edifice at first, and therefore was called the little Chappel, which in the Language of the Countrey is *Zirkviza*; whence the Lake was named *Zirknisko Jesero* or the Chappel-Lake, but now by abuse *Zirknisko Jesero*.

It is distant from the Capitall City of the Province *Labac*, six German miles; it is a good German Mile long, or better than 4000 Geometrical paces; and is about half as much in breadth. Its ordinary depth is 10 Cubits, its least 5 or 6, rarely three, but its greatest is sixteen Cubits. It is every where surrounded with woody mountains, which on the South and West side are very high and three Miles broad, running far in length into the Turkish country, and afford nothing but horrid stony deserts, overgrown with trees. On the North and East side...
side there is, between the Mountains and the Lake, a small territory, which tho' narrow is nevertheless pleasant, and is inhabited by one Town, three Castles and nine Villages, adorned with twenty Churches: as may be seen in the Map I send (Fig. 1) which was drawn by my self upon the place, with all possible care.

In the Mountain called Lavornik standing near the Lake, there are two holes, or exceeding deep precipices, in which many thousand wild Pigeons roost all the Winter; entering in Autumn, and coming out with the first of the Spring: What they live upon in these caverns is unknown, but I take it to be the Nitrous Sand. In the other hill called Slivenza, 'tis the belief of the Country People that the Witches hold their assemblies, because that several times lights like *ignes fatui* are observed there. On the top of this hill is a hole of an unknown depth, out of which there often breath out noxious Steams, supposed to occasion tempests of Thunder and Lightning and Hail; and for this reason the Priest of Zircnits every Whitson-Munday goes to the Hole in Procession, and uses over it a certain form of Exorcism.

There runn into this Lake continually eight Rivulets. The two least are called Bellebrech and Trefenz; the third is the fountain Oberch, out of which abundance of Water gushes with great force; the fourth fifth and sixth called Steberziza, Lipsinziza and Seromschiza, may for their bigness deserve the name of Rivers; the seaventh called Martinschiza breaks out at a cleft in the Rock: The Last called Circnizer-ach is a pretty larg River.

Now this Lake being every where surrounded with Mountains, and nowhere running over, Nature has given it two visible Channels or stony Caverns, called Velka-Karlouza and Mala-Karlouza, by which the Water runs under the Mountain; and a third concealed subterraneous Passage, which without doubt communicates with the other two under ground (as I shall hereafter prove) These having
having run half a German Mile, come out at the other side of the Mountain, near the Chappel of St. Cantian (as I have faithfully drawn it in Fig. II. in a desert place at a stony Cave A; and become the River called by the inhabitants Jefero, that is the Lake. This River Jefero marked B, is reasonably bigg; and having run half a quarter of a Mile, enters a wide stony Cavern, I, running slowly under the hill for the space of a good Musquet-shot; then coming out again on the other side, after it has run thro' a small platt m, m; it enters a third Cavern or Grotto C; wherein having pass'd 50 Paces, one may say Siste Viator, ne plus ultra, for it runs no longer peacibly as before, but with great noise and roaring falls down a very much inclined channel of stone, so that neither I nor any else durst follow it farther. In June 1678 I went my self in a small fisher-boat under the Mountain, through the Cave I, and entred the Grotto C, till I came to the aforesaid Falls, without any danger or trouble, the passage being wide enough.

It must be noted, that the Valley wherein this River Jefero runs, is exceeding steep, but the Plat of Ground m, m, is plain and stony, of an Oval Form, and is sur-rounded with (as it were) a very high Rampart K, K, K, so steep, that it would be impossible for a Cat to climb out of it, unless at one place, whereat a Man may make a shift to go up and down, tho' not without peril of his Life; the Way being in some places not above three or four Inches, and no where above six Inches wide. In the Year 1684 I went down here in Company with a French Gentleman, but the Water being up and we wanting a Boat, we could not go under the Hill nor enter the Grotto C; so we returned, and with great difficulty descended by a steep and narrow Passage at D, and came to a Cave bigger than any Church, through which the River Jefero runs. Here we found several Figures of Stone, the Workmanship of Nature, and strange Holes or Caverns in the Earth.
Earth; but by reason the River was then up, we could go no farther. At other times when the Water is down, one may go with lighted Torches a great way under ground; and 'tis said there are here very odd Figures formed by the petrified Water: among the rest, one resembling a Weaver at Work, of which the Country People want not their Superstitious Traditions.

But to return to our Lake; I say that about the Feast of St. John Baptist or St. James-Tide, and sometimes not till August, the Water runs away, and it is dry: But it fills again most commonly in October or November, yet so as not to observe any certain time; for sometimes it has been dry twice or thrice in a Year; as in the Year 1685, it was dry in January. Again the Water began to draw off on the 15th of August St. N., and it was quite clear by the 8th of September; and this present Year 1687, it has been thrice empty, which makes the Fishing very poor and inconsiderable.

Sometimes again, tho' but seldom, it has hapned to be three or four Years together full of Water, and then is the best of the Fishing. But it never yet was observed that this Lake was dry for a whole Year together.

The right of Fishing in this Lake, upon certain Terms agreed on, does at this time belong to the Lordships or Castles following, 1. to Haasberg, 2. Steegberg, 3. Laas, 4. Schneeporg, 5. Avesberg, 6. to Sitticium, which is a Monastery of Cisterian Monks.

There are three Islands in this Lake, viz. Malaa-Goriza and Velka-Goriza which are uninhabited. The third is a very pretty Island called Vornek, that is reasonably big, having upon it a Village of four Houses called Ottok, above this Town, upon a little eminence stands a Church, which is no small Ornament. Those that live on it have Fields, Meadows, Pastures, Wood, Gardens and Orchards, and all things necessary for Life.

There is also a very fine Peninsula, all covered with Wood, called Dorvasek. When the Lake is up, and one comes
comes in a Boat between the Iland Vorneck and this Peninsula, the farther part of the Lake, lying under the Mountain, very well resembles a curious Port for Shipping. At the farther end when the Water draws off, there appears rows of Stakes, a Signe that there hath been formerly a Bridge, and therefore it is at this day called the Old Bridge.

In this Lake there are many Pitts in the shape of Basons or Cauldrons, which are not all of the same depth or breadth, the breadth of them being from 20 to 60 Cubits more or less, and the depth from 8 to 20 Cubits. In the bottom of these Pitts are several holes, at which the Water and Fishes enter, when the Lake ebbs away.

The principal Pitts in which they Fish are Eighteen, situated and named as is represented in the first Fig. They are called Maljoberch, Velkjoberch, Kamine, Sueinskajamma, Vodonos, Louretshka, Kraloudnor, Resheto, Ribeskajamma, Rethje, Sitarza, Lipauza, Gebno, Koteu, Ainz, Zeiuenza, Pounigk, and Levishe. Besides these there are several other lesser Pitts of no Note, because there is no such Fishing in them as in those but now mentioned.

In the Months of June, July, and August, when this Lake begins to draw off, it grows quite dry in 25 Days, if no great Rains intervene. And the aforesaid 18 Pitts are all emptied one after the other, in a certain and never failing Order of Time.

When the Lake begins to sink, which appears by a certain Stone which they observe, the Inhabitants of the Town called Oberdorff or Seedorf, give Notice thereof to all the Neighbouring Fishermen, that are appointed by the several Lords having Right in this Fishing. The People of this Town have Orders not only to watch the falling away of the Water, but likewise to take care that no body presume to Fish in the Lake when it is full of Water; that being forbidden: so that these are, as it were, the Keepers of the Lake.

The
The first Pitt called Maljoberch, is not properly a Pitt like a Cauldron, but only a depression of the bottom without any holes in it: but there grows much Grass and Weeds, and may Fish are Caught therein: Three days after the Water begins to Ebb, this Pitt is emptied: Then the Parish Clark of Seedorff gives Notice thereof by Tolling a Bell, and all the Inhabitants of the Town, Old and Young, Men and Women, lay aside all other Business and go to Fishing, stark naked as they were born, without any regard to Modesty or Shame. The Fish they Catch, they divide in halves, one part they give to the Prince of Eggenberg, as the Lord of the Mannour, the other half is their own.

(2.) The Pitt Velkioberch is emptied the third day after Maljoberch, the manner and right of Fishing as in that.

(3.) Four Hours after this, the Pitt Kamine begins to empty; here they generally Fish with a Trawle, as in several other Pitts of lesser Note, having first purchased leave of the aforefaid Lord of the Mannour. Here, as likewise in the Pitt (4.) Sueinskajamma. (which sinks one hour after Kamine) is much Fish caught, and an abundance of large Crabbs, but they are lean and of no good taff.

(5.) The fifth Pitt Vodonos, dries five days after Kamine. In this and the other Pitts which follow, they Fish with a long Nett or Sayne. Herein they can have no more than five or six Hawl's, by reason of the great swiftness wherewith the Water runs away at the holes in the Bottom, (which is such that a Horse can hardly keep pace with it) and carries away the Fish with great violence under the Earth. Sometimes when the Fishermen are not nimble, they can scarce get two Hawl's before the Water be gon; to prevent which they have a Mark near this Pitt, viz. the Stone Ribe's ekanen, that is The Fishers Stone, which as soon as it begins to appear upon the recess
cess of the Water, gives Notice that it is time to begin the Fishing.

(6.) The Pitt Louretscha is evacuated a day and a half after Vodonas, the Fishing is after the same manner, and the same Caution necessary, because of the sudden recess of the Water.

(7.) The Water leaves the Pit Kraloudnor twelve hours after Louretscha; and three days after that (8.) the Pitt Refscheto. In this latter, in the Year 1685, after the Lake had been some Years without being dry, there were taken at the first Hawl, 21 Carts of Fish, at the second 17, and at the third 9, as I have been credibly informed by those that were present.

(9.) The Pitt Ribeskajamma falls dry at the same time with Refscheto, which is that next to it. In this Pitt they fish under ground, which is a Curiosity not unpleasant, and differing from all the rest. For there is in the Bottom a great hole in the Stone, by which Men may easily go down with lighted Torches, as into a deep Cistern; and there is under ground a large Cavern like a Vault, the Bottom or Pavement whereof is as it were a Sive full of little Holes, whereby the Water runs away leaving the Fish dry, where they are Caught.

(10.) The Pitt Rethe is empty two hours after Ribeskajamma, and is of no great Consequence for Fish: An hour after this the Pitt (11.) Sitarza, and in five or six hours more (12.) Lipauza falls dry.

(13.) The third Day after Refscheto, the Pitt Gebno is evacuated; in this they rarely Fish with Nets, but let it fall dry, and the Holes in the Bottom being so small, that they exceed not the size of a Mans Arm, all the great Fish are left behind in the Pitt.

(14.) Two days after Gebno the Pitt Koteu becomes dry: In this they sometimes take the Fish as in the former, but the Holes being greater let bigger Fishes pass.

(15.) The Pitt Ainz empties 4 or 5 hours after Koteu: In this
this they seldom (unless they cannot help it) let the
Water run away without using their Netts, as in Gebno;
because of one great Hole in the Bottom, whereby many
great Fishes may escape. (16.) The Pitt Zelvenza sinks
three hours after Ainz; in this they allways Fish with
Netts, as in (17.) Pounigk, which is emptied the next
day after Koteu.

(18.) The last Pitt called Lusische is evacuated the
third Day after Pounigk, that is the 25th. Day from the be-
inning of the Recefs of the Water of the Lake, so that
in 25 Days the Fishing of this Lake is over. In this last
Pitt, about 17 Years since, I am certainly informed, that
there fell a Flash of Lightning, about the Time of Fish-
ing; which stunned a great Multitude of large Fishes, so as they
fill'd 28 Carts with them: (By a Cart is meant as much
as one Horse can draw.) These Fish are not properly
Thunder-struck, but only stunned with the Violence and
Sulphurous Vapour of the Lightning, which makes them
rise and swim as dead upon the top of the Water; but
if they be taken up and put in fresh Water, they soon re-
cover, otherwise they Die: This is no uncommon Acci-
dent in this Lake.

The Fishing being thus ended, a Signe is given by
tolling the Bell in the Chappel of St. John Baptif, near the
Town of Cirkniz. Upon which all the Inhabitants of
the neighbouring Villages and of Cirkniz, without regard
either to Age or Sex, go for the most part stark naked, in-
to the Lake, and look for Fish among the Weeds and
Sedge, and in the smaller Pitts. And many creep into
the Subterraneous Caverns and Passages, and find Score of
large Fishes there. They having full Liberty to search all
over the Lake, excepting in the Pitts Piaze, Narte, and
Velkoberch. This Barbarous and Immodest Custom of
going Naked, has been often attempted to be reclaimed
by the Carthusian Monks, but all in vain, for so prevalent
is a Habit of vicious Practices over good Precepts, that they
they have not yet been able to persuade them so much as to cover their Secrets.

There are besides these some other Pitts in the Lake, as Skednenza, Mala and Velka-bobnarza, in which they Fish likewise, as also in Mala-karouza and Velka-karouza: In both these they go far under ground with lighted Torches and find Fish, but these Pitts are of no great value. In Velka-bobnarza one may go in at great holes, and descend many Fathoms under ground. These two Names Velka and Mala-bobnarza, signify in the Carniolan Tongue the Greater and Lesser Drummer; nor is it without Reason that these Pitts are so called; for when it Thunders and Lightens, there is heard in these two Pitts, as it were, the Sound of many Drums Beating, which Anno 1685, I heard with my own Ears; it Thundring three times successively, and the Sound of Drums answering accordingly.

The two Pitts Narte and Piauze, are never emptied, but always remain Fenny, when the rest of the Lake is quite dry. It is believed, that in these Pitts the Fish lay their Spawn, and therefore it is prohibited to Fish in them. In them is an incredible Number of Horse-leeches, which according to the vulgar Opinion, understand certain Words; for that upon repeating them, they will come in great Parties towards him that repeats them, whereas if he be silent, very few of them will touch him. These Horse-leeches often stick upon the People in the fishing time, (some of them being dispersed all over the Lake) and the Method they take to get them off, is to get some other Person to pils upon the Leech, which makes it let go its hold; and this without any respect to Modesty is practised, as well upon the Women as Men.

There are in the Mountain nigh the Lake, but something higher than it, two great and terrible stony Caves, the one called Vrainajamma, the other Sekadulze, which tho' far distant one from the other have yet the same Effect, viz. when it Thunders and Lightens, these two
Caves do emit Water with a wonderful and incredible force, and with it sometimes a great quantity of Ducks with some Filth; which I myself observed in October 1685, not without great danger of my Life. I took my Horse and rid Crofs the Lake, as far as the Iland Vornek, in Company with two old experienced Fishermen; when suddeily the Cavern in the Mountain Slivenza, began to breath forth misty Vapours forming a Cloud. Upon which my Fishermen advised me to make haft, for without doubt those Clouds would produce a Tempeft. They had scarce said so, when it began to Lighten and Thunders dreadfully; and I had difficulty to persuade them to accompany me as far as the Pitt Velkaobnarza, being desirous to examine what is laid of it, that when it Thunders the Sound of many Drummers is heard in it. This I found three times to succeed as reported; and then with all the speed we could, we hafted to the Iland Velka-Gori-za, not being able to go farther, because the Water was in many places grown out of our depth, where two hours before we had paßed drie. Here we got one of the little Fisher-boats, which when the Lake is drie lie dispersed here and there on the bottom; and having got in my Horse, we began our Voyage, but had the ill luck to over-fet our Boat, and so were obliged to Swim for’t, and with much to do arrived safe on the other Shore. Then we could see from the other side that the Water gushed with great Impetus out of the Cave Sekadulze, being cast three or four Fathoms, as, if it were forced by a Fire-Engine, and several blind Ducks were thrown out by the Water. It is not to be wondered that the Lake fills so fast, for considering the Violence wherewith the Water rushes, it is as much as a great River; this Cave Sekadulze, being a Fathom wide, and higher than a Man. It is lookt upon as a dangerous thing to enter into this Cave, because the Water come so all on a suddain, that if it should chance to come, it is impossible to escape it.

When
When it Rains moderately, the Water spouts with great Violence two or three Fathoms perpendicularly, out of the Pitts Koteu and Zeflenza. It comes likewise forcible out of the Spring Trefenz, as likewise out of Vel-kioberch, bringing with it at this latter abundance of Fish, and some Ducks. But when it Rains very hard and long together, especially with Thunder, then the Water breaks out with very great force, not only from all the aforesaid Pitts, Holes and Caves, but likewise at several thousand other little holes (which are all over the bottom of the Lake, and which when the Lake is dry, drink up the Waters of the eight Rivulets that run into it) spitting several Fathoms high, from some perpendicularly, from others obliquely, so that there is not a pleasanter sight than this. And out of the Pitts, Vodonos, Reschetto, and some others having great holes at the Bottom, there comes with the Water a great quantity of Fish. In case of great Rains, the eight Rivulets are likewise much encreased, so that all things concurring, this Lake in 24 hours time, will from quite dry be full of Water, and sometimes in 18 hours; tho' at other times it has been known to be three Weeks in filling: But it is a constant Observation, that Thunder and Lightning help much to fill it speedily.

This Lake being thus by turns wet and dry, serves the Inhabitants for many purposes. For, first, while it is full of Water, it draws to it several sorts of Wild-Geese and Ducks, and other Water-Fowl, as Herons, Swans, and the like, which may be shot, and are very good Meat.

Next as soon as the Lake is emptied, they pluck up the Rushes and Weeds, which make excellent Litter for Cattle. 3. Twenty days after it is fully dry, they do cut a great quantity of Hay upon it. 4. After the Hay is inn, they Plow it and sow Millet, which sometimes by the too sudden coming of the Water is destroyed, but it generally comes to Maturity. 5. While the Millet is on the

K k k 2 Ground
Ground they catch a great Number of Quails. 6. The Millet being inn, there is good Pasture for Cattle. 7. When the Lake is dry, there is great variety of Hunting; there coming out of neighbouring Woods and Mountains plenty of Hares, Foxes, Deer, Swine, Bears, &c. So soon as the Water is gone. 8. When it is full, one may Fish in it. 9. In Winter time it will be so firmly frozen as to bear all sorts of Carriages, and is a great convenience to the People to fetch their Wood and other Necessaries; lastly at the time when the Water goes away, it yields great abundance of Fish, as has been already said. And that which is most Wonderful is, that all this comes to pass in the same place, and the same Year, viz. If the Lake be early dry, and it fill not too soon; but it is to be noted, that the Hay does not grow, nor is the Millet sown all over the Lake, but only in the more fertile places.

There are only three sorts of Fish taken in this Lake, which are very well tasted. They are the Mustela Fluviatilis or Eel-pout, some of them weighing 2 or 3 Pounds. Tench, some of them weighing 6 or 7 Pounds; and thirdly Pikes in very great plenty, of 10, 20, 30, and some of 40 Pound weight; in the Bellies of these it is common to find whole Ducks. Crabbis are found nowhere but in the Pitts Kamine and Sueinskajamma; they are large but ill tasted.

The Cause or rather Modus of all these wonderful Phenomena in the Lake of Zirknitz is, according to my Opinion and Speculations, as followeth. There is under the Bottom of the Lake, another Subterraneous One, with which it communicates by the several holes described: There are also one or more Lakes under the Mountain Javornik, but whose surface is higher than that of the Lake of Zirknitz. This upper Lake is possibly fed by some of those many Rivers, which in this Country bury themselves underground, and has a Passage sufficient to carry the Waters they ordinarily bring unto it; but when it Rains,
Rains, especially in Thunder Showers, which are the most hafty, the Water is precipitated with great Violence down the steep Valleys, in which are the Channels of these Rivulets; so that the Water in this Lake, being encreased by the sudain coming in of the Rains faster than it can empty, swells presently: and finding several Holes or Caverns in the Mountain higher than its ordinary surface, it runs over by them both into the Subterraneous Lake under that of Circnitz, (into which the Water comes up by the several Holes or Pitts in the Bottom thereof) as likewise by visible Passages above ground, such as Urainajamna, Sekadulze, and Trefenz.

That some of these Passages, bring Fish, some Ducks and Fish, others only Water, seems to depend on the position of the inward Mouths of these Subterraneous Channels; for if they be so constituted, as to draw off the Water from the surface of the upper Lake, on which the Ducks swim, they must needs be drawn away by the Stream into these Caverns, and come out with the Water: But if so be that the Channels open, into the upper Lake, under the surface of the Water, and from thence ascend obliquely for some space, before they come to descend; then the Water they carry is drawn from below the surface, and consequently can bring with it no Ducks, but only Fish. Those Pitts which yield only Water, may well be supposed to be fed by passages too narrow to let the Fish pass, tho' their multitude may make the quantity of Water they emit to be very considerable.

The Manner of the falling away of the Water or emptying of the Lake, I thus explain. After a long drought or want of Rain, all the Springs that feed the upper Lake under Javornik are much diminished; so that wanting fresh supplies, it ceases to run over by the several Channels, but now mentioned: hence the Lake of Circnitz, and that under it, are fed only by the eight Rivulets that always fall into them; and then the Water draws off faster.
than it comes in, both by the Channels of Mala and Velka-Karlonza, as also by a concealed Subterraneous Passage out of the under Lake, which latter alone is able to transmit more Water, than the said eight Rivulets afford. Consequently the Lake must sink, and that in a certain proportion of Time, depending on the quantity of Water to be evacuated, compared with the excess of that that runs out above that that enters it, in the same time: Those Rivuls that are higher are soonest drie, the lower latest, and so come to be emptied in the Order above described. And when the Lake is all dry, then the said Rivulets soak by several little holes in the Bottom, into the under Lake, and all their Water is carried away by the aforesaid Subterraneous Passage.

That there is such a Passage is very evident, and that it communicates under ground with the Channels of Mala and Velka-Karlonza, coming out with them, as has been already said, near St. Cantian at a Rocky Cave, and making the River Jesero. For when the Lake of Zirknitz is very full, and runs out at both Velka and Mala-Karlonza, the River Jesero at St. Cantian overflows, and runs with great Violence. When it only runs out at Mala-Karlonza (which is somewhat lower than the other) then the Water of Jesero is much less rapid. But when the Lake is so fallen, that it runs out at neither of the two, the River Jesero is still less, but runs with a considerable Stream, till two days after the Lake has been dry; after which, the said River becomes little, voiding no more Water than the Lake receives from the eight Rivulets that run into it; by which it is clearly proved, that this Subterraneous Passage does meet with the Channels of Velka and Mala-Karlonza, and needs no farther Illustration.

Hence in appears, why this Lake sometimes is twice or thrice drie in a Year, at other times continues full for 3 or 4 Years together, but was never known to be drie for a whole Years time; for it falls drie at any time when there
there falls but little Rain in a long space of time; and in Rainy Years it continues always full; but it never happens in this Country, that there is a drought for a whole Year together.

The Ducks I have so often mentioned, and which are cast out with the Water, are generated in the Lake, under the Mountain Javornic; when they first come out, they swim well, but are stark blind, and have no Feathers on them, or but few, and therefore are easily caught; but in 14 days time they get Feathers, and recover their sight yet sooner, and afterwards fly away in Flocks. They are black, only white on the Fore-head, their Bodies not bigg, resembling ordinary Wild-Ducks, and are of a good taff, but too fatt, having near as much fatt as lean.

I kill'd some of them as soon as they had been cast out at Sekadulze, and opening their Bodies; I found in them much sand, and in some few, small Fishes; in others green stufflike Grass or Herbs: which was the more strange, because I never found any green thing growing in any of our Subterraneous Grottoes or Lakes in Carniola; I tried also to procure some of the Fish at the time of their being cast out, to open them and see what they live upon, but notwithstanding all my endeavour, I could not get any of them to sateifie my Curiosity withall.

Almoft every Year, at a Hole in the Mountain called Storseg, about half a German Mile from the Lake of Zirknitz, near the Town of Laas, whenever there happen great Floods of Rain, this sort of Ducks is cast out in great abundance, by the Water gushing out with much force. I conceive that this Cavern Storseg is another Passage out of the same Lake under Javornic, that overflows and fills up our Lake of Zirknitz; but this being somewhat higher, it never runs out, unleas the said Lake be more than ordinary swell'd by the Violence of the Rains. The casting out of great Numbers of Ducks here, is so common that it is lookt upon as no Rarity.

It may
It may seem strange and hard to believe, that there should be such Subterraneous Lakes and Channels as we here suppose; but besides that without them it would be impossible to account for all these several Effects, which are most true, and which I myself have observed; there is a most Notable Instance of the like things, found in the Subterranean Cavern called, The Grotto Podpetshio, which is represented in Fig. III.

This Grotto is in Carniola in the Parish of Guetenfeld, distant four German Miles from the City Labac. a is a Hole or entrance into the Rocky Mountain; b is a great Cavern in the Mountain, capable to hold above a hundred Horsemen; i, k is a Channel big enough for a Man to pass by, as far as the Lake o, out of which Lake the Inhabitants hereabouts draw all their Water, (having none nearer) and fetch it with lighted Torches. Into this Lake o the Water runs with a great stream by the Channel l. And out of this Lake it fall down a Precipice into a great Cavern, with so much noise that the discharge of a Pistol would not be heard here. There is likewise another Channel m which tends upwards obliquely, and leads to the great Lake n, whose length and breadth are hitherto undiscovered; I lookt about it with many lights, and could see nothing but Water, and throwing Stones several ways as far as I could, I heard them all fall in the Water: and I found the depth of it near the Bank to be 10 Cubits, and doubt not but it is much deeper in the middle.

The Country People told me, that this Channel l affords always an equal quantity of Water, or else is quite dry; and that sometimes it will cease to run in a Moment, and continue dry for some Weeks, and then on a sudden it will run again with great force, so as the Noife thereof frequently frights the People as they come for Water.

Out of the Cave b there is another Channel e, which is divided into three others d, e, f. This Channel f tends obliquely
obliquely downwards, till it comes to a running Water in g, from whence one may go on to h, where looking thro' a little hole, one may see another little Lake.

All the Channels I have mentioned, are formed in a very hard Rock; and are smooth or polished, as if cut by Men's Hands: These may be seen by any one that will go with lighted Torches; and there are many such, in which I have not been.

If any one would carry a Boat to the Lake n, and would row upon it, I doubt not but he might find several curious things. I believe this Subterraneous Lake to be a German Mile long: for from this Grotto Podperschio, at a Miles distance, there is a Village called Kumpale, whose Inhabitants have no other Water, than what they fetch out of a hole in the Rock, going with lighted Torches, by a large Channel, to a great Lake under ground. I measured with good Geometrical Instruments, such as Miners use; the Level of these two Lakes of Podperschio and Kumpale, and found them to be in one Horizon; and this I did twice, both when the Channel l at Podperschio run, and when it did not run. When it began to run, I found that the Lake n was two Cubits higher than it had been before; when it ceased to run, I came again on purpose to observe it, and found that then also, the other Lake at Kumpale was in the same Level; from whence it is most certain, that these two, are only one continued Subterraneous Lake, &c.
A Correct Tide-Table, shewing the true Times of the High-waters at London-Bridge to every Day in the Year 1688. By J. Flamsteed Math. Reg. & R. S. S.

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M stands for Morning, A for Afternoon, O for Sunday.

This Table may be made to serve the underwritten Places by

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<tr>
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<td>1 00</td>
<td>Gravesend, Rocheller, Rammekins.</td>
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<tr>
<td>Silly.</td>
<td>1 45</td>
<td>Buoy of the Nore and Flushing.</td>
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<td>Mounts Bay.</td>
<td>1 55</td>
<td>Shoe beacon, Portsmouth.</td>
<td>2 30</td>
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<tr>
<td>Bridlington Peer, and Humber.</td>
<td>2 00</td>
<td>Redland and Olyen.</td>
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<tr>
<td>Fowey, Loot and Plymouth.</td>
<td>3 15</td>
<td>Spithead, Harwich, Dover, Calais.</td>
<td>3 00</td>
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<tr>
<td>Dartmouth, Harboroum, and Hull.</td>
<td>3 30</td>
<td>Orfordness, Gunfleet, Haslings.</td>
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<tr>
<td>Torbay and Tynmouth.</td>
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<td>Shoreham, Diep.</td>
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<tr>
<td>Exmouth, Topham, and Lyme.</td>
<td>3 50</td>
<td>Needles, and Tarmouth Peer.</td>
<td>4 40</td>
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<tr>
<td>Weymouth.</td>
<td>4 20</td>
<td>St. Helens and Haver de Grace.</td>
<td>5 30</td>
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<tr>
<td>Bridgewater and Texel.</td>
<td>4 45</td>
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<tr>
<td>Portland, Harflew, and without the Wt.</td>
<td>5 40</td>
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But Note, that in such of these Places as lie open to the Sea, and where no great Rivers are, the Quarter-moon-high-waters, hold out longer than the times shewed by this Reduction, near half an hour.

As also that, when by reason of the long Droughts in Summer, or continual hard Frosts in Winter, the fresh Waters are low; or when the Wind blows hard at N, or N. W. the Tides may hold up longer in the River of Thames, than the Times shewed in the Table. But when the Wind is strong at W. or W. by S. or there are great Freshes; they hold not out so long, but the difference is seldom above half an hour.
A Conjecture at the Quantity of Blood in Men, together with an estimate of the Celerity of its Circulation. By Allen Moulin M. D. Reg. Soc. S.

In a Sheep weighing alive 118 lbs. we found but 5 lbs. ¾ of Blood which is but ½ of the weight of the Sheep. In a Lamb weighing 30 lbs. ½ when living, there was but 1½ lbs. of Blood which is nearly a 20th part.

In a Duck weighing alive 21 lbs. 14 Ounces 50 gr. we found an ounce and a half and 53 gr. of Blood, which is less than a 28th of the whole weight of the living Duck.

In a Rabbit weighing 10 Ounces, 7 Dr. and 50 gr. we found 2 Dr. 57 gr. of Blood, which is about a 30th Part.

In the right Ventricle and Auricle of the Heart of a Dog, I found 6 ounces of Blood, after that I injected into the jugular Vein a Liquor that coagulated the Blood. I found a greater quantity of Blood in the Heart of another Dog, whom I treated after the same manner. The Hearts were much distended by the Blood found in them. I shall therefore suppose that 4 ounces only were received at a time by thee Hearts without force, that is naturally: And least I should suppose a greater quantity of Blood to be admitted at a time than really is, I will suppose a Mans Heart which is much larger, (and has much larger Vessels than thos I speak of) to receive but 4 ounces at each Diastole. Allowing 75 Pulses to every Minute, there will be 4500 in an hour, and 18000 ounces of Blood transmitted in that time. This last Number is the Product of the foregoing 4500, being multiplied by 4, the Number of Ounces at a Diastole.

Now
Now if we shall suppose that a Man's Blood bears the same Proportion to his weight, as that of any of the aforesaid Animals had to its weight, which in a Lamb was the greatest, being $\frac{2}{5}$ part, it will follow that the quantity of circulating Blood in a Man weighing 160 lb. will not exceed 8 lb., or 128 ounces; According to which computation the Blood will circulate 140 times in an hour. But let us suppose that instead of 8 lb., the mafle of Blood in such a Man be 12 lb. it will follow that it will circulate between 93 and 94 times in an hour; which is a circulation and half, and somewhat more, every minute. I take this last computation to be very modest, when especially it is considered that in the Lamb when opened, there was scarce a dram of Blood; in the Sheep not 3 oun. to be seen. From the celerity of the motion of the Blood now mentioned, we may give a good account of the sudden Refection with victuals, and particularly such as are liquid: we may also account for the quick passing of Urin, from the same thing; and also the quick motion of the Chyle into the Breasts of Nurses, without supposing unknown passages, from the Stomach or any other part, into the Bladder and Breasts.

Half an ounce of Blood at a Diastole is the greatest quantity that I remember any Anatomist supposes to get into the Heart, and they suppose the quantity of Blood in the Body to be between 15 and 25 lb. by which it will appear how their computations and mine differ.
Catalogus Ecliprium omnium Satellitum Jovialium Anno 1688 per universam Terram Visibilium; momenta Occultationum eorum in Jovis Umbra, ac ex eadem Egressium sub Meridiano Londinensi exhibens. Supputante E. H.

Cum instituto perutili Cl. Flamsteedius Astronomus Regius, harum Ecliprium Catalogo Aetha Philosophica per annos aliquot ulterior auxerit, ejusque usus eximios ad inveniendas Locorum Longitudines docuerit, in Num. 154 & 165; nimis publici interesse visum est, quam ut opus restitutioni Geographiae maxime accommodatum non continuaretur. Cumque accuratus ille Author, procul dubio magis arduis intentus, insanis annis Catalogum supputatum non dederit, aliena ope uti necesse erat; ideoque ex Tabulis aliciae, neque parrem cum celo consensum professis, profit haec Ecliprium series, quam Astronomis universalis serio commendamus; ut tandem Restauratae Geographiae fundamenta, hac methodo facilium ac nullo fere Instrumentorum apparatu praestanda, sed quae minime fallant, jaceantur.

Quae huc pertinent praecipue Astronomicè doctos laterè non possint discere cupidi Num. 154. quod quærunt abunde inventum. Unicurn momenta non abs erit; nempe, Tubo octo vel etiam septem pedum, haec est facile portatili, momenta harum Ecliprium satis distincte observari potest, presertim in exterioribus Satellitibus, si modo Lenti Obiectivæ apertura 2½ vel 3 pollices pateat. Sic enim Radiorum maxima copia ad oculum refracta pervenit, unde minima haec Stellarè in vicinia Jovis conspici possint, quæ alias luce ejus nimirum obscurarentur; ac quamvis coloribus ingantur, ac Jovis limbus parum nitidus videatur, tamen cum de momento amissæ vel recuperatae Lucis unice agatur, sufficit eas lumine quantum eri possit quæstas in oculos certius incurrere.

In Catalogo quem jam damus im. & em. Immersiones & Emeressiones denotant Satellitibus ejus quem numeros annexus monstratur; Intimo pro primo habito, eximo pro quarto. Astériscus vero (*) eas ex his Eclipibus quæ Londini visibiìe esse possunt designat, quaeque Jussu Societatis Regiae amnuece cælo observari debent.

Intra Hora quadrantea momento hic posta cum cælo consentientia peramus: in primo ac tertio Satellite multo propius, in quarto & secundo ambiguam: Itaque paulo ante tempus praesignatum observatori attendere debet. Equationem Luminis ex drisvis Jovis à Terra distantias ortam confulto omnisimus, eo fine ut necessitas ejus quantitatem si observaveri percepertur.

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Umbram & ex ea Emerfionum sub Meridiano Londinensi

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Accounts of Books.


This Book contains an Hypothesis, and Demonstration thereupon, concerning the Nature of Bodies and their motions. The Author defines a dense Body to be that which hath least Vacuity. A Bubble a rarer Fluid in a more Solid: a Drop a denser Fluid in a more Rare. His Position is, That a dense Body is more potent than a rare. His Supposition is, That in a Body mixt of these two, both endeavour to recede from the Center of it: And thence his first Proposition is, That the most dense Parts will get out most, the less dense will remain in inner Stations, which he calls natural. 2. He supposes, any other Body immers'd in this will find and take its natural Station, according to its comparative Density: the endeavour to go to this natural Station, if downwards, is Gravity; if upwards, is Levity. These Bodies are compress'd by External Bodies. Thence, 4. he concludes, Spherical figured Bodies to have least of any figured Bodies of this Compression. 5. Hence, That denser and rarer Bodies will not mix, but 6. the inclosed will be prest by the other into a Spherical Body, a Drop, or a Bubble. 7. If the Figure be alter'd, it will have an endeavour to restore itself. 8. Lesser Globules will have more of that endeavour; whence a greater broken into lesser Globules produces more of this endeavour outward. 9. That a Globule, in its natural place, is easily dissipated. 10. The nearer a Globule is to its proper place, the less is its Gravity or Levity. But, 11. In a turbid Body the denser parts will settle about the Center, the rarer outwards: those he calls a Terrella, these an Atmosphere: this Compound will find its
its natural station with respect to others: two of these meeting, may coalesce, and make one Terrella and one Atmosphere; many of them will make a Terra. If two or more of these touch, and do not mix, they will be difficult to be separated: the more there are of these in the same space, the harder they will be to be separated: hence he deduces a Problem, That 'tis possible to diminish Bodies, that the Coherence hence arising shall be greater than a given Power: this he supposes the cause of Hardness. His next Position is, That a heating Globule immers'd in a terminated Fluid, whether Spherical, or Oval, will settle itself in the Center of Gravity of it: but if through this Fluid there be a passage to another Fluid, the heating Body will be put out of that Center into the Focus of the Oval: The Conflict between the included and passing Particles will create a Vortex, whose included matter shall move exactly as the Elliptical Hypothesis of the Planets supposes, and answer not only to that but to any other Hypothesis.

The Application of this Hypothesis he explains in a Letter to Mr. Aston; in which he expresses his Esteem of Aristarchus, the vindicating whose Honour, put him, about two years since, upon these Principles, which he in the interim digested, and sent to the Oxford Society; from whom receiving no Objections, he thought good to publish now: and that because they will serve to explain not only the Aristarchian but the Ptolomaic, Tychonic, and perhaps any other System of the World, and any kind of Philosophy, not ridiculous at first sight, whether a Vacuum be affirmed or denied. But as to Elasticity, he does not affirm these Principles to have given the only cause, nor that they can explain Vegetation without an Animas; but he supposes them sufficient to explain Cohesion. He explains a threefold effect of Pressure: 1. That which acts on a Body in its own place; 2. That which presses it towards the Center when out of its place: 3. The difference between the Moment and Impediment tending upwards or downwards. Thus far he communicated to the Oxford
Oxford Society. To this he adds quatuor Lemmata de novo, which he applies to the Explication of Cartesius his System, supposing the matter between the Vortices that join to that of the Sun, to influence that by its Ingress, so as to keep the Sun in the Focus of the Elliptick Vortex. This premised, he subjoins his first Lemma, where he presents the Sun in the Center of Gravity of its System without Vortex or turbinated motion: in the second he directs it to the Focus of the Ellipse: in the third he generates the Vortex by the conflict of the entering and contain'd matter, exactly agreeing with the Phænomena; and turns round the Sun by the motion of the Vortex, giving the Planets their exact Motions, which they cannot deviate from.

Lastly, He generates Earths or Planets by the Coalition of many smaller into greater Bodies: these he explains more particularly from his Principles, and then answers two Objections which may be made against it (as he conceives,) and a third which a Demonstration of Mr. Newton's, upon a Supposition of his, doth directly oppose: to which he answers, That that Hypothesis ought to be corrected; and gives his Reasons which he thinks sufficient. He disapproves of the Hypothesis of the Planets gravitating upon each other, and explains his Reasons from the similitude of a Ship in the Water; and ends his Epistle with this Conclusion, That though the Moon were a thousand times bigger than the Earth, it would not be able to move the least Sand out of its place, if that were the Center of the Earth: the like he supposes of the other Planets, with respect to the Sun.
Tabularum Astronomicarum pars prior, de motibus Solis & Lune, necnon de positione fixarum, ex ipsis Observationibus deducitis: cum usum Tabularum, &c. Authore Ph. de la Hire Regio Matheos Professor ac Regie Scientiarum Academie Socio. 4to. Parisii. 1687.

This Author, long since eminent for his Skill in Geometry, does now succeed the accurate Mr. Picart in the Royal Observatory at Paris, and this Book is the first Fruits of his Astronomical Endeavours. It is chiefly designed to teach an accurate method of Calculus for Eclipses, especially Solar, where he makes use of the Contemplation of the Constructions of them, by the parallel of Latitude supposed to be projected into an Ellipsis, which is here attributed to the excellent Mr. Cassini; though first published in English by Mr. Flamsteed in Sir Jonas Moor's Works, under the Title of The Doctrine of the Sphere, and there ascribed to its first Inventor, Sir Christopher Wren.

What is most considerable in this Book, is the large Table of the Longitudes and Latitudes of Places, chiefly in France, which have been taken by the King's Order, with great exactness, and may possibly be inserted in the next Transaction. 2. A Table of the right Ascensions and Declinations of sixty three principal fixed Stars, to the Year 1686. compleat, deduced from new and accurate Observations. 3. An Empirical Table of the Moons Equations in the New and Full; deduced simply from Observations of Eclipses: here the greatest is made 4° 57'. 44", and the rest nearly oscillatory, or equal at equal distances either from Apogeeon or Perigeon, which our Mr. Street, in his Astronomia Carolina, has made precisely so, only his greatest Equation is about three minutes bigger. 4. A Correction of the Moons Motion, arising from the distance of the Moon from the Apogeeon of the Sun, or which is all one, from the Anomaly of the Sun; about the Inven-
tion whereof, there is a Dispute between this Author and one Mr. Le Febure, each of them esteeming it a Discovery worth contending for. Mr. De la Hire makes the greatest quantity of this Equation to be thirteen minutes, in the mean distance of the Sun, to be added to the Moons place in September and subtracted in March; which Le Febure allows to be but 11. 9". If there be any thing due to the first Proposer of this Discovery, it will appear that neither the one or the other of these Pretenders have any just claim to it; for that it is conceived, that the whole matter is fully and amply set forth in the Appendix to the Catalogue of the Southern Stars, published in London by E. Halley in the Year 1679, and soon after Translated into French, and printed in Paris; witness the Journal des Scavans of Sept. 4. 1679. There these Messieurs might have read, under the Title of Quadrarum Lunaris Theorie Emendationem Spectantium, the following Passage, Quoniam tantas inaequalitates in Terræ revolutionibus non patiuntur Horologia, necessē est Lunam ipsam citationi motu ferri in sua orbita, quam Terra est Aphelia, remissori cum in Peribele ita ut omnium accelerationum summa mensē Septembri, ad tredecem minuta circiter assurgat. Retardationes vero omnes aggregatæ, mensē Martio, tantundem efficient. Adhibeatur itaque temporiis æquatior quà Terræ motum diurnum æquabilem statuit; in Calculo vero loci Lunæ, medio Lunæ motui addenda est nona pars æquationis Solis sublative, auferenda vero ab eo, si æquatio sit additiva: wherein is contained not only the Form of this Equation of the Lunar Motions, but the very Quantity, viz. thirteen Minutes, exactly as Mr. De la Hire has it. Hence it should seem, either that this inequality is most justly stated by the exact Coincidence of the Conclusions of two so different Inquirers; or that the latter having seen the afore-cited Passage, and finding it warranted by Observation, might think it an Invention not unworthy a Frenchman: And whereas Mr. De la Hire seems to conclude, that this Equation ceases in the Quadratures, and is greatest in the New and Full Moons; when he comes to the considera-
tion of the Lunar Motions extra Syzygias, (which is here promised,) he will find it no less requisite in the Quadra-
tures than in Eclipses; several undoubted Observations shew-
ing the Necessity thereof.

Among the Precepts for the use of the Tables, there is a
pretty Remark concerning Refractions, which this Author
faith he hath often experienced; viz. That the Beams of
the Stars being observed in a deep Valley to pass near the
Brow of the Hill, are always more refracted than if there
were no such Hill, or the Observation were made on the
top thereof; as if the Rays of Light were bent downwards
in a Curve, by passing near the Surface of the Mountain.

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The Report made to his Majesty by the Company of Parish-
Clerks of London, of the Number of Christnings
and Burials in the Years 1686 and 1687.

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<th>Year</th>
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<th>Females</th>
<th>Total</th>
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<tr>
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<td>7575</td>
<td>7119</td>
<td>14694</td>
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<tr>
<td>1687</td>
<td>7737</td>
<td>7214</td>
<td>14951</td>
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<td>11828</td>
<td>10286</td>
<td>22114</td>
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<tr>
<td></td>
<td>11174</td>
<td>11460</td>
<td>22634</td>
</tr>
</tbody>
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