PHILOSOPHICAL TRANSACTIONS.

Giving Some

ACCOUNT

OF THE

Preſent *Undertakings*, *Studies*, and *Labours*

OF THE

INGENIOUS.

In many Conſiderable PARTS

OF THE

WORLD.

VOL. XVI. *For the Years* 636, and 1687.

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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.*

TO THE

RIGHT HONOURABLE

JOHN

EARL OF CARBERY

PRESIDENT

OF THE

ROYAL SOCIETY, &c.

This Second VOLUME

OF THE

PHILOSOPHICAL TRANSACTIONS

Is Most Humbly Dedicated

By Lord's Most

To The

RIGHT HONORABLE

FULKE LORD BROOKE

Of

Beauchamp's-Court.

MY LORD;

HAving *Compleated the fifteenth Volume of the* Philosophical Transactions, (*which contains part of the great Stock of Experimental Learning, communicated to the* Royal Society *the last year,*) *I now Humbly Dedicate it to Your* Lordship; *a* Person *of* Honor, *always ready to Favor, whatever makes for the Improvement of Knowlege, and the Public Good.*

But this imperfect Character of Your Lordship, *tho' of it self sufficient to Justify the present Address, is not the only Inducement to it: I could mention, how much We are all indebted to Your* Lordship, *for a Uniform and Steddy Loyalty to the* King, *and a Pious Love for Your Country:*

I

I might add, That Your Lordſhip's *Kindneſs has reacht the Publiſher of theſe Tracts, and made Him wholly Your Own: But I muſt take care, not to be Uneaſy to Your* Lordſhip; *who is more inclined to Do great things, then to Hear of them after they are done.*

Wherefore, I ſhall only recommend to Your Lordſhip's *Patronage and Protection, the following Diſcourſes: Some of which retreive loſt Peices of Antiquity, (as the Incombuſtible Cloth, &c.) and by theſe means add to the Authority of the Antients, who have ſuffered in their Reputation by Our Ignorance: Others extend the bounds of Learning, and inform Mankind by New Diſcoveryes: Theſe are all preſented to Your* Lordſhip, *in token of a much greater Debt, from,*

My Lord,

Your *Lordſhip's* moſt Obedient Humble Servant,
WILLIAM MUSGRAVE,
Reg. Soc. Sec.

PHILOSOPHICAL TRANSACTIONS.

For the Months of *January*, and *February*, 1686.

THE CONTENTS.

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-*

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 tryed 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 tho' upon an extraordinary occasion these Transactions have for some Months last past been omitted, yet that defect will be soon supplyed 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.

A DIS-

A

DISCOURSE

Concerning GRAVITY, *and its Properties, wherein the Deſcent of* Heavy Bodies, *and the Motion of* Projects *is briefly, but fully handled: Together with the* Solution *of a* Problem *of great Uſe in* GUNNERY. *By E. HALLEY.*

NATURE amidſt the great variety of *Problems* wherewith 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 underſtood 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 Philoſophiæ*; yet neither he, nor any of his Followers can ſhew how a Body ſuſpended *in libero æthere*, 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 Circulo*, 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 ſame *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 *Attractions*, the *Loadſtone* drawing only *in* and *about* its *Poles*, and the *Earth* near equally in all parts of its *Surface*, this Compariſon avails no more than to explain *ignotum per æque 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 ſay, 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 *Galilæus*, *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 it ſelf exactly into a *Spherical ſurface*, and the *Prominences* of the *Land*, conſidering the Bulk of the whole, differ but inſenſibly therefrom.

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 *Receſſes* 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 proportionably ſhortned.

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 ſmaleſt *Bodies* would deſcend the ſame *ſpaces* in equal times; the truth whereof will appear from the *Experiment* I beford 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 encreaſes 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 *Phænomena* of the *Cæleſtial 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 it ſelf more vigirouſly 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 alwaics 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 *Mathamatically* deducible. Mr. *Iſaac Newton* has ſhewed how to define the ſpaces of the *deſcent* of a *Body*, let fall from any given highth, down to the *Center*. Suppoſing the *Gravitation* to increaſe, as in the fifth Property; but conſidering the ſmalneſs 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 parralel 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.

Pro-

Tab. 1.

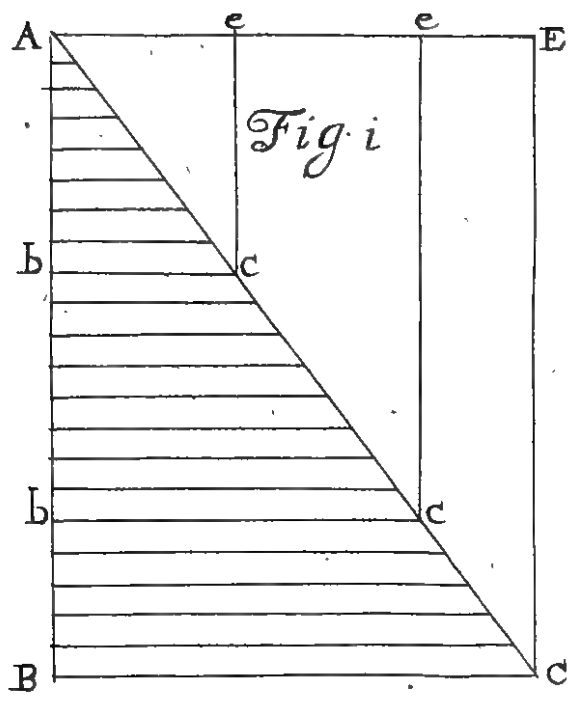


Fig. 1

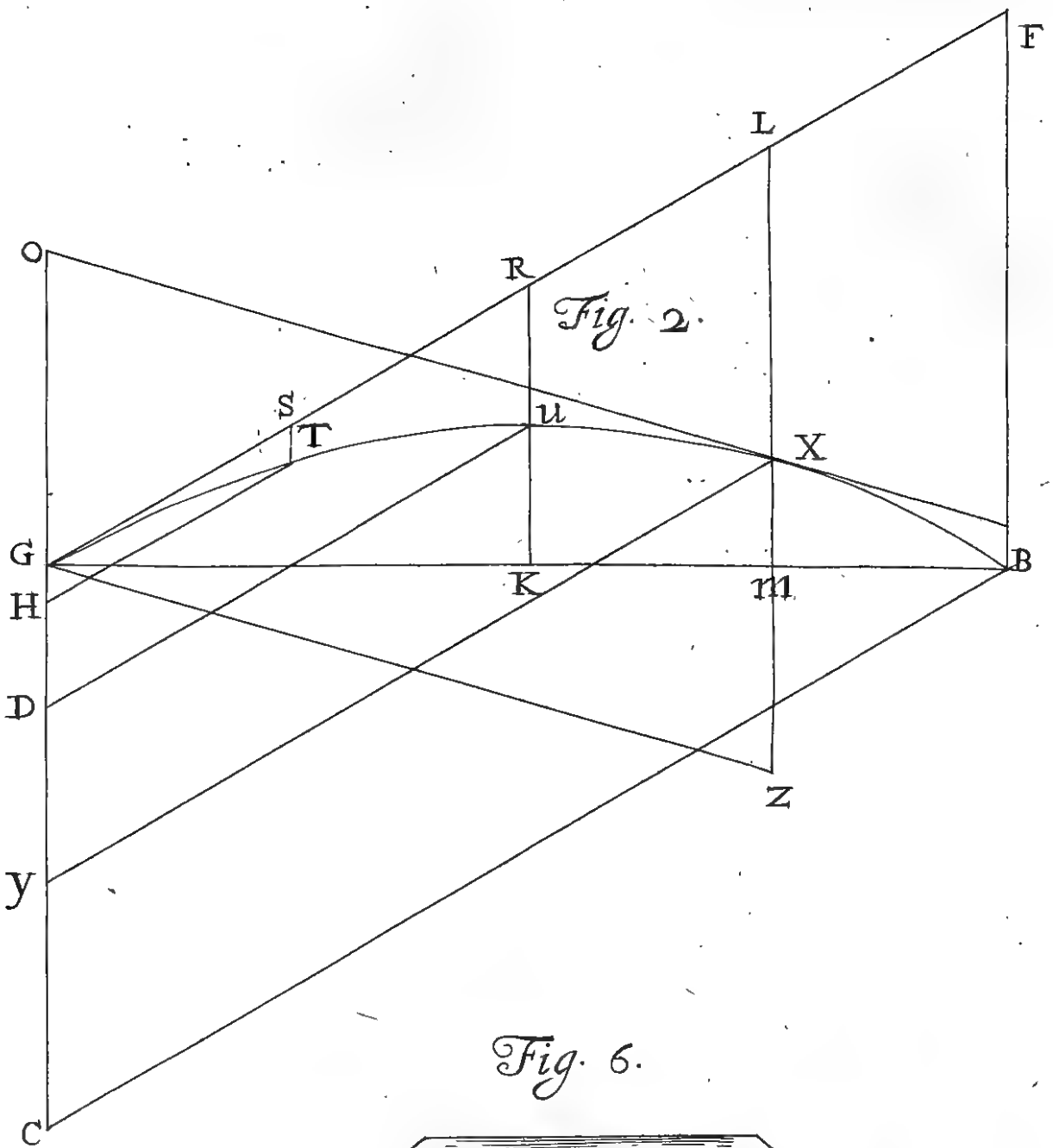


Fig. 2

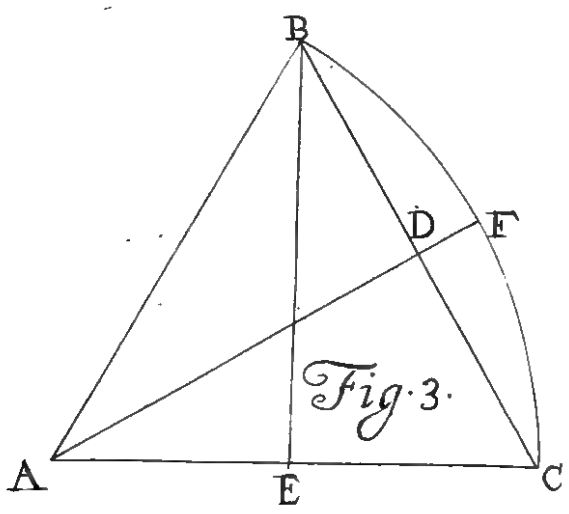


Fig. 3

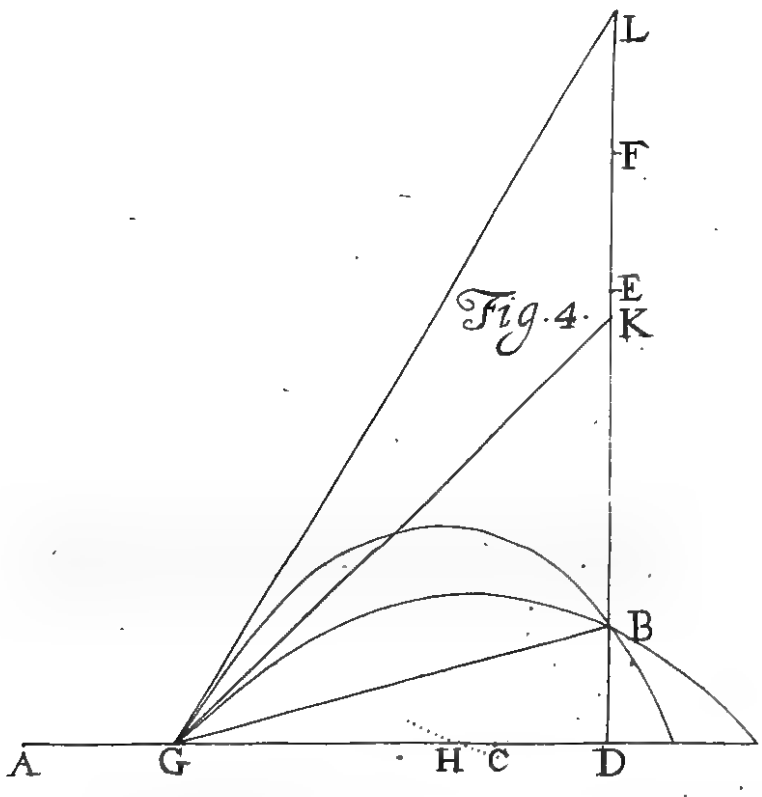


Fig. 4

Fig. 6.

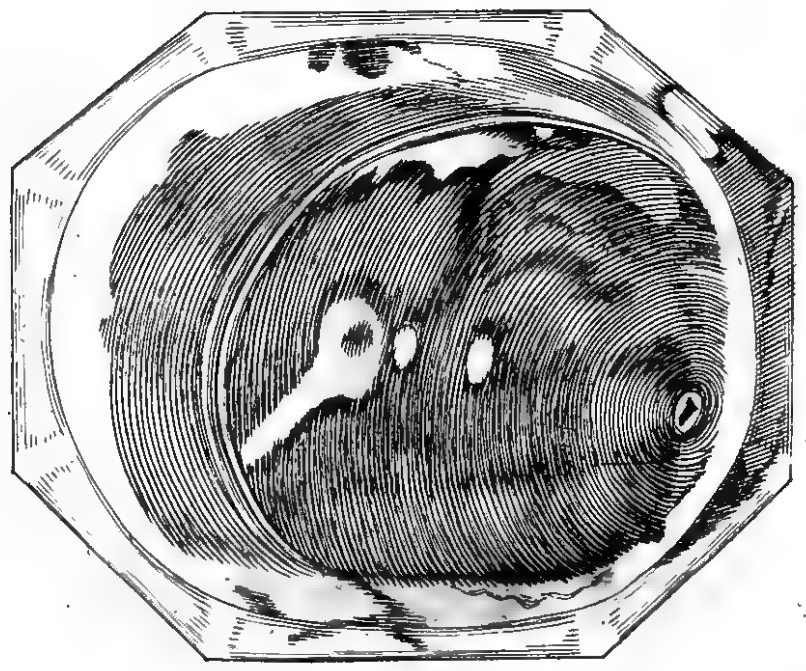
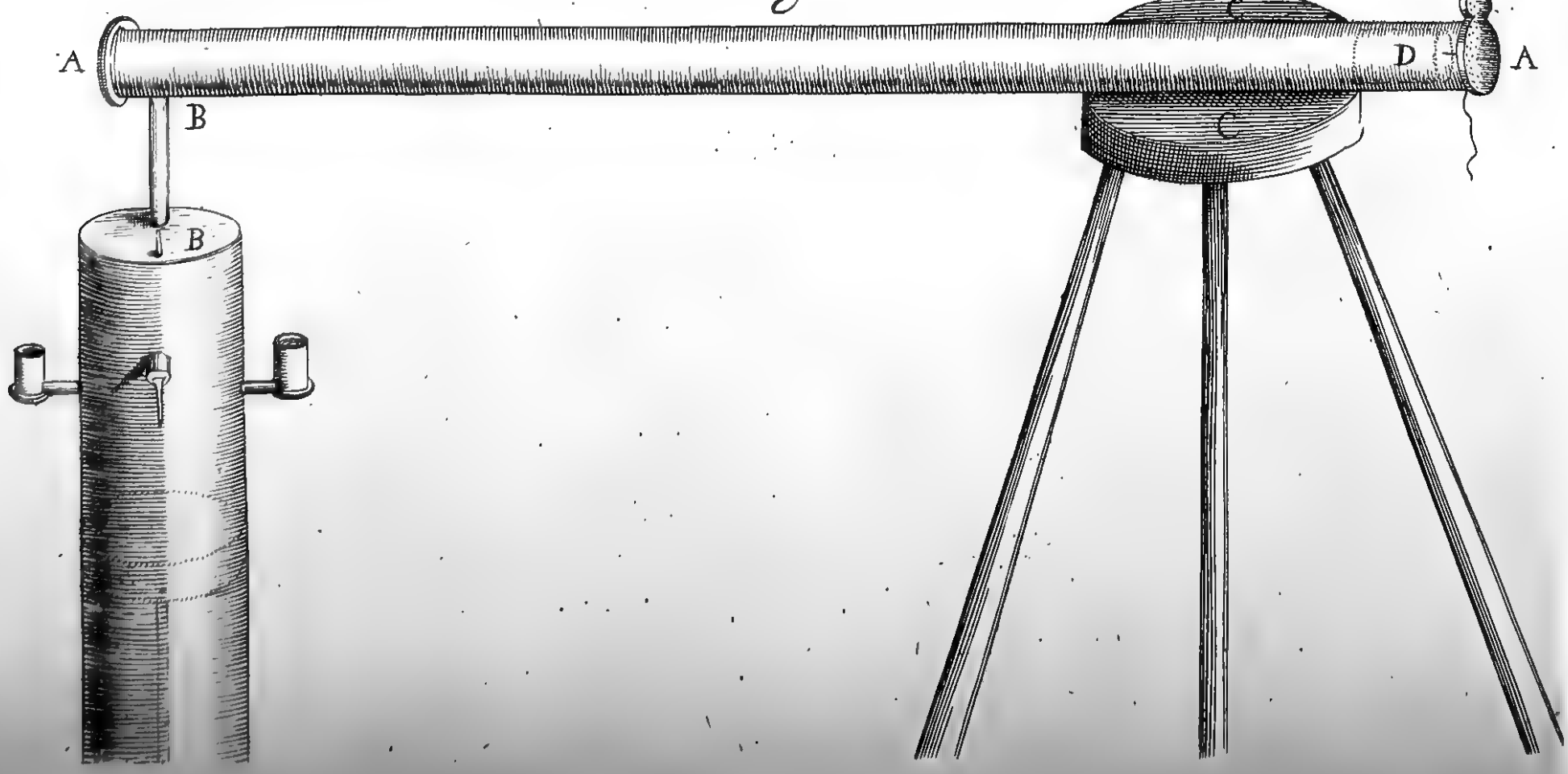


Fig. 5.



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 *equable Motion*; but in the next ſecond of time, the ſame power of *Gravity* continually acting thereon, ſuperadds a new *Veloſity* 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 *Veloſity* 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 bc, bc, bc, bc, &c. parallel to B C, 'tis manifeſt that the ſeveral lines, bc, 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 bc 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 B C ſuppoſed infinitely many; which ſum is the ſpace deſended in the time repreſented by A B. 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 20 th 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 equably 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 ſo, 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 Treatice 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 $\frac{1}{8}$ 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 eaſily *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 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 U D, 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 $\frac{sz}{c}$=FB=GC, and by reaſon of the *Parabola* $\frac{psz}{c}$=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=to $\frac{psz}{c}$: which *Equation* reduced, will be $\frac{psc}{rr}=z$. But by the former *Lemma* $\frac{2sc}{p}$ is equal to the *Sine* of the double *Angle*, whereof s is the *Sine*: wherefore 'twil be as *Radius* to *Sine* of double the *Angle* FGB, ſo is half the *Parameter*, to the *Horizontal rang* 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 *ſines* of all doubled *Arches*, to the *ſines* of their doubled *Complements*.

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

Corollary.

From hence it is plain, that the greateſt *Altitude* of the perpendicular *Projection* is a 4*th* of *Parameter*, or half the greateſt *Horizontal* Rang; the *verſed ſine* of 180 degrees being = 2 r.

Prop. VIII. The *Lines* GF, or times of the flight of a *Project* caſt with the ſame degree of *velocity* at different *Elevations*, are as the *ſines* of the *Elevations*.

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

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

Solution. As *Radius* to *Secant* of FGB, ſo GM the *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 alwaies 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 $\frac{tb}{r} \mp h$ $\begin{matrix}\text{in aſcents}\\ \text{in deſcents}\end{matrix}$=LX, and $\frac{ptb}{r} \mp ph$=GL *quad.* =XY *quad. ratione Parabolæ*; but $bb + \frac{ttbb}{rr}$=GL *quad.* 47. 1. *Euclid.* Wherefore

$\frac{ptb}{r} \mp ph = bb + \frac{ttbb}{rr}$ which Equation tranſpoſed, is

$\frac{ttbb}{rr} = \frac{ptb}{r} \mp ph - bb$, divided by bb is

$\frac{tt}{rr} = \frac{pt}{br} \mp \frac{ph}{bb} - 1$. this Equation ſhews the Queſtion to have two Anſwers, and the Roots thereof are $-\frac{t}{r} = \frac{p}{2b} \mp \sqrt{\frac{pp \mp 4ph}{4bb}} - 1$ 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* $\mp$ double height descent to the *square* of a *Secant* $= \frac{pp \mp 4ph}{4bb}$ the *Tangent* answering to that *Secant*, will be $\sqrt{\frac{pp \mp 4ph}{4bb} - 1}$ 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 $\frac{p}{b}\frac{r}{}$: 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 $\frac{p}{2b}\frac{r}{}$ 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* $4bb \mp 4ph = pp$ 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 $= \frac{1}{4}p - \frac{bb}{p}$ in *heights*, and $\frac{b}{p}\frac{b}{} - \frac{1}{4}p$ 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 $bb = \frac{1}{4}pp \mp ph$ being reduced $\frac{1}{2}p$ will be $= \sqrt{bb + hh} \pm h$ $\begin{matrix}\text{in aſcents}\\ \text{in deſcents,}\end{matrix}$ 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 *b*, 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 *hights* 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. $\frac{t}{r} = \frac{p}{2b} + \sqrt{\frac{1}{4}pp \mp ph - bb}$, and tis this. Having made the right *Angle* L D A, *Tab.* 1. *fig.* 4. make D A, D F = *p*, or greateſt Rang, D G = *b* the *Horizontal* diſtance, and D B D C = *h*, the *Perpendicular hight* of the *Object*; and draw G B, and make DE = thereto. Then with the *Radius* A C and *center* E ſweep an Arch, which if the thing be poſſible, will Interſect the line A D in H; and the line D H being laid both waies from F will give the points K and L, to which draw the lines G L, G K; 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* D C = D B muſt be laid from A, ſo as to have A C = to A D + D C. *Note* likewiſe, that if in *deſcents* D H be greater than F D, 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 *præcognita*, 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* impreſt 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 Shott 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 alwaies 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 alwaies equal, and that the leaſt force in U is to that in G and B, as

B, as *Radius* to the Secant of the *Angle* of *Elevation* F G 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 Forreign, 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* containes a *Problem*, untouch't 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 requi ed 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 Entituled, *L'art de jetter 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 impress 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. 'Tis

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 Surpaſſes 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 Braſs 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 Errours committed in ordinary *Practice*, by the unequal Goodneſs and Dryneſs of the ſame ſort of *Pouder*, by the Unfitneſs of the *Shott* to the *Bore*, and by the Looſneſs of the Carriage.

In a Smaller *Braſs-Shott* of about an Inch and half *Diameter*, caſt by a *Croſs-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 ſo 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 Ghericke* hath found a new Sort that ſhoots by Rarefaction; and he hath Publiſht 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 my ſelf 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 ſoder'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 peice 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 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 A A 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: *Stutgardiæ, Febr.* 120. 1686.

AUrifaber Stutgardianus, qui & gemmis & Metallicis typis nummorum cudendorum inſculpendis artificioſus eſt, nomine *Chriſtophorus Muller*, Anno 1685, aurum *aqua regis* ſolutum, oleo *Tartari* præcipitatum atque edulcoratum, quod aurum fulminans dicunt, dum in ſcutella, quam Maturellam 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 Friſio*, egit *lib. 6. Artis Vitrariæ*; invenit iterato tertium eodem labore: quod color pulveris iſtius puniceus, qui per dies aliquot ſiccatus in vaſculo manſerat, quouſque inter terendum

rendum etiam ad marginem effluxit, relictis tamen puris hinc inde ſpatiis Onychini coloris, duriſſimam hanc gemmam, quæ limam ſpernit, ita profunde penetraverit, non tantum in ſcutella, ſed & ipſo piſtillo, & diſtinxerit maculis atque circulis ſat ordinate ductis, ut color hic neque ſimplici aqua, neque lixivia, vel acriori alio liquore potuerit deleri, & quidem ſine polituræ elegantioris detrimento.

Talis itaque tinctura per repetitas trituras dicti pulveris tentata denuo aliquoties, in ſimilis coloris alio Vaſculo, neque vero apparuit poſtea ut antea nunquam. Sed hoc imprimis circa tinctionem hujus vaſculi obſervandum eſt, quod ſecundum texturam gemmæ, tam nudo quam armato oculo, in tincta interna, & ſincera externa parte vaſis, notentur fibræ ſeu ductus circulares, juxta quos, bracteis ſucci lapidei novi per intervalla impoſitis, in ejuſmodi molem excreviſſe credendum eſt; uti Bezoar aliique lapides laminis ſuper accreſcentibus augentur, & ligna, in quorum ultimorum trunco, circuli ſeu annuli deſignant ſucci annui numerum & incrementa: adeo ut hic, purpureus ille color lineis pallidioribus & obſcurioribus, prout vel denſiores vel rariores poros, molliorem vel duriorem texturam offendit, circulares ambitus circa verticem aliquem, veluti circa medullam ſeu cor, ut appellant, aut granum aut paleam in aliis lapidibus & lignis, ſignaverit; intermiſtis quoque hinc inde maculis & ſpatiis obſcurioribus. Veluti Illuſtr. *Boyle*, Specim. de Orig. & Virt. Gemmarum, §. 1. pag. 22, 23, in Adamante & Granatis acies & commiſſuras tenuium bractearum aut planorum obſervavit; quod granum artifices ſeu planam contexturam non diſſimilem fiſſilitati ligni vocant.

Jam vero tingi poſſe quoque Marmora & Alabaſtra & Oſſa per lixiviatos & acres ſuccos, hinc inde ſcriptum eſt: quod fortaſſis & de Gemmis ſperandum eſt, quando *Rob. Boyle* Cit. §. 2. pag. 123. ex iis tincturam manifeſtam extractam eſſe ſcribit, alibi, p. 43. & 190. per vapores minerales tinctos eſſe cryſtallos petroſos, atque pag. 45. ipſum Sapphirum per vapores ſubterraneos.

Cum

Cum denique ex obſervatione noſtra manifeſtum ſit, revera tinctam eſſe gemmam Chalcedoniam, quamvis fortuito acciderit, neque repetito proceſſu ſimile quid evenerit, merebitur tamen meditationem, an ex aſtrorum fluxu, aliave abſcondita potius vi venerit, & tentamen, an ex mixtura ſalium & ſuccorum acrium poſſit imitando produci ejuſmodi Tinctura, & quidem ſine Igne, ut ſplendor & Pelluciditas gemmæ non deſtruatur, durities autem maneat, adeoque ipſa gemmæ pretioſitas non tantum ſervetur, ſed & per tincturam novam creſcat.

Hujus Tincturæ figuram & modum, ſi forte quem delectet, addere placuit, qualis noctu oppoſita Candelæ viſa fuit, aliquomodo nec ſatis accurate delineatum. Tab. 1. Fig. 6.

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 *Stockholm*; 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 ſame Row, the other. As the *Peppinjay-green* is made of *Blew Bice* and *Camlodia*, 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 ſame *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

A ſhort Diſcription of the Simple Colours *ſpecified in this Table.*

1. *Paniſh White* made of *Chalk* and *Alumn* burnt together.

2. I take the *Lapis Armenius* to be the blew *Bice* ſold 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 *Bergblaw*.

3. *Ultramarine* is made of the bleweſt *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 *Neri*'s Art of Glaſs, *lib.* 7.

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

5. *Litmaſe*, or *Litmoſe*, 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: *Linſchoten* ſays, it is called *Anil*, that it grows in *Cambaia*, 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 *Blews* at the Head of our *Table*; the *Yellows* and *Reds* made uſe of, are theſe that follow.

1. *Ceruſe* is the Ruſt of *Lead* made by a vaporous Calcination; *Pliny* writes thus of it in the 34. *lib. cap.* 18. *Ceruſe*, or *Pſimythium* is made in the Plummers Shops; of ſmall Plates

Plates of Lead laid upon a Veſſel of very ſtrong Vinegar, what falls into the Vinegar is taken out, and dryed in the Sun: and in the 35 *Book*, *Chap.* 6. he ſays it was made at *Rome* of burnt *Marble-ſtint* quench'd in Vinegar.

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

3. *Gutta Gambæ*, 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 *Tithimal*; others *Ricinus*; others refer it to the greater *Cataputia*, *Eſula*, or the Flowers of the *Indian Ricinus*, and will have it coloured with *Turmerick*: as *Schroder*.

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 *Poyſons* 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 tryed, which afforded him very good *Gold*, but in ſo ſmall a Proportion, that he loſt by the tryal.

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 *Jupiters* Face was painted therewith, as likewise the Bodies of those that entred in Triumph. The factitious *Cinnabar* is that which we now use; and is made by a sublimation of *Mercury* and *Sulphur*.

10. *Carmin* made of *Cochineel*.

11. *Lake*, thought to be an *Arabick word*: It is made of Flocks dyed, or shavings of *Scarlet-cloath*, or of the *Cochineel Insect*, or else of *Kermes-berries*, their Tincture being extracted with a Lye of *Pot-ashes*, and then precipitated with a Solution of *Roch-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-lac*, by extracting its Tincture with *Urine*. Dr. *Merret*, ibidem.

12. *Sanguis Draconis* is the Gum of a Tree which looks like dryed 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 Præfatiunculam hanc atque Catalogum Colorum Latinitate donare.

CUM aliquando viderim *Nomenclaturam* Colorum simplicium Trilinguem *Stockholmiæ* editam per *D. Sl. Brenner;* mihi in mentem venit opus me præstiturum *Genio,* ac fini *Regiæ Societatis,* nec absonum, nec inutile, si talis, non modo *Simplicium,* verum etiam *Mixtorum Colorum Tabulæ* conficiendæ modum excogitare potuerim: magis autem fore gratum si cuique *Vocabulo Specimen Coloris* apponi possit; quod Amice *Lector* hic tandem effectum vides.

Constructionem Tabulæ quod spectat, in *Capite* omnes *Cærulei* Simplices, & Primarii apponuntur, & ad *Latus* primo *Luteos,* ac deinde *Rubeos* affixos vides, cum *speciminibus* propriis, & *nominibus* in Officinis notioribus: Cæteri, viz. *Pallidiores Cærulei, Flavi, Rubeique* necnon *Virides,* & *Purpurei* omnes, e mixtura *Simplicium* æquis partibus Orti, reliquam Tabulæ partem complent. puta *Specimen* Colori *Herbeo* affixum, compositum est ex æquo pondere *Cyprii* ad Caput *Tabulæ* videndi, & *Guttæ Gambæ* ad Latus, intime Commixtorum: Sic dicendum de cæteris. Speciminibus etiam adjeci nomina *Latina, Græca, Gallica,* & *Anglica,* saltem quæ mihi nota; quæ autem desiderantur magis verborum gnarus apponas *Curiose Lector,* ac nostro defectui subministres Rogo.

Ad *usum* vero hujusce quod attinet, non leviusculum hinc enaturum confido: restat enim hucusque quid *Desideratum* nempe justa *Colorum statera.* Jam siquis *Plantarum,* vel *Animalium* Integumentum describere velit, ope hujus *Tabulæ* minimo Labore, sine ulla *Ambage,* vel *Ambiguitate* rem conficiet, idemque genuinis quasi depictum coloribus, *Lectoris* eadem instructi *Tabula* oculis subjiciet. Exempli gratia, *Gentianellæ* flos colore est *azurino,* exterius in *saligneum* vergente, hujusque plantæ folia prope *Herbei* sunt coloris.

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

Sequitur Pigmentorum Simplicium in hac Tabula exhibitorum Deſcriptio aliqualis.

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

2. *Montanum*, vel *Lapis Armenius*, levis eſt & friabilis: olim ex *Armenia* deferebatur, hodie vero reperitur in *Germania* in Argenti fodinis; dicitur etiam *Melochitis*, *Bergblaw*. Scrod. Pharm. Med. Chym. l. 4. Claſ. 4. §. 465.

3. *Cyprium*, vel *Ultramarinum* ex lapide *Lazuli*, ſeu Cyano per calcinationem fit. Hujus præparationis methodum cum nimis tædioſum foret hic percurrere, videas *D. Dris Merreti* Notas in Art. Vitrariam *Neri*. l. 7. c. 115.

4. *Smaltum* Efficitur calcinando in fornace *Zafferum*, una cum *cineribus clavellatis*. Modum exhibet Ars Vitraria. Dr. *Merret*, lib. 7. cap. 72.

5. *Litmas* vel *Litmos*, uti videtur, ſuccus eſt plantæ alicujus inſpiſſatus.

Indicum, Authore *Plinio* ex *India* provenit, conſtans limo quodam arundinum ſpumæ adhæreſcente; probatur carbone, fincerum enim reddit flammam excellentis purpuræ, ac dum fumat Odorem Maris redolet, l. 35. c. 6.

A *Linſchoten* vero aliter deſcribitur. *Anil*, vel *Indicum* in regione *Cambaiæ* fit, ex planta quadam *Rorimarino* ſimili; quæ carpitur, & exiccata, aqua denuo humectatur, ac tundendo maceratur, quo facto evaporatur aqua, ac pigmentum conficitur. *Linſchot*. cap. 69.

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

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 *Talu'e* poſitorum. jam Pauca de *Luteis* & *Ru'ris* ſubjiciam.

1. *Ceruſſa* eſt Ærugo *Plumbi* per Calcinationem vaporoſam. *Dioſc.* l. 5. c. 103. De hac ita *Plinius*; *Ceruſſa* vel *Pſimythium* fit ex laminis Plumbi tenuiſſimis ſuper vas aceti aſperrimi impoſitis, atque ita diſtillantibus iis, quod in vas decidit, ad ſolem ſiccatur, *lib.* 34. *cap.* 18. Idem teritur aliud genus Romæ factum, cremato *ſilice Marmoroſo* & reſtincto *aceto*, l. 35. *c.* 6.

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

3. *Gutta Gambæ*, ſuccus inſpiſſatus Plantæ minus notæ; ex *India* utraq; venit, juxta quoſdam *Euphorbii*, alios *Ricini* vel *Tithimali*; vel *Scammonii* ſuccus eſt. Sunt qui ad *Eſulam*, & *Cataputiam* majorem, vel ad flores *Ricini Indi* originem ejus referunt, coloremque ex *Curcuma* conciliatum volunt. *Scrod. ib. l.* 4. *c.* 4. §. 465.

4. *Ochra*, Terræ ſpecies: duplex autem habetur, *Nativa*, quæ apud nos multis in locis reperitur, præſertim in *Saltu de Dean*. *Factitia* altera ex Plumbo aduſto & in aceto extincto, facta vero eſt tempore *Plinii* ex Calcinata *Rubrica*: *Plin. l.* 35. *c.* 6.

5. *Auripigmentum*, *Arſenicum*. Minerale eſt pingue, & inflammabile, jure inter *venena* referendum propter in inſignem ejus qualitatem corroſivam. *Plinius* dicit in *Syria* effodi in ſumma tellure, & olim ſperaſſe *Caligulam Imperatorem*, aurum exinde colligi poſſe; quamobrem excoqui juſſit ad pond *lib.* 14. ex quo purum quidem Aurum elicuit, ſed tam exigua quantitate, ut experimenti ſumptus non rependeret.

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-uſta*, Ochra eſt nativa lutea nudo igne aduſta.

9. *Cinna-*

9. *Cinnabaris* Græcis *Miltos*, 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, eoq; *Jovis* ſimulachri faciem diebus feſtis illinere ſolebant, ut & *Triumphantium* corpora: *Plinio* veteres citante *l.* 33. *c.* 7. Ubi dicit *Romam* ſolummodo ex *Hiſpania* advectum fuiſſe. Altera *Factitia* ac nobis uſitata, fit ex *Mercurio* cum ſulphure ſublimato. *Scrod. l.* 3. *c.* 15.

10. *Carmin* fit ex *Coccinella*.

11. *Lacca*, vocabulum creditur *Arabicum*, efficitur autem *Lacca* hæc ex *Coccino*, ex floccis *Scarlata* tinctis, vel ex *Coccinella*, vel ex granis *Kermes*, Lixivio *cinerum clavellatorum* extrahendo tincturam, quæ deinde ſolutione *Aluminis* *Rupei* præcipitatur: pari modo *Vegetabilium* quorumvis *Laccam* extrahas. Informationem pleniorem cupiens adeat. *Nob. D. Boyle Tract. de Color. Part.* 3. *Exp.* 49. et *Merreti Notrs in Art. Vit. Neri l.* 7. *c.* 116. 119. Alia etiam datur *Lacca* ex *Gummi-lac*, cujus tinctura *Urina humana* extrahitur. *Merret, ib.*

12. *Sanguis Draconis*, lachryma arboris cujuſdam inſtar ſanguinis Exiccati concreta; Ex *India* orientali advehitur, et arbor e qua Lachryma hæc exudat accurate deſcribitur in *Hortu Malabarico*.

13. *Rubrica Anglica*, in multis *Angliæ* locis reperitur.

14. *Atramentum Fuliginoſum*, nihil aliud eſt quam fuligo *Reſinæ*, vel Picis concrematæ collecta, qua propter officinas ædificavere fumum illum non emittentes; olim ad Atramentum Scriptorium in uſu erat. *Plin. l.* 35. *c.* 6.

An ESSAY *towards the Recovery of the* Jewiſh Weights *and* Meaſures, *Comprehending their* Money, *by help of Ancient Standards compared with ours of* England. *By* Richard Cumberland, D. D. *in Octavo*, London, 1686.

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 *Nilus*, 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 *Nilometrion* 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 *Epha*, and the other *Meaſures* of Capacity, endeavouring to prove the *Content* of *Epha*, equal to $\frac{1}{10}$ of the *Ardub*, 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 *Coyns* 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 determins its value 2 *s.* 4 *d.* $\frac{1}{4}$ 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 *Horary Yard*, which he says is 3 Foot 3 ¼ Inches *English*, following therein the Ingenious Mr. *Hugens* 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 *Averdupoize* 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 231 *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.* ½.

Ephemeris ad Annum a Nativitate Domini 1686, *ad Longitudinem Urbis* Londinensis; *ex Novis Hypothesibus exactissime supputata, &* Regiæ Societati *dicata*, Londini *in Octavo. Impensis* Gulielmi Cooper.

THere being at this time a great want of *Ephemerides* of any tollerable exactness, several of our *Astronomers* were perswaded 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 preciſeneſs 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 *Tychonick* 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. PEPYS. R. S. Pr.

LONDON,

Printed by *J. Streater*, and are to be ſold by *Sam. Smith*, at the Sign of the *Princes*'s Arms in St. *Paul*'s *Church-yard*.

PHILOSOPHICAL TRANSACTIONS.

For *March* and *April* 1686.

THE CONTENTS.

THE PREFACE.

TArtary, *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 furnisht 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 Sollicite 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* Chinese *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 Pallace 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*

been

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 equalified 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 prētended, 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 pronounciation and interpretation in Latine; which may ſupply a fit Subject for the Curious to practice upon, and give a taſt of the Philoſophy and of the manner of Expreſſion in that Remote Part of the World. To theſe I have added the the figure of the* Roman Abacus. *Which queſtion leſs 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 ſayes 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 Emperour of China *into the Eaſtern* Tartary, *Anno.* 1682.

THe Emperour 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 Peices in the ſight of the whole Court: The moſt Conſiderable among the *Mandarines*, 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 Cheif of all the Revolt) had by a voluntary Death prevented his deſerved Puniſhment, and ſo put an end to a Warr, which had laſted for ſeaven Years.

The Peace having been ſetled, by the Re-eſtabliſhing in the Empire and all the Provinces, the Peaceable Injoyment of their Ancient Liberties: The Emperour departed the 23*d.* of *March* to go into the Province of *Leaotum*, the Country of his Anceſtors, with a Deſigne of viſiting their Sepulchres, and (after having honoured them with the uſual Ceremonies) of proſecuting his Journey into the Eaſtern *Tartary*: This Journy 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 Journy, each in their guilded Chariot; the princi-

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 then 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 Unckle, 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 extroardinary 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 400 miles, but much more unequal by reaſon of the Mountains; from the Frontier of this Province to the City of *Cla*, 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 extreamly ſteep, ſometimes by Valleys of extraordinary depth, and through Defert Plains, where in for two or three dayes march we met with nothing. The Mountaines of this Country are covered on the Eaſt ſide with great Oakes and old Forreſts which have not been cut for ſome Ages.

All the Country which is beyond the Province of *Leao-tum* is exceeding deſert where nothing is to be ſeen on all ſides but Mountains and Vallys, and Denns of *Bears*, *Tigres* and other *Devouring* beaſts, you can ſcarce find a houſe, but only ſome *poor Reed hutts*, upon the ſides of ſome brooks, and ſtreames. All the Citys and *Burrow-towns* which I have ſeen in the Province of *Leao-tum*, and which are in very great numbers are intirely 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, cauſed 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 *Leao-tum*, which is called *Xin-Yam*, is a City very fair and prety 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 *minuts* 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

Vla which was almoſt the very extream 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 Extream 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 Raiſiing 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 cleanſing the Ways, where their Kings and their Queens are to paſs, 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 ſort of Matts 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 Emperor did very ſeldom make uſe of this Way, being almoſt alwayes in Hunting: And when he accompanied the Queens he only Rode by the ſide of it, to the end that the great number of Horſe 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 Immediatly in their Chariots, with their Train and their Equipage; they notwithſtanding left ſome ſpace between the King 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 Moneths.

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 Droves, 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 ſituated between the South Sea and the Mountaines of the North: It is there where is the beginning of that ſo much cellebrated Wall, and which ſeperates the Province of *Leao-tum* from that of *Pekely*; from whence it is extended very farr on the ſide of the North over the tops of the higheſt Mountains. When we entred this Province, the Emperour, the Kings, and the Grandees of the Court, quitted 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 paſſed 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 poſſeſt themſelves of a great circute 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 progreſſe and without quitting their range, what ever Obſtacles they found in way (the Emperour having joyned with them ſeveral of the Captains, and of the Grandees of the Court, for the better keeping of their Order) they Reduced this great Circle to another much leſs, which had about 300 *paces* in the Diameter: 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 Vigerouſly in this little ſpace, that the poor creatures tired with the violence 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 leſs 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 ſort 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 meanes, and with other weapons.

The *Emperour* 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 councel'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-Yam*, 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 tould him we had a Book in our Library at *Pekin* which had explain'd the Nature of it, and diſpatched 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 agreable 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 *Songoro*, 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 alwayes covered with Snow, from whence it had its Name, becauſe *Cham-pe* ſignifies the white Mountaine.

So ſoon as the Emperour 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, he 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 ſeen 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 alwayes a great number of them ready fitted to Repulſe the *Muſcovites*, who come often into this River, to diſpute the fiſhing of Pearls. The Emperor Repoſed himſelf two dayes, after which he Deſcended upon the River with ſome Lords, accompanied with more then 100 Boates, till he arrived at the City of *Vla*, 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* from

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 Divertiſement of Fiſhing, that the Emperor went to *Vla*; but the Rains coming on ſo ſuddainly, 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 dayes at *Vla*; but ſeeing the Rains were not at all diſcontinued, he was obliged to come back to *Kirin*, without having injoyed the Pleaſure of Fiſhing: as we aſcended the River, the Bark wherein I was with the Emperors Father in Law, was ſo indammaged by the agitation of the Waves, that we were conſtrained to go a Shore, and mount a Charriot drawn by one Oxe, which carryed us very ſlowly to *Kirin*, the Rains not at all ceaſing during our Journy.

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 Deminiſh, and we re-took our way towards *Leao-tum*. I cannot here expreſs the paines and Fatigues theſe had cauſed us to undergo, dureing the whole courſe of this Journy, 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 overturned 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 tireing upon the Ways. The Men were not at all leſs incommoded, and all were enfeebled for want of Victuals, and of Re-

freſhments neceſſary for ſo great a Journy: 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 midle 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 Journy.

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 *Mandarines*, 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 approch-

proched, 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 andſwelled 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; thisPrince 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*, whome he diſtinguiſhed on all Occations.

As the night was fair, and the Heavens very cleer; 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: Pleaſing himſelf to ſhew to all, the Knowledg he had acquired in theſe Sciences. All the Marks of his Favours which he ſo often gave me, even to the ſending me to eat from his own Table; theſe marks I ſay were ſo 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, ſaid that when the Emperor had ſome Regret or appeared ſomewhat Sad, he wonld Reſume his ordinary Gaiietie 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 *Kirin*, 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 Martinius*, by changing only the *Latitudes* according to the hights 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 *Nincrita* (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 *Nincrita* 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 ſomwhat more to the North, they arrive in 40 dayes Journy at the Eaſtern Sea, which is (as I beleive) the Streight of *Anien*: I was told this by the General of the Militia which is at *Kirin*; and who had performed this Voyage himſelf.

The

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 *Leao-tum*, and we arrived at *Seac-Lyſto*, ſo the place is called in the *Chineſe* Language. —— 95. *ſtadia.*
The 2*d.* day we arrived at *Cha-cay Angha.*—85. *ſtadia.*
The 3*d.* day at another Torrent——
of the ſame Name.—— } — 70. *ſtadia.*
The 4*th.* at *Kiaghuchen.* —— 50. *ſtadia.*
The 5*th.* at *Feyteri.* —— 80. *ſtadia.*
The 6*th.* at the Torrent of *Seipery.*—— 60. *ſtadia.*
The 7*th.* at the Torrent of *Ciam.*—— 60. *ſtadia.*
The 8*th.* at *Courou.* —— 50. *ſtadia.*
The 9*th.* at the Burrow of *Sape.* —— 40. *ſtadia.*
The 10*th.* at *Quaranny Pyra.* —— 40. *ſtadia.*
The 11*th.* at *Elten eme Ambayaga.*—— 70. *ſtadia.*
The 12*th.* at *Ypatan.* —— 58. *ſtadia.*
The 13*th.* at *Suayen ny Pyra.* —— 60. *ſtadia.*
The 14*th.* at *Ylmen.*—— 70. *ſtadia.*
The 15*th.* at *Seuten.* —— 70. *ſtadia.*
The 16*th.* at the City of *Kirin.* —— 70. *ſtadia.*
1028.

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 30*th.* 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 poſſitively reſolved, that I, with one of the two Fathers that were at the Court of *Pekin*, the Choiſe 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 Journy. The firſt was, that he might keep his Militia during the Peace as well as in the Warrs, in continual Exerciſe; and for this Reaſon it was, that after he had eſtabliſh't 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 Councel 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 Enemys 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 ſhew 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 Companys and Marching

ing in Battell-Array after their Colours, with the ſound of Drums and Trumpets: During their Hunting, they intirely 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 *Tartars*, of which I have ſpoken in my laſt Letter. This Army had its Vant-guard and Rere-guard, and its Main Body, its Right Wing and left Wing, was commanded by ſo many Generals and petty Kings. There were ſpent more then Seventy days before they were on their March, in bringing together all the Ammunitions of the Army upon the Waggons, 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 ſelf, but with reſpect of the Eaſtern *Tartary*) there is nothing to be found but Mountains, Rocks, and Vallies, 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 Graſiers, 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 *E*arth, 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 Droves 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 whome

whome have no Religion, nor do they beleive any God. For the reſt both of the one and the other are Slaves, and wholy depend upon the will of their Maſters, whoſe Religion and Manners they Blindly follow: Like in this to their Droves, 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 thoſe 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 Journy, was that he might keep the weſtern *Tartars* in their Duty, and to Prevent any purnitious 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 Noyſe 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 accompanyed with all the Marks of Grandure, with which he was invironned at the Court at *Pekin*. To wit, with a Multitude of Drums, Trumpets, Timbals, and other Muſical Inſtruments, which formed Conſorts During his ſitting at Table, when he entred the Pallace, or when he went out. He cauſed all

theſe

theſe to march with him, that he might by this outward Pomp Aſtoniſh theſe *Barbarous* People, to ſtricke them with a Fear and Reſpect of his Emperial 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* incompaſs 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 ſeperates *China* from their Countrey. I have paſſed it fower 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 ſpred concerning it among the *Europeans*, is far ſhort of what I my ſelf have ſeen.

Two things have more eſpecially canſed my Admiration. The firſt is, that in this long extent from the Eaſt to the Weſt, it paſſes in ſeveral places not only through vaſt champanes, but alſo above the tops of exceeding high Mountains, upon which it is raiſed by little, & little, and Fortifyed at certaine Intervales 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 meanes of an Inſtrument, and I found that it was in that place 1037 *Geometrical feet* above the Horizon; in ſuch ſort that 'tis 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 obleiged 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, 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 Diſtributs to them Lands and Paſtures, whilſt he has given their Conntry 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 perſwaded 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 Diſguiſeing his true Sentiments, by theſe Exteriour 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 interupted 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 whome 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 cheif 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 Princeſſe did not Favour us.

The 3*d*. 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 ſurpriſing, 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 accompanyed 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 *Leaotum*, 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

Pe-

Pekin, 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 Furrs. The Reaſon that may be aſſigned for this ſo extraordinary Cold, is that this Region is very much elevated and ful 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 Paſe* 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 peices 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 Journy 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 Journy, 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 Rancounter, gave ſome Reaſon to hope that our Religion might find an eaſy Entrance to thoſe Princes, particularly if care be taken to inſinuate 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 County: 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 Journy, 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 heighth of theſe 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 Unckle, 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 then 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 Journy, they are like to thoſe which happened to us the laſt Year; in the Journy to the Eaſtern *Tartary*, which I have fully diſcribed 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 Unckle, to whome he had particularly recommended us.

During more than 600 *miles*, which we had paſſed 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 Charriot; 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 benifit which the Religion may draw from our Journy, 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 par-

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 tryed 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 Journy, 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 haſt, 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 Warr 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 Countrys, have made Diſcoveries much differing from thoſe which our *Geographers* have informed us of hitherto. Very lately *Monſieur D' Arey*, who commands one of the Kings Ships, in the Fleet of *Monſieur Le Maréſcal 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 Countrys between *Moſcovy* and *China*: and told him, that from 3 Citys which he ſhewed him, whoſe Names were *Lopſla*, *Abaſinko*, *Nerginſko*, all 3 under the Government of the great Dukes, tho' Situated in the great *Tartary*, there was a Way to *Pekin*,

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which was not more than 25 or 30 dayes Journy. 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 aſcend above a Monoſyllabical Name tho' the Character be compoſed of many ſingle Characters, each of which hath its proper Senſe and Monaſyllabical 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 pitty it is that Diſcourſe is not publiſhed in Latine, that the Learned of *Europe*, may think of further Improveing it, and bringing it to Uſe.

But whatever we may judge of Language, tis paſt diſpute that Writing was ever Artificial, how Antiently ſo ever it were in Uſe, and was the Invention of ſome thinking and Stvdious 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 gheſſed by the *Ægyptian* Hieroglyphicks, the *Chineſe* Characters, the *Mexican* Chronology, and the Litteral Characters of ſeveral Nations, each of which ſeem to proceed upon differing methods. and from diſſering thoughts of Invention.

Which of theſe ways is the moſt Antient, is hard to Prove. The *Ægyptian Mummys* and *Obleisks* prove a great Antiquity of the Hieroglyphicks, but yet the *Chineſe* Chronology (if to be credited) outſtrips the *Ægyptian* 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*, dureing 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 cheifly 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 then eighty eight millions ſix hundred and fourty thouſand

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one hundred and two Solar Years, there having been run out since the Creation 8864 *Ven.* of Years (every *Ven.* conteining ten thousand such Years) and of the present *Ven.* this Year 1686 is the 102d. Which account is abundantly more extravagant than the *Ægyptian*: 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 *Ægypt* 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 writen by *Fohi*, the most Antient Book.

These accounts made me the more desirous to understand somewhat of the Reallity ahd 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 Jouius* affirmes 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 Practise 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 Contrivance, 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 expedition, so without doubt must be their way of Printing any thing just as it is writen, Since I find, that they can Ingrave their Stamps for a sheet, as soon as one of our Compositers can set and correct a sheet of our Literal Character, and when so

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 diſcribe their other Arts of Pottery, Staining, Verniſhing, &c.

By a *Chineſe* Manuſcript, out of which I tranſcribed the Lords Prayer in the Year 1666 (when it was loſt) Ifound that the Pronuntiations had no Affinity with the ſtroaks 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 thatby which it was Pronounced, whoſe pronountiation is loſt though the Significancy be reteined, as if one ſhould Read what is written in *Hebrew* בראשית into the *Latine* or *Roman* Language, *In Principio Creavit* inſtead of *Braſit bra.* or *Bereſith Bara* according to the *Maſorethæ*.

Since that time I procured from *China* a Dictionary of the Court Language, (as I found it writen 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 picturs 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 *Velſerus*) ſave only that, inſtead of pinns and ſliding Groves of the *Romane*, the *Chineſe Abacus* hath Strings or Wires and Beads, to ſlide upon them; and that, inſtead of four pinns 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 *horizantal*, 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 Remarkale 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 poſſition 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 retaine 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 ſave only that they proceed contrary wayes, 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 ſtroake added for a thouſand, as will appear by the Table anexed. 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 *Europian* way. Now that theſe are properly

perly numeral 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 Charactars or Marks, and by their Litteral or word Characters; for as one ſingle ſtroke ſignifyes 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 ſatsfaction 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 conſiderably 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 leſt 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 throughly underſtanding in the whole Character; ſeeming to intimate 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 *Ægyptian* 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 *Calepines* 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 peice of Learning in the World, & depends wholy upon the ſtrength of the memory in retaining the form & ſignification of a perplexed ſcraul. 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 Pronuntiation 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 ſttoak 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 bigneſs, 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 eaſie to be believed, when we conſider that the Printed Characters are exactly the ſame with the written. inſomuch 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 affirms 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 gencrally very thin and fine, and very tranſparent, but brown, ſo that what ever is Written or Printed on it, is almoſt as Legible

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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 ſow, bind or ſtich 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 it ſelf, (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 contexed. Theſe are the firſt kind of which there are but a very few, And I think thoſe I have deſcribed in the 13*th* line of the Plate are all.

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

each of which have a primitive ſingle or diſtinct notion or ſignification as well as ſound, 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 Numbers in the *Hebrew Greek Arabick*, &c, Languages, for though there may be two or three of the ſingle ſtrokes joynd together into a compound Character, it hinders not, but that it may ſtill ſignify a Letter, as in the *Greek* Α.Λ.Δ.Ι.Γ.Π.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 *Æthiopick*, and in the *Hanſcret*, and *Sunſcrit* Languages and Characters: The firſt of which being the *Brackmans* Character we find in *P. Kircher's China Illuſtrata*, deſcribed by *P. Roth* who ſtudyed it 7 Years; and the ſecond (being a Literal Character uſed 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 tranſcribed and tranſlated alſo into Engliſh, A Dictionary of their Language in their own Character: who did me the favour to let me peruſe it.

In which Characters or ways of Writing a Vowel is always joynd with a Conſonant into one compound Character to make it effable. And then the ſingle ſtroaks may be taken for ſingle Ineffable Letters as are the Conſonants, and the Compoſition of two or three (of which one at leaſt may be a Vowel) will make Syllables.

Of this kind, there are not ſo many in the whole *Chineſe* Character, but that it will be eaſy enough to aſſigne each a proper Monaſyllable which ſhall only have one or two Conſonants, and one or two Vowels: That is the Conſonants together and not ſeparate, either both behind the Vowel or Vowels, if it be a diphthong or both after it or them.

Of

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 Pronounciation of it, haveing been lost. And secondly, I want some further help to make a full and compleat Discovery: what I have learnt from the Book of *Fohi* 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 Chatacters, is a decompounded sort being made up of two three or more of those of the second kind, diminisht proportionably in their size, either as to their length, or bredth, 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 crouded together within the same Square, according as there are more in number, so they are always more squeezed together. In this Decompouud sort, there is a Regular order observed in the placing of the several Characters of the 2*d*. 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 Dictionarys, explained would be easie enough to be Discovered.

This method alone of crouding together all the Characters (how many soever go to make up the decompounded 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 beleive it to be a Real and not a Literal Character: For if the Primitive Lan-

guage, or Pronuntiation 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 roat and depend wholy 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 ſignifyed 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 expriſſed 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 particulers of by the next opportunity, by Printing a Specimew of the Book *Te-kim* which explicated 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 aſſert 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 Spcimen I have ſeen of it, I conceive it to contain the whole Ground, Rule or Grammer, of their Character, Language and Philoſophy, and that by the underſtanding of it, the Foundation and Rule of their Language and Chatacter, may be without much difficulty Decipered 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 *Æthyopick* 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 *Horozontal* 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 unrouling 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 tagether, 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 Pronounciation of this Character, by the Court Language, or by any other now used, I conceive it to be wholy 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 Smple Characters (though there are some instances of affinity in Characters and Words.) The reason of which differing pronounciation 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 Monasyllabical 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 Monasyllables : 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

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 *Syntaxis* of them, it being neceſſary to conſider 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 *tam, jo, van.* for *Adam. Jovan*

Now, though I conceive this Character is not Effable properly as a Literal Character by any of their preſent Languages, 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 triſſyllables, *&c.* According to the Number and Order of Simple Characters in the Square of the Compounded. And I am apt to think that the preſent pronounciation of Languages, as of *Hebrew Syriack Arabick Greek* and *Latine* or any other Language that has been

ſo

ſo 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 pronounciation 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 *Maſorethæ* 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 Pronounciation (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 Arabicum*, Printed at *Rome* 1592. Now as by ſuch a Langnage the Character might be made Effable without Muſical Tones or Difficult Aſpirations, ſo had we Dictionarys 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.

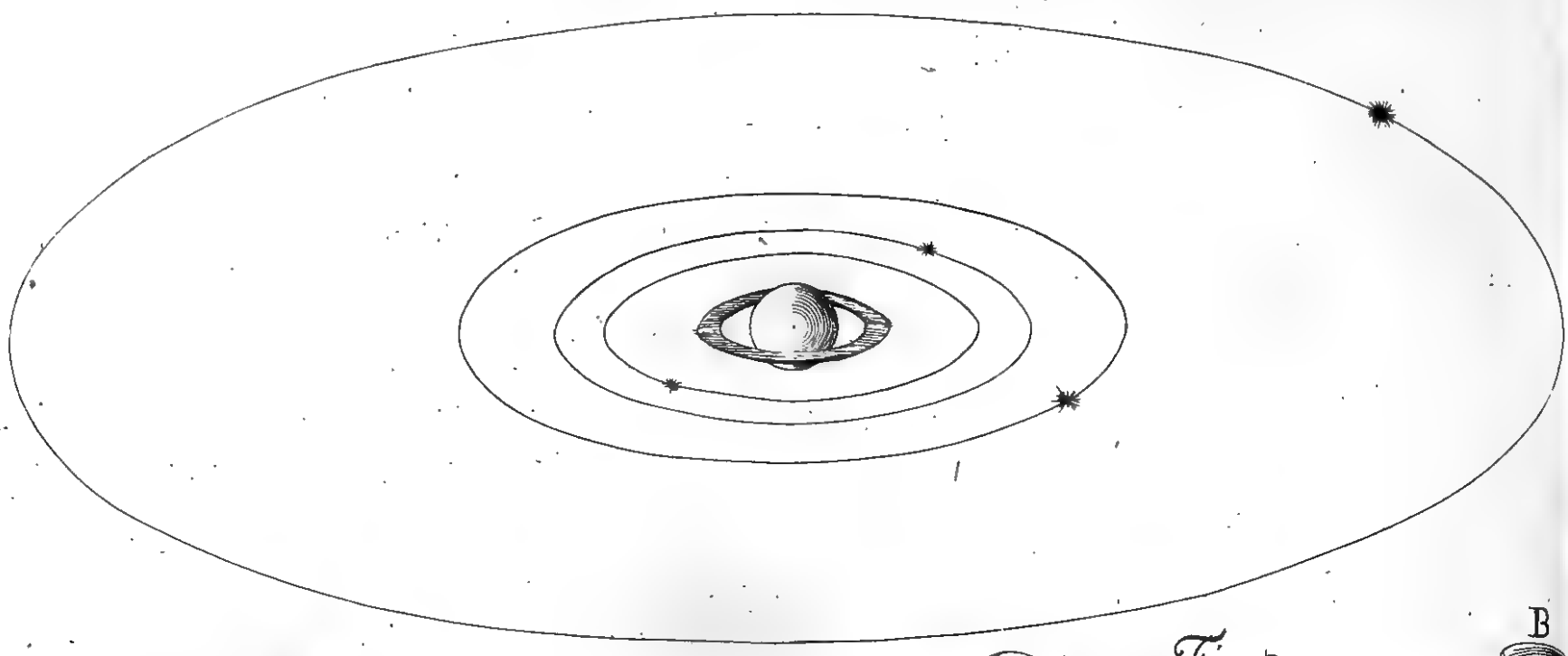
IMPRIMATUR,

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

Printed by *J. Streater*, and are to be ſold by *Sam. Smith* at the Sign of the *Princes*'s Arms in St. *Paul*'s *Church yard.*

N. 181.

Orbita quatuor Interiorum Satellitum Saturni cum Ansæ omnium maxime diductæ conspiciuntur



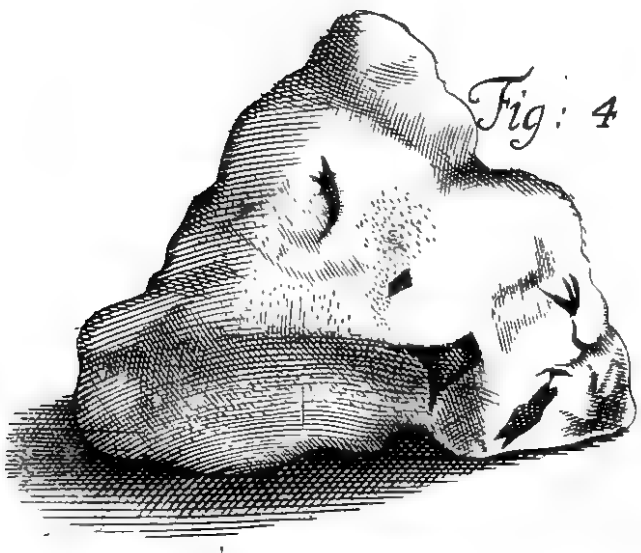
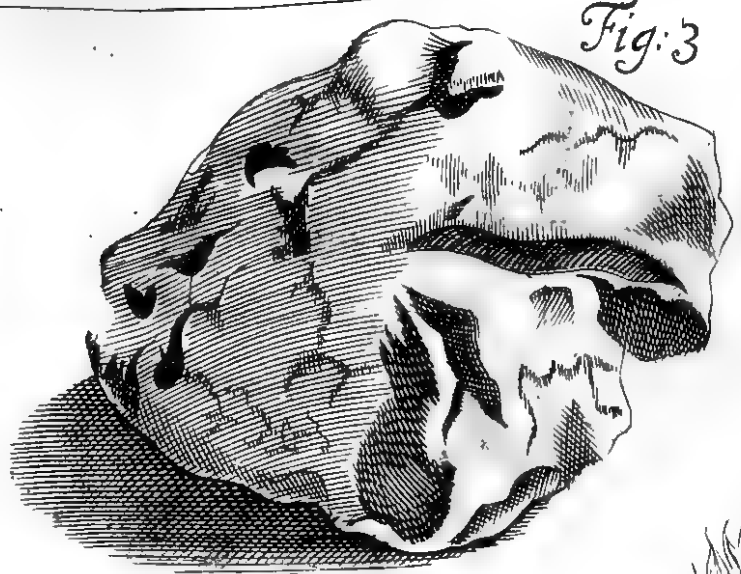


Fig: 4



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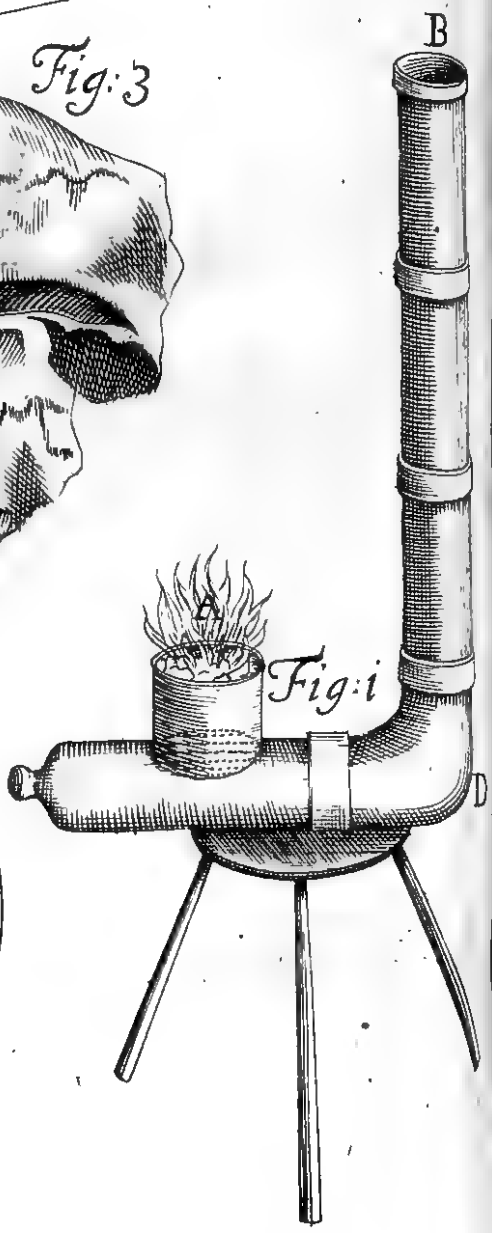


Fig: i

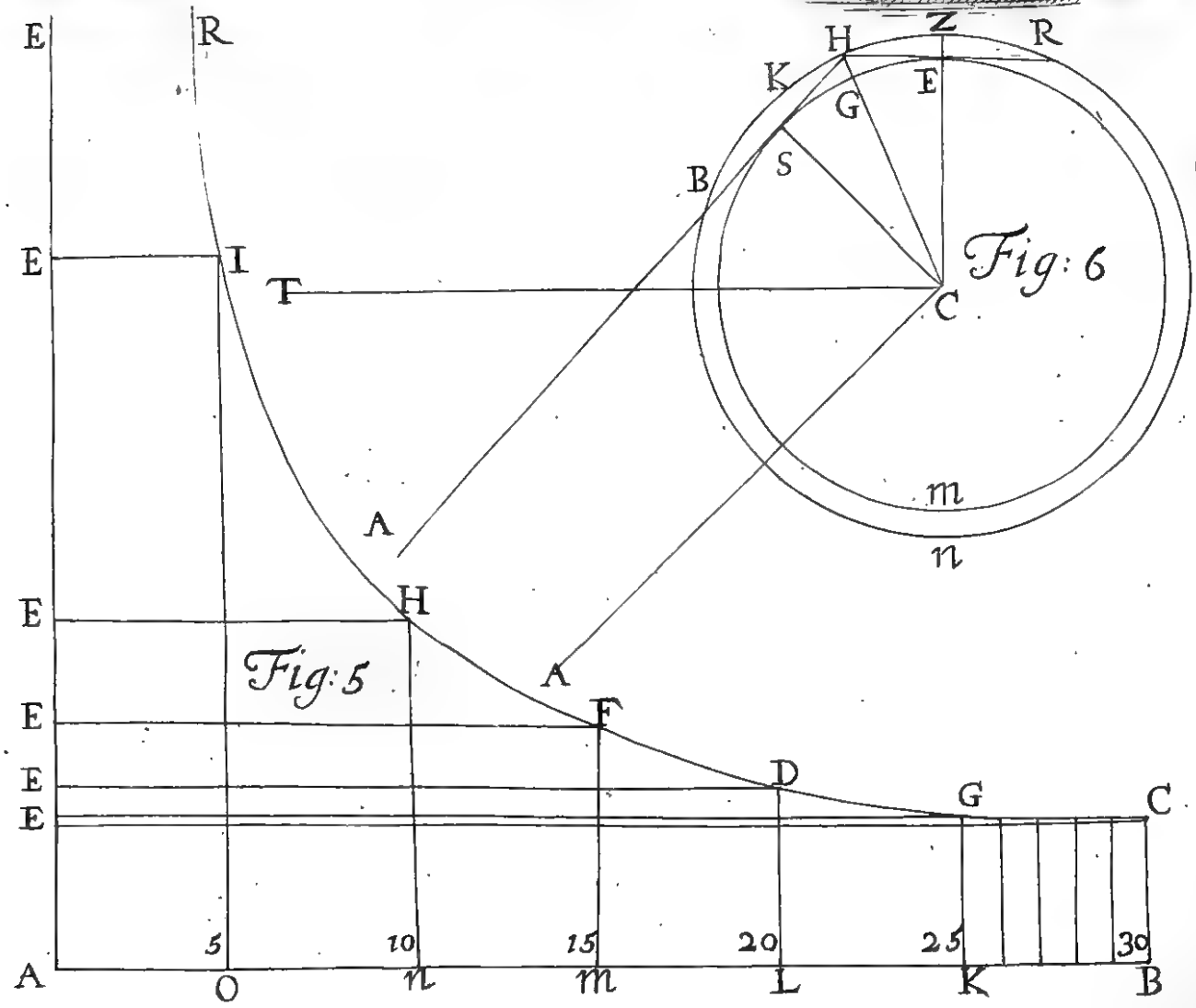


Fig: 5

Fig: 6

PHILOSOPHICAL TRANSACTIONS.

May the 25th. 1686.

THE CONTENTS.

An

An Account of an Engine *that consumes* Smoak, *shown lately at St.* Germans Fair *in* Paris *Communicated by Mr.* Justell R.S.S.

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 speak of it, as well Philosophers as others, have asserted it impossible: but Mr.* Dalesme *Enginier, prosecuting 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 nicest Nose smell it, altho' 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 Trevet made on purpose. A is the place where the Fire is made, where if you put little peices 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: If you take one of these peices 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 fœtid things, as a Coal steept in Cats-piss, which stinks abominably when taken out of the Fire, notwithstanding in this Engine makes not the least ill scent. The same did Red-Herrings broiled thereon; on the other side all perfumes are lost in it, and Encense makes no smell at all, when burnt therein. We have since learnt that this is not shown, 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 press 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 inoffencive both to the Eye and Nose.*

An Extract of the Journal Des Scavans. *of* April 22 *ſt. N.* 1686. *Giving an account of two new* Satellites *of* Saturn, *diſcovered lately by Mr.* Caſſini *at the Royal Obſervatory at* Paris.

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 Knowledg, and the Arts neceſſary to the Commerce and Society of Mankind, has incited Aſtronomers more ſtrictly to Examine, if there were not yet ſomthing conſiderable, that had not been hitherto perceived.

The diligence of thoſe that have gon 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 *Anſæ* of *Saturn* till then unknown; but it ſeems there remained yet four others to diſcover. The middlemoſt and outermoſt, or third and fift *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 Diſcoverys is as follows.

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 dayes 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 *Satellits Orb* being nearly in the same plain with it, they appear very close togather. 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 *Ansæ*, which at present cannot be.

These Conjunctions of so long duration hapning often at the times most proper to observe *Saturn*, have frequently hindred 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 ſeldome 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 ſome 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 alternatly, 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 E-

longations of the firſt, which likewiſe made it hard to determine their Degreſſions. It was not without a great nnmber 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 Diſtances 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* obſerves, 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 Syſtemes, 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 togather 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 *Saturns* ſecond has its Period 9 hours and half ſhorter than *Jupiters* ſecond *Satellite*.

The

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 fift *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. *Artouquel* 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 Terraſs 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 fixt Starrs, from the other *Satellites* of *Saturn*, and from each other, and found the periods of their Motion, we have eſtabliſhed *Epochæ* from Obſervations, as near as we could to the Conjunctions.

Ra-

Radices or Epochæ of their Motions.

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

The ſecond was 36 *degrees* diſtant from the Perigee to the *Weſt*, the 30*th* of March 1686 ſt. 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, performe their Revolutions in leſs time, than thoſe of *Jupiter*, that anſwer to them; except the firſt, as may be ſeen in this Table.

	day	*hour*	*min.*
The firſt Satellite *of* Jupiter *revolves in*	1	18	29
The firſt Satellite *of* Saturn *in*	1	21	19
The ſecond of Saturn *in*	2	17	43
The ſecond of Jupiter *in*	3	13	19
The third of Saturn *in*	4	12	27
The third of Jupiter *in*	7	4	0
The fourth of Saturn *in*	15	23	15
The fourth of Jupiter *in*	16	18	5
The fift of Saturn *in*	79	21	0

Theſe are the particulars of the Diſcovery, whereby the admirable Analogy and Uniformity of the parts of the Univerſe are moſt evident, and the Infinite Wiſdome and Power of the Creator is demonſtrated to the Contemplative. In the Concluſion, the Diſcoverer conſiders that the Antient Aſtronomers, having tranſlated the Names of their Heroes amoung the Starrs, 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 Starrs 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 whoſe 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 ſo the reſt might not be crouded, but its diſtance to that of *Hugenius*'s, is as Cube Root of 25 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 *Lipſick 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* 31*th*. 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*

Greſham College, 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 Immerſion at 9 *h.* 46 *m.* at *Lipſick*, that is at *London* 8 *h.* 54 *m.* yet his *Jupiters* place being 13 *m.* too ſlow, 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 Immerſion, which was very difficult to be obſerved, 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 Ingreſs happened much about the length of the Spot, called by *Hevelius palus Mareotis*, to the North of the ſaid Spot, or about the 124*th.* 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 Emerſion was exactly in a right Line with the Moons Center, and the Northern Part of *Palus Mæotis*, or about the 324th degree of the inner Limb of the *Selenographick* Table of *Hevelius*.

The other Occultation hapned *May* the 28*th. Mane*, or Aſtronomically, the 27*th* after mid-night; the preceding Night was cloudy dark Weather; ſo that there was no encouragement to ſet up for it; however by good hap, both Im-

Immerſion and Emerſion were obſerved.

The Immerſion was ſeen at *Totteridg* (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 verſt in this ſort of Obſervation: who between a gap of the Clouds obſerved the Contact of the *Moons* limb and *Jupiters*, at 15*h*. 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 15*h*. 4½ *min*.

The Emerſion was obſerved at *London* by *E. Halley*, to fall out at 15*h*. 49 *min*; for at 15*h*. 50 *min*. *Jupiter* was all out, and the limbs ſo little ſeperated, that he judged, that a *minute* before, the center of *Jupiter* had been upon the *Moons* edg: The point of the Emerſion was over againſt the *Southern* part of the ſpot, called by *Hevelius Inſula Macra*, or at the 342*d* diviſion of the inner limb of his Mapp 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 Philosophising being now universally Granted between all men, I am sure that a difference in Opinion will be no breach of affection between two intirely 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 Letres*, *Mois d' Aout* 1684. *Art* 4. and *Mois de Janvier* 1685. *Art* 7. The Problem proposed is, *Why Bodies dissolved float in Liquors lighter than themselves*; as for Example: Mercury dissolved in strong Spirit of Niter swims therein, tho' each small Particle of Mercury, be far heavyer than so much of the Liquor whose place it occupies. This, says he, cannot be solved by the prime Law of Hydrostaticks, which is, that a Body which in an equal Quantity is heavyer then a like quantity of Liquor, sinks in that Liquor; thus a Cubick Inch of Iron being heavier then a Cubick Inch of *Aqua-Fortis*, and each Particle (how small soever) of Iron being heavier then a like Particle of *Aqua-Fortis*; Iron being put into *Aqua-Fortis* should sink, and yet we find, that Iron being dissolved 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 dissolved Solid, for they being so

ſo very Minute, are Movable by the leaſt Force imaginable, and the Action of the Particles of the *Menſtruum*, 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 *Menſtruum* over a digeſting Fire (as the *Chymiſt* ſpeaks) will diſſolve a greater Quantity of a Body put into it, than when tis 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 *Menſtruum* continued hot. For, *ſays he*, the Particles of the *Menſtruum* 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 *Menſtruum* 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 Phænomenon.

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 ſpecifick Gravity of a Liquor, and the ſpecifick 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 ſeperate 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 Surfaces 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

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 my ſelf 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 Practiſe, but that Really there is ſomething of that Proportion hindred by the Airs 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 ſeperated or paſſed through than Air, and conſequently we muſt needs Graunt, 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 hindred 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 ſeperate 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 Sence 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 agreable to truth, and explicates ſo many Phænomena eaſily and plainly, that I would not be thought to deny it. Neither would I be thought wholy 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 Coheſion of the Parts of Iron, may very well be ſuppoſed 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* inſinuating themſelves into the ſolid body, and looſening its Parts. And tho it may be objected, that in the Parts of Water there may be ſuppoſed as Violent

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 it's 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 concurr 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*, Phyſitian of *Bern* in *Switſerland*, 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* 10*th.* 1681.

Illuſtres Nobiliſſimi doctiſſimiq; Viri.

TAcito tempora greſſu diffugiunt, nulloq; ſono Annus vertitur, vitæ emblemata quibus menſuramur, incitamurq; ea, quæ alicujus boni eſſe poſſunt, ne ſero ſuſpendamus: moti unde, licet adhuc immaturum fructum decerpere, Hiſtoriamq; de petrificata *noſtra, (cujus obitum inane expectavimus) continuare, quam occultare malluimus; ne aut Phænomini hactenus nihil contigiſſe, aut non obſervaſſe putemur. Videmus enim hinc et inde Hiſtoriam iſtam grate acceptam, varijs prælis mandatam, ſed non æqualiter ad ſenſum verborum translatam vel examinatam eſſe; plurimosq; doctos hæc, etſi pauca, ob caſus infrequentiam, admirari, progreſſum monere, quosdam vero ad ſortilegia, vel inter iſtas ſpecies referre, quæ fidem oculumq; fallant: Aſſentirer forſan, niſi ſummus naturæ Author in hac prius imperſcrutabilia ſæpius recluderet, phyſicoq; ſcrutinio ad redundantem Nominis ſui Gloriam rimanda concederet: In hoc dum laboramus Clariſſimorum Virorum deſiderium nos non impleturos, ſed favorem excitaturos ſperamus.*

Ab eo quo Hiſtoriam ſecunda Calendarum Octobris *Anni Seculi octogeſimi primi pertexui, ægra noſtra moderate vixit, ſatq; bene; naturæ functionibus (ut ante relatum) in excipiendis & excernendis occupatis, ad decimam octavam Anni octogeſimi ſecundi*

di menſis Auguſti, *qua torqueri, nauſeaq; et ſingultu aſſq; tamen vomitu agitari cœpit: dato cardiaco cum ſpiritu nitri dulci ad vigeſimam nonam dicti menſis ceſſarunt ſymptomata; hac vero ſuperioris & inferioris ventris cruciatibus ſummis angi, in latera volvi, reſpiratione impediri, Hyſterico Paroxyſmo infeſtari, cum ructibus, cordis palpitatione & oſcitatione viſa; Occurrebatur Anodynis & Antiſpasmodicis (omiſſis clyſteribus, quorum uſum ægra ob inteſtinalis motus inverſionem valde, horrebat.) ſuccedebant expanſiones & jactationes artuum, motus convulſivi totius abdominis, conſtrictio muſculorum laryngis & faucium cum Aphonia, tandemq; parturientis dolor ſubito alto ſe dictitans, quo contractis omnibus membris, alvo dejecit inſequenti, trigeſima, calculum* Fig. tertiæ *cruore conſperſum; cujus enixum ſequebantur altera die duo minores longe, cum hæmorrhoidali fluxu, dilaceratis vaſis: poſthac inſtar puerperæ habita, juſculis reſtaurata, remediis ſublevata convaluit, intraq; ſeptimanas paucas, reſoluta jam quaſi natura, ad actiones obeundas vires collegit.*

Hæc rerum triſtis facies & viciſſitudo, hic ægræ ſtatus, ab ultimis præteritorum tolerabilior, in dolorificum verſus: Calculi non tantum majoris ponderis ſed & durioris ſubſtantiæ, valdeq; anguloſi, nec ſingulis digeſtionibus, ſed velut in quadam matrice matureſcentes abrupti pelluntur, tertia quartave ſeptimana inferne nec ulterius ſuperne excluduntur: Alvus prius libera demum adſtringi incipit, & una alterave a conſtrictione die lapidem parturit: Urinam e veſica reddit paucam, potui in quantitate non reſpondentem, variam, plurimum craſſam & turbidam, quæ raro ſupprimitur, ſuppreſſam emingendo antecedit calculus fabæ magnitudine majoris, anguloſus, cæteriſq; per omnia ſimilis: Et quod antehac per intervalla, nunc 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, ejuſdem coloris, conſiſtentiæ, odoris urinoſi, & ex ægræ relatione, multifaria cum nauſea, ſaporis; quæcunq; clarius in ſpagyrico examine apparuere. Tumet abdomen nec ſolum ut ante in ſiniſtro hypochondrio durities, lapidumq; allidentium ſonitus, ſed in tota ventris dextra regione aliquando profundius ob muſculorum laxitatem ſentitur, magnumq; dolorem circa hypogaſtrium queritur. Appetit cibum

ve modice, qui ex radice Glycyrrhizæ, graminis & hordeo usualis est, perq; vices aliquid vini tenuioris conceditur. Dormiendo subsultat: Fluunt menses rarius & parcius nec tamen desistunt: Pulsum habet & languidum, & celerem, & profundum, & interceptum, pro variis symptomatibus variantem: Respiratio liberior, non valida sed sensu vix perceptibilis: Menteq; plus nunquam movetur: Tandem duodecima Decembris *Anni ultimo elapsi, tibiæ dextra Gangræna ad palmæ latitudinem correpta, scarificatione cæteriſq; necessariis curata, nunc Angina notha, ob tonsillarum inflammationem: premitur, plurimumq; arteriosi sanguinis e faucibus fluit, majoris forsan excernendi lapidis proäromus: revulsionem per phlebotomiam in pede & clysmata tentatam secuta fuit, vigesima* Februarij, *dejectio fæcum naturalium per inferiora; vigesima tertia vero & dejectio fæculenta & rejectio per fauces oleosæ clysmatis substantiæ, cum fœtore absq; lapillis, unde imminens suffocationis metus abstinere jussit.*

Hic Casus rarus & mirus varia ingenia suscitavit: Naturam enim sortilegia abhorrere cujuscunq; Philosophi sententia est; ipsam vero a limite & communi experientia in ægra nostra plurimum recessisse, si quis antehac proposita Phænomena in dubium vocavit, nunc specimina credat: Majorum siquidem morborum argumentum existit gravium symptomatum concursus, quæ seorsim sumpta, etsi explicatu singula leviora videantur, juncta vero ob motus varietatem ardue pugnant.

Calculos in humano corpore, ad Macrocosmi leges, ex principiis activis, vinculo salino, cum matrice terra & phlegmate, diversimode concrescere docet Analysis; Inq; glanduloſis partibus corporisq; ductibus generari nihil ignoti, quod gravissimi Authores testantur, nostraq; observatione constat, præter renum vesicæq; calculos, anno seculi septuagesimo septimo, Catarin. Scertenleib *puellam, excretis tussiendo plurimis lapillis tophaceis, in Nosocomio nostro Pthysi occubuisse; E contra Sabulo multaq; pituita gypsea in intestinis concreta varie dejecta,* Catarinam Blaseram *Anno octogesimo in eodem hospitio integre restitutam esse; Virum Ampl.* D. Joh. W. *majoris Senatorii ordinis, arthriticum mense* Julio *Anni octogesimi tertii, utroq; uretere calculis obstructo, ab impedita mictione,*

dicema

decima & ſeptima morbi die, non juvantibus variis ſeri vacuationibus, Phlebotomijs & Lithontripticis, Apoplexia obijſſe; quos lapides, alterius longe a noſtræ ægrotæ ſubſtantiæ, nulloq; acido ſpiritu ob oleoſam impregnationem ſolubiles, extraxi; Ren ſiniſter naturali duplo, dexter vero triplo major, dilatatis tunicis, multo ſero tumidi ſcatebant, plurimis obhærentibus lapillis ruffis, aſperis, cum ex ureteribus ſecti eſſent apice rotundo, forſan levigato in ductu, & forma glandis quercus minoris: Nuperiſq; e tonſillis puellæ Mariæ Haffneriæ *ad triginta duos tophos ſecuit Civitatis hujus Chirurgus expertiſſimus* D. Albertus Baurenkoningius: *Inſuper a Clariſſimo veſtro* Dn. Doctore Sclareo *Hiſtoria communicata de calculis felleis raræ magnitudinis pro anguſtia ductus cholidochj: Et alia filij Ebræi cujuſdam undecem Annorum* Weinhemii *in* Palatinatu *degentis, lapillos diverſi generis, immo ſilices, per virgam anumq; excernentis, ab Urbis* Heidelbergæ *Secretario* Cl. D. Zweifelio *mihi perſcripta.*

Verum cum ſimilia viſu, reipſa plurimum diſſimilia ſint; ut Naturæ Curioſis oblectationem aliquam, generiq; humano ſolatium fructumve præſtemus, accuratiuſq; loquamur, Phyſico examini calculos hoſce ſubjecimus.

1. *Solvendo: Sic ſpiritus Sulphuris, Vitrioli, Acetiq; affuſus, aliquem effervescendi motum incipit, imprimis in ijs qui ventriculo excreti, rarioris texturæ, friabilioriſq; ſubſtantiæ ſunt; ſed citius, acidis ſuis particulis inflexos poros ingreſſis, ſubſiſtit, nullamq; ſolutionem perficit.*

Salis Armoniaci Spiritus ne quicquam movet, & omni modo tentatus, veluti homogenius ſubjecto ſuo, conquieſcit.

Sed Nitroſus Achilles *cuncta deſtruendo ſubegit.*

2. *Diſtillando per retortam: Oeſophago excreti Salis Volatilis cum ſpiritu & Phlegmate paucum, terræ plurimum, Salisque fixi fere nihil; Poſteriores alvo redditi, cum ijs ex veſica ejuſdem figuræ & ſubſtantiæ, plus Volatilis, cum pauco ad guſtum ſubacido phlegmate, ſed ſpiritu urinoſo forti, modicum fixi ſalis ac plurimum terræ habebant. Calculorum horum unciæ ſex exhibuerunt Capitis mortui uncias quinq; cum drachmis duabus, & ex his ſalis lixivioſi vix ſcrupulum cum dimidio, phlegmatis cum*

Spiritu et immisto sale volatili drachmas quinq; & semis, adhærente quadam portione recipientis lateribus : Hic liquor junctim sumptus, addito spiritus vini Alkolisati quanto, in Alembico exiguo caloris gradu sublimatus, depositi in Capite salis volatilis urinosi scrupulos duos & semis. Olei nihil conceptum nisi volatilium fluorem salium eo referre velimus.

3. *Præcipitando. Liquor distillatus spiritus Vitrioli additamento in rubram tincturam vertitur, tandemq; crassior evadens quodammodo secedit in fundum ; Affusus vero idem spiritus a distillatione residuo capiti mortuo, aut sali inde elixiviato, non aliam quam cum sale & oleo Tartari impetuosam effervescentiam excitat.*

Sic Lapides nostri constant plurima Terra, Sale Vol. exiguo, acido perpauco, quod sale spirituq; Urinoso infractum & edulcoratum esse, spiritus Armoniaci ejusdem naturæ demonstrat, acidorum partibus immixtus eas retundendo & implicando in dulcem Saporem cogit, post non resolubiles.

Exin concludimus salium lixiviosorum naturam a salis Tartari non recedere in ægra nostra; & reperta matrice, incorporandi subjecto, accedente acido, motum (effervescentia aliqua prægressa) invicem sisti, inque calculos hosce coire ; prout Vitrioli spiritus particulis suis acutissimis & flexibilibus (unde oleosus tangitur) sal Tartari penetrando quidem destruit, sed destructum in sui naturam aliter colligando cogit : In hisce calculis, ut jam ad suam crasin dispositis, nil præstitit; verum sal fixum, igne sublatis implicandi spiritibus, in suam naturam reduxit, ex qua coagulum constat.

E contra, Nitri spiritus acidus quidem, sed ob subtilissimi salis conjunctionem particulis rigidioribus, penetrantissimis, inseparabilibus constans, non tantum una qualitate cuncta solvebat, sed & altera reunionem impediebat; cum particulæ hujus rigidiores, in actu continuæ, sese flectere, saliaq; divisa in alienam naturam combinare non valuerint.

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

Hinc

Hinc longe alia calculorum horum generandi ratio & locus quam eorum qui ab renibus excluduntur; cum hi e particulis ſeri rigidioribus, vel ad pororum renalium relationem craſſioribus, ſenſim obhærentibus eoſq; obliterantibus contexentur; lubrica quidem aqua flexibilibus particulis decidat, ſalia vero ſero innatantia volatilia inſenſibiliter reticulo huic implicentur, tandemq; in lapideam duritiem accreſcant; Quod prius communi experientia conſtans exhibet ſenes, quibus craſſiores humores, minusq; meabiles meatus contingunt, in hunc affectum valde pronos; Poſterius diſtillatione firmatur; etenim imminuendo ejusmodi calculos donec collum anguſtum retortæ ingrediantur, prodit ſpiritus urinoſus cum ſale volatili multo & aliquo oleo, remanentq; in fundo retortæ non commotæ figuræ lapidum, quæ in cineres commovendo decidunt, quæq; vero rurſus affuſo diſtillato liquore in calculos conjunguntur: ex quibus ſalis volatilis copia & implicandi modus in his optime conſtant.

Qualiter vero & ubi in ægra noſtra generentur lapilli & tophi Tartarei *(ea in vivis) vix eſſet hujus loci & temporis divinare, niſi rationi aliquid concedendum foret.*

Veſicas ſub epidermide limpido ſero flagrantes, ibiq; ob impeditam cuticulæ tranſpirationem obſtructoſq; glandularum ſubcutanearum poros, denegantes refluxum collecto, ſanguini pellenti non vero quieto ortum debent; cum hic a tempore quo coagulari viſus eſt, nuſquam ampullas ſuſcitavit, & ſecus motui contrarium eſſet: Mordax vero lancinanſq; humoris qualitas atq; inſpiſſatio ſingularis, acidi in corpore prædominantis argumentum; cujus rimari naturam difficile, cum leviſſima additione vel detractione motuve, humores alterentur, ut ex chylo ſanguis, ex ſero lympha, ex aqua 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 & aceſcunt; haud ſecus ac analogum ſanguini vinum, quod evanidis ſulphuris particulis quibuſcum acidæ incorporatæ hærebant, relictis his, in acorem vertitur: Et certe dulcis acidiq; ratio non alia eſt, quam diverſimoda major minorve acutarum partium cum aliis commixtio, actuſq;*

retardatio, ut in ſaccharo, melle, &c. Hinc ſanguis, etſi tandem inſpiſſatus, tamen dulcis linguæ occurrit: immo pro tactus ratione magis minuſq; feriunt, parva inter titillationem & dolorem diſtantia.

Merito ergo glandulæ præprimis inferioris ventris, ſeri lymphatici (vel pituitæ in hoc acidæ) receptacula & ergaſtula, in vitio occurrunt, quo humor, jam heterogeneus ductibus ſuis, haud exoneratus, atq; e pancreate in duodenum longo intervallo non ſolutus, acidior evaſit: Hinc prior hiſce præ utero attribuenda mali labes, (cum naturaliter abſq; impregnatione, menſium ſuppreſſio ante Annos ſenectutis, nulla contingat) quæ in hoc corpore primos effectus latentes ederit, unde reſtagnans ſanguis majorem corruptionem, majoreſq; turbas fovebat; non enim ſubordinatæ cauſæ pugnant.

Subita vero veſicarum evaneſcentia ad remedia reſolventia volatilia commode refertur, quibus obſtructiones univerſi referare nitebamur; factum unde ut una cum meatibus glanduloſis patefactis non modo refluxus reſoluto humori datus, ſed & magnum pituitæ receptaculum pancreas, impetu in inteſtina & abhinc maſſam chyli viſcoſam, indeq; ſanguinis univerſam, humorem contentum acidum effuderit, ſicq; diatheſin pravam hucuſq; continuatam induxerit: Qui Chylus juxta principia ſua alius vix ſtatui poteſt, ægra adhuc in ſanis magno aquarum potui ad juvenilem viſcerum æſtuantium calorem ſupprimendum dedita; Aquis etſi in hac urbe ſaluberrimis in ſubjecto capaci evidentem cauſam non detrahimus, ex qua conſequens obſtructio ductuum glandularumve concinnari potuit: Quantum vero vel an contribuat bilis in petrificatione hac vix invenire eſt, cum hæc aliter ac noſtri calculi ſale lixivioſo redundet.

Hinc ventriculus, inteſtina, glandulæ primarij generationis loci, quamvis & in veſica ſecundario procreentur: Latex quippe urinoſus primæ digeſtionis vitio ita inquinatus, ſecundæ excrementum, multo acido, ſaleq; & craſſo phlegmate imbutus, in veſica ſtagnans, in coagulum invicem accedentibus particulis aptis coivit; unde & mucus & calculi abſque alterius rei acceſſu vel diſſipationis ope.

Qua-

Quatenus vero ante, ſilices exiguos variaque cæmenta evomuerit, cum abhinc vomitu nihil excreverit, cauſa delitescit in corpore; aquarum tamen pro ratione ſubjecti occupati diverſa, diverſa eſt lapides producendi & incorporandi vis.

Pondus ſpecimina probant, non enim deſiſtente agendi vi in ſubjecto diſpoſito, effectus continuantur, ut decem hactenus libras ſuperarint.

Alienæ a podagricorum tophis ſubſtantiæ primos, ventriculo excretos, rarioris compacturæ, Aer non ut ſalia humectando, cum minima haberent, in fluorem, ſed rariores minuſq; firmiter implexos angulos movendo inſenſibiliter contritos in pollinem redegit; quemadmodum in vitriolo albo, lignis corruptis exſuccis, aliiſque ab aere contingere videmus; contra vero vini ſpiritus rectificatus raros poros facillime intrans, nec aeris 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 & principium Coli circa Cæcum obhærentibus, retractis orbicularibus muſculoſis inteſtinorum fibris, periſtaltici motus inverſionem contigiſſe, cauſam vero tam violentam ut calculum, facile valvulam aut ineptam everſiſſe, aut plane dirupiſſe.

Hoc oſtio patente, quid ni ſtimulata inteſtina Clyſmata ſurſum abſque excrementis duriſſimis rejecerint? cum ſcybala videamus in colicis adeo indurata cellulis inhærere, tandemq; ad alvum deſcendere, ut vix coctione ſolvi, multoque minus clyſmate dilui poſſint; Æque quidem mirum hæc contigiſſe & etiamnum contingere infartis ductibus craſſioribus lapillis, verum ad horum figuræ varietatem ſpectantes, eos non ad inteſtinorum cavitatem conformari, ſed ubiq; lateraliter, immo in aliquibus per ipſa quibus perforantur foramina chylo deſcenſum & clyſmatibus aſcenſum concedere.

Urinoſi laticis colorem varie immutari, ſubſtantiamve alterari pro accedentis vel deficientis ratione quemvis dies docet; Cæruleæ vero pellucidæ contra naturæ ordinem ſuccedentis cum tempore alia eſt perquirenda ratio; illis enim magis minuſve bile ſaturatis in-

tenditur vel remittitur tinctura, aut admixtis variis heterogeneis, vel spiritibus exhalatis incrassatur, inque opacam & virulentam vertitur urina.

Cujus collectæ excretionem impediebat mucus in vesica, ejus collum glutinans, tantam vero octo librarum quantitatem vesica capere incapax, nisi non naturalem extensionem ei concedamus; qualem in puella sub finem anni septuagesimi secundi Johanna Heuschleria *observavi; ad quam ut asciticam accersitus, quærenti causas, obtigit inflammatio colli vesicæ, Anodyna & post Catheterem applicare jussi, unde incredibilis lotij quantitas libras novem superans, subsidente ventre, continuo fluxit, ipsaque convaluit; Urinas vero non tam in vesica quam renibus, vasisque cæteris redundare superius exemplum* Dn. I. W. *declarat.*

Evenire unde potuit ut excedens hujus laticis urinosi quantitas apertis Cœliacæ ostiolis in cavitatem ventriculi exudarit; verum propius observantibus constat, urina non redundante ejusmodi fieri vacuationem, plurimum puram, aliquando vero quibusdam chyli ciborumq; particulis mixtam; Nec si quis antecedentem historiam serio examinabit, ne quicquam excretiones ante primas ægræ ingestum, multo minus huc usque datum intelliget, quod urinosum saporem induere valuerit; Nec latex semper redundans vasa sanguifera eructare cogit: Inde ex ipsius rei contingentibus veris aliquid contra naturæ leges in hoc corpore contingere, conjicere licet, forsanque continuatæ calculorum generationis aliqua causa petenda, cum ventriculus nova saburra perversoq; fermento humorum quotidie tentetur; secus jam jam remediis alteratus esset: Memor quidem exempli quod mihi contigit, Anno 1677. *in* Eva Zubera *annorum quadraginta cive urbis hujus, quæ enixu partus violento, vesica urina distenta, fœtus exitu valide compressa, hacq; violenta causa aperto uracho, urinæ per umbilicum integro puerperio majorem portionem exoneravit, demum consolidato hoc, naturaliter fluxit; Ast a naturalibus & manifestis ad non naturalia occulta hactenus concludendum non est.*

Abstinentiæ thema Lentulus *noster ad* divum Jacobum primum, Regem Angliæ Potentissimum *pertractavit, ignota tum transpirationis hujusq; principii circulationis causa varie ratiocinatus*

natus; ſed ad hanc reflectentes, hominem reſpirare adq; ſubſtantiæ deperditæ reſtaurationem refici, 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, facta tamen digeſtione amplius non ponderet quam cibum ante ſumtum: Hinc coctionum energia omnia imminui inq; ſpiritus tandem reſolvi, & tranſpirationis, in ſolutione morborum inſenſibili & hecticorum devorata ſubſtantia, veritas conſiſtit; qua non ob epidermidis conſtipationem procedente, non opus erat refectione; ſecus aer inſpirari ad ſpirituum vitalium refectionem debuit, ut expirari poſſit, ſicq; in motu manere; qui ipſe aer inſpiratus, incraſſatus, in vaſis in ſerum verſus, urinandi materiam tempore abſtinentiæ commodam præbuit, ut hydropicos ſæpius cernimus ſolo aere, aquoſis ſuis particulis, in creſcere.

Hæc ſunt, Excellentiſſimi Domini, quæ olim deſideraſtis, exigua quidem, niſi favore veſtro, digna ad majora videantur. Plurima horum Calculorum ſpecimina doctis præclaris amiciſq; viris in rei teſtimonium mittere voluimus, ut ſi aliquid cum tempore obſervari velint, hortari dignentur; Inclyti enim Senatus noſtri Ampliſſimi mandato, pro Clementia ſua in miſeros, ægra noſtra publico loco ſuſtentatur et obſervatur, cautumq; eſt ne mortua ante exactam eviſcerationem ſepeliatur, quo publico ex ipſius laudatiſſimo deſiderio aliquid boni redundare poſſit.

Dabam *Bernæ* in *Helvetiis* ultima *Feb.* 1686.

Sigiſm. Konig. M. D.
Incl. Rpl. Ph.

Horum Calculorum ſpecimina duo una miſit *Cl.D. Konig*, quorum figuras juſta magnitudine accurate exhibent *Fig.* 3 & 4. R. Societas rei novitate permota, voluit eos ſpagyrico examini ſubjicere, adminiſtrante Chymico excellentiſſimo *D.D. Slareo*. Eventum e Tranſactione proxime edenda ſcies.

A Diſcourſe of the Rule of the decreaſe of the hight 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 elce 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 Veſſell holding ten Gallons, as 1 to 860; all which, conſidering the difficulty of the Experiment agree well enough, the *Mercury* ſtanding at all thoſe times about 29 *Inches* $\frac{3}{4}$; but by reaſon twas Summer Weather and conſequently the *Air* rarified when all theſe were tryed, we may without ſenſible Errour 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 $\frac{1}{2}$ 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* encreaſing in the ſame proportion as the incumbent weight of the *Atmoſphere* decreaſes, that is as the *Mercury* in the *Barometer* ſinks, the upper parts of the *Air* are much more rarified than the lower, and

and each ſpace anſwering to an *Inch* of *Quickſilver* grows greater and greater, ſo that the *Atmoſphere* muſt be extended to a much greater hight. Now upon theſe principles, to determine the hight of the *Mercury* at any aſſigned hight in the *Air*, and *e contra* having the hight of the *Mercury* given, to find the hight 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 hights 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 hight of the *Mercury*: For by the *65th prop. lib. 2. Conic. Mydorgii*, the Rectangles AB CE, AKGE, ALDE, &c. (in fig. 5) are alwais equal, and conſequently the ſides CB, GK, LD, &c. are reciprocally as the ſides, AB, AK, AL, &c. If then the lines AB, AK, AL, be ſuppoſed equal to the hights 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 hights of the *Barometer*; that is to ſay the ſumme of all the lines between CB and KG, or the *Area* CBKG, will be proportioned to the diſtance or ſpace intercepted between the Levels of two places in the *Air*, where the *Mercury* would ſtand at the hights 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, GKLD, 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 hight of any place in the *Atmoſphere*, having any aſſigned hight of the *Mercury*, may moſt

eaſi-

eaſily be found: For the line CB in the *Hyberbola*, whereof the *Areas* deſign the *Tabular Logarithms*, being 0, 0144765; t'will be, as 0, 0144765, to the difference of the *Logarithms* of 30, and any other leſſer Number, ſo 900 *feet* or the ſpace anſwering to an Inch of *Mercury*, if the *Air* were equally preſt with 30 Inches of *Mercury* and every where alike, to the hight of the *Barometer* in the *Air*, where it will ſtand at that leſſer Number of Inches: And by the converſe of this proporion may the hight 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 hights of the Mercury.

Inch.	*Feet.*
30.	0
29.	915.
28.	1862.
27.	2844.
26.	3863.
25.	4922.
20.	10947.
15.	18715.
10.	29662.
5.	48378.
1.	91831.
0, 5.	110547.
0, 25.	129262.
0, 1.	29 *mil. or* 154000.
0, 01.	41 *mil.* 216169.
0, 001.	53 *mil.* 278338.

A Table ſhewing the hights of the Mercury, *at given Altitudes.*

Feet.	*Inch.*
0	30, 00.
1000.	28, 91.
2000.	27, 86.
3000	26, 85.
4000	25, 87.
5000 *feet*	24, 93.
1 *mile*	24, 67.
2	20, 29.
3	16. 68.
4	13. 72.
5	11. 28.
10	4. 24.
15	1. 60.
20	0. 95.
25	0. 23.
30	0. 08.
40	0. 012.

Up-

Upon theſe Suppoſitions it appears, that at the hight 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 Sunn 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.* 6. that the proportion of the hight of the whole *Air*, to the Semidiameter of the Earth, is much about, as 1 to 90, or as the exceſs of the *Secant* of about 8 $\frac{1}{2}$ 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 hight 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 hight of the *Air* need not be ſo great as if they went ſtreight; and having from the Angle ECS taken the double *Refraction* of the *Horizontal Ray*, the half of the remainder will be 8 $\frac{1}{2}$ degrees *circiter*, whoſe *Secant* being 10 111 it follows that as 10000 to 111, ſo the Semidiameter of of the Earth ſuppoſed 4000 miles, to 44, 4 miles; which will be the hight 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 aſſunder.

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 18oooooth 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 8ooth 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 28 ½ inches of *Mercury*, and at other times by no leſs than 30 ½, ſo that the under parts being preſſed by about a 15th part, leſs weight, the *ſpecifick* gravity of the *Air* upon that ſcore will ſometimes be a 15th part lighter than another; Beſides heat and cold does very conſiderably dilate and contract the *Air*, and conſequently alter its gravity, to which add the mixture of *effluvia* or ſteams riſing from allmoſt all Bodies, which aſſimulating 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 Specifick 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 tho 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 8ooth 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 Wooll and the like, whoſe bodies being compreſſable 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 ſpecifick gravity of the *Air* obſerved at any time; but the Method here ſhewn will compute by a like calculation, the hights of the *Quickſilver*, and the Rarefactions of the *Air* from any aſſigned hight of the *Barometer* at the Earths Surface, and any ſpecifick Gravity given. As to the Condenſation and Rarefaction by heat and cold, and the various mixture of Aqueous and other Vapours, theſe two objections ſeem generally to compenſate each other, for when the *Air* is rarified by heat the Vapours are raiſed moſt copiouſly, ſo that tho' the *Air* properly ſo called, be expanded and conſequently lighter, yet the *interſtices* thereof being crouded 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 Caſwell* of *Oxford* upon the top of *Snowdon* hill in *Caernarvan-Sheir*, ſeems to prove that the firſt Inches of *Mercury* have their portions of *Air* near enough to what I now determine; for the hight 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. *Paſcall*'s Book, *del' 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 hight 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 hight of the *Mercury* at one time, from the hight 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 hight of the Cylinder of *Mercury*, is equal to the weight of the whole incumbent *Air*, and conſequently that that whole is ſomtimes 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 encreaſed or diminiſhed, in any particular place, will give a reaſon for the greater and leſſer hight 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 enclined to Rain, the *Mercury* is commonly low.

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

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

4. That *cæteris paribus* the greateſt hights of the *Mercury* are found upon Eaſterly and North-eaſterly winds.

5. That in calm froſty weather the *Mercury* generally ſtands high.

6.

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 Præcipitation of the Vapours, lodging in the *Air*, whereby it comes to be at one time much more crouded, than at another, and conſequently heavier; but this latter in a great meaſure depends upon the former. Now from theſe Principles I ſhall endeavour to Explicate the ſeveral *Phænomena* of the *Barometer*, taking them in the ſame Order, 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 togather and forme little drops of Rain; but the *Mercurys* 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 wais 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 ſetled Weather the* Mercury *is generally high*? To this I anſwer, That the greater hight 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 hight 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 Præcipitate and fall down in drops, which is the reaſon of the Serene good Weater, which attends the greater hights 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 ſtagnant Air which is left behind, as likewiſe that on the ſides, cannot come in ſo faſt as to ſupply the Evacuation made by ſo ſwift a Current, ſo that the *Air* muſt neceſſarily be attenu-

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 *Airs* rarefaction.

4. *Why* cæteris paribus *the* Mercury *ſtands higheſt upon an Eaſterly or North-eaſterly Wind.* This happens becauſe that in the great *Atlantick Ocean* on this ſide the 35*th* 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 freeſes 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 preſt to a more than ordinary hight, and as a concurring cauſe, the ſhrinking of the lower parts of the *Air* into leſſer room by cold, muſt needs cauſe a deſcent of the upper parts of the *Atmoſphere* to reduce the cavity made by this contraction to an *Æquilibrium*.

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 riſen an Inch and half in leſs than ſix 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 *Æquilibrium*, 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 *Stokholm*, 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 uſually greater Storms of Wind than the more Southerly, whereby the *Mercury* ſhould ſink lower, in that extream; and then the Northerly Winds bringing the Condenſed and Ponderous *Air* from the Neighbourhood of the *Pole*, and that again being checked by a Southerly Wind, at no great diſtance, and ſo heaped, muſt of neceſſity make the *Mercury* in ſuch caſe ſtand higher, in the other extream.

8. 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 *Almoſphere* 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 ſetled ſtate of about 29 ½ 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 crouded 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*, riſes 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.

An Account of two 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. *Paul*'s-Church-Yard, *Anno* 1686. 8*vo*.

'TIS 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 *Peripatetick* 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 *Peripatetick*, 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 Errours, 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 Errour, 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, examins 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 endeavours to avoid the frequent uſe of this word *Nature*.

The fourth Section, in the firſt place, examins 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 fift propoſes the Reaſons whereby our Author was perſwaded 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 *Phænomena*, &c.

The ſixth diſcuſſes the Arguments in behalf of *Nature*, drawn from the common conſent 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 ſubtilty 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.

Traite

Traite du Mouvement des eaux et des autres Corps fluides par feu Mr. Mariotte, *A* Paris. *An.* 1686. *Octavo.*

THis Book having been deſigned by the Ingenious Mr. *Mariotte*, and by him in a great Meaſure compleated 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 2*d.* 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 3*d.* is about the Origine and Cauſe of Winds, of which he aſſignes 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 3*d.* is from the Moons reſpect to her *Apogæon* or *Perigæon*, whereby ſhe ſometimes riſes from, other times deſcends towards the Earth. The particular cauſes are, 1*ſt.* the extraordinary riſing of the Vapours and Exhalations out of certain places of the Earth.

2*d.*

2*d.* The fall of great Rains and Hails. 3*d.* The great Quantity of nitrous and Sulphureous Exhalations in Earthquakes. 4*th.* The Soudain melting of Snow in the High Mountains; and from these several causes combined, he thinks he can account for all the Phænomena of Winds, particularly the *Trade Winds* between the *Tropicks*, called by him *Vents Alizez*, 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 *Æquilibrium* of Fluids; the first Discourse demonstrating from the Principles of Mechanicks, how Fluids counterpoise one anothers 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 counterpois'd 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 hights of the Reservatory, 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; togather 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 1*st.* 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

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 hights of the reſervatory, are in a ſubduple proportion of theſe hights; and it being found that at the hight of 13 foot, a *jet d'eau* of ¼ of an Inch Diameter, evacuated 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 hight of the Reſervatory through the ſame Bore.

The third Diſcourſe ſhews that the quantity evacuated by different Bores at the ſame hight 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 *Aquæduct* 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 Reſervatories, but allways 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 Reſervatory 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 encreaſed: 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

The fift 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, 'tis laid down that for a Reſervatory of 52 foot high, whoſe *Ajutage* 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 reſiſtance 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 *Centeſmes* 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 ½ 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 ¼ 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. Streater*, and are to be sold by *Sam. Smith* at the Sign of the *Princes*'s Arms in St. *Paul*'s *Church-yard.*

PHILOSOPHICAL TRANSACTIONS.

June the 26. 1686.

THE CONTENTS

An

ESSAY

Towards An

UNIVERSAL ALPHABET.

By Mr. *Francis Lodwick* R. S. 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 ſoever

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 falſly 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 careleſly 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 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 *Enbiſh* words occurred to my *Memory*, wherin they are expreſt.

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

	1	2	3	4	5
1	B bond	D dark	J Jeſt	G Game	=
2	P Pond	T tart	Ch. Cheſt.	K came	=
3	M mind	N name	gn *Seignior* } *Fr.*	ng ſong	=
4	=	dh this	J *Jean* }	g gaen } *l.d.*	V Valley
5	=	th thing	ſh ſhall	ch dach }	F Folly
6		n *danſe Fr.*			

	6	7	8	9	10	11	
=		L lane	H hand	Y yarn	R rand	W wand	*Fr ſign. Fren.*
=							*Ld. Lowdnish*
=							*W. Welch*
Z	Zeal	lh *W.*					
S	Seal						

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 oomprehended.

Thoſe

Thoſe places filled by two ſtrokes (=) ſignifie 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 *ſ* 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-

ſible

ſible 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 nigher 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 diſtinct 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 Organe, 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 12*th*. Conſonantal Character, anſwering to the *Hebrew*, *Aleph*; and over the ſame place the Vowel beginning ſuch a Syllable.

This Character may ſeem ſomewhat to complicate for diſpatch in ordinary Writing, but for Printing it will be the

the ſame 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 9.11.12.13.14*th.* 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 compounded 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 begining and end of every Sentence requiring it.

[ ] *Explication.*
( ) *Parentheſis.*
¡ ¡ *Emphaſis.*
¿? ? *Interrogation.*
¡! ! *Wonder.*
¿ ¿ *Irony.*

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 then 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 joyn all theſe Syllables into one word, but how prepoſtorous 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 joyn 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 diſmembring 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 Compounded, 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 throughout the Variations, *3dly*, of one Vowel and three or four Conſonants

ſonants following. And of three Conſonants going before, and one Vowel following. 4*thly* of one, two or three Conſonants going before a Vowel, and one two, three, or four Conſonants following. 5*thly*, of ſome Syllables with Dipththongs or Tripththongs. 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 eaſie to the moſt difficult expreſſions, without heed to their Sgnifications.

Further let there follow ſome words of ſeveral Syllables, with the Accent Variouſly 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 gradully to the moſtdifficult, 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 ſoever, 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 Signes 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.

Some

The Universall Alphabet.

The Table of Consonants

	1	2	3	4	5	6	7
1	b	d	j	g	=	=	P L
2	p	t	ch	k	=	=	
3	m	n	gn	ng	=	=	
4	=	dh	j	g	v	z	B Lh
5	=	th	sh	ch	f	s	
6		h	n				

8	9	10	11	12		
h	y	r	w	l		

The Table of Vowels

14	13	12	11	10	9	8	7	6	5	4	3	2	1
>	>	>	>	O	Y	C	C	–	C	C	–	/	/
ou	oo	eu	u	o	y	ui	u	i	eu	e	a	a	a

The Lords Prayer in English.

Our Father which art in heaven, hallowed be thy name. Thy kingdom come. Thy will be done in earth, as it is in heaven. Give us this day our daily bread. And forgive us our debts, as we forgive our debtors. And lead us not into temptation, but deliver us from evil. For thine is the kingdom, the power, and the glory, for ever and ever. Amen.

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* 13*th.* and in the *Nouvelles de la Republique des Letres* 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 hiscontrivance, in the Philoſophical Tranſactions of the Month of *December*, 1685. I find I muſt explain my ſelf more at large than I did in that Paper; but I begg his pardon if I ſay nothing concerning the new diſpoſition, which he ſay's 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 ſayd nothing, that might make him beleive, that I did in the leaſt queſtion the truth, which he intended to prove againſt me by thoſe Experiments; and without any tryals I am fully enough convinced, that the *Mercury* in his Engine muſt follow the lawes of the *equilibrium* of *fluid Bodies*: But the conſequence which he draws from that Principle, ſeems to me very groundleſs; for altho' the lowermoſt part of the Bellows be pres't by the weight of 40 inches of *Mercury*, it doth not follow, that all the parts which are ſituated higher muſt bare 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 undenyable, 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 forbare to ſpeak of them; and I will ſtick only to that which is moſt material, and makes his Perpetual Motion to be altogather impoſſible.

As for the Argument the Author drawes 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* Transaction: *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 discover the Nature of the *Calculus Humanus* (which I found to have no attributes that are proper to a real Stone) and bringing 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 weighed 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 *Concretions*, 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 Tryal*, it was very Spungy, for when it lay under Water, there palled a good while before I could clear it of the lurking bubbles, so that it grew heavyer, from time to time as the bubbles were expeld, and at last arrived near the Standard of a true Stony *Concretion*, or rather somwhat beyond it.

This

This Stone ſent us for thirteen Dramms, muſt either have been *Averdupoiſe*, 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 } 5 *dr.* — 48 *gr.*

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 extraodinary *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 290, conſiderably ſhort of that of 2 to one. Shells and Teſtaceous 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 Teſtaceous Matter, from whence the Stone might receive its original: For this being broken into peices, 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 heavyer than *Chalk*, can ſcarſe 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 peice that weighed five drams out of the Water, diſcovered its weight to beare the proportion of 403 to 184, or 756 to 345 to that of Water. This Anomalous Subſtance being ſo near the weight of our petrifyed Water, would almoſt in-

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 ſeeme 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 petrifyed 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*: Tho' *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 *fixt Salt* obtained by his diſtillation, that thoſe *tryals* do neceſſarily make it an *Animal Subſtance*; which Experiment ſo far failed us, that I am not ſatisfyed 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 these should abound with *Volatile Salt* is strange, I have tryed the *Bezoar Stone* said to be generated in the Stomacks of some *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 so soft, that it answers the *Cylindrical* Figure of the *Ureter*, but these are much harder, and do not in any measure comply with the Constriction of the *Bowels*.

We may in some measure question that principle, or rather *Hypothesis* of *Acidum*, our Correspondent trusts to, for the *Combination* or *Coagulation* of the Humors in the Body, in order to this *Petrifaction*; it being supposed not proved.

We may also question whether the *fixt* or *Alcalizate Salt*, found in the *Caput Mortuum* after Distillation, were really pre-existent 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 some metallick particles, whether they may not be an *Ingredient* in this ponderous Stone, especially since *Dr. Lister* has found them in much lighter *Concretions*, as those of the *Kidneys* are. For though we find them not in this unprepared stone, yet after Reverberation or a strong Calcination, many bodies have detected an *Iron Contexture*. The *Marchasite* it self, though very pregnant with *Iron*, shews it not, till it has been calcined: which shall be done with some 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 Conſiſtence 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, petrifyed Waters, *&c.* do anſwer the ſame Standard of Specifick 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 groſs powder, and conveyed it into a coated *Retort*, which coated *Retort* was kept for ſome Houres in a naked Fire, ſo hot that the Glaſs 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 Hartshorn 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 conſentaneous to 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 carryed 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 30*th 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 *Apogæon* 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 ſight 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 *Nuremburg*, made by the Induſtrious Obſervers Mr. *Eimmart* and Mr. *Wurtzelbaur*.

The Obſervation of Mr. Eimmart *was as follows.*

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

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

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

12*h.* 13*min*, or 10*m.* 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.

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

Whence

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

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

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

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

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

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

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

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

By theſe Obſervations the middle of the Eclipſe ought to have been about 11*h.* 19*m. P.M.* at *Nuremburg*, differing but one *minute* from Mr. *Eimmarts* Obſervation. The duration will be 3*h.* 51*min.* and the total Darkneſs 1*h.* 46*m.* The Longitude of *Nuremburg* has been formerly ſtated 11 *degrees* from *London*,& ſince found to be ſo by Obſervations of the laſt Eclipſe of the Sun *July* 2*d* 1684, which made it 44½ *min.* of time. So that the middle of this Eclipſe at *London* ſhould have been 10*h.* 34½*m.* which from the Obſervation of Mr. *Hevelius* had been formerly concluded 10*h.* 35*m.*

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.* Juſtell 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

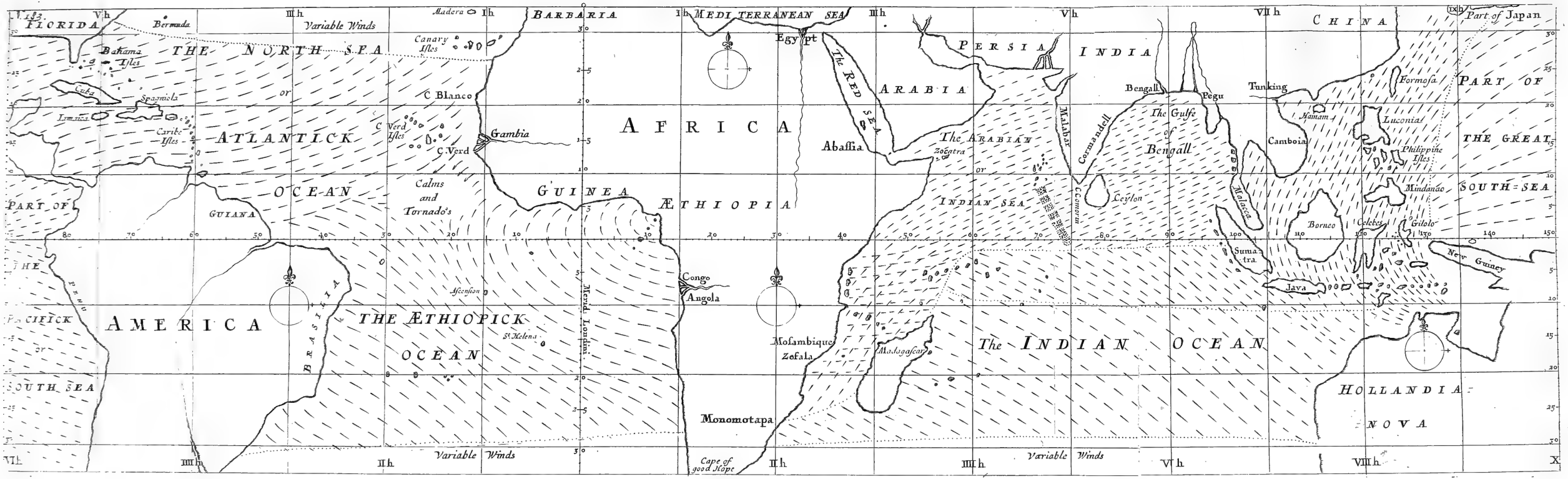
give us ſo much trouble to deſtroy them this, I will do what I at preſent can to ſatisfie you. Theſe Inſects are undoubtedly of a peculiar *ſpecies*, although to look on them, they appear in nothing different from the common ſort, but they take their flight like Birds, which is particular to them. They 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 Pulſe, the Willows and even the Hemp notwithſtanding its great bitterneſs. Afterwards about the end of *Auguſt* they ceaſed flying, and copulated, and the Female ſtuck her tayle into the hard Earth where ſhe caſt a foam, and made therewith in the ground, a hole as big as that of a Gooſe quill, and about an Inch long, wherein ſhe laid her Eggs, which are much of the ſize of Millet ſeed, there would be ſometimes 50 of theſe Eggs in a hole, which are ſo covered over with the ſame Earth that the Water does not get in. After this all theſe Inſects died and ſtunk very much. They begun this Year to hatch in the Month of *April*, and ſome there are, that are not yet hatched. 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 Graſshoppers

hoppers which are not yet bigger than flyes. There are yet a muiltitude 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 extraordinaryly 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.*

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


FLORIDA
Bermuda
Bahama Isles
THE NORTH SEA or ATLANTICK OCEAN
Cuba
Spagniola
Jamaica
Caribe Isles
C Blanco
C Verd Isles
C Verd
Gambia
Canary Isles
Madera
Variable Winds
BARBARIA
MEDITERRANEAN SEA
Egypt
The RED SEA
ARABIA
PERSIA
INDIA
Abassia
The ARABIAN or INDIAN SEA
Zocatra
Malabar
Coromandell
Ceylon
Bengall
Pegu
Tunking
CHINA
Part of Japan
The Gulfe of Bengall
Camboia
Hainam
Formosa
Luconia
Philippine Isles
PART OF THE GREAT SOUTH-SEA
Mindanao
Celebes
Gilolo
Borneo
Malacca
Sumatra
Java
New Guiney
HOLLANDIA NOVA
AFRICA
GUINEA
ÆTHIOPIA
Calms and Tornado's
Congo
Angola
Ascension
St. Helena
Mosambique
Zofala
Madagascar
Monomotapa
Cape of good Hope
Meridi. Londini
The INDIAN OCEAN
Variable Winds
PART OF THE PACIFICK or SOUTH SEA
AMERICA
BRASILIA
THE ÆTHIOPICK OCEAN
GUIANA
Peru

PHILOSOPHICAL TRANSACTIONS.

For the Months of *July*, *August* and *September* 1686.

THE CONTENTS.

An Extract of two Essays in Political Arithmetick *concerning the comparative Magnitudes, &c. of* London *and* Paris *by Sr.* William Petty *Knight, 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 togather. The second by compareing the number of Houses, which by the Chimny-Books are found above 80000 in *London*, whereas a great Author among the *French*, (who seldome faile 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 5*ths* 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'-Hostel Dieu*; wheras at *London* there dies scarce one in fiftie in our Hospitals. Hereupon in the second Essay, our Author extends his Charity to those poor wretches, shewing how by a reasonable expence, 3000 persons might be there saved *per Annum*, who die for want of good aocommodation. The whole is so close writt, that it will not bare Epitomizing, wherefore I rather recommend it to the Curious who cannot but be satisfied therewith.

An

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.

AN exact Relation of the constant and Periodical Winds, observable in several Tracts of the *Ocean*, is a part of Natural History not less desireable and useful, than it is difficult to obtain, and it's *Phænomena* hard to explicate: I am not Ignorant that several Writers have undertaken this subject, and although *Varenius* (*Lib. I. Chap. XXI. Geo. Gen*) seems to have endeavoured after the best information from *Voiagers*, yet cannot his accounts be admitted for accurate, by those that shall attentively consider and compare them togather; 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 *Æthiopick 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 *Atlantick* and *Æthiopick* 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 Compas 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*, assoon 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 4*th.* 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, seldome more. 'tis likewise observed, that the strength of these *Winds* does gradually decrease, as you saile 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 8 *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 *Brazile*.

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 *Braſilian* more *Eaſterly*, ſo as to become almoſt due *Eaſt*, the little deflection they have being ſtill to the *Southwards*. In this part of the Ocean it has been my fortune to paſs a full year, in an employment that obliged me to regard more than ordinary the Weather, and I found the Winds conſtantly about the *South-Eaſt*, the moſt uſual point *S E b E*; when it was *Eaſterly* it generally blew hard, and was gloomy, dark, and ſometimes rainy weather; if it came to the *Southwards* it was generally Serene, and a ſmall gale next to a 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 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 *Tropick* of ♑, the *South-Eaſterly Winds* become more *Eaſterly*, and the *North-eaſterly Winds* on this ſide the *Line* vere 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 Leona* to the *Iſle* of St. *Thomas*; for the *South-Eaſt* Trade-Wind having paſſed the *Line*, and approaching the Coaſt of *Guinea* within 80 or 100 *Leagues* inclines towards the ſhore, and becomes S. S. E, and by degrees, as you come nearer, it vears about to *South*, S. S. *Weſt*, and in with the land *South-Weſt*, and ſometimes *Weſt South-Weſt*; which variation is better expreſſed in the Mapp hereto annexed, than it can well be in words. Theſe are the Winds, which are obſerved on this coaſt when it blows

true, but there are frequent Calms, Violent ſuddain Guſts called *Tornado*'s, from all points of the compas, and ſometimes unwholſome foggy *Eaſterly Winds* called *Hermitaa* 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 *Eaſtermoſt Iſlands* that bear that name, there is a tract of Sea wherein it were improper to ſay there is any *Trade Wind*, or yet a Variable; for it ſeems condemned to perpetual Calms, attended with terrible Thunder and Lightning, and Rains ſo frequent, that our Navigators from thence call this part of the Sea the *Rains*: the little Winds that are, be only ſome ſuddain uncertain Guſts, of very little continuance and leſs extent; ſo that ſometimes each hour you ſhall have a different Gale, which dies away into a Calme before another ſucceed; and in a fleet of Shipps in ſight of one another, each ſhall have the Wind from a ſeveral point of the Compaſs; with theſe weak *Brizes* Shipps are obliged to make the beſt of their way to the *Southward* through the aforeſaid ſix degrees, wherein 'tis reported ſome have been detained whole months for want of Wind.

From the three laſt obſervables is ſhewn the reaſon of two notable occurrents in the *Eaſt-India* and *Guinea* Navigations. The one is, why notwithſtanding the narroweſt part of the Sea between *Guinea* and *Braſile* be about 500 leagues over, yet 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 neighberhood 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 practiſe of all the *Guiny* Shipps, and which may ſeem very ſtrang 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 alwaies find the *Winds* more and more contrary; ſo that when near the ſhore they could lie *South*, at a greater diſtance they can make their way no better than S. E. and afterwards E. S. E, with which courſes they fetch commonly the Iſle of St. *Thomas* and Cape *Lopez*, where finding the Winds to the *Eaſtward* of the *South*, they keep them favourable by running away to the *Weſtward* in the *South Lat.* of 3 or 4 *degrees*, where the *S. E. Winds* are perpetual.

For the ſake of theſe general *Winds*, all thoſe that uſe the *VVeſt-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 runn 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 togea-

ther

ther there being none at all. But their Violence is ſo unconceivable, and their other *Phænomena* 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 every where ſenſible; and the great Variety which happens in their Periods, Force and Direction, from the ſituation of the Mountains, Vallies and Woods, and from the various texture of the Soil, more or leſs capable of retaining and reflecting Heat, and of exhaling or condenſing Vapours is ſuch, that it were an endleſs task, to endeavour to account for them.

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 perſwaded 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 *Ethiopick* Ocean, as it is deſcribed in the 4*th. Remark* aforegoing.

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 *Bengall*, 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 *Bengall*, 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 *Southwards* of the *Equator*, subject to the same changes of the Winds, *viz.* near the *African*-Coast, between it and the Island *Madagascar* or St. *Laurence*, 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 *Camboia* and *China*, the *Monſoons* blow *North* and *South*, that is to ſay, the N. E. Winds are much *Northerly*, and the S. W. much *Southerly*: This Conſtitution reaches to the *Eaſtwards* of the *Philippine*-Iſles, and as far *Northerly* as *Japan*. The *Northern Monſoon* ſetting in, in theſe Seas, in *October* or *November*, and the *Southern* in *May*, blowing all the Summer Months: Here it is to be noted, That the Points of the Compaſs, from whence the Wind comes in theſe Parts of the World, are not ſo fixt as in thoſe lately deſcribed; for the *Southerly* will frequently paſs a Point or two to the *Eaſtwards* of the *South*, and the *Northerly* as much to the *Weſtwards* of the *North*, which ſeems occaſioned by the great quantity of Land which is interſperſed in theſe Seas.

6. That in the ſame *Meridians*, but to the *Southwards* of the *Equator*, being that Tract lying between *Sumatra* and *Java* to the *Weſt*, and *New Guinea* to the *Eaſt*, the ſame *Northerly* and *Southerly Monſoons* are obſerved, but with this difference, that the inclination of the *Northerly* is towards the N. W. and of the *Southerly* towards the S. E. but the *plagæ venti* are not more conſtant here than in the former, *viz.* variable 5 or 6 Points; Beſides the times of the Change of theſe Winds, are not the ſame as in the *Chineſe* Seas, but about a Month or ſix 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 ſail in theſe Seas, are obliged to obſerve the ſeaſons proper for their Voiages, 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 Voiages, and either return to the port from whence they came, or elce 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* Ilands, 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 *Spanyards* who go yearly from the Coaſt of new *Spain* to the *Manilha'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 *Candiſh*, and ſince by *Schouten*, 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 *Æthiopick*; 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 conſtancy, that they ſcarce ever need to attend the Sails, and ſtrength, that it is rare to fail of croſſing this vaſt Ocean in ten weeks time, which is about 13 miles *per diem*; beſides 'tis ſaid 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 Voiage 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 30*th.* degree of Latitude on both sides; for the *Spanyards* homewards bound from the *Manilha's*, 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 gon about by the *Magellan* Streights, have found the limits of of S. E. Winds, much about the same Latitude to the *Southwards*; besides a farther *Analogy* between the Winds of this Ocean, and the *Ethiopick*, appears in that, upon the Coast of *Peru*, they are alwais 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 togather 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 knowledg.

To help the conception of the reader in a matter of so much difficulty, I believed it necessary to adjoyn 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 *Monſoons*. 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 alwaies before it; the ſharp end of each little ſtroak pointing out that part of the Horizon, from whence the Wind continually comes; and where there are *Monſoons* the rows of the ſtroaks run alternately backwards and forwards, by which means they are thicker there than elſewhere. As to the great South Sea, conſidering its vaſt extent, and the little Variety there is in its Winds, and the great *Analogy* between them, and thoſe of the *Atlantick* and *Æthiopick* Oceans, beſides that the greateſt part thereof is wholly unknown to us; I thought it unneceſſary to lengthen the Mapp therewith.

In the foregoing Hiſtory are contained ſeveral Problems, that Merit well the conſideration of our acuteſt Naturaliſts, both by reaſon of the conſtancy of the effect, and of the immenſe extent there of; 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 the ſaid Winds extend no farther with Conſtancy than to the Latitudes of 30 *deg.* 3. Why there ſhould be a conſtant Southweſterly 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 alwaies true, that to the Northward of the *Equator* it is enclined 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 elcewhere; 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 *Phænomena*, 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 enclined 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 *Earths 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 *Atlantick* 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 Earths *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, capable of producing a like conſtant effect, not liable to the ſame Objections, but agreable 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 conſequently more ponderous, muſt have a Motion towards thoſe parts thereof, which are more rarified, and leſs ponderous, to bring it to an *Æquilibrium*; and ſecondly, that the preſence of the Sun continually ſhifting to the Weſtwards, that part towards which the Air tends, by reaſon of the Rarifaction made by his greateſt *Meridian* Heat, is with him carried Weſtward, and conſequently the tendency of the whole Body of the lower Air is that way.

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

wards and Southwards, being leſs rarified than that in the middle, it follows, that from both ſides it ought to tend towards the *E*quator: This Motion compounded with the former *E*aſterly Wind anſwers all the *Phænomena* of the general Trade Winds, which if the whole ſurface of the Globe were Sea, would undoubtedly blow all round the World, as they are found to do in the *Atlantick* and *Æthiopick* Oceans.

*B*ut 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 Deſarts of *Lybia* are uſually reported to be, the heat occaſioned by the reflection of the Suns Beams, and the retention there of 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 *Æquilibrium:* This I take to be the cauſe, why near the Coaſt of *Guinea* the Wind always ſets in upon the Land, blowing Weſterly inſtead of Eaſterly, there being ſufficient reaſon to believe, that the Inland Parts of *Africa* are prodigiouſly hot, ſince the Northern borders thereof were ſo intemperate, as to give the Ancients cauſe to conclude, that all beyond the *Tropick* 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 *Æquilibrio* 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 *Æquilibrium*; 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 *Phænomenon* of the *Monſoons*, by this means moſt eaſily ſolved, and without it hardly explicable.

Suppoſing therefore ſuch a Circulation as above, tis to be conſidered that to the Northward of the *Indian* Ocean there is every where Land within the uſual limit of the Latitude of 30. *viz. Arabia. Perſia, India* &c. which for the ſame reaſon as the *Mediterranean* Parts of *Africa*, are ſubject to unſufferable heats when the Sun is to the North, paſſing nearly Vertical; but yet are temperate enough when the Sun is removed towards the other *Tropick*; becauſe of a ridg 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 *October*; when the Sun being retired, and all things growing cooler Northward, and the Heat encreaſing 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 ſeldome 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 leaſure to apply their ſerious thoughts about it.

A Dioptrick Problem, *Why four Convex-glaſſes in a Teleſcope, ſhew Objects Erect. by* William Molineux *of* Dublin *Eſq.* R. S. *Soc.*

IN the *Journal des Scavans* for Munday the 17*th.* 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* Phænomenon *obliges all Skil'd 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, beleives 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 beleive '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 it ſelf to ſhew Objects erect or reverſe, but in reſpect of placeing of the Eye that looks through it. For if the Eye that looks through ſuch a ſingle Convex-glaſs

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 Glaſs 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 Reverſing of Objects in a *Teleſcope* of two Convex-glaſſes proceeds wholy 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 then its *Focus* (for ſo is the third or immediate *Eye-glaſs*, it being alwayes 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-glaſs* does nothing towards the erecting or reverſing the Species, which it receives erect from the middle *Eye-glaſs*; no more than in a Teleſcope of two Convex-glaſſes, the *Eye-glaſs* 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 any thing to do with the erecting or inverting, but meerly in repreſenting in the ſame poſture the Species immediatly before them.

The *French* Problem therefore ſhould not have broken a Teleſcope of four Convex-glaſſes into four peices, 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*)

does nothing towards erecting or reverſing, but repreſents the Image as it is in the *Diſtinct-Baſe* 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-Baſe* 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 coppyed it from the Stone, to Mr. *Juſtel*, who was pleaſed to communicate it to the *Royal Society*, together with the Sentiments of Dr. *Voſſius* therupon, of which the Reader may Judg.

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. IIII, 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
SACERDOTI. APOLLI
NIS. ALBANI. LONGA
NI. BOVILLENSES. DE
CVRIONES. OB. MERI
TA. SVFENATIS. HER
METIS. PATRIS. EIVS
L. D. D. D.

P. SVFENATI. P. F. -- --
MYRONI.
EQVITI. ROMANO. DEC---

ALI. SCRIBARVM. AED - - -
CVRVLIVM. LVPERCO - - -
TI. LAVINATI. FRETRIAC - -
APOLI. ANTINOITON - - -
NOSTIDON. DECVR - - -
IIII. VIRO. ALBANI - - -
GANI. BOVILLEN : --
MVNICIPES. OB.
EIVS. L . . . D . - - - -

An Extract of the Letter of Dr. *Voſſius* to Mr. *Iuſtel* upon the Subject of this Inſcription.

——*Bene noſti claſſem Ægyptiacam ſive Cataplum Alexandrinum antequam portus Oſtiæ eſſet exſtructus, ſingulis Annis appuliſſe Puteolos, unde demum frumentum Romam deferebatur. Poſtquam vero Auguſtus, & Claudius Cæſares & poſtea Nero Oſtiæ portum aperuerunt, jam annona non tantum Puteolos ſed & longe maxima ſui parte Oſtiam appetebat. Conſtat autem tempore Tiberii pulſos Roma fuiſſe Judæos & Ægyptios; unde factum eſt ut ab Oſtia per agrum Laurentem deportaretur frumentum Ariciam et Albam longam uſque ad Bovillas, ad decimum nempe ab Urbe Lapidem; neque enim longius progredi permittebatur. A Bovillis enim Romam per Inſtitores Romanos deferebatur, neque enim Ægyptiis aut Judæis in Urbe habitare aut horrea habere erat licitum. Menſoribus vero & Venditoribus frumenti Oſtiæ & paſſim alibi præfuiſſe Decuriones & hoc quoque ex jure conſtat Sed vero omnibus iſtis minoribus Decurionibus, qui in ſingulis locis & Urbibus frumenti curam haberent, præfuiſſe alium Decurionem*

nem, qui vicem Præfecti Annonæ obiret, & in omnibus iſtis inferiorum Decurionum Collegiis primum teneret locum, id manifeſte ex hac patet Inſcriptione, ubi minores Decuriones Bovillani honorem faciunt Equiti Romano & Palatino, qui Decurio ſeu Curialis & Fretriacus in omnibus eſſet locis & urbibus, a quibus & per quas Annona Ægyptiaca Romam devehebatur. Decuriones vero promotos fuiſſe ad honorem Sacerdotii, ita ut ſimul Flamines, Luperci, Epulones Jovis, & Paraſiti fierent Apollinis ; & hoc quoq; multis conſtat exemplis. Omne vero dubium tollit, quod in hac Inſcriptione eques ille Romanus vocetur Antinoiton & Eunoſtidon Decurio. Antinoi enim urbs præcipua tum temporis Ægypti ſuperioris erat Civitas, unde per multas foſſas frumentum deferebatur ad Mareotin lacum, qui ad Eunoſti portum exit in Mare. Ab hoc portu dicti Eunoſtidæ curatores frumenti Ægyptiaci ; unde demum confectus deus Eunoſtus rei frumentariæ Inſpector, qui huic præſideret portui.

Several Obſervations of the Eclipſe of *Jupiter* by the *Moon* on *March* the 31*th.* 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. *Caſſini*, made in the Royal Obſervatory at *Paris*, publiſhed in the *Journal des Scavans* of the 10*th* of *June* laſt, the ſubſtance whereof is as follows.

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

At 9*h.* 31*m.* 6*ſec.* ♃ was in a perpendicular falling on the Limb of the ☽ over againſt the Northern Part of the ſpot *Grimaldi* (*Mareotis*) near to *Riccioli* (*ſtag. Miris*) and was diſtant from the Limb about four times as much as the ſaid ſpot.

9*h.*

9h. 4m. 21sec. ♃ touched the circumference of ☽, which undulated by reaſon of the Vapours near the Horizon.

9. 41. 20. he quite diſappeared in the inequalities of the ☽s Limb, the total Immerſion might be ſome ſeconds later.

So the central immerſion was at 9h. 4m. 51sec.

♃ entred over againſt that part of *Grimaldi* next *Riccioli*. The Vapeurs of the Horizon hindered the Obſervation of the Immerſions of the Satellites, but not their Emerſions, for

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

At 10h. 40m. 24sec. the firſt Limb of ♃ began to come out of the dark ſide of the ☽, over againſt the North part of the Caſpian ſpot, about Cleomedes, (*ad montes Riphæos*)

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

At the Emerſion of the Center, the Altitude of ♃ was 11d. 31m.

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

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

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

At 11h. 45m. the Diameter of the ☽ was 32m. 27s. and according to the *calculus* of Mr. *Caſſini*, her parallax was 61 *min.*

Together with this Obſervation is joyned that of *R. P. Bonfa.* made at *Avignon* who obſerved the central immerſion at 9h. 42m. 12s. and the central Emerſion at 10h. 45m. 25s.

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* 28*th. ſt. vet Mane.* The Immerſion of the Center hapned at 3*h.* 37*m.* 23*ſ.* on the Eaſt ſide of the Spot *Xenophanes.* The Emerſion was at 4*h.* 28*m.* 24*ſ.* between *Seneca* and *Beroſus*, according to *Riccioli*, or *ad montes Alanos Hevelii*, a little to the Northward of the *Palus Mæotis.* This occultation could not be obſerved at *Paris* by reaſon of Clouds.

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

At 10*h.* 19*m.* 56*ſ.* Mr. *Zimmerman* obſerved the firſt contact of the Limbs of ♃ and the ☽, and at 10*h.* 20*m.* 47*ſ.* ♃ was all eclipſed.

At 11*h.* 22*m.* 51*ſ.* ♃ was wholly clear from the Eclipſe.

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

At 11*h.* 31*m.* 06*ſ.* the third Satellite of ♃ emerged. Theſe times were collected from the Culminations of fixt Stars, and the Vibrations of a Pendulum.

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

At 10*h.* 20*m.* 50*ſ.* ♃ applyed to the Limb of the ☽, over againſt the *loca paludoſa Inſulæ Circinnæ.*

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

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

At 11*h.* 19*m.* 40*ſ.* ♃ began to Emerge.

At 11*h.* 21*m.* 20*ſ.* he was quite free from the interpoſition of the ☽. The point of the Emerſion was ſomewhat to the North of the *Palus Mæotis.*

No Spot in the ☽ was ſo near the apparent magnitude of ♃s diſk as the *Inſula Besbicus Hevelii.*

At 11*h.* 40*m.* 00*ſ.* the Altitude of *Procyon* was 8*gr.* 37*m.* whence the Pendulum Clock, which had been ſet by Alti-

tudes of the ☉ the afternoon preceding, may be examined.

The Account we have but now lately received from the famous Mr. *Hevelius* from *Dantzick*, 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. vesperi, observata Gedani a* Joh. Hevelio.

AD hanc Observationem summa alacritate accessi, non obstante invaletudine mea, cum Cœlum fere undeq; esset serenum, nisi quod circa Horizontem, ubi Luna atq; Jupiter exoriri debebant, vapores quidam atq; nubeculæ existerent. Inprimis ex eo maximopere fui excitatus, quod hujus generis Observationes, Occultationes nempe Jovis admodum raro contingant, sed adhuc rarius ex voto observentur. Me quod attinet, scias, mi Lector, etiamsi hucusq; per 56 annos Rebus Cœlestibus pro meo modulo operam dederim, atq; nullam Observationem alicujus momenti, (absit gloriola) lubens neglexerim, haud feliciorem fuisse quam quod in hunc usq; diem spatio 50 circiter annorum, non nisi tres tales Jovis Eclipses rite deprehendere & annotare potuerim: utpote primam Anno 1646, die 24 Decemb. vesperi, sed tantummodo ejus finem: secundam, Anno 1679, die 5 Junii ante meridiem de die, quo tempore res omnis felicius successit; tertiam hoc Anno currente 1686 die 10 April. vesperi.

Quam Observationem, mi Astrophile, prout peragi potuit, a me nunc benevole accipias, rogo. Quæ vero obtenta, atq; annotata fuerunt, ex subsequente Tabella & Observationis Typo patebunt. Omnium primo nonnullas Altitudines Solis, & Arcturi 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, ea ratione, qua tum licuit meliori. Inter alia autem notandum occurrit, quod hæcce Occultatio non Luna omnino exiſtente plena, ſed altera die circiter poſt ipſum Plenilunium veſperi acciderit; & quidem eodem tempore (quod permirum ſane accidit, & eſt caſus, qualis haud facile unquam continget) eademq; facie, ut illa Occultatio Anni 1646 die 24 Decemb. veſperi viſa eſt; quo tempore Luna jam ad biduum pariter decreverat, & ſine dubio eandem Librationem etiam exhibuit, quam in hac noſtra ultima Obſervatione. Nam Sectio Luminis atq; umbræ plane fuit eadem, & per eaſdem maculas tranſiit (quod ſatis admirari nequeo) nimirum ad Lacum Hyperboreum majorem & minorem, tum ad montes Riphæos, per paludem Mæotidem, per Lacum majorem maris Caſpii, & ſinum ejus inferiorem ad Montem Neroſum.

E contrario, Jovis Occultatio Anno 1679 a me habita, plane extitit diverſa, ſiquidem illa non circa Plenilunium, ſed Novilunium accidit, tertia circiter die ante Conjunctionem ipſam, adeo ut phaſis tantummodo parvula decreſcens conſpecta ſit, inſtar Phaſeos meæ Lunæ cornutæ decreſcentis, ſub Numero 37, in mea Selenographia, *pag.* 402 conſpicuæ: tranſibat enim per ſinum Apollinis, per loca paludoſa Inſulæ Cercinnæ, Mare Syrticum, Montem Cataractes, & partem inferiorem Sin. Sirbonis, montemq; Lion: prout ex ipſo ſchemate dictæ Occultationis An. 1679, in Anno meo Climacterico *pag.* 38. clare liquet.

Poſtquam itaq; initio, ut ſupra dicebam, nonnullas Diſtantias Jovis a limbo Lunæ Orientali ceperam, atq; Jupiter magis magiſq; Lunæ appropinquaret, omni diligentia invigilavi, ut non ſolum quam accuratiſſime ipſum momentum temporis annotarem, quando Jupiter prius Limbo ſuo occiduo limbum Lunæ orientalem attingeret, ſed etiam quando dimidius, nec non quando omnino totus eſſet tectus. Hæc etenim recte ſcire Aſtronomiæ plurimum intereſt; præſer-

tim, cum a nemine Obſervatorum hucuſq; nondum, quantum ſciem, adhuc ſit deprehenſa. 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 primæ apparitionis Jovis occaſum verſus, ad Sectionem Luminis & Umbræ, nec non cum dimidius, ut & totus appareret, exactiſſime deprehendere potuerim. His acquiſitis Diametrum Lunæ optimo Micrometro, atq; Teleſcopio duodecim circiter pedum inveſtigavi, pariter unam aut alteram Jovis Diſtantiam a confinio Lucis & umbræ, 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 nonnulla bene notanda me conferam.

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

Horologi. ambulator. H. M. S.		*Altitudines Quadrante captæ.* Gr. M. S.	*Tempus ex Altitud. correctum.* H. M. S.
5 10 10	Altitudo Solis.	13 47 0	5 11 43
5 12 30	Altitudo Solis.	13 28 0	5 13 55
5 17 40	Altitudo Solis.	12 41 0	5 19 21
5 23 50	Altitudo Solis.	11 46 0	5 25 43
8 7 10	Altitudo Arcturi.	29 55 0	8 12 50
8 11 15	Altitudo Arcturi.	30 32 0	8 17 4
8 15 10	Altitudo Arcturi.	30 59 0	8 20 51
	Luna oritur circit.		9 24 0
9 44 50	Jupiter ob nubes & vapores citius haud conſpectus; diſtabat tum ab Ins. Cercinna 43 circit. minut.		9 52 50

Jovis

H.	M.	S.					H.	M.	S.
10	21	30	Jovis distantia erat tanta, quanta distantia M. Sinai a Palude Maræotide.				10	31	30
10	40	35	Jovis distantia erat fere æqualis distantiæ inter M. Ætnam & M. Porphyritem.				10	51	5
10	51	30	Jovis limbus a ☽ limbo distabat tanto interstitio, quanto Pal. Maræotis a limbo ☽				11	2	0
10	56	9	♃ limbo suo tangere incipiebat Lunæ limbum, atq; sic initium Occultationis				11	7	9
10	56	54	Dimidius Jupiter occultabatur. (accidit.				11	7	54
10	57	39	Totus Jupiter omnino a ☽ tectus.				11	8	39
11	8	31	Occultatio Comitis Jovis ultimi ad M. Alabastrinum accidit. Duo tantummodo Comites a parte orientali conspecti sunt.						
11	15	44	Altitudo Lyræ.	32	59	0	11	26	0
11	19	0	Insula Besbicus & Rhodus reperiebantur sub eodem perpendiculo; id quod ad 35gr. circ. a Linea ☽ verticali re-						
11	21	37	Altitudo Lyræ. (movebatur.	33	50	0	11	32	15
11	24	57	Altitudo Lyræ.	34	24	0	11	36	24
11	38	15	Emersionis initium Jovis.				11	49	15
11	39	0	Dimidius Jupiter emergebat.				11	50	0
11	39	45	Totus Jupiter apparebat.				11	50	45
			Diameter Lunæ Micrometro observata erat 31*m.* 0*s.*						
11	54	10	Distantia Jovis a confinio Lucis & Umbræ ☽ erat æqualis distantiæ M. Ætnæ a M. Porphyrite.				12	5	40
11	57	20	Distantia Jovis a confinio Lucis & Umbræ elongabatur intervallo inter Insulam Besbic. & M. Ætnam. Et comes ♃ remotissimus a Jove tantum aberat, quantum ipse comes a dicto confinio Lucis.				12	9	20
12	6	9	Altitudo Lyræ.	40	19	0	12	18	39
12	9	18	Eadem Altitudo denuo.	40	46	0	12	21	49
12	13	20	Altitudo Lunæ.	16	15	0			

Primo liquidum eſt ex ipſa Obſervatione & occultationis Schemate, quod orbita, ſeu Linea Jovis itineraria, per Montem Alabaſtrinum, per M. Chriſti, M. Carpathes, infra M. Macrocemnios, & per Lacum Hyperborium inferiorem inceſſerit. Secundo, quod Inſula Besbica & Inſula *Rhodus* ſub uno eodemq; perpendiculo, tempore occultationis, hora circiter 11*m.* 30 extiterit; ſic ut 35 gradus Lunæ limbi culminaverit. Intravit itaq; Jupiter limbum Lunæ illuminatum circa 61 gradum, a linea ſcilicet perpendiculari Nonageſimi atq; puncto Zenith, ortum verſus; exivit vero circa 31 gradum a dicta linea perpendiculari Nonageſimi occaſum verſus, ad limbum Lunæ obſcuratum. Proinde Linea Jovis itineraria fuit ſubtenſa 104 fere graduum, attenta videlicet parte Lunæ Boreali.

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

Et tantæ Magnitudinis extitit etiam Diameter Jovis 50 circiter ſecund. quoties illam per maculas Lunæ dimenſus ſum: uti ex parte ſecunda Machinæ noſtræ cœleſtis ſuo loco patet. Quod autem Anno 1679. die 5 Jun. cum ſimilem Jovis Eclipſim obſervarem, longe ea extiterit minor, nimirum tantum 30*m.* 53*ſ.* Id ex eo eveniſſe puto, quod Obſervatio illa, tempore diurno, ſplendente Sole fuerit obſervata; quo radii Stellarum & Planetarum adventitii magis a Luce Solis abſterguntur, quam tempore nocturno, nocte obſcura. Quod ſi autem quæras, quamnam Diametrum 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 adventitii

titii magis obſtent, ſicuti diximus, quam tempore diurno. An vero recte Judicium meum expono, futuræ Obſervationes, dummodo accuratiſſime peragentur, docebunt.

Poſtremo Corollarii loco, adhuc adjiciam Tabellam, calculum 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 & ipſo cœlo dictæ Tabulæ diſcedunt. Invenies non tantum in plurimis integris Minutis, ſed ad ſemihoram, imo integram nonnullas a vero exorbitare; ſic ut Rerum Cœleſtium Cultores abunde adhuc habeant, quod quærant, caſtigant.

Calculus ad Horizontem Gedanenſem.

Gedani.	*Ex Obſerv.* H. M. S.	*Ex Keple.* H. M. S.	*Ex Lanſb.* H. M. *S.*	*Ex Bulli.* H. M. S.	*Ex Riccio.* H. M. S.	*Ex Wingio* H. M. S.
Initium.	11 7 9	10 31 5	12 15 25	10 38 21	10 47 9	10 18 4
Immerſio.	11 8 39	10 33 17	12 18 46	10 40 41	10 49 41	10 18 8
Emerſio.	11 49 15	11 17 45	13 1 26	11 21 43	11 47 13	11 23 20
Finis.	11 50 45	11 19 57	13 4 47	11 24 3	11 49 45	11 23 24
Duratio.	0 42 6	0 48 52	0 49 22	0 45 42	1 2 36	1 5 20
Semid.).	0 15 30	0 16 12	0 17 52	0 16 52	0 16 13	0 16 32

Quibus finio, & Te, Benigne Aſtrophile, bene valere jubeo, rogans, ut qualem qualem hancce Obſervatiunculam boni conſulas, donec quædam præſtantiora in Lucem prodeant. &c.

PRiuſquam haſce literas obſignarem, in manus meas inciderunt paucula illa, quæ de conjunctione Lunæ & Jovis poſteriori, die 8 Maj. *St. N.* mane, a me fuerunt annotata. Idcirco & ea volui, licet nullius ſint ponderis, vobis communicare.

Pri-

Primo, obſervata eſt Altitudo Arcturi, 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.

Secun. Horolog ambul.	Occultatio Jovis quæ accidere debuit Dantiſci *Anno* 1686. die 8 Maji. *St. N.* mane.		*Tempus Correct.*
H. M. S.		*gr. m. ſ.*	H. M. S.
3 23 20	Altitudo Arcturi.	31 16 0	3 20 12
3 24 25	Eadem Altitudo.	31 4 0	3 21 35
3 44 30	Jupiter a limbo ☽ diſtabat majori adhuc intervallo quam *M.* Sinai a *M.* Ætna.		3 41 30
3 47 0	Jovis diſtantia erat tanta, quanta *M.* Porphyritidis a *Byzantio.*		3 44 0
3 52 0	Jovis a limbo Lunæ diſtantia erat æqualis diſtantiæ Inſulæ Sardiniæ & Paludis Maræotidis.		3 49 0
3 59 0	Jupiter a limbo Lunæ paulo plus diſtabat quam Pal. Maræotis ab Ætna.		3 56 0
4 16 40	Diſtantia Jovis a limbo Lunæ æquabatur fere Diſtantiæ M. Porphyritidis ab Inſula Cercinna.		4 13 40
	Planetarum Occaſus factus eſt.		4 17 0

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

JOHANNES HEVELIUS.

An account of a Book. *Methodus Figurarum lineis rectis & curvis comprehensarum quadraturas determinandi Autnore* J. Craige. 4to. Londini 1685.

THE great use of drawing the Tangents of Curve Lines, has made the most famous amongst the Modern Mathematicians endeavour 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, Slusius*, Dr. *Barrow*, Dr. *Wallis, Tschurnehuys*, and *Leibnitius*; 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 determinating the Quadrature of any Curvilinear space, has laid down a rule for inverting *Slusius* his method mentioned in the *Philosophick Transactions Num.* 90. He has illustrated his Method of Quadratures by several Figures which have been already considered by Geometers. As for the Circle & Hyperbola, he asserts that their indefinite Quadratures are impossible, and therfore 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 termes, for in these he has recourse to *Leibnitius* 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 Greg ry* relates in his Treatise. He has subjoyned 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 *Quadratrices*, published in the *Acta Lipsiensia Eruditorum* of *October*, 168 .

Since the Publication of this Treatise, the Author is pleased to make the following Addition.

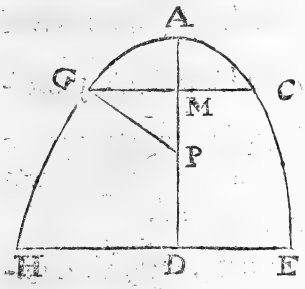
Additio ad Methodum Figurarum Quadraturas Determinandi. Autore *Johanne Craige.*

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

Poſtquam expreſſio data per y *multiplicatur, appendantur omnes termini qui ſub maximo continentur (Terminorum magnitudinem e dimenſionibus quantitatis* y *menſurans) & connectantur ſigno affirmativo vel negativo, prout libuerit; adæquentur omnes illi termini (prius in coefficientes incognitas multiplicati) Quadrato quantitatis per* x *deſignatæ: eritq; inde reſultans æquatio quæſita, vel quæſitam includet; & determinationes coefficientium terminos æquationem conſtituentes a reliquis diſtinguent.*

Sit

Sit in appoſito ſchemate abſciſſa AM=y, *ordinata* MC=z, *& Curvæ* ACE *proprietas* $z^2=\frac{a^2y^2+y^4}{p^2}$, *& invenienda ſit quadratura Areæ a lineis rectis & illa Curva comprehenſæ. Quærenda eſt alia Curva* A G H, *in qua* P M= $\sqrt{\frac{a^2y^2+y^4}{p^2}}=z$; *ubi* P G *Curvæ quæſitæ perpendicularem, &* MG=x *illius ordinatam denotat. Cumq; hæc expreſſio lineæ* PM *in* y *multiplicata contineat ſextam quantitatis* y *dimenſionem, ideo appono omnes terminos ſub illa ſexta dimenſione contentos, unde reſultans æquatio eſt.*



$$\frac{na^6+ma^5y+la^4y^2+ha^3y^3+ka^2y^4+gay^5+fy^6}{p^2}=x^4.$$

Ex hac æquatione invenio valorem Lineæ P M. *quem compa-ro cum valore dato, unde*

$$PM=\frac{ma^5+3la^4y+3ha^3y^2+4ka^2y^3+5gay^4+6fy^5}{4p\sqrt{na^6+ma^5y+la^4y^2+ha^3y^3+ka^2y^4+gay^5+fy^6}}=\sqrt{\frac{a^2y^2+y^4}{pp}}.$$

auferantur fractiones & Signa radicalia, & determinentur coefficientes n, m, l &c: *(ut in* prob: 2 *tractatus noſtri) rejectis iis quarum determinationes abſurdum involvunt: & cæteræ, in quibus nihil tale contingit, æquationem conſtituent. Sic in exemplo propoſito, erit* $f=\frac{4}{9}$, $k=\frac{12}{9}$, $l=\frac{12}{9}$, $n=\frac{4}{9}$. *ſed dum* g *determino, invenio* 24g=144g, *quod abſurdum involvit; & ſic pro* h *comparatio erit* 6h=6h *unde nullus illius valor, & pro* m *erit* 48m=144m, *quod itidem eſt abſurdum: quapropter termini a quantitatibus* g, h, m *affecti ad æquationem non pertinebunt; unde reliqui a literis* n, l, k, f *affecti æquationem naturam Curvæ definientem conſtituent. ſc.* $\frac{4a^6+12a^4y^2+12a^2y^4+4y^6}{9p^2}=x^4$,

$=x4$, *adeoq*; $AMC=\sqrt{\frac{a6+3a4y2+3a2y4+y6}{6p2}}=\frac{x2}{2}$. *Exem.* 2

Sit Curvæ Lineæ A C E *talis proprietas* $z2=\frac{qy2+y3}{q}$ *& inveniendæ sit Quadratura spatii* A M C. *Quærenda est Curva* AGH *in qua sit* $PM=\sqrt{\frac{qy2+y3}{p}}=Z$ *& quoniam hic valor in* y *multiplicatus continet quintam quantitatis* y *dimensionem, apponantur omnes termini sub illa quinta dimensione, & æquentur quadrato quantitatis per* x *designatæ; unde æquatio resultans est.*

$\frac{nq5+mq4y+lq3y2+kq\ y3+hqy4+fy5}{p}=x4$. *atq; sola coefficientis* (m) *determinatio absurdum involvet, eruntq; reliquæ,* $n=\frac{64}{225}$, $l=-\frac{16}{15}$, $k=-\frac{16}{45}$, $h=\frac{16}{15}$, $f=\frac{16}{25}$, *unde æquatio curvam quæsitam definiens est.*

$\frac{64q5}{225p}-\frac{16q3y2}{15p}-\frac{16q2y3}{45p}+\frac{16qy4}{15p}+\frac{16y5}{25p}=x4$ *adeoq;*

$AMC=\sqrt{\frac{16q5}{225p}-\frac{4q3y2}{15p}-\frac{4q2y3}{45p}+\frac{4qy4}{15p}+\frac{4y5}{25p}}=\frac{xx}{2}$

Exem. 3. *Inuenienda sit Quadratura spatii* AMC, *definita natura Curvæ* ACE *hac Æquatione* $z2=\frac{3a}{4y+4a}$. *Quæratur alia Curva* AGH, *in qua* $PM=\sqrt{\frac{a3}{4y+4a}}=z$. *Ex præmissis constat Æquationem primam fore* $\frac{na3y2+ma4y+16a5}{4a+4y}=4x$ *& determinationes Coefficientium* $n=16$, $m=32$, $l=16$. *Quibus substitutis, erit æquatio* $\frac{16a3y2+32a\ y+16a5}{4y+4a}=x4$ $=a2y+4a4$: *adeoq;* $AMC=\sqrt{a3y+a}=\frac{1}{2}x2$.

Notatu dignissimum est, has tres (sicut infinitas alias) Quadraturas abscissæ AM (*seu* y) *non convenire. Quoniam in istiusmodi*

modi Figuris, ſimpliciſſima Areæ expreſſio huic portioni non reſpondet: attamen Quadratura abſciſſæ conveniens exinde parvo labore deducitur. Ut in Exem: 3. *ubi Area eſt* $\sqrt{a3y+a4}$; *fiat* $y=0$, *& erit Area* $\sqrt{a4}=a2$, *& ſubducatur hæc ex generali, proveniet Quadratura portionis abſciſſæ reſpondentis, ſc.* $\sqrt{a3y+a4}-a2$. *Quam obſervatiunculam mihi primus ſignificavit Vir celeberrimus D. Iſaacus Newton.*

Tentetur jam idem proceſſus in Circulo ACE, *cujus diameter ſit* r, *ac proinde* $Z=\sqrt{ry-y2}$, *Quærenda eſt Curva* AGH *in qua* $PM=\sqrt{ry-y2}=z$, *ſed ex dictis conſtat æquationem primam fore* $nr4+mr3y+lr2y2+hry3-ky4=x4$: *& ſingulæ coefficientium determinationes erunt impoſſibiles; adeoq; nulla datur Curva* AGH *in qua* $PM=\sqrt{ry-y2}$, *ac proinde Circuli Quadratura indefinita eſt impoſſibilis. Fieri tamen poteſt ut ſit aliqua hujuſmodi Curva* AGH, *ſed ex earum numero, quas poſt* Carteſium *Mechanicas Geometræ communiter appellant: ſed quia harum uſus non libenter admittunt Mathematici, præſtat hujuſmodi Quadraturas per ſeries infinitas exhibere.*

Benevole Lector

Ob inopiam Typorum Numeralium minuſculorum, qui ad deſignandas quantitatum poteſtates ſupra Symbola dextrorſum apponi ſolent, feſtinante prælo, Typographus paulo majoribus uſus eſt in eadem linea immediate ſequentibus; ubicunq; itaq; offenderis a3, *vel* x2, *&c. cubum vel quadratum, &c. e quantitate, cui ſuffigitur numerus, intelligas.*

LONDON,

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PHILOSOPHICAL TRANSACTIONS.

For the Month of *October*, 1686.

THE CONTENTS.

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 thereupon.*

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 Custome-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 it's 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 *Phænomenon* seems to be, that the Impulse of the Ocean in the Quarter Moons is not so Vigorous as in the New and Full; nor the Motion of the Waters so quick: (as is evident by dayly 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

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contrary, in Rivers, at any conſiderable diſtance from the Sea, the reſiſtance of the weight of the freſh Water, which is kept ſuſpended during the time of the Flood, is longer overcome by the more potent *Impetus* in the New and Full, than by the weaker in the Quadratures: and from hence this difference ſhould be ſtill more and more conſiderable as the Port is farther removed from the Sea.

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 Knowledg, 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 25*th.* 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 ſerue 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 layd upon it. It is plain therefore that the weight bearing upon a large ſpace doth not preſs euery 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: moreouer, the water it ſelf being heauy in the Bladder, makes ſome preſſure: ſo

that it appears, that the preſſure in this experiment was not quite ſo great vpon the Air as vpon the water: I haue 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 vpon this *Hydroſtatical Principle, that liquors haue a ſtrength to aſcend as high as their ſource is*; and although the reſiſtence of the *Medium* doth always hinder *Iets d'eau* in the open Air from reaching quite ſo high, neuertheleſs 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 heigths will be reciprocally in the ſame reaſon as their ſpecifick gravity's are. Thus, Quickſiluer being 13 times and a half heauier than water, bears as much preſſure when its ſpring is one foot aboue the ſpout hole, as water doth when it's ſpring is 13 foot and a half high, and the heigth to which Mercury ſhall aſcend will be 13 times and a half leſſer than the heigth 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 bareing 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 Grauity's of the ſayd liquor's

For we haue ſeen *Prop.* 1. that the heigth's to be attain'd are in the ſame reaſon as the ſpecifick grauity's; Now *Galilæus*, *Hugenius*, and others haue demonſtrated that the Velo-

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city's of bodies are to one another as the ſquare roots of th heigths to which they may aſcend: and ſo in this occaſion they are alſo as the roots of the ſpecifick Grauity's.

If therefore we would know what is the Velocity of Air being driven by any degree of preſſure whatſoeuer, we ought but to find what would be the velocity of water vnder the ſame preſſure: and then take the ſquare roots of the ſpecifick grauitys of theſe two liquor's; becauſe as much as the ſquare root of the ſpecifick Gravity of Water, doth exceed the ſquare Root of the ſpecifick 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 ſhott by the Pneumatick Engine, as hath been deſcribed in *Philoſophical Tranſaction, Num.* 79. I ſhould firſt compute what was the velocity of the Air it ſelf that droue 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 obſeruation 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 grauity of Air to that of Water: and we haue found it not to be always the ſame; becauſe the heigth, the heat, and the moiſture of the Atmoſphere are variable: neuertheleſs we may ſay in general that the reaſon between the ſpecifick grauitys of water and Air is much about 840 to 1. Taking then their ſquare roots, as I haue ſayd aboue, 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 13.5 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 Jupiters Satellites for the Year* 1687. *Togather with a Table of the Parallaxes of the Orb, and an Ephemeris of Jupiters* 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.* Flamsted's *own Observation of the Eclipse of Jupiter by the Moon on March* 31*th. past.*

I Give you here a Catalogue of all the Eclipses of ♃s Satellites, for the ensueing year 1687. and togather with it 2 Tables, one of his Geocentrick places, the other of the Parallaxes of his Orbit to every day in the said Year. This is the 4*th.* Catalogue I have got published in the Transactions. With the 1*st.* 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 ♃ Geocentrick places and Parallexes, the appearances of the Satellits 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 print-

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ed, he may repair to the above-mentioned Tranſactions. I ſhall only add.

That whereas for the two Years laſt paſt, the 4*th*. Satellit has not been Eclipſed. As this Year enters, it begins to fall into ♃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 Emerſion are Viſible with us, as are all thoſe in the Catalogue which are alike marked with an Aſteriſck (*) which if they ſhall be exactly obſerued, may ſerue to determine the place of the Node of the orbit of ♃s Satellits, and its Inclination to the orbit of ♃, by compareing the obſeruation either with ſuch as wee haue already obtained, or as may be made hereafter.

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

I giue you further herewith an obſeruation of the Lunar Eclipſe *Nouember* 30, 1685. made at *Lisbon* by my kind Friend Mr. *Henry Iacobs*: and another of my own of the Occultation of ♃ by the Moon, *March* the 31*th*. this Year 1686. of which you haue publiſhed ſeuerall forreign obſeruations already.

Tab.

Tabula Parallaxium *Jovis*

D	*Janua.* A G.	M.	*Febru.* A G.	M.	*Martii.* A G.	M.	*April.* A G.	M.	*Maii.* A G.	M.	*Junii.* S G.	M.	D
1	6	30	9	37	10	49	9	41	5	43	0	17	1
2	6	38	9	41	10	44	9	36	5	38	0	2	2
3	6	44	9	45	10	50	9	31	5	27	0	4	3
4	6	52	9	49	10	55	9	25	5	17	0	5	4
5	6	59	9	53	0	59	9	19	5	05	1	06	5
6	7	06	9	57	10	49	9	13	4	55	1	15	6
7	7	13	10	0	10	49	9	07	4	44	1	31	7
8	7	20	10	04	10	48	9	0	4	33	1	44	8
9	7	26	10	08	10	48	8	54	4	22	1	56	9
10	7	33	10	11	10	47	8	48	4	11	2	08	10
11	7	40	10	14	0	46	8	41	3	59	2	21	11
12	7	46	10	18	10	44	8	34	3	48	2	33	12
13	7	53	10	21	10	42	8	27	3	36	2	45	13
14	7	59	10	24	10	41	8	21	3	24	2	57	14
15	8	06	10	26	10	40	8	12	3	12	3	09	15
16	8	11	10	2	10	38	8	06	3	00	3	21	16
17	8	17	10	31	10	36	7	59	2	48	3	33	17
18	8	23	10	3	10	33	7	52	2	37	3	44	18
19	8	29	0	36	10	31	7	46	2	25	3	56	19
20	8	35	10	38	10	28	7	39	2	12	4	08	20
21	8	41	10	40	10	25	7	33	2	00	4	19	21
22	8	46	10	4	10	22	7	14	1	48	4	30	22
23	8	52	10	43	10	19	7	05	1	35	4	42	23
24	8	57	10	44	10	15	6	56	1	21	4	53	24
25	9	02	10	45	10	12	6	47	1	07	5	04	25
26	9	08	10	46	10	08	6	37	0	58	5	15	26
27	9	13	10	47	10	04	6	28	0	45	5	25	27
28	9	17	10	48	10	00	6	18	0	33	5	36	28
29	9	22			9	55	6	08	0	21	5	46	29
30	9	27			9	51	5	58	0 A	08	5	57	30
31	9	31			9	46			0 S	04			31

ad diem quemlibet Anni 1687.

D	Iulii. S G.	M.	Augu. S G.	M.	Sept. S G.	M.	Octob. S G.	M.	Novem. S G.	M.	Decem. S G.	M.	D
1	6	07	10	02	11	02	9	37	6	24	2	18	1
2	6	17	10	06	11	02	9	33	6	17	2	09	2
3	6	27	10	11	11	01	9	28	6	09	2	00	3
4	6	37	10	15	11	00	9	23	6	02	1	52	4
5	6	47	10	19	10	59	9	18	5	54	1	42	5
6	6	56	10	23	10	57	9	12	5	46	1	34	6
7	7	05	10	27	10	56	9	07	5	38	1	25	7
8	7	14	10	31	10	54	9	01	5	31	1	16	8
9	7	23	10	34	10	52	8	56	5	23	1	07	9
10	7	32	10	37	10	50	8	50	5	15	0	58	10
11	7	41	10	40	10	48	8	45	5	07	0	50	11
12	7	49	10	43	10	46	8	39	4	59	0	41	12
13	7	57	10	46	10	43	8	33	4	51	0	32	13
14	8	05	10	48	10	41	8	27	4	42	0	23	14
15	8	14	10	50	10	38	8	21	4	34	0	14	15
16	8	21	10	52	10	35	8	15	4	26	0	05	16
17	8	29	10	54	10	32	8	08	4	18	0	A04	17
18	8	36	10	56	10	29	8	02	4	09	0	13	18
19	8	44	10	57	10	26	7	55	4	01	0	22	19
20	8	51	10	59	10	23	7	49	3	53	0	31	20
21	8	58	11	00	10	19	7	42	3	44	0	40	21
22	9	05	11	01	10	15	7	36	3	36	0	48	22
23	9	11	11	02	10	11	7	29	3	27	0	57	23
24	9	28	11	03	10	08	7	22	3	19	1	06	24
25	9	24	11	03	10	04	7	15	3	10	1	15	25
26	9	30	11	04	10	00	7	08	3	01	1	24	26
27	9	35	11	04	9	56	7	01	2	53	1	33	27
28	9	4	11	04	9	51	6	54	2	44	1	42	28
29	9	46	11	04	9	47	6	46	2	35	1	51	29
30	9	5	11	04	9	42	6	39	2	27	1	59	30
31	9	57	11	03			6	32			2	08	31

Catalogus Eclipsium Comitum Jovialium ubique Terrarum Anno in-

Januarii.					Februarii.					Martii.				
D.	H.	M.			D.	H.	M.			D.	H.	M.		
1	01	27	1	i	1	02	10	3	e	1	15	04	*	i
2	09	34	2	i		17	2[illegible]	*	i		18	06	3 *	e
	19	55	1 *	i		18	2[illegible]	4 *	e	2	05	27	1	i
3	07	23	3	i		21	51	1	i	3	19	25	2	i
4	14	22	1	i	3	09	04	2	i		23	56	1	i
5	22	50	2	i		16	19	1 *	i	5	18	26	1 *	i
6	08	50	1	i	5	10	47	1	i	7	05	05	4	i
8	03	17	1	i	6	22	21	2	i		6	43		e
9	12	06	2	i	7	05	16	1	i		8	44	2	i
	21	45	1	i	8	03	08		i		12	54	1	i
10	11	18	3	i		6	08	3	e	8	19	03		i
11	16	13	1	i		23	44	1	i		22	06	3	e
13	01	23	2	i	10	11	39	2	i	9	07	22	1	i
	10	41	1	i		18	13	1 *	i	10	22	02	2	i
15	05	09	1	i	12	12	41	1	i	11	01	52	1	i
	23	53	4	pen	14	00	56	2	i	12	20	20	1	i
16	14	39	2	i		7	10	1	i	14	11	40	2	i
	23	37	1	i	15	7	06		i		14	49	1 *	i
17	15	15	3	i		10	07	3	e	15	23	03		i
	18	14	3 *	e	16	01	38	1	i	16	02	06	3	e
18	18	05	1 *	i	17	14	14	2	i		9	18	1	i
20	03	56	2	i		20	07	1	i	18	00	39	2	i
22	07	01	1	i	18	11	11		i		3	47	1	i
23	17	12	2 *	i		12	32	4	e	19	22	16	1	i
24	01	29	1	i	19	14	35	1	i	21	13	57	2 *	i
	19	12	3 *	i	21	03	32	2	i		16	44	1 *	i
	22	11		e		9	04	1	i	23	03	03		i
25	19	57	1	i	22	11	05		i		6	07	3	e
27	06	29	2	i		14	06	3	e		11	13	1	i
	14	25	1	i	23	03	33	1	i		23	02		i
29	08	54	1	i	24	16	50	2 *	i	24	0	54	4	e
30	19	47	2	i		22	01	1	i	25	3	15	2	i
31	03	22	1	i	26	16	30	1 *	i		5	42	1	i
	23	10	3	i	28	06	07	2	i	27	00	11	1	i
						10	59	1	i	28	16	34	2 *	i
											18	39	1	i
										30	07	02		i
											10	08	3	e
											13	09	1 *	i

quente 1687 visibilium, tempora Ingressuum illorum in ♃s Umbram, & ab ea Emersionum sub Meridiano Grenovicano apparentia exhibens, Juxta Calculum *Jo. Flamstedii* Math. Reg. & R. S. S.

Aprilis.					Maii.					Junii.				
D.	H.	M.			D.	H.	M.			D.	H.	M.		
1	05	52	2	i	1	09	44	1	i	2	03	30	1	e
	7	37	1	i	3	04	13	1	i		21	59	3	e
3	02	06	1	i		5	33	2	i	4	02	58	1	e
4	19	10	2	i	4	22	41	1	i		7	54	2	e
	20	35	1	i	5	02	58	3	i	5	21	27	1	e
6	11	02		i	6	17	10	1	i	7	15	55	1	e
	14	08	*	e		18	50	2	i		21	12	2	e
	15	04	1	* i	8	11	33		* i	9	10	23		* e
8	08	28	2	i	10	6	06	1	i	10	01	57	3	e
	9	33		i		7	07	2	i	11	04	51	1	e
9	17	00	*	i	12	00	35	1	i		10	29	2	* e
	19	04		e		6	56	3	i	12	23	20	1	e
10	04	01	1	i	13	4	53		i	14	17	48		e
11	21	46	2	i		6	17	4	e		23	45	2	e
	22	30	1	i		19	03	1	i	15	16	41	4	i
13	15	02	3	* i		21	24	2	i		19	57		e
	16	57	1	i	15	13	31	1	* i	16	12	16	1	* e
	18	08	3	e	17	08	00	1	i	17	05	55	3	e
15	11	04	2	i		10	42	2	* i	18	06	44	1	e
	11	27	1	i	19	02	28	1	i		13	03	2	* e
17	05	56	1	i		10	54	3	* i	20	01	13	1	e
19	00	22	2	i	20	20	56	1	i	21	19	41	1	e
	0	25	1	i		23	59	2	i	22	02	21	2	e
20	18	54	1	i	22	15	24	1	* i	23	14	10	1	* e
	19	01	3	i	24	09	53	1	* i	24	09	54	3	* e
22	13	23	1	* i		13	16	2	* i	25	08	38	1	* e
	13	40	2	* i	26	04	21	1	i		15	38	2	e
24	07	50	1	i		14	51	3	* i	27	03	07	1	e
26	02	19	1	i	27	22	49	1	i	28	21	34	1	e
	2	57	2	i	28	02	33	2	i	29	04	55	2	e
	10	56		* i	29	17	17	1	i	30	16	03	1	e
	13	12	4	* e	8 ⊙	22	46	4	i					
27	20	47	1	i	30	01	24		e					
	23	00	3	i	31	14	02	1	* e					
29	15	1	2	* i		18	36	2	e					
	15	16	1	* i										

Julii.					Augusti.					Septemb.				
D.	H.	M.			D.	H.	M.			D.	H.	M.		
1	13	53	3	e	1	12	42	1	e	1	04	33	2	e
2	10	32	1	e	3	07	11	1	e	2	09	29	1 *	e
	10	38	4 *	i		17	58	2	e	3	22	48	3	i
	13	32	4	e	4	22	40	4	i	4	02	07	3	e
	18	13	2	e	5	1	40	1	e		3	59	1	e
4	05	00	1	e		1	52	4	e		17	53	2	e
5	23	29	1	e	6	06	40	3	i	5	22	28	1	e
6	07	32	2	e		9	56	3 *	e	7	10	55	4	i
7	17	57	1	e		20	09	1	e		14	21	4	e
8	17	52	3	e	7	07	17	2	e		16	58	1	e
9	12	26	1 *	e	8	14	38	1	e	8	07	13	2 *	e
	20	59	2	e	10	09	07	1 *	e	9	11	27	1	e
11	06	55	1	e		20	37	2	e	11	02	51	3	i
13	01	23	1	e	12	03	37	1	e		5	57	1	e
	10	07	2 *	e	13	10	42	3	i		6	10	3 *	e
14	19	52	1	e		13	58	3	i		20	32	2	e
15	18	38	3	i		22	06	1	e	13	00	2	1	e
	21	52	3	e	14	09	56	2 *	e	14	18	5	1	e
16	14	21	1	e	15	16	35	1	e	15	09	52	2	e
	23	25	2	e	17	11	05	1	e	16	13	25	1	e
18	08	50	1	e		23	15	2	e	18	06	54	3 *	i
19	04	38	4	i	19	05	34	1	e		7	54	1 *	e
	7	40	4	e	20	14	44	3	i		10	13	3	e
20	03	19	1	e		18	01	3	e		23	12	2	e
	12	43	2	e	21	00	03	1	e	20	02	24	1	e
21	21	47	1	e		12	35	2	e	21	20	54	1	e
22	22	38	3	i		16	47	4	i	22	12	31	2	e
23	01	53	3	e		20	05	4	e	23	15	23	1	e
	16	16	1	e	22	18	33	1	e	24	05	03	4	i
24	02	02	2	e	24	13	02	1	e		8	37	4	e
25	10	45	1 *	e	25	01	54	2	e	25	09	52	1	e
27	05	14	1	e	26	07	32	1 *	e		10	56	3	i
	15	21	2	e	27	18	46	3	i		14	16	3	e
28	23	43	1	e		22	03	3	e	26	01	51	2	e
30	02	39	3	i	28	02	01	1	e	27	04	22	1	e
	05	54	3	e		15	14	2	e	28	22	51	1	e
	18	12	1	e	29	20	31	1	e	29	15	10	2	e
31	04	39	2	e	31	15	00	1	e	30	17	20	1	e

Octobris.					Novembr.					Decembre.		
D.	H.	M.			D.	H.	M.			D.	H.	M.
2	11	49	1	e	1	14	01	1	e			
	14	58	3	i	3	08	26	1	e			
	18	18	3	e	4	04	15	2*	e			
3	04	29	2	e	5	02	58	1	e			
4	06	19	1	*e	6	21	26	1	e			
6	00	48	1	e	7	14	21	3	e			
	17	48	2	e		17	32	2	e			
7	19	17	1	e	8	15	54	1	e			
9	13	46	1	e	10	10	23	1	e			
	18	59	3	i	11	06	50	2	e			
	22	20	3	e	12	04	51	1	e			
10	07	07	2	*e	13	11	15	4	i			
	23	11	4	i		15	04	4	e			
11	02	49	4	e		23	19	1	e			
	8	15	1	e	14	20	07	2	e			
13	02	44	1	e		18	20	3	e			
	20	26	2	e	15	17	47	1	e			
14	21	13	1	e	17	12	15	1	e	*Toto Decembre*		
16	15	42	1	e	18	09	24	2	e	Jupiter *latet*		
	23	00	3	i	19	06	43	1	e	*sub Radiis*		
17	02	22	3	e	21	01	12	1	e	*Solis.*		
	9	45	2	e		22	17	3	e			
18	10	11	1	e		22	40	2	e			
20	04	40	1	*e	22	19	39	1	e			
	23	03	2	e	24	14	07	1	e			
21	23	09	1	e	25	11	57	2	e			
23	17	37	1	e	26	08	35	1	e			
24	06	23	3	e	28	03	03	1	e			
	12	21	2	e	29	01	13	2	e			
25	12	06	1	e		2	14	3	e			
27	06	35	1	e		21	30	1	e			
	17	13	4	i	30	05	04	4	i			
	20	59	4	e		9	00	4	e			
28	01	39	2	e								
29	01	03	1	e								
30	19	32	1	e								
31	10	22	3	e								
	14	57	2	e								

Jovis loca Geocenrica

	Janu. ♐ G.	M.	*Febru.* ♑ G.	M.	*March.* ♑ G.	M.	*April.* ♒ G.	M.	*May.* ♓ G.	M.	*June.* ♈ G.	M.	
1	13	46	19	19	22	46	24	07	22	39	19	05	1
2	13	58	19	29	22	51	24	07	22	34	18	57	2
3	14	10	19	38	22	57	24	07	22	28	18	49	3
4	14	22	19	47	23	02	24	06	22	22	18	42	4
5	14	34	19	55	23	06	24	05	22	16	18	34	5
6	14	45	20	04	23	11	24	04	22	10	18	27	6
7	14	57	20	12	23	15	24	03	22	04	18	19	7
8	15	09	20	21	23	20	24	01	21	58	18	11	8
9	15	20	20	29	23	24	23	59	21	52	18	04	9
10	15	32	20	38	23	27	23	58	21	45	17	56	10
11	15	43	20	46	23	31	23	56	21	39	17	48	11
12	15	54	20	54	23	35	23	54	21	32	17	41	12
13	16	06	21	01	23	38	23	51	21	25	17	34	13
14	16	16	21	09	23	41	23	49	21	18	17	27	14
15	16	27	21	17	23	44	23	46	21	11	17	20	15
16	16	38	21	24	23	47	23	43	21	04	17	13	16
17	16	49	21	31	23	50	23	40	20	57	17	06	17
18	17	00	21	38	23	52	23	37	20	50	16	59	18
19	17	10	21	45	23	55	23	33	20	43	16	52	19
20	17	21	21	52	23	57	23	30	20	35	16	46	20
21	17	32	21	59	23	59	23	26	20	28	16	39	21
22	17	42	22	05	24	00	23	22	20	20	16	33	22
23	17	52	22	12	24	02	23	18	20	14	16	26	23
24	18	02	22	18	24	03	23	14	20	06	16	20	24
25	18	12	22	24	24	04	23	09	19	58	16	14	25
26	18	23	22	30	24	05	23	04	19	50	16	08	26
27	18	33	22	35	24	06	23	00	19	43	16	02	27
28	18	42	22	41	24	07	22	56	19	35	15	56	28
29	18	51			24	07	22	50	19	28	15	51	29
30	19	0			24	08	22	4	19	20	15	44	30
31	19	10			24	08			19	12			31

in diem quemlibet *Anni.* 1687.

D	*Julii.* ♑ G.	M.	*Augusti.* ♒ G.	M.	*Septem.* ♓ G.	M.	*Octob.* ♈ G.	M.	*Novem.* ♉ G.	M.	*Dece.* ♍ G.	M.	D
1	15	40	14 D	17	15	47	19	40	25	27	2	02	1
2	15	34	14	17	15	53	19	50	25	39	2	16	2
3	15	29	14	17	15	59	19	59	25	51	2	29	3
4	15	24	14	17	16	05	20	10	26	04	2	43	4
5	15	20	14	18	16	11	20	20	26	17	2	57	5
6	15	15	14	19	16	17	20	30	26	29	3	11	6
7	15	11	14	21	16	24	20	40	26	42	3	25	7
8	15	07	14	22	16	30	20	51	26	55	3	38	8
9	15	03	14	23	16	37	21	01	27	08	3	52	9
10	14	59	14	25	16	44	21	12	27	21	4	06	10
11	14	55	14	27	16	50	21	23	27	34	4	20	11
12	14	51	14	29	16	58	21	34	27	47	4	34	12
13	14	48	14	31	17	07	21	44	28	00	4	48	13
14	14	45	14	34	17	14	22	55	28	13	5	02	14
15	14	42	14	36	17	21	22	06	28	26	5	16	15
16	14	39	14	39	17	28	22	17	28	39	5	29	16
17	14	36	14	42	17	36	22	28	28	53	5	42	17
18	14	33	14	45	17	44	22	40	29	06	5	57	18
19	14	31	14	49	17	53	22	52	29	19	6	11	19
20	14	28	14	52	18	01	23	03	29	33	6	25	20
21	14	26	14	56	18	09	23	14	29	46	6	39	21
22	14	25	15	00	18	18	23	26	29	59	6	53	22
23	14	23	15	04	18	27	23	37	0 ♍	13	7	07	23
24	14	21	15	08	18	35	23	49	0	26	7	21	24
25	14	20	15	12	18	44	24	01	0	40	7	35	25
26	14	19	15	17	18	53	24	13	0	53	7	48	26
27	14	18	15	21	19	02	24	25	1	07	8	02	27
28	14	17	15	26	19	12	24	37	1	21	8	18	28
29	14	17	15	31	19	21	24	50	1	34	8	30	29
30	14	17	15	37	19	31	25	02	1	48	8	44	30
31	14	17	15	42			25	14			8	58	31

Defectus Lunaris Ulissipponæ a Do. Jacobeo Observatus Nov: 30. 1686.

	H.	M.
Initium	8	02
Immersio	9	06
Emersio	10	50
Finis	11	57

Jovis a Luna tecti Observationes Grenovici habitæ a Jo. Flamsteedio *Math. Reg. Martii* 31. 1686.

	Temp. corr per hor. oscil H. M. S.	
Martii 31 ♀	9. 32. 30	♃ *s limbus tangebat limbum Lunæ lucidum, Mæotidis diametrum a termino ejus boreo.*
	33. 42	♃ *Totus tectus erat. Quantum per vapores horizontis & undulationem limbi valde turbidam, licuit conjicere.*
	10. 11. 12	*Differentia declinationum limbi Lunæ vere Australini & loci Ingressus, Tubo ped.* 8 *& Micrometro* 1546 = 12 *m.* 42 *sec.*
	30. 30	*Jovis particula emerserat, e regione Borealis limbi Mæotidis.*
	31. 36	*Jupiter totus liber.*
	35. 50	*Differentia declinationum centri Jovis, & limbi Lunæ Australini* 3456 = 28 *m.* 15 *s.*
	41. 40	*Repet.* 3585 = 29 *m.* 28 *s.*
	44. 00	*Lunæ Diameter* 3906 = 32 *m.* 07 *s.*
	45. 44	*Repet.* 3915 = 32 *m.* 11 *s.*

Ac-

Accounts of Books. The Natural Hiſtory of Staffordſhire. *By* Robert Plott *L. L. D. Keeper of the* Aſhmolean Muſæum *and Profeſſor of Chymiſtry in the Univerſity of* Oxford.

THere 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 *Oxford-ſhire* written ſome yeares ſince by our *Author*. He begins with the Heavens and Air, giving account of thoſe unuſuall Meteors, which have ſometimes appeared in this Countrey; ſuch are the *Solar Rain-bow* obſerved by Mr. *Wolverſtan Dec.* 4. 1680. which appeared at firſt about the *Azimuth* of Two, two houres 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 Tempeſts. Here he takes an occaſion to deduce the cauſe of the circles in Graſſe called commonly *Fairy Walkes*, which he doth not think do owe their cauſe 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 leſſer 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 *R*elation 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' inferiour to thoſe in *Worceſterſhire* and *Cheſhire* by reaſon of the weakeneſſe of the Liquor, yet after a tedious proceſſe to Cryſtaliſe the Salt, become very uſeful to the whole Countrey; and laſtly, what are for Colour, or Taſt, 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: *B*ut the Coale-Workes with the Iron-Mines moſt deſerve our conſideration. 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 are thoſe of *Cannal*, with which the Choire 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 ſtagnation 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 thereby the Intervention of the upper Air is wholly ſtoppt. *Cap.* III. Be-

Before we come to the Iron-ſtones, our Author conſiders thoſe great Quarries of Marble, Alabaſter, and other uſefull 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 Alkaliſate ſalts, which compound transparent, opake, and ſemiopake ſtones, as they are mixed with ſulphures or Earths of different fineſſes. He conſiders Pebles and Fireſtones by themſelves, as wherein the Sulphur is predominant; and therefore are they eaſely Calcinable. When he comes to the Iron-workes he explaines 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 Teſtaceous Fiſhes, which have been long theught to be petrifyed ſhells, tho ſome Naturaliſts are perſwaded 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 ſpeakes of the *Entrochi* and *Trochitæ* he explaines 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-Moſſe* with Scarlat Heads, and ſome *Fungi* [tho the *Fungus Phalloides* is deſcribed, and a Cutt annexed in the 2*d*. 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 preſently uſed, gathered and kept in the Rain Water, which in time bred there a Marſh, and being buried in earth by thoſe frequent Deterrations from the adjoyning Hills, in time were ſo far covered, as we now ſee them. Some Trees he finds of wonderfull Growth in this Countrey, 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 ſett down with Atteſtations of Workmen and of Sr. *Harvey* himſelf. *Cap.* 6.

Under Brutes, our Author comprehends all irrational liueing Creatures: amongſt birds he takes notice of a Swan with Red Leggs, and a ſort of *Colymbus* or *Ducker* 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 *Eruca*, a white Earwig and ſeveral more. He found amongſt Fiſhes a *Muſtela Fluviatilis* 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; Toads haveing little blood, and very viſcous juices, require not much perſpiration. In diſcourſing of ſheep, he ſolves the Problem why the Teſticles and Horns *ſe mutuo ponunt ac tollunt*, becauſe thoſe excrementitious juices which form hair, horns & wooll are more vigorously thrown out in Males than in Females,

and

and in those when uncastrated, than when guelt; All a long, many Monsters and *Lusus naturæ* are described, and many cutt in Brasse. *Cap.* 7.

The Next Chap. is of men and women. And first he speakes of a man in *Stafford-shire* who married being 108 years of Age, and had a child extremly like him; next of a woman who had a Monstrous Birth, with a Bagg filled with *Grinder-Teeth*, and very hairy: of another woman who was brought a-bed without Knowing she was with child. [This Dr. *Plott* sayes 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 suspition 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 perswaded her she was troubled with] Then our Author speakes 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 materialy from the old Relations); *Mary Foster* who recoveringof 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 vpon a Wheel after the manner of an Overſhott Mill.So in Agriculture he examines all ſorts of Compoſt, wherewith they emprove their Ground, as Marles, Lime-ſtones, Eſſe 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 paſſes to Buildings, where he deſcribes the Cathedral at *Litchfield*, and upon account of its declination from Eaſt. towards N. he diſcourſes of the reaſons that enduced *Pagans* and *Chriſtians* to build their Temples E.&W. He curiouſly deſcribes the ſtairecaſe to the ſteeple of the Coliegiate-Church at *Tamworth*, which is made with two *Cochlea's* 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 carryed 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

th e

they lodged their Troops; as *Etoſetum*, now *Wall*, and *Pennocraſium* now *Stretton*. In the *Saxon* time we find *Litchfield* raiſed by *Wlphere* K. of the *Mercians* to the Honour of St. *Ciadda*; *Wlphere* Caſtle at *Berry-bank* has yet ſome Ruines which are viſible: *Tamworth* was K. *Offa*'s Seat; and *Wolverhampton*, or *Wulphrunes-Hampton*, called ſo from *Wulphrune* Wife to *Althelm* Duke of *Northampton* in K. *Edgar*'s Reign, was by her endowed with a Deanary and Prebends; and ſeveral *Lows* or ſepulchral Hillocks, raiſed by the *Saxons* are to be ſeen up and down, Marks of thoſe Bloody Engagements between them and the *Danes*. There are no *Daniſh* Antiquity, 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 *Norwey*. Laſtly he clears many Cuſtoms and Tenures brought in by the *Normans*, 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 *Whitchnover*, and ſeveral others. *Cap.* X.

2. *SCIOTERICUM TELESCOPICUM or a new Contrivance of adapting a Teleſcope to a Horizontall Diall, for obſerving the moment of Time by Day or Night. by* Will: Molineux *Eſq. R. S. S.* Dublin. 1686 *in* 4*to.*

THE Author dividing his Book into XI Chapters, he firſt declares the Uſe & Advantage of this new Contrivance, which he conceives ſo great, that ſince the firſt mention of Dials, he hath not heard of a more plain and eaſy addition 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 perfection, 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 comeing 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 Subſtraction 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 3*d*. 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 *Teleſcopicall 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-Joynt compoſed, is at large deſcribed in the 4*th*. 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. *Hautev ille* and *Sturmius*, ſeem to be defective. The way of ſetting the Dial to his true Poſition, is explained in the 6*th*. 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 8*th*. Chap. to the manner of obſerving the Time, after the Dial is juſtly levelled and ſtated; he ſhews it to be done by looking at the Sun through the Teleſcopick or *Stile* Ruler, and bringing the Menſurator upon the Suns Center; and then the Horizontal Ruler ſhall cut the hour, minute, and part of a mi-

nute moſt exactly in the Dial. By the ſame Teleſcopical 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 Teleſcopick-Ruler, the Horizontal-Ruler cuts the Stars horary diſtance from the Meridian, to which adding the Stars Right Aſcenſion, and from the ſum ſubſtracting the Suns 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 Suns and Stars Aſcenſions, he declareth in the *9th.* Chap. and alſo Chap 10, the Equation of Time, upon ſuppoſition of the equability of the Earths 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.

LONDON,

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N.185.

Tab. II

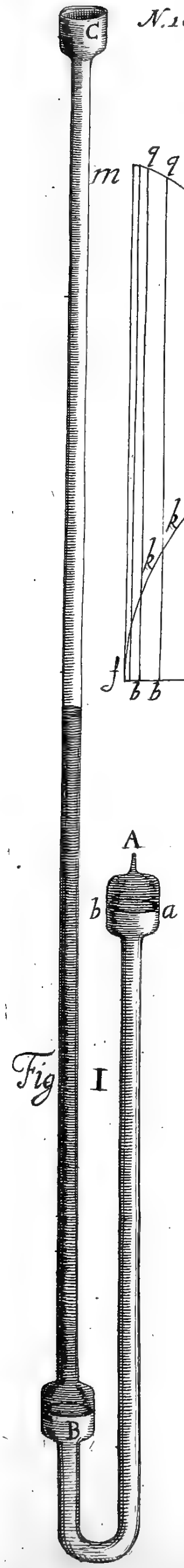


Fig I

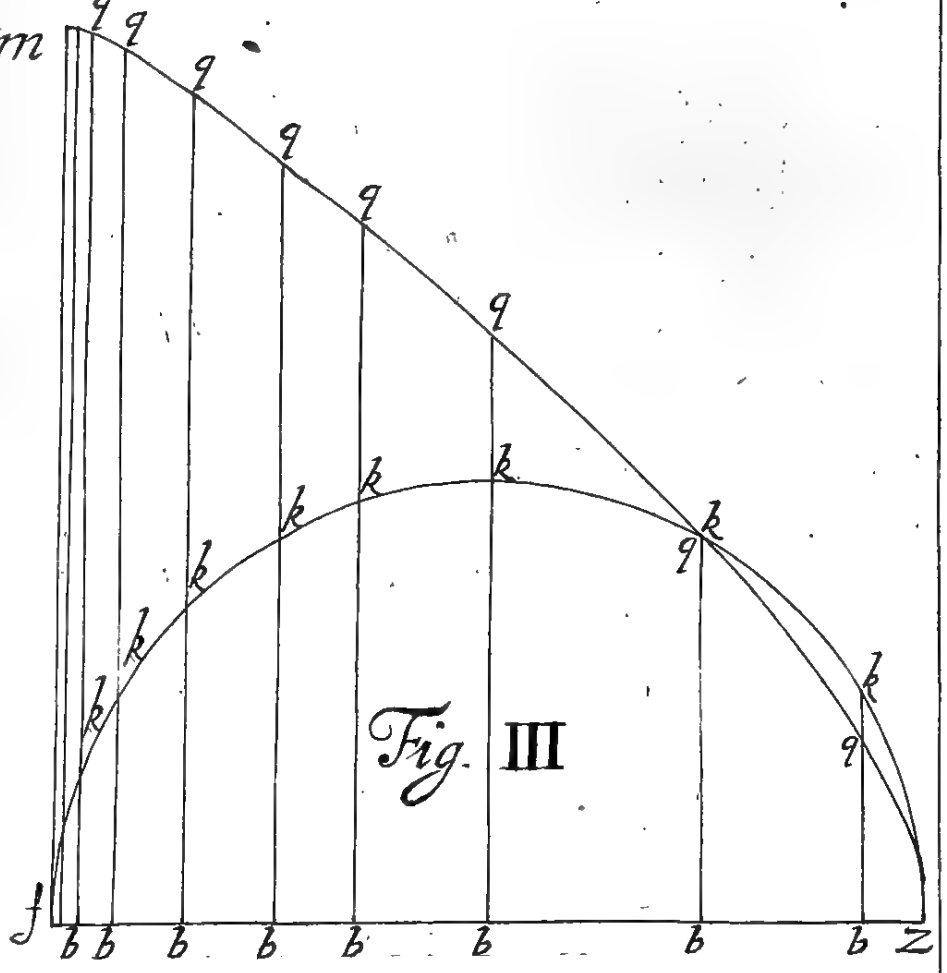
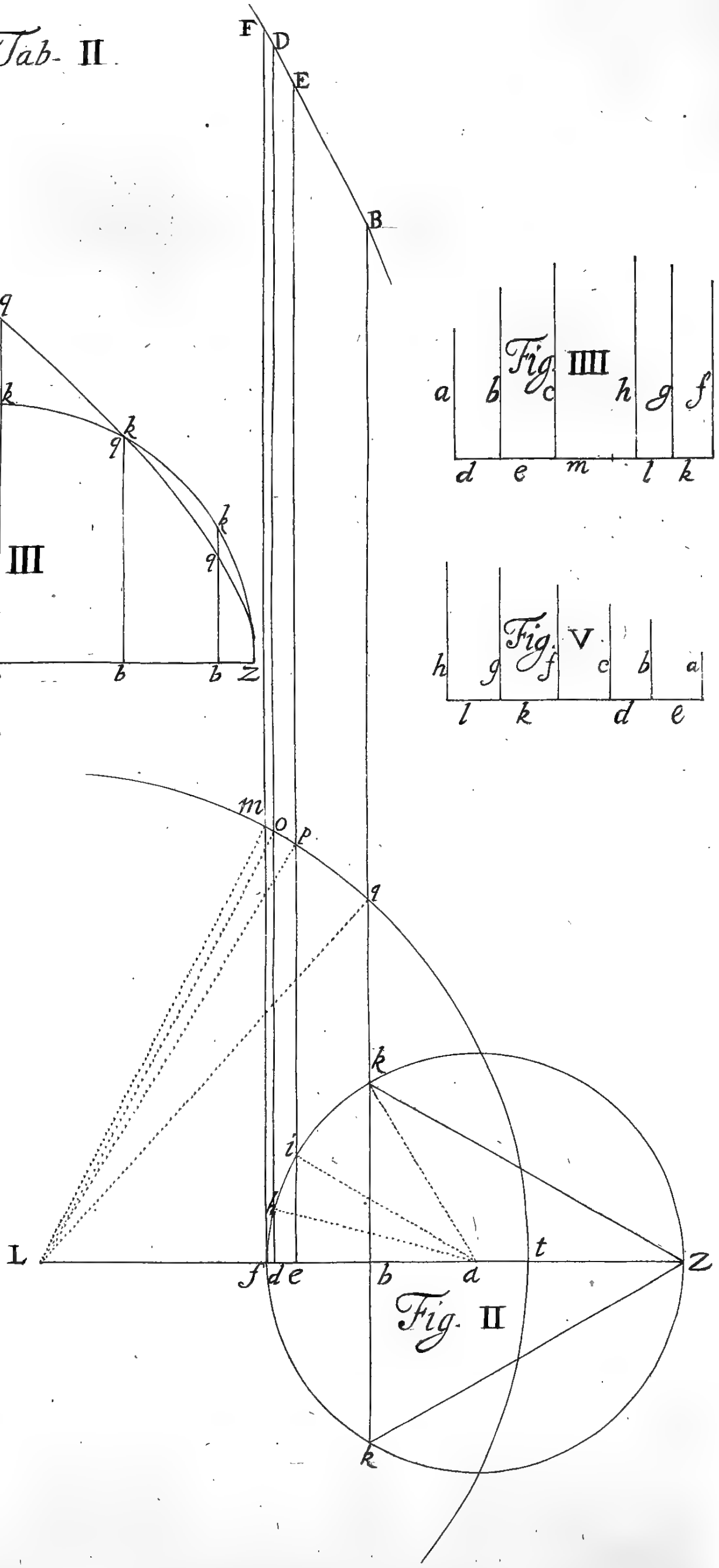


Fig. III

Fig. IIII

Fig. V



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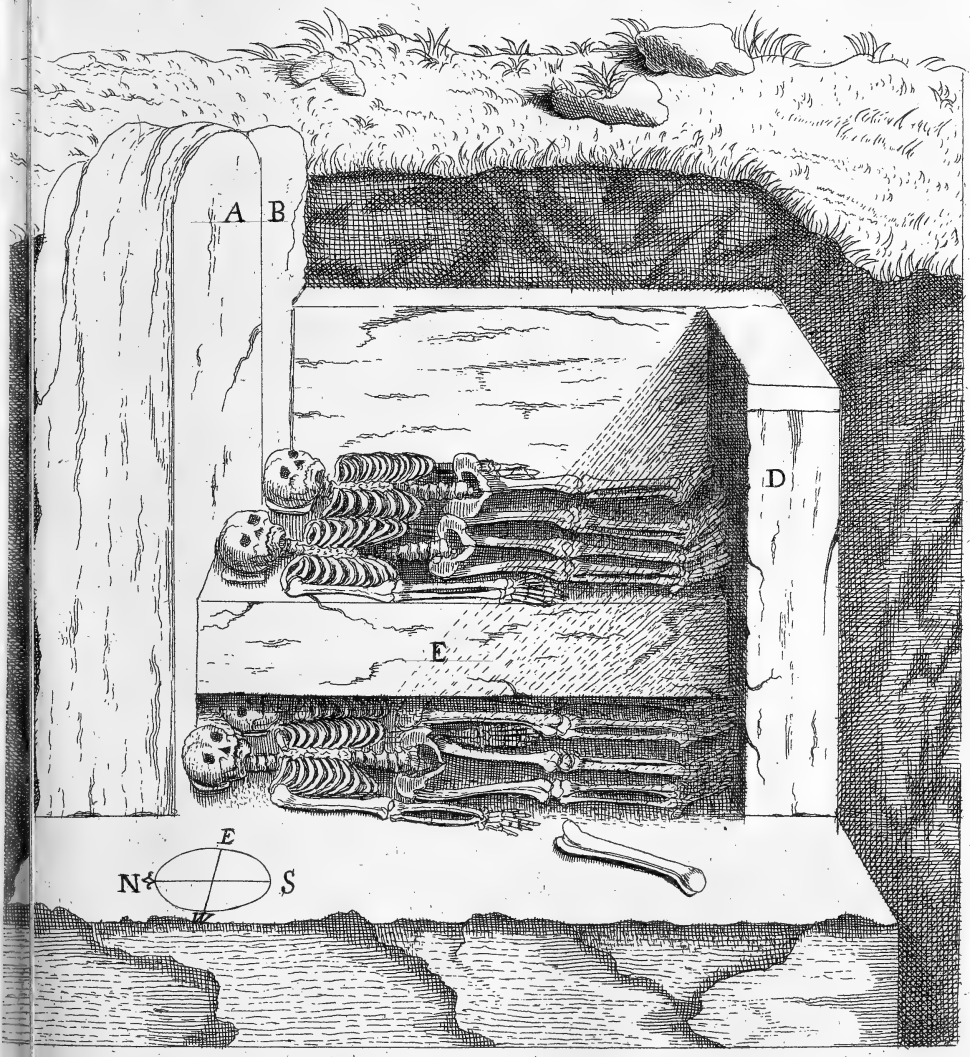
A
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S

PHILOSOPHICAL TRANSACTIONS.

For the Months of *November* and *December* 1686.

THE CONTENTS.

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 *Ree*.

At 3 ½*h*. at St. *John de Luz*, at *Bayonne*, and *Memiſſan*.

At 3 ¾*h*. at *Royan*, *Brouage* and *Rochelle*.

At 3*h*. on the Coaſt of *Poitou*.

At 3 ¼*h*. at *Ollonne* and *Beauvoir*.

On the Coaſt of *Britany*.

At 1 ½*h*. at *Bell Iſle*.

At 3 *h*. at the mouth of the *Loyre*, at *Garaude*, *Morbihan*, *Blavet*, and *Concarneau*.

At 3¾*h*. at *Apenars*, *Vannes*, and *Auray*.

At 2 ¾*h*. at *Apenmark*, *Audierne*, the *Race of Fontenay*, and *Le Conquet*.

At 2¾*h*. at *Breſt*, and at *Cape de Four*.

At 4*h*. at St. *Paul de Leon*.

At 4½*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 *Havrē de Grace*.

At 9¾*h*. at *Feſcan* and St. *Valeri*.

At 10½*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 *Dunkerk*, *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 11*th.* day of *Iuly*; 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*, Prevoſt 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 expoſed on all ſides to the Sunn, 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 cauſed two great Sones, which appeared in this place above gound 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 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 ſound 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 peices 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

We obſerved beſides, that in the place where were laid the two Heads of the Bodies, that lay upon the Tomb-Stone E 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 E, 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 Cheſnut colour and about the bigneſs of a Cheſnut, 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 neer 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

ſhape, 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 Horſes 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 proceſs, 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 Bodes 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 runns 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, ungent that they make one ſneeze; and when theſe Bones are handled they produce a tingling in ones fingers 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 digged 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 *manes* 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 nowto 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 lookt upon as a piaculum *to remoue or deface them: Mr.* de Cocherel *having diſcovered this but now deſcribed, thought it his duty to inquire into the Condition therof, as not being willing, without Legall Authority, to diſturb the Bones of thoſe there interred: This was the occaſion of this* Verbal Proceſs, *whi h for the Novelty of the thing, was thoughtfit to be Publiſhed in the form of Law, as it was communicated by* Mr. Juſtell. 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 all about this City, ſpoiling ſeveral fine Houſes, and very large Aqueducts, by breaking down their conducts, &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 joyned 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 Vaulte of an Oval Figure, in which there was a Stone Sepulcher pretty large, with the following Inſcription P. M. R. C. *cum Vxore*, 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 Iudgment; but after that the buſineſs ſhall be better examined, I ſhall give you a further Account of it; intending to go my ſelf 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 chearful 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 Diſtraction, 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 altogether) 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 ſeldome 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 *Feaver*, *November* the 4*th.* 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 ſound, 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 ſound, 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 diſcolour'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 ſound and ſtrong, as of any ſound 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* extreamly hard, thin and white, a ſlender Imboydery of Veſſels.

The *Pia Mater* all full of ſeeming turgid Glands, and a great diſtention of Lymphæducts 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* extreamly 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 *Striæ* 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 preſt 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 waſted, 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 oblongatæ.*

The other parts of the Brain unmentioned had nothing remarkable, nor have I time now to Philoſophiſe 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 Vociforation when he was diſpleaſed at any thing.

Remedies were applyed 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-Bridg* to every Day in the Year 1687. By *J. Flamsteed* Math. R. & R. S. S.

D.	*January.*				*February.*				*March.*			
	Morn.		*After.*		*Morn.*		*After.*		*Morn.*		*After.*	
	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
1	11	52			1	19	1	50			0	33
2	0	⊙29	1	05	2	17	2	40	1	04	1	33
3	1	37	2	07	3	01	3	21	2	01	2	23
4	2	34	2	58	3	39	3	56	2	44	3	03
5	3	20	3	41	4	12	4	28	3	20	3	36
6	4	00	4	18	4	⊙45	5	03	3	⊙52	4	09
7	4	36	4	54	5	23	5	44	4	26	4	44
8	5	14	5	34	6	07	6	33	5	02	5	24
9	5	⊙56	6	20	7	00	7	31	5	47	6	13
10	6	43	7	09	8	02	8	35	6	39	7	08
11	7	37	8	05	9	08	9	42	7	39	8	13
12	8	36	9	08	10	17	10	51	8	47	9	21
13	9	42	10	15	11	⊙24	11	56	9	⊙54	10	26
14	10	49	11	21			0	25	10	57	11	26
15	11	54			0	52	1	16	11	56		
16	0	⊙25	0	52	1	39	2	00	0	22	0	47
17	1	16	1	41	2	19	2	37	1	10	1	32
18	2	06	2	26	2	53	3	08	1	52	2	10
19	2	45	3	02	3	22	3	36	2	28	2	45
20	3	18	3	32	3	⊙50	4	03	3	00	3	16
21	3	46	4	00	4	17	4	32	3	⊙31	3	47
22	4	13	4	28	4	48	5	06	4	03	4	20
23	4	⊙43	4	58	5	26	5	49	4	37	4	57
24	5	14	5	31	6	14	6	43	5	20	5	45
25	5	51	6	12	7	18	7	53	6	13	6	44
26	6	36	7	03	8	31	9	11	7	19	7	55
27	7	33	8	07	9	⊙54	10	36	8	⊙35	9	15
28	8	42	9	20	11	18	11	56	9	55	10	34
29	10	02	10	42					11	10	11	44
30	11	⊙24									0	16
31	0	04	0	44					0	47	1	15

	April.				May.				June.			
D.	Mor.		After.		Mor.		After.		Mor.		After.	
	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
1	1	40	2	03	2	☉ 00	2	24	3	05	3	24
2	2	25	2	44	2	44	3	04	3	41	3	58
3	3	☉ 02	3	20	3	23	3	41	4	14	4	32
4	3	38	3	55	3	59	4	17	4	49	5	07
5	4	11	4	30	4	35	4	53	5	☉ 26	5	46
6	4	49	5	10	5	13	5	35	6	05	6	26
7	5	33	5	58	5	59	6	24	6	48	7	11
8	6	24	6	51	6	☉ 49	7	15	7	34	7	59
9	7	21	7	52	7	40	8	07	8	25	8	51
10	8	☉ 22	8	52	8	34	9	01	9	19	9	47
11	9	23	9	53	9	29	9	58	10	18	10	50
12	10	22	10	50	10	25	10	51	11	☉ 23	11	56
13	11	18	11	43	11	18	11	44			0	28
14			0	10			0	11	0	59	1	32
15	0	35	0	58	0	☉ 39	1	06	2	01	2	28
16	1	20	1	42	1	32	1	56	2	52	3	14
17	2	☉ 03	2	23	2	20	2	44	3	36	3	56
18	2	41	3	00	3	06	3	26	4	17	4	37
19	3	18	3	37	3	46	4	06	4	☉ 57	5	19
20	3	55	4	14	4	26	4	49	5	41	6	05
21	4	34	4	55	5	13	5	38	6	30	6	56
22	5	19	5	45	6	☉ 06	6	33	7	22	7	50
23	6	15	6	47	7	01	7	31	8	20	8	51
24	7	☉ 20	7	54	8	02	8	34	9	21	9	55
25	8	30	9	04	9	05	9	35	10	28	11	03
26	9	39	10	13	10	07	10	38	11	☉ 36		
27	10	46	11	19	11	08	11	41	0	08	0	41
28	11	49					0	11	1	08	1	36
29	0	18	0	45	0	☉ 41	1	08	2	00	2	23
30	1	13	1	38	1	35	2	00	2	44	3	03
31					2	24	2	45				

	July.				August.				September.			
D	Mor.		After.		Mor.		After.		Mor.		After.	
	H	M	H	M	H	M	H	M	H	M	H	M
1	3	20	3	36	3	54	4	07	4	29	4	44
2	3	51	4	06	4	21	4	35	5	01	5	21
3	4⊙	21	4	35	4	49	5	05	5	44	6	09
4	4	50	5	06	5	22	5	40	6○	37	7	08
5	5	23	5	39	6	02	6	26	7	44	8	22
6	5	59	6	19	6	51	7	19	9	01	9	42
7	6	39	7	02	7⊙	52	8	26	10	22	11	02
8	7	27	7	54	9	04	9	44	11	42		
9	8	21	8	50	10	25	11	06	0	18	0	50
10	9⊙	27	10	06	11	46			1	18	1	46
11	10	44	11	21	0	25	1	00	2⊙	12	2	33
12	11	59			1	34	2	02	2	53	3	14
13	0	36	1	11	2	27	2	49	3	29	3	46
14	1	43	2	13	3⊙	09	3	27	4	03	4	21
15	2	39	3	03	3	45	4	01	4	40	5	00
16	3	24	3	42	4	18	4	35	5	22	5	47
17	4⊙	00	4	18	4	53	5	14	6	14	6	42
18	4	36	4	54	5	35	6	00	7⊙	13	7	45
19	5	13	5	33	6	26	6	53	8	18	8	52
20	5	56	6	20	7	25	7	58	9	27	10	01
21	6	44	7	12	8⊙	33	9	08	10	33	11	07
22	7	40	8	15	9	43	10	19	11	31	11	58
23	8	50	9	24	10	54	11	26			0	23
24	10	02	10	33	11	58			0	47	1	10
25	11	08	11	42	0	26	0	53	1⊙	31	1	50
29			0	15	1	17	1	40	2	08	2	26
27	0	45	1	14	2	00	2	19	2	42	2	57
28	1	39	2	03	2⊙	36	2	51	3	13	3	28
29	2	23	2	41	3	06	3	19	3	43	3	58
30	2	57	3	18	3	33	3	46	4	15	4	33
31	⊙	27	3	41	3	59	4	13				

	October.				November.				December.			
D.	Mor.		After.		Mor.		After.		Mor.		After.	
	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
1	4	52	5	14	6	29	6	59	6	57	7	25
2	5	☉38	6	05	7	31	8	05	7	55	8	26
3	6	35	7	07	8	39	9	12	8	57	9	29
4	7	42	8	20	9	45	10	19	10	☉02	10	33
5	8	57	9	36	10	51	11	23	11	06	11	38
6	10	14	10	51	11	☉54					0	04
7	11	25	11	58	0	25	0	53	0	42	1	11
8			0	30	1	20	1	46	1	41	2	08
9	0	☉59	1	26	2	10	2	33	2	31	2	53
10	1	50	2	14	2	55	3	14	3	12	3	30
11	2	35	2	55	3	34	3	52	3	☉49	4	05
12	3	14	3	32	4	11	4	31	4	21	4	38
13	3	50	4	09	4	☉50	5	11	4	56	5	12
14	4	28	4	48	5	33	5	56	5	29	5	49
15	5	10	5	34	6	20	6	43	6	09	6	30
16	6	☉00	6	27	7	08	7	33	6	50	7	12
17	6	56	7	25	7	58	8	25	7	34	7	59
18	7	54	8	23	8	51	9	16	8	☉25	8	51
19	8	54	9	23	9	42	10	09	9	19	9	48
20	9	53	10	19	10	☉35	11	02	10	19	10	51
21	10	47	11	13	11	28	11	56	11	24	11	58
22	11	40					0	23			0	32
23	0	☉05	0	29	0	50	1	15	1	04	1	34
24	0	52	1	14	1	41	2	06	2	02	2	29
25	1	36	1	55	2	29	2	52	2	☉52	3	14
26	2	16	2	35	3	12	3	33	3	34	3	54
27	2	53	3	11	3	☉51	4	11	4	12	4	32
28	3	27	3	45	4	33	4	55	4	50	5	09
29	4	☉03	4	25	5	17	5	41	5	29	5	52
30	4	46	5	08	6	06	6	30	6	16	6	41
31	5	53	6	02					7	08	7	37

Eclipsis Lunæ Observata Dublinii, Novembris 19no. 1686. a Dno. Gulielmo Molineux Reg. Soc. S. & ab eodem Regiæ Societati communicata.

	H.	M.	S	
Penumbra notabilis	9	15	00	
Initium ob interpositas Nubes præcise determinare haud licuit, ideoq; incertius pono				
Eclipsin incepisse ad 9 h. 25m. vel	9	27	00	*
Umbra ad Paludem Maræotim	9	38	20	
Palus Maræotis tecta	9	40	20	*
Mons Sinai *Tegitur*	9	46	30	*
Mons Thambes *Tectus*	10	1	20	*
Mons Audus *Tegitur*	10	8	00	*
Mons Neptunus *Tectus*	10	14	00	*
Umbra ad Montem Sipylum	10	15	10	*
Insula Circinna tegitur	10	16	40	
Ad Montem Didymum	10	18	20	*
Mons Didymus *tegitur*	10	20	10	
Emergit M. Audus	10	23	00	
Umbra ad paludem Maræotim.	10	48	30	
Emergit Maræotis	10	52	00	
Ad Montem Sinai	11	38	00	
Emergit Sinai	11	39	30	
Finis Eclipsis	12	4	00	

Notanda.

Tempora sunt Horologii Oscillatorii ad Stellas fixas rectificati.

Quæ Asterismo Notantur Observationes, per hiantes Nubes captæ sunt, adeoq; accuratas haberi nolo.

Quantitatem hujus Eclipsis sex puto Digitorum.

Calculum quod spectat in Initio determinando, Ephemerides Gallicæ (La Connoissance des Temps) ad veritatem propius accedunt quam Anglicæ (Streetianæ Regiomontanæ) Illæ enim Initium

Initium ponunt ad 9h. 31m. *hæ vero ad* 9h. 38m. *Meridianorum habito respectu.*

In assignandis autem Medio, Fine, Quantitate & Duratione Ephemerides Anglicæ Gallicis *sunt accuratiores; Finis enim ab* Anglicis *ponitur ad* 12h. 14m. *a* Gallicis *vero ad* 12h. 29m. *Quantitas ab illis supputata sex fere Digitorum; ab his* 7½ Dig.

A 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 *Londons* being bigger than *Paris* and *Roven*, or than *Paris* and *Rome* put together, and bigger than any City of the World, should scape uncontradicted, and 'tis expected that I (if continuing in that Perswasion) should make some Reply to these contradictions.

2. I begin with the Ingenious Author of the *Novelles de la Republique des Lettres*, who saith, that *Reyin Persia* is far bigger than *London*; for that in the *6th.* Century of Christianity (I suppose *An.* 550.) It had 150 0, or rather 4 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 *Moschees* till 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 *Roven*, but saith that several Parishes inserted

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. 1*ſt*. That the *London Bills* appear in *Grants* 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 Auzouts* large Letter, I made Remarques upon every Paragraph thereof, but ſuppreſſing it (becauſe it lookt like a War againſt one with whome 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 81230; 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. } 487680.

The *Medium* of the *Paris* Burials was allowed by *Monsieur Auzout* to be 15867, 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 advantagious to *Paris* than *Monsieur Auzouts* Opinion of one to Dye out of 25) the Number of People at *Paris* will be 491430; more than by *Monsieur Auzouts* last mentioned Accompt. } 491430.

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

The *Medium* of the *London* Burialls is 23212, which Multiplyed by 30 (as hath been done for *Paris*) the Number of the people there will bee. } 696360

The Number of Houses at *London* appears by the Register to bee 105315. Whereunto adding a 10*th*. part or 10531, as the least Number of double Families that can bee supposed in *London*, the total of Families will be 115846: and allowing 6 Heads for each Family, as was done for *Paris*, the total of the People at *London* will be. } 695076.

The *Medium* of the 2 last *London* Accounts is — 695718.

The People of *Paris* according to the above-said Account is } 488055.

Of *Roven* according to *Monsieur Auzouts* utmost Demand, } 80000. } 693055.

Of *Rome* according to his own Report thereof. } 125000.

So as there are more People at *London*, than at *Paris*, *Roven*, and *Rome* by } 2663.

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 *Roven* put together, by } 114284.

Several other Estimates, *Viz.*

I. That *London* alone is equal to *Paris*, *Roven*, 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 *Roven*, 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 Christendome.

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 proportions; produced before the Royall Society, by Mr. Robert Hook *R. S. Soc. and Profeſs. Geom.* Greſham.

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 ſeveral contrivances thought on, to make the more minute variations in the Airs preſſure ſenſible.

And firſt, the Wheel-*Barometer* was invented and Publiſhed by Mr. *Hook*, Anno 1665, in his *Micrography*: (where it is deſcribed at large) but this did not anſwer fully the deſigned exactneſs, both for that the Mercury being apt to ſtick againſt the ſides of the Glaſs, would riſe and fall *per ſaltum*, all at once, and becauſe it is very difficult to adjuſt the 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 device to do the ſame thing, which was to encreaſe the diviſions 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 aſunder. This Invention was afterwards in the Year 1673 Publiſhed in *France* by Mr. *Hubin*, who neatly performed the Glaſs-work; but the Cane being neceſſarily ſmall and apt to be be obſtructed with bubbles, (whereby the intercourſe of the outward Air would be intercepted) and beſides the utmoſt limits of riſe and fall ſcarce reaching two foot and a half, Mr. *Hook* was not yet ſatisfied, till he had found out the

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.* 3*d.* 1685 *st. 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 hight of the other Cane B C, as the weight or specifick Gravity of the Liquor that is to fill that Cane is to the Specifick Gravity of Mercury, below the line *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 the doing it, yet it will not be unnecessary to shew here how it may be done. One way, (and the best that occurs at present) is to leave a small hole at the top of the Cylinder A, and another near the top of the Cylinder B: this latter being well stopt, pour in as much Mercury, at the other hole in A, as shall fill both Canes as high as the Level of the said hole; which done, stop either by Hermetically sealing it, or else by a drop of seal-wax (the glass being first ground rough to make it stick) the hole in A; then opening the hole in B, draw off as much of the Mercury of the Cane B C till it will runn no longer: which done, stopp 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 hight of the Mercury will be as is usual in the ordinary plaine and Wheele-*Barometers*.

Then

Then pour into the Cane B C as much Spirit of Wine tinged with *Cochineele*, and Oyle of *Turpentine*, equall parts of each, as ſhall ſtand above the ſurface of the Mercury ſo many feet as you make the enlarged ſcale of your Barometer, or as is between the middle of the Cylinders B and C, and you will find the Mercury ſink in the Cane B C, and Riſe in the other Cane A D, 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 B C, ſo much Mercury as may fill up the Cylinders A & B to ſuch hights, 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 præponderate 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 ſwiming 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 hight of the Mercury will be enlarg-

larged into almoſt the length of the Cane, without that the Counter-preſſure from the Liquors will be in the leaſt altered, the hight 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 *B C* in the Barometer) whoſe deſcent and aſcent muſt be added and ſubſtracted to reduce it to a rigorous exactneſs; but it is ſtill worth while to enquire if the Mercury it ſelf do not ſhrink and ſwell with cold and heat, ſo as not to need this correction.

Thus is a remedy found out for the defects and inconveniences of the Barometers hitherto produced, and an Inſtrument diſcovered, which like a new Sence, 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 *Meteorologie*, 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 pretentions of all others.

Ac-

Accounts of Books. (1.) *Le grand & fameux Probleme de la* Quadrature *du* Cercle *reſolu Geometriquement par le Cercle & la Ligne droite, par Monſieur* Mallement *de* Meſſange. *A* Paris, *in* 12° 1686. *With a Refutation of the ſame, by Mr.* D. Cluverius. *Reg.* S. Soc.

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 ſine $h d$ 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

$f z$ continued; but to contract his Work into a little compass, he assures us that it is all one, if instead of the whole circumferences $B b$, $E e$, $D d$, $F f$ 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 $f z$ continued, shall pass through the Points o, p, q and intersect the Tangent $F f$ in the Point m, so as to leave $f m$ = 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 so 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 $f m$, as the sines $k b$, $i e$, $h d$ 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 $f m$ to its respective ordinates; that it was a sort of *Linea Quadratrix*, to be reckoned among the *Lineæ Geometricæ 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 intersect the Circle in the middle of the Arch $k z$, and continge it in the point z. This *Curve* will be better understood in *Fig.* 3, where it is drawn as it ought, and wherein the proportion of the line $f m$ 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 $m o p q t$ in *Fig.* 2, yet 'tis not apparent but that a Circle passing through the point m, may intersect it in several points, as o, p, q: (but to suppose 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 $f z$, 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 *b*,*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 $\frac{bb-aa}{de}-\frac{cc+aa}{de+ee}$ is equal to $1=\frac{cc-aa}{dd+ed}\cdot\frac{cc+bb}{ed}$, 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 $\frac{cc-aa}{dd+ed}+\frac{cc-bb}{ee+de}=1=\frac{cc-bb}{de}+\frac{bb-aa}{de+dd}$ will shew 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 $\frac{c-b}{b-a}=\frac{e}{d}$, or $\frac{c-a}{b-a}-\frac{e}{d}=1$, then the Line passing through the Extremities is right: If $\frac{cc-bb}{bb-aa}=\frac{e}{d}$, then a Parabola is designed. The Characteristick of an Hyperbola or Ellipsis 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*, *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 otherwise: but there being only occasion for this first Case, the Rule is this, $\frac{cc-bb}{2e}+\frac{1}{2}e=e+m$: And $\sqrt{\frac{cccc-2ccbb+bbbb}{4ee}+\frac{1}{4}ee+\frac{1}{2}bb+\frac{1}{2}cc}=Radius$.

Thirdly, in a Circle, having *a*, *b*, *d* and *e*, to find *c*: The

Equation is $\frac{b^2 e - a^2 e}{d} - d e - e^2 + b^2 = c^2$. 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 ſubtenſe of an Arch, out of the ſubtenſe of a double Arch. The Rule is thus; $2R^2 - \sqrt{4R^4 - A^2R^2} = B^2$; Suppoſing A to be the Chord of a double Arch, and B of a ſingle Arch. From hence it is eaſily deduced, that $\sqrt{3R^2}$ being the ſide of an equilateral Triangle inſcribed, the ſide of a Hexagon will be R: of the Dodecagon $\sqrt{un\ \frac{1}{2}R^2} - \sqrt{\frac{1}{2}R^2}$: 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

$bq = 173205{,}08$	$ab = 50000{,}00$	
$ep = 200000{,}00$	$eb = 36602{,}54$	$fm = 9439{,}51$
$do = 207055{,}23$	$de = 9990{,}04$	

But ſuppoſing, as our Authour will have it, that do ſtands in the ſame Circle with bq and ep, it follows that the Square of $do = 422638679$ *&c.* whereas it ſhould have been equall to 428718707 *&c.* Square of do in the Table. The Square of the Tangent fm is alſo a great deal to 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 Atchivements of this Author; who would have done well, in a Matter that ſo little needed it, to have forborn to make uſe of the ſacred Words of our Saviour, *Math.* 11*th.* 25*th.*

II Voiage de Siam *des Peres Jeſuites envoyez par le Roy aux Indes & a la* Chine. *A* Paris 1686. 4°.

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 Authors 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 Embaſſie, as likewiſe the ſix Jeſuites who are Mathematicians and by the Kings Letters Patents are ſo ſtiled; 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 obſervingthe 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 ſailed 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 remarkables 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 Starrs 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 Voiage from the *Cape* of *Good Hope* to the Iland *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 *Hortentots*, whom he describes at larg, the *Namaquaas*, (of these two there are the Figures) the *Ubiquaas*, the *Gouriquaas*, *Ilassiquaas*, *Sousiquaas* and the *Odiquaas*: and here he relates a Voiage made in the Year 1685, as farr 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 Musical, 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 *Goat*, of the *Zembra*, the *Sea Cow*, the *Cerastes* or Horned *Serpent*, the *Camelion*, and two sorts of uncommon *Lizards*, whereof one is made to have 3 fair Crosses 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 *Rhinoceroses* there as bigg as ordinary *Elephants*, but, by I know not what mistake, he makes the *Rhinoceros* a two horned Animal. The Voiage

age from the *Cape* to *Jaua* (in ſight whereof they arrived *Aug. 5th ſt. n.*) containes nothing very Extraordinary.

The third Book is the Voiage from *Jaua* to the Kingdome 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* Embaſſadour at the Court of *Siam*, who, as they ſay, was received with more Honour and Reſpect, than was ever yet ſhewn to any Ambaſſadour whatever; and that even thoſe of *Perſia*, the *Mogul* and the *Tartar* Emperour 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* Ambaſſadour made his harangue, ſitting with his Hat on his Head. Here are deſcribed the *Baloons* 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 incredable Swiftneſs, working their Bodies all the while through the Rounds of the Ladder.

The fifth Book is entituled the Return of the Voiage of *Siam*, and firſt relates ſeveral notable Shews preſented to entertain the Ambaſſadour; as the fight of two *Elephants*, who were only ſuffered to twiſt 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 Magnetical 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 mediam noctem*, made at a place near *Louvo* called *Thlee-Pouſſonne*, in the preſence of the King. It begun about 15*h.* 20*m.* the Total Darkneſs at 16*h.* 23*m.* 45*ſ.* the Emerſion or end of Total Darkneſs at 18*h.* 2*m.* 36*ſ.* or rather, as is there ſaid, at 18*h.* 10*m.* 25*ſ.* whereby the Longitude of this place is found 98 degrees and half from *Paris*, and about 6*h.* 45*m.* to the Eaſt of *London*, as may be ſeen by comparing this Obſervation with the Obſervations thereof made at *Dantzick*, *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.* 168½, and in *Philoſ. Tranſ.* of *June* 1683. The relation of the homeward bound Voiage (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 Kingdome and Capital City of *Siam*: Next the habits of the People, and their uſe of *Betele*, *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 *Metempſychoſis* 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: heir preſent God they call *Sommonokhodom*.

A Remark concerning the Longitude of the Cape *of* Good Hope.

IN the ſecond Book of this Voiage 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* 2*d. ſt. n.* 1685, when at 11*h.* 29*m.* 20*ſ.* the firſt or innermoſt *Satellite* touched the *Weſtern* edge of *Jupiter* and at 11*h.* 30*m.* 50*ſ.* it appeared no more: this Obſervation is ſaid to be made with an excellent *Teleſcope* of twelve Foot: The other was on *June* 4*th.* following *ſt. n.* when the *Emerſion* of the ſame *Satellite* was obſerved at 9*h.* 37*m.* 40*ſ.* 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 no have happen'd at 8*h.* 26*m.* This ſame *Emerſion* is computed by Mr. *Flamſteed* at 8*h.* 19*m.* 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 ſhew 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, 9*gr.* 19*m.* which Arch that *Satellite* moves in 1*h.* 6*m.* and the utmoſt duration of an Eclipſe thereof in this poſition of *Jupiter* being ſcarce 2*h.* 20*m.* (as appears by the accurate Obſervations of Mr. *Caſſini* and Mr. *Flamſteed*) it will follow, that from the Immerſion behind *Jupiters* Weſtern Edg, to the Emerſion out of the ſhaddow, there could not be full 3*h.* 26*m.* wherefore the Emerſion out of the ſhaddow, on *June* 2*d.* ought, according to the time of the Immerſion, to be at 14*h.* 56*m.* at lateſt, at the *Cape*; which by Mr. *Flamſteeds Calculus* was at *London* 13*h.* 51*m.* or according to Sigr. *Caſſini* at

13*h.* 58*m.* 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 tis probable that the *Satellite* might, in the latter time, be ſeveral minutes Emerged out of the ſhaddow, 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 tis 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 Errour to be committed in ſo ſhort a diſtance Sailing.


BRITI
NATURAL HISTORY.

Tabula Colorum Physiologica

tam Mixtorum quam Simplicium, Crassitiemque unà cum Specimenibus adjectis Regiæ Societati Londinensi humillime D.D.D. a Ric. Waller S.R.S.

Colores Simplices

	Candidi Kirsp.	Montanum.	Cyprium.	Smalt.	Litmose.	Indicum.	Atramentum Sinicum.
	Niveus. Snow ish.	Glastinus Woden C.	Cyaneus. Κυάνεος	Lazurius Co d'Azure Azure	Violaceus. Ἰάνθινος Violet C.	Indicus. Ἰνδικος.	Coracinus Κοράκινος Raven C.

Colores Mixti

	Cærulei	Purpurei	Lutei	Rubei	Virides
Cærusa	Lacteus. Γαλακτικός Blanch comme du lait Milky ish	Argenteus. Ἀργύρεος Silver Co.	Turcoinus Turcoise	Cæruleus Ὑακινθόχρους Skie Col	Hyacinthinus Ὑακίνθινος Jacinth C.		Plumbeus Co. de plomb. Lead Co.
Testacea	Cinereus. Τεφρώδης Ash-col.	Ferreus. Iron-gray	Fuscus. Φαιός Brun. Browne.	Murinus. Mouse C.	Lividus. Dark-gray		Niger. Μέλας Black.

Simplicia

	Candidi	Cærulei	Purpurei	Lutei	Rubei	Virides
Cærusa	Lacteus. Γαλακτικός Blanch comme du lait Milky ish	Argenteus. Ἀργύρεος Silver Co.	Turcoinus Turcoise	Cæruleus Ὑακινθόχρους Skie Col	Hyacinthinus Ὑακίνθινος Jacinth C.	Plumbeus Co. de plomb. Lead Co.
Testacea	Cinereus. Τεφρώδης Ash-col.	Ferreus. Iron-gray	Fuscus. Φαιός Brun. Browne.	Murinus. Mouse C.	Lividus. Dark-gray	Niger. Μέλας Black.

Lutei simplices

	Cærulei	Purpurei	Lutei	Rubei	Virides
Marticos	Limoneus Limon C.	Palleus. Straw C.	Cymatilis. Wave C.	Saligneus Οἰσυίνος Willow gr	Thalassinus Sea gr.	Lividus Black & blew	Nigellus Ὑακομέλας Blackish
Crocea Gamba	Aureus. Χρυσοειδὴς Coleur d'or. Gold Colour.	Luteolus. Ὑπόχλωρος Yellowish.	Bittaceus Poppinjay gr	Herbeus Grass green	Porraceus. Ῥοδόσινος. Leeke Co.		
Ochra	Luteus. Ξανθός. Co d'oeuf. Egg Col.	Electricus. Ἠλέκτροικος Amber Co.		Ditreus. Ὑάλινος Glass Co.			
Auripigmentum	Citrinus. Κίτρινος Orange Co	Byssinus. Βύσσινος Ranssilke C.					
Umbra	Fasaus. Φαιὸς. Brun. Browne.	Subfuscus. Dun.				Murinus. Mouse C.	Castaneus. Chesnut.

Rubei simplices

	Cærulei	Purpurei	Lutei	Rubei	Virides
Minium	Igneus. Πυρροειδὴς Co du feu. Fire Col.	Gilvus. Κιρρὸς Bricke C.				Pullus. Earth Co.
Ochra usta	Ruffus. Carret C.	Helvus. Sorrel.	Badius. Βάδιος Bay. Bay.			Æthiopicus. Αἰθιοπικὸς Negro Black.
Cinnabaris	Miniatus. Μιλτώδης du Vermillon.	Carneus Σαρκοειδὴς Carnation			Livido-purpureus. Gris de lion.	Fuligineus. Λιγυυώδης Soot C.
Carmin	Coccineus. Κόκκινος Co Escarlate. Crimson.	Roseus Ῥοδόεις Rosey	Molochinus Μολόχινος Mallow C	Ostrinus Purple Royal	Dibaphus. Purple in grain	Purpureus. Πορφύριος Co de Pourpr. Purple	Atrabaphicus	
Sacca	Rubinus. Ruby-red.	Caryophylleus Pinke Col.	Persicus Peach col.	Amathistinus Amathist Co.	Paonaceus.			Furvus.
Sanguis Draconis	Sanguineus. Αἱματώδης Co du Sang. Blood-red							Prelius.
Rubrica	Ferrugineus. Σιδηροειδὴς Rust Co.		Bæticus. Bronn			Hiberus Moré Murrey		Ater. Coal-black
Atramentum Fuliginosum	Piceus. Πίσσινος Co Poix. Pitchy.	Griseus Gray	Canus Πόλιος Hoary	Cinereus Τεφρώδης Ash-col.	Ferreus. Iron-gray	Lividus. Dark-gray		Niger. Μέλας Black.

Numb 186

PHILOSOPHICAL TRANSACTIONS

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

The CONTENTS.

I. *Historia Plantarum, species hactenus editas aliasque insuper multas noviter inventas & descriptas complectens, &c. Autore* Joanne Rajo *e* Societate Regia. *Tomus primus.* Londini, 1686. Fol. *Apud* Henricum Faithorne *R. S. Typographum ; ad Insigne Rosæ in Cæmeterio D.* Pauli.

II. *Philosophiæ Naturalis Principia Mathematica, Autore* Is. Newton, Trin. Coll. Cantab. *Soc. Matheseos Professore* Lucasiano *& Societatis Regalis Sodali.* Londini. 4*to. Prostat apud plures Bibliopolas*

An Account of a Comet seen at Lipsick, Sept. 1686. *taken from the* Lipsick 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 Cœlestial 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 notice of but at *Rome:* and now this of *September* 1686. we have no other account of, than this from *Lipsick.* The truth is, that where Comets are destitute 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 acquainted

quainted with the Conſtellations (which few People are,) and muſt look over the Heavens deſignedly with great attention, notwithſtanding all which 'tis poſſible for ſuch obſcure Stars to paſs by unſeen.

This Comet was obſerved at *Lipſick* 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 8*th.* and 9*th.* of *September ſt. vet.* 1686. and obſerved it as follows.

Sept. 8. 4*h mane* about day-break, he found the Comet in the Conſtellation of *Leo*, to the right hand of the *Lucida in Lumbis* ♌ (*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 upright. Over the Comet in the ſame verticall was the Star θ ♌ of *Bayer*, or 21 *Tychoni*, diſtant therefrom by the Micrometer, exactly a degree; and a Line drawn from the *lucida in lumbis* ♌ 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 obſcurer and more difficult to obſerve than before, by reaſon of the day-light: however, at 3*h* 58 *m* the diſtance thereof from θ ♌ was found by the Micrometer 2°. 23½ *m.* and at 4 *h* 40 *m.* again 2 *gr.* 25¼ *m.* To verifie the Times, the Altitude of the *Lucida in Lumbis* ♌ was Obſerved 11 *gr.* 1*cmin.* at 4*h.* 08*m. mane.* A right Line drawn by the Comet and the ſaid θ *Leonis* towards β *Leonis*, or the the *Lucida Colli*, left that Star a little to the right hand. The following days being Cloudy no more could be Obſerved.

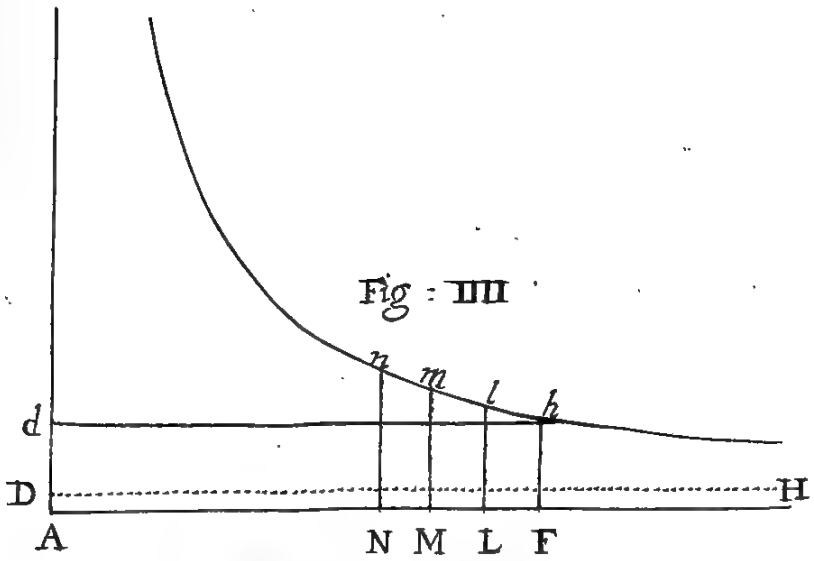
This Comet was ſeen by a Country-man, who firſt gave notice therof, from the 6*t* to the 12*th* of *September*; the reſult of whoſe Obſervations is, that the Comet was direct in motion, that it moved about 1½ degree *per diem*, and that it ſeemed rather to decreaſe in Latitude. On the 7*th* of

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 ♍ 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 ♍ 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 ♍, with much the same North Latitude as before.

These Observations being so few, do scarce suffice to conclude any thing 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 in more than probable that they have their periodical returns, tho hitherto unknown. And that the Prophecy of *Seneca* [*Erit qui demonstret aliquando in quibus Cometæ partibus errent; cur tam seducti a reliquis, quot qualesque sint,*] is not wholly to be despaired of, will soon appear, from the accurate Theory of the Comet of 168⅘, to be found in the incomparable Treatise of M. *Isaac Newton*, an account whereof is given at the end of this *Transaction*


BRITISH MUSEUM
NATURAL HISTORY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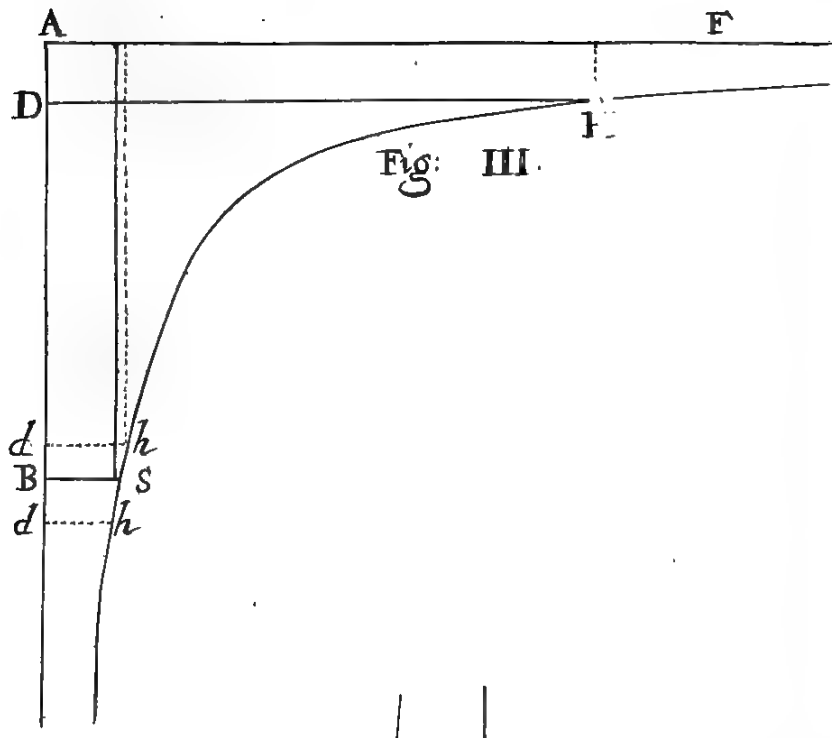
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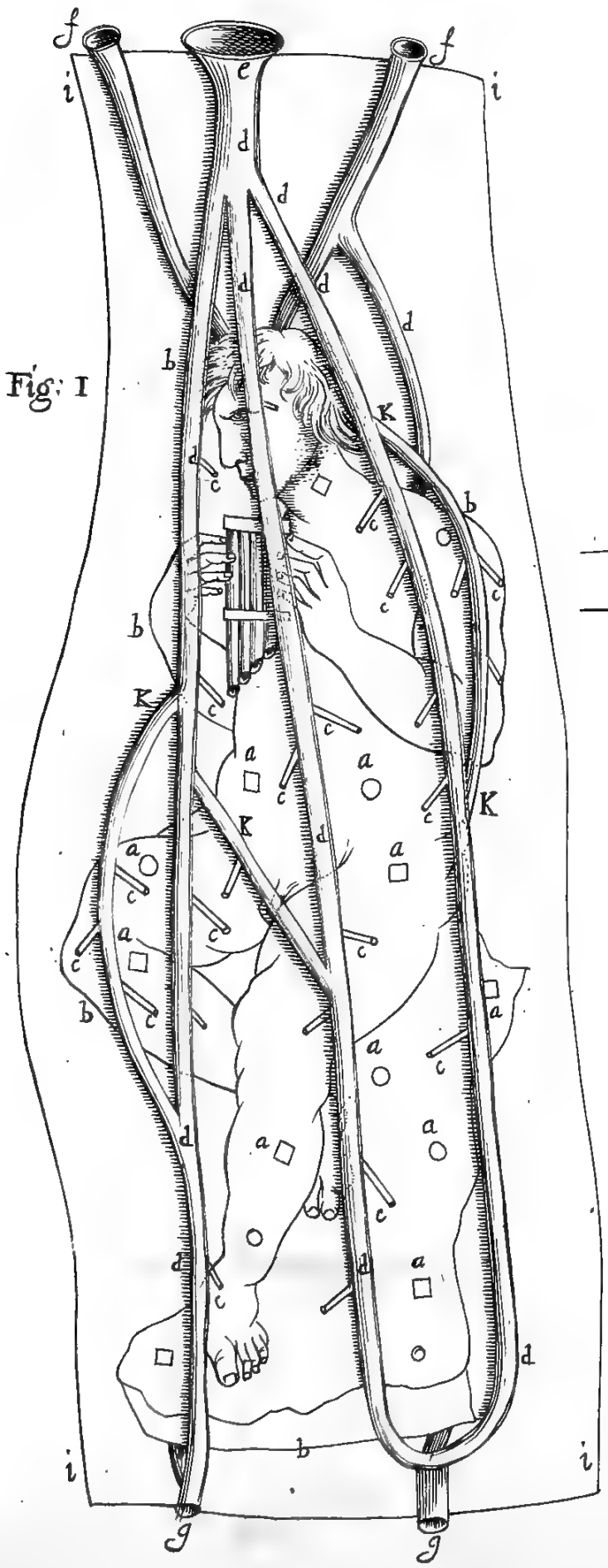
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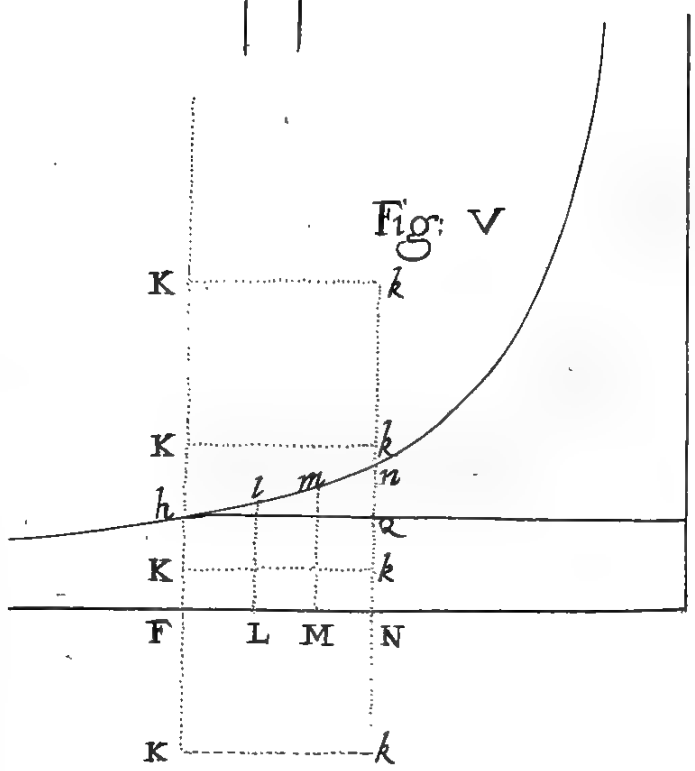
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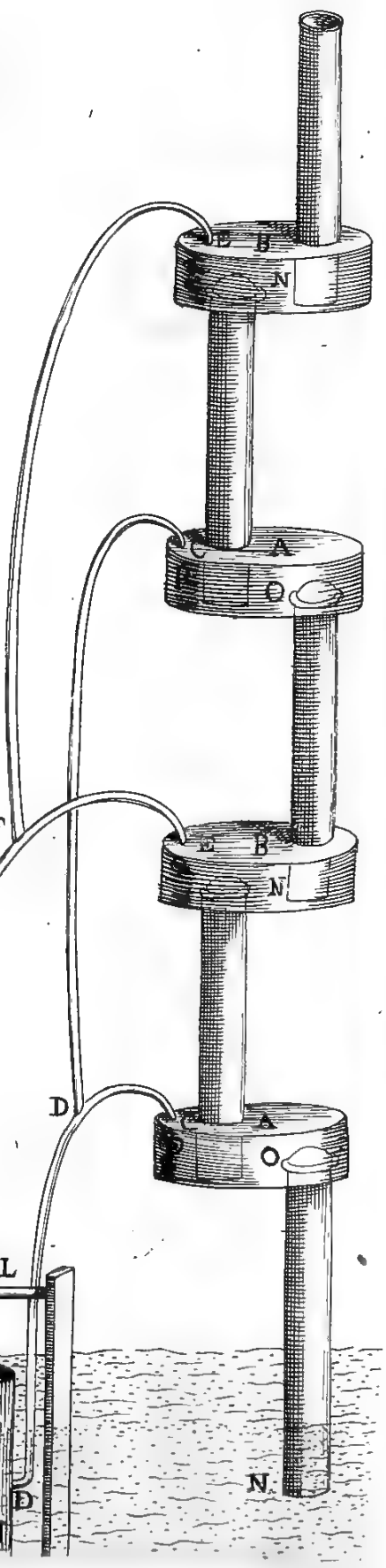
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Fig: II

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 bitts 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 joynts 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 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 ſmoak, and that ſmoak 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 chanels; in the Figure marked *c. c. c. c. c. c.* (all which muſt be contrived ſo as to enter into the great Chanels *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 Chanels marked *d. 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 Chanels *c. c. c. c. c.* for the more eaſie diſtribution of the Metal. Theſe great Chanels 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 Chanel 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 Chanels and waxen Statue joyn; and whereat, when the Mould is burnt, the wax as well of the Statue as of the Chanels may run out. The great Chanels being thus placed, the Mould muſt

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 drie, 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 bitts 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 Chanels *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 Chanels, as afore: which done I put it all togather, into a liquid ſubſtance made of Plaiſter and Tile or Brick duſt tempred 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 Coulour.

The Statue being caſt, I take off the *Mould* and cut off all the little Chanels; 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 Chanels 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 Metle 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 Chanels, 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 alwais 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 bigneſs 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 Horsback, 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 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, publiſh't 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 ſaith, that it would be a very hard matter to hinder but ſome Receptacles 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 Receptacle, I thought it might be conceived that the water may alſo be let out of the inferiour Receptacles 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 Receptacle ſhould be fill'd to a certain height: and ſo I did not Iudge it needfull to prevent this Objection.

The ſecond Difficulty, which I had very well foreſeen (as it is plain in my firſt explication) lyes 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 12000 foot 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 vpon it.

it more than I would then do, not having occaſion for ſuch work: but ſince I have ſeen Mr. *Nuis* his Objection, 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 rarefied 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 it's great eſt 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 Tranſaction of the month of *October* 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 rarifi'd at all; but being rarefi'd, 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. *Boile's* Experiments quoted by Mr. *Nuis*, the Rarefaction of the Air is much leſſer 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 it ſelf 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 $\frac{1}{9}$ 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 Recepticles 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'le 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 compreſt 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 Rarefaction, 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 heighth 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 fili'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 aſſureing 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; reſolving 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 faile, 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 ſaith 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 from them, I have already given the reasons of my dissent, 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.

Occultatio Saturni a Luna plena, Anno 1687. *Martii* 19*no. mane: observata a Dno* Ed. Haines *R. S. S. ad* Totteridg *prope* Londinum, *sub Latitudine* 51. 39.

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

Horologii						*Temp. corr*		
H.	*m.*	*s.*		*G.*	*m.*	*H.*	*m.*	*s.*
12	06	10	*Alt. Pollucis*	28	35	12	12	14
	10	05		28	00			
	13	30		27	28			
	16	47		26	59	12	22	47
1	18	00	☽ *limbus tangebat ansam occid.* ♄*ni*			1	24	00
1	18	30	*Immersio centri* ♄*ni paulo infra Paludem Maræotin.*			1	24	30
1	19	00	*Jam Saturnus omnino latuit.*			1	25	00
			Eodem die post meridiem					
4	01	25	*Altitudo centri Solis.*	20	00	4	7	17
	03	47		19	41			
	06	20		19	18			
	09	06		18	55	4	14	43
			Emersio ob nubes videri non potuit.					

A Dis-

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 (ſecluding 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: which two ſo compounded, do create a Parabola.

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 $1-r$ to 1; ſo 1 to m. (which m is therefore greater than 1.)

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 $\frac{1}{m}\frac{1}{m}$ of the impreſſed Force. And for a third Moment (at equal diſtance of time) $\frac{1}{m}\frac{1}{m}\frac{1}{m}$; 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 1) 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 $\frac{1}{m-1}$ 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 multiplyer.) 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

(as will appear by dividing VR by $R-1$;) $V + \frac{V}{R} + \frac{V}{RR} + \frac{V}{R^3} +$ &c. $= \frac{VR}{R-1}$; (ſuppoſing the Progreſſion to begin at $V = 1$.) That is (dividing all by R, that ſo the Progreſſion may begin at $\frac{V}{R} = \frac{1}{m}$:) $\frac{V}{R-1} = \frac{V}{R} + \frac{V}{RR} + \frac{V}{R^3} +$ &c. That is, in our preſent Caſe (becauſe of $V = 1$, & $R = m$:) $\frac{1}{m} + \frac{1}{mm} + \frac{1}{m^3}$ &c. $= \frac{1}{m-1}$. That is, (putting $n = m - 1$) $\frac{1}{n}$ of what it would have been if there had been no reſiſtance.

$$
\begin{array}{l|l}
R-1 & VR\,(\,V + \frac{V}{R},\ \frac{V}{RR},\ \&c. \\
 & \underline{VR - V} \\
 & \quad +V \\
 & \quad +V - \frac{V}{R} \\
 & \quad\quad \underline{\quad\quad} \\
 & \quad\quad +\frac{V}{R} \\
 & \quad\quad +\frac{V}{R} - \frac{V}{RR} \\
 & \quad\quad\quad \underline{\quad\quad\quad} \\
 & \quad\quad\quad +\frac{V}{RR} \\
 & \quad\quad\quad \&c.
\end{array}
$$

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 *Prop.* 15. For let *S H*, (*vid.* Fig. III.) be an Hyperbola between the Aſymptotes *A B*, *AF* : And let the ordinate *D H* (in the exteriour Hyperbola, parallel to *A F*,) repreſent the impreſſed force undiminiſhed; or the Line to be deſcribed in ſuch time, by a Celerity anſwerable to ſuch undiminiſhed force. And let *B S* (a like ordinate) be $\frac{1}{m}$ thereof ; which therefore, being leſs than

D H

$D\,H$ (as being equal to a Part of it) will be further than it from $A\,F$. In $A\,B$ (which I put $= 1$) let $B\,d$ be such a Part thereof, as is $B\,S$ of $D\,H$. Now because (as is well known) all the inscribed Parellelograms, in the exteriour Hyperbola, $A\,S$, $A\,H$, &c. are equal; and therefore their sides reciprocal: Therefore as $A\,d = 1 - \frac{1}{m}$ (supposing $B\,d$ to be taken, from B toward A,) to $A\,B = 1$, (or as $m - 1$ to m:) so is $B\,S = \frac{1}{m}\,D\,H$, to $d\,h$, which is therefore equal to $m\frac{1}{-}1$ of $D\,H$; that is (as will appear by dividing 1, by $m - 1$,) to $\frac{1}{m} + \frac{1}{mm} + \frac{1}{m^3}$ &c. of $D\,H$.

$$
\begin{array}{l}
m-1)\ 1\ (\frac{1}{m} + \frac{1}{mm} + \frac{1}{m^3} + \text{&c.} \\
\quad \underline{1 - \frac{1}{m}} \\
\quad\quad + \frac{1}{m} \\
\quad\quad \underline{+ \frac{1}{m} - \frac{1}{mm}} \\
\quad\quad\quad + \frac{1}{mm} \\
\quad\quad\quad \underline{+ \frac{1}{mm} - \frac{1}{mmm}} \\
\quad\quad\quad\quad \text{&c.} \quad + \frac{1}{mmm}
\end{array}
$$

Or if $B\,d$ be taken beyond B; then as $A\,d = 1 + \frac{1}{m}$, to $A\,B = 1$, or as $m + 1$ to m, so is $\frac{1}{m}\,DH$ to $d\,h$, which is therefore equal to $m\frac{1}{+}1\ D\,H$; that is (as will appear by like dividing of 1 by $m + 1$;) $=$ to $\frac{1}{m} - \frac{1}{mm} + \frac{1}{m^3} - \&c.$ of $D\,H$.

12. Let such ordinate $d\,h$, or (equal to it in the Asymptote) $A\,F$, be so divided in L, M, N &c. (by perpendiculars cutting the Hyperbola in l, m, n, &c.) as that $F\,L$, $L\,M$ $M\,N$ 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 $\frac{1}{m}$, or as m to 1. See *Fig.* IV

13. This is done by taking $A\,F$, $A\,L$, $A\,N$, &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 proport:
That is A. B :: B. C :: C. D :: &c.
And dividing A − B. B :: B − C. C :: C − D. D :: &c.
That is a. B :: b. C :: d. D :: &c.
And alternly $a. b. c.$ &c. :: B. C. D. &c. :: A. B. C. &c.
That is, in continual proportion as A to B, or as m to 1.

14. This being done; the Hyperbolick ſpaces Fl, Lm, Mn, &c. are equal. As is demonſtrated by *Gregory San-Vincent*; and as ſuch is commonly admitted.

15. So that Fl, Lm, Mn, &c. may fitly repreſent equal times, in which are diſpatched unequal lengths, repreſented by FL, LM, MN, &c.

16. And becauſe they are in number infinite (though equal to a finite Magnitude) the duration is infinite: And conſequenlty the impreſſed force, and motion thence ariſing, never to be wholly extinguiſhed (without ſome further impediment) but perpetually approaching to A, in the nature of Aſymptotes.

17. The ſpaces Fl, Fm, Fn, &c. are therefore as Logarithms (in Arithmetical progreſſion increaſing) anſwering to the lines AF, AL, AM, &c.; or to FL, LM, MN, &c. in Geometrical progreſſion decreaſing,

18. Becauſe FL, LM, MN, &c. are as $\dot{m}$, $\dot{m}\dot{m}$, $\dot{m}^3$, &c (infinitely) terminated at A; therefore (by ¶ 10) their Aggregate FA or dh, is to DH, (ſo much length as would have been diſpatched, in the ſame time, by ſuch impreſſed force undiminiſhed) as 1 to $m - 1 = n$.

19. If therefore we take, as 1 to n, ſo AF to DH; this will repreſent the length to be diſpatched, in the ſame time, by ſuch undiminiſhed force.

20. And if ſuch DH be ſuppoſed to be divided into equal parts innumerable (and therefore infinitely ſmall;) theſe anſwer to thoſe (as many) parts unequal in FA, or $h d$.

21

21. But, what is the proportion of r to 1, or (which depends on it) of $1-r$ to 1, or 1 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 $\frac{A}{R-1}$ (as at ¶ 10) that is (as by diviſion will appear) $\frac{A}{R} + \frac{A}{R^2} + \frac{A}{R^3}$ &c. That is (in our preſent caſe) $\frac{a}{m} + \frac{a}{mm} + \frac{a}{m^3}$ &c. 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 (ſecluding 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, ſecluding 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 1 &c. 1 1 1 &c, 1 1 &c. 1 &c. and ſo continually as in the line of of Projection.

1
1 1
1 1 1
1 1 1 1
&c.

24. Hence ariſeth (in the tranſverſe lines) 1 for the firſt moment 1, for the ſecond $1+1$, 1 1 1 for the third $1+1+1$, and ſo forth, in 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 $\frac{1}{m}$; for the ſecond $\frac{1}{m}+\frac{1}{m^2}$; for the third $\frac{1}{m}+\frac{1}{m^2}+\frac{1}{m^3}$ &c. And ſuch is therefore the Deſcent of a heavy Body falling by its own weight. The ſeveral impulſes of Gravity being ſuppoſed equal.

$$\begin{array}{ccccc} \frac{1}{m} & & & & \\ \frac{1}{m^2} & \frac{1}{m} & & & \\ \frac{1}{m^3} & \frac{1}{m^2} & \frac{1}{m} & & \\ \frac{1}{m^4} & \frac{1}{m^3} & \frac{1}{m^2} & \frac{1}{m} & \end{array}$$

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 $\frac{1}{m}$ in the one, is equal to $\frac{1}{m}$ 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

(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 pendicular line; it deſcends therefore at the rate $\frac{1}{m}$, $\frac{1}{mm}$, $\frac{1}{m^3}$, &c. of f (the impreſſed force) increaſed by $\frac{1}{m}$, $\frac{1}{m}+\frac{1}{m^2}$, $\frac{1}{m}+\frac{1}{m^2}+\frac{1}{m^3}$ &c. of g the impulſe of Gravity: (by ¶ 7. & ¶ 27.) 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 ceaſeth 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 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 percuſſion, is that which (at that point) is at right angles to that Tangent.

41. If the Projection (at ¶ 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, mma, &c. (each Series having one term fewer than that before it :) then (for the ſame reaſons as at ¶ 22.) the Aggregates of the ſeveral Columns (or erect Series) will be $\frac{1-a}{n}$, $\frac{1-ma}{n}$, $\frac{1-mma}{n}$, and ſo forth, till (the multiple of a becoming $=1$) the progreſſion expire.

42. Now all the abatements here, a, ma, mma, &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 $\frac{nt-1+a}{n}$; & 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 Deſcent 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

thenceforth (the ablative part exceeding the positive) it will descend.

45. In an Horizontal or Oblique projection; having taken $\frac{1-a}{n}f$ 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 resistence 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 $hKkn$ (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 wherewith 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 ¶ 48.

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 heavyer 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* Wilt-ſhire.

——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 Tempeſts 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 taſt, 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. *Aglionby. Reg. Soc. S.*

JE veux Monſieur, vous faire part d'une choſe fort extraordinaire, qui m'eſt arrivée il y a quelques jours dans l'Hoſpital 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 *a ſept lieues de* Tholouſe. *Elle a eté baptiſée en qualité de fille, ſous le nom de* Marguerite. *Son Pere eſt pauvre homme de* Pourdiac, *qu'on appelle* Malauſe. *Elle eſt agée de 21 a 22 ans, ayant bien la mine exterieure d'une fille, mais les marques réelles d'un homme bien puiſſant. Son viſage eſt feminin & aſſez agreable, la gorge bien jolie, & les mammelles auſſi bien faites qu'on les puiſſe deſirer a une fille, les feſſes & les cuiſſes grandes comme aux femmes, les parties honteuſes tout comme celles d'une femme, mais elle n'eſt percée que de la profondeur de deux petits travers de doigts ; & au milieu de cette fente, il pend un membre viril d'une groſſeur fort conſiderable, & qui dans l'erection luy ſort au dehors d'enuiron huit pouces. Ce membre eſt bien formé, hormis qu'il n'a point de prepuce, & qu'il n'eſt pas accompagné de teſticules apparens. 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 méme conduit de la Verge.*

J'aurois eu de la peine a le croire, ſi je ne l'auois veu moyméme, & examiné fort exactement dans le temps que ſes menſtrues couloient, leſquelles luy ſuruiennent preſque tous les mois aſſez regulierement, 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'ay

J'ay fait voir cela a pluſieurs de nos medecins, & apres avoir conſulté Meſſieurs les Vicaries Generaux, nous luy avons fait prendre un habit d'homme, ſous le nom d' Arnaud Malauſe; *& on va preſentement luy faire apprendre quelque metier. Il n' y avoit pas a heſiter 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 ecrire ce fait, qui commence deja d'etre public dans cette ville, mais qui eſt bien rare, & bien extraordinare.

Tholoſe
Decemb. 4. 1686.

Accounts of BOOKS.

I. *Hiſtoria Plantarum, ſpecies hactenus editas aliaſq; inſuper multas noviter inventas & deſcriptas complectens &c. Autore* Joanne Rajo e Societate Regia. *Tomus primus.* Londini, 1686 Fol. *Apud* Henricum Faithorne *R.S. Typographum*; *ad inſigne Roſæ in Cæmeterio D.* Pauli.

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, Taſts, and Uſes, their Places, and Diviſions; of Collecting, Drying, and Preſerving them, their Chymical *Analyſis*, and their Diſeaſes.

The 2*d.* 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 *Lamellæ*, Plates, Brims, and Caps; and as they are noxious, or eſculent; or grow upon Trees.

The 3*d.* 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 4*th.* Treats of ſuch Herbs as have an imperfect or ſtamineous 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 *Amaranthi*, the *Beets*, ſome *Kali's*, &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, ſucceeding 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 *Stœcha's*, the *Jacobæa's* or *Ragworts*; or elſe the Flower is diſpoſed into a *Thyrſus* 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 *Jacea's* or *Knapweeds*, the great *Centory*, the great *Burr-dock*, and moſt of the *Thiſtles*, which are ſub-divided 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 *Barbulæ* and *Diſcus*, and from the Figures the Flowers make; of this Tribe are the *Sun-flowers*, the *Chryſanthemum's* and *Marigolds*, the *Yarrows, Daiſies, Feverfew*, the *Lavender-cot-*

tons, the *Tanſies*, *Wormwoods*, *Southernwoods*, *Mugworts*, *Scabioſes*, *Teaſels*, *Eringo*, the *Globe-thiſtle*, *&c.*

The 9*th*. 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*, *Burnit*, *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 *Cummins Parſlys*, *Hemlocks*, *Smallage*, *Aniſeed*, *Caraways*, the *Carrots*, *Coriander*, *&c.* all which are very nicely diſtinguiſhed, and variouſly ſub-divided.

The 10*th*. 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 *Croſworts*, the *Ladies Bed-ſtraw*, the *Wood-roofs*, the *Cleavers* or *Gooſegraſs*, *&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 *Turnſoles*, the *Gromils*, *Scorpion-graſs*, *Comfrey*, the *Honey-Worts*, &c.

The 11*th*. 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*, *labiated* 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 *Hyſſops*, the *Savoury's*, *Thymes*, *Poley-mountain*, the *Germanders*, the *Mints*, *Penneroyalls*, *Vervain*, the *Majorams*, *Baſil*, the *Clarys*, *Betonys*, *Marrubiums*, *Lamiums*, *Sideritis*, *Ground-Ivy*, *Baulm*, *Calamint*, *Ground-pine*, *Bugle*, *&c.*

The 12*th.* Comprehends thoſe Herbs, to each of whoſe Flowers ſucceed more than 4 naked Seeds, whoſe number is indefinite, they being *Polyſpermous*; here we may note that Mr. *Ray* takes thoſe for naked Seeds whoſe *Folliculæ* 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 *Althæa's*, *Avens*, *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 *Travellers-joy*, and ſome *Climbers*, *Dropwort*, *Meddow-ſweet*, the *Anemonies*, *Paſque-flowers*: Thoſe of the former Section having *Perianthia* or Cups about their Flowers.

The 13*th.* 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 five *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 *Guinny pepper*, *Sparagus*, *Lillies* of the Vallie. &c.

The 14*th.* Contains the *Multiſiliquoſe* or *corniculated* Herbs, which after each Flower bear many Pods or horned Seed Veſſels. Of this kind are ſome *Sedums* or *Houſeleecks*,

leeks, Orpines, Peionys, black Hellebore, ſome *Althæa's, Monks-hoods, Columbines, Larks-ſpur's.*

The 15*th.* 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 ſeminal Veſſels, of this laſt kind are the *Butterworts,* the *Toad-flax* or *Linaria, Birthworts, Figworts, Foxgloves, Cock-combs* or *Rattles, Eyebrights, Cow-wheats, &c.*

The 16*th.* 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 *Lyſimachiæ* or *Willow-herbs, Rues,* the *Spurges, Plantaines, &c,* theſe make the 17*th.* Book.

The 18*th.* and laſt Book of the firſt Tome comprehends the *Legumes* or *Papilionaceous* Herbs, whoſe Flower ſomewhat 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 *Liguorice*, *Goats-Rue*; or *echinated* and *monoſpermous*, as in *Cocks-head*; or propendent, as in the *Orobi*, *Aſtragoli* or *Heath-Peaſe*, *Chiches*; or as their Cods are included or hid in Bottles, or Veſicles, 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*, *Fænugreek*, *Anonis* or *Reſt-Harrows* *Saint-foin* or *Medick-Fodder*, the *Medica's* or *Snail Trefoils*, the *Loti* which are almoſt *Pentaphyllous* or five leaved *Legumes*, the *Cytiſi* or *ſhrub Trefoils*; to theſe are ſubjoined many *anomalous ſiliquoſe* Herbs, very near a kin to the *Papilionaceous*; as ſeveral *Fumitorys*, *Acaſia'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 referr'd 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 bee 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 *Characteriſtick* 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

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.

II.

II. *Philoſophiæ Naturalis Principia Mathematica, Autore* Iſ. Newton Trin. Coll. Cantab. *Soc. Matheſeos Profeſſore* Lucaſiano, *& Societatis Regalis Sodali.* 4to. Londini. *Proſtat apud plures Bibliopolas.*

THis incomparable Author having at length been prevailed upon to appear in publick, has in this Treatiſe given a moſt notable inſtance of the extent of the powers 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 Geometry, 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 himſelf attempted them.

This Treatiſe is divided into three Books, whereof the two firſt are entituled *de Motu Corporum*, the third *de Syſtemate Mundi.*

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, Mathematical and vulgar: ſhewing the neceſſity of ſuch diſtinction. To theſe definitions are ſubjoyned, 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 *Præcognita* 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 fift 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 *Conick* Sections about the *Focus* thereof; then he demonſtrates that the *Vis Centripeta*, 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 *Conick* 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 ſubtilty 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 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 *Corollarys* of great uſe in explicating the *Phenomena* of the *Moons* Motions, the Flux and Reflux of the Sea, the Preceſſion of the *Equinoctial* Points; and the like.

This done our Author with his uſual Acuteneſs proceeds to examine into the Cauſes of this Tendency or centripetal 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 Atoms, 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 diſtance 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 compoſed of Particles whoſe Tendencies to each other do decreaſe in any other *Ratio* of the Diſtances: Which Speculation 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 *Dioptricks*.

Hitherto our Author has conſidered the Effects of compound Motions *in Mediis 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

would be the consequence of a resistence 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 10*th*. *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 *Hydrostaticks* 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 flie 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 varyed: Here with great exactness is an Account given of several Experiments tried with *Pendula*, in order to verify the aforegoing 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 *Vortical* 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 alltogether impossible.

The

The III. and laſt Book is entituled *de Syſtemate Mundi*, wherein the Demonſtrations of the two former Books are applyed 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 Earths Axis is made out,) together with the retroceſſion of the *Moons* Nodes, the Quantity and inequalities of whoſe Motion are here exactly ſtated *a priore*: Laſtly the Theory of the Motion of Comets is attempted with ſuch ſucceſs, that in an Example of the great Comet which appeared in $168\frac{9}{10}$, 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 *Trajectoriæ* 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, ſaith 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 applyed, 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.

PHILOSOPHICAL TRANSACTIONS

For the Months of *April*, *May* and *June* 1687.

The CONTENTS.

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 boyled in about a Gallon of *Milk*, till the half be boyled 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 dryed, and well powdered, may be given mixt with the *Crabs* Claws, and *Venice* Treacle, with *Sallet* Oyl 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 infused 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*, *Parkinsoni*, five *Lychnis viscosa flore muscoso*, *Casp. Bauhini.* Anglice, *Spanish Catch-flie.* It grows plentifully about *Thetford*, and about the Mills near *New-Market*. *Vide* Raii *Catalogum Plantarum Angliæ, & Histor. 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' a preſent ſur les nouvelles decouvertes, que j'ay faites depuis quelque temps dans le Ciel, eſt ſi peu de choſe, que je ne l'ay pas jugé digne d' eſtre preſenté a la Societé Royale.

Je n' eus pas plusſtoſt donné au Journal la decouverte des deux nouveaux Satellites de Saturne, que je vis qu'il y avoit quelque choſe a claircir, touchant leur diſtances, & la durée de leur conjonctions.

La diſtance du premier Satellite au centre de Saturne m' a paru variable, & ſon mouvement ſenſiblement inegal, plus viſte, en ce temps, dans le demicerle occidental, que dans l'oriental. J'ay dernierement determiné ſa moyenne diſtance de $\frac{39}{40}$ du diametre de l'anneau de Saturne, ſon mouvement journalier de 6 ſig. 10 d. 41'. 31". *Ainſi ſi ſon mouvement eſtoit egal, la duree de ſa conjonction avec Saturne, c'eſt a 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 a remarquer que je n'ay juſqu' a preſent pû voir ce Satellite plus pres de Saturne, que d'un Quart d'un Anſe.*

J'ay calculé l'Epoque de ſon mouvement, pour le dernier Decembre 1685. *a midi au meridien de* Paris *en* ♈ 24 d. 50'.

La diſtance du ſecond Satellite du centre de Saturne m' a paru plus uniforme. Je l'ay determinée d'un diametre de l'anneau & $\frac{1}{4}$. Son mouvement paroit auſſi plus egal. J'ay calculé le journalier de 4 ſig. 11 d. 31'. 30". *Ainſi la durée de ſa conjunction deuroit eſtre de* 8 h. 36'. *Je n'ay pas non plus vû juſqu' a preſent ce Satellite plus proche de l'anneau de Saturne que d' $\frac{1}{4}$ d'un anſe. Comme ce Satellite ſe voioit la plus part du temps dedans les confins de la diſtance du Premier, au quel il eſt egal en grandeur, & ſemblable dans la coleur, la difficulté de diſtinguer l'un de l'autre a eſté extreme, de ſort que ſans un aſſiduité particuliere aux obſervations, & ſans une grande multitude de combinaiſons je n'en ſerois pas venu a bout.*

J'ay determiné l'Epoque de ce Satellite pour le 31 *Decembre* 1685. *a midi. en* ♍ 9. d. 10'.

La diſtance du Troiſieme du centre de Saturne paroit d'un diametre de l'anneau & $\frac{3}{4}$. *Son mouvement journalier* 2 ſig. 18. d. 41'. 50". *Ainſi ſa conjonction doit durer* 10 *heures. L'epoque de ſon mouvement pour le midi du dernier de l'année* 1685. ♍ 9 d. 39'.

La diſtance du Quatrieme Satellite au centre de Saturne paroit de 4 *diametres de l'anneau. Son mouvement journalier de* 22 d. 34'. 38", *la duree de ſa conjonction* 15 h. 6'. *L'epoque de ſon mouvement au meſme temps & lieu que les autres en* ♐ 18 d. 1'.

La diſtance du cinquiéſme Satellite au centre de Saturne de 12 *diametres de l'anneau. Son mouvement journalier de* 4 d. 32'. 17". *Ses conjonctions durent* 24 *heures. L'epoque de ſon mouvement au meſme temps & lieu en* ♐ 16. 19. *Sur ces principes on peut conſtruire les Tables, & les Ephemerides.*

Voicy, Monſieur, en deux pages le reſultat d'un Travail tres long & tres penible, que je vous prie de communiquer a la Societé Royale, la ſuppliant de l'agreer, & d'attribuer au perfond reſpect, que je luy dois, la reſerve que j'ay eüe de ne luy preſenter que des choſes bien digerées, &c.

Pàris, *le* 10. *Octobre,* 1686. *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, à Caſſino *Detecti Anno* 1686.

Ann. Chriſ. Curr.	*Epochæ* o. ′.	*Annis*	*Mot. Med.* s. o. ′.	*Diebus*	*Mot. Med.* s. o ′.	*H. M.*	*Mot. Med* sex. ° ′. ° ′. ″.	*M.*	*Motus Medii.* °. ′.
1681	♒ 19.34	1	4. 2.34	1	6.10.42	1	♑ 7.57	31	4. 6
1685	♍ 10.30	2	8. 5. 7	2	0.21.23	2	0.15.53	32	4. 14
1686	♉ 13. 4	3	0. 7.41	3	7. 2. 5	3	0.23.50	33	4. 22
1687	♌ 15.37	4	10.20.56	4	1.12.46	4	0.31.47	34	4. 30
1688	♍ 18.11	5	2.23.30	5	7.23.28	5	0.39.44	35	4. 38
1689	♐ 1.26	6	6.26.04	6	2.04.09	6	0.47.40	36	4. 46
1701	♌ 4.14	7	10.28.38	7	8.14.50	7	0.55.37	37	4. 54
Menſ.	*Mot. Med.*	8	9.11.52	8	2.25.32	8	1.03.34	38	5. 2
Anni.		9	1.14.26	9	9.06.14	9	1.11.31	39	5. 10
Com.	s. o. ′.	10	5.17.00	10	3.16.55	10	1.19.28	40	5. 18
Jan.	0. 0. 0	11	9 19.34	11	9.27.36	11	1.27.24	41	5. 26
Febr.	5. 1.27	12	8. 2.48	12	4. 8.18	12	1.35.21	42	5. 34
Mar.	3. 0.49	13	0. 5.22	13	10.19.00	13	1.43.18	43	5. 42
Apri.	8.02.16	14	4. 7.56	14	4.29.41	14	1.51.15	44	5. 50
Maii	6.23.02	15	8.10.29	15	11.10.23	15	1.59.11	45	5. 58
Juni	11.24.29	16	6.23.43	16	5.21.04	16	2. 7. 8	46	6. 5
Julii	10.15.15	17	10.26.17	17	0 01.46	17	2.15.05	47	6. 13
Aug.	3.16.42	18	2.28.51	18	6.12.28	18	2.23.01	48	6. 21
Sept.	8.18.09	19	7. 1.25	19	0.23.09	19	2.30.58	49	6. 29
Octo.	7.08.54	20	5.14.39	20	7. 3.50	20	2.38.55	50	6. 37
Nov.	0.10.21			21	1.14.32	21	2.46.52	51	6. 45
Dec.	11.01.07			22	7.25.13	22	2.54.49	52	6. 53
				23	2.05.55	23	3. 2.45	53	7. 1
				24	8.16.36	24	3.10.42	54	7. 9
				25	2.27.18	25	3.18.39	55	7. 17
				26	9.07.59	26	3.26.35	56	7. 25
				27	3.18 41	27	3.34.32	57	7. 33
				28	9.29.22	28	3.42.28	58	7 41
				29	4.10.03	29	3.50 25	59	7. 49
				30	10.20.45	30	3.58.22	60	7. 57

In Anno Biſſextili poſt Februarium adde unum diem motumque ei competentem.

Tabula Motus Medii penitimi Satellitis Saturni, à Cassino *Detecti Anno* 1686.

Ann. Christ. Curr.	*Epochæ* o. ′.	*Annus*	*Mot. Med.* s. o. ′.	*Dies*	*Mot. Med.* s. o ′.	*H. M*	*Mot. Med* sex. ° ′. ° ′. ″.	*M.*	*Motus Medi.* °. ′.
1681	☌. 20.41	1	4. 6.37	1	4.11.31	1	○. 5.29	31	2. 50
1685	♄. 28.42	2	8.13.15	2	8.23.03	2	0.10.58	32	2. 56
1686	☊. 5.20	3	0.19.52	3	1. 4.34	3	0.16.26	33	3. 01
1687	♌. 11.57	4	9. 8. 1	4	5.16.06	4	0.21.55	34	3. 7
1688	♍. 18.35	5	1.14.39	5	9.27.37	5	0.27.24	35	3. 12
1689	♎. 6.44	6	5.21.16	6	2.09.09	6	0.32.53	36	3. 17
1701	♒. 0.48	7	9.27.54	7	6.20.40	7	0.38.22	37	3. 23
Mens. Anni Com.	*Mot. Med.* s. o. ′.	8	6.16. 3	8	11. 2.12	8	0.43.51	38	3. 28
		9	10.22.40	9	3.13.43	9	0.49.19	39	3. 34
Jan.	0. 0. 0	10	2.29.18	10	7.25.15	10	0.54.48	40	3. 40
Febr.	3.27.16	11	7 05.55	11	0.06.46	11	1.00.17	41	3. 45
Mar.	6.19.58	12	3.24.04	12	4.18.18	12	1. 5.46	42	3. 50
Apri.	10.17.15	13	8.00.42	13	8.29.49	13	1.11.15	43	3. 56
Maii	10. 3. 0	14	0.07.19	14	1.11.21	14	1.16.44	44	4. 01
Juni	2. 0.16	15	4.13.57	15	5.22.52	15	1.22.12	45	4. 7
Julii	1.16. 1	16	1.02.06	16	10.04.24	16	1.27.42	46	4. 12
Aug.	5.13.18	17	5.08.43	17	2.15.55	17	1.33.11	47	4. 17
Sept.	9.10.34	18	9.15.21	18	6.27.27	18	1.38.39	48	4. 23
Octo.	8.26.19	19	1.21.58	19	11.08.58	19	1.44.08	49	4. 28
Nov.	0.23.36	20	10.10.07	20	3.20.30	20	1.49.37	50	4. 34
Dec.	0. 9.21			21	8. 2. 1	21	1.55.06	51	4. 39
				22	0.13.33	22	2.00.34	52	4. 45
				23	4.25. 4	23	2. 6.03	53	4. 50
				24	9.06.36	24	2.11.31	54	4. 56
				25	1.18.07	25	2.17.00	55	5. 01
				26	5.29.39	26	2.22.29	56	5. 7
				27	10.11.10	27	2.27.58	57	5. 12
				28	2.22.42	28	2.33.26	58	5. 18
				29	7.04.13	29	2.38.55	59	5. 23
				30	11.15.45	30	2.44.24	60	5. 29

In Anno Bissextili post Februarium adde unum diem motumque ei competentem.

Tabula Motus Medii Satellitis Saturnii Medii, à Caſſino detecti Anno 1673.

Ann. Chriſ. Curr.	*Epochæ* o. ′.	*Annus*	*Mot. Med.* s. o. ′.	*Dies*	*Mot. Med.* s. o. ′.	*H. M.*	*Mot. Me. sex.* °. ′. ″.	*M.*	*Motus Med.* o. ′.
1661	♑. 22.50	1	9.14.29	1	2.18.42	1	0. 3.17	31	1. 41
1681	♍. 16. 3	2	6.28.58	2	5. 7.24	2	0. 6.33	32	1. 45
1685	♒. 2.41	3	4.13.27	3	7.26.05	3	0. 9.50	33	1. 48
1686	♏. 17.10	4	4.16.38	4	10.14.47	4	0.13. 7	34	1. 52
1687	♍. 1.39	5	2.01.08	5	1. 3.29	5	0.16.24	35	1. 55
1688	♊. 16. 9	6	11.15.37	6	3.22.11	6	0.19.40	36	1. 58
1689	♊. 19.20	7	9.00.06	7	6.10.53	7	0.22.57	37	2. 1
1701	♌. 9.15	8	9. 3.17	8	8.29.35	8	0.26.14	38	2. 5
Menſ.	*Mot. Med.*	9	6.17.46	9	11.18.16	9	0.29.31	39	2. 8
Anni		10	4.02.15	10	2. 6.58	10	0.32.47	40	2. 11
Com.	s. o. ′.	11	1.16.45	11	4.25.40	11	0.36.04	41	2. 14
Jan.	0. 0. 0	12	1.19.55	12	7.14.22	12	0.39.21	42	2. 18
Febr.	9. 9.37	13	11.04.24	13	10.03.04	13	0.42.38	43	2. 21
Mar.	10.23. 8	14	8.18.54	14	0.21.46	14	0.45.55	44	2. 24
Apri.	8. 2.45	15	6.03.23	15	3.10.27	15	0.49.11	45	2. 28
Maii	2.23.40	16	6. 6.34	16	5.29.09	16	0.52.28	46	2. 31
Junii	0. 3.17	17	3.21.03	17	8.17.51	17	0.55.45	47	2. 34
Juli.	6.24.12	18	1.05.32	18	11.06.33	18	0.59. 1	48	2. 37
Aug.	4. 3.49	19	10.20.01	19	1.25.15	19	1.02.18	49	2. 40
Sept.	1.13.25	20	10.23.12	20	4.13.57	20	1. 5.35	50	2. 44
Octo.	8. 4.20			21	7.02.39	21	1. 8.52	51	2. 47
Nov	5.13.57			22	9.21.20	22	1.12.08	52	2. 50
Dece.	0. 4.52			23	0.10.02	23	1.15.25	53	2. 54
				24	2.28.44	24	1.18.42	54	2. 57
				25	5.17.26	25	1.21.59	55	3. 00
				26	8.06.08	26	1.25.15	56	3. 4
				27	10.24.50	27	1.28.32	57	3. 7
				28	1.13.32	28	1.31.49	58	3. 10
				29	4.02.13	29	1.35.06	59	3. 13
				30	6.20.55	30	1.38.22	60	3. 17

In Anno Biſſextili poſt Februarium adde unum diem, motumque competentem.

Tabula Motus Medii penextimi Satellitis Saturni, ab Hugenio *inventi Anno* 1655.

Ann. Christ. Curr.	*Epochæ* s. o. ′.	*Anni*	*Mot. Med.* s. o. ′.	*Dies*	*Mot. Med.* s. o. ′.	*H. M.*	*Mot. Me.* o. ′ ″.	*M.*	*Motus Med.* ′. ″.
1641	♈. 24.43	1	10.20.41	1	0.22.35	1	0. 56	31	29.10
1661	♓. 11.19	2	9.11.22	2	1.15. 9	2	1. 53	32	30. 6
1681	♈. 27.56	3	8.02.03	3	2. 7.44	3	2. 49	33	31. 3
1685	♐. 13.15	4	7.15.19	4	3. 0.18	4	3. 46	34	31.59
1686	♍. 3.56	5	6. 6.00	5	3.22.53	5	4. 42	35	32.55
1687	♍. 24.37	6	4.26.41	6	4.15.28	6	5. 39	36	33.52
1688	♌. 15.19	7	3.17.22	7	5. 8. 2	7	6. 35	37	34.48
1689	♋. 28.34	8	3.00.39	8	6. 0.37	8	7. 32	38	35.45
1701	♊. 14.32	9	1.21.20	9	6.23.12	9	8. 28	39	36.41
Mens.	*Mot. Med.*	10	0.12. 1	10	7.15.46	10	9. 24	40	37.38
Anni Com.	s. o. ′.	11	11. 2.42	11	8. 8.21	11	10. 21	41	38.34
		12	10.15.58	12	9. 0.55	12	11. 17	42	39.31
Jan.	0. 0. 0	13	9.06.39	13	9.23.30	13	12. 14	43	40.27
Febr.	11. 9.54	14	7.27.20	14	10.16. 5	14	13. 10	44	41.24
Mar.	8.12. 3	15	6.18.01	15	11. 8.39	15	14. 7	45	42.20
Apri.	7.21.57	16	6. 1.17	16	0. 1.14	16	15. 3	46	43.17
Maii	6. 9.16	17	4.21.58	17	0.23.48	17	16. 0	47	44.13
Junii	5.19.10	18	3.12.40	18	1.16.23	18	16. 56	48	45.10
Juli.	4. 6.29	19	2. 3.21	19	2. 8.58	19	17. 52	49	46. 6
Aug.	3.16.22	20	1.16.36	20	3. 1.32	20	18. 49	50	47. 3
Sept.	2.26.16			21	3.24. 7	21	19. 45	51	47.59
Octo.	1.13.35			22	4.16.42	22	20. 42	52	48.56
Nov.	0.23.29			23	5. 9.16	23	21. 38	53	49.52
Dece.	11.10.48			24	6. 1.51	24	22. 35	54	50.49
				25	6.24.25	25	23. 3	55	51.45
In Anno Bissextili post Februarium adde unum diem, motumque competentem.				26	7.17.00	26	24. 27	56	52.42
				27	8. 9.35	27	25. 24	57	53.38
				28	9. 2. 9	28	26. 20	58	54.35
				29	9.24.44	29	27. 17	59	55.31
				30	10.17.18	30	28. 13	60	56.27

Tabula Mediorum Motuum Extimi Satellitis Saturnii, à Caſſino detecti Anno 1671.

Annis Chriſt. Curr.	*Epochæ* s. o. ′.	*Annus*	*Mot. Med.* s. o. ′.	*Dies*	*Mot. Med.* s. o. ′.	*H.* *M.*	*M.M* ° ′. ′. ″.	*M.*	*Motus Med.* ′.
1661	♐. 24.45	1	7. 6.23	1	0. 4.32	1	0.11	31	5.51
1681	♈. 25.15	2	2.12.47	2	0. 9. 5	2	0.23	32	6. 3
1685	♏. 25.21	3	9.19.10	3	0.13.37	3	0.34	33	6.14
1686	♉. 1.44	4	5.00.06	4	0.18. 9	4	0.45	34	6.25
1687	♐. 8. 7	5	0. 6.29	5	0.22.41	5	0 57	35	6.37
1688	♎. 14.31	6	7.12.53	6	0.27.14	6	1. 8	36	6.48
1689	♒. 25.27	7	2.19.16	7	1.01.46	7	1.19	37	7.00
1701	♉. 25.45	8	10. 0.12	8	1. 6.18	8	1.31	38	7.11
Menſibus.	*Mot. Med.* s. o. ′.	9	5. 6.35	9	1.10.50	9	1.42	39	7.22
		10	0.12.59	10	1.15.23	10	1.53	40	7.34
Jan.	0. 0. 0	11	7.19.22	11	1.19.55	11	2. 5	41	7.45
Febr.	4.20.41	12	3. 0.18	12	1.24.27	12	2.16	42	7.56
Mar.	8.27.45	13	10. 6.41	13	1.28.59	13	2.27	43	8. 8
Apri.	1.18.25	14	5.13.05	14	2. 3.32	14	2.39	44	8.19
Maii	6. 4.34	15	0.19.28	15	2. 8.04	15	2.50	45	8.30
Junii	10.25.15	16	8. 0.24	16	2.12.36	16	3. 1	46	8.42
Julii.	3.11.23	17	3. 6.47	17	2.17.08	17	3.13	47	8.53
Aug.	8. 2. 4	18	10.13.11	18	2.21.41	18	3.24	48	9. 4
Sept.	0.22.45	19	5.19.34	19	2.26.13	19	3.35	49	9.16
Octo.	5. 8.53	20	1. 0.30	20	3. 0.46	20	3.47	50	9.27
Nov.	9.29.34			21	3. 5.18	21	3.58	51	9.38
Dec.	2.15.43			22	3. 9.50	22	4. 9	52	9.50
				23	3.14.22	23	4.21	53	10.01
In Anno Biſſextili poſt Februarium adde unum diem, motumque competentem.				24	3.18.54	24	4.32	54	10.12
				25	3.23.27	25	4.43	55	10.24
				26	3.27.59	26	4.55	56	10.35
				27	4.02.31	27	5. 6	57	10.46
				28	4. 7.04	28	5.17	58	10.58
				29	4.11.36	29	5.29	59	11. 9
				30	4.16. 8	30	5.40	60	11.21

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.

	Periodus.			Diſtantia.
	d.	h.	′	
Intimi	1	21	18½ ——	0, 964
Penintimi	2	17	41½ ——	1, 235
Medii	4	13	47¼ ——	1, 740
Penextimi	15	22	41 ——	4, 000
Extimi	79	7	54 ——	11, 621

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 ſatisfie 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

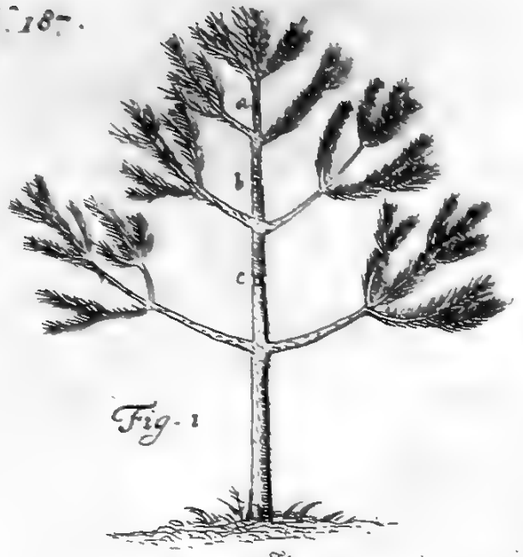


Fig. 1

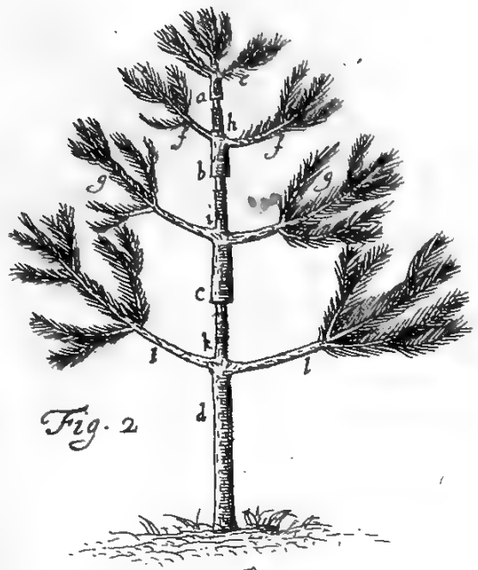


Fig. 2

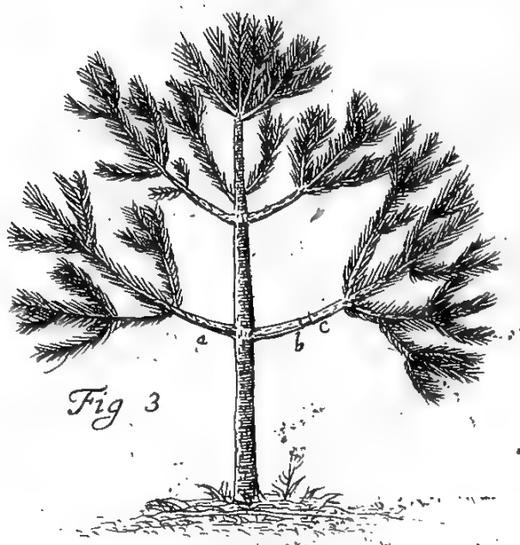


Fig 3

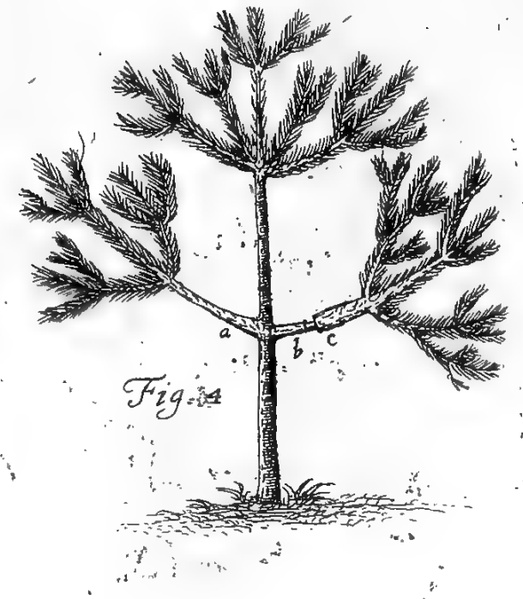


Fig. 4

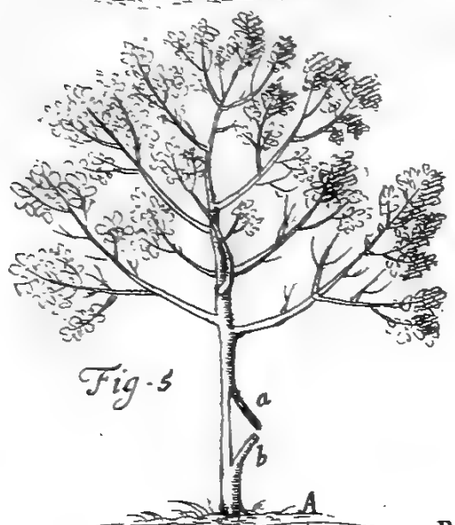


Fig. 5

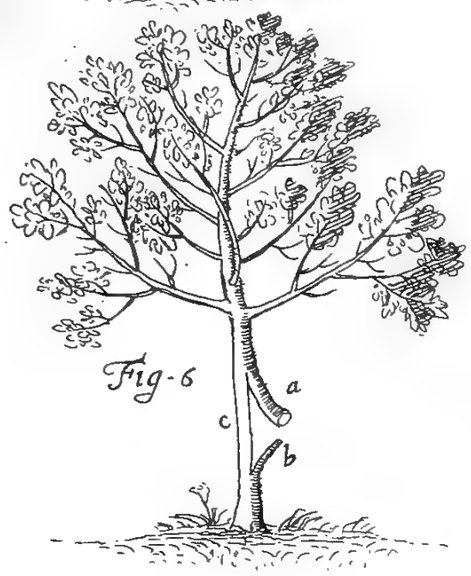


Fig. 6

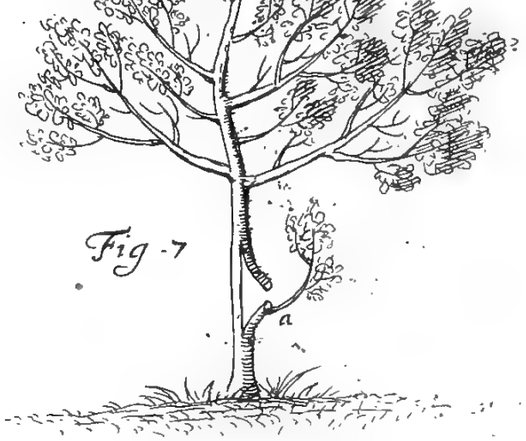


Fig. 7

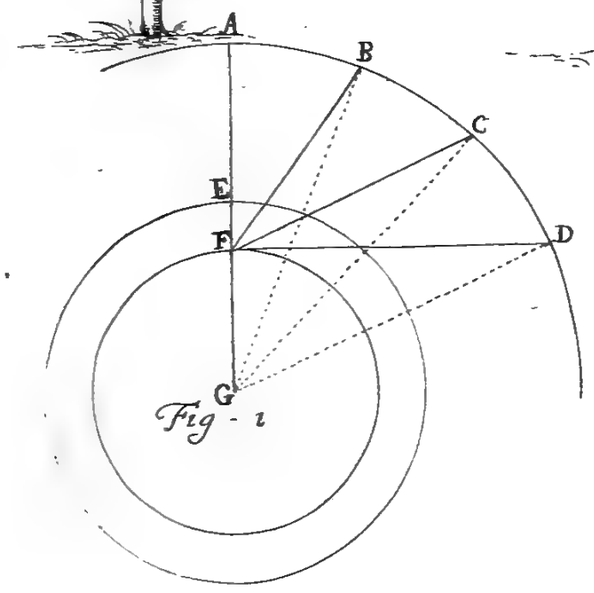


Fig. 1

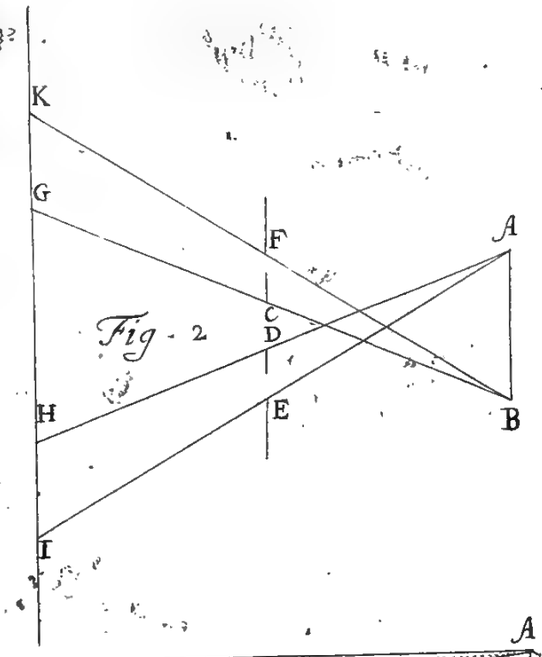


Fig. 2

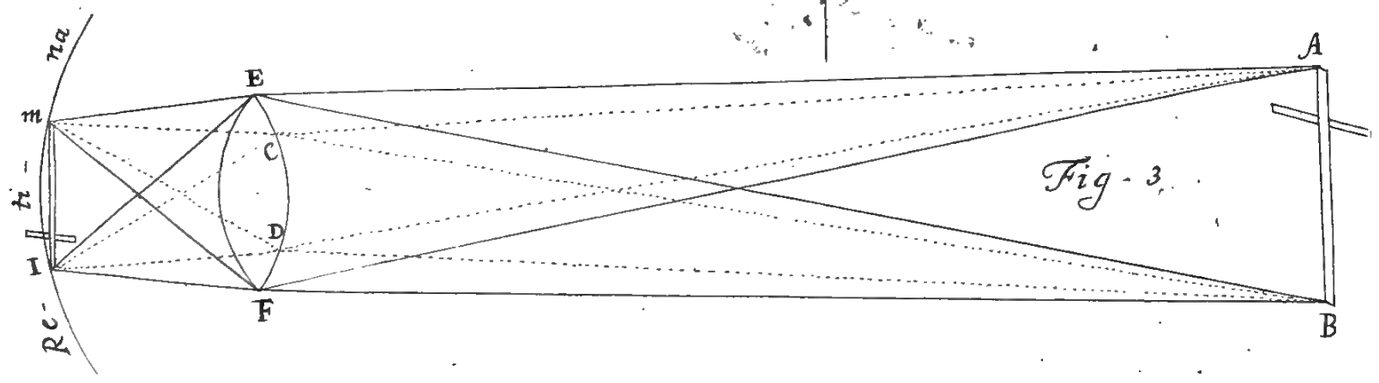


Fig. 3

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. 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 mortifyed; but the upper part increaſed to the 3*d.* 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 *Aſh* 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 upermoſt Knot or Joynt, was obſerved to grow and ſhoot out its Top, about

half a Yard; and the Parts all about the Ring, to increaſe very much in thickneſs 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 *Obctober* 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 halfe an inch in breadth, by leaving a like helical ſwath of Bark to comunicate 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 obſervable, 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 Joynt 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 Joynts, 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 Joynt continued of the ſame bigneſs, but above the Ring it increaſed and grew to the bigneſs of ones Finger, and from the new Joynt 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 Joynt ſhooting out new Body and Limbs, as the Top or Body; and the Body of the Tree below the Joynt *h* 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 Joynt, increaſed not at all. The like ſhooting forth and increaſing, was obſerved in the 2*d*. Limbs Joynt and Stock below it *g g*. *i* to *c*, between which and *k*, it increaſed not.

The like alſo ſucceeded in the lower Branches *l l*, and Joynt *k*, and in the Stock *d*, below the Joynt *k*.

Fig. the 3*d.* Repreſents a young *Scotch* Firr of two Years old, on one of the lowermoſt Branches *c*, 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 ſoyl 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 uper 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 heighth 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 heighth and bigneſs than did the former *A*. *C* increaſed yet much more in all its parts than *B*. But *D* increaſed in Limbs, Heighth, and Bigneſs moſt of all; ſwelling in bigneſs, and ſtretching in heighth 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 highth, that had been pruned, and had only a ſmall Top left, were alſo killed by the ſaid Froſt; whereas thoſe Trees of the ſame Kind and Heighth, 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 præceding Winter.

Where

Where theſe prunings had been tryed upon Trees 20 Foot high ; the difference of their Increaſe, was ſenſible the following Summer, but in 7 or 8 Years time, the difference is prodigious ; the 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 *Pinaſter* 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 flouriſh 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 farr 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 nouriſht and increaſed by a double Food; the one an impregnated Water, and the other an impregnated Air, and that without a convenient ſupply of theſe two, the Vegetable cannot ſubſiſt, at leaſt not increaſe. Theſe do mutually mix and coaleſs, and parts of the Air convert to Water, and parts of Water convert to Air. As ſome of this latter are rarifyed and freed from their Chains and become Spiritual and Aiery, ſo others of the fore-mentioned, are clogge'd 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 conveigh 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, aud 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 els where explained.

Con-

Concerning the Apparent Magnitude of the Sun *and* Moon, *or the Apparent Diſtance of two Stars, when nigh the* Horizon, *and when Higher elevated.*

I Do not Deſigne 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 at aſolution thereof, and have come ſhort (as I conceive) of being ſatisfactory; that thereby I may again ſett the minds of Philoſophers on Work, and rouſe them up to enquire a new after this ſurpriſing *Phanomenon*. That I may doe this the more Effectualy, I ſhall breifly 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 *m.* 30 *ſ.* we will take it *Numero Rotundo* to de 30, that is, an Arch of a great Circle in the Heavens of 30 Minuts 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 accomodate 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

an Inſtrument we take her Diameter, both in one poſture and t'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 tryals 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 tryed it my ſelfe, 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 Occupy'd by her body; then obſerving her again, when more Elevated and free from all Extravagant greatneſs, I ſtill found the ſame ſquares of the Lettice poſſeſſed by her. This way is Equivalent to that now more uſed, of taking her Diameter by Mr. *Townlys Micrometers*: but I have alſo tryed and found the ſame thing by an Accurate Sextant, taking the diſtance of the Moons Oppoſite Limbs.

Now this *Phænomenon* affords two things to be conſiderd, 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 a bout the *Horizon*, then when more elevated; and ſecondly, ſhee 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, wheras in truth the Meridionall 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 Iudgment than to any Natural Affection of the Organ or Medium of ſence; 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 tis a meer Deceipt: for we only think ſo, becauſe ſhe ſeems nigher the tops of Trees or Chimnys or Houſes or a ſpace of Ground, to which we can compare her, and Eſtimat 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 Cluſter of Chimnys, 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 ſhee 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 *A D* to Repreſent that blew ſurface in which we Imagine the fixed Stars: and let *F D* be the *Horizon.* Divide the Arch *A D* into three equal parts by the lines *B F, C F*; it is manifeſt that the Angle *A F B* is greater then the Angle *B F C*, and this again greater than the Angle *C F D*. Wherefore ſays he, to make the Angle *C F D* equal to the Angle *C F B*, the Arch *C D* muſt be greater then the Arch *C B*; 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 *B F C*, that ſhee may appear under an equal Angle in the *Horizon*, as ſuppoſe *C F D*, tis neceſſary that Arch *C D* ſhould be greater then *C B*; and conſequently tho 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 *G F* repreſenting the Earth very large

in proportion to the Circle *A D*; and then indeed taking the Point *F* in the Earths ſurface, and by lines from thence dividing the Angle *A F D* into what ever equal parts, the Intercepted Arches *A B*, *B C*, *C D* 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 *F B*, *F C*, *F D*, 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 ſence) 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 *A D*, 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 it ſelf, thereby tranſmiting a larger Projection on the *Retina*. In this Opinion I doe find he is not alone, for in the Journalls *des Scavans*, this diſquiſition being again revived by a French *Abbe*, He therein follows this Sentiment of *Gaſſendus*; it was firſt Publiſhed in the 3*d* Conferance 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 Pupill cauſeth a different ſhape in the Eye; an open Pupil making the *Cryſtalline* flatter and the Eye longer, and the narrower Pupil ſhortning

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 veiwing 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 *Phænomenon*, as follows. When the Moon is nigh the *Horizon*, by compariſon with interpoſed Objects, we are apt to Imagine her much farther from us then when more Elevated, and therefore (ſays he) we order our Eyes as for veiwing an Object farther from us, that is, we ſomthing enlarge the Pupil, and thereby make the *Cryſtalline* more flatt: moreover the Duskiſhneſs of the Moon in that poſture does not ſo much ſtrain the ſight; 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 Duskiſhneſs, 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, admiting the projection *K I* on the Retina, whereas the leſſer

aperture

Aperture *C D* admits only the projection *G H*; but *G H* is leſs then *K I*, wherefore a leſſer Aperture diminiſhes the projection. I admire that any Man that undertooke (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 *A B* be a Remote Object, and *E F* the *Cryſtalline* at its large aperture, projecting the Image *I M* on the *Retina*. Let then *C D* be the leſſer Aperture of the *Pupil* before the *Cryſtalline*: I ſay the Image *I M* ſhall be projected as large as before, for the Cone of Rays *E A F* conſiſts partly of the Cone of Rays *C A D*, therefore where the former *E A F* is Projected, the latter *C A D*, 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 Teleſcopes greater or leſſer Aperture, makes no difference in the Angle it receives: for imagine *E F* to be an Object-Glaſs of a Teleſcope, and t'is 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 admited to determine on the Projection of each Point. But all this

by

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 Duskiſhneſs of the Moon nigh the *Horizon* admits the *Pupill* to enlarge it ſelf, 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 *Phænomenon* in them, and yet I hope neither he nor *Gaſſendus* will Aſſert, that they at one time ſtrain the Eye more than at an other, 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 inoffencive to the Eye, as that of a green Field; but perhaps he will then ſay that this other Reaſon holds which is 2*ly*. 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 *Des-Cartes*: therefore I paſs it over, only ſubjoyning that if there were any thing in this Surmiſe, my-thinks the *Horizontal* Moon ſhould be fancyed nigher to us then 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 2*d.* 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 *Horizontall* 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 alledged, 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 voſtre Sentement*, &c.

After

After which I have only to Subſcribe my ſelf an unworthy Member, and an humble Servant and Admirer of that Illuſtrious Company.

Dublin
March 10*th.* &c. *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 fourty 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 my ſelf,) that the apparent Magnitude taken by Inſtrument (however the Fancy may apprehend it) is not greater at the *Horizon*, than when higher. And Mr. *Caſwell* (when your Letter was communicated to our company here) affirmed the ſame.

And (though I have not my ſelf 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 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 inlarged, 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 inlarged; 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 highth) 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 *Horozon*, 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 fanſied 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 ſuppoſed diſtance.

True it is that, *Cæteris paribus*, we judg that to be the greater Object, which makes at the Eye the greater Angle: 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 Caſement 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 Imagination will appear greater.

Now ſure it is, that one great advantage for Eſtimating 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 Vally unſeen, it will appear much nearer than if we ſee the Vally 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 Vally may be ſeen) it will then appear much further than before it did.

And on this account it is, that the Sun ſetting, appears 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 Heaven it ſelf ſeems Contiguous to the viſible *Horizon*.

Now when the Sun or Moon is near the *Horizon*, there

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 fanſied 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 judg 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 beed 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 Suns Eclipſe *May* 1*ſt*. was here obſerved about ½ a Digit; between one and two a Clock after noon.

Account of *a* BOOK.

A Continuation of the New Digeſter *of* Bones: *It's Improvements and new Uſes it hath been applyed 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 2*d*. 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 Pulſe, Gellies, *&c*. He gives the Deſcription of another *E*ngine, 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 applyed to, but for brevities ſake, I will mention but one that ſeems to be very conſiderable. He hath tryed, 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 it ſelf. The Author doth afterwards relate, how theſe Gellies may be applyed for the preſerving of Summer Fruits: Upon this he alledgeth many Experiments, which give him Occaſion to make ſeveral Obſervations; as for *Example*, he ſaith 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 ſower in 3 Months time; whereas other *Strawberries* which he ſhut up in the Month of *June*, having been kept 8 Months, were not ſower at all, but had given a Vinous Taſt 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 diſtiling *per deſcenſum* in ſeveral degrees of Rarefaction and Condenſation 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 Condenſation of the Air will be of great advantage for a quick Diſtillation.

In

In the ſecond Section are explain'd the Improvements made by the Author, on the *Pneumatick* 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 Uſes this Engine hath lately been apply'd to; whereof I'll 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 boiling, he can preſerve great Quantities of Fruit with their Taſt: 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, and 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 judg

of the reſt; the firſt is, that two equal peices 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 advantagious. 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. Ambroſio 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 ſayd 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.

London, Printed by *J. Streater*, and ſold by *S. Smith*, at the *Prince*'s *Arms*, in St. *Paul*'s Church-Yard.

Numb. 188.

PHILOSOPHICAL TRANSACTIONS

For the Months of *July* and *Auguſt* 1687.

The CONTENTS.

Ob-

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 *Peritonæum*, we discovered the Bladder very *Schirrous* and thick, *viz.* $\frac{1}{4}$ of an Inch; of a Præternatural Figure, and distended to the bigness of a Childs Head: And at the entrance of the *Ureters* on each side were two *Protuberancies*, of the bigness of a Hens Egg each; the *Ureters* were of the largness of the small Gutts 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 larg 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 happned upon the breach of ſome of theſe Watery Tumours, when the Bladder was crouded 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 *Veſiculæ* 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 *Peritonæum* 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 rann 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 *Veſiculæ* being opened had a large cluſter of ſmall *Ova* as big as Grapes, all repleat 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 Aſh. 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 frighted by a Cow as ſhee 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 peice 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 ſhe Weeps through it; when ſhe Laughs it wrincles 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

De Conſtructione Problematum Solidorum, ſive Æquationum tertiæ vel quartæ Poteſtatis, unica data Parabola ac Circulo efficienda; diſſertatiuncula Authore *Edm.* Halley.

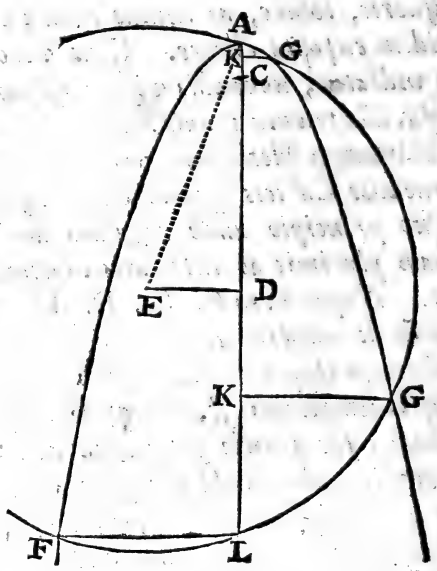
QVo pacto æquationes omnes Cubum vel Quadrato-quadratum quantitatis incognitæ involventes, ope Parabolæ cujuſcunq; datæ & Circuli, conſtrui poſſint, clare tradit ac Liquido demonſtrat præclarus ille Carteſius *in Lib. III. Geometriæ ſuæ: ſed primum jubet ſecundum æquationis terminum, ſi adfuerit, tollere, ac deinde reductæ æquationis Radices regula ibidem expoſita elicere. Cum vero operatio iſta nimis laborioſa videatur, nonnullis viſum eſt conſtructionem ſimilem etiam abſq; ulla prævia reductione comminiſci; inter quos* Franciſcus *a* Schooten *Methodum valde facilem ac ſimpliciſſimam pro conſtruendis Cubicis quomodolibet affectis prodidiſſet, ſi modo expoſito principio unde regulam derivavit, Lectoris memoriæ, quam plurimis ac intricatis cautionibus obruit, melius ſtuduiſſet. Nuper vero Vir Cl. D.* Thomas Baker *noſtras, integro libello de conſtructionibus hiſce conſcripto, non ſolum Cubicas ſed etiam Biquadraticas omnes cujuſcunq; generis unica generali regula complexus eſt, eamq; demonſtrationibus ac Exemplis per omnes caſus abunde ſatis illuſtravit; nec non ſub finem modum proponit unde regula iſta generalis inveſtigari poſſit: Haud tamen illum ipſum oſtendit, cujus ope (uti ſuſpicor) Clavem ſuam Geometricam Catholicam obtinuit, vel ſaltem multo facilius obtinere potuit. Cumq; perplexis cautionibus de ſignis + & — Regula hæc D.* Bakeri *non minus obnoxia ſit quam illa* Schooteni, *ut vix abſente libro conſtructiones illas quis tuto peragat; haud injucundum nec Tyronibus incommodum fore vi-*

ſum eſt, utriuſq; fundamentum exponere, ac ſimul emendata methodo, in re tam difficili, lucem quantum valeam afferre.

Conſtructio quam tradit Carteſius, *quæq; facillime radices æquationum omnium Cubicarum vel biquadraticarum, ubi deficit ſecundus terminus, eruit, ut nota ſupponi poteſt; attamen cum cardo ſit a quo ſubſequentia pendent, ne diſſertatiuncula hæc capite truncata videatur, ex illius Geometria deſumptam placuit Regulam adjungere, pauculis nonnullis in melius uti reor tranſpoſitis.*

Deficiente ſecundo termino omnes æquationes Cubicæ reducuntur ad hanc formam $z^3 .*. apz. aaq. = o$, *ac Biquadraticæ ad hanc* $z^4 .*. apzz. aaqz. a^3 r = o$. *(ubi* a *deſignat Latus rectum Parabolæ cujuſvis datæ, quam in Conſtructione adhibere licet,) vel ſumendo* a *pro Unitate, ad hanc* $z^3 .*. pz. q = o$, *vel ad hanc* $z^4 .*. pzz. qz. r = o$.

Jam data Parabola FAG *cujus Axis ſit* AC-DKL *ac latus rectum* a *vel* 1, *fiat* AC *ejus dimidium ac collocetur ſemper a vertice* A *verſus interiora figuræ: dein ſumatur* $CD = \frac{1}{2}p$ *in linea illa* AC *continuata verſus* C *ſi in æquatione fuerit* $-p$, *vel verſus alteram partem ſi habeatur* $+p$. *Porro e puncto* D, *aut ex puncto* C *ſi non habeatur quantitas* p, *erigenda eſt ad axem perpendicularis* DE *æqualis* $\frac{1}{2}q$, *dextrorſum quidem ſi fuerit* $-q$, *ad alterum vero axis latus ſi fuerit* $+q$; *ac Circulus centro* E *radio* AE *deſcriptus, ſi æquatio fuerit tantum Cubica, Parabolam tot punctis* F *&* G *interſecabit quot veras habet Radices, quarum quidem affirmativæ ut* GK



erunt

erunt ad dextram Axis partem, Negativæ ut F L *ad ſiniſtram.*

Aſt ſi Æquatio Biquadratica fuerit, augeri vel minui debet Circuli Radius A E, *addendo ſi fuerit* — r, *vel ſubducendo, ſi ſit* + r, *ex ejus quadrato rectangulum* a r, *ſeu contentum ſub Latere recto & quantitate data* r; *id quod nullo fere negotio efficitur Geometrice. Hujus vero Circuli interſectiones cum Parabola omnes veras Biquadraticæ Æquationis radices dimiſſis ad Axem perpendiculis exhibebunt; Affirmativas quidem ad dextram Axis, Negativas vero ad ſiniſtram. Totius demonſtrationem* Carteſio *ejus inventori relinquo.*

Notandum hic mi operam dare ut ſemper habeantur Radices affirmativæ ad dextrum Axis latus, ut evitetur confuſio a pluribus cautionibus, quarum cauſa minime evidens eſt, neceſſario oritura.

His præmiſſis, ut aditus pateat ad conſtructionem etiam earum æquationum ubi reperitur terminus ſecundus, conſideranda venit regula pro tollendo termino ſecundo, ac reducenda æquatione ad aliam quæ methodo præcedente conſtrui poſſit. Omnes vero hujus claſſis æquationes cubicæ ad hanc formam $z^3 . b z z . a p z . a a - q = o$, *vel ad hanc* $z^3 . b z z . * . a a q = o$. *Biquadraticæ vero ad hanc* $z^4 . b z^3 . a p z z . a a q z . a^3 r = o$, *vel hanc* $z^4 . b z^3 . * . a a q z . a^3 r = o$, *vel.* $z^4 . b z^3 . a p z z . * . a^3 r = o$ *vel deniq; ad hanc* $z^4 . b z^3 . * . * . a^3 r = o$ *reduci poſſunt: e quibus omnibus, prout ſignis* + *&* — *diverſimode connectuntur, ingens oritur varietas; unde Regula generalis omnibus inſerviens obſcura ac maxime difficilis redditur, niſi methodo quam ſubjungimus illuſtrata nodiſq; extricata tractetur.*

Tollitur in Biquadraticis ſecundus terminus, ponendo $x = z - \frac{1}{4} b$, *ſi fuerit* + b *in æquatione, vel* $x = z + \frac{1}{4} b$ *ſi fuerit* — b: *hinc* $x - \frac{1}{4} b$ *in primo caſu, &* $+ \frac{1}{4} b$ *in altero æquatur* z; *& in æquatione quavis propoſita, ſubſtituta loco* z *quantitate æquali, prodibit nova æquatio termino ſecundo carens, cujus radices omnes* x *data differentia* $\frac{1}{4} b$ *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.*

Exemp. I.

$z^4 + bz^3 - apzz - aaqz + aaar = 0.$

Sit $x - \frac{1}{4}b = z$ *Et erit*

$xx - \frac{1}{2}bx + \frac{1}{16}bb = zz$

$xxx - \frac{1}{4}xxb + \frac{1}{16}xbb - \frac{1}{64}bbb = z^3$

& $x^4 - bx^3 + \frac{3}{8}bbxx - \frac{1}{16}b^3x + \frac{1}{256}b^4. = z^4.$

hinc.

$$\begin{aligned} x^4 - bx^3 + \tfrac{3}{8}bbxx - \tfrac{1}{16}bbbx + \tfrac{1}{256}b^4. &= z^4 \\ +bx^3 - \tfrac{3}{4}bbxx + \tfrac{3}{16}bbbx - \tfrac{1}{64}b^4 &= +bz^3 \\ - apxx + \tfrac{1}{2}apbx - \tfrac{1}{16}apbb &= -apzz \\ - aaqx + \tfrac{1}{4}aaqb &= -aaqz \\ + aaar & \end{aligned}$$

Harum omnium ſumma ſit æquatio nova ſecundo termino carens, quæq; proinde juxta regulam Carteſianam conſtrui poſſit, ſumendo loco $\frac{1}{2}p$ *dimidium coefficientis termini tertii per* a *ſive Latus rectum diviſi, hoc eſt* $-\frac{3}{16}\frac{bb}{a} - \frac{1}{2}p$; *ac Loco* $\frac{1}{2}q$, *dimidium coefficientis termini quarti per* a a *diviſi, ſive* $+\frac{1}{16}\frac{bbb}{aa} + \frac{1}{4}\frac{pb}{a} - \frac{1}{2}q$. *Cujus partes ſigno* + *notatæ ſiniſtrorſum ab Axe, ſigno* − *notatæ dextrorſum collocandæ ſunt, ut habeatur centrum Circuli ad conſtructionem requiſiti, ac cujus interſectiones cum Parabola, dimiſſis in axem perpendiculis, radices omnes veras* x *deſignet, affirmativas quidem ad dextram axis, negativas vero ad ſiniſtram. Cum vero* $x - \frac{1}{4}b = z$, *ducendo lineam Axi parallelam, ad dextrum ejus latus & ad diſtantiam* $\frac{1}{4}b$, *perpendicula illa ad hanc parallelam terminata deſignabunt omnes radices quæſitas* z, *affirmativas ad dextram, negativas vero ad ſiniſtram. 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 Parabolæ A *ductæ : id quod maxima ex parte efficitur capiendo loco lineæ* A E *lineam* E O, *quæ ad* O *interſectionem Parabolæ ac parallelæ prædictæ terminatur ; ejus enim quadratum omnes termini quinti partes ex ablatione termini ſecundi æquationi novæ ingeſtas complectitur (uti facile probabitur:) ac reſtat ſolummodo ut ipſius* E O *quadratum augeatur, ſi in æquatione habeatur* — r, *vel minuatur ſi ſit* + r, *additione vel ſubductione rectanguli* a r, *unde conflatur quadratum Radii Circuli quæſiti.*

Hæc eſt methodus inveſtigandi regulam centralem Dni Bakeri *omnibus cautionibus libera ac ſatis facilis ; ac ſola differentia ex eo provenit, quod ego juxta Axem, ille vero juxta Axi parallelam circuli ejuſdem centrum determinat : quodq; ego ſemper radices affirmativas ex Axis dextro latere invenio, quas ille nunc dextro nunc ſiniſtro conſtituit.*

Æquationes cubicas quod attinet, eæ reduci debent ad Biquadraticas, antequam eadem regula generali conſtrui poſſint ; id quod fit ducendo æquationem propoſitam in radicem ſuam z, *unde provenit æquatio Biquadratica in qua deficit terminus ultimus ſive* r : *quapropter ſublato ſecundo termino & invento centro* E, *linea* E O *eſt radius Circuli ; cum ſcilicet* a r *ſit* = o, *& in nova æquatione totus terminus quintus ex ipſa ablatione termini ſecundi oriatur. Conſtruenda ſit hæc æquatio.*

Exemp. II.

$z^3 - bzz + apz + aaq = o$: *Quæ ducta in* z *fit*

$z^4 - bz^3 + apzz + aaqz = o$

Ad tollendum ſecundum terminum ponatur $x + \frac{1}{4}b = z$, *& fiet*

$$\begin{aligned} x^4 + bx^3 + \tfrac{3}{8}bbxx + \tfrac{1}{16}b^3x + \tfrac{1}{256}b^4 &= +z^4 \\ -bx^3 - \tfrac{3}{4}bbxx - \tfrac{3}{16}b^3x - \tfrac{1}{64}b^4 &= -bz^3 \\ + apxx + \tfrac{1}{2}abpx + \tfrac{1}{16}apbb &= +apzz \\ + aaqx + \tfrac{1}{4}aaqb &= +aaqz \end{aligned}$$

In hac nova Æquatione, tertii termini ſemicoefficiens per a *diviſa, viz.* $= \frac{3bb}{16a} + \frac{1}{2}p$, *loco* $\frac{1}{2}p$ *uſurpanda eſt ; ac coeffi-*

cientis termini quarti dimidium, diviſum per a a *Lateris recti quadratum*, viz. $-\frac{bbb}{16aa} + \frac{pb}{4a} + \frac{1}{2}q$, *vicem ipſius* $\frac{1}{2}q$ *in conſtructione* Carteſii *ſubit; unde centrum* E *determinatur. Deinde ducta Axi parallela ad diſtantiam* $\frac{1}{4}b$ *ad ſiniſtrum ejus latus (ob* $x + \frac{1}{4}b = z$*) cujus interſectio cum Parabola ſit* O; *circulus centro* E, *Radio* EO *deſcriptus Parabolam ſecet vel tanget in tot punctis quot æquatio veras habet radices: quæ quidem radices ſeu* z *ſunt perpendicula de punctis illis in Axi parallelam demiſſa; ad dextram quidem Affirmativæ, Negativæ ad ſiniſtram.*

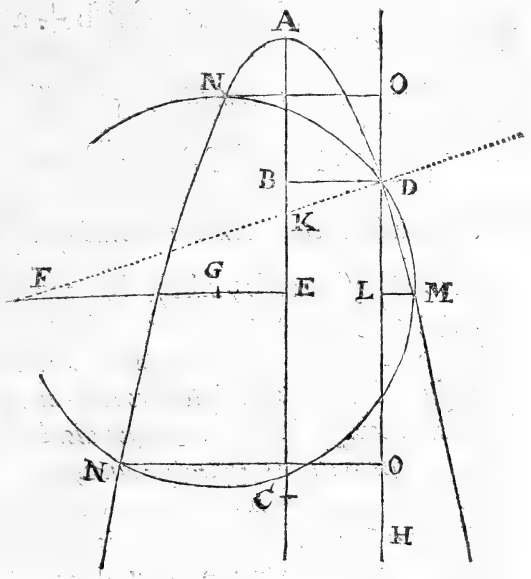
Si in æquatione defuerit terminus tertius vel quartus vel uterq;, in inveſtiganda regula centrali nulla omnino obſervanda eſt methodus differentia, ſed deficiente quantitate p *vel* q, *deerunt partes illæ linearum* C D *ac* D E *ex quantitate illa aliquo modo deductæ, ac procedendum eſt cum reliquis coefficientibus termini tertii & quarti in æquatione nova, ſicut in præmiſſis exemplis præſcriptum eſt.*

Hactenus Cl. Bakeri *methodum generalem pertractavimus, qua quidem nulla alia facilior ac paratior expectanda eſt, aſſumpta ad conſtructionem ſive Parabola, ſive alia quævis linea curva, cum ſcilicet æquatio ad Biquadraticam aſcendit. Etenim dum hæc ſcribo mihi occurrit regulæ Centralis Effectio Geometrica præter omnem ſpem expedita, ac harum rerum Curioſis abunde ſatiſfactura.*

Deſcripta Parabola N A M, *cujus vertex* A, *Axis* A B C *ac latus rectum* a, *reducatur æquatio ad hanc formam* $z^4 . b\,z^3 . a\,p\,z\,z . a\,a\,q\,z . a^3\,r = o$ *vel ad hanc* $z^3 . b\,z\,z . a\,p\,z . a\,a\,q = o$ *ſi cubica tantum fuerit: dein ad diſtantiam* B D $= \frac{1}{4}b$ *ducatur linea* D H *Axi parallela, ad ſiniſtram quidem ſi fuerit* $-b$, *ad dextram ſi* $+b$, *parabolæ occurrens in puncto* D; *de quo dimittatur perpendiculum in axem* B D. *In linea* A B *continuata verſus* B *fiat* B K $= \frac{1}{2}a$, *& ducatur linea* D K *utrinq; interminata. Porro ſit* K C $= 2$ A B *in Axe ſemper ultra* K *continuato; ac ſi habeatur quantitas* p *ſigno* — *affecta, verſus eaſdem partes etiam ſumatur* C E $= \frac{1}{2}p$, *vel in contrarias,*

ſi

ſi habeatur + p, *ac e puncto* E *erigatur Axi perpendiculum* EF *(vel epuncto* C *ſi defuerit quantitas* p *) lineæ* DK, *ſi opus eſt continuatæ, occurrens in puncto* F; *quod quidem circuli requiſiti centrum eſt, ſi defuerit quantitas* q; *Aſt ſi habeatur* q, *ſumenda eſt in* FE, *ſi opus eſt continuata, linea* FG = ½ q, *ſiniſtrorſum quidem ſi fuerit* + q, *dextrorſum ſi* — q *collocanda: Et punctum* G *erit centrum circuli ad conſtructionem propoſitam idonei; ejuſq; Radius, ſi defuerit quantitas* r, *hoc eſt ſi tantum cubica fuerit, erit linea* GD; *cujus quadratum in Biquadraticis augendum eſt ſi fuerit* — r, *vel minuendum ſi* + r *additione vel ſubductione rectanguli ſub* r *& latere recto. Deſcripto ſic Circulo, ab interſectionibus ejus cum Parabola demiſſis in lineam* DH *perpendiculis, quæ ad ſiniſtram ſunt, ut* NO, *radices æquationis negativas ſemper deſignant, quæ ad dextram ut* ML *affirmativas.*



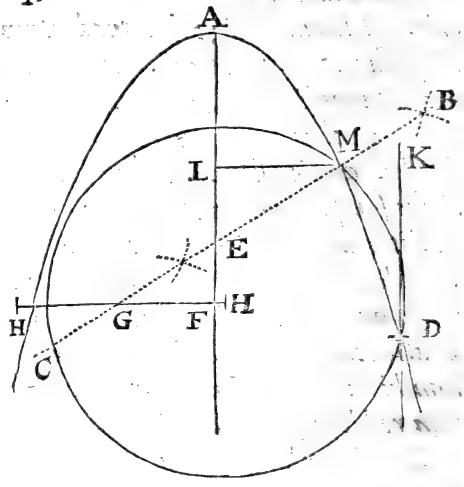
Aliter ac paulo ſimplicius Æquationes cubicæ juxta Schooteni *Regulam conſtruuntur, quaq; etiam radices ad Axem referuntur: quoniam vero ipſe inventor nec modum inveniendi nec demonſtrationem inventi exponit, non abs re erit ejuſdem fundamentum hic adjicere, ſimul atq; Effectionem Geometricam concinniorem reddere, atq; cautionibus quibus implicatur extricare.*

Hæc Regula derivatur ex eo quod omnis æquatio Cubica reduci poſſit ad Biquadraticam, in qua deficiet terminus ſecundus: Hoc fit ducendo æquationem propoſitam in z — b = o, *ſi fuerit* + b *in*

æquatione, vel in $z + b = o$, *ſi fuerit* $- b$; *& æquatio nova producta eaſdem habebit radices cum Cubica, atq; inſuper alteram ipſi* $- b$ *æqualem, ſi fuerit* $- b$ *in æquatione; vel contra.*

Proponatur conſtruenda $z^3 - z^2 b + a p z + a a q = o$. *Hæc ducta in* $z + b$ *fit* $z^4 - z^3 b + a p z^2 + a a q z + z^3 b - b b z z + a b p z + a a q b$. *Hic deficit ſecundus terminus, ac coefficiens tertii* $- b b + a p$ *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 quæſiti: atq; ob datam unam ex radicibus æquationis novæ,* viz. $-$ *vel* $+ b$, *dabitur etiam punctum in circumferentia, id eſt Radius ejus. Deniq; deſcripto circulo, ab interſectionibus ejus cum Parabola demiſſa in Axem perpendicula æquationis radices exhibebunt, affirmativas & negativas, eadem lege ac ſupra.*

Inveſtigatur autem centrum Circuli conſtructione perquam facili, cæteriſq; omnibus in Cubicis præferenda. Deſcriptæ Parabolæ AMD *ſit vertex* A, *atq; Axis* AF: *ad diſtantiam ipſi* b *æqualem ducatur Axi parallela* DK, *ad dextram ſi fuerit* $+ b$ *in æquatione, ad ſiniſtram ſi* $- b$, *quæ Parabolæ occurrat in puncto* D. *Centris* D *&* A *deſcribantur radiis æqualibus arcus occulti utrinq; ſeſe interſecantes, ac per ſectionum puncta ducatur linea interminata* BC, *quæ medio lineæ ſuppoſitæ* AD *perpendiculariter inſiſtat, & Axi occurrat in puncto* E. *Ab* E, *inferne quidem ſi in æquatione habeatur* $- p$, *vel ſuperne verſus* A *ſi fuerit* $+ p$, *ponatur*



tur EF = ½ p; *& ex* F *(vel ex* E *ſi defuerit* p*) educatur perpendiculum* FG, *lineæ* BC *occurrens in puncto* G; *& in* GF *producta fiat* GH = ½ q, *dextrorſum quidem ſi in æquatione habeatur* — q, *aliter ſiniſtrorſum, applicanda: ac punctum* H *erit centrum quæſitum,* HD *vero circuli Radius, qui demiſſis in axem perpendiculis ab interſectionibus ſuis cum Parabola, ut* LM, *Radices omnes, ut prius, commonſtrabit. Quomodo vero conſtructio hæc ex præmiſſis conſequatur, per ſe ſatis edens eſt, nec opus eſt ut in eadem demonſtranda diutius immorer.*

Ne in his edendis fruſtraneam navaſſe operam, & ex aliorum inventis gloriolam captare videar, conſulat Lector Cl. Bakeri *librum Anno* 1684 Londini *editum, & quæ de hoc Argumento ſcripſit a* Schooten *in Commentario ſuo in Librum III. Geometriæ Carteſianæ. Brevi conceſſo otio tractatulum alium de numero Radicum in hujuſmodi Æquationibus, earumq; limitibus, ex contemplatione Conſtructionum præcedentium, aggredi ac in lucem proferre ſtatuo.*

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 groſs 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 Errours 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 ſtear 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 tobe hoped to draw any farther advantage from it; ſince the Stone it ſelf, 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 diffe-

rent

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 tryal 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 surprised 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 Magneticall 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 Magneticall 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 suspended at liberty, would remain immoveable, and that one point thereof would regard the Pole of the World, which might be called the true Pole of the stone, whilest 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

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 ſtopped there; and that it had alſo the ſame inclination towards the Pole which is found in Needles after they have been touched: Laſtly I fixed upon the Ring a ſmall *Fleur de Lis* of Braſs, in the Point which exactly reſpected the North, the Ring being firſt well ſettled.

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 alwais 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 ſurpriſing: 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 applyed 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 ſtrowed 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 ſtreight, to make a Ring thereof; but I found that it had quite

quite loſt its Vertue : 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 looſes 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 Vertue, although it be put in a poſition contrary to its Poles. And this Experiment is confirmed by another much more conſiderable: Which is, that a Ring of Steel having been touched with a ſtrong Load-ſtone, cannot without difficulty recieve a contrary touch from a Magnet leſs ſtrong than the firſt ; but that in time by little and little it reſumes its former Vertue, much as we ſee Magnets do, which being applyed to another Stone, by the Poles of the ſame denomination, looſe their firſt Vertue and take a contrary; which they afterwards looſe by degrees, to reaſſume 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 Compaſs.

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 Vertue of the Stone which is applyed 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.

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 ½ Inches. However to put this matter paſt diſpute, care was taken to find out exactly and mark the Poles of the Societys 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 immoveable, 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.

Obſer-

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 *Luſace*, 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 *Lipſick* 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 Dwarfe 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 Ey 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 peice of Wood put into the *Focus* Flames in a Moment, ſo as a freſh Wind can hardly put it out. (2) Water applyed 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 peice of Tinn 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 applyed to the *Focus* melt, which I have tryed with ſeveral ſorts 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 ſuffred the moſt intenſe Heat of Fire, in a little time melt down into a yellow Glaſs, as do. (9) Pot-ſhreads, 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

of burning Mountains, in this Solar Fire, melts into a white tranſparent Glaſs. (11) A piece of a very ſtrong Crucible put in the *Focus*, in 8 Minutes was melted into a Glaſs. (12) 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 my ſelf 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 tryed what effect the Beams of the full Moon, concentred 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 encreaſed.

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 Paſts 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

Printed by *J. Streater*, and are to be Sold by *Sam. Smith* at the *Princes Armes* in St. *Paules Churchyard*.

PHILOSOPHICAL TRANSACTIONS.

For the Months of *September* and *October*, 1687.

The CONTENTS.

An Account of ſome Saxon *Coyns found in* Suffolk; *Communicated by* Sir P. S. *R. S. Soc.*

IN *May* 1687. at *Honedon* 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 *Tellow 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 bigneſs, *viz.* of a Groat, and about the ſame weight. I gheſs 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*.

Some ſay there was no Pot.

Cantuariæ Monetarii VII *Sunto, quorum quidem* IV *Regis*, II *Præſuli ac unus Cænobiarchæ deſervito. In Civitate Roffenſi tres ſint, Regii duo, tertius Epiſcopi. Londini* VIII. *Vintoniæ* VI. *In vico Lewiſio* II. *In vico Haſtingo* I. *Ciceſtriæ* I. *Hamtonæ* II. *Exceſtriæ* II. *Werham* II. *Schaftsburiæ* II. *Ad aliud quodque oppidum Monetarius unus eſto.*

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 ON LVND.
WILLEM ON LVND.
WILLEM ON CINT. *Canterbury* quær.
RICHARD ON 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 ſignifie where the Mony is ſtamp'd; as *A* for *Paris*, &c.

Theſe *Saxon* Monies were *Denarii*, or *Pennies*; for *Greaves*, of the *Denarius*, p. 117. ſays, In *Ethelred*'s time it was the 20*th* 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 intrinſick 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.* 1 *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, integram ſolvito Libram.* If more or leſs was found, it might anſwer another Mulct enjoined by the *Saxon* Laws for killing or maiming ſome Perſon of another Quality. Or the *æſtimatio capitis* might be laid in the Grave with the Perſon that was killed.

Thoſe who believe they were *Peter-Pence*, *Rome-Scot*, *Rome Feoh*, 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 Sepulturâ*, 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 ſaw; *viz.*

Reverse

1
ÆÐELSTAN RE+ — P NE / FEHO *b*

II
ÆÐELSTAN RE+ — LAND / EHO *c*

3 *wt.* 23 *grains*
ÆÐELSTAN RE+ — STEF / ANVS

4 24 *gr.*
ÆÐELSTAN RE+ — AREM / ONETA *d*

5 21 *gr.*
EADMVND RE+ — BEN / DICTVS

6 16 *gr.*
EADMVND RE+ — MAN / ANO

7 19 *gr.*
EADHVND RE+ — ALB / ERIHG *f*

8
EADMVND RE+ — IVEH / NETA *g*

9
EADMVN RE+ — HTIL / HAH *h*

10 24 *gr.*
EADMVND RE+ — MREA / ATENO

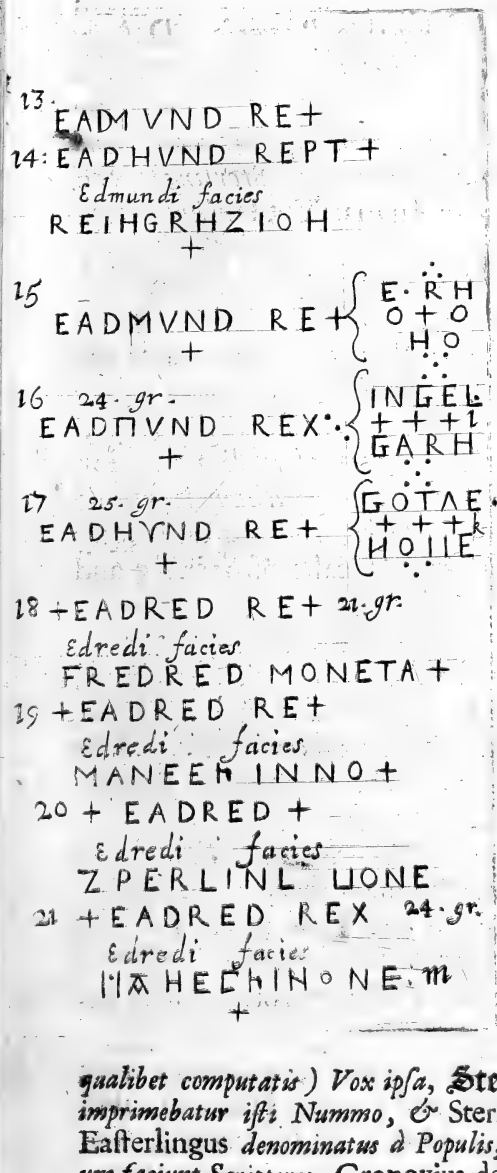
11
EADMVN RE+ — LITIL / MAN

12
EADMVND RE+ — MAN / MANO

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 ᛗᛗ ᛖ, ᛖᛁ for M; *&c.*

Some Pieces are diminished in their Weight, by lying long under ground, and several of them coloured Green. (*o*)

Spanhemius, in his Dissertations *de Numismatis*, tells us of the way of Writing Letters backwards, *In Antiquissimis aliquot Græcorum Numismatis, in quibus* ƎΛΛƎJ pro ΓΕΛΑΣ; ΝΩΙΑΤƧΗJΗƧ pro ΣΕΓΕΣΤΑΙΩΝ, &c. *aliaq; ad genus Phœnicum more sinistrorsum non semel scripta leguntur. Eandem quoque scripturæ rationem in Antiquis aliquot* Gothorum *Saxis adnotavit Antiquitatis patriæ restaurator* Olaus Wormius. This



The ſame Reverſe with the laſt.

This Reverſe is written round the +, whereas moſt of the Reverſes 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 Reverſes are written round the +

The H is a very clear Character, and ſtands for a Letter that is not defaced.

Sterling, &c. P. & T. *paſſim confundi Docti obſervant,* πιμπ pro πίντε, σολὶ pro σολὶ &c. *Ruſpina* pro *Roſtina*, &c. Bochart. Geogr. pag. 450. 706. *Denarium & Sterlingum eundem eſſe Nummum*, (Matth. Pariſ. in Hen. III. *tredecim ſolidis & 4 ſterlingis pro Marcâ qualibet computatis*) *Vox ipſa*, **Sterling**, *utrùm formatur à ſigno quod imprimebatur iſti Nummo, &* Sterlingus *ſit quaſi* Stellatus, *an potius* Eaſterlingus *denominatus à Populis, qui* Eaſterlings *dicuntur, ambiguum faciunt Scriptores.* Gronovius de Siſtertiis, pag. 346. (*l*)

But I find *Gronovius* may be corrected in what he writes in the *Addenda* to the ſame Treatiſe by this Reverſe; *Dubium non eſt* (ſays he) *ſi* Saxonibus Anglis *deberetur ea Vox*, **Sterling**, *in monumentis illorum repertam iri. — conſtat inter omnes ante* Normannorum *ingreſſum in* Angliam, *non reperiri mentionem hujus Vocabuli; cum ipſo Gulielmo primùm legi, Sterlingos*, &c. *appellatos, ergò his debetur ea Vox in* Anglia. Yet I believe what he writes juſt before, *Denariis autem nomen etiam* **Sterlinges** *fuiſſe, in Continente quâ* Normanni *imperabant, oſtendunt duo reſcripta Pontificum Romanorum in Decreto* 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 on 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 ſaw, 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 940; *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

In the Church-yard at *Foultſham* in *Norfolk*, there is a Tomb-ſtone with this Inſcription, which ſome of the Learned in theſe Curioſities may perhaps explain.

On one ſide	ᚪᚴ ᚳᚩᚷ ᚷᚩᚦ
At one end	ᚩᚦᚩ
On the other ſide	ᚦᚩᚷ ᚻᛖᛋᚹᛖᚪ
On the other end	ᚹᚩᚷ

Remarks upon the foregoing Obſervations by W. W. *Reg. Soc. Soc.*

(*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 Coyns, on their Reverſes: This his Succeſſors have ſince followed; before they writ, *Civit. London*; *Civitas Cantuariæ*, *Villa Caleſiæ*. The want of knowing this Cuſtom, has cauſed ſome Learned Men to miſtake ſome Coyns of *Edward* IV. with *Civitas Norwic.* 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 Coyn 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 Coyns 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*.

(*b*) This Reverſe is to be read *PENE FEHO*; *i. e. Pennymony*, a Duplication uſual amongſt the *Saxons*; ſo afterwards

Sterling-

Sterling-mony. *Feho*, or *Feoh*, is a common Word for Mony. St. *Mark* xii. 41. Þa ſæt ſe Þælenð ongen Þæne tollſceamol, ⁊ ȝeſeah hu Þ folc hyna ſeoh; *Then ſet Jeſus over againſt the Treaſury, and ſaw the People put in* Mony.

(*c*) *LAND* WEHO; This was coyned 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 *Mailroſe*, written by the Abbot of *Dundrainand*, a *Scottiſh man*, ſays only, *Regem Scottorum* Conſtantinum *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 tye themſelves up to one Stamp, nor to the ſame Letters.

A R E M
+ + +
O NETA.

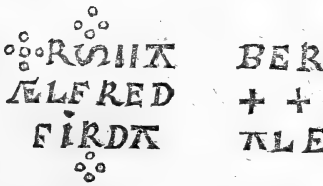
(*d*) This I ſhould read *REgia Moneta*, to diſtinguiſh it from the *Biſhops* or *Abbots*, for it was probably coyned at *Canterbury*; *A*, I take to be a Mint-maſters Mark.

(*e*) Tho' theſe Coyns, 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 Steams in a long ſeries of Ages ariſing from the Humane Bodies, might corrode ſo far into the Metal, as to raiſe ſome little Verdigreaſe upon the Surface of the Coyns; to which that Greenneſs is to be imputed.

(*f*) Probably this *Albericus* was a Nobleman, and they might have had the *Jus monetæ* 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*, *HLudowicus*.

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 ⊬ 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 *Ælfred*'s Life, which has two other of thoſe *Gallick* Letters of which *Bouteroüe* has given us an Alphabet. The Coyn is,



The ᔕ and Ⱡ are *S* and *F* in his Alphabet; and I am apt to think, that that Inverſion of Letters in theſe *Saxon* Monies, as ⊔ for *M*, ⊔ for Π, Ⱡ for *F*, took its riſe from them; for in this Alphabet we have Δ and ▽ for *D*; ᔕ, ƨ, 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 *Ælfred*'s Life.

(*k*) This *Gotæ mone*, 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 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 MALHECHI HONE, or *Malmeſbury Mony*: The H, which is an entire Letter, ſeems to have been taken from the ſquare *B*, or B.

(*n*) This P was the old *Saxon* Þ 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 ꝑ, þ, ð: 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: *Primâ ſtirpe extinctâ*, Carolus M. *Literas expolire cæpit, aut certe jam tantiſper expolitum Scripturæ genus à Merovinginco in elegantiorem formam commutavit, quæ in eandem formam evaſit, quæ hactenus minuti* Romani *Characteris nomen retinet.* (Lib. 1. Cap. 11. num. 10.) 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*, *quæ* [*Carolina Scriptura*] *principio nonnihil* Merovingici *Characteris habebat intermiſtum; at ſubinde politior effecta, in eandem formam*, &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 *Voſſius* ſhould be miſtaken, when he thought Ω and Ð 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 *Goldaſtus*: yet I will not deny but *Theodore*, or ſome other of thoſe *Greeks*, who in that Age had ſo

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 Scripturæ formam non* Franci *à* Romanis, *qui* Langobardicis *paſſim Elementis tunc utebantur, ſed à* Francis 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

We took a Pan of Water, about 4 inches deep, and 7 inches $\frac{9}{10}$ 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 eaſie 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 ſmoak, and the Water were not ſenſibly warm. This Quantity in ſo ſhort a time ſeemed very conſiderable, being little leſs than 6 ounces in 24 hours from ſo ſmall a Surface as a Circle of 8 Inches diameter. To reduce this Experiment to an exact Calculus and determine the thickneſs of the skin of Water that had ſo evaporated, I aſſume the Experiment alledged by Dr. *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 $253\frac{1}{3}$ 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 $\frac{233}{253\frac{1}{3}}$ or 35 parts of 38 of a Cube inch of Water. Now the Area of the Circle, whoſe Diameter is $7\frac{9}{10}$ inches, is 49 ſquare inches; by which dividing the quantity of Water evaporated, *viz.* $\frac{35}{38}$ of an inch, the Quote $\frac{35}{1862}$ or $\frac{1}{53}$ ſhews that the thickneſs of the Water evaporated, was the 53*d* part of an Inch: but we will ſuppoſe it only the 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 ſaid to ſet always in, at the Streights of *Gibralter*, 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 ballanced by the weaker Action of the Sun, eſpecially when riſing, before the Water be warmed: ſo that if I allow $\frac{1}{10}$ of an inch of the Surface of the Sea to be raiſed *per diem* in Vapours, it may not be an improbable Conjecture.

Upon this Suppoſition, every 10 ſquare Inches of the Surface of the Water yields in Vapour *per diem* a Cube inch of Water; and each ſquare foot half a Wine pint; every ſpace of 4 foot ſquare, a Gallon; a mile ſquare, 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 gheſs 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 *Neiſter*, 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 $\frac{1}{5}$ 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 *Gibralter*, is intended, with leave, for a farther Entertainment

tainment of this Honourable Company: in the mean time, it it needful to advertiſe the Reader, that in making the Experiment herein mentioned, the Water uſed, had been ſalted to the ſame degree as is the common Sea-water, by the Solution of about a 40*th* part of Salt.

Obſervationes nonnullæ Eclipſeos Nuperæ Solaris, Maii 1. St. vet. diverſis in locis habitæ, ac cum Regiâ Societate Communicatæ.

HÆC *Eclipſis, etiamſi contemnendæ quantitatis fuerit, ac nudis oculis non omnino percipi potuerit, tamen ad accuratam determinationem Parallaxis & Latitudinis Lunæ maxime idonea videtur. Quapropter quas hactenus obtinere potuimus obſervationes cape Lector Benevole.*

Londini *ſeorſim obſervantibus* Hookio & Halleio; *Initii momentum, cœlo licet puriſſimo, ob obliquam incidentiam Lunæ, debite definire non licuit. Sed hora* $1^h.\ 16'.$ *jam cæpta erat Eclipſis ſatis notabiliter: circa* $1^h.\ 40'.$ *prope medium Eclipſis, Chorda partis Eclipſatæ, ſive inter cornua, inventa eſt* $9'.\ 30''.$ *cui reſpondet arcus* 36 gr. *in diametro vero non niſi* $1'.\ 30''.$ *Finis conſenſu utriuſque obſervatoris contigit accurate hora* $2^h.\ 3'.\ 00.$

Grenovici *in Obſervatorio Regio* Flamſteedius *eadem de cauſa Initium non vidit, finem vero determinavit* $2^h.\ 4'.\ 15''.$ *Medio Eclipſis ſive maximâ obſcuratione, Chorda partis Eclipſatæ erat* $9'.\ 54''.$

Apud Totteridge *prope* Londinum *verſus Corum, finem videt Dominus* Haines, Reg. Soc. Soc. *ad* $2^h.\ 2'.$ *Quantitatem vero Maximam dimidii Digiti, ab Auſtro.*

In Inſula Barbada, *ad Oppidum* Bridge-Town, *ſub Lat.* 12 gr. $58'.$ *Finem habuit Dominus* Frank $1'.\ 30''.$ *temporis ante quam Solis Altitudo fuit* 31 gr. $47'.$ *ad ortum, hoc eſt hora* $7^h.\ 56'.\ 45''.$ A. M. *Quantitatem Maximam æſtimatione definivit duorum digitorum ab Auſtro.*

Norim-

Norimbergæ *eandem Eclipſim obſervavit* J. P. Wurtzelbaur. *Initium quidem accurate ad* $1^h. 58' \frac{1}{2}$; *circa medium, ſc. ad* $2^h. 36' \frac{1}{2}$ *quantitatem maximam duorum dig. præciſe; Finem vero ad* $3^h. 18'. 33''$.

Ulmæ Sueviæ, *obſervavit* Honoldus *Initium ad* $1^h. 48'$; *Quantitatem maximam* $2\frac{3}{4}$ *dig. Finem vero ad* $3^h. 16'$.

Lipſiæ, *obſervatore* Kirchio, *Eclipſis jam ſatis notabilis ad horam* $2^h. 20'. 10''$. *ad* $2^h. 47' \frac{1}{2}$ *digiti* $1\frac{1}{3}$ *circiter. Finis vero incidit præciſe in* $3^h. 15'$.

Vratiſlaviæ Sileſiæ *denique obſervavit D.* G. Schultzius *Maximam obſcurationem, paulo citius quam* $3^h. 12' \frac{1}{2}$ *fuiſſe* $1\frac{1}{2}$ *dig. Finem vero hora* $3^h. 37'$.

In omnibus hujuſmodi obſervationibus momentum Finis multo tutius determinatur; itaque huic potius fidendum eſt, præſertim in Eclipſibus parvis, ubi ob incidentiam maxime obliquam diu hærent quaſi in Contactu Luminaria.

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.*

THis 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 *Caſtor*, an *Otter*, two *Civet Cats*, an *Elke*, and a *Coati mondi*, of all which, a large Account has been already given by Mr. *Oldenburg* 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 Volumn 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 leſſer 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 ſomething 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 Fibreo* 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 carnoſus*, 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 *Cryſtalline* 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 *graſing* 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-*

culation 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 Cocks*, 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* ſix: 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 *OEſophagus*, 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 *Rectum* or the *Burſa Fabritii*: between the *Cornea* and *Sclerotica* a *cartilaginous* Circle was obſerved. They end with the diſcovery of a *black Purſe* in the *Eyes* of Birds.

The Twenty fifth, ſix *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 *Caſſowar*, 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 muſculous *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 ½ from the extremity of the *Head* to the *Tail*. Amongſt the *Internal* Parts, the Structure of the *Urine Bladder* is very curious for its *exteriour Tunicle* being *membranous:* the inſide was ſtrengthened with an infinite number of *muſculous Fibres*, not unlike thoſe in the *Ventricles* of the *Hearts* of *Animals*. This Contrivance

ſeems 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 obſervable: 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 *Venæ 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 *Bellows*; but I ſhall refer, as to the other Particulars in this and the former *Anatomical Diſcourſes*, to the Book it ſelf, 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.

An Experiment to this purpoſe made by Mr. Hook. *Vid.* Ph. Tr. n. 28. p. 539.

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 expoſita, Studio & Operâ Patrum Societatis JESU*, &c. *Adjecta eſt Tabula Chronologica Sinicæ Monarchiæ 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 performed

ed by very ancient Miſſionairs 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 Apophthegmes 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 Priviledges 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 *Tarquinius Superbus* and the firſt Conſulats, when *Darius Hyſtaſpis* 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 ſifted the credible from the fabulous. They begin their Account with the Years of the Reign of King *Fohi*, 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 *Fohi* is ſaid to have reigned 115 Years, and to have invented the Character now in uſe in *China*, and his Succeſſor *Xinnum* 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 *Æra*, chooſe to begin their Annals with the third King *Hoam-ti*, and the Year before Chriſt 2697. 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 account 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 Kings Reign, with a ſhort Character of the Prince, and the principal of his Acts, with the moſt notable Contingencies of his time: amongſt the reſt, ſeveral 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 *Chineſe* 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 *Chim-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 Intercalation of 7 mon. in 19 years; ſo that 7 years in each Cycle have 13 mon. This Diſtribution of mon. was ordained by K. *Yao*, above 2300 years *ante Chriſtum*, and is, if rightly intercalated, a more exact meaſure of the Cœleſtial 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.

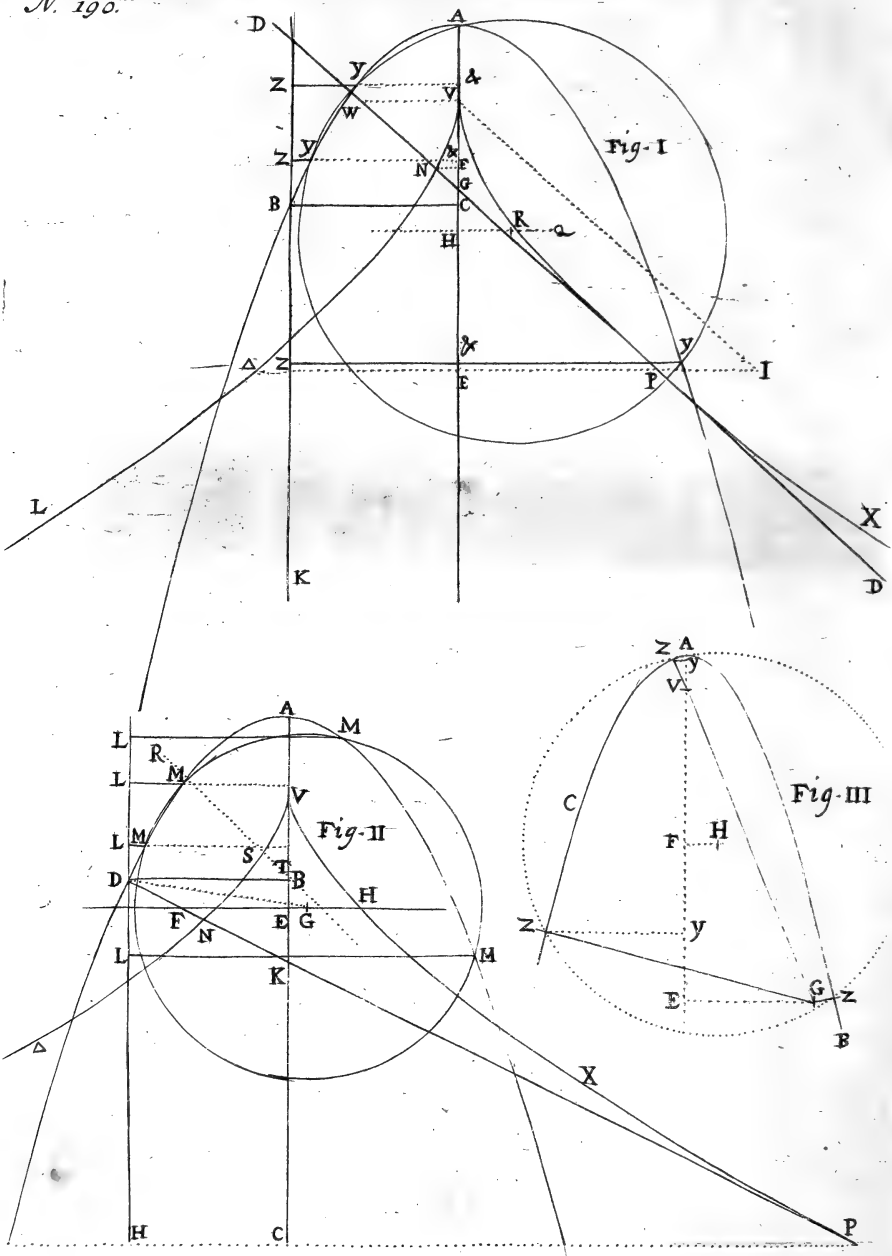
'Tis here ſaid, that the famous Wall of *China*, extending above 400 Leagues, was begun by King *Xi-Hoam-ti* about the year *ant. Chr.* 210. to hinder the Incurſions of the *Tartars*, which in all Ages have infeſted this Country. The following Cycles are more amply deſcribed, and towards the End, the Tranſactions of the *Romiſh* Miſſionaries are inſerted, with a brief account of that great Revolution in *China*, by the entire Conqueſt of that Kingdom by the *Tartars*. This Chronology ends with the year of Chriſt 1683, being the laſt of the 73*d* Cycle, ſince the King *Hoamti*; and contains in all 4380 years.

'Twill be needleſs to adverti[illegible], that this Account places the beginning of the *Chineſe* Empire long before the *Deluge*, according to the Holy Scriptures; wherefore if this be to be wholly rejected, as fabulous; or if not, how it is to be reconciled with the ſacred Chronology, belongs more properly to the Diſquiſition of the Divines.

THE ROYAL SOCIETY,
BURLINGTON HOUSE,
PICCADILLY,
LONDON, W.

ROBERT HARRISON,
Asst. Secretary R.S.

N. 190.



PHILOSOPHICAL TRANSACTIONS.

For the MONTH of *NOVEMBER.* 1687.

The *CONTENTS.*

DE SESTERTIO Dissertatiuncula ex Opusculis Posthumis Viri Celeberrimi D. D. *Isaaci Barrow* nuper editis decerpta.

Gassendus pecuniam Gallicam confert cum multiplis sestertii nummi: Supponit autem denarium, Sestertii quadruplum, sub primorum Cæsarum *temporibus octavam unciæ partem æquasse pondere: quam hypothesin aliquatenus redarguit noster Gravius:* (De Den. pag. 96, & 113.) *probat enim sub illis, qui Vespasiano priores imperarunt Cæsaribus, varium & inconstans denarii pondus extitisse; majus scilicet & minus alternatim, sæpius tamen decrescendo, ita ut ab Augusto ad Vespasianum decreverit a septima parte unciæ ad partem octavam; in quo ferme statu perstitit a Vespasiano ad Alexandrum Severum.*

Unde consequi videtur ad lectionem veterum authorum magis conducere, ut moderni nummi cum Consulari denario (recentiore nimirum) comparentur, tum quoniam is stati certique ponderis fuit (unciæ septimam partem adæquans) tum quia tempus, quo in usu fuit, plerosque comprehendit poetas & historicos nobiliores, tum quia verisimilius est præcipuos authores ad hunc potius respexisse, quam ad Cæsarium illum mutabilem & nullo certo pondere definitum. Pag. 119.

*Denarium vero Consularem noster Gravius (*Pag. 61. 94, &c.*) ex appensis multis denariis, ex eorundem cum aliis aureis argenteisque nummis (Romanis, Hebræis, Grecis, Persicis, &c.) collatione, & ex Vespasianei congii mensura deduxit cum* LXII *granis Anglicis æquiponderare. (*Pag. 81.*) Unde cum denarius noster octo grana pendat, Consularis iste denarius valebit septem denarios nostros cum tribus quartis. At denarius Cæsareus, $\frac{1}{8}$ unciæ pondus habens, pendet* $54\frac{1}{4}$ *grana, valebitque denarios* $6\frac{2}{3}\frac{5}{2}$.

Brerwoodus autem denarium Consularem ($\frac{1}{7}$ unciæ pendentem) æstimat denariis nostris $8\frac{4}{7}$; *& Cæsareum ($\frac{1}{8}$ unciæ) denariis* $7\frac{1}{2}$: *quæ magna est a Gravio discrepantia. Sed is non videtur Romana pondera cum nostris accurate contulisse.*

In

In eo quoque graviter errare videtur idem Breerwoodus, quod Cæsareum denarium Atticæ drachmæ putat æqualem: cum huic potius æquetur denarius Consularis; imo quum exquisitius rem pensitando Attica drachma etiam Consularem denarium (tanto majorem Cæsareo) 5 granis Anglicis exsuperet, ut luculente probat Gravius. Pag. 72.

Consultius itaque visum est a Gravio adsertis proportionibus adhærere; Et cum Consulari nummo pecunias nostras conferre. Quibus ex suppositis adjuncta tabella computatur.

Tabula valorem Nummi *Romani* in moneta nostra *Angliæ* exhibens.

	Lib.	Sol.	Den.	ob. 2æ.	Q. 4æ.	C. 8æ.	16æ
IIS. Sestertius. 2 ½ Æris.	1	000	00	01	1	1	0	3
	2	000	00	03	1	1	1	
	3	000	00	05	1	1	0	1
X Denarius. 10 Æris.	4	000	00	07	1	1	0	0
	5	000	00	09	1	0	0	3
	6	000	00	11	1	0	1	0
	7	000	01	01	0	0	0	1
	8	000	01	03	1	0	0	
	9	000	01	05	0	1	0	3
	10	000	1	7	0	1	1	
	20	000	3	2	0	3	0	
	30	000	4	10	0	0	1	
Centum æris 10 Denarii.	40	000	6	5	1	0	0	
	50	000	8	0	0	3	1	
	60	000	9	8	0	1	0	
	70	000	11	3	1	0	1	
	80	000	12	11	0	0	0	
	90	000	14	6	0	1	1	
	100	000	16	1	0	3		
	200	001	12	3	1	0		
	300	002	8	5	0	1		
Mille æris. 100 Denarii.	400	003	4	7	0	0		

		Lib.	Sol.	Den.	Æs.
	500	4	0	8	3
	600	4	16	10	2
	700	5	13	0	1
	800	6	9	2	0
	900	7	5	3	3
Sestertium.	1,000	8	01	05	2
	2,000	16	02	11	0
	3,000	24	04	04	2
Decem millia æris, 1000 Denarii.	4,000	32	05	10	0
	5,000	40	07	03	2
	6,000	48	08	09	0
	7,000	56	10	02	2
	8,000	64	11	08	0
	9,000	72	13	01	2
	10,000	80	14	07	
	20,000	161	09	02	
	30,000	242	03	09	
Centum millia æris, 10,000 denarii.	40,000	322	18	04	
	50,000	403	12	11	
	60,000	484	07	06	
	70,000	565	02	01	
	80,000	645	16	08	
	90,000	726	11	03	
Sestertium semel	100,000	807	05	10	
bis	200,000	1614	11	08	
ter	300,000	2421	17	06	
&c.	400,000	3229	03	04	
	500,000	4036	09	02	
	600,000	4843	15	00	
	700,000	5651	00	10	
	800,000	6458	06	08	
	900,000	7265	12	06	

De Numero Radicum in Æquationibus Solidis ac Biquadraticis, ſive tertiæ ac quartæ poteſtatis, earumq; limitibus, tractatulus Authore *E. Halley.*

CUm in tractatulo, quem nuper publici juris feci in actis hiſce Philoſophicis, Num. 188; *Methodum aperuiſſem, qua Problemata ſolida utcunq; affecta minimo negotio, unica data Parabola & Circulo, ſimpliciſſime conſtrui poſſint; ſub finem mihi ſeſe obtulit contemplatio jucunda ſatis, nempe ex his Conſtructionibus Numerum radicum in quavis Æquatione, 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 ſecundæ claſſis Geometris, me non ingratum nec inutile præſtiturum omnino perſuaſum habui.*

Propius vero inſpicienti mihi compertum eſt, me imprudentem inter ardua Geometrica illapſum, ac jam iis tractandis deſignatum, quibus olim laboravere Viri illuſtres Harriottus *noſtras, ac* Carteſius; *in quibus pari fato utriq; Paralogiſmum, (forſan in eorum ſcriptis Geometricis unicum) diverſo tamen modo, admiſere; uti poſthac probabitur: ſed* Quandoq; bonus dormitat. *Qua propter agnita rei tum difficultate tum præſtantia, totis viribus incumbere ſtatui, ne promiſſis exequendis impar crederer, ac ne Geometriæ pars tam eximia, tamq; parum culta, diutius tenebris involuta lateret; ſed ope noſtra lucide his paucis expoſita daretur.*

Imprimis vero Lectorem monitum velim, quod dum his legendis operam dat, oportet prædictam diſſertationem Num. 188. *editam, ad manum habere, ac Conſtructiones ibidem traditas probe callere; quia quæ ſequuntur ab illis maxima ex parte pendent, quas tamen hic repetere vix integrum eſſet.*

Ex Carteſio *& ex ibi dictis conſtat, tam in Cubicis quam in Biquadraticis æquationibus, radices exponi poſſe demittendo perpendicula in Axem, datamve diametrum Parabolæ datæ, ab interſectionibus Curvæ illius cum Circulo. Cumq; Circulus Parabolam ſecans, vel in quatuor vel duobus punctis eam interſecare neceſſe 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 æqualitas duarum radicum ejuſdem ſigni concluditur. In Cubicis autem, quoniam una ex interſectionibus ad Conſtructionem requiritur, non niſi una vel tres reliquæ radices deſignant unam vel tres; uti in Caſu contactus, unde conſtat duas æquales reperiri Radices, Problemaq; unde reſultat æquatio revera planum eſſe.*

Cubicæ itaq; omnes quomodocunq; affectæ una vel triplici radice explicabiles ſunt, utiq; ſemper poſſibiles, nempe ſi radices Negativas pro veris admiſeris: ſic Biquadraticæ, quarum terminus ultimus r *ſigno* — *affecta eſt, duabus vel quatuor. Aſt ſi habeatur* + r *in æquatione, eaq; tanta ſit, ut* $\sqrt{GD^{q} - ar}$, *(vide* fig. pag. 341*) minor ſit quam ut Circulus, eo Radio ac centro* G *deſcriptus, Parabolam contingere in aliquo puncto poſſit, æquatio data omnino impoſſibilis eſt, nec ulla Radice Negativa vel Affirmativa explicabilis: Sed de his plura in ſequentibus.*

Quoniam vero tanta intercedit differentia inter caſus Cubicarum & Biquadraticarum, ut ſimul comprehendi nequeant; primum Cubicas deinde alteras tractabimus. Cubicæ vero infinitis Circulis in data Parabola conſtruuntur, Biquadraticæ autem unico tantum (ſaltem his methodis): id adeo quia ponendo z — e *ſive indeterminata aliqua, æqualem nihilo, æquatio Cubica reducitur ad Biquadraticam eaſdem radices cum Cubica habentem, atq; inſuper aliam ipſi* e *æqualem; unde fit ut tot Circulis diverſis conſtrui poſſit Cubica, quot imaginari velis quantitates* e, *id eſt infinitis. Inter has vero Conſtructiones illa, quam dedi (pag. 342.) longe facillima eſt. Huic tamen non multum cedit alia, quæ ad enucleationem Numeri Radicum, earumq; limi-*

tum

tum magis accommodata videtur, quæq; ortum trahit ex allatione ſecundi termini, ponendo modo vulgari x=z +*vel*— *tertia parte Coefficientis termini ſecundi. Hæc autem eſt. Data Parabola* A B Y *(Fig.* I.*) ejuſq; Vertice* A, *axe* A E *& Latere recto* a, *reducatur æquatio ad formam conſuetam,* viz. z^3. b z^2. a p z. a a q.= o. *Deinde ad diſtantiam* $\frac{1}{3}$b *ducatur Axi parallela* B K, *dextrorſum quidem ſi fuerit* + b, *aliter ſiniſtrorſum, Parabolæ occurrens in* B; *ac lineæ ſuppoſitæ* A B *erigatur perpendicularis utrinque interminata* DP, *axi occurrens in puncto* G. *De* B *in Axem demitte perpendiculum* B C, *& ipſi* A C *fiat* G E *ſemper æqualis, ac verſus inferiora ponatur. Ab* E *fiat* E H = $\frac{1}{2}$ p, *ſurſum quidem, ſi in æquatione fuerit* + p, *deorſum vero ſi* — p, *ac e puncto H (vel ex* E *ſi defuerit quantitas* p*) educatur perpendiculum* H Q *interminatæ* D P *occurrens in puncto* O. *Denique in linea* H Q *interminata, fiat* O R = $\frac{1}{2}$ q, *ab* O *dextrorſum ſi fuerit* — q, *ſiniſtroſum ſi* + q, *collocanda: ac Circulus centro* R, *radio* R A *deſcriptus, tot punctis ſecabit Parabolam, quot æquatio propoſita veras habet radices; eæq; erunt perpendicula* Z Y *a punctis interſectionum* Y *in axi parallelam* B K *demiſſa; quarum quæ ad dextram lineæ* B K *Affirmativæ ſunt, ad ſiniſtram Negativæ.*

Hujus Conſtructionis commoditas in eo conſiſtit, quod circulo per Verticem tranſeunte peragitur, perinde ac ſi defuiſſet ſecundus Terminus; ideoq; ad Radicum Numerum determinandum, ſufficit Loci ſive Lineæ Curvæ proprietates perſpectas habere, quæ 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 curvæ, in quam incidunt centra omnium Circulorum per verticem tranſeuntium ac deinde Parabolam tangentium, naturam definire.

Locus autem ille eſt Parabolois, quam cum Cl. Walliſio *ſemicubicalem appellare licet, ſive in qua Cubi applicatorum ad Axem ſunt inter ſe ut Quadrata portionum Axis. Cujus Latus rectum eſt* $\frac{2}{8}\frac{7}{}$ *Lateris recti datæ Parabolæ, Vertex vero punctum* V (Fig. I) *exiſtente* A V *dimidium lat ris recti ejuſdem Parabolæ. Hoc eſt, ſi ponatur Unitas pro latere recto datæ Para-*

lobæ, $\frac{8}{27}$ *cubi ordinatim applicatæ æquabuntur quadrato partis diametri, ſive cubus ex* $\frac{2}{3}$ V H *quadrato ex* H R, *ſi ſcil.* R *ſit centrum circuli qui per verticem Parabolæ tranſeat eamq; deinde contingat; Hæc eſt Curva illa quam primus mortalium* Nelius *Noſtras rectæ datæ æqualem demonſtravit, eaq; occaſione apud Principes Geometras dudum celebris; ejuſq; proprietates* Cl. Walliſius *ſub finem Libri de Ciſſoide, &* Hugenius prop. 8 *&* 9 de linearum Curvarum evolutione, *aliiq; acri ingenio diſquiſivere, Quorum ſcripta conſulat Lector. Hæc Curva utrinq; ab Axe Parabolæ deſcripta,* viz. V N L, V P X, *ſpatium complectitur, in quo ſi ponatur centrum Circuli, qui per verticem* A *tranſeat, interſecabit ille Parabolam in tribus aliis punctis; Spatia vero ab Axe remotiora centra præbent circulis non niſi uno præter verticem puncto Parabolam ſecantibus.*

His probe intellectis jam ad determinandum Radicum numerum accingimur: Ac primum deficiat ſecundus terminus; ſitque Latus rectum 1, *vel* A V = $\frac{1}{2}$; *In conſtructione* V H *eſt* $\frac{1}{2}$ p, H R *vero* $\frac{1}{2}$ q; *cumq; ſi fuerit* + p, *ab* V *verſus ſuperiora ponenda ſit* $\frac{1}{2}$ p, *centrum circuli extra ſpatium* L V X *ſemper conſtituitur; ideoq; una tantum radice explicabilis eſt, affirmativa ſi* − q, *negativa ſi* + q: *quæ quidem radices* Cardani *Regulis inveſtigantur. Si vero fuerit* − p, V H = $\frac{1}{2}$ p *inferne ponitur, ac fieri poteſt ut* H R *cadat inter Axem & Curvam* V X *vel* V L, *ſi ſcilicet Cubus ex* $\frac{2}{3}$ V H, *ſive ex* $\frac{1}{3}$ p, *major ſit quam quadratum ex* $\frac{1}{2}$ q, *ſive* $\frac{4}{27}$ p p p *major quam* $\frac{1}{4}$ q q, *quo in caſu tres dantur radices, duæ Negativæ, ſi fuerit* − q, *ac una Affirmativa earum ſummæ æqualis; vel ſi* + q, *duæ Affirmativæ unaq; Negativa. Quod ſi* $\frac{4}{27}$ p p p *minor ſit quam* $\frac{1}{4}$ q q, *una tantum reperitur Radix, Affirmativa ſi* − q, *negativa ſi* + q. *Atq; hæc paſſim docentur ab iis qui hanc Geometriæ partem tractarunt.*

Jam adſint omnes termini, ac primum proponatur, Exempli cauſa, æquatio hæc $z^3 - z^2 b + zp - q = 0$; *cui etiam Figuram* I. *adaptavimus. In hujus conſtructione* B C = $\frac{1}{3}$b, VG = $\frac{1}{2}$AC = $\frac{1}{18}$bb, VE $\frac{1}{6}$bb, VH $\frac{1}{6}$bb − $\frac{1}{2}$p, GH $\frac{1}{9}$bb − $\frac{1}{2}$p *vel* $\frac{1}{2}$p − $\frac{1}{9}$bb, *hinc* H O = $\frac{1}{27}b^3 - \frac{1}{6}bp$ *vel* $\frac{1}{6}bp - \frac{1}{27}b^3$, *atq;* HR *ſive diſtantia*

tia Centri circuli R *ab Axe, eſt ſemper differentia inter* $\frac{1}{6}$b p *&* $\frac{1}{27}$b^3 + $\frac{1}{2}$q; *quæ ſi æquantur, centrum cadit in Axe; ſi* $\frac{1}{6}$b p *major ſit quam* $\frac{1}{27}$b^3 + $\frac{1}{2}$q *ad ſiniſtram Axis, ſin minor ad dextram. Si itaq; Cubi ex* $\frac{2}{3}$VH, *(hoc eſt ex* $\frac{1}{9}$b b − $\frac{1}{3}$ p *quam nominemus* d*) Latus quadratum ſive* √ d d d, *majus ſit quam* H R, *ſive differentia inter* $\frac{1}{27}$b^3 + $\frac{1}{2}$q *&* $\frac{1}{6}$ b p; *reperitur centrum* R *intra ſpatium* N PV, *Paraboloidibus* V P X, V N L *ac recta interminata* D N P *circumſcriptum: ac proinde circulus Parabolam ſecabit in tribus punctis* Y, Y, Y, *ad dextram lineæ* B K *ſitis, atq; adeo æquatio tres habet radices Affirmativas. Centro vero extra hoc ſpatium* N V P *conſtituto, non niſi una radice Affirmativa explicari poteſt. Hic obiter notandum rectam* DP *Paraboloidem* VPX *tangere in puncto* P, *exiſtente* E P $\frac{1}{27}$b^3; *alteram vero* V N L *ſecare in puncto* N, *ita ut demiſſo in axem Perpendiculo* N F, V F *ſit pars quarta ipſius* E V *ſive* $\frac{1}{24}$bb, N F *vero* $\frac{1}{108}$b^3. V W *autem, quæ e puncto* V *axi perpendiculariter erecta lineæ* D P *occurrit in* W, *æqualis eſt* $\frac{1}{54}$b b b *ſive* $\frac{1}{2}$E P.

Hinc tuto concluditur ſi in æquatione vel p *major ſit quam* $\frac{1}{3}$b b, *vel* q *major quam* $\frac{1}{27}$b^3, *non niſi unam eamq; affirmativam radicem reperiri; Fallit itaq;* Regula Carteſii (*Edit.* Amſt. 1659 *pag.* 70) *ubi tot veras dari radices quot ſunt in æquatione mutationes ſignorum* + *&* − *pronunciat, fruſtra etiam in Commentariis ſuis Sphalma hoc excuſante* Schootenio; *Fingi enim poſſunt infinite plures æquationes præcedentis formulæ tres ſignorum mutationes habentis, quæ unam tantum quam quæ tres habeant radices. Propoſitio etiam quinta Sectionis quintæ Artis Analyticæ* Harriotti *Noſtri, uti* Prob. 18 *Numeroſæ Poteſt. Reſol.* Vietæ, *vix ſatis firma eſt, cum ex limitationibus quas ibi poſuerunt, toti parallelogrammo* P I V W *id conveniat, quod ſoli ſpatio* N V P *jam competere probavimus, hoc eſt ut centrum præbeat circulo tribus aliis punctis præter vertícem Parabolam ſecante.*

Quantitas autem q, *ſive terminus ult., datis* b *&* p, *ea lege ut* p *minor ſit quam* $\frac{1}{3}$bb, *accurate limitatur ex præcedente æquatione* $\sqrt{\text{d d d}} = \frac{1}{27}$b^3 + $\frac{1}{2}$q ∽ $\frac{1}{6}$b p; *cum ſcil. Circulus Parabo-*

lam contingat. Itaq; $\frac{1}{2}$q *minor esse debet quam* $\frac{1}{6}$b p$-$ $_{2}\frac{1}{7}$b^3+ $\sqrt{\text{d d d}}$; *at si* p *major fuerit quam* $\frac{1}{4}$b b, *majorem etiam esse oportet* $\frac{1}{2}$ q *quam* $\frac{1}{6}$b p$-$ $_{2}\frac{1}{7}$b^3 $-\sqrt{\text{d}^3}$ *ne cadat centrum in spatiolo* N V W: *Atq; his conditionibus æquatio semper triplici radice explicabilis erit, aliter non nisi una. Semper vero, sive tres sive una, Affirmativæ sunt, ob positionem centri* R *ad dextram lineæ* D P.

Atq; hic est casus maxime difficilis, ita ut quicunq; præmissa bene calleat sequentia facili negotio intelliget. Detur jam æquatio z^3 $-$ b z^2 + p z + q = o. *Hic ut tres habeantur radices, oportet centrum circuli alicubi intra spatium* P N $\triangle$, *rectis* P N, P $\triangle$ *& curva Paraboloidis* N $\triangle$ *definitum, reperiri; quapropter cum* E F *sit* $=\frac{1}{8}$b b, p *minor esse debet quam* $\frac{1}{4}$bb; *jam ad determinationem quantitatis* q, *existente* d $=\frac{1}{9}$bb $-\frac{1}{3}$p *ut antea,* $\sqrt{\text{d d d}}$ + $_{2}\frac{1}{7}$ b b b $-\frac{1}{6}$b p *semper major esse debet quam* $\frac{1}{2}$ q, *ut constituatur centrum circuli in spatio prædicto* P N $\triangle$: *quod cum fit æquatio talis duas habet radices Affirmativas ac unam negativam. Si vero* p *major est quam* $\frac{1}{3}$b b, *vel* $\frac{1}{2}$q *major quam* $\sqrt{\text{d d d}}$ + $_{2}\frac{1}{7}$ b b b $-\frac{1}{6}$ b p, *non nisi una eaq; negativa radice explicabilis est.*

Proponatur jam æquatio z^3 $-$ bz^2 $-$ p z $-$ q = o. *Ut hæc æquatio tres habeat Radices, oportet centrum circuli alicubi inveniri in spatio indefinito, inter rectam* D P D *& curvam Paraboloidis* P X; *hic quantitas* p *non est obnoxia limitationibus,* $\frac{1}{2}$q *vero semper minor esse debet quam* $\sqrt{\text{ddd}}$ $-$ $_{2}\frac{1}{7}$bbb $-\frac{1}{6}$bp, *posito* d $=\frac{1}{9}$ bb + $\frac{1}{3}$p: *Hoc pacto duæ dantur Radices Negativæ, ac una Affirmativa; aliter vero si* $\frac{1}{2}$q *major sit quam* $\sqrt{\text{ddd}}$ $-$ $_{2}\frac{1}{7}$ b b b $-$ $\frac{1}{6}$b p, *unica tantum Affirmativa exponi potest. Quarto loco sit æquatio* z^3 $-$ b z^2 $-$ p z + q = o, *quæ duas Affirmativas habet Radices ac unam Negativam si centrum circuli reperiatur in spatio indefinito inter rectas* P $\triangle$, PD *ac curvam Paraboloidis* $\triangle$ L; *hoc est, (posito* d $=\frac{1}{9}$bb + $\frac{1}{3}$p,) *si* $\frac{1}{2}$q *minor sit quam* $\sqrt{\text{d d d}}$ + $_{2}\frac{1}{7}$b b b + $\frac{1}{6}$b p; *si vero* $\frac{1}{2}$q *major hac quantitate fuerit, una tantum Negativa inest radix.*

Quatuor autem æquationes reliquæ, in quibus habetur + b, *quoad limitationem Numeri Radicum non differunt a prædictis, si sig-*

num

num termini ultimi mutetur, ſervato ſigno termini tertii ; quæ vero Affirmativæ erant radices in illis hic fiunt Negativæ ; & vice verſa. Sic in æquatione $z^3 - bz^2 + pz - q = o$ *Una vel tres erant Affirmativæ Radices ; in hac vero* $z^3 + bz^2 + pz + q = o$ *vel una uel tres Negativæ ſunt, ſub iiſdem conditionibus; nulla vero omnino Affirmativa. Sic in* $z^3 + bz^2 + pz - q = o$, *duæ ſunt Negativæ & una Affirmativa, ſi* p *minor ſit quam* $\frac{1}{3}bb$, *ac* $\frac{1}{2}q$ *minor quam* $\sqrt{d^3 + \frac{1}{27}b^3 - \frac{1}{6}bp}$, *quemadmodum in* $z^3 - bz^2 + pz + q = o$ *duæ erant Affirmativæ & una Negativa ; excedentibus autem leges præſcriptas* p *vel* q, *una tantum hic eſt radix Affirmativa, quæ ibi Negativa erat. Pari modo in* $z^3 + bz^2 - pz + q = o$ *vel duæ ſunt Affirm. ac una Neg. vel una Negativa tantum. Deniq; iiſdem de cauſis in æquatione* $z^3 + bz^2 - pz - q$ *duæ ſunt Negativæ & una Affirm. vel una Affirm. tantum, quibus in æquatione* $z^3 - bz^2 - pz + q$ *duæ erant Affirm. & una Negativa, vel una Negativa tantum, nempe prout* $\frac{1}{2}q$ *major vel minor fuerit quam* $\sqrt{d^3 + \frac{1}{27}b^3 + \frac{1}{6}bp}$.

Si defuerit terminus tertius, ſive pz, *centrum* R *ſemper cadit in linea* IPE △, *quocirca ſi fuerit* $z^3 - bz^2 . * . - q$ *vel* $z^3 + bz^2 . * . + q$, *una tantum eſſe poteſt radix, ſi* $-b$ *Affirmativa, ſi* $+b$ *Negativa. At ſi fuerit* $z^3 - bz^2 . * . + q$ *vel* $z^3 + bz^2 . * . - q$, *duæ poſſunt eſſe Affirmativæ ac una Negativa in priore, vel una Affirm, & duæ Neg. in poſteriori, cadente centro in linea* P △ *inter* P *ac* △, *hoc eſt ſi* $\frac{1}{4}q$ *minor ſit quam* $\frac{1}{27}b^3$; *ſin major fuerit, una tantum Negativa in priore, vel una Affirm. in poſteriore dari poteſt.*

Hactenus numerum radicum in Cubicis æquationibus plenius aſſecuti ſumus, reſtat ut nonnulla adjiciam de quantitate radicum. Hic primum notandum quod omnis æquatio tres habens radices ope Tabulæ Sinuum, Triſectione ſcilicet anguli, ſatis expedite reſolvi poſſit; ponendo ſcil. $\sqrt{\frac{4}{9}bb - \frac{4}{3}p}$ *vel* $\sqrt{4d}$, *ſi fuerit* $+p$ *in æquatione, vel* $\sqrt{\frac{4}{9}bb + \frac{4}{3}p}$, *ſi* $-p$, *pro Radio Circuli ; Angulum vero triſecandum qui Sinum habeat in Tabula Sinuum* $\frac{\frac{1}{27}b^3 + \frac{1}{6}bp + \frac{1}{2}q}{\sqrt{ddd}}$: *Inventò hoc angulo, Sinus*

tertiæ partis ejus, ut & Sinus tertiæ partis compl. ad Semicirculum, eorumq; ſumma, ex Tabula Sinuum dabuntur. Hi vero Sinus in Radium $\sqrt{\frac{4}{9}bb + \frac{4}{3}p}$ *ducendi ſunt, & habebuntur quantitates (*y &, y &, y &, *in Fig) quarum &* $\frac{1}{3}b$ *vel ſumma vel differentia, prout caſus poſtulat, veras radices Æquationis exhibebunt. Hæc omnia ex inventis* Carteſii *derivantur: Ut vero caſus omnes quantum fieri poſſit breviter complectar, dico quod centro* R, *in prima æquationum formula, cadente in ſpatio* V G P, *ſectiones duæ* 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 ſpatio* G N V, *duæ majores ſunt quam* $\frac{1}{3}b$, *minores vero quam* $\frac{2}{3}b$, *tertia vero eſt* b — *duabus alteris, ac proinde minor quam* $\frac{1}{3}b$: *ſed adhibita limitatione quantitatis* p, *arctioribus terminis radices includuntur. Maxima enim radix minor eſt quam* $\sqrt{\frac{4}{9}bb - \frac{4}{3}p} + \frac{1}{3}b$, *major vero quam* $\sqrt{\frac{1}{4}bb - p} + \frac{1}{2}b$; *at cum* $\frac{1}{4}bb$ *minor eſt quam* p, *limes ille fit* $\sqrt{\frac{1}{9}bb - \frac{1}{3}p} + \frac{1}{3}b$. *Radix media ſemper minor eſt quam* $\sqrt{\frac{1}{4}bb - p} + \frac{1}{2}b$; *major vero quam* $\frac{1}{3}b - \sqrt{\frac{1}{9}bb - \frac{1}{3}p}$; *hunc vero limitem nunquam excedit radix minima, ſed cum quantitate* q *evaneſcit.*

In ſecunda formula præſcriptis legibus duæ ſunt affirmativæ ac una negativa, ac cadente centro in ſpatio GPE *altera ex affirmativis major eſt, altera minor quam* $\frac{1}{3}b$, *major vero non excedit* b, *Negativa autem major non eſſe poteſt quam* $\sqrt{\frac{1}{3}bb} - \frac{1}{3}b$, *eſt autem differentia ipſius* b *& ſummæ Affirmativarum. Centro autem in ſpatio* E N G △ *poſito, utraq; Affirmativa major eſt quam* $\frac{1}{3}b$, *minor vero quam* $\sqrt{\frac{1}{3}bb} + \frac{1}{3}b$, *Negativa vero ſemper minor eſt quam* $\frac{1}{3}b$. *Limites autem propiores ex data* p *evadunt, radicis quidem maximæ Affirmativæ* $\sqrt{\frac{1}{4}bb - p} + \frac{1}{2}b$, *qua ſemper minor eſt, ut & major quam* $\sqrt{\frac{1}{9}bb - \frac{1}{3}p} + \frac{1}{3}b$; *hoc tamen limite minor eſt altera Affirmativa, quæ cum quantitate* q *minuitur. Negativa vero ſemper minor eſt quam* $\sqrt{\frac{4}{9}bb - \frac{4}{3}p} - \frac{1}{3}b$, *ac deficiente quantitate* q *evaneſcit.*

In tertia formula duæ Negat. ſunt ac una Affirmativa: in hac, ut &

ut & in quarta, Radices non limitantur a quantitate b. *Affirmativa vero ſemper minor eſt quam* $\sqrt{\frac{4}{9}bb+\frac{4}{3}p}+\frac{1}{3}b$, *major tamen quam* $\sqrt{p+\frac{1}{4}bb}+\frac{1}{2}b$: *maxima vero ex Negativis ſemper major eſt quam* $\sqrt{\frac{1}{9}bb+\frac{1}{3}p}-\frac{1}{3}b$, *minor vero quam* $\sqrt{p+\frac{1}{4}bb}-\frac{1}{2}b$. *Minor autem ex Negativis ſemper minuitur cum minuta quantitate* q.

In quarta formula, cadente centro intra ſpatium L △ P D; *ſi duæ ſint Affirmativæ ac una Negativa, maxima ex Affirmativis major eſſe nequit quam* $\sqrt{p+\frac{1}{4}bb}+\frac{1}{2}b$, *nec minor quam* $\sqrt{\frac{1}{9}bb+\frac{1}{3}p}+\frac{1}{3}b$; *minor vero radix ab hoc limite minuitur, minuta quantitate* q. *Negativa autem minor eſt quam* $\sqrt{\frac{4}{9}bb+\frac{4}{3}p}-\frac{1}{3}b$; *major vero quam* $\sqrt{p+\frac{1}{4}bb}-\frac{1}{2}b$.

Notandum vero hic radices Negativas ubiq; ſigno Affirmativo notari, quia hæ ſunt radices Affirmativæ quatuor æquationum illarum, in quibus habetur + b, *ac* q *ſigno contrario notatur; ut ſupra monui. Horum omnium demonſtratio ex eo conſequitur, quod ubicunq; centrum circuli* R *incidit in Lineas Curvas* V P X *vel* V △ L, *circumferentia ejus Parabolam tangit in puncto, cujus diſtantia ab axe eſt* $\sqrt{\frac{2}{3}}$ V H, *eamq; ſecat ex altera Axis parte, ad diſtantiam* $2\sqrt{\frac{2}{3}}$ V H; *cum vero centrum cadit in lineam* DPD, *altera ex radicibus fit* = o, *ac proinde Cubica reducitur ad Quadraticam, ſive ad* $z^2-bz+p=o$ *cujus radices limites deſignant ubi evaneſcit quantitas* q: *ac quo minor eſt* q, *eo propius ad has limites accedunt radices. Quadratica eſt etiam cum centrum cadit in Axe; hoc eſt, cum* $\frac{1}{2}q=\frac{1}{6}bp-\frac{1}{27}b^3$ *in prima formula; vel* $\frac{1}{2}q=\frac{1}{27}bbb-\frac{1}{6}bp$ *in ſecunda; in tertia impoſſibile eſt; at in quarta cum* $\frac{1}{2}q=\frac{1}{27}bbb+\frac{1}{6}bp$; *quo in caſu minor ex Radicibus Affirmativis eſt* $\frac{1}{3}b$, *major* $\sqrt{\frac{1}{3}bb+p}+\frac{1}{3}b$; *Negativa vero* $\sqrt{\frac{1}{3}bb+p}-\frac{1}{3}b$. *In prima, Radices ſunt* $\frac{1}{3}b$ *&* $\frac{1}{3}b\pm\sqrt{\frac{1}{3}bb-p}$. *In ſecunda vero formula,* $\frac{1}{3}b$ *&* $\sqrt{\frac{1}{3}bb-p}+\frac{1}{3}b$ *ſunt Affirmativæ: Negativa autem* $\sqrt{\frac{1}{3}bb-p}-\frac{1}{3}b$.

Atq; hæc in Cubicis ſufficere poſſe videntur; ob eximium vero Uſum Methodi, qua ope Tabulæ Sinuum radices harum æquati-

onum inveniuntur, placuit unum vel alterum exemplum adjungere, ut praxis illius compendium inde innotescat. Proponatur Æquatio $zzz-39zz+479z-1881=0$; *quæruntur radices* z. $\sqrt{\frac{1}{9}bb-\frac{1}{3}p}=\sqrt{9\frac{1}{3}}=\sqrt{d}$, *cujus duplum* $\sqrt{37\frac{1}{3}}$ *radius est Circuli; &* $\frac{\frac{1}{27}bbb+\frac{1}{2}q-\frac{1}{6}bp}{\sqrt{ddd}}=\frac{2197+940\frac{1}{2}}{9\frac{1}{3}\sqrt{9\frac{1}{3}}}-3113\frac{1}{2}$, *sive* $\frac{24}{9\frac{1}{3}\sqrt{9\frac{1}{3}}}$ *est sinus Tabularis Anguli, hoc est, facta divisione ope Logarithmorum, Log.* 9.9251560, *cui respondet Angulus* 57gr. 19m. 11s.$\frac{1}{2}$. *Hujus tertia pars* 19g. 6m. 24s. *& complementi* 40g. 53m. 36s. *Sinus dant Log.* 9.514983. *&* 9.816011, *qui ducti in* Rad. $\sqrt{37\frac{1}{3}}$ *producunt* Y &, *&* Y & *Log,* 0.301030 = 2 *&* *Log.* 0.601059 = 4, *tertia vero* Y & *æqualis est eorum summæ sive* 6. *Ideoq; radices sunt* 13−4=9. 13−2=11 *&* 13+6=19, *ex quibus singulis conflatur prædicta æquatio. Ubi Notandum duas minores radices non excedere* $\frac{1}{3}b$ *vel* 13, *quia centrum* R *in constructione cadit ad dextram Axis; id est* $\frac{1}{6}bp$ *minor est quam* $\frac{1}{27}b^3+\frac{1}{2}q$.

Exemplum alterum sit $x^3-15x^2-229x-525=0$. *& quærantur radices.* $\sqrt{\frac{1}{9}bb+\frac{1}{3}p}=\sqrt{101\frac{1}{3}}=\sqrt{d}$, *& Radius Circuli* $\sqrt{405\frac{1}{3}}$. $\frac{\frac{1}{27}b^3+\frac{1}{6}bp+\frac{1}{2}q}{\sqrt{ddd}}=\frac{125+572\frac{1}{2}+262\frac{1}{2}}{101\frac{1}{3}\sqrt{101\frac{1}{3}}}$

$=\frac{960}{101\frac{1}{3}\sqrt{101\frac{1}{3}}}=$ *Sinui Tabulari Arcus, cujus Log.* 9.9736426, *& Arcus ipse* 70gr. 14m. 22s. *hujus pars tertia est* 23gr. 24m. 47$\frac{1}{2}$s. *& complementi* 36. 35. 12$\frac{1}{2}$; *quorum Sinus Log. sunt* 9.599183 *&* 9.775275, *quibus addito Log.* $\sqrt{405\frac{1}{3}}$ *fiunt Log.* 0.903089=8 *&* *Log.* 1. 079181 = 12, *& eorum summa* = 20. *Hinc concluditur* $20+\frac{1}{3}b$ *vel* 25 *æquari radici Affirmativæ, &* 8 *&* 12 $-\frac{1}{3}b$ *sive* 3 *&* 7 *Negativis. Quod si æquatio fuisset* $x^3+15x^2-229x+525=0$, 3 *&* 7 *fuissent Affirmativæ; 25 vero Negativa. Cæteræ autem Cubicæ unica tantum Radice explicabiles juxta Regulas* Cardani *resolvendæ sunt, postquam demptus fuerit secundus terminus; nec video quo pacto minori calculo hoc negotium peragi possit. At si desideretur radix hæc in Quantitatibus* b, p, q *expressa, dico*

eam

eam esse in prima formula, $\frac{1}{3}b + vel -$ *Summa vel differentia Radicum Cubicarum ex* $\sqrt{\frac{1}{4}qq - {}_{1}\frac{1}{08}p^2b^2 + {}_{2}\frac{1}{7}b^3q - \frac{1}{6}bpq + {}_{2}\frac{1}{7}p^3} \pm {}_{2}\frac{1}{7}b^3 + \frac{1}{2}q - \frac{1}{6}bp$: *viz.* $+$, *si* $_{2}\frac{1}{7}b^3 + \frac{1}{2}q$ *major sit quam* $\frac{1}{6}bp$, *aliter* $-$; *Summa vero quoties* $\frac{1}{3}bb$ *major est quam* p; *sin minor fuerit* $\frac{1}{3}bb$, *differentia. Inq; cæteris formulis radix semper conflatur ex iisdem elementis, variatis tamen signis* $+$ *&* $-$, *ut facile percipiet qui velit experiri.*

Ope vero Tabulæ Logarithmicæ Sinuum Versorum Radices hæ satis prompte inveniuntur; nempe si Coefficientes Numeri sint Surdi vel fracti, ac radices Numeris ineffabiles; ut plerumq; fit. Hæc autem est Regula: In prima ac secunda formula, si $\frac{1}{3}bb$ *minor sit quam* p; *sit* $\frac{1}{3}p - \frac{1}{9}bb = d$, *& posita differentia inter* $\frac{1}{6}bp$ *&* $_{2}\frac{1}{7}b^3 + \frac{1}{2}q$, *hoc est* HR, *in prima, ac inter* $\frac{1}{6}bp + \frac{1}{2}q$ *&* $_{2}\frac{1}{7}b^3$, *in secunda, pro Radio; inveniatur angulus cujus Tangens est* $d\sqrt{d}$. *Deinde ut Co-sinus hujus anguli, ad ejusdem Sinum versum: ita differentia pro Radio habita, ad quartum; cujus Latus cubicum trisecando Logarithmum habebitur: ac diviso* $\frac{1}{3}p - \frac{1}{9}bb$ *per hoc Latus Cub. e Quoto subducatur Divisor: Residuum erit quantitas* Y &, *in Fig.* I. *Hujus Residui ac* $\frac{1}{3}b$ *summa, si centrum cadit ad dextram Axis, aliter differentia earundem, Radix erit quæsita. Quod si* $\frac{1}{3}bb$ *major sit quam* p, *posito* HR *pro Radio, sit* $d\sqrt{d}$ *sive distantia Paraboloidis ab Axe, Sinus Arcus cujusdam; Hujus Sinus versus ducatur in Radium, sive* $\frac{1}{6}bp - {}_{2}\frac{1}{7}b^3 \pm \frac{1}{2}q$, *ac trisecto producti Logarithmo, habebitur ejus Latus Cubicum, per quod dividatur* $\frac{1}{9}bb - \frac{1}{3}p$. *dico Quoti ac divisoris summam eadem Lege additam vel ablatam ex* $\frac{1}{3}b$, *Radicem quæsitam exhibere. Ac par est ratio in tertia ac quarta formulis, nisi quod* $_{2}\frac{1}{7}bbb + \frac{1}{6}bp \pm \frac{1}{2}q$ *pro Radio assumenda est, ac* $\frac{1}{9}bb + \frac{1}{3}p$ *in* $\sqrt{\frac{1}{9}bb + \frac{1}{3}p}$ *sive* $d\sqrt{d}$ *pro Sinu: Sed hæc præcepta exemplis fortasse melius percipientur.*

Sit æquatio Cubica $zzz - 17zz + 54z - 350$, *ac quæratur Radix* z: *Hic* $\frac{1}{3}bb$ *major est quam* p, *sed* q *major est quam Cubus ex* $\frac{1}{3}b$, *ideoq; una tantum Affirmativa Radice explicabilis est. Jam* $\frac{2}{9}\frac{8}{0} - \frac{5}{3}\frac{4}{}$ *est* d, *ac* $\frac{1}{9}\frac{2}{2}\sqrt{\frac{1}{9}\frac{2}{2}}$ *pro Sinu habenda est, ad Radium* $\pm\frac{2}{2}\frac{9}{7}\frac{1}{3} + 175 - 153$, *hoc est* $\frac{1}{2}\frac{5}{7}\frac{0}{}$:

Arcus vero competens fit 15gr. 3m. 49s. *Hujus Sinus Verſi Log.* 8.5362376. *additus Log. Radii* 2.3095913. *dat* 0.8457889. *cujus tertia pars* 0.2819276. *eſt Log. Radicis Cubicæ* 1.91394, *quo diviſore diviſo* $\frac{1}{9}\frac{2}{7}$ *ſive* d, *fit Quotus* 7.37281; *Quoti ac diviſoris ſumma, aucta additione* $\frac{1}{3}$b, *fit Radix quæſita, nempe* 14.9534, &c.

Exactis Cubicis Biquadraticas jam aggrediamur ; Hæ ſemper vel nullam, vel duas, vel quatuor Radices veras habent, quarum determinatio partim a Coefficientibus, partim a ſigno & magnitudine numeri abſoluti dati, pendet ; Harum omnium Conſtructionem generalem (in N°. 188.Pag. 341*) ſatis concinnam prodidi, quam Lector jam vidiſſe ſupponitur ; Figuram tamen eo ſpectantem (*Fig. II.*) huc transferre viſum eſt. In Conſtructione æquationis* $z^4 - bz^3 + pzz - qz + r = 0$, *fit* $BD = \frac{1}{4}b$, $AB = \frac{1}{16}bb$, $BK = \frac{1}{2}$, *ſive dimidio Lateris recti,* $KC = 2\,AB = \frac{1}{8}bb$. $KE = \frac{1}{8}bb - \frac{1}{2}p$, $AE - \frac{1}{2} = \frac{3}{16}bb - \frac{1}{2}p$ $FE = \frac{1}{16}b^3 - \frac{1}{4}bp$, *ac* $EG = \frac{1}{16}b^3 - \frac{1}{4}bp + \frac{1}{2}q$; *quo facto Circulus centro* G, *Radio* $\sqrt{GD^2 - r}$, *interſecabit Parabolam vel nullo, duobus aut quatuor punctis, quæ perpendiculis in lineam* DH, *Radices omnes* z *exhibent. Ut autem quatuor ſint, evidens eſt centrum circuli alicubi conſtitui debere intra ſpatium, de cujus puncto quovis tria perpendicula in Curvam Parabolæ demitti poſſint; atq; ſimul radium minorem eſſe maximo ex illis perpendicularibus, majorem vero medio. Quod ſi centrum conſtituatur extra hoc ſpatium, ut non niſi una perpendicularis in Parabolam demitti poſſit, qua major ſit radius; vel ſi minor ſit media ex tribus perpend. major vero quam minima ex illis, duæ tantum poſſunt eſſe radices ; nulla vero omnino datur, quoties radius* $\sqrt{GD^2 - r}$ *minor eſt minima ex tribus, vel una illa, quoties una tantum eſt.*

Jam quale ſpatium hoc ſit, quibuſq; limitibus diſcernitur, ac quibus conditionibus radius Circuli minor vel major ſit prædictis perpendicularibus, nobis reſtat inquirendum ; ac primum quo pacto perpendicularis in Parabolam demitti poſſit oſtendendum eſt.

Sit A

Sit A B C *Parabola*, A E *Axis ejus*, A V (Fig. III.) *ſemi-Latus rectum*, G *punctum de quo demittenda eſt perpendicularis: Ducatur Axi perpend.* G E, *ac biſecetur* V E *in* F, *& erecta perpend.* F H *ad idem Axis Latus, ſiat* F H = $\frac{1}{4}$ G E ; *dico quod Circulus, Centro* H, *radio* H A *deſcriptus, Parabolam interſecabit in punctis tribus vel uno* Z ; *ad quæ ductæ rectæ* G Z *Curvæ Parabolicæ perpendiculariter inſiſtunt.*

Ut autem tres ſint hujuſmodi interſectiones, oportet centrum circuli H *ita collocari, ut ſit intra ſpatium Paraboloidibus (in Fig.* I.) *incluſum; hoc eſt ut* F H *minor ſit quam* $\sqrt{\frac{8}{27}}$ V F^3 *ſive* F H^2 *minus quam cubus ex* $\frac{2}{3}$ U F : *atq; adeo* G E = 4 F H *minor erit quam* $4\sqrt{\frac{8}{27}}$ V F^3 *ſive* $4\sqrt{\frac{1}{27}}$ V E^3, *hoc eſt quadratum ex* G E *minor erit quam* $\frac{16}{27}$ V E^3. *Coincidunt itaq; hi limites cum Paraboloidibus duabus ejuſdem generis cum iis quibus in Cubicis uſi ſumus, ſed quarum Latus rectum duplo minor eſt ;* viz. $\frac{27}{16}$ *Lateris recti Parabolæ, hoc eſt* $\frac{27}{8}$ *ipſius* A V : *ideoq; ea ipſa eſt linea Curva cujus evolutione generatur Parabola, ſic demonſtrante* Hugenio ; *quamq; ſemper contingit linea* D F, (*Fig.* II.) *quæ Parabolæ perpendiculariter inſiſtit in puncto* D. *Punctum autem* P, *ſive in quo contingit recta* D F *Paraboloidem, centrum eſt Circuli, qui radio* D P *deſcriptus cum Parabola in puncto* D *coincidit, ſive ejuſdem Curvitatis eſt ; ut per ſe ſatis conſtat.*

Deſcriptis itaq; hujuſmodi Paraboloidibus V X P, V N △ (*Fig.* II.) *utrinq; ab Axe ; perſpicuum eſt quod, niſi centrum Circuli conſtituatur intra hos limites, non poſſit ille pluribus quam duobus in punctis Parabolam interſecare : unde determinare licet quibus ſub conditionibus Coefficientes terminorum intermediorum coercentur, in æquationibus Biquadraticis, ut habeantur quatuor radices. Ac prima fronte clarum eſt* p *majorem eſſe non poſſe quam* $\frac{1}{8}$ b b (*ſcil. in formulis ubi habetur* + p) *nec* q *quam* $\frac{1}{16}$ b^3. *Generaliter vero* $\frac{1}{16}$ b^3 ∓ $\frac{1}{4}$ p b ∓ $\frac{1}{2}$ q, *id eſt diſtantia centri ab Axe* E G, *minor eſſe debet quam* E H = $4\sqrt{\frac{1}{27}}$ V E^3, *hoc eſt* (*ob* V E = $\frac{3}{16}$ b b ∓ $\frac{1}{2}$ p) *quam* $\frac{1}{4}$ b b ∓ $\frac{2}{3}$ p $\sqrt{\frac{1}{16}\text{b b} + \text{vel} - \frac{1}{6}\text{p}}$; *ſignis* + *&* − *in dubio relictis, ut ſecundum æquationis cujusvis naturam variari poſſint ; quem-*

 admodum

admodum in Cubicis ſuperius oſtenſum eſt ; ac nollem doctis tædium injicere, aut diſcentibus ſingula particulatim rimandi voluptatem ac exercitationem præripere.

Termini autem ultimi r limitatio eadem facilitate inveniri nequit ; id adeo, quia Problema ſit Solidum, in Curvam Parabolæ demittere perpendicularem, quodq; non ſine ſolutione æquationis Cubicæ reſolvi poſſit. Itaq; primo loco deficiat ſecundus terminus, vel ſi adfuerit, tollatur, ut æquatio habeat formulam $z^4 . * . p z^2 . q z . r . = o$. Ac ſi fuerit $-r$, ſemper duabus vel quatuor Radicibus explicari poteſt; ut autem quatuor ſint, oportet centrum circuli intra Paraboloides prædictas conſtitui, ſive ut ſit $-p$, ac $q q$ minus quam $\frac{8}{27} p^3$ ſive cubo ex $\frac{2}{3} p$. Deinde habeantur radices æquationis hujus $y^3 . * . \frac{1}{2} p y . \frac{1}{4} q = o$, quantitatibus p & q iiſdem ſignis annexis quibus in Biquadratica. Hæ autem Radices auxilio Tabulæ Sinuum ſatis expedite inveniuntur. Inventis autem tribus illis y, (quæ ſunt ordinatim applicatæ ad Axem Parabolæ, de punctis ubi incidunt perpendicula in Curvam ejus. ſcil. Z Y in Fig. III.) $p yy - 3y^4$ ex minore y, quantitatem maximam r deſignabit, ſi fuerit $- r$; qua ſi minor fuerit r, æquatio quatuor habebit radices, aliter duas. Aſt ſi fuerit $+ r$, oportebit eam minorem eſſe quam $3y^4 - pyy$ ex media y, nam ſi major ſit, non niſi duas habere poteſt radices, ſaltem ſi minor ſit r quam $3 y^4 - p y y$ ex maxima y. Hæc vero ſi major ſit, nulla omnino radice vera explicabilis eſt æquatio. Hi vero iidem limites aliter deſignantur ex quantitate q, ſcil. $\frac{1}{2} q y - y^4$ in primo caſu, $y^4 - \frac{1}{2} q y$ in ſecundo, ac $y^4 + \frac{1}{2} q y$ in tertio.

Fieri autem poteſt ut duæ minores quantitates y non longe diſtent ab invicem, unde evenit quod utraq; ex perpendicularibus major ſit quam recta G A, ſcil. cum $q q$ majus ſit quam $\frac{4}{27} p^3$, minus vero quam $\frac{8}{27} p^3$; cadente centro intra ſpatium Paraboloidibus utriuſq; Figuræ I & II interjectum. Hoc in caſu, ſi fuerit $+ r$, non niſi duæ poſſunt eſſe radices, exiſtente $y^4 + \frac{1}{2} q y$ ex maxima y, major quam r; aliter nulla. At ſi $\frac{1}{2} q y - y^4$ ex minima y, major fuerit quam r ſigno $-$ notata, r vero major quam $\frac{1}{2} q y - y^4$ ex media y, tunc habentur quatuor radices

dices; at duæ tantum ſi vel major priore vel minor poſteriore inventa ſit r.

Si vero in æquatione fuerit + p, *vel ſi ſit* − p *&* q q *majus fuerit quam* $_{2}^{8}{}_{7}$p^{3}, *æquatio* y^{3} .∗. $\frac{1}{2}$p y. $\frac{1}{4}$q *unica tantum explicatur radice* y; *hoc eſt una tantum perpendicularis de centro Circuli demitti poteſt: unde certo concluditur duas tantum radices haberi poſſe in æquatione data, quarum ſumma, ſi fuerit*—r, *cum quantitate* r *augetur; at ſi habeatur* + r, *obtenta quantitate* y, *quantitas illa* r *minor eſſe debet quam* y^{4} + $\frac{1}{2}$q y; *nam ſi ea major ſit, æquatio propoſita abſurda & impoſſibilis eſt.*

Longum & ſuperfluum eſſet omnes hujus cenſus æquationes percurrere, cum ex jam dictis attendenti ſatis evidens ſit, quæ Negativæ, quæ Affirmativæ ſint; atq; quod Radicum harum Limites ex quantitatibus inventis y *petantur. In exemplum vero, quod cuivis in cæteris imitari licet, proponantur indagandi limites ſive conditiones, ſub quibus in Æquatione Biquadratica* 4 *Radices Affirm. dari poſſint. Hoc autem fit quoties centrum circuli* G *ponitur in ſpatio* U P K, *(Fig.* II.*) ac ſimul habetur* + r *ſive Circuli radius minor quam* G D: *Unde patet, æquationem de qua agitur hujus eſſe formulæ* z^{4} − b z^{3} + p z^{2} − q z + r = o; p *vero majorem eſſe non poſſe quam* $\frac{1}{8}$bb, *nec* $\frac{1}{4}$pb *hoc in caſu, quam* $_{1}^{1}{}_{6}$b^{3} + $\frac{1}{2}$q; *deinde opus eſt ut* $\frac{1}{4}$bb − $\frac{2}{3}$p *in* $\sqrt{\ }$ $_{1}^{1}{}_{6}$b b − $\frac{1}{6}$p *major ſit quam* $_{1}^{1}{}_{6}$b^{3} + $\frac{1}{2}$q − $\frac{1}{4}$p b; *& ex his limitibus certo conſtabit centrum intra ſpatium* U P K *inveniri. Ut vero definiatur quantitas* r, *ſolvenda primum eſt Cubica* y^{3} .∗. − $_{1}^{3}{}_{6}$b^{2} − $\frac{1}{2}$p y = $_{3}^{1}{}_{2}$b^{3} + $\frac{1}{4}$q − $\frac{1}{8}$p b; *& habebuntur puncta, in quæ perpendiculares de centro in Curvam Parabolæ cadunt.*

Inventis autem tribus valoribus hujus y, r *minor eſſe debet quam* $_{2}^{3}{}_{5}{}_{6}$b^{4} + $\frac{1}{4}$b q − $_{1}^{1}{}_{6}$b b p + 3y^{4} − $\frac{3}{8}$b^{2}y y + p y y *ex media* y, *major vero quam* $_{2}^{3}{}_{5}{}_{6}$b^{4} + $\frac{1}{4}$b q − $_{1}^{1}{}_{6}$b b p + 3 y^{4} − $\frac{3}{8}$b^{2} yy + p y y *ex minima* y. *Hos vero limites ſi excedat* r, *non niſi duæ Radices haberi poſſunt. Deniq; ſi* $_{2}^{3}{}_{5}{}_{6}$b^{4} + $\frac{1}{4}$b p − $_{1}^{1}{}_{6}$b b p + 3 y^{4} − $\frac{3}{8}$bby y + p y y *ex maxima* y, *minor fuerit quam* r, *æquatio propoſita impoſſibilis eſt.*

Accidit etiam ut quatuor ſint Affirmativæ, cum Centrum G *conſtituitur in ſpatiolo* V T S ; *ducta ſcil.* R T S *perpendiculari in medium ſuppoſitæ lineæ* A D : *Hoc autem fit cum* p *major eſt quam* $\frac{5}{16}$b b, *ac* $\frac{1}{4}$b b $-$ $\frac{2}{3}$p $\sqrt{\ }$ $\frac{1}{16}$b b $-$ $\frac{1}{8}$p *major quam* $\frac{1}{8}$p b $-$ $\frac{5}{128}$b b b $-$ $\frac{1}{2}$q. *Quo in caſu ſemper duæ, aliquando tres ex Radicibus fiunt majores quam* $\frac{1}{4}$b.

Notandum vero hic limitem illum ex minima y *productum, aliquando negativum fieri, ſive minorem nihilo ; quoties ſcil. maxima ex tribus perpendicularibus major eſt quam* G D. *(Fig.* II. *) Hoc ſi acciderit quantitas* $+$ r *a limite præſcripto ex media* y, *in nihilum minui poteſt. Defectus vero limitis ex minima* y *monſtrat quanta poſſit eſſe* $-$ r *in æquatione, ſi habeantur tres radices Affirmativæ ac una Negativa ; quam ſi excedat, non niſi duæ, altera Affirmativa, altera Negativa, dari poſſunt. Hæc autem omnia demonſtrantur ex eo quod prædicti limites quantitatis* r, *ſint differentiæ Quadratorum lineæ* G D *& perpendicularium in Curvam Parabolæ.*

Ob perplexas vero cautiones, quas parit in æquationibus hiſce ſignorum diverſitas, præſtat ſemper ſecundum terminum tollere, ac deinde juxta præcepta jam tradita radicum numerum ac ſigna inquirere ; præſertim ſi quantitates illæ y *non multum diſtent ab invicem. Ex quatuor autem hiſce radicibus Affirmativis, duæ ſemper ſunt minores quam* $\frac{1}{4}$b, *duæ vero majores; nempe ſi* D G *minor ſit quam* A G, *ſive* $\frac{1}{4}$p b *quam* $\frac{3}{64}$b^3 $+$ q. *Tres autem minores ſunt quam* $\frac{1}{4}$b, *quoties perpendicularis media, ſive ex media* y *inventa, major eſt quam* A G, *ſive* $\frac{3}{8}$bby *major quam* 3y^3 $-$ p yy *ex eadem media* y; *Quarta vero & maxima radix major eſt quam maxima* y $+$ $\frac{1}{4}$b ; *æquatur autem differentiæ ipſius* b *& ſummæ cæterarum trium radicum, ideoq; minor eſt* b. *Sed jam* Manum de Tabula ; *Fortaſſis illi qui naturam Parabolæ penitius perſpectam habent, majori compendio hæc omnia peragere valebunt ; at ſi quantitates hæ omnes* b. p. q. *&* r, *abſq; reſolutione Cubicæ æquationis rite determinari poſſint, non ſine cauſa ambigitur ; quæcunq; enim æquationibus planis hac in re fiunt, non veros 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 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 appearence have hapned to the Earths Surface. A neceſſary conſeqvence 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 10*th*. he found the Meridian altitude of ☉ 64*gr*. 2*m*. 20*s*. and the next Day 64*gr*. 2*m*. 25*s*. and on *December* 14°.3 days after the Solſtice, wherein the Sun was got two minutes higher, he found the Meridian Altitude 17*gr*.

9*m*. 10*s*. wherefore the ſolſtitiall Altitude was 17*gr*. 7*m*. 10*s*. Theſe heights were taken by an Inſtrument of 6 foot Radius of Braſs; and the skill and diligence of the obſerver is not to be doubted.

To compare with theſe I find among *Bernard Walthers* obſervations made in the ſame City of *Nurenburg*, two hundred Years before. *viz*. in the Year 1487, that the Meridian Altitude of the Sun in the ſummer Solſtice was obſerved by the Parallactick inſtrument of *Ptolomy* wherby the Chord of the Suns diſtance from the Zenith was obſerved 44890 parts of 100000 *Radius*; the ſame being confirmed by the concurrence of the obſervations of ſeveral Years both before and after. The arch anſwering to this Chord gives the Suns diſtance from the Zenith 25*gr*. 56*m*. 30*s*. and conſequently the Meridian Altitude its Complement to a Quadrant, 64*gr*. 3*m*. 30*s*. Again the ſame Year 1487 the Chord of the Meridian diſtance of ⊙ from the Zenith, on the day of the Winter ſolſtice was found 118790, confirmed likewiſe by many ſubſequent obſervations; the arch anſwering to this Chord is 72*gr*. 52*m*. 40*s*. and its complement 17*gr*. 7*m*. 20*s*. the Meridian hight of the Sun in the Winter ſolſtice.

Hence it appears that the ſolſtitiall hights were very nearly the ſame at *Nurenburg* 200 Years ago as now they are, that of the Summer ſolſtice being but one minute differing, the other only 10*s*. both which may poſſibly ariſe from the defects 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 Meridian 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*, *Virginia*, *Jamaica &c*. on the other, ought to change faſteſt; but I have never yet heard of any ſuch thing obſerved by any of our Navigators; whence if there be

be ſuch a change of the Earths Poles, it muſt neceſſarily require a long time to become ſenſible.

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 Earths Axis makes with the plain 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 Earths 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 *Ptolomy*, 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 *Ptolomy* 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 *Ægyptian 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 *Ptolomy*, 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 20000 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 Ovall whoſe ſhorteſt diameter is the Axis, and greateſt Circle the Equinoctial; if the Poles be ſuppoſed changed, the Equinoctial will be ſo 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 topps of hills, and ſo deep under ground; 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 graduall manner, as when produced by ſuch an eaſie tranſlation of the Poles, as can by obſervation be admitted, thoſe Inundations could never be fatall to the Inhabitants, for that they would alwais 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 our, without the ſuppoſition of a great and ſudden alteration in the Poles of the Earths diurnal Revolution; for which whether wee ſhould have recourſe to the Intelligent powers that firſt impreſt this whirling motion on the Ball; or leave it to be performed naturally, by the caſuall 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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PHILOSOPHICAL TRANSACTIONS

For the Month of December, 1687.

THE CONTENTS.

An Account of the diſeaſes of Doggs, 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.

Doggs 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 *Doggs*, and that by Fitts, and may ſometimes hold out 9 months (3) *La Rage Mue* which is a diſeaſe that lies in the Blood (4) The *Falling Madneſs* which ſeaſes 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 Eyes 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 catched 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. Johns wort* gathered in their prime, equal parts of each, lett them be made into very fine Pouder. 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 4*l.* of *Canary* 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 ſtopt. Then let there be made a digeſtion or gentle boyling therof *in Balneo*, for 4 hours, ſhutting in the ſteam, then preſs it and ſtrain it.

The doſe is from two to three Ounces (and in ſome Perſons 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, leaſt the Poyſon ſeaſe 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 Proteſs 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 Cataplaſme of *London Treacle*, *Alliaria* or *Hedge Garlicke*, *Rue* and *Salt*.

Take dried *Rue* and *Scordium* each 2 Dr. *Virginia Snake-Root* 1½ Dr. Flowers of *St. Johns wort* 3 Dr. fine filings of *Tinn* and *Garlik* cut ſmall, each 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 diſolve, may ſerve the turn.

Make up of this *Electuary* 4 ½ Ounces at a time, that ſo the Doſe may be half an Ounce.

AN


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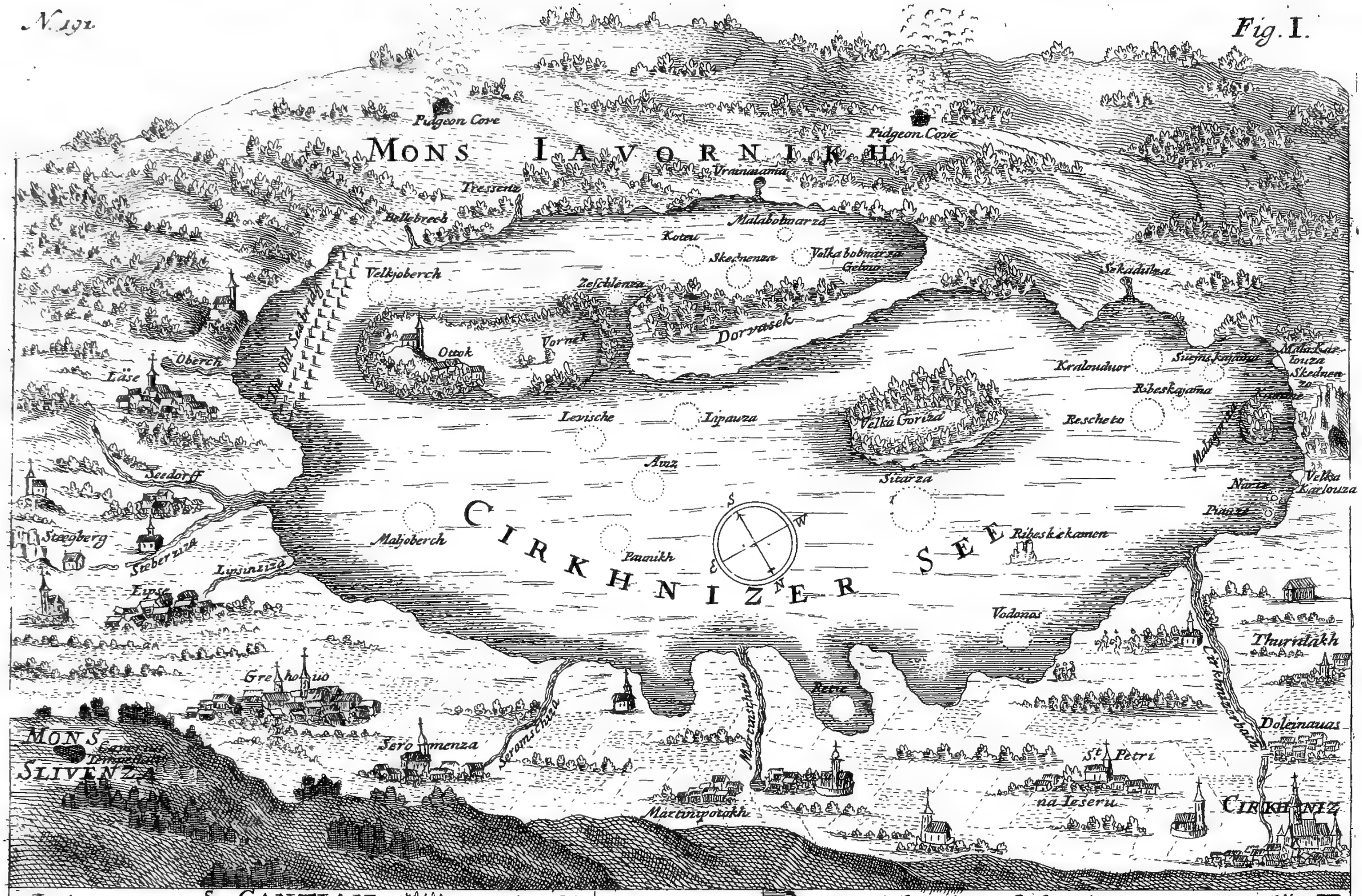
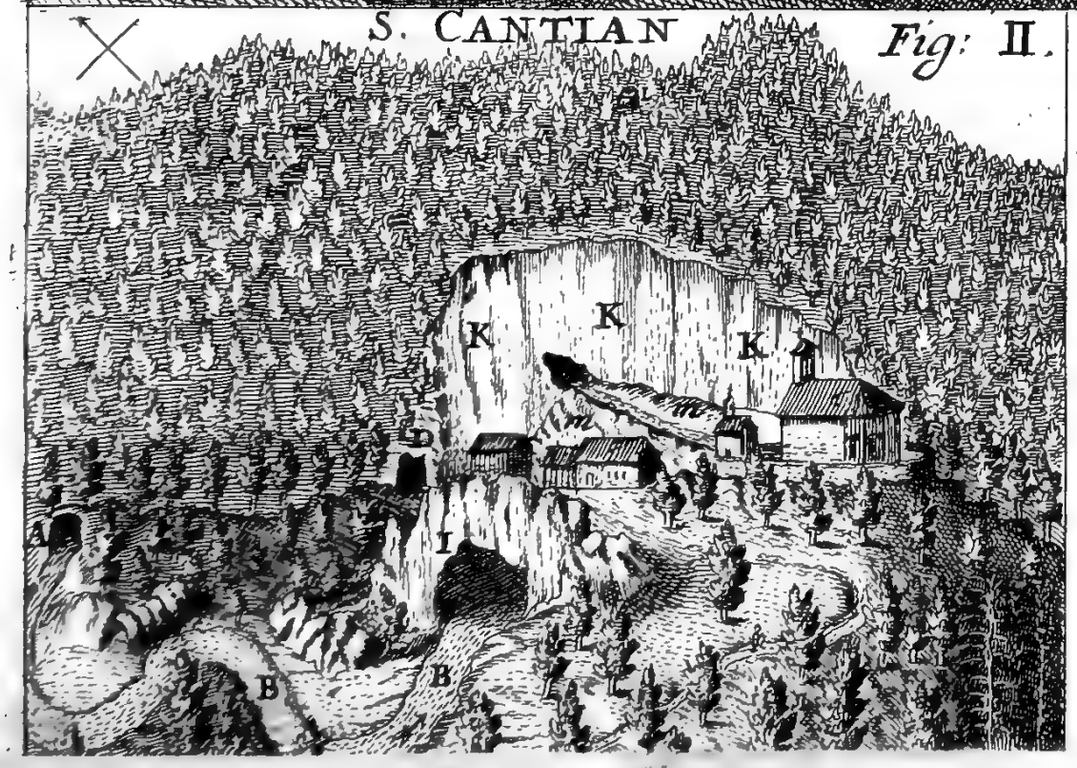
N. 192.

Fig. I.



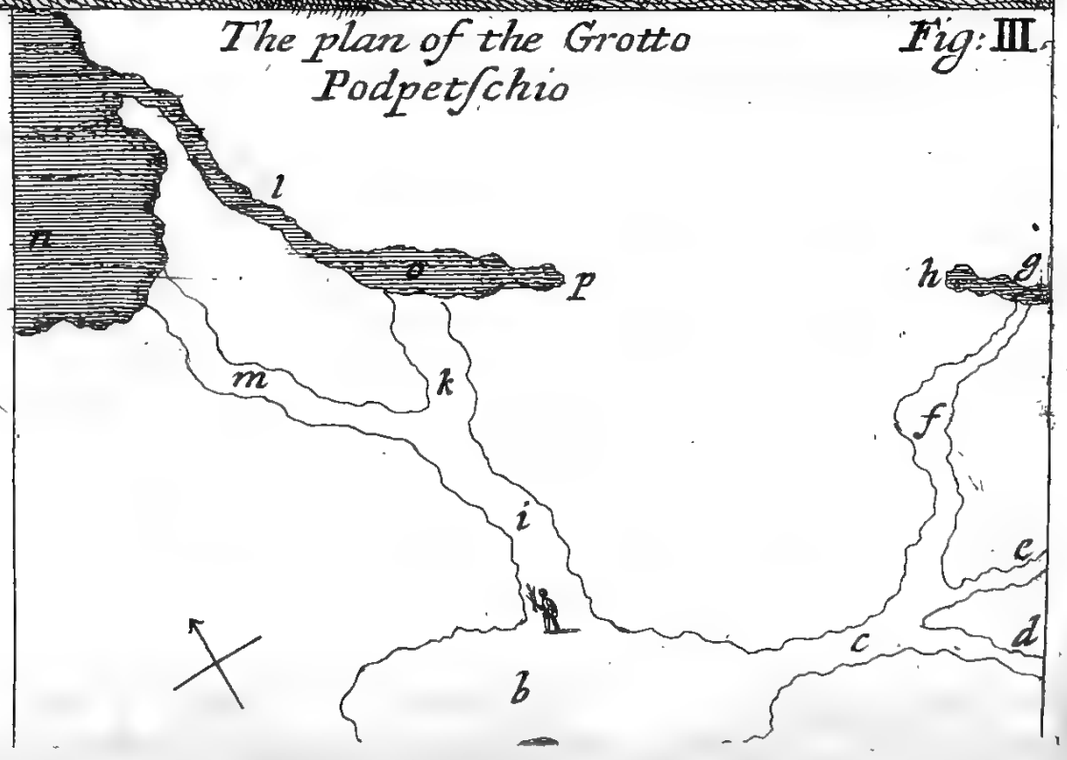
S. CANTIAN

Fig: II.



The plan of the Grotto Podpetschio

Fig: III.



An Extract of a Letter written to the Royal Society *out of* Carniola, *by Mr.* John Weichard Valvaſor R. Soc. S. *being a full and accurate deſcription of the wonderfull Lake of* Zirknitz *in that Country.* Vide Phil Tranſact. N. 54, & 109.

THis Lake was by the Ancients called *Lugea Palus*, by the moderns *Lacus Lugeus*, tho at preſent its Latine name be *Lacus Cirknicenſis*, in high Dutch *Zirckwizer-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 a one, 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 *Zirkvisko Jeſero* or the Chappel-Lake, but now by abuſe * being changed into *n 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 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. I*) which was drawn by my ſelf upon the place, with all poſſible care.

In the Mountain called *Iavornik* ſtanding near the Lake, there are two holes, or exceeding deep precipices, in which many thouſand wild Pidgeons rooſt all the Winter; entring in Autumn, and coming out with the firſt of the Spring: What they live upon in theſe caverns is unknown, but I take it to be the Nitrous Sand. In the other hill called *Slivenza*, tis the belief of the Country People that the Witches hold there aſſemblys, 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 *Zirchnits* every *Whitſon-Munday* goes to the Hole in Proceſſion, and uſes over it a certain form of Exoreiſme.

There runn into this Lake continually eight Rivulets. The two leaſt are called *Belle rech* and *Treſenz*; 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 *Cirknizer-bach* 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 *Velki-Karlouza* and *Mala Karl uza*, 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 *Jeſero*, that is *the Lake*. This River *Jeſero* 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-ſhott; 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 paſſed 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 *Jeſero* runs, is exceeding ſteep, but the Plat of Ground *m*, *m*, is plain and ſtony, of an Oval Form, and is ſurrounded 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 *Jeſero* runs. Here we found ſeveral Figures of Stone, the Workmanſhip of Nature, and ſtrange Holes or Caverns in the

Earth; but by reaſon the River was then up, we could go no farther. At other times when the Water is down, one may go with lighted Torches a great way under ground; and '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 ſomtimes it has been drie 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 *Sept.* 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 *Haaſperg*, 2. *Steegberg*, 3. *Laas*, 4. *Schneeperg*, 5. *Aveſperg*, 6. to *Sitticium*, which is a Monaſtery of *Ciſtertian Monks*.

There are three Ilands in this Lake, *viz. Mala-Goriza* and *Velka-Goriza* which are uninhabited. The third is a very pretty Iland called *Varnek* 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, Meddows, 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 *Vornek* 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*, *Louretſchka*, *Kvalouduor*, *Reſcheto*, *Ribeskajamma*, *Rathje*, *Sittarza*, *Lipauza*, *Gebno*, *Koteu*, *Ainz*, *Zeſtenza*, *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 drie 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 Catched 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 aforeſaid 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 taſt.

(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 *Ribes e'a nen*, that is *The Fiſh rs Stone*, which as ſoon as it begins to appear upon the re-

ceſs

ceſs of the Water, gives Notice that it is time to begin the Fiſhing.

(6.) The Pitt *Louretſchka* is evacuated a day and a half after *Vodonos*, the Fiſhing is after the ſame manner, and the ſame Caution neceſſary, becauſe of the ſuddain receſs of the Water.

(7.) The Water leaves the Pit *Kralouduor* twelve hours after *Louretſchka*; and three days after that (8.) the Pitt *Reſcheto*. In this latter, in the Year 1685, after the Lake had been ſome Years without being dry, there were taken at the firſt Hawl, 21 Carts of Fiſh, at the 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 *Reſcheto*, 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 *Rethje* is empty two hours after *Ribeskajamma*, and is of no great Conſequence for Fiſh: An hour after this the Pitt (11.) *Sittarza*, and in five or ſix hours more (12.) *Lipauza* falls dry.

(13.) The third Day after *Reſcheto* the Pitt *Gebno* is evacuated; in this they rarely Fiſh with Netts, 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 *Zeſtouza* 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 *Leuiſche* is evacuated the third Day after *Pounigk*, that is the 25th. Day from the beginning of the Receſs of the Water of the Lake, ſo that in 25 Days the Fiſhing of this Lake is over. In this laſt Pitt, about 17 Years ſince, I am certainly informed, that there fell a Flaſh of Lightning, about the Time of Fiſhing; which ſtunned a great Multitude of large Fiſhes, ſo 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 Sulfurious Vapour of the Lightning, which makes them riſe and ſwim as dead upon the top of the Water; but if they be taken up and put in freſh Water, they ſoon recover, otherwiſe they Die: This is no uncommon Accident in this Lake.

The Fiſhing being thus ended, a Signe is given by tolling the Bell in the Chappel of St. *John Baptiſt*, 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, into the Lake, and look for Fiſh among the Weeds and Sedge, and in the ſmaller Pitts. And many creep into the Subterraneous Caverns and Paſſages, and find ſtore of large Fiſhes there. They having full Liberty to ſearch all over the Lake, excepting in the Pitts *Piauze*, *Narte*, and *Velkjoberch*. This Barbarous and Immodeſt Cuſtom of going Naked, has been often attempted to be reclaimed by the *Carthuſian Monks*, but all in vain, for ſo prevalent is a Habit of vicious Practices over good Precepts, that they

they have not yet been able to perſwade them ſo much as to cover their Secrets.

There are beſides theſe ſome other Pitts in the Lake, as *Skednenza*, *Mala* and *Velka-bobnarza*, in which they Fiſh likewiſe, as alſo in *Mala-karlouza* and *Velka-karlouza*: In both theſe they go far under ground with lighted Torches and find Fiſh, but theſe Pitts are of no great value. In *Velka-bobnarza* one may go in at great holes, and deſcend many Fathoms under ground. Theſe two Names *Velka* and *Mala-bobnarza*, ſignifie in the *Carniolan* Tongue the *Greater* and *Leſſer Drummer*; nor is it without Reaſon that theſe Pitts are ſo called; for when it Thunders and Lightens, there is heard in theſe two Pitts, as it were, the Sound of many Drums Beating, which *Anno* 1685, I heard with my own Ears; it Thundring 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 piſs upon the *Leech*, which makes it let go its hold; and this without any reſpect to Modeſty is practiſed, as well upon the Women as Men.

There are in the Mountain nigh the Lake, but ſomething higher than it, two great and terrible ſtony Caves, the one called *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 Fiſh; which I my ſelf obſerved in *October* 1685, not without great danger of my Life. I took my Horſe and rid Croſs the Lake, as far as the Iland *Vornek*, in Company with two old experienced Fiſhermen; when ſuddainly the Cavern in the Mountain *Slivenza*, began to breath forth miſty Vapours forming a Cloud. Upon which my Fiſhermen adviſed me to make haſt, for without doubt thoſe Clouds would produce a Tempeſt. They had ſcarce ſaid ſo, when it began to Lighten and Thunder dreadfully; and I had difficulty to perſwade them to accompany me as far as the Pitt *Velkabobnarza*, being deſirous to examine what is ſaid of it, that when it Thunders the Sound of many Drummers is heard in it. This I found three times to ſucceed as reported; and then with all the ſpeed we could, we haſted to the Iland *Velka-Goriza*, 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 overſet 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 wondred that the Lake fills ſo faſt, for conſidering the Violence wherewith the Water ruſhes, it is as much as a great River; this Cave *Sekadulze*, being a Fathom wide, and higher than a Man. It is 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 *Zeſlenza*. It comes likewiſe forceable out of the Spring *Treſenz*, as likewiſe out of *Velkioberch*, bringing with it at this latter abundance of Fiſh, and ſome *Ducks*. But when it Rains very hard and long togather, 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) ſpirting ſeveral Fathoms high, from ſome perpendicularly, from others obliquely , ſo that there is not a pleaſanter ſight than this. And out of the Pitts, *Vodonos*, *Reſcheto*, and ſome others having great holes at the Bottom, there comes with the Water a great quantity of Fiſh. In caſe of great Rains, the 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 ſuddain coming of the Water is deſtroyed, but it generally comes to Maturity. 5. While the *Millet* is on the

Ground they catch a great Number of Quails. 6. The *Millet* being 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 Flaviatilis* 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*. *Crabbs* are found no where but in the Pitts *Kamine* and *Sueinskajamma*; they are large but ill taſted.

The Cauſe or rather *Modus* of all theſe wonderful *Phænomena* in the Lake of *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 under ground, 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 haſty, the Water is precipitated with great Violence down the ſteep Valleys, in which are the Channels of theſe Rivulets; ſo that the Water in this Lake, being encreaſed by the ſuddain 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 *Cirknitz*, (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 *Vrainajamma*, *Sekadulze*, and *Treſenz*.

That ſome of theſe Paſſages, bring *Fiſh*, ſome *Ducks* and *Fiſh*, others only Water, ſeems to depend on the poſition of the inward Mouths of theſe Subterraneous Channels; for if they be ſo conſtituted, as to draw off the Water from the ſurface of the upper Lake, on which the *Ducks* ſwim, they muſt needs be 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 *Zirknitz*, and that under it, are fed only by the eight Rivulets that alwais fall into them; and then the Water draws off faſter

than it comes in, both by the Chanels of *Mala* and *Velka-karlouza*, 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 Pitts 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 Chanels of *Mala* and *Velka-Karlouza*, 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-Karlouza*, the River *Jeſero* at St. *Cantian* overflows, and runs with great Violence. When it only runs out at *Mala-Karlouza* (which is ſomwhat 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-Karlouza*, 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 taſt, 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 ſtuff like Graſs or Herbs: which was the more ſtrange, becauſe I never found any green thing growing in any of our Subterraneous Grottoes or Lakes in *Carniola*; I 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 ſatisfie my Curioſity withall.

Almoſt every Year, at a Hole in the Mountain called *Storſeg*, about half a *German* Mile from the Lake of *Zirknitz*, near the Town of *Laas*, whenever there happen great Floods of Rain, this ſort of *Ducks* is caſt out in great abundance, by the Water guſhing out with much force. I conceive that this Cavern *Storſeg* is another Paſſage out of the ſame Lake under *Javornic*, that overflows and fills up our Lake of *Zirknitz*; but this being ſomewhat higher, it never runs out, unleſs the ſaid Lake be more than ordinary 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 my self have observed; there is a most Notable Instance of the like things, found in the Subterranean Cavern called, *The Grotto Podpetschio*, which is represented in *Fig.* III.

This *Grotto* is in *Carniola* in the Parish of *Guetenffeld*, 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 bigg 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 *k*. 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 suddain it will run again with great force, so as the Noise thereof frequently frights the People as they come for Water.

Out of the Cave *b* there is another Channel *c*, which is divided into three others *d*, *e*, *f*. This Channel *f* tends obliquely

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 Mens Hands: Theſe may be ſeen by any one that will go with lighted Torches; and there are many ſuch, in which I have not been.

If any one would carry a Boat to the Lake *n*, and would row upon it, I doubt not but he might find ſeveral curious things. I believe this Subterraneous Lake to be a *German* Mile long: for from this Grotto *Podpetſchio*, at a Miles diſtance, there is a Village called *Kumpale*, whoſe Inhabitants have no other Water, than what they fetch out of a hole in the Rock, going with lighted Torches, by a large Channel, to a great Lake under ground. I meaſured with good Geometrical Inſtruments, ſuch as Miners uſe, the Level of theſe two Lakes of *Podpetſchio* and *Kumpale*, and found them to be in one Horizon; and this I did twice, both when the Channel *l* at *Podpetſchio* run, and when it did not run. When it began to run, I found that the Lake *n* was two Cubits higher than it had been before; when it ceaſed to run, I came again on purpoſe to obſerve it, and found that then alſo, the other Lake at *Kumpale* was in the ſame Level; from whence it is moſt certain, that theſe two, are only one continued Subterranean Lake, *&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.

	JANUARY.				FEBRUARY.				MARCH.				
	M.		A.		M.		A.		M.		A.		
D.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	D.
1	8 ⊙	07	8	37	9	54	0	31	9	40	10	17	1
2	9	10	9	44	11	0	11	43	0	50	11	22	2
3	10	19	10	55			0	15	11	52			3
4	11	30			0	45	1	12	0 ⊙	20	0	46	4
5	0	05	0	39	1 ⊙	37	2	0	1	10	1	32	5
6	1	09	1	36	2	19	2	36	1	52	2	10	6
7	2	02	2	25	2	52	3	07	2	2	2	43	7
8	2 ⊙	45	3	03	3	22	3	36	2	38	3	12	8
9	3	20	3	35	3	50	4	03	3	26	3	39	9
10	3	50	4	04	4	16	4	29	3	53	4	07	10
11	4	18	4	33	4	43	4	58	4 ⊙	22	4	37	11
12	4	47	5	01	5 ⊙	14	5	33	4	55	5	15	12
13	5	1	5	34	5	54	6	1	5	38	6	04	13
14	5	52	6	11	6	43	7	13	6	31	7	01	14
15	6 ⊙	32	6	55	7	44	8	20	7	36	8	12	15
16	7	19	7	45	8	57	9	37	8	5	9	2	16
17	8	16	8	49	10	18	10	59	10	07	10	47	17
18	9	24	10	01	11	40			11 ⊙	24	11	58	18
19	10	38	11	18	0 ⊙	16	0	50			0	30	19
20	11	57			1	20	1	49	1	00	1	2	20
21	0	34	1	08	2	15	2	36	1	53	2	16	21
22	1 ⊙	39	2	07	2	56	3	14	2	38	2	58	22
23	2	32	2	56	3	32	3	49	3	17	3	35	23
24	3	15	3	33	4	06	4	23	3	54	4	12	24
25	3	50	4	07	4	42	5	02	4 ⊙	32	4	53	25
26	4	24	4	42	5 ⊙	24	5	48	5	17	5	42	26
27	5	00	5	20	6	15	6	46	6	10	6	39	27
28	5	41	6	05	7	18	7	52	7	09	7	42	28
29	6 ⊙	32	7	01	8	28	9	02	8	15	8	49	29
30	7	32	8	04					9	20	9	53	30
31	8	41	9	16					10	24	10	54	31

A Correct TIDE-TABLE, by *J. Flamsteed*, Math. Reg. & R. S. S.

	APRIL.				MAY.				JUNE.				
	M.		A.		M.		A.		M.		A.		
D.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	D.
1	11 ⊙	21	11	48	11	29	11	49			00	15	1
2			0	12			0	13	00	44	1	12	2
3	0	35	0	57	0	38	1	02	1 ⊙	39	2	05	3
4	1	18	1	38	1	24	1	45	2	28	2	50	4
5	1	57	2	15	2	06	2	27	3	11	3	30	5
6	2	32	2	49	2 ⊙	47	3	06	3	50	4	09	6
7	3	05	3	21	3	24	3	42	4	28	4	48	7
8	3 ⊙	36	3	51	4	00	4	19	5	09	5	30	8
9	4	10	4	28	4	40	5	01	5	53	6	16	9
10	4	47	5	08	5	24	5	50	6 ⊙	41	7	08	10
11	5	31	5	58	6	17	6	44	7	35	8	05	11
12	6	26	6	55	7	14	7	55	8	36	9	10	12
13	7	30	8	08	8 ⊙	17	8	49	9	43	10	18	13
14	8	41	9	16	9	19	9	51	10	52	11	29	14
15	9 ⊙	51	10	26	10	23	10	57			00	04	15
16	10	59	11	33	11	30			00	39	1	10	16
17			0	05	00	03	0	23	1 ⊙	40	2	07	17
18	00	36	1	04	0	59	1	33	2	31	2	55	18
19	1	31	1	55	2	01	2	27	3	14	3	33	19
20	2	20	2	43	2 ⊙	51	3	13	3	51	4	08	20
21	3	04	3	24	3	33	3	51	4	24	4	40	21
22	3 ⊙	24	4	04	4	10	4	30	4	56	5	13	22
23	4	43	4	44	4	50	5	10	5	30	5	50	23
24	5	07	5	30	5	31	5	54	6 ⊙	08	6	28	24
25	5	56	6	23	6	15	6	38	6	50	7	11	25
26	6	49	7	18	7	01	7	25	7	34	7	59	26
27	7	47	8	17	7 ⊙	49	8	15	8	26	8	54	27
28	8	46	9	13	8	41	9	05	9	23	9	53	28
29	9 ⊙	40	10	07	9	3	9	56	10	25	10	58	29
30	10	37	11	00	10	23	10	51	11	33			30
31					11	19	11	47					31

A Correct TIDE-TABLE, by *J. Flamsteed*, Math. Reg. & R. S. S.

	JULY.				AUGUST.				SEPTEMBER.				
	M.		A.		M.		A.		M.		A.		
D	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	D.
1	0 ⊙	08	0	41	1	51	2	17	3	00	3	23	1
2	1	12	1	41	2	39	3	00	3 ⊙	39	3	56	2
3	2	10	2	36	3	18	3	36	4	13	4	32	3
4	2	56	3	16	3	52	4	10	4	52	5	14	4
5	3	35	3	52	4 ⊙	26	4	45	5	39	6	08	5
6	4	10	4	26	5	05	5	25	6	31	7	12	6
7	4	45	5	04	5	49	6	14	7	49	8	23	7
8	5 ⊙	24	5	46	6	41	7	13	9	00	9	39	8
9	6	09	6	34	7	47	8	23	10 ⊙	1-	10	49	9
10	7	00	7	30	9	01	9	4	11	21	11	52	10
11	8	02	8	36	10	19	10	57			00	21	11
12	9	01	9	50	11 ⊙	31			00	46	1	09	12
13	10	27	11	04	0	06	00	40	1	31	1	50	13
14	1	34			1	07	1	33	2	08	2	26	14
15	00 ⊙	08	0	52	1	55	2	15	2	40	2	55	15
16	1	22	1	51	2	34	2	51	3 ⊙	09	3	24	16
17	2	14	2	36	3	05	3	19	3	37	3	51	17
18	2	56	3	13	3	33	3	46	4	06	4	21	18
19	3	29	3	45	3 ⊙	59	4	12	4	38	4	55	19
20	3	58	4	11	4	24	4	40	5	14	5	36	20
21	4	25	4	39	4	55	5	12	6	00	6	29	21
22	4 ⊙	53	5	08	5	30	5	51	6	58	7	31	22
23	5	24	5	41	6	15	6	4	8 ⊙	05	8	43	23
24	6	01	6	22	7	11	7	43	9	20	10	01	24
25	6	43	7	08	8	17	8	52	10	35	11	11	25
26	7	35	8	05	9 ⊙	31	10	10	11	44			26
27	8	33	9	13	10	49	11	26	00	16	00	46	27
28	9	50	10	27			00	03	1	13	1	3	28
29	11 ⊙	03	11	41	0	37	1	08	2	04	2	27	29
30			00	18	1	36	2	01	2 ⊙	48	3	07	30
31	0	52	1	24	2	24	2	45					31

A Correct TIDE-TABLE, by *J. Flamsteed*, Math. Reg. & R. S. S.

	OCTOBER.				NOVEMBER.				DECEMBER.				
	M.		A.		M.		A.		M.		A.		
D.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	D.
1	3	26	3	45	4	39	5	00	4	58	5	18	1
2	4	05	4	26	5	24	5	50	5 ⊙	38	6	00	2
3	4	46	5	09	6	17	6	44	6	22	6	44	3
4	5	30	6	04	7 ⊙	13	7	40	7	06	7	30	4
5	6	34	7	06	8	10	8	36	7	54	8	20	5
6	7	40	8	15	9	04	9	31	8	44	9	11	6
7	8 ⊙	49	9	21	9	56	10	23	9	36	10	03	7
8	9	55	10	26	10	49	11	15	10	31	10	59	8
9	10	5	11	21	11	39			11 ⊙	28	11	57	9
10	11	47			00	04	0	20			0	26	10
11	0	11	0	34	00 ⊙	52	1	15	0	54	1	20	11
12	0	56	1	16	1	37	1	58	1	47	2	12	12
13	1	37	1	56	2	20	2	40	2	34	2	55	13
14	2 ⊙	15	2	32	3	00	3	18	3	14	3	33	14
15	2	40	3	03	3	35	3	52	3	51	4	09	15
16	3	18	3	34	4	10	4	29	4 ⊙	26	4	44	16
17	3	50	4	06	4	49	5	11	5	03	5	24	17
18	4	25	4	43	5 ⊙	33	5	58	5	45	6	07	18
19	5	04	5	26	6	23	6	48	6	31	6	56	19
20	5	51	6	17	7	15	7	44	7	22	7	52	20
21	6 ⊙	46	7	18	8	15	8	45	8	22	8	55	21
22	7	52	8	25	9	16	9	48	9	29	10	06	22
23	8	57	9	31	10	22	10	55	10 ⊙	44	11	21	23
24	10	04	10	38	11	29			11	56			24
25	11	11	11	43	0 ⊙	03	0	36	00	37	1	11	25
26			00	10	1	08	1	38	1	41	2	09	26
27	00	44	1	12	2	07	2	33	2	34	2	56	27
28	1 ⊙	39	2	06	2	57	3	18	3	16	3	34	28
29	2	30	2	53	3	38	3	58	3	50	4	06	29
30	3	14	3	34	4	17	4	36	4 ⊙	22	4	37	30
31	3	55	4	14					4	52	5	10	31

M *ſtands for Morning*, A *for Afternoon*, ⊙ *for Sunday.*

This Table may be made to ſerve the underwritten Places by

Adding	*h.*	*m.*
For *Tinmouth-haven Hartlepool* and *Amſterdam.*	0	30
Breſt.	1	00
Silly.	1	45
Mounts Bay.	1	55
Bridlington Peer, and *Humber.*	2	00
Fowey, *Looe* and *Plymouth.*	3	15
Dartmouth, *Harborow*, and *Hull.*	3	30
Torbay and *Tinmouth.*	3	40
Exmouth, *Topſham*, and *Lyme.*	3	50
Weymouth.	4	20
Bridgwater and *Texel.*	4	45
Portland, *Hareflew*, and without the *Vie.*	5	40

Subſtracting	*h.*	*m.*
For *Leith*, *Maes*, and *Gouries-Gat.*	0	15
Graveſend, *Rocheſter*, *Rammekins.*	1	00
Buoy of the *Nore* and *Fluſhing.*	1	20
Shoe Beacon, *Portſmouth*, *Redſand* and *Oſtend.*	2	30
Spithead, *Harwich*, *Dover*, *Calice.*	3	00
Orfordneſſe, *Gunfleet*, *Haſtings*, *Shoreham*, *Diep.*	4	00
Needles, and *Yarmouth Peer.*	4	40
St. *Hellens* and *Haver de Grace.*	5	30

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 ſhewd 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*l.* we found but 5*l.* $\frac{1}{4}$ of Blood which is but $\frac{1}{47\frac{2}{2}}$ of the weight of the *Sheep*. In a Lamb weighing 30*l.* $\frac{1}{2}$ when living, there was but $1\frac{1}{2}$*l.* of Blood which is nearly a 20*th.* part.

In a *Duck* weighing alive 2*l.* 14 Ounces 50 gr. we found an ounce a half and 53 gr. of Blood, which is leſs than a 28*th.* 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 30*th.* 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 theſe 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 thoſe 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 multiplyed by 4, the Number of Ounces at a *Diaſtole*.

Now

Now if we ſhall ſuppoſe that a Mans 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 $\frac{1}{28}$ part, it will follow that the quantity of circulating Blood in a Man weighing 160*l.* will not exceed 8*l.* or 128 ounces; According to which computation the Blood will circulate 140 times in an hour. But let us ſuppoſe that inſtead of 8*l.* the maſſe of Blood in ſuch a Man be 12*l.* 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 ſuddain 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 gett into the Heart, and they ſuppoſe the quantity of Blood in the Body to be between 15 and 25*l.* by which it will appear how their computations and mine differ.

Catalogus Eclipſium omnium Satellitum Jovialium Anno 1688 per univerſam Terram Viſibilium; momenta Occultationum eorum in Jovis Umbrâ, ac ex eâdem Egreſſuum ſub Meridiano *Londinenſi* exhibens. Supputante *E. H.*

CUM inſtituto perutili Cl. Flamſteedius *Aſtronomus Regius, harum Eclipſium Catalogo Acta Philoſophica per annos aliquot ultimo elapſos auxerit, ejuſque uſus eximios ad inveniendas Locorum Longitudines docuerit, in* Num. 154. & 165; *nimis publici intereſſe viſum eſt, quam ut opus reſtitutioni Geographiæ maxime accommodatum non continuaretur. Cumque accuratus ille Author, proculdubio magis arduis intentus, inſtantis anni Catalogum ſupputatum non dederit, alienâ ope uti neceſſe erat; ideoque ex Tabulis aliis, neque parem cum cœlo conſenſum profeſſis, prodit hæc Eclipſium ſeries, quam Aſtronomis univerſis ſerio commendamus; ut tandem* Reſtauratæ Geographiæ *fundamenta, hac methodo facillimâ ac nullo fere Inſtrumentorum apparatu præſtandâ, ſed quæ minime fallat, jaceantur.*

Quæ huc pertinent præcepta Aſtronomicè doctos latere non poſſunt; diſcere cupidi Num. 154. *quod quærunt abunde invenient. Unicum monere non abs re erit, nempe, Tubo octo vel etiam ſeptem pedum, hoc eſt, facile portatili, momenta harum Eclipſium ſatis diſtincte obſervari poſſe, præſertim in exterioribus Satellitibus, ſi modo Lentis Objectivæ apertura* $2\frac{1}{2}$ *vel* 3 *pollices pateat. Sic enim Radiorum maxima copia ad oculum refracta perveniet, unde minimæ hæ Stellulæ in vicinia* Jovis *conſpici poſſint, quæ alias luce ejus nimiâ obfuſcarentur; ac quamvis coloribus tingantur, ac* Jovis *limbus parum nitidus videatur, tamen cum de momento amiſſæ vel recuperatæ Lucis unice agatur, ſufficit eas lumine quantum fieri poſſit auctas in oculos certius incurrere.*

In Catalogo quem jam damus im. *&* em. *Immerſiones & Emerſiones denotant Satellitis ejus quem numerus annexus commonſtrat; Intimo pro primo habito, extimo pro quarto. Aſteriſcus vero* (*) *eas ex his Eclipſibus quæ Londini viſibiles eſſe poſſunt deſignat, quæque Juſſu Societatis Regiæ annuente cælo obſervari debent.*

Intra Horæ quadrantem momenta hic poſita cum cœlo conſentientia ſperamus: in primo ac tertio Satellite multo propius, in quarto & ſecundo ambiguum: Itaque paulo ante tempus præſignatum obſervator attendere debet. Æquationem Luminis ex diverſis Jovis à Terra diſtantiis ortam conſultò omiſimus, eo fine ut neceſſitas ejus quantaque ſit obſervanti perciperetur.

Catalogus Eclipſium Satellitum Jovis Anno 1688. per totum Ter-
Umbram & ex ea Emerſionum ſub Meridiano Londinenſi

Januarii. D.	H.	M.			Februarii. D.	H.	M.			Martii. D.	H.	M.		
2	09	56	im	1	1	10	16	im	3	1	2	16	im	3
	17	9	im	4		11	57	im	1		5	46	em	3
3	10	47	im	2	3	6	25	im	1	2	14	8	im	1
	18	22	im	3	4	10	23	im	2	3	20	52	im	2
4	4	24	im	1	5	0	54	im	1	4	8	36	im	1
5	22	52	im	1		5	7	im	4	6	3	6	im	1
7	0	4	im	2		8	55	em	4	7	10	11	im	2
	17	20	im	1	6	19	23	im	1		21	35	im	1
9	11	48	im	1	7	23	41	im	2	8	6	18	im	3
10	13	21	im	2	8	13	52	im	1		9	48	im	3
	22	20	im	3		14	15	im	3	9	16	4	im	1 *
11	6	16	im	1	10	8	20	im	1		17	19	im	4 *
13	0	44	im	1	11	12	59	im	2		21	19	em	4
14	2	38	im	2	12	2	49	im	1	10	23	30	im	2
	19	13	im	1 *	13	21	18	im	1	11	10	34	im	1
16	13	40	im	1	15	2	18	im	2	13	5	3	im	1
17	15	55	im	2		15	46	im	1	14	12	49	im	2
18	2	17	im	3		18	15	im	3 *		23	32	im	1
	8	9	im	1		21	41	em	3	15	10	19	im	3
19	11	6	im	4	17	10	15	im	1		13	50	em	3
20	2	37	im	1	18	15	37	im	2	16	18	2	im	1
21	5	12	im	2	19	4	44	im	1	18	2	8	im	2
	21	6	im	1	20	23	13	im	1		12	31	im	1
23	15	34	im	1	21	23	11	im	4	20	7	0	im	1
24	18	30	im	2 *	22	3	7	em	4	21	15	57	im	2 *
25	6	16	im	3		4	56	im	2	22	1	29	im	1
	10	2	im	1		17	42	im	1 *		14	21	im	3
27	4	31	im	1		22	17	im	3		17	52	em	3
28	7	47	im	2	23	1	44	em	3	23	19	58	im	1
	23	0	im	1	24	12	12	im	1	25	4	46	im	2
30	17	28	im	1 *	25	18	15	im	2		14	27	im	1 *
31	21	5	im	2	26	6	40	im	1	26	11	26	im	4
					28	1	10	im	1		15	32	em	4 *
					29	7	34	im	2	27	8	56	im	1
						19	39	im	1	28	17	5	im	2 *
										29	3	25	im	1
											18	21	im	3
											21	53	em	3
										30	21	54	im	1

rarum orbem Visibilium, momenta Immersionum in Jovis exhibens, Calculante *E. H.*

Aprilis. D.	H.	M.		Maii. D.	H.	M.		Junii. D.	H.	M	
1	7	23	im 2	1	18	34	im 1	1	11	44	im 4 *
	16	23	im 1 *	3	7	10	im 2		16	10	em 4 *
3	10	52	im 1		13	2	im 1 *	2	6	24	im 3
4	20	41	im 2	4	14	26	im 3 *		15	6	im 1 *
5	5	21	im 1		18	00	em 3	4	6	47	im 2
	22	25	im 3	5	7	31	im 1		9	35	im 1
6	1	57	em 3	6	20	28	im 2	6	4	3	im 1
	23	50	im 1	7	2	00	im 1	7	20	5	im 2
8	10	0	im 2	8	20	28	im 1		22	32	im 1
	18	19	im 1	10	9	46	im 2	9	10	22	im 3 *
10	12	48	im 1		14	57	im 1 *		17	00	im 1
11	23	19	im 2	11	18	27	im 3	11	9	22	im 2
12	5	33	im 4		22	1	em 3		11	28	im 1 *
	7	17	im 1	12	9	25	im 1	13	5	56	im 1
	9	43	em 4	13	23	4	im 2	14	22	39	im 2
13	2	26	im 3	14	3	54	im 1	15	0	24	im 1
	5	58	em 3	15	17	41	im 4	16	14	21	im 3 *
14	1	46	im 1		22	3	em 4		18	52	im 1
15	12	38	im 2		22	23	im 1	18	5	46	im 4
	20	15	im 1	17	12	21	im 2 *		11	57	im 2 *
17	14	44	im 1 *		16	51	im 1		13	20	im 1 *
19	1	56	im 2	18	22	26	im 3	20	7	49	im 1
	9	13	im 1	19	2	0	em 3	22	1	14	im 2
20	6	26	im 3		11	19	im 1 *		2	17	im 1
	10	00	em 3	21	1	39	im 2	23	18	19	im 3
21	3	42	im 1		5	48	im 1		20	46	im 1
22	15	15	im 2 *	23	0	16	im 1	25	14	31	im 2 *
	22	11	im 1	24	14	56	im 2 *		15	14	im 1 *
24	16	40	im 1 *		18	45	im 1	27	9	42	im 1 *
26	4	33	im 2	26	2	24	im 3	29	3	49	im 2
	11	9	im 1		13	13	im 1 *		4	11	im 1
27	10	27	im 3	28	4	13	im 2	30	22	18	im 3
	14	1	em 3 *		7	41	im 1		22	39	im 1
28	5	37	im 1	30	2	9	im 1				
	23	37	im 4	31	17	30	im 2				
29	3	55	em 4		20	30	im 1				
	17	52	im 2								
30	0	6	im 1								

Reſiduum præcedentis Tabulæ.

Julii. D.	H.	M.		Auguſti. D.	H.	M.		Septembr. D.	H.	M.	
2	17	6	im 2	1	21	36	em 1	1	6	19	em 2 *
8 ☉	17	7	im 1	3	16	5	em 1	2	18	20	em 1
4	13	57	em 1 *		19	47	em 2	3	10	27	im 3 *
5	4	22	em 4	5	10	34	em 1 *		14	7	em 3
6	8	26	em 1 *		21	57	em 3	4	12	50	em 1
	9	22	em 2 *	7	5	3	em 1		19	38	em 2
8	2	55	em 1		9	6	em 2 *	6	7	19	em 1 *
	5	55	em 3		12	5	im 4 *	8	1	48	em 1
9	21	23	em 1		16	43	em 4		8	57	em 2 *
	22	40	em 2	8	23	32	em 1	9	20	17	em 1
11	15	52	em 1	10	8	1	em 1	10	0	29	im 4
13	10	21	em 1 *		22	25	em 2		5	13	em 4
	11	58	em 2 *	12	12	30	em 1 *		14	30	im 3
15	4	50	em 1	13	1	59	em 3		18	10	em 3
	9	55	em 3 *	14	6	59	em 1	11	14	47	em 1
16	23	18	em 1		11	44	em 2 *		22	17	em 2
17	1	16	em 2	16	1	29	em 1	13	9	16	em 1 *
18	17	47	em 1	17	19	58	em 1	15	3	46	em 1
20	12	15	em 1 *	18	1	3	em 2		11	36	em 2
	14	34	em 2 *	19	14	27	em 1	16	22	15	em 1
21	22	31	em 4	20	2	21	im 3	17	18	33	im 3
22	6	44	em 1		6	1	em 3		22	13	em 3
	13	55	em 3 *	21	8	5	em 1 *	18	16	44	em 1
24	1	13	em 1		14	22	em 2	19	0	55	em 2
	3	52	em 2	23	3	25	em 1	20	11	13	em 1
25	19	41	em 1	24	6	17	im 4	22	5	42	em 1 *
27	14	10	em 1 *		10	57	em 4 *		14	14	em 2
	17	10	em 2		21	54	em 1	24	0	12	em 1
29	8	38	em 1 *	25	3	41	em 2		22	35	im 3
	17	56	em 3	26	16	23	em 1	25	2	15	em 3
31	3	7	em 1	27	6	25	im 3		18	41	em 1
	6	28	em 2		10	5	em 3 *	26	3	33	em 2
				28	10	52	em 1		18	41	im 4
					17	0	em 2		23	27	em 4
				30	5	22	em 1	27	13	10	em 1
				31	23	51	em 1	29	7	39	em 1 *
									16	52	em 2

Reſiduum præcedentis Tabulæ.

Octobris.				Novembris.				Decembris.			
D.	H.	M.		D.	H.	M.		D.	H.	M.	
1	2	8	em 1	1	22	45	em 1	2	0	42	em 1
2	2	37	im 3	3	17	14	em 1		16	11	em 2
	6	17	em 3 *	4	5	55	em 2 *		19	5	im 4
	20	37	em 1	5	11	43	em 1		23	55	em 4
3	6	12	em 2 *	6	22	40	im 3	3	19	10	em 1
4	15	6	em 1	7	2	20	em 3	5	13	38	em 1
6	9	35	em 1 *		6	11	em 1 *		18	10	em 3
	19	30	em 2		19	13	em 2	6	5	27	em 2 *
8	4	4	em 1	9	0	39	em 1	7	8	5	em 1
9	6	39	im 3 *	10	19	7	em 1	9	2	33	em 1
	10	19	em 3	11	8	30	em 2		18	43	em 2
	22	33	em 1	12	13	35	em 1	10	21	1	em 1
10	8	49	em 2 *	14	2	38	im 3	12	15	28	em 1
11	17	2	em 1		6	18	em 3 *		22	6	em 3
13	11	31	em 1		8	4	em 1	13	7	59	em 2
	12	53	im 4		21	47	em 2	14	9	56	em 1
	17	39	em 4	16	1	4	im 4	16	4	24	em 1 *
	22	8	em 2		2	31	em 1		21	16	em 2
15	6	0	em 1 *		5	52	em 4 *	17	22	52	em 1
16	10	40	im 3	17	20	59	em 1	19	13	5	im 4
	14	20	em 3	18	11	3	em 2		17	19	em 1
17	0	28	em 1	19	15	27	em 1		17	55	em 4
	11	26	em 2	21	6	35	im 3 *	20	2	3	em 3
18	18	57	em 1		9	55	em 1		10	31	em 2
20	13	26	em 1		10	15	em 3	21	11	47	em 1
21	0	44	em 2	22	0	21	em 2	23	6	15	em 1
22	7	54	em 1 *	23	4	23	em 1 *		23	49	em 2
23	14	40	im 3	24	22	51	em 1	25	0	43	em 1
	18	20	em 3	25	13	38	em 2	26	19	10	em 1
24	2	23	em 1	26	17	19	em 1	27	6	0	em 3
	14	2	em 2	28	11	47	em 1		13	5	em 2
25	20	52	em 1		14	12	em 3	28	13	38	em 1
27	15	20	em 1	29	2	54	em 2	30	8	5	em 1
28	3	20	em 2	30	6	14	em 1 *	31	2	21	em 2
29	9	49	em 1								
30	7	00	im 4 *								
	11	48	em 4								
	18	40	im 3								
	22	20	em 3								
31	4	17	em 1								
	16	38	em 2								

Accounts of BOOKS.

Propoſitiones Hydroſtaticæ ad Illuſtrand. Ariſtarchi Samii *Syſtema deſtinatæ, & quædam Phænomena Naturæ Generalia. Auth.* Franciſco Jeſſop, *Arm. Lond.* 4^to. 1687.

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 it ſelf. 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 thence 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 it ſelf 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 *Ptolomaick*, *Tychonick*, and perhaps any other Syſtem of the World, and any kind of Philoſophy, not ridiculous at firſt ſight, whether a *Vacuum* be aſſerted or denied. But as to *Elaſticity*, he does not aſſert theſe Principles to have given the only cauſe, nor that they can explain Vegetation without an *Anima*; 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 joyn 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 entring 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.

Tabu-

Tabularum Aſtronomicarum pars prior, de motibus Solis & Lunæ, necnon de poſitione fixarum, ex ipſis Obſervationibus deductis: cum uſu Tabularum, &c. *Authore* Ph. de la Hire *Regio Matheſeos Profeſſore ac Regiæ Scientiarum Academiæ Socio.* 4^to. Pariſiis. 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 aſſerted 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 fixt 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 *Apogæon* or *Perigæon*, 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 *Apogæon* 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 ſubſtracted 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 *Quædam Lunaris Theoriæ Emendationem Spectantia*, the following Paſſage, *Quoniam tantas inæqualitates in Terræ revolutionibus non patiuntur Horologia, neceſſe eſt Lunam ipſam citatiori motu ferri in ſua orbita, quum Terra eſt Aphelia, remiſſiori cum in Perihelio ita ut omnium accelerationum ſumma menſe Septembri, ad* tredecem *minuta circiter aſſurgat. Retardationes vero omnes aggregatæ, menſe Martio, tantundem efficiant. Adhibeatur itaq; iſta temporis æquatio quæ Terræ motum diurnum æquabilem ſtatuit; in Calculo vero loci Lunæ, medio Lunæ motui addenda eſt nona pars æquationis Solis ſublativæ, 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 conſideration

tion of the Lunar Motions *extra Syzygias*, (which is here promiſed) he will find it no leſs requiſite in the Quadratures than in Eclipſes; ſeveral undoubted Obſervations ſhewing the Neceſſity thereof.

Among the Precepts for the uſe of the Tables, there is a pretty Remark concerning Refractions, which this Author ſaith 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.

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.

		Anno 1686.	*Anno* 1687.
Chriſtned	Males	7575	7737
	Females	7119	7214
	In all	14694	14951
Buried	Males	11828	11174
	Females	10781	10286
	In all	22609	21460

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Tables

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Fig. 3.

Fig. 4.

Fig. 5.

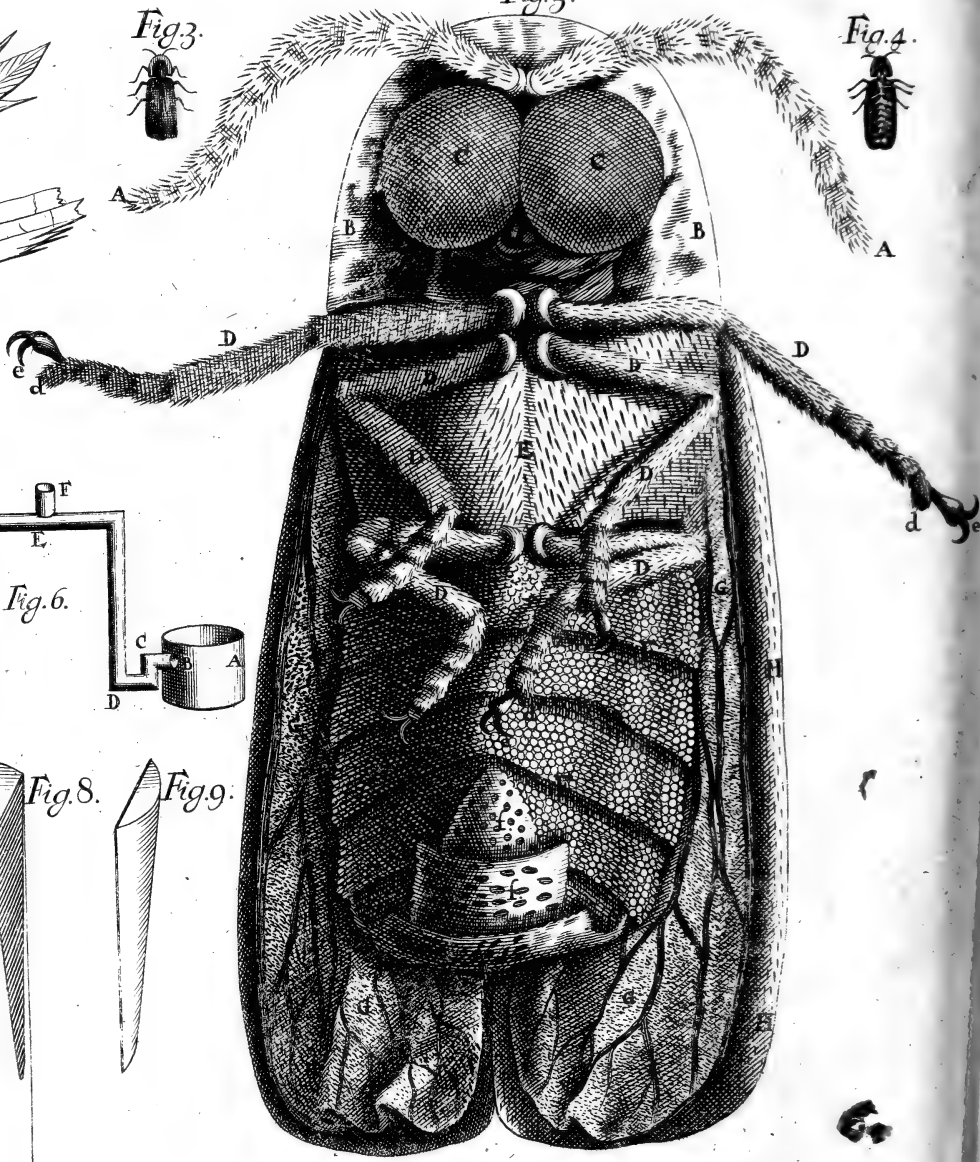


Fig. 6.

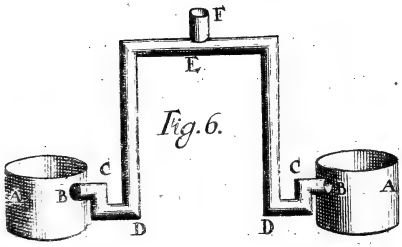


Fig. 8.

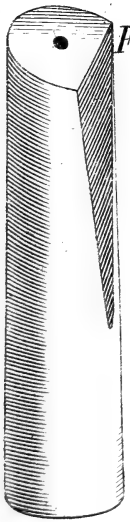
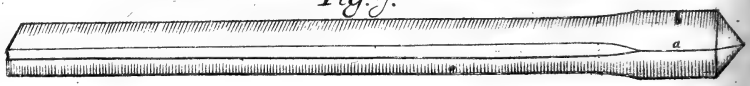


Fig. 9.

Fig. 7.



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