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TUTE·SI·RECTE·VIXERIS

PHILOSOPHICAL TRANSACTIONS.

Giving Some

ACCOUNT

OF THE

Present Undertakings, Studies, and Labours

OF THE

INGENIOUS,

In Many

Considerable Parts of the World.

VOL. XXVII. For the Years 1710, 1711, and 1712.

LONDON:

Printed for *H. Clements* at the *Half-Moon*, and *W. Innys* at the *Princes-Armes*, in St. *Pauls Church-yard*; and *D. Brown* without *Temple-Bar*. MDCCXII.

BRITISH MUSEUM
NATURAL HISTORY.

TO THE

QUEEN.

May it Pleaſe Your moſt Excellent Majeſty,

NOW it hath pleaſed GOD to eſtabliſh *Your Majeſty*'s Health, I moſt humbly preſent to *Your Majeſty*, inſtead of Medicinal Preſcriptions, ſome Papers which have been lately laid before the *Royal Society*, inſtituted by Your Royal Uncle King *Charles* II. for *Promoting*

Arts

Arts and Sciences, the greater Glory of GOD, *and the Good of Mankind*, as it is expreſs'd in the Words of his Charter of Incorporation. The Accounts here publiſh'd are ſuch as conduce to thoſe Ends, and lead Us to the Admiration of the Works of the Great Creator: And therefore I hope *Your Majeſty*'s Exemplary Piety and Goodneſs, ſufficiently known to all, but more eſpecially to thoſe who have the Honour to ſerve You, will Pardon my Preſumption; Cuſtom having made ſuch Addreſſes in almoſt all Ages a Teſtimony of Duty.

The *Royal Society* is very ſenſible of *Your Majeſty*'s great Grace and Favour to their Body, in thinking of them amidſt Your very many and weighty Affairs; and giving them the Direction of Your Royal Obſervatory at *Greenwich*, ſet up by their Patron and Founder, for Promoting the Ends of their Inſtitution, more particularly *Aſtronomy* and *Navigation*, for the Benefit of this Trading Kingdom.

This

This Truſt in a particular manner requires moſt humble Thanks; and ſo do other great, tho' too little regarded Bleſſings, which we partake with all Your Subjects; and which, next to Almighty GOD, we owe to *Your Majeſty*'s great Care, Protection, and Wiſdom: I mean, that we have lived in a manner eaſily and quietly, when almoſt all our Neighbours have been under the great Calamities of War and its Conſequences, Plague, Peſtilence, and Famine, in the Bowels of their Countries.

The beſt Return for ſo many Benefits that can be made, and I dare preſume the moſt pleaſing to *Your Majeſty*, would be, that all of Us, in our ſeveral Capacities, ſhould ſhew Ourſelves Thankful and Dutiful to GOD, live in peaceable Submiſſion to the Laws of our Country, of which *Your Majeſty* under *GOD* is the great Guardian, and be ready to do all good Offices which Civil Society requires of one to another.

I do

I do assure YOUR MAJESTY I will endeavour thus to gain *Your Majesty*'s Favour; and remain with unfeigned and profound Respect,

Your Majesty's most Obedient, and

Most Dutiful Subject

And Servant,

July 26. 1712.

Hans Sloane.


BRITISH MUSEUM
NATURAL HIS

TAB. I. Philos. Transact. N. 325.

TAB. III.

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N. Parr Gucht Sculp.

(Numb. 325.)

PHILOSOPHICAL TRANSACTIONS.

For the Months of January, February, *and* March, 1710.

The CONTENTS.

I. *A Diſcourſe upon the Uſefulneſs of the Silk of Spiders.* *By* Monſieur Bon, *Preſident of the Court of Accounts, Aydes and Finances, and Preſident of the Royal Society of Sciences at* Montpellier. *Communicated by the Author.*

NEXT to the Principal Care which all Men owe to their more neceſſary and eſſential Duties, whether they relate to their own Imployments, or reſpect themſelves or other People; it is requiſite, that they carefully make Choice of ſuch Diverſions, as are as well Uſeful as Entertaining: And as Inquiries into Nature are agreeable to all ſorts of Men, of what Degree or Station ſoever; it is no wonder, that the greateſt part of Mankind has prefer'd this kind Study, which has always been look'd on as a Recreation, and a means to Inſtruct as well as Divert the Mind.

And indeed what Amuſements can we find more ſolid and agreeable; or in what Science can we make ſo great a Progreſs with ſo little Pains? It is not the ſame in other Parts of Philoſophy, where Knowledge is not to be attained without profound Meditation and continual Labour. What a difference is there betwixt this and other Studies? The one requires ſome few leiſure Moments only, but the others a Mans whole Time.

How then can we blame thoſe, who ſometimes amuſe themſelves in unfolding the Secrets of Nature, which coſts them ſo little? Or ought any one to deprive himſelf of the like Diverſions? The leaſt Inſect or Plant, or uncommon Stone, may afford us agreeable Reflecti-

ons

ons in the moſt Solitary Place. Every thing induces us to admire the Infinite Power and Wiſdom of the Creator: And I dare ſay, that it is undoubtedly this Wonderful Variety, which appears in all his Works, that has moſt contributed to make the *Pagans* themſelves acknowledge a Firſt Being to be the Sole Author of the Univerſe.

Philoſophers of all Ages, and eſpecially the Moderns, have look'd on this part of Knowledge as the Foundation of Natural Philoſophy; and in applying themſelves to ſearch carefully into Matters of Fact, it was only from thence to arrive, at laſt, at the True Knowledge of the Cauſes. The Induſtry, with which the Royal Academy of Sciences at *Paris*, and We of *Montpellier*, have cultivated this part of Philoſophy, were ſufficient to prove the Uſefulneſs of it: But, without alledging here the Example of thoſe Learned Societies, who ſeem by their Inſtitution to be particularly engaged in this Study; how many Emperors, Kings, Princes and Magiſtrates, have we ſeen apply themſelves to it, for their own private Satisfaction.

Alexander made it his common Diverſion, in the midſt of his Labours in Conquering the World; and the Famous * *Ariſtotle* receiv'd of him 480000 Crowns for his Hiſtory of Animals, which he compoſed by his Order: And *Pliny* was as well rewarded for preſenting the Emperor † *Titus* with thoſe Learned and Curious Collections he had made of Inquiries into Nature.

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* Athenæus *Deipnoſophiſtarum lib. 9. Arbitratus verò apud doctiſſimum Ariſtotelem in opere Talentorum multorum mercede famoſo, (nam Stagiritem rumor increbuit ab Alexandro donatum fuiſſe talentis octingentis ad impenſam condendis ijs libris neceſſariam) ut comperi nihil memoratum fuiſſe &c.*

† *Pliny*'s Epiſtle Dedicatory.

Not

Not only Prophane Hiſtory furniſhes us with Inſtances of the Application that has been made to this kind of Learning; but Eccleſiaſtical Hiſtory affords us much greater Examples of the many Popes and Fathers of the Church, who have thought fit to join this with their other Studies. St. *Auguſtine* may ſuffice to convince us of this; who, how watchful ſoever he was to ſuppreſs all growing Errors, and inſtruct the Faithful in the Duties of Chriſtianity, applied himſelf nevertheleſs to this part of Knowledge: And his Treatiſe *De Civitate Dei* ſhows us, that we ought not to deſpiſe the Knowledge of any thing, which God himſelf has thought worthy to create.

But we need not go ſo far for Inſtances, when we have them here at home, in the Perſon of the Reverend † *William Pelliſſier*, Biſhop of *Montpellier*. Has not he writ ſeveral Books upon this Subject? Or could the famous *Rondeletius* ever have perfected his Great Work of Fiſhes and Shells found in our Seas, without the Aſſiſtance and Incouragement of this worthy Prelate? Our Kings themſelves have ſometimes taken Pleaſure in examining Nature; and the Hiſtorians of *France* aſſure us, that * *Francis* I. made ſo great a Progreſs in this kind of Learning, without any other Aſſiſtance, than the Converſation of the Learned *James Cholin*, and *Peter Caſtelan*,

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† Gariel. *Series Præſulum Magalonenſium, in vita Guillelmi Peliſſerij. Et* Thuan. *lib.* 38. *Hiſtor. ſui temporis, ubi de obitu Guillelmi Rondeletii.*

* Thuan. *Hiſt. ſui temporis lib.* 2. *Præcipuéque naturalis hiſtoriæ narratione delectabatur, in qua tantum audiendo profecerat, ut quamvis à pueritia nullis literis imbutus, quidquid de Animalibus, Inſectis, Plantis, Metallis, Gemmis, ab antiquis et recentibus Scriptoribus memoriæ proditum eſt, et meminiſſet, et apté edifſereret. Uſus ad hoc fuerat operâ Jac. Cholini primùm, dein Petri Caſtellani viri probitate et morum gravitate et doctrinâ præſtantiſſimi, quem Epiſcopatu Matiſconenſi, magnique Eleemoſinarij dignitate propterea remuneravit, ac Magiſtrum Bibliothecæ poſt Budæi obitum conſtituit.*

Mezeray *edit. in fol. Paris* 1685. *tom.* 2. *pag.* 1045.

that

that he was ignorant of nothing treated of, by either Antient or Modern Authors, upon the Subject of Animals, Insects, Plants, Metals, or precious Stones,

The Liberality of this Prince towards Men of Learning, drew into his Kingdom so many Famous Learned Men, that he was justly called the Father of the Muses. But if he deserved this glorious Title, with how much greater reason is it due to *Lewis* the Great? Who tho' continually possess'd with a Thousand different Cares, and is obliged at once to sustain the Efforts of all *Europe* in Arms against him; yet in the midst of so many Labours, nothing can divert him from the generous Design he always had, of making Arts and Sciences flourish: An undeniable Proof of which we have in his Establishing this Society, of which he has been pleased to declare himself Protector.

And what better Acknowledgment can we make, than by prosecuting his Intentions; and that You, Sirs, who are appointed to make the Natural History of this Province, would redouble, if possible, Your Care and Studies, to render your Inquiries as well profitable as pleasant. As for my self, who have a very different Imployment, and ought to give my self up entirely to the Study of the Laws; yet I am perswaded, that to answer in some measure the Favour the King has done me, in Nominating me an Honorary Member, together with Persons so Illustrious in themselves, as well for their Birth as the Dignity of their Professions, I ought to employ all my leisure Hours in endeavouring to assist You, as far as I am capable, in searching into Nature. The advantage I have, in being one of Your Number, ought to inspire me with these Thoughts, as You have been always pleased to acknowledge, and I hope will continue to do, if my chief Imployment would permit me to spend more time among You, and to Merit the Place I here enjoy.

The Obſervation I have now the Honour to preſent You is entirely New, and perhaps may one Day be as profitable. The Approbation You gave the bare Relation of the Experiments I deſigned to make on this Subject, engaged me to put them in execution; and it is to Your Encouragement that is owing what I am going to relate.

You will be ſurpriz'd to hear, that Spiders make a Silk, as beautiful, ſtrong and gloſſy, as common Silk: The prejudice that is entertained againſt ſo common and diſpicable an Inſect, is the reaſon why the Publick has been hitherto ignorant of the Uſefulneſs of it. And indeed who would ever have imagin'd it? When that of common Silk, as conſiderable as it is, lay ſo long a time unknown and neglected after its Diſcovery. It was in the Iſland of † *Cous*, that *Pamphila*, Daughter of *Platis*, firſt found out the Invention of working it. This Diſcovery was ſoon after known to the *Romans*, who brought their Silk from the Country of the * *Seres*, where Silk-Worms naturally breed: But far from making any advantage of ſo uſeful a Diſcovery, they could never imagine theſe Worms ſhould produce ſo beautiful and valuable a Thread, and made a Thouſand Chymerical Conjectures about it. So that their Ignorance and Idleneſs together, made Silk for ſeveral Ages ſo extraordinary ſcarce and valuable, that it was ſold for its

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† Ariſtotelis *Hiſt. Animal. lib.* 5. *cap.* 19. *Prima texiſſe in Co inſulâ Pamphila Platis filia dicitur.*
Plinij *Hiſt. Natural. lib.* 11. *cap.* 22.

* The *Seres* are a People of *Aſian Scythia* near the Mountain *Imaus*. *Vide* Plinij *Hiſt. Natural. lib.* 6. *cap.* 17. *et lib.* 16. *cap.* 17.
Iſidor. *Originum lib.* 19. *cap* 23. *Sericum dictum, quia id Seres primi miſerunt, vermiculi enim illi naſci perhibentur, a quibus hæc circum arbores fila ducuntur.*

weight

weight in Gold: And * *Vopiscus* relates, that for this reason the Emperor *Aurelian* refused his Empress a Suit of Cloaths of Silk, notwithstanding she earnestly desired it. Its scarcity continued a long time; and it was to the Monks at last that we owe the Manner of breeding Silk-Worms, who brought their Eggs from *Greece*, under the Reign of the Emperor *Justinian*, as we learn from † *Godefridus* in his Notes upon the *Code*; and *Ulpian* assures us, that the Price of Silk was equal to that of Pearls.

It was late before *France* made any advantage of this Discovery; when *Henry* II. brought to the Marriages of his Daughter and Sister the || first Silk Stockings that were seen in his Kingdom. To him and his Successors it is we owe the Establishment of this Manufacture at *Tours* and *Lions*, which has made Silk so common, and so greatly increased the Magnificence of Furniture and Cloaths.

So many Examples ought to shew us of what Importance it is to neglect nothing in the Study of Nature: What at first seems of no use, or almost impossible to

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* Vopiscus *sub finem vitæ Aureliani. Vestem holosericam neque ipse in vestiario habuit, neque alteri utendam dedit, & cum ab eo uxor sua peteret, ut unico pallio blateo serico uteretur, Ille respondit, absit, ut auro fila pensentur; libra enim auri tunc libra Serici fuit.*

† *Putat Seres vermiculos fuisse, quorum semen ovis piscium simile in Graciam fuerit allatum a Monachis ex Serindia Indiæ civitate sub Justiniano, ut tradit Procopius.* —— *Temporibus Gratiani ignorabatur in Imperio Romano Serici conficiendi ratio. l.* 1. *Cod.* Quæ res venire non possunt. *Vestis Serica inter res pretiosissimas computabatar ab Ulpiano L.* 37. §. 2. *ff. de evictionibus & L.* 1. *& temperent. Cod. de vestibus Holoberis lib.* 11. *soli principi licebat gestare vestes sericas aut saltem holosericas, et in solis Gynæciis principis confici poterant; & lege Rhodiâ Holosericæ auro æqualia.*

|| Mezeray *edit. Paris. in Fol. tom.* 3: *sub finem vitæ Henrici* IV. *Pag.* 1254.

be put in execution, oftentimes turns to the greateſt advantage, and becomes eaſy by Care and Induſtry. This is the Fate of all new Diſcoveries; and I dare promiſe my ſelf, that I what I now propoſe, will be favourably received. The Ingenious Fable of * *Arachne* ſhows us, that it is to the Spider we owe the firſt Hints of weaving Cloath and laying Nets for Animals: So the conſtant advantage, which I am ſatisfy'd may ariſe from this Inſect, will undoubtedly make it hereafter eſteem'd as highly as Silk-Worms and Bees, which of all Inſects are the moſt neceſſary, as well as wonderful in their Works.

Tho' the Hiſtory of Spiders be very large, an account of the great Number of Species, which are obſervable in each different kind; I think it notwithſtanding abſolutely neceſſary in a few Words to give a General and Curſory Account of this Inſect, before I enter upon the Deſcription of its Silk. I ſhall therefore reduce all the different ſorts of Spiders to two principal kinds, *viz.* ſuch as have long Legs, and ſuch as have ſhort ones: The latter of which furniſhes the Silk I am now ſpeaking of. In reſpect of their particular differences, they are diſtinguiſh'd by their Colour, ſome being Black, others Brown, Yellow, Green, White, and others of all theſe ſeveral Colours mixt together.

They differ likewiſe in the Number and Poſition of their Eyes; ſome having ſix, others eight, and others ten, differently placed upon the top of the Head, as may eaſily be ſeen by the naked Eye, but much better by the help of a Glaſs. Theſe are the principal Differences, they being alike in other reſpects as their Body, which Nature has divided into two parts: The fore-

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* *Plinij Hiſt. Natural. lib. 7. Cap. 56. Quæ quis invenerit in vita. Fuſos in laniſicio Cloſter filius Arachnes, Linum & retia Arachne invenit.*

part

part is covered with a Shell or hard Scale ſet with Hairs; it contains the Head and Breaſt, to which are fix'd its eight Legs, each of them conſiſting of ſix Joints. They have likewiſe two other Legs, which may be called their Arms; and two Claws, armed with two crooked Nails, and joyned by Articulations to the Extremity of the Head: With theſe Claws they kill the Inſects they feed on, their Mouth being immediately underneath them. They have likewiſe two ſmall Nails at the End of each Leg, and a ſpongy Subſtance between them, which undoubtedly is of Service to them when they go upon ſmooth Bodies.

The hinder Part of the Body of this Inſect is joyned to the fore-part only by a ſmall Thread, and cover'd with a thin Skin, on which are Hairs of divers Colours: It contains the Back, Belly, Parts of Generations, and the *Anus*. I ſhall apply my ſelf more particularly to the Deſcription of the *Anus*, as being the Part from whence the Spiders draw their Silk; it not being my deſign to give a General Deſcription of this Inſect, but only to ſpeak of their Silk, and the Uſefulneſs of it.

It is certain, that all Spiders ſpin their Thread from the *Anus*; about which there are five *Papillæ*, or ſmall Nipples, which at firſt ſight one would take for ſo many Spindles, that ſerve to form the Thread: I have found theſe *Papillæ* to be Muſcular, and furniſhed with a Sphincter. A little within theſe I have obſerv'd two others, from the middle of which iſſue ſeveral Threads, in a pretty large quantity, ſometimes more, and ſometimes leſs, which the Spiders make uſe of after a very Mechanical manner, when they have a mind to go from one place to another. They hang themſelves perpendicular by a Thread, and turning their Head towards the Wind, they ſhoot ſeveral others from their *Anus*, like ſo many Darts: And if by chance the Wind, which ſpreads them abroad, faſtens them to any ſolid Body,

(which

(which they perceive by the reſiſtance they find in drawing them in from time to time with their Feet) they then make uſe of this kind of Bridge to paſs to the place where their Threads are fixt. But if theſe Threads meet with nothing to fix on, the Spiders continue to let them out further, until their great length, and the force with which the Wind drives them, ſurpaſſing the weight of their Bodies, they find themſelves to be ſtrongly drawn; and then breaking the firſt Thread, which they hung by, they let themſelves looſe to be driven by the Wind, and flutter on their Backs in the Air with their Legs ſtretch'd out. And by theſe two ways it is, that they paſs over Roads, Streets, and the largeſt Rivers.

One may himſelf wind up theſe Threads, which by reaſon of their being united together, ſeem to be but one when they are about a Foot in length; but I have diſtinguiſh'd them into 15 or 20 at their iſſuing from the *Anus*. What is further remarkable, is the eaſineſs with which this Inſect moves its *Anus* every way, by means of the many Rings that border upon it. This is abſolutely neceſſary for 'em, in order to wind up their Threads or Silk, which in the Female Spider is of two ſorts. However, I believe this Inſect to be Androgynous, having always found the Signs of a Male in ſuch Spiders as lay Eggs: But it being of no Service to diſcuſs this particular, I ſhall return to my Subject.

The firſt Thread that they wind is weak, and ſerves them for no other uſe than to make that ſort of Web, in which they catch Flies: The ſecond is much ſtronger than the firſt; in this they wrap up their Eggs, and by this means preſerve them from the Cold, and ſecure them from ſuch Inſects as would deſtroy them. Theſe laſt Threads are wrapt very looſely about their Eggs, and reſemble in form the Bags of Silk-Worms, that have been prepar'd and looſen'd between the Fingers in order to

to be put upon the Diſtaff. Theſe Spiders Bags (if I may ſo call them) are of a Grey Colour when they are new, but turn blackiſh when they have been long expoſed to the Air. It is true, one may find ſeveral other Spiders Bags of different Colours, and that afford a better Silk, eſpecially thoſe of the *Tarantula*; but the ſcarcity of them would render it very difficult to make Experiments upon them; ſo that we muſt confine ourſelves to the Bags of ſuch Spiders as are moſt common, which are the ſhort Leg'd ones. Theſe always find out ſome Place, ſecure from the Wind and Rain, to make their Bags in; as hollow Trees, the Corners of Windows or Vaults, or under the Eaves of Houſes. And by getting together a great many of theſe Bags, it was that I made this new Silk, which is no ways inferior in Beauty to common Silk. It eaſily takes all ſorts of Colours; and one may as well make large pieces of it, as the Stockings and Gloves which I here preſent you. I ſhall next proceed to ſhow the manner how I prepared the Bags, to make the Silk that is now before You.

After I had got together 12 or 13 Ounces of theſe Spiders Bags, I beat them well for ſome time with the Hand and a ſmall Stick, to free them from Duſt. Then I waſhed them in warm Water, 'till the Water that came from them was clear. After this, I let them ſteep in a large Pot, with Soap, Saltpetre, and ſome pieces of Gum-Arabick; and let the whole boyle 2 or 3 hours over a gentle Fire. Then I waſhed them again with warm Water, to free them from the Soap: And having let them dry for ſome Days, I looſen'd them a little between the Fingers, that they might be more eaſily carded by the common Silk Carders, excepting that I cauſed them to uſe much finer Cards. By this means I had a Silk of a very particular Aſh-colour, which is eaſy to be ſpun, and (as you here ſee) affords a Thread

much

much ſtronger and finer than that of common Silk. Which ſhows, that all other ſorrs of Work may be made of it: And there is no reaſon to fear but that it will endure any Tryals of the Loom, after having paſſed that of the Stocking-Weavers.

Having already ſhown the Uſefulneſs and Poſſibility of making this Silk, the only difficulty now lies in procuring a ſufficient quantity of Spiders Bags to make any conſiderable Work of it. And this would be no difficult matter, if we could breed Spiders as they do Silk-Worms; for they multiply much more, and every Spider lays 6 or 700 Eggs; whereas the *Papilio*'s, or Flyes, of Silk-Worms, lay but 100, or thereabouts: And of this Number we muſt abate at leaſt half, on account of their being ſubject to ſeveral Diſeaſes, and are ſo tender, that the leaſt matter hinders them from making their Bags. Whereas on the contrary, the Eggs of Spiders hatch of themſelves, without any Care, in the Months of *Auguſt* and *September*, in 15 or 16 Days after they are laid; and the Spiders that laid them Die ſometime after. As for the Young Spiders that are bred from theſe Eggs, they live 10 or 11 Months without Eating; and continue in their Bags, without growing either bigger or leſs, till the hot Weather forces them to come forth and ſeek Food. The Reaſon of this is plain and natural: For all Inſects, and a great many other Animals, as Bears, Serpents, Mountain Rats, *&c.* that lye hid during the Winter, abound with a Viſcid Matter, which is not eaſily put in motion: So that it is not ſtrange, that Young Spiders ſhould live in the Cold Weather upon their own Subſtance, without any loſs of Spirits. But as ſoon as the warm Weather comes, it put in motion this Matter, and forces them to Spin, and run from place to place in ſearch of Food: And as ſoon as they begin to Eat, one may perceive them to grow bigger and bigger every Day. From whence we may cer-

certainly conclude, that if we could find out a way of breeding Young Spiders in Rooms, they would furniſh us with a much greater quantity of Bags than Silk-Worms do: For I have always found, that of 7 or 800 Young Spiders, there ſcarce died one in the Year; and on the contrary, of a hundred Young Silk-Worms, not Forty liv'd to make their Bags.

So great and conſiderable a Difference as this, will undoubtedly move the Curioſity of ſuch as are Lovers of Arts and Sciences, to endeavour to find out a way of Breeding theſe Inſects. In hopes that ſome lucky Chance, or my own Induſtry, might favour me with ſo Uſeful a Secret, I made uſe of the following Expedient to furniſh my ſelf with a large quantity of theſe Bags, which I now propoſe to the Curious, who may make the ſame Tryal of it as my ſelf.

I ordered to be brought to me all the large ſhort-leg'd Spiders, that could be found in the Months of *Auguſt* and *September*. Theſe I ſhut up in Papers, and put them into Pots, and covered the Pots with a Paper prick'd full of Holes with a Pin, as were likewiſe the ſeveral Papers that were in it, that the Spiders might have Air. I fed them with Flies; and ſome time after found, that the greateſt part of them had made their Bags, of which theſe are ſome.

But I more eaſily procured a great quantity of them, by promiſing to pay the ſame price for them by the Pound as for common Silk. This Advantage furniſhed me in a ſhort time with a large quantity: And they aſſured me, they found no difficulty in getting them; and that if they were permitted to go into every Houſe, where they ſaw theſe Spiders Bags in the Windows, they could furniſh me with what I pleaſed. So that we may eaſily conclude, that there are Spiders Bags enough in the Kingdom to make large pieces of Work; and that this New Silk which I propoſe, is not ſo ſcarce or dear

as common Silk was at firſt. And ſo much the more, by reaſon Spiders Bags, in reſpect of their lightneſs, afford much more Silk than the others; as a Proof of which, 13 Ounces yield near 4 Ounces of clean Silk; 3 Ounces of which will make a Pair of Stockings for the largeſt ſiz'd Man. Theſe here weigh but two Ounces and a Quarter, and the Gloves about three Quarters of an Ounce; whereas Stockings of common Silk weigh 7 or 8 Ounces.

It is certain a great Advantage may be made of this Inſect, which the Publick has always look'd on as troubleſome and dangerous, on account of its Venom: But I can aſſure You, notwithſtanding, that Spiders are not Venomous, having been very often bit by them my ſelf, without any ill Conſequence. And as for their Silk, it is ſo far from having any Venom, that every body makes uſe of it to ſtop Bleeding and heal Cuts; and indeed its Natural *Gluten* is a kind of Balſam, that cures ſmall Wounds, by defending them from the Air.

Theſe Reaſons ought to be ſufficient to take away the Fear and Prejudice, that ſome People might have againſt making uſe of the Silk of Spiders: But is is neceſſary before I end this Diſcourſe, to add others, ſo ſtrong and ſolid, that the moſt obſtinate muſt needs be convinced, that of all Inſects, Spiders leaſt deſerve the Contempt of the Publick.

Their Silk is Uſeful, not only in reſpect of the Manufacture it produces; but it Uſefulneſs is much greater, and more eſſential, on account of the Specifick Medicines, that may be drawn from it. It yields by Diſtillation a large quantity of Spirit and Volatile Salt; and I have found by comparing, that it affords at leaſt as much as common Silk, which of all mixt Bodies yields the moſt. This Salt and Volatile Spirit, which is drawn from Spiders Bags, is very active; as may be judged by the following Experiments. It changes the Tincture

of

of the Flowers of *Turnſole* into a beautiful Green Emeral Colour. It congeles, and reduces to a ſort of Snow, the Diſſolution of Corroſive Sublimate; whereas the Volatile Alcalies, drawn from Human Scull, Hartſhorn, and divers other mixt Bodies, only render it white or milky. So that this New Alkali which I propoſe, being prepared after the ſame manner as that which is drawn from the Bags of Silk-Worms, in making the *Engliſh Drops*, ſo famous over all *Europe*, may ſerve to make other New Drops, which may deſervedly be called *Drops of Montpellier*; which we need not ſcruple to make uſe of, with much greater Succeſs than the old ones, in Apoplexies, Lethargies, and all Soporous Diſeaſes, by reaſon of their great Activity: And they will be taken with leſs regret, becauſe their ſmell is not ſo fetid and diſagreeable. I ſhall not enlarge further on this Subject, but recommend to the Phyſitians and Chymiſts of this Society, the Care of Inquiring into the other Uſes, which Spiders Bags, and the Principles that are to be drawn from them by a Chymical *Analyſis*, may afford in Phyſick.

Explication of the TABLES.

Tab. 1. A. *Shows the Belly of a Spider, with the* Anus *and five* Papillæ, *from whence the Threads iſſue.*

B. C. *The Side, and Fore-part of the* Penis *of a Spider, as magnify'd by a Miſcroſcope.*

D. *The Follicle or Bag of a Field-Spider with a harder Shell, at the breaking of which the Young Spiders come out mixt with the Silk.*

E. *The Follicle or Bag of an Houſe-Spider wih a ſofter Shell, in which the Young ones are incloſed.*

Tab. 2. F. *A Spider hanging on the Branch of a Tree, with its Head turned againſt the Wind, and ſpinning out its Thread, 'till it finds that it adheres to ſome Body, (as to the Wall here repreſented) by which kind of Bridge it paſſes over Rivers*, &c.

G. *A Spider having broke the firſt Thread, by which it hung, and let out ſeveral others, is carried by the Wind, and floats in the Air with its Legs extended.*

II. *An Account of the Moon's Eclipſe*, February 2. $170\frac{2}{1}$. *obſerved at* Streatham *near* London, *and compared with the Calculation. By the Rev. Mr* H. Creſſener, *M. A. Fellow of the Royal Society.*

IN the laſt Lunar Eclipſe, on the ſecond of *February* 1709-10. the time of the end (which was what alone the want of a proper *Apparatus* and a favourable Skie would give me leave exactly to determine) I found to be the ſame (with but a very inconſiderable Difference) which the Calculation, according to our moſt Learned *Preſidents* admirable Theory, promis'd me to expect.

There being therefore no Examples of any Calculation (that I know of) according to that Theory, nor of the Theory's Agreement with Obſervation yet made Publick; I thought it proper to offer this one to this Learned Society's Peruſal, that the exact conſent with Obſervation in this, may prompt ſome of them to try the like in others. I have added the Calculation from the famous Mr. *Flamſteed*'s Tables, according to *Horrox*'s Theory,

Theory, as I find them publiſh'd in the Ingenious Mr. *Whiſton*'s Aſtronomical Lectures, with the *Radix*'s of the Mean Motions, corrected according to their firſt Authors later Obſervations, which are the ſame with thoſe aſſum'd in Sir *Iſaac Newton*'s Theory,

By comparing theſe two Calculations we may obſerve, that tho' moſt of the additional Equations in Sir *Iſaac Newton*'s Theory be very ſmall in this Situation of the Moon, yet they all conſpire ſo as to make its Place conſiderably more agreeable to Obſervation, than thoſe of *Horrox*'s Syſtem.

The Obſervation was made at *Streatham*, about ſix Miles near direct South of *London*, with a very good Eight foot Teleſcope. To correct the Clock, (for want of an Inſtrument,) I carried with me next Day two Watches, that were before adjuſted to the Clock, and compar'd them with Mr. *Flamſteed*'s at the Royal Obſervatory, having firſt noted its Error by an Obſervation of the Sun's Tranſit of the Meridian his Aſſiſtant communicated to me: Upon my return, I found my Watches ſtill to agree together, and to my Clock, which prov'd them to have gone true, and gave me the exact Error of my Clock, and the true time at Obſervation.

Mr. *Flamſteed* has ſince been pleaſed to acquaint me, that by his Obſervation of the Meridional Tranſit of the *Lyons Heart* during the Eclipſe, his Clock needed a yet further Correction of one Minute, which I have here accounted for.

17$\frac{02}{10}$. *Feb.*	*D.*	*H.*	*M.*	*Sec.*
The Mean Time of the Mean Oppoſition	2	4	9	42
The Mean Time of the True Oppoſition	2	10	54	48
At which the True Place of the Sun is	10	24	55	50

And its Æquation to be added.

The Place of the Moon at this Time, from Sir Isaac Newton's *Theory.*

	S.	D.	′	″
Mean Motion of the Moon	4	26	57	37
Annual Æquation Subtr.			8	34
The Correct Mean Motion	4	26	49	03
Mean Motion of Apog.	11	18	13	54
Annual Æquation of Apog. Ad.			14	31
Correct Mean Motion of Apog.	11	18	28	25
Second Æq. from the dist. of Ap. from Sun Ad.			2	57
Place of the Moon the 2d time Æquat.	4	26	52	00
Mean Motion of Node	11	01	34	25
Æquation of Node Subt.			06	54
Correct Mean Motion of Node	11	01	27	31
The 3d Æquat. of the Moon from Nodes Aspect with the Sun Subt.				10
Place of the Moon the 3d time Æquated	4	26	51	50
Second Æquation of Apog. Subtr.		7	45	41
True Place of Apog.	11	10	42	44
Mean Anomaly	05	16	09	06
Æquation of Center Sub.		1	53	31
Moons Place the 4th time Æquated	4	24	58	19
The Variation. Ad.				11
Moons Place the 5th time Æquated	4	24	58	30
The 6th Æquation from the distance of the Luminaries and Apog. Ad.			1	20
Moons Place 6th time Æquated	4	24	59	50
The 7th Æquation Ad.				34
True place of the Moon in its Orbit	4	25	00	24
True Place of the Sun	10	24	55	50
Moon beyond the Opposition			4	34
Which divided by the Horary Motion of Moon from Sun gives			7	42
	D.	H.		
The Mean Time therefore of Oppos. *Feb.*	2	10	47	06
And the true Time	2	10	32	20

The

The Place of the Moon at the same time from the Tables in Mr. Whiston's *Astronomy, according to* Horrox's *Theory.*

Mean Motion of the Moon	4	26	57	37
Physical Parts Sub.			8	21
Correct Mean Motion	4	26	49	16
Mean Motion of Apog.	11	18	13	54
Æquation of Apog. Sub.		7	25	00
Mean Anomaly	5	16	00	22
Æquation of the Center Sub.		1	53	53
Place of Moon in its Orbit	4	24	55	23
Distance from the Opposition				27
That is in time to be added				45½
The Mean time therefore of true Opposition is exactly (D. H.)	2	10	55	33
The Apparent time	2	10	40	41
Place of Moon in Ecliptick	4	24	57	27
Reduction between the true Opposition and middle of Eclipse Ad. (D. H.)			2	47
Middle of Eclipse	2	10	43	34
Continuance of Eclipse		2	55	06
Digits Eclips'd		9	55	
Beginning of Eclipse	2	9	16	01
End of Eclipse		12	11	07
End of Eclipse by the Moons Place from Sir *Isaac Newton*'s Theory.		12	02	00
End by Observation		12	01	30
End by Calculation from *Horrox*'s Theory		12	11	08

The Error therefore of Sir *Isaac Newton*'s Theory is by this Observation but half a Minute, or none; of *Horrox*'s System, Nine Minutes and a half.

III. *A Letter from Mr* Anthony van Leeuwenhoek, *F. R. S. containing ſome Microſcopical Obſervations upon the Chryſtalized Particles of Silver diſſolved in* Aqua fortis.

AFter having examined the Coagulation of thoſe Particles that I found in *Aqua fortis* impregnated with Silver, and ſhewn, that theſe Particles had aſſum'd the Figure of ſo many rough Diamonds; I ſeparated the Silver and melted it, and then poured freſh *Aqua fortis* upon it, to the end that I might once again diſcover the Chryſtalline or Adamantine Figures thereof; but in vain, for I could only now and then meet with one ſingle Chryſtalline Figure of the Shape and Faſhion of a Diamond.

This cauſed in me a great diſcontent, and the more, becauſe if any Body ſhould imitate me, and not meet with the ſame Succeſs, as I have deſcribed in my foregoing Obſervations, they might blame me, for not having faithfully related what I had diſcovered.

For my further Satisfaction therefore, I took a piece of Silver, being part of a *Piece of Eight*, which was ſtampt with the Arms of *Portugal*, and had been coined many Years ago, and threw it into *Aqua fortis*, where it had not lain long till the Water was tinged with a Green Colour, from whence I inferr'd there was a great deal of Copper in it.

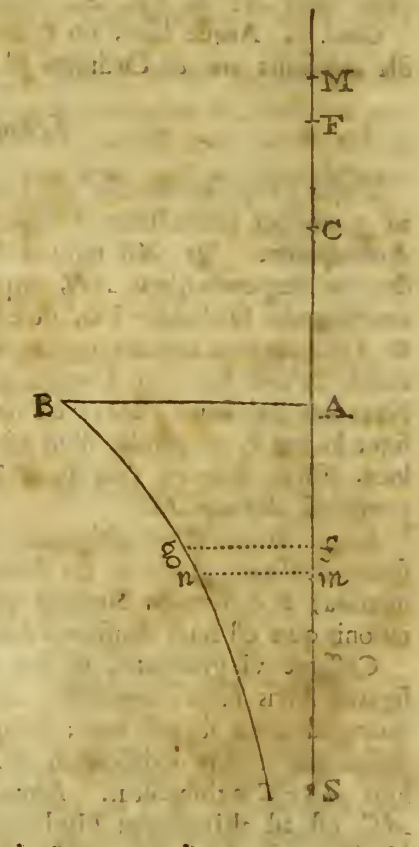
After this Silver had lain Eleven Days in the *Aqua fortis*, I ſaw a great many long Particles Coagulated in it, which I judged to be Sexangular, and as clear as Chryſtal.

I poured off this Water as gently as I could, to the end that the long Particles which I had discovered by my Microscope, might remain in the Glass; and then I poured upon them four times as much Rain Water as there had been *Aqua fortis* before in the same place, to the end that the Salt Particles, which were still in the Glass, might go over to the Water: Then I drew this Water off again, and pour'd on fresh, and then view'd the afore-mentioned Particles thro' my Microscope, and observ'd 'em in great Numbers sticking to the sides of the Glass; but found, that those which had been as clear as Chrystal before, had lost a great deal of their Transparency, and assumed a pale red Colour, which from time to time grew redder; and after some Hours the Colour was so deep that it appeared blackish, at least it appeared so to me, having no manner of Transparency, and where the Particles lay thick together, they appeared to the naked Eye like a whitish Matter.

I likewise pour'd off very gently the *Aqua fortis* from another Glass, in which were a great Number of these long Chrystalline Particles, and then turn'd the Glass upside down, to the end, that that little Water which remain'd in it might be drain'd out; by which means a great Number of the said Particles remained sticking to the sides of the Glass; and forasmuch as I had pour'd no Rain Water upon them, they preserv'd their Transparency: And you must observe, that the afore-mention'd Coagulated Particles are but a very small part of the Silver which was thrown into the *Aqua fortis*.

As often as I dissolved the Silver in *Aqua fortis*, I could not discover any Diamond-like Figures worth speaking of, but only several very long Particles, such as I have described by Figure 1, 2, 3, 4, 5. Upon which I considered whether my *Aqua fortis* was good; but was informed, that it was the same that was sold not only

Hæc ita se habent ex Hypothesi, quod vis gravitatis eadem sit ad omnes altitudines. Ceterum ex Philosophia *Newtoniana* constat eam diminui, in recessu à centro telluris, in duplicata ratione distantiæ: conclusio itaque paulo aliter se habebit. Sit *S* centrum telluris, & *AB* superficies ejusdem; sumatur ipsis *SF*, *SA* tertia proportionalis *Sf*, erigatur ordinata *fg* quæ sit ut Aeris densitas in *F*: & Curva *Bgn* quam punctum *g* perpetuo tangit, erit eadem atque prius Logistica, sed inverso situ. Augeatur enim altitudo *AF* particula quam minima *FM*, capiatur *Sm* ad *SA* ut *SA* ad *SM*, ducatur Ordinata *mn* quæ sit ut Aeris densitas in *M*; & erit *Sm* ad *Sf* ut *SF* ad *SM*, & divisim *fm* ad *FM* ut *Sf* ad *SM*, sive ut *Sf* ad *SF*, hoc est, ut *SAq* ad *SFq*. Unde *fm* est ut *SFq* inverse & *FM* directe, id est, ut gravitatio & moles Aeris inter *F* & *M* conjunctim; adeoque *fm*×*fg* sive area *fgnm* est ut gravitatio, moles & densitas ejusdem Aeris conjunctim, hoc est, ut pressio illius in Aerem inferiorem: & summa similium omnium arearum infra *fg* est ut summa pressionum omnium supra *F*, id est, ut Aeris in *F* densitas *fg*: & summarum differentia *fgnm* ut densitatum differentia *fg*—*mn*. Detur lineola *fm*; & erit *fg* ut area *fgnm*, adeoque ut *fg*—*mn*, atque inde (componendo) ut *mn*. Ergo data lineola *fm* erit mensura datæ illius rationis quæ est inter *fg* & *mn*: atque hinc patet Curvam *Bgn* esse Logisticam. Sed & eandem esse cum supra descripta Logistica, facile abinde colligitur, quod ordinatæ basi *AB* viciniſſimæ & ad æqualia intervalla quam minima dispositæ, respective sint æquales in utraque Curva; ac proinde eadem curvatura, eadem inclinatio tangentis ad punctum *B*, eademque subtangentis magnitudo.



Ergo

Ergo si distantiæ *SF* à centro telluris, capiantur in Musica progressione; harum reciprocæ, nempe distantiæ *Sf*, erunt in progressione Arithmetica; & Aeris densitates *fg* erunt in progressione Geometrica.

Ad inveniendam itaque densitatem in loco quovis *F*, minuenda est altitudo *AF* in ratione distantiæ *SF* ad telluris semidiametrum *SA*: & Logarithmus rationis inter densitates Aeris in *A* & *F*, erit ad Modulum Canonis, ut altitudo illa diminuta *Af*, ad Atmosphæræ homogeneæ altitudinem *AC*.

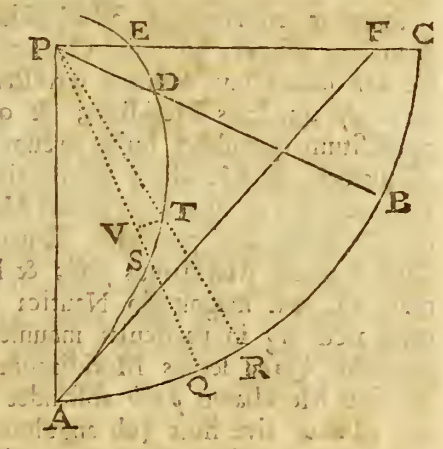
Quæ supra demonstrata sunt, accurate obtinebunt, si modo Atmosphæra ex Aere pariter Elastico tota constet: rationes igitur allatas paululum conturbabunt admisti vapores atque exhalationes, quibus etiam accedet Caloris Frigorisque diversa temperies ad altitudines diversas.

Propositio VI.

Logarithmorum Canonem ad Spiralem Æquiangulam accomodare.

Æquiangula Spiralis appellatur Linea illa curva *ADE*, quæ polo *P* descripta, in eodem dato angulo secat exeuntes à polo radios *PA*, *PD*, *PE*, &c.

Si centro *P* & intervallo quovis *PA* describatur circulus *ABC*, qui radiis *PA*, *PD*, *PE* occurrat in *A*, *B*, *C*: Dico interceptum arcum *BC* mensuram fore rationis quam habet *PD* ad *PE*, & interceptum arcum *AB* mensuram rationis quam habet *PA* ad *PD*. Dividatur enim arcus *AB* in particulas quam minimas & æquales *QR*, & jungantur *PQ*, *PR* secantes Spiralem ad *S* & *T* in angulis datis *PST*, *PTS*: & ob datam particulam *QR*, dabitur angulus *QPR*, atque adeo species Figuræ *SPT*, & ratio laterum *PS*, *RT*. Data ergo particula *QR* mensura erit rationis datæ quam



 habet

IV. *A Letter from Dr.* Archibald Adams *to Dr.* Hans Sloane, *R. S. Secr. concerning the Manner of making Microscopes*, &c.

Norwich, August 11. 1709.

SIR,

PUrsuant to what I wrote some time ago concerning Microscopes, I think that all the Microscopes which preceded Mr. *Leeuwenhoek*'s, are so much outdone by his, that it will be proper for me only to take Notice of these and the rest of later Invention, not designing to lessen their Usefulness, but only to add a few Thoughts which may be of Service.

I had not an opportunity of examining Mr *Leeuwenhoek*'s Glasses particularly, which is a Favour he allows to none; therefore I am not capable at this distance to describe either their Make or Use, any further than that to me they appear'd to be Spherules lodg'd between two Plates of Gold or Brass, in a hole whose Diameter might not be bigger than that of a small Pins head, and the Objects I saw through them were pretty and diverting; but still their Make and Truth are unknown.

Mr. *Butterfield* is very Curious in melting his Glass, but I suppose unsuccessful in casting his Spheres; for besides that a sufficient quantity of beaten Glass cannot stick to the moistned Point of a fine Needle; so neither can it run equally, hold the Needle how you will, nor the *Globule* when run stick to the Needle, but must unavoidably drop; and wheresoever it happens to fall, it must in that almost liquid State receive Impressions sufficient to spoil the Figure of a Sphere.

Mr.

Mr. *Gray* has ſhown the defect of his Method, which he us'd to recover by grinding and poliſhing his Glaſſes on a Braſs Plane, and ſo reduce 'em to Hemiſpherules; but how far ſhort poliſh'd Glaſſes (I ſpeak of ſmall ones) come of thoſe which are caſt, I leave to any one to judge who has ſeen both. His Water and Quickſilver Miſcroſcopes I never ſaw, ſo can ſay little to them.

After what manner Mr. *Wilſon*'s Glaſſes are made I know not, but ſure his greateſt Magnifyers are ill plac'd, they being ſunk to ſo great a diſtance from the Eye, the Object cannot appear to that Advantage it otherwiſe would; if therefore inſtead of a hollow Cap he would contrive a plain Plate of any Metal for the Reception of the Glaſs, then the Eye and the Object might come to their due diſtance; neither ought there to be any Calx or Glaſs between the Object and the Spherule, when we uſe the greateſt Magnifyers, becauſe if the *Focus* of a Sphere be upon the extremity of its Circumference, any ſmall diſtance from that muſt ſpoil the truth of the Objects appearance.

I cannot ſay, that the Glaſſes I have made are without fault, but I think they magnify more than any I have yet ſeen; and were they plac'd to the beſt advantage, they would Magnify much more than they do: They are made thus.

I take a piece of fine Window Glaſs, and I raſe it with a Diamond into as many lengths as I think needful, not exceeding an eighth of an Inch in breadth; then holding one of theſe lengths between the Fore-Finger and Thumb of each Hand, over a very fine Flame, until the Glaſs begin to ſoften, I draw it out till it be as fine as a Hair and break: Then Inuring each of the Ends into the pureſt part of the Flame, I have two Spheres preſently, which I can make larger or leſs as I pleaſe; if they ſtay long in the Flame, they'll have ſpots, ſo I draw 'em out preſently after they

they turn round. As for the Stem, I break it off as near the Ball as I can, and lodging the remainder of this Stem between the Plates, and by drilling the Hole exactly round, all this Protuberance is bury'd between the Plates, and the *Microscope* performs to Admiration; insomuch, that the same Thread of very fine Muslin appeared 3 or 4 times bigger in one of these, than it did in the first or second of Mr. *Wilson's*. I thought I saw Animals in fine Old Brandy, but they were so nimble in their Motion, that I can give no particular Description of them. Human Blood is so far from showing any Red *Globules* swimming in *Serum*, that immediately after its Emission it appears to be a Body of infinite Branches, running in no certain Order, variously colour'd; where it lies thickest on the Glass, its of a dull Red, where thin, inclining to Yellow; but the whole so blended as to represent very near the top of a Yew-tree in a very fine Landskip, having its supposed Branches of a red and yellow confusedly intermixt. But not satisfy'd with this appearance, tho' the same as to quality in Eleven different Glasses, and as many different sorts of Blood, I resolved to view it another way, which was, by diluting one third of thick in the *Serum* of Blood; and laying it upon my Glass, I could see the red Branches as before, and the transparent fill'd with Particles of great variety of Figures, which I took to be the Salts of the Blood, but fewest Globular, and they were pellucid.

If the Fluids moving in an Evanescent Artery appear Globular, I suppose its because the Canal is round, which alters the case much.

I had

I had at the ſame time an opportunity of ſeeing ſome Pleuritick Blood; and thought, that its Branches ſpread in a different Method from the ſound, and more ſtrongly perplex'd with overthwart Branches, which appeared black, like Blood that had ſtood two or three Days. Whether the Attraction of Particles ariſing from this difference of Figure, may not render the Blood incapable of paſſing through the Capillary Arteries of the *Pleura* in that caſe, I'll leave it to my Betters to judge; I ſhould think, that ſince the Propellent force of the Heart is leaſt at the Capillary Arteries, then there the attractive force of the Particles of the Blood ſhould be greateſt; and ſince Spherical Bodies are the moſt attractive of any, reſpect being had to their Solidities, were the Blood ſo plentifully ſtock'd with Globules, as ſome ſay, we ſhould never be free from Obſtructions, the Natural Conſequence of this attractive force. If my Glaſſes have deceived me, and this that I have written be found to be a miſtake, no Man ſhall be more ready to retract and acknowledge it than,

Sir,

Your aſſured humble

and obliged Servant,

Archibald Adams.

V. *An*

V. *An Abstract out of a Letter from Doctor* W. Holbrooke *of* Mancheſter, *to Dr.* W. Cole, *Fellow of the College of Phyſitians in* London; *concerning Stones voided by Stoole. With Dr.* Cole's *Anſwer to the ſame.*

Mancheſter, September 4. 1700.

SIR,

I Muſt beg your Patience a while longer, and deſire your Thoughts of what I think a remarkable Caſe. One *Crumbleholm* came to me ſometime ago, and complain'd of a great loſs of Appetite, with Scorbutick Itch, and ever and anon ſevere Convulſive Cholicks below his Navel, all along the *Hypogaſtrium*. They laſt not above a quarter of an Hour, but often return, and raiſe Tumours the bigneſs of a large Walnut, which diſappear and remove as the Pain ſhifts. He has been troubled with it ſome Years, and took Phyſick of almoſt every one he met with; but, as far as I can perceive, not in any regular Method, which gave me ſome hopes, that I might relieve him. Accordingly I began with mild Emollient and Carminative Glyſters; purged with *Decoct. Sen. Gereon. Syr. de Spin. cervin. & Tinct. Sacr.* In the Intervals of the Purges I gave *Æthiops Mineral*, with bitter Decoctions Alterative, made more Carminative with *Rad. Zedoar.* and *Caſtor.* He was relieved for that purpoſe; his Appetite and Complexion mended, but preſently was as Ill as ever. Then he ſhow'd me the Stones voided by Stoole, upon a ſlight Mercurial Purge, which he took laſt *Eaſter*. Upon opening one of them,

I found he had ſwallowed either ſome Plumb or Apricock Stones, which by their ſtay in the Inteſtines were inclos'd in the Excrements, as I take it; and, by the Purge being diſlodged from their *Sinus*, ſent forth, as you find. Hoping then that by ſtronger Evacuations, if I could remove any other that might remain, it might tend to his Cure, I order'd ſtronger Medicines, of which the Bearer, who is my particular Friend, and was the Apothecary, can give you a more particular Account: However, I could not get any more from him; and he being out of hopes, and uneaſy to be kept any longer from his Buſineſs, has left off taking any thing. Laſt Week I ſaw him, and found him much in the ſame Condition, tho' ſomewhat weaker, and ſunk more in his Fleſh. If you think by communicating this to any of your Friends, or making tryals of the other Stone untouch'd, you may be better ſatisfy'd in the Young Man's Caſe, or may think of any thing that may contribute to his Cure, pleaſe to ſignify it by the Bearer, and you will mightily oblige,

Your very Humble

And Obedient Servant,

W. Holbrooke.

Dr. Cole's *Anſwer to the foregoing Letter.*

Dear Sir,

I Received yours by Mr. *Harriſon*, together with your very obliging Preſent, the two *Human Bezoars*, (if I may ſo call them;) but have as yet had little opportunity of having the Opinion of many Phyſitians here concerning them: One very Ingenious Gentleman, to whom I ſhowed them, was an Acquaintance of yours, Mr *Roger Kennion* of *Cambridge*, who went on *Monday* laſt for *France*, who with Dr. *Hobart*, as alſo Dr *Sloane*, admire them.

And now, *Sir*, as to the latter part of your Letter; I look upon theſe Stones to be not formed of *adhering Excrements*, as you ſeem to ſuppoſe, but to be made thus.

When the Plumb-Stones happen to be included in a fit Glandulous Receptacle, I conceive they may come to be thus coated over by the viſcous Liquor ſecreted out of the Secretory Ducts of thoſe Glandules, which by long lying there may come to acquire ſo great a Bulk, by the continual appulſe of the ſame Liquor.

This Receptacle I gueſs to be the *Inteſtinum cæcum*, which, tho' ſmall naturally, may be, as other Membranous and Glandulous Parts are, capable of a conſiderable Extenſion: So that, when by reaſon of the *Periſtaltick* Motion of the *Inteſtines* above, one of the Plumb-Stones may happen to be, by its pointed Extremity, intruded; the whole may, by the ſame repeated, tho' ſlow Motion, dilate the Cavity ſo, that the whole Body of the Stone may by the ſame Method be ſtill farther and farther protruded, till it come to the further Extremity; which being cloſed, muſt be preſumed to detain it there, ſince 'tis hard to conceive it can quickly get out

out again, that *Periſtaltick* Motion being always forward. One of theſe Stones being thus enter'd, 'tis eaſy to conceive more may be admitted, ſince the firſt cannot but dilate the Paſſage for another that follows, and ſo on till the Cavity be full. Whilſt theſe Stones lye there, they muſt be conceived to offend the part, as having extended it beyond its Natural State: So that the Secretory Ducts of the Gland, of which the inner Coat of that, as well as the reſt of the Inteſtines, is conſtituted, muſt be proportionally dilated; whereby an eaſier way is made for the Liquor, they ſeparate, to be excreted. This being of a viſcid and concreſcible Nature, muſt, ſince it cannot get forth, be preſum'd to adhere to the *Subſtratum*, the Stones, and ſo by degrees Incruſt them; which Cruſt by the long confinement muſt grow ſo much thicker, for the ſame reaſon as it began, the Ducts being kept conſtanly open, and the Cavity more and more dilated the greater the Incruſtation is. So that I conceive the Symptoms are eaſily accountable for, from the offence given to the part, which being ſenſible, as all membranous and fibrous Parts are, the Pain muſt grow greater, the greater the Extenſion is; and the change of the Poſture of the Tumor may very well be conceived to proceed from the different Poſtures the Inteſtines put on, by the Chyle or Excrements paſſing along them, and ſometimes filling one part, ſometimes another, as they are protruded further and further, their Lubricity on the Surface, length, and confinement obviouſly favouring that *Phænomenon*. I am of Opinion, the true *Bezoar Stones* are form'd in the Beaſts, that yield them, in the ſame manner; but whether their Stomachs or Inteſtines have other Cavities capable of receiving and retaining them to their full growth, is to be determined by Anatomy. This I think is certain, that all of them have either a Straw, Stick, or other Subſtance different from the Ex-

terior Matter, which we call the Stone, in the middle of them; and thence I conclude the manner of their formation to be the same. From the continuance of his Symptoms, I believe there may be more behind; and cannot think any other Method more likely to extrude them, than by having his *Abdomen* well anointed with some Emollient Oyles or Liniments, and very well agitated backward and forward as much and as long as he can bear, and this both Morning and Evening: After a little while, that the Stones may be presum'd by this agitation to be somewhat dislodged, some gentle Purgatives I conceive may be of use to be now and then given to carry them downwards, and with all Emollient Glysters to sollicit it gently, *&c.*

W. Cole.

VI. *An Account of the Dissection of a Person, who dy'd of an Ulcer in the Right Kidney.* By J. Douglas, *M. D. F. R. S.*

I Was desired lately to assist at the opening of a Gentleman, who dy'd the Day before, in the 45th Year of his Age; where I observ'd the following Particulars, relating to the Unusual Structure and Morbid Disposition of the Parts contained in the Cavities of the *Thorax* and *Abdomen.*

1. When the Skin with the other Integuments were taken off, I observed that part of the *Omentum* had thrust itself thro' the Annular Holes of the Abdominal Muscles on the Left Side, and there formed a *Epiplocele*, or *Hernia omentalis*, as large as a Walnut.

2. The

2. The *Omentum* reached as low down as the *Pubis* and Inside of the *Ilia*, to which it was ty'd, and by Fibrous Connections it adhered to all the *Peritonæum* below the Navel.

3. All the Fat on the *Omentum* and Guts was firm, and hard like Tallow.

4. The Inteſtines and Stomach were quite empty, without either Wind or *Fæces*.

5. The Left Kidney was much larger than ordinary, being near eight Inches long; its Surface being divided into ſeveral diſtinct Lobes, as it a *Fœtus*.

6. The Right Kidney was full of a fœtid purulent Matter: All its inner Subſtance was wholly waſted; and its external or cortical Part was ſtreached ſo very thin, that a ſmall touch of the Finger could eaſily break thro' it.

7. All the Fat and Glands about the Kidney laſt mentioned were hard, obſtructed, indurate, and big, which made a great compreſſion on the *Muſculus Pſoas* and the *Muſculus Quadratus lumborum*.

8. The Ureter proceeding from this Right Kidney, was covered with a Cruſt or Bed of indurate Glands; and beſides, its capacity was ſtraightned and contracted in ſeveral Places.

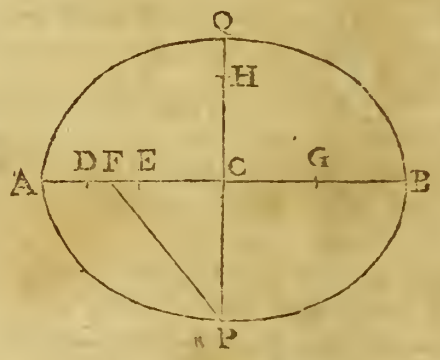
9. The Cavity of the *Veſica Urinaria* was very ſmall; its Subſtance ſo very thick and hard, that I could not even by the help of a Blow-pipe diſtend it any wider: Its Inſide ſeem'd excoriated with ſeveral little fleſhy Caruncles, or red Excreſcences, here and there.

10. There was a remarkable Corroſion in all the Inſide of the *Urethra*.

11. All the Upper and Convex Part of the Liver adhered firmly to the *Peritonæum* that covers the Diaphragm, and to the ſame Membrane where it covers part of the *Muſculus Abdominis tranſverſalis*: Its Subſtance was

ſo

ficie locatum ad axis illius terminum. Jungantur puncta *P*, *F*, ac ſumatur *CD* quæ ſit menſura rationis inter *PF* + *FC* & *CP* ad Modulum *CA*, pariterque ſumatur *CE* quæ ſit anguli *CPF* menſura ad Modulum *CP*; ſitque *FD* exceſſus menſuræ *CD* ſupra *CF*, atque *FE* exceſſus ipſius *CF* ſupra menſuram *CE*: & Solidi convolutione circum axem majorem *AB* geniti vis in corpuſculum ad *A* locatum, erit ad Sphæræ homogeneæ & eodem axe deſcriptæ vim in idem corpuſculum, ut $3FD \times CPq$ ad $CF cub$; Solidi autem converſione circum axem minorem *PQ* geniti vis in corpuſculum ad *P* locatum, erit ad Sphæræ homogeneæ & eodem axe deſcriptæ vim in idem corpuſculum, ut $3FE \times CAq$ ad $CF cub$. Unde cum vis Sphæræ prioris in corpuſculum ad *A*, ſit ad vim Sphæræ poſterioris in corpuſculum ad *P*, ut *CA* ad *CP*: erit vis Solidi prioris in corpuſculum ad *A*, ad vim Solidi poſterioris in corpuſculum ad *P*, ut $FD \times CP$ ad $FE \times CA$.

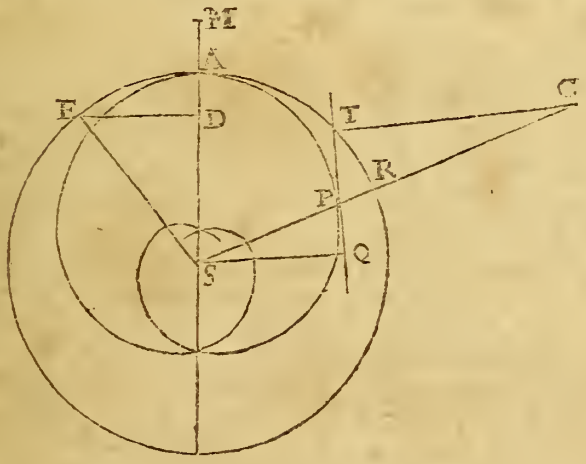


Hinc quoniam Solidum poſterius medium eſt proportionale inter Solidum prius & Sphæram priorem: vis Solidi poſterioris in corpuſculum ad *A*, erit media proportionalis quamproxime inter vires Solidi prioris & Sphæræ prioris in idem corpuſculum ad *A*, ſi modo axes Ellipſeos ſint prope æquales. Itaque in hoc caſu, ponendo *CG* mediam proportionalem inter *CF* & $3FD$, & capiendo *CH* ad $3FE$ ut *CA* ad *CF*; poſterioris Solidi vires ad *A* & *P*, vel ad *B* & *Q*, erunt ad invicem quamproxime ut *CG* ad *CH*. Id quod non inutile præbet compendium ad inventionem Figuræ Telluris, qualem eam ſubtiliter inſtituit celeberrimus *Newtonus*, ſummus ille Philoſophiæ ſanioris Inſtaurator.

Conſideratio virium centripetarum aliud porro mihi ſuggerit Exemplum, in quo ſatis ampla ſe prodit mutationum varietas. Proponatur Trajectoriarum ſpecies enumerare, in quibus corpora moveri poſſunt, quæ à viribus centripetis in ratione diſtantiarum triplicata decreſcentibus agitantur, quæque de loco dato, cum data velocitate, ſecundum datam rectam egrediuntur.

Caſ. 1.

Caſ. 1. Sit S centrum virium, exeatque corpus de loco P ſecundum rectam PQ vel QP, ea cum velocitate quam acquirere poſſet ab iiſdem viribus, libere cadendo verſus centrum S de loco C, & caſu ſuo deſcribendo altitudinem CP. In datam rectam QPT demittantur perpendicula SQ, CT, centroque S & intervallo $\sqrt{SQq + QTq}$ deſcribatur circulus RTA, rectæ SPC occurrens in R: deinde ad Modulum $\sqrt{SCq - SRq}$ ſit arcus RA menſura rationis inter $SR \pm \sqrt{SRq - SPq}$ & SP, jaceant autem arcus ille RA & punctum Q ad diverſas partes rectæ SR; & punctum A erit Apſis ſumma Trajectoriæ. Exhinc vero Trajectoria dabitur, ſumendo SM æqualem ipſi $\sqrt{SCq - SRq}$, deinde in recta SA



capiendo longitudinem quamvis SD quæ ſit minor quam SA, ad eandem erigendo perpendiculum DE ſecans circulum in E, & jungendo SE. Nam ſi ad utraſque partes puncti A ponatur arcus circularis AR, cujus longitudo ſit menſura rationis inter $SE + ED$ & SD ad Modulum SM, & in ſemidiametris SR capiantur diſtantiæ SP æquales ipſi SD: erunt puncta P ad Trajectoriam deſcribendam. Tempus autem quo radius SP, à centro ad corpus motum ductus, percurret aream quamvis SAP, erit ut recta DE: nam area percurſa æquatur ipſi DE in Modulum dimidiatum $\frac{1}{2}SM$ ductæ. Velocitas vero corporis in loco quovis P, erit ad velocitatem qua in Circulo, ad eandem diſtantiam SP, cum iiſdem viribus revolvi

can furniſh them withal, as well as what he wants; ſo that by a mutual Commutation each may improve his Stock. It were highly to be wiſh'd, that other *Nations* would, as he has yearly promis'd, do the like, and eſpecially our own, ſince we have ſeveral *Noble* as well as private *Perſons* in *ENGLAND*, and ſome particular *Communities*, which have not been wanting either for *Coſt* or *Induſtry* to ſtock their *Gardens* with many *Rare* and *Exotick Plants*; and till ſome *Curious Perſon* will take the Pains to publiſh a *Catalogue* of them, I preſume it will not in the *interim* be amiſs to give here an Extract from this, of ſuch *Plants* as have very rarely or never been Cultivated in any of our *Publick* or other *Curious Gardens* here in *England*.

In giving theſe I ſhall follow the *Author's Method*, but divide them under theſe 3 general *Heads*, viz.

I. A Liſt of the *Non-Deſcript* Plants, *viz.* ſuch as Dr. *Boerhave* has given as New, or without any *Author* to them.

II. A *Catalogue* of the more *rare Plants* lately *diſcovered*.

III. Such as are no leſs *rare* in our *Engliſh Gardens*, tho' *formerlly* deſcribed.

I. *A*

A Catalogue *of the* Non Deſcript *Plants, viz.*

I. *Such as Dr.* Boerhave *has given as* New, *or without any* Author *to them.*

Ranunculus fol. *Rutæ*, flore aureo ſimplici p. 3.
Thalictrum fl. luteo, caule anguloſo, fol. minori 7.
Oenanthe aquatica minor 9.
Phellandrium fol. *Thyſſelini*, caule rotundo 11.
Phellandrium fol. *Thyſſelini*, caule ſulcato 11.
Laſerpitium lato, glauco ſplendente, trifido folio, flore albo, umbella Sphærica 13.
Caucalis *Africana*, fol. minore *Rutæ* 15.
Sphondylium folio frequentius laciniato 16.
Panax folio glabro nitente lato 16.
Panax fol. glabro nitente altior 16.
Myrrhis annua glabra alba minor 17.
Myrrhis *Oriental.* fol. anguſtiore Peucedani, ſem. villoſo 17.
Lactuca altiſſima, fol. *Souchi* laciniato, fl. parvo cæruleo 21.
Lactuca Sylv. folio ad latera ſpinoſo 21.
Sonchus Orient. *Lactucæ* folio, fl. luteo, *ſem.* eleganter crenato 23.
Hieracium folio, caule, & calyce hirſutis 25.
Hieracium folio amplo longo dentato, floſculis parvis luteis 25.
Dens Leonis folio *Coronopi* 26.
Cichorium ſem. adunco, fl. triplo majore, capitulis minoribus 27.
Jacobea maritima, fol. integro ſerrato viridi 31.
Anemonoſpermos *Africana* fol. Jacobeæ, fl. luteo extùs puniceo 31.
Helenium *Indicum* maximum, flore pleno aureo 32.
Helenium *Indicum* maximum, fl. pleno ſulphureo 32.
Chamæmelum marin. *Aſiat.* nudum humifuſ. fol. craſſo 36.

Millefolium tomentoſiſſimum 38.
Senecio *Ægyptius* fol. *Matricariæ* 40.
Senecio *African.* arboreſcens, fol. ſerrato 41.
Elichryſum *Afric.* fol. oblongo ſubincano ſupra viridi, fl. luteo 42.
Elichryſum *Afric.* fol. oblongo anguſto, fl. rubello poſtea aureo 42.
Elichryſum *Afric.* f. oblongo lato tomèntoſo, fl. luteo 43.
Elichryſum *Afric.* fol. oblongo tomentoſo, caulem amplectante, flore luteo 43.
Santolina *Orient.* odore Chamæmeli, fol. vermiculato 44.
Abſinthium Santonicum *Ægyptiacum* 45.
Scabioſa integrifolia *Syriaca* Sivan *dicta* 47.
Scabioſa *Africana* fruteſcens, fol. *Rutæ Caninæ* 47.
Cirſium maximum, capite parvo 51.
Cirſium rad. *Aſphodeli*, fol. lato & lucido 51.
Cirſium majus, fol. ſubtus incano 51.
Cirſium anguſti fol. capitulo magno 51.
Clinopodium Siculum folio Satureiæ 61.
Lamium arboreſcens perenne Canadenſe, fol. rotundiore & viridiore 63.
Sclarea Æthiopica fol. ſubrotundo perennis 63.
Horminum pratenſe, folio non ſerrato 64.
Sclarea Africana ampliſſimo folio annua 64.
Teucrium Orientale, facie Chamedryos 73.
Linum umbilicatum, folio latiore 78.
Symphytum magis maculoſum 78.
Symphytum maximè maculoſum 78.
Echium folio aſperrimo & verrucoſo 78.
Echium ferox Ægyptium, fl. carneo 79.
Cerinthe quorundam major, verſicolore fl. laciniato 79.
Alſine folio Kali, flore ſubcæruleo 83.
Lychnis Suecica *Scrotum Arietis* dicta 85.
Lychnis ſylv. vel marina fl. rubro pulcherrimo 85.
Lychnis fol. Bellidis craſſiori ſubhirſuto 85.
Lychnis flore pallide viridi 85.

Lychnis

Lychnis montana folio Gramineo fl. ſpicato exiguo 86.
Lychnis *Sicula* elatior, folio *Salicis* 86.
Lychnis anguſtifolia, calyculis ſtriatis 86.
Lychnis *Alpina* repens alba, fol. *Lini*, petalis bifidis 86.
Lychnis fol. Centaurij minoris glabro 86.
Lychnis repens, caule lignoſo, anguſtifolia 87.
Caryophylus Sinenſis, fl. pulcherrimo 88.
Sedum aizoides Alpina, trifido folio minor 91.
Blattaria fl. luteo amplo, folio laciniato 92.
Blattaria fl. luteo amplo, fol. hirſuto Verbaſci 92.
Digitalis fol. glabro anguſto 93.
Antirrhinum flore luteo grandi 95.
Antirrhinum fol. Linariæ, fl. toto albo 95.
Antirrhinum anguſtifolium, fl. magno purpureo 95.
Scrophularia fol. Sambuci hirſuta 96.
Polygala Afric. fruteſc. fol. Myrti, fl. alto intus rubro 97.
Veronica fol. tenuiter laciniatis inſtar Paronychiæ 98.
Veronica pratenſis Serpillifolia anguſtifolia 98.
Convolvulus peregrinus fol. anguloſo, fl. albo parvo 102.
Convolvulus peregrinus tenuifol. argent. piloſus, fl. carneo 102.
Campanula longifolia, fl. conglomerato albo 104.
Trachelium peregrinum fruteſc. craſſiſſimo trunco, inſtar *Endiviæ* 104.
Rapunculus Valerianoides cæruleus umbellatus 104.
Rapuntium galeatum Virginianum, cæruleo flore 105.
Tithymalus folio Salicis hirſuto 106.
Tithymalus fol. cordiformi ſerrato 107.
Tithymalus Mauritanicus, aphyllos anguloſus ſpinoſus minor 107.
Geranium Afric. fruteſc. Malvæ fol. laciniato odorato inſtar Meliſſæ fl. purpuraſcente 110.
Geranium Afric. fruteſc. fol. Achimillæ hirſuto, cum fimbrijs purpureis 110.
Geranium Columbinum flore minore dilute rubro 111.
Geranium fol. *Altheæ* Afric. odore *Meliſſæ* 111.

Geranium *Afric.* fol. *Alchimillæ* piloſo maculato 112.
Geranium *Uvæ criſpe* fol. caulic. virid. ſurrectis, fol. profundius inciſis, flore ſaturatè rubro 112.
Malva *Afric.* fruteſc. fol. Groſſulariæ, fl. rubro 114.
Althea *Sabdariffa* erecta trifoliata 115.
Hermanniâ fruteſcens fol. oblongo ſerrato latiori 115.
Hermannia fruteſc. fol. Groſſulariæ parvo hirſuto 115.
Hermannia fruteſc. f. Ibiſci hirſuto molli, caule piloſo 115.
Hermannia ſruteſc. fol. multifido tenui, caule rubro 116.
Hermannia fruteſc. fol. oblongo molli cordato hirſuto 116.
Ciſtus mas folio longiore 116.
Papauer *Orientale* annuum 119.
Nigella latifol. fl. parvo ſimplici 120.
Linum *Afric.* luteum, folijs conjugatis 120.
Linum fl. rubro, odore Moſchi 120.
Sedum *Afric.* arboreſc. fol. viridi obtuſo majus 120.
Sedum *Afric.* fruteſc. fol. longo ſerrato confertim natō 121.
Sedum *Afric.* fruteſc. caule pellucido, fol. ſubrotundo 121.
Sedum *Afric.* folio villoſo oblongo 121.
Sedum *Afric.* folio rotundo minori 121.
Telephium majus caule rubro, fl. luteo 122.
Ficoides *Afric.* arboreſc. lignoſa, fol. glauco brevi, fl. pallido 122.
Ficoides *Afr.* arboreſc. lignoſa, perfoliata, fol. glauco brevi ad ſuprema averſa parte ſpinâ unica armatâ 123.
Ficoides Afric. arboreſc. fol. tenuiſimo triangulari aſpero, fl. luteo 123.
Ficoides Afric. arboreſc. fol. viridi longo triangulari aſpero 123.
Ficoides Afric. arboreſc. lignoſa, ſpinis validis ligneis ad ramos armata, folio tenui & brevi 123.
Ficoides Afr. fruteſcens fol. glauco parvo, fl. violaceo 123.
Ficoides Afric. fol. triangul. craſſo glauco ad 3 margines aculeato 123.
Ficoides Afric. humilis fol. craſſo viridi ad extrema ſpinoſo, fl. violaceo 123.

Ficoides

Ficoides Afr. humilis, fol. viridi craſſo longo ad ſuperiora ſpinoſo conjugato 123.
Ficoides Afric. erecta arboreſc. geniculato caule, fol. viridi 123.
Ficoides Afr. erecta arboreſc. lignoſa, fl. radiato primò purpureo, dein argenteo interdiu clauſo, nocte aperto 124.
Ficoides Afric. fol. glauco craſſo fl. aureo 124.
Ficoides Afric. fol. variegato aſpero, ad apicem ſtellâ ſpinoſâ ornato, flore violaceo 124.
Ficoides Afric. fol. variegato aſpero ad apic. ſtellâ purp. ornato, minor 124.
Ficoides Afric. fol. variegato aſpero, ad apic. ſtella purp. ornato erecta 124.
Ficoides Afric. fol. viridi, micis quaſi glaciatis ſplendentibus ornato fl. coccineo 124.
Ficoides Afric. fol. longo tenui, flore rubro 124.
Ficoides Afric. fol. longo tenui, fl. aurantio 124
Ficoides Afric. humilis fol. craſſo ſplend. viridi Aloeformi, fl. luteo magno 124.
Pæonia fol. trifidi amplo ſupra viridi, infra pallido, fl. ſimpl. purp. amplo 125.
Conſolida Regalis Hort. fl. carneo, calcari longiſſimo 128.
Fumaria Neapolitana floſculis ſubflaveſcentibus in ſummitate nigricantibus 130.
Fabago Africana fruteſcens minor 135.
Thlaſpi Alyſſon *dictum*, campeſtre minus, fol. breviori 137.
Thlaſpi *Alyſſon* fol. Leucoij latiſſimo aſpero viridi 137.
Sinapi arvenſe album hyemale, folio Rapi, ſem. luteo 142.
Eryſimum ſem. minimo pallido, ſiliquis *Erucæ* 143.
Heſperis exigua lutea, fol. dentato anguſto 146.
Heſperis fl. albo minimo, ſiliquâ longâ, fol. profundè dentato.
Heſperis maritima exigua ſupina 147.
Heſperis ſiliquis hirſutis, flore parvo rubello 147.
Heſperis hirſuta fl. albo minore, fol. aſpero parvo Lavandulæ, ſiliquis *Cornu Cervini* diviſura 147.

Eadem

Eadem fl. purpureo vario 147.
Dentaria pentaphyllos, folijs mollioribus 147.
Geniſta Hiſp. virgultis longioribus tenuioribus & ſulcatis 148.
Geniſta-Spartium fol. minimis, ſpinis molliſſimis 149.
Cytiſus glaber, folijs medijs longioribus 150.
Phaſeolus erectus caule & folio rigido, flore pallido luteo, ſiliquâ craſſa & amplâ 152.
Melilotus lutea, floſculis minimis ſpicatis 152.
Trifolium annuum fuſcum, flore dilute rubello 153.
Trifolium perenne fuſcum, fl. albo 153.
Trifolium Afric. fol. obtuſo, fl. pallide cæruleo 153.
Anonis ſpinoſa, fl. albo minor 154.
Anonis ſpicata ſive Alopecuroides major 154.
Anonis folio Viciæ 154.
Medica ſiliquâ falcatâ planâ, ad margines aculeata, lutea 155.
Medica Cochleata polycarpos, capſula compreſſa 155.
Medica Cochl. polycarpos ſpinoſâ capſulâ, ſeu ſpinis longioribus capſulam inuolventibus 155.
Lotus ſiliquis geminis peregrina 156.
Lathyrus latifol. minor, fl. majore 158.
Lathyrus Siculus flore odorato magno 159.
Lathyrus anguſtifol. *Siculus*, ſiliq. hirſutis, fl. purpureo cæruleo 159.
Lythyrus latifolius fl. gilvo é *Smyrna* Dr. Sherard 159.
Vicia fl. albo ſiliquâ longâ glabrâ 160.
Vicia fol. & ſiliquâ latis, ſiliquâ hirſutâ 160.
Vicia major, fl. purpureo ſparſo, ſiliquis multis erectis 161.
Orobus latifolius repens, ſiliquâ parvâ 162
Orobus latif. repens fl. cæruleo, fol. & ſiliquis hirſutis 162.
Coronilla major, fl. violaceo 165.
Hedyſarum clypeatum aſperum, ſiliquâ ſpinoſiſſimâ fl. purpureo 165.
Aſtragalus *Orient.* fol. *Viciæ* incanis, anguſtis, oblongis 167.
Aſtragalus *Syriacus* hirſutus *Sherard* 167.

Aſtra-

Aſtragalus hirſutus Smyrna miſſus *Sher.* 167.
Aſtragalus fol. Tragacanthæ glabro, parvus *Sher.* 167.
Aſtragalus repens minor fl. cæruleo, ſiliquâ Epiglottidi ſimili 167.
Aſtragalus ſiliquâ bullatâ & bifariam diviſâ *Sher.* 167.
Herba mimoſa *Zeylanica* ſpinoſiſſima 168.
Bryonia alba aſperior, folijs majoribus 170.
Solanum fruticoſum bacciferum fol. rigidiore 173.
Colocaſia folijs ad caulem apertis 176.
Opuntia fol. oblongo media; ſpinis frequentioribus & brevioribus armato 181.
Lapathum fol. longiſſimo criſpo 183.
Acetoſa rotundifolia annua 184.
Halimus folio minore 186.
Chenopodium *Americ.* vel *Armenium* folio Kali 187.
Botrys Ambroſioides *Mexicana* perennis 187.
Reſeda maxima *Cretica*, folijs Cannabinis 194.
Hyacinthus *Oriental.* fl. pleno carneo parvo 199.
Hyacinthus *Orient.* fl. pleno cærul. purp. minore 199.
Hyacinthus *Orient.* fl. pleno albo internè rubis punctis adſperſo 199.
Hyacinthus *Orient* fl. pleno cæruleo porcellano 199.
Hyacinthus *Orient.* fl. pleno cærul. purp. magno 199.
Crocus vernus latifol. aureus minor 200.
Crocus vernus latif. fl. externè pallido, intus cæruleo ſtriato 202.
Crocus vern. latif. fl. ext. pallido violaceo variegato, intus cæruleo 202.
Crocus vern. latif. fl. purpureo minor 202.
Crocus vern. latif. fl. albo purpureo major 202.
Crocus vern. latif. fl. albo purp. minor 202.
Crocus vern. alterno floris folio albo, alterno cæruleo 202.
Crocus vernus fl. candido pnro 202.
Iris bulboſa *Hiſpanica* variegata 205.
Iris bulb. *Anglicana* fl. albo, cæruleis lineis variegato 205.

Aloe

Aloe *Afric.* caulescens perfoliata, angustiori spinosissimo folio *Beaum.*

Aloe *Afric.* caulesc. fol. spinosis, macul. ab utraque parte albicantibus obscurioribus, folijs glaucis *Beaumont* 210.

Aloe *Afric.* humilis spinis herbaceis inermibus & verrucis obsita, folio crassiori *Beaum.* 210.

Aloe *Afric.* fol. obscuro viridi, spinis ad latera & verrucis in dorso armato 211.

Lilium *Martagon* purpureum punctatum 214.

Lilium Martagon *Bizantinum* medium 214.

Lilium Martagon *Bizantinum* minus 214.

Ornithogalum viride minus 218.

Lilium *Javanicum* habitum. *an* Lilio-Asphodelus *Com.* Rar. 14?

Cyclamen radice *Anemones*, fl. purp. minore odorato 223.

Lingua Cervina fol. in summo multifidis & corniculatis, minor, eleganter laciniata 234.

Buxus *Africana* folio oblongiori non serrato 238.

Lycium *Africanum* fructu rubro 246.

Lycium *Pruni* folio subrotundo, fl. candicante 246.

Rhamnus *Afric.* spinis longis, cortice albo fructu cæruleo 246.

Alaternoides *Afr.* fol. Ericæ, flore muscoso albo 248.

Alaternoides *Afr.* fol. Telephij legit. *Imperati* 248.

Philyrea fol. magis serrato subrotundiori 248.

Ligustrum fol. latioribus 248.

Lauro similis flore, folio tenero 249.

Jasminum *Indicum* fol. conjugatis max. fl. albo odoratissimum 250.

Jasminum *Castaneæ* folio, fl. odoratissimo rubro, fructu qui COFFE duro *Commel.* 250.

Olea *Africana* humilis lucida 250.

Viburnum *Americ.* fl. albo 255.

Viburnum *Americ.* fl. purpureo cæruleo 255.

Viburnum *Americ.* folijs longioribus 255.

Peri-

Periclymenum minus 256.
Periclymenum *Afric.* folio Pruni 257.
Berberis *Mauritanica* 260.
Malus *Limonia* fol. anguſtiore ſpinoſa 264.
Malus *Limonia* fol. anguſtiore non ſpinoſa 264.
Ceraſus *Hottentottorum* fol. minori magiſque rotundo 266.
Meſpilus magno oblongo laciniato folio 275.
Evonymo affinis Afric. Ulmi folio, fl. rotundo Malvaceo, tetracoccos 278.
Chryſanthemum baccifer. *Populi* fol. *Africanum* 278.
Arbuſcula alatis folijs ad Jaſminum vulgatius accedentibus 278.
Arbuſcula *Africana* tenui muſcoſo floſculo 278.

II. *Theſe are of* late Diſcovery, *and rare in our* Engliſh *Gardens.*

PEntaphylloides fol. Ulmariæ, flore albo 5. Tournef.
Bulbocaſtanum *Luſit.* fol. tenuiter diviſo. 9. V.Luſit.
Oenanthe caule flexoſo & fiſtuloſo 9. Mor. Umb.
Oenanthe *Luſit.* ſem. craſſiore globoſo 9. Tourn. 313.
Angelica *Alpina* ad nodos florida 10. Tour. 313.
Apium degener fol. longius diſſectis 12. Mor. U. 24.
Thapſia Apij folio *Luſit.* fætidiſſima fl. albo 12. T. 322.
Laſerpitium folijs amplioribus, ſem. criſpo 13. T. 324.
Laſerpitium humilius Paludapij folio, fl. purp. 13. T. 325.
Laſerpitium anguſtifolium ſem. criſpo 14. Tourn.
Paſtinaca tenuifolia *Cretica*, umbella radijs Gingidij longioribus M. Umb.
Caucalis major Daucoides *Tingitana* M. Umb. 65.
Cachrys ſem. fungoſo lævi, fol. Ferulaceis M. U. 62.
Ferula durior ſeu rigidis & breviſſimis folijs Bocc. M. 84.
Sphondilium max. *Tranſylvanicum* Ricini *fol.* Breyn. *Prodr.* 2.
Valeriana fol. Calcitrapæ magis ſecto 19. M. Umb.
Hieracium fol. caulem amplexo 25. *Triumfet.*

Aſter *Amer.* latif. maximus, puniceis caulibus H. *Ludg.* Bat. 651. Fig.

Aſter *Novæ Belgiæ* latifol. paniculatus, fl. ſaturatè violaceis H. L. Bat. 67. *Fig.*

Aſter *Novæ Belgiæ* latifol. umbellatus, fl. dilutè violaceis H. L. B. 69. *Fig.*

Aſter *Novæ Angliæ* altiſſimus hirſutus, fl. ampliſſimis purpuro violaceis *Parad. Batav.* Prodr. 98. Fig.

Aſter *Novæ Angliæ* purp. Virgæ aureæ facie & folijs undulatis P. Bat. pr. 96. Fig.

Virga Aurea *Novæ Angliæ* lato rigido folio P. Bat. pr. 243. Fig.

Jacobea *Afric.* fruteſc. fol. rigido & hirſuto major H. Amſt. 2. Fig. 75.

Jacobea *Afric.* fruteſc. fol. rigido & hirſuto minor H. Amſt. 2. p. 149.

Jacobea *Afric.* fruteſc. fol. glauco craſſo ſucculento H. Amſt. 2. Fig. 74.

Jacobea *Afr.* fol. Hederæ terreſtris H. Amſt. 2. Fig. 73.

Ane nonoſpermos *Afric.* fol. Card. Benedict. fl. albo extus puniceo H. Amſt. 2. Fig. 22.

Chryſanthemum *Canadenſe*, Ranunculi rad. *Strumoſum* vulgo H. L. B.

Ptarmica Alpina *Matricariæ* folijs 37. *Triumfet.* 83.

Ptarmica *Alpina* incanis ſerratis folijs H. L. Bat. 694.

Ptarmica fol. profundius ſerratis, læte viridibus elatior H. L. B. 694.

Calendula humilis Afr. fol. Leucoij, fl. albo H. Amſt.

Senecio *Amer.* purpureo cæruleo flore El. Bot. 362.

Senecio *Afric.* arboreſcens, fol. Ficoides H. Amſt. 2. Fig.

Eupatorium *Novæ Angliæ* Urticæ folijs, fl. purp. maculato caule H. L. B. 667.

Coma aurea *Afric.* fruteſc. fol. glauco ad extrema trifido H. Amſt. 2. Fig.

Chryſanthemum *Cannabinum* Americanum H. R. *Blæs* 254.

Abrotanum fœm. caneſcens fol. Stœchadis citrinæ *Breyn.* Pr. 1.

Pana-

Tanacetum *Afr.* arboreſcens, fol. Lavandulæ H. *Aſtm.* 2. Fig.
Scabioſa folio Cardiacæ *Bocc. Sicul.*
Carduus *Creticus* incanus, fl. luteo purpureo I. R. H. 441.
Carduus *Melitenſis* capitulis conglobatis I. R. H. 442.
Carduus *Melitenſis* Erucæ folio fl. luteo I. R. H. 442.
Carduus Sphærocephalus *Tingitanus* I. R. H. 441.
Jacea argentea *Raguſina* Zanon 107.
Jacea cinerea laciniata, fl. purpureo *Triumpheti* 72.
Serratula *Virginiana* folijs rigidis P. B. pr. 227. Fig.
Serratula *Novæborac.* altiſſima, fol. Doriæ mollibus ſubincanis P. Bat.
Gallium ſaxatile glauco folio *Bocc.* Mus. Tab. 116.
Betonica major *Danica* Park. 615.
Betonica minima *Alpina* Helvetica *Park.* 614.
Clinopodium *Canad.* fiſtuloſum anguſtifolium H. L. Bat.
Horminum ſanguineum *Aſphodeli* radice *Triumph.* 69.
Horminum Verbenæ lacinijs *Triumph.* 66.
Bugula odorata *Luſitanica* Corn. 46.
Ocimum *Ægyptiac* odorat. fol. longis pediculis innixus *Ambroſ.*
Marrubiaſtrum fol. Cardiacæ Bocc. *Mus.* Tab. 98.
Pſeudo-Dictamnus *Afric.* Hederæ Terreſtris fol. *Old.* I. R. H. 188.
Calamintha prælta odore Pulegij Bocc. *Tab.* 40.
Dracocephalum Americanum *Breyn.* Pr. 1. Fig.
Bugula *Alpina* maxima I. R. H. 209.
Marrubium aq. fol. profundiſſimé diſſectis H. L. B. 408.
Verbena altiſſima *Americana* P. Bat.
Verbena latifol. *Luſit.* procerior I. R. H. 200.
Auricula Urſi minima, fl. carneo & niveo 1. B. 3. p. 869.
Portulaca *Curaſſavica* Capparidis fol. P. Bat. pr. 213. Fig.
Portulaca *Curaſſ.* lanuginoſa erecta P. Bat. pr. 214. Fig.
Blattaria fl. cæruleo, fol. ſplendente *Mandragoræ* Triump.
Blattaria incana multifida *Bocc.* 61.
Linaria *Americ.* max. purpureo flore H. L. Bat. 377 Fig.
Scrophularia nemorenſis fol. *Urticæ* rugoſo, fl. atro punicante H. *Catholic.*

Polygala fruteſcens *Cap. Bonæ Spei* Breyn. *Cent.* 107.
Polygala fruteſc. fol. *Buxi* fl. maximo *Old.* I. R. H. 175.
Hypericum fruteſcens *Virgin.* tomentoſum & incanum P. Bat. pr. 188. Fig.
Convolvulus *Amer.* piloſus, fl. luteo, umbone purpureo H. *Amſt.* Fig.
Campanula altiſſima hirſuta flor. conglomeratis Hort. Bat.
Campanula minima *Afric.* Erini facie, fl. violaceo, cauliculis procumbentibus H. L. B. 109.
Tithymalus *Raguſinus* fl. luteo pentapetalo H. L. B. 601.
Tithymalus *Afric.* caule tuberoſo minor ex *Hort.* Beaum. 107.
Datura *Amer.* Hyoſcyami folio *Hor.* Bat. 2.
Datura *Cochin.* ſpinoſiſſima *Zan.* 76.
Geranium *Afric.* noctu olens tuberoſum fol. *Vitis* hirſuto H. Amſt. 2.
Geranium *Afric.* fruteſcens fol. glauco, ſapore *Acetoſæ* Com. 2. Fig.
Geranium fætidum *Park.*
Altheæ fruteſc. *Luſit.* fol. rotundiori undulato I. R. H. 97.
Malva rotundifolia *Italica*, fl. amplo purpureſcente I. R. H. 96.
Malva *Hiſpan.* fol. rotundis undulatis *Flor.* Bat. 2.
Malva rotundifol. glabra *Hiſp.* fl. amplo rubello *Pluk.* 44. 3.
Malva Sylveſtris fol. *Betonicæ* Bocc. 114.
Ketmia *Africana* Populi folio I. R. H. 100.
Ciſtus *Ledon* fol. latis & hirſutis *Flor.* Bat. 2.
Colyledon fl. luteo rad. repente *Dodart.* mem. 73.
Colyledon fl. luteo medio H. L. Bat. 191.
Colyledon *Afr.* fruteſc. fl. umbellato coccineo *Comel.* 2. 24.
Telephium *Amboinenſe* maximum H. *Beaumont.*
Helleborus niger trifoliatus H. *Farnes.* 92.
Sinapiſtrum *Luſit.* tryphyllum fl. rubro, ſiliquis corniculatis H. L. Bat.
Fumaria Africana veſicaria ſcandens P. *Bat.*
Clematis tetraphyllos *Americana* ſiliquoſa H. R. *Par.* 71.

Aſclepias

Aſclepias *Africana* aizoides, fl. pulchré fimbriato *Com.* 19.
Apocynum majus *Syriacum* rectum *Corn.* 91.
Apocynum minus rectum *Canadenſe* Corn. 93.
Apocynum *Canad.* humilius fol. anguſtiſſimo H. L. *Bat.*
Apocynum rectum latifol. *Americ.* majus *Park.* 385.
Apocynum fruticos. fol. rotundiori craſſo P. *Bat.*
Apocynum fruteſc. fol. rotundiori magis acuto P. *Bat.*
Apocynum erect. *Canad.* latifolium P. *Bat.*
Thlaſpi incanum fol. *Leucoij* Bocc.
Leucoium ſaxat. fol. viridi, fl. purpureo eleganti *Cupani.*
Thlaſpi latif. platycarpon *Leucoij* folio *Bocc.* 55.
Thlaſpi verum primum *Dioſcoridis Zan.* 191.
Lepidium humile minus incanum *Alepicum* I. R. H.
Cochlearia major *Batavica* erecta fol. oblongo H. L. *Bat.* 165.
Sinapi *Indicum* Lactucæ folio P. *Bat.*
Sinapi *Indic.* Lact. fol. minus ſeu anguſto profundius crenato P. B.
Sinapi *Hiſpanicum* fol. Naſturtij *Tourn.* 227. fl. pallide purpureo 142.
Naſturtium *Pyrenaicum* aquaticum P. *Bat.*
Naſturtium montanum fol *Aſari* Bocc. 5.
Cardamine *Sicula* fol. *Fumariæ* T. 224. Bocc. 84.
Leucoium *Luſit.* purpureum fol. eleganter dentatis P. *Bat.* 193. Fig.
Heſperis *Sicula* fruteſcens, ſiliqua tricuſpidi T. 223. *Boc.* Mus. Tab. 111.
Heſperis *Sicula* Coronopi fol. ſiliquâ tricuſpidi T. 223. *Bocc.* Muſ. Tab. 111.
Geniſta tinctoria *Germanica* fol. lucidis glabris H. L. B.
Phaſeolus *Indicus* flor. & fructu candidiſſimis *Volk.*
Phaſeolus *Indicus* cochleato flore *Triumph.* 92.
Fænum Græcum Sylv. minus *Monſpel* Breyn. Cent. 79. Fig.
Fænum Græcum Sativum, polyceration *Cretic.* majus Breyn. Cent. 80.
Anonis ſpicata ſive Alopecuroides *Luſitanica* Hofm.

Medi-

Medica annua, siliquis hirsutis falcatis *Flor. Bat.* 1.
Colutea vesic. *Afr.* frut. fol. Senæ, fl. sanguineo *Com.*
Onobrychis minus, fr. maximo insigniter echinato *Triumph.* 65.
Lupinus peregr. major, fl. incarnato H. L. *Bat.*
Lupinus anguſtifol. cerul. elatior *Ray* H. Plant. 908.
Hedysarum triphyllum *Canad.* Cornuti 44.
Hedysarum annuum siliqua aspera undulata intorta T. 401.
Astragalus purp. perennis *Monspessulanus* Magn.
Bryonia *Zeyl.* fol. profundè laciniatis H. L. *Bat.* Fig.
Bryonia *Afr.* laciniata; tuberosa rad. fl. herbaceis P. *Bat.*
Polygonatum racemosum fl. luteo majus *Corn.* 37.
Polygonatum racemosum fl. luteo minus *Corn.*
Asparagus aculeatus max. sarmentosus *Zeylanicus* H. L. Bat. Fig.
Anapodaphyllon *Canad.* Morini T. 239.
Arum max. cauliculis nigricantibus, *Zeylanicum* H. L. Bat.
Arum tryphyllum *Dodart.* Mem. 81.
Cucumis *Canad.* monospermos, fr. echinato *Par. Bat.* Fig. 133.
Cucumis puniceus *Indicus* major P. Bat.
Ficus *Indica* Scolopendriæ folio Epiphyllitis P. *Bat.* Cat. 8.
Cereus erect. *Curass.* tetragonus articulatus P. B. *pr.*
Cereus scand. minor trigonus articulatus, fr. suavissimo P. Bat. 118. Fig.
Cereus scand. minor polygonus articulatus, P. Bat. 120.
Acetosa *Moscovitica* sterilis H. Ox. 583.
Atriplex anguſtissimo & longissimo folio H. L. Bat.
Parietaria *Sicula* fol. Alsines *Bocc.* 47.
Pimpinella sanguisorba eleganter laciniata S. B. P. T.
Pimpinella max. *Canad.* alba spicata *Corn.* 175.
Pimpinella Agrimonoides *Bocc.* 58.
Gnaphaloides *Lusitanica* T. 439.
Mercurialis procumbens dicoccos *Afric.* fol. Violæ tricoloris P. *Bat.*

Hya-

Hyacintho affinis *Afric.* tuberosa rad. umbellata cærulea inodora H. L. Bat.
Colchicum variegatum *Corn.* 137.
Canna *Indica* angustifol. fl. flavo H. L. Bat.
Ornithogalo affinis rad. tuberosa, fol. Cyclaminis *Breyn.* Cent.
Ornithogalum *Afric.* lut. odorat. fol. Cepaceis rad. tuberosa H L. *Bat.* Fig.
Scilla *Afric.* fl. parvo viridi, bulbo ampliſſimo lanuginoso H. *Amst.* 2 Fig.
Lilium *Amer.* puniceo flore, *Bella dona* dictum P. Bat. Fig. 194.
Lilio narciſſus *Afr.* platicaulis humilis, fl. purp. odorato H. *Amst.*
Gramen *Sparteum* marit *Hollandium*, spicâ Secalinâ *Ray.*
Gr. Dactylon max. *Americanum* H. R. Par.
Arundo *Indica* variegata seu *Laconica* Theophrasti *Corn.* 55.
Polypodium majus folio serrato *Barrel.* Icon.
Fraxinus *Alepensis* H. L. Bat.
Fraxinus *Americana* florida H. R. *Par,*
Fraxinus florifera *Botryoides* H. R. Blæs.
Lentiscus vulg. fol. minoribus & pallidioribus H. L. *Bat.*
Jasminum *Afric.* folio Ilicis *Com.* Fig. 6.
Vitis Idea *Zelanica* odoratiſſima T. 608.
Myrtus folijs Buxi *Schuyl.* Hort. 49.

III. *The following* Plants, *tho* formerly discovered, *are not common in our* Engliſh *Phyſick* Gardens.

A *Nemone* trifolia C. B. 176. *Phyt.* 317.
Anemone Sylv. alba major C. B. 176.
Ranunculus nemorosus luteus C. B. 198. flor. duobus *Var.*
Meum latifol. adulterinum C. B. 148.
Crithmum marit. majus odore Apij C. B. 288. 1.
Apium montanum tenuifolium C. B. 153.
Thapsia latifol. villosa C. B. 148.
Thapsia folijs *Libanoditis* fætidiſſima C. B. 148.

Caucalis

Caucalis pumila maritima C. B. 152.
Valeriana tuberosa I. B. 3. p. 209.
Sonchus lævis laciniatus cæruleus Alpinus C. B. 124.
Tussilago *Alpina* rotundifolia glabra C. B. 197.
Cacalia tomentosa C. B. 198.
Bellis spinosa fol. *Agerati* C. B. 262.
Dipsacus sativus fol. laciniato C. B. 385.
Eryngium montanum pumilum C. B. 386.
Atractylis fl purpureo *Ludg.* 1468.
Jacea *Babylonica* C. B. pr. 129.
Jacea marit. candidissima fol. *Stæbes* C. B. 272.
Centaurium *Alpinum* luteum C. B. 117. pr. 56.
Rubeola repens lutea foliis spinosis C. B. 334.
Tragoriganum *Creticum* minus & tenuis *Alpin.* Exot. 79.
Tragorig. *Cret.* majori crassiori, asperiori folio *Alp.* Ex. 79.
Sideritis *Alpina* Hyssopifolia C. B. 233.
Sideritis hirsuta vulg. erecta C. B. 233.
Verbena nodiflora C. B. pr. 125. Fig.
Alsine affinis *Androsace* dicta major C. B. 251.
Soldanella *Alpina* rotundifolia C. B. 295.
Gentiana palustris latifol. fl. punctato C. B. 188.
Hyoscyamus albus *Ægyptius* Alp. *Exot.* 192.
Linaria tryphylla minor lutea C. B. 212.
Hedera saxatilis magno flore C. B. 306.
Tithymalus Characias fol. serrato C. B. 293.
Ruta Sylv. fl. magno albo C. B. 336.
Alcea villosa hirsuta C. B. 3 6.
Nigella *Cretica* C. B prodr. 75.
Peonia folio latiori promiscua Vormarij I. B.
Jonthlaspi minimum spicatum *Col.* 284.
Leucoium mont. fl. pedato *Col.* 2. 61.
Jondraba *Apula* Alyssoides spicata *Col.* 285.

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PHILOSOPHICAL TRANSACTIONS.

For the Months of April, May, *and* June, 1710.

Osteographia Elephantina:

OR,

A full and exact Description of all the Bones of an *Elephant*, which dy'd near *Dundee*, *April* the 27*th*, 1706. with their several Dimensions.

To which are premis'd,

1. *An Historical Account of the Natural Endowments, and several wonderful Performances of* Elephants, *with the manner of Taking and Taming them.*
2. *A short Anatomical Account of its Parts.*

And added,

1. *An exact Account of the Weight of all the Bones in this Subject.*
2. *The Method I us'd in preparing the Sceleton.*
3. *Four large Copper Plates, wherein are represented the Figures of the Stuff'd Skin, and prepared Sceleton, as they now stand in the Publick Hall of Rarities at* Dundee; *with the separated Bones in several Views, and other Parts of this* Elephant.

Communicated in a Letter to Dr. *Hans Sloane*, R. S. Secr. By Mr. *Patrick Blair*, Surgeon, *&c.*

Osteographia Elephantina:

OR,

A full and exact Description of all the Bones of an *Elephant*, which died near *Dundee*, *April* the 27*th*, 1706. with their several Dimensions. Communicated in a Letter to Dr. *Hans Sloane*, R. S. Secr. By Mr *Patrick Blair*, Surgeon, *&c.*

SIR,

THE *Elephant*, tho' an Animal so considerable for its Bigness and Strength, so remarkable for its extraordinary Endowments and stupendous Actions (if I may so call them,) that it has become the Subject of the most Curious Naturalists of all Ages, and been admir'd by all those who beheld it; yet has its Body been hitherto very little subjected to Anatomical Enquiries. This induc'd Me (when upon *April* 27. 1706. the last *Elephant* that was in *Britain* died near this Place) to bestow some Pains in viewing its Parts at the Opening: But the Time was so short, and Inconveniencies I labour'd under so great, that I was doubtful, w. ether what I had observ'd might prove worth your Own or your honourable Society's while, until I had address'd your self, and you were pleased to honour me with a return dated *July* the 11th following: Wherein you signify'd, 'You were glad the *Elephant* had fall'n where Notice 'might be taken of its Parts by Dissection, and that the Bones 'would be well worth Observation, for several Reasons; but 'chiefly one, namely, that there have been large Bones, sup-'posed to be those of *Elephants*, found many Feet deep in 'the Ground, and that if there were a Sceleton to compare 'them by, that matter would be more certain: And there-

Preface.

'fore (tho' I had told you in mine that I was able to make but 'few of them) you desired me to let you have my Observations. The better to enable me to do which, you favour'd me with two Treatises on *Elephants*, which I suppose to be the only Two hitherto communicated to the *Royal Society*; one whereof gives an Anatomical Account of the *Elephant* accidentally burnt in *Dublin*, *Anno* 1681. written by Dr. *Moulins*; which, tho' it requires a further Enlargement, being very brief both in the Anatomy and Osteology, and the Figures not very exact, yet seems to have been the only Book which undeceiv'd the Author of the other, *viz. Wilhelmi Ernesti Tentzelij Historiographi Ducalis Saxoniæ Epist. de Sceleto Elephantino, Tonna nuper effosso, ad Anton. Magliabechium magni Ducis Hetruriæ Bibliothecarium.* This is the Treatise which describes the Bones mention'd by you, found in an Hill near *Erfurt* in *Germany*; wherein the Author earnestly intreats, 'That 'tho' by distance of Place he cannot expect from his Friend such 'a Figure of the *Elephant* at *Florence*, (as *Cyampinus* formerly ob-'tain'd) yet, that he would, as exactly as possible, take the Di-'mensions of all the Bones, especially of the Head, Teeth and 'Tusks, their Number, Situation and Origin; and he desires further to know, how old that Sceleton at *Florence* was, how high, and when it was dissected.

Therefore, *Sir*, in Obedience to your repeated Request, in the several Letters you were pleased to Honour me with, and finding the Author of the last nam'd Treatise, has favour'd the Repository of your Society with several Specimen's of the Bones he describes, some whereof perhaps being broke, may come not to be so well known; that I may satisfy you to whom I am so much bound, for the many special and signal Testimonies of your Favour, your honourable and learned Society, for whom I have so great a Veneration and Respect, and to whom I shall be extreamly glad, if by these means I may be capable to do any small piece of Service, and the Learned *Tentzelius* in that he so earnestly desires, and wherein I do not yet understand his Friend has answer'd him: In a word, that I may satisfy the World in such Things as were of Moment in this rare and curious Animal, I shall observe the following Particulars, *&c.*

The Method of Procedure;

1*st*, Shew, how the *Elephant* fell in our way.

2*dly*,

2*dly*, Remove ſome miſtakes which have been entertain'd, concerning its Original Names in the Holy Scriptures.

3*dly*, Give a ſhort Hiſtorical Account from Authors of the ſeveral Natural Functions and Automatical Performances of this Animal, with the Method of taking and taming it.

4*thly*, I ſhall give ſuch a Superficial Anatomical Deſcription of its Parts, as the Inconveniences I labour'd under at the opening would permit.

5*thly*, I ſhall give an exact Deſcription of all its Bones, ſuch as is uſually given in Treatiſes of *Oſteologie*, with a particular Account of the Dimenſions of theſe in this Subject.

6*thly*, A true Account of their Weight and Number.

7*thly*, The Method I us'd in mounting the Sceleton.

To all theſe I have added the Figures of the ſtuff'd Skin, mounted Sceleton, ſeparated Bones in different Views, and other Parts of this Animal; all done from the Original, (and repreſented in ſeveral large Copper Plates) as it now ſtands in the Hall of Rarities in this Place; the Copy whereof the *Royal Society* has been already pleaſed to approve, as intimated in yours to me in *June* laſt.

How the Elephant fell in our way.

After this Animal had travell'd moſt part of *Europe*, ſhe came at laſt to this Kingdom; where, after ſome ſtay at *Edinburgh*, they conducted her to the *North*, and in their return came along the Sea-Coaſt; where being but few Places on the Road for making Advantage, by long and continued Marches they haſtned hither; and when they were come within a Mile of this Place, the poor Beaſt, much fatigu'd and wearied, fell down. They us'd many Endeavours to get her on foot again, but they all prov'd ineffectual. At laſt they digg'd a deep Ditch, to whoſe Side ſhe might lean, till ſhe were ſufficiently reſted; but that proved her Ruin; for ſhortly afterwards there fell great Rains, which fill'd the Ditch with Water: So that after lying in the puddle a whole Day, ſhe died next Morning, being *Saturday April* the 27*th* 1706. When the Keepers ſaw that ſhe was Dead, they came to the Ma-

giſtrates of this Burgh, and having made Oath they had done her no deſigned injury, they got an Atteſtation accordingly, and went off, having firſt given the Cadaver to an Ingenious Gentleman, Capt. *George Yeman*, ſince Provoſt of this Town; by whoſe Care the People were prevented from carrying it all away in pieces, as they did one of the fore Joints, and we ſtill continue Maſters of the Remains; for the Day ſhe died, he was pleaſed to go out himſelf, and take me along with him, in order to have the Skin flea'd off, which was his chief deſign, and the Body opened, which was mine. As I was very glad of the Opportunity, ſo I was concern'd becauſe of the diſadvantage I was at, which kept me from proſecuting what I deſign'd: For there went out a great Multitude, the Day was very hot, and being the laſt Day of the Week, the Subject could admit of no delay, eſpecially ſince it lay in the high Way and open Fields: So that I ſcarce had any convenience to pry into, or ſo much as to ſee any thing of moment, much leſs to enquire ſo nicely into the Structure of the Parts, as the Subject requir'd. 'Twas One of the Clock in the Afternoon before all were in readineſs to go out, and moſt of the time was ſpent by the Butchers in fleaing off the Skin. All I got done, was to take ſuch narrow Inſpection of the Muſcles of the *Proboſcis*, (or *Promuſcis*, as ſome call it, in *Engliſh* the Trunk) as I could. Afterwards I caus'd the *Abdomen* to be open'd, and then the *Thorax*, and that by the unweildy Hands of unruly Butchers, who at opening the firſt, would have wholly cut through the *Oſſa Innominata*, had I not hinder'd them; and at laſt, whether I would or not, did ſo flaſh the *Sternum*, and mangle ſeveral of the *Cartilages*, as to render them uſeleſs, cutting and tearing where ſoever they came. I had not much above an Hour to beſtow when Night came on, and that amidſt a Throng and Rabble in mighty hot Weather. During that time I view'd the Situation of the *Viſcera*, took the Figure and Dimenſions of the *Liver*, extracted the *Uterus* and *Bladder*, and caus'd the *Head* to be cut off, which (with ſome other Parts I deſign'd to have diſſected) were brought to Town. I had a mind to be more fully ſatisfy'd about the *Inteſtines*, *Spleen* and *Kidneys* on *Monday*; but when I went out again, the *Inteſtines* were all dry'd by the Heat; ſo that their Figure and Structure were quite ſpoil'd, and the Country People were ſo earneſt to have Parts of it, that they had ſtole away the whole fore Foot before that time; which, after much Pains and the earneſt Care of Provoſt *Yeman*, we recover'd about 6 Weeks after-

afterwards: So that the time I design'd to have bestow'd in Dissecting the Parts I had reserv'd, was taken up in excarnating, boyling, and taking care of the Bones; which, had not some Physitians and Surgeons gone out and assisted me on the *Monday*, had been all carried off; and the heat of the Weather was such that the other Parts would not keep. This, I hope, will be a sufficient excuse for the Lameness of the following Account.

The Behemoth *in* Job *is not the* Elephant.

Because the Names given to the *Elephant* in Holy Scripture have been much mistaken, tho' perhaps it may seem forreign to my Business, yet I hope 'twill not be unpleasing, if from Authors I endeavour to clear them. *Junius* and *Tremellius*, *Franzius*, &c. who comment upon the 40*th Ch.* of *Job v.* 15. and downward, take the *Behemoth* for the *Elephant*; but others, such as the Learned *Bochart*, *Par.* 2. *lib.* 4. *c.* 15. and from him Dr. *Patrick*, are of Opinion, 'tis not the *Elephant* which is meant there, but the *Hippopotamos*, or River Horse; for *Buxtorf* and such others as are acquainted with the Original, agree, that the Word *Behemoth* does not properly signify any thing more than a great Beast; and both in *Job* and *Esdras*, 6 *Ch. v.* 49. (where the *Behemoth* is translated *Enoch* in the *English* Bible) the *Behemoth* and *Leviathan* are nam'd together. *Esdras* makes them the Work of the Fifth Day, wherein Fishes, other Sea Animals, and Sea Fowls were created; by which not the *Elephant*, but the *Hippopotamos* may be meant, which *Bochart* proves by the following Arguments. 1. As in *Job* 39. Land Animals, such as Quadrupeds and Fowls, are spoken of; so in the 40 and 41. *Behemoth* and *Leviathan*, as belonging more properly to the Water, are treated of. 2. The Force of the *Behemoth* is said to be in the Navel of his Belly, whereas 'tis the softest part of the *Elephant*; but in the *Hippopotamos* it is so thick and impenetrable, that it resists both Spears and Darts, which he abundantly proves from Authors. 3. The *Behemoth* is said to move his *Tail* like a *Cedar*; now the *Tail* of an *Elephant* is long like that of an *Ox*, and but small in proportion to the Body; and to move like a *Cedar*, would import some strong round substance, and rather seems to agree with what *Bellonius* affirms of the *Hippopotamos*, that *Caudam habet brevem, crassam & rotundam*, tho' *Bochart* renders it *Retorquet, & non arrigit Caudam*, as *Junius* has it. 4. *Bochart* says, that the Word in the Original will not imply *Nervis Testium ipsius*, as *Junius* has it, but *Nervis Femorum &c.* Not the Sinews of his Stones, but the Nerves of his Thighs are intricate. 5. The *Elephant* seldom lies down, and never in the

the Covert of Reeds and Fens; for tho' it loves Water very well, yet it would be very hurtful to such an unweildy Animal to lye down among such moisture as Reeds usually grow in, or the being among the Willows of the Brook would import. 6. At the taking of an *Elephant* they never pretend to ensnare it by the *Proboscis*; and when taken it is a most decile Creature, it being more compatible for the *Hippopotamos* to pass through Snares: The usual way of catching it being in Nets made of Iron, which they make on purpose at *Damascus*, as *Albertus* and *Vincentius* affirm; and when taken, is no ways managable, but they are forc'd to kill it with Iron Mallets, because of the thickness of the Skin. 7. Tho the Bones of the *Elephant* be proportionably big enough, yet they are far from such Strength as to make a Parallel between them and Brass or Iron; for they shall be shewn hereafter to be more porous than the Bones of most *Quadrupeds*: And although their Tusks and Teeth may be said to exceed all other Bones in Solidity and Whiteness, yet I am assur'd, that the Teeth of the *Hippopotamos* doth even exceed them; for the Ivory of an *Elephant* after some time becomes Yellow, and the Teeth of the *Hippopotamos* when apply'd to any use, continue always of a pure white Colour.

The different Names of the Elephant.

An *Elephant* in the *Syriac* and *Arabic* is *Senhab*, but in the *Chaldaic* and later *Hebrew* 'tis taken for *Elephant's* Teeth, because *Sen* in the *Hebrew* signifies a Tooth. Hence it is, that 1 *Kings*, *Ch.* 10. *V.* 22. 'tis rendred by *Junius*, &c. *Ebora*, *Semias & Pavones*, *Ivory*, *Apes* and *Peacocks*, in our Translation; where *Senhab* is rendred by the later *Hebrews*, *Dentes Elephantorum*, but by the *Syrians* and the *Arabians*, *Elephantos*; and therefore *Bochart* thinks it should rather have been *Elephantes*, *Simias & Pavones*: First, because of their better Coherence; and secondly, because *Ivory* would not have been *Senhabim* in the Plural Number, but *Senhab*, *Dens Elephantis*; for *Ivory* is denoted elsewhere in Scripture by the Word *Sen*, as *V.* 18. of that same Chapter, where 'tis said, *Solomon* built a great Throne of *Ivory*. *Sendephil* also in the *Chaldaic* Phrase is taken for *Ivory*; for *Phil* signifies an *Elephant* both in the *Syriac*, *Chaldaic* and *Arabic*. An *Elephant* in the Ancient *Hebrew* was call'd *Alikhaban*, and by Contraction *Alkaban*, that it may be distinguish'd from *Ikhaban*, which signifies a Buffle or Bugle, because both are of that Colour: So *Bochart* conjectures, that *Sen* being prepon'd to *Kahab*, may by Contraction be call'd *Senhab*, which by a *Synecdoche* may mean the whole *Elephant*.

Elephant. In *Greek* it is call'd, ἐλέφας, and sometimes βοῦς, which is rendred *Bos Martius*, whereby they mean the *Elephant*. In *Latin* 'tis call'd *Barrus*, from the Voice; or some think that *Barrus* is the proper Name, as in *Horace* — *Nigris digniſſima Barris*; and that *Barrire*, to Bray as an *Elephant*, comes from it. Thus we have from *Pellonius*, *Elephantes barrire dicimus, ſicut Oves decimus ballare.* Amongſt the *Indians* they are call'd *Praſij* and *Taxillæ.* Thus *Elianus* ſays, *Maximi Elephantorum qui illic ſunt Praſij dicti, ſecundi vero ab ijs exiſtimantur Taxillæ.* In the *Punic* and *Moorish* Language it is call'd *Cæſar*; hence it is, as *Servius* ſays, *Cæſar, vel quod cæſo Matris Ventre natus eſt, vel quod Avus ejus in Africa manu propriâ occidit Elephantem, qui Cæſar Panorum Linguâ.* It is alſo call'd in *Latin*, *Bos*, *Lucas*, and *Elephantas*, from the *Greek.*

Hor. Epiſt. 12.

Hiſt. Lib. 13. 12.

The *Elephant* is ſaid to live to a great Age: Some aſſerting, they live to One Hundred and Twenty Years; Others, to 200 Years; ſome to 300; and there are who affirm, that they can live till they be 500 Years old, and that they are very ſtrong and robuſt at the 200 Year. *Tentzelius* tells us, that when a certain *German*, who had ſometimes been in the *Indies*, ſaw theſe Bones he treats of, concluded from certain Marks the *Indians* have, that that *Elephant* could not have been under 200 Years old. Mr. *Tavernier* ſays, he could never learn exactly how long the *Elephants* liv'd; but that their Keepers have told him, they knew ſuch an *Elephant* to have been in their Great Grand father, Grand-father, and Father's Cuſtody, which he modeſtly computes not to have been under 120 or 130 Years. And 'tis memorable, which *Juba* King of *Lybia* told, as it is related by *Philoſtratus*, that the Knights of *Lybia* at a certain time fought upon *Elephants*, ſome whereof had a Tower engraven upon their Teeth, others nothing; and when by the Night they were ſeparated, ſuch as had the Tower were beat, and fled to the high Hill *Atlas*: And that the ſame *Juba* after 400 Years took one of them, which had this Enſign ſo lively engraven, as if it had been but lately done. I am not to anſwer for the truth of this, but they ſeem generally to live to a great Age; for the Keeper told, that the *Elephant* which fell in our way was 26 or 28 Years old; notwithſtanding which ſhe ſeems to have been Young, according to the Term of Life, for the *Epiphyſes* ſeparated from the Bones by Boyling as eaſily, as thoſe of an Human Subject would have done at the Age of 10 or 12. However, 'tis an Animal Subject to many Diſtempers; ſo that

To what Age they live.

Tavernier's *Travels in India*, p. 96.

that tho' they may live to some of the fore mentioned Ages, yet mostly them perish before they come to such length.

Usual bigness of the Elephant.

'Tis certainly an Animal of considerable Bigness; but whether ever so large as to contain 32 strong Men upon its Back, as is related *Maccab* (*h. 6. v.* 37. beside the *Indian* that govern'd it, is much to be doubted; and 'tis more probable that this is an Error in the Impression, as is well enough observ'd by *Grentemesnil*, who instead of Ἄνδρες δυνάμεως δύο καὶ τεσσαρακοντα οἱ πολεμοῦντες ἐπ' αὐτῆς, *Viri fortes duo & triginta, pugnantes in ijs*, believes it should be rather, Ἄνδρες δυνάμεως δυὸ ἢ τρεῖς ἀκόντιοις πολεμοῦντες ἐπ' αυτῆς, *Viri fortes duo aut tres pugnantes super ipsos Jaculis*. Indeed *Philostratus* speaks of 10 or 15 *Indians* fighting in Castles with Darts on *Elephants* Backs: And *Paulus Vineta* says, that in the Ginger Islands they have Wooden Castles upon *Elephant's* Backs, which can contain 15 or 20 Men. But the Learned *Bochart* very pleasantly says of these Authors, that *de magnis majora loquuntur*; because this is a big Beast, they delight to speak at random of it. I rather believe what *Heliodorus* say:, that the Towers upon the *Elephants* Backs could contain 6 fighting Men, who from each side drew Darts, the hinder part remaining void; or *Cadamustus*, that they put Towers upon the Back, which can hold 3 or 4 Men that fight upon them; and *Ælianus*, that they carry 3 Warriours fighting from either side, and the 4th which governs them. Which 3 last Accounts seem very well to quadrate with the usual height ascrib'd to them: About which some Authors talking more largely, tell us of 18 or 16 foot high; but the most received Account is, that they are from 13 to 8 foot: So that as our *Elephant* was none of the biggest, she did not seem to have been any of the least size. I shall give you her particular Dimensions hereafter.

Bochart *de Animal. S.S. Script. C.* 27. *Col.* 269.

Philost. lib. 2. *c.* 1.

Lib. 3. *C.* 41.

Heliod. *lib.* 9.

Cap. 62.

Their manner of Procreation.

The next to be consider'd, is their manner of Procreation, about which Authors differ very much. All agree that it is an Animal of extraordinary Modesty, and therefore never copulates in view of any; which because 'tis a big unweildy Body, hath put Authors to a loss as to the Posture. Some asserting, that it is Retrocoient and Retromingent; among whom is Dr. *Moulins*, from an Observation he has made of the Situation and Structure of the *Penis*. Others observing the distance betwixt the *Anus* and *Vagina*, and that the Duggs are situated between the fore Limbs, are of Opinion, that the Female is in a Supine, and the Male in a Prone Posture: Among whom is *Tavernier*, who tells us, 'That 'the Female gathers a great deal of Herbs and Weeds, and makes her

'her Bed some 4 or 5 foot high from the Ground, where she 'throws herself, and lies on her Back in expectation of the Male, 'whom she invites by a peculiar Cry; therefore perhaps it may be, that the Duggs are placed so forward, to avoid the Pressure. A third Opinion is, that at the *Coitus*, the Female descends into a Ditch, and that the Congress with the Male is no otherwise with them than with other Quadrupeds. As to the first, I can scarce believe it probable, because there can be no such thing as a Retrocoient Animal; for that would quite invert the order of Nature, and give a far different motion to the Muscles of the Thighs, than they can be supposed to have from their Situation; and I am credibly inform'd by those, who have been at the Pains to observe them, that Hares, Cats, Rabbits, *&c.* who are said to be Retrocoient, do Copulate no other way than Dogs and other Quadrupeds; and that Retrograde Posture we see Dogs in at that time, is nothing but an endeavour to get rid, when (by means of the swelling of the *Glans*,) the Male and Female are too close together, and far from a design of penetrating further into the *Vagina*. As to the second Opinion, were it not for Monsieur *Tavernier*'s Assertion, I should think it too unweildy an Animal, and of too small an Inclination to lye down, to acquire such a Posture. The third Opinion is, that the Natural Sagacity of the Animal disposes the Female to go into the Ditch, and both fore and hind Legs seem to be so articulated as to favour this: For when the Female would bring the Body low, she has no more to do, but to stretch forward her fore Feet, and then the Articulation of the *Humerus* with the *Cubitus* will bend backward; and to bring back her hind Feet, so as to bend the Knees forward, by which she can bring the fore part of the Body so low, as to make the *Nates* Protuberant, and bend the hind Legs, whereby to put the *Vagina* in a convenient Posture for Reception of the *Penis*, according to that of *Aristotle*, *Subsistit Fœmina, Clunibusque Submissis, insistit pedibus ac innititur*; and elsewhere, *Flectit certe suos posteriores Poplites modo Hominis.* Which of the two last Opinions may be true, I know not, but you have the Assertion of two famous Authors for both.

What Time they begin to Copulate is uncertain; tho' from their usual term of Life, Authors seem probably to conjecture, that some begin at the fifth Year, others much later, yea, not till the Twentieth. The time also of their going with Young is in debate; for their innate Modesty keeps such as would *How long they go with Young.*

obſerve them from any certainty. The only way to know, is (where they abound) to obſerve their ſeparating themſelves from the Flock; for it is a gregarious Animal, as Naturaliſts term them; and 'tis obſerv'd, when they begin to be proud, (ſo to ſpeak,) that the Male and Female go apart, (and if any obſerve them at that time, the Male runs upon them with Fury and Madneſs) and do not return till the Female is impregnate. Some fondly imagine from their extraordinary Bigneſs, that they go with Young 9 Years, others 6, and others 2; but to me the moſt probable is, that of 15 or 16 Months; and if we obſerve the ordinary courſe of Geſtation in other viviparous Animals, it is according to the Bigneſs and Term of Life, that the Female uſually goes with Young. Thus you have Bitches and Cats going but 9 Weeks, while Mares and Cows go 9 Months: So that, *Cæteris paribus*, this our Animal may be ſuppos'd to go 15 or 16 Months; and Mr *Knox* in his Relation of the Iſland of *Ceylan*, tells us, they go not with Young above one Year: Some ſay, they bring forth after every third Year; and others, never but once in their Life. The firſt Opinion may be probable, but the ſecond is ſcarce to be believed; for it would be ſtill more wonderful, and next to an Impoſſibility, to ſee ſuch Numbers of *Elephants* in Armies and Countries, as we read of. Mr. *Tavernier* tells us, 'He has been inform'd, that the Great *Mogul* keeps Three or 'Four Thouſand *Elephants*; but that the chief Maſter aſſur'd him, 'he had not above 500 ſaid to be of his Houſe, and deſign'd 'for carrying Women, Tents and Luggage, and about 80 or 90 'for War; which is a great Number of tam'd ones. And from thence we may ſuppoſe, that there muſt be a far greater Number of Wild ones in his Dominions, beſides what are in the Kingdom of *Pegu* (where, as *Schotto* relates from *Garzias ab Orta*, at one Hunting there were 4000 taken at once) *Siam*, *Cochin* and *Boutan* near Great *Tartary*, beſides theſe of the Iſland of *Sumatra* and *Ceylan*; where *Tavernier* reports for a certain truth, 'That when any *King* or *Roja* has one of them, if they bring 'the Breed of any other Place, ſo ſoon as the other *Elephants* be-'hold the *Ceylan Elephants*, by an Inſtinct of Nature they do them 'Reverence, by laying their Trunks upon the Ground, and rai-'ſing them up again. 'Tis ſaid the Male never copulates with the Female after once ſhe is impregnate; and ſome will have us to believe, that every Male keeps to his own Female. 'Tis alſo ſaid to be a very temperate Creature, and ſeldom in Luſt.

Acta Lipſ. Suppl. Tom. 6. 1. pag. 39.

Mirab. Animal. Ter. lib. 8.

Tavernier's *Travels in* India *195.*

Tavernier

Tavernier tells us, that the Male never meddles with the Female when once he is taken, but is sometimes seized with a lustful Rage, whereof he gives this memorable Instance: 'One Day 'when *Chajehan* King of *India* was a Hunting upon one of his *Page 95.* 'Elephants, with one of his Sons who sat by him, the *Elephant* 'became so furious by reason of his Lust, that the Governor, who 'was by no means able to master him, declar'd to the King, that 'to allay his Fury, who would else doubtless bruise him to pieces 'among the Trees, there was no way but for One of the Three 'to forfeit his Life, and that he would willingly Sacrifice his for 'the safety of the King, and the Prince his Son; only he desir'd 'his Majesty would take care of his Children; which said, he 'threw himself among the *Elephant's* Feet, who had no sooner 'taken him in his Trunk, and squeez'd him to pieces with his 'Feet, but he grew as quiet and peaceable as before. Whether this Rage proceeds from Lust, or it be a kind of Madness, which Mr *Knox* in the forecited Place tells us, they are seiz'd with at certain Seasons, which is known by the Efflux of a Liquor from their Jaws like Oyl, and which afterwards goes off of its own accord, I shall not determine; but 'tis probable to have been the latter, and that by this sign the Keeper did know the Disease. The said Mr *Knox* adds, that the Females suckle indifferently the young ones of others as well as their own. 'Tis reported of them, that they only bring forth one at once, tho' if it were not for the unanimous Assertion of all Authors, I would be ready to believe they bring forth more, for Reasons hereafter to be given; and that that one is about the bigness of an Hog, or as some say of an big Calf; which seems to quadrate with the Account of *Tavernier*, who tells us, that when the Merchants bring the *Elephants* to sell, the Children do usually leap upon their Backs, which could not be done were they higher. They are said to suck for 6 Years, or according to some 8; tho I rather adhere to the Opinion of those, who tell us, they quit their Dame at 6 Months, if it be true, that when they are brought forth, they both see and walk; for if so, they may as soon come to purchase their Food as Colts and Calves.

The Natural Food of the *Elephant* is Grass, and when that's wanting, they dig up Roots with their Tusks. This perhaps may be one of the Reasons, why the *Behemoth* is taken for the *Elephant*, because 'tis said to eat Hay like an Ox; but that, as *Bochart* tells us, is common to the *Hippopotamos* also. They are said to have a *Its Natural Food.*

great delight in Cucumbers and Melons, and a particular Inſtinct in avoiding whatever Herbs may be hurtful to them. Tis alſo obſervable, they will not go near any Graſs that has been trampled on by Men, for fear of Snares. When they are tam'd, they eat Hay, Oats, Barley, or ſuch other Food as Oxen and Horſes. It drinks a great quantity of Water, which it ſucks up by the Trunk, and whenever that's full, it emptieth it in the Mouth. It naturally affects muddy Water rather than clear: When Tame, it drinks clear Water well enough. When they are to go to Battel, they give them Spirituous Liquors, ſuch as Wine, *&c.* in order to make them drunk and furious, as appears from the Hiſtory in the third Book of *Maccabees*, Chap. 6.

Acuteneſs of Smelling.

It has a very acute ſenſe of Smelling, by which it readily finds out its Food. 'Twas pleaſant, that when they came to ſee the Creature, with Apples in their Pockets, it pull'd them out to the aſtoniſhment of thoſe who had them. I'm inform'd one of the greateſt Miſchiefs it got, was, when in the North of the Kingdom, being in an Hou e, next to which was another with a great deal of Corn in it, and the poor Beaſt being hungry, and ſmelling the Corn, beat up and preſt into a very narrow Door, where its Sides were very much cruſh'd, and they had much ado to get it out: And when at *Perth*, it beat up a Stable next to the Houſe where it was, and moſt induſtriouſly ſingl'd out the clean Straw from among the Dung that lay among the Horſes Feet.

Several Natural Functions of the Elephant.

I come next to give you ſome Inſtances of its Natural Endowments, the manner of taking it, and its wonderful Docility when Tame. *Pliny* ſays, that *maximum eſt Animal, proximumq; humanis Senſibus*; as appears in their Care of their Young, for they rather chuſe to loſe their own Life, than that they ſhould loſe theirs. They always go in Flocks, and the greateſt go foremoſt, and when they are to paſs a River, they lift the young ones acroſs upon their two Tusks, and twiſt the *Proboſcis* round about their middle; and make ſuch as are bigger go before them, the greateſt coming laſt; for did the greateſt paſs firſt, the River might chance to be ſo deep, that neither the leſſer ones could paſs, nor the bigger ſo readily aſſiſt them. When they paſs by any of their Dead, they cover the *Cadaver* with Branches of Trees, Graſs, or what elſe they can get. When any is wounded, the reſt take care of him, bring him Meat, relieve him from Danger, and run together to ſave him from the Hunter. When a Snare is laid for them, they ſoon perceive it; if it be a Ditch, he that's neareſt

halts,

halts, (as it were by an Instinct) which when the rest perceive, they immediately return with Fury upon the Hunter. *Tavernier Loco citato.* tells us, 'That being once deceiv'd, and having escap'd the Snare, 'they are very distrustful ever after; and when they get to 'the Wood again, they break off a great Bough from one of 'the Trees with their Trunk, with which they examine every 'Step they go, before they set down their Feet, to try if there be 'any hole in their way. When they go in Troops, if one of them perceives an Herb on which any Man has trampl'd, he pulls it up, and delivers it to the next, who smells it and gives it to a third, and so on till it come to the last, who makes a great Noise, upon which all go to flight, and retire to Hills, Mountains, Shady, and other less frequented Places, where when there is no more Grass, some dig up Roots, others go and pull tender Buds, Herbs and Leaves of Trees; and the first that finds any thing, returns and convenes the rest of the Flock, that he may communicate to them what he has purchased. When they are in a Battel, such as are wearied or wounded, return to the Multitude, and such as have been less expos'd, advance of their own accord. When they are to pass over a Ditch, one or more go down (according to the breadth of it) and stand across it, where making as it were the Column of a Bridge, all the rest stepping upon their Backs, pass over. When all have past, they bring him or them out after this manner: At the side of the Ditch one of them stands, and stretches out his Foot, which he that is in the Ditch takes hold of, by twisting his *Proboscis* round it; then the rest make haste and provide Branches of Trees, which they throw in, that he may the more easily step up upon them.

Their Love, Fidelity and Gratitude is wonderful: *Ælianus* tells us, when *Porus* King of *India* was subdu'd by *Alexander* the Great, he was wounded with several Darts, as was the *Elephant* he rode upon, who was careful to pull them out of his Master's Body with his *Proboscis*; and when he perceived his Master faintish by the loss of Blood, he gradually lean'd himself down, till he fell flat upon the Ground, that his Master might receive no damage by lighting off. There is also a Story related by *Athenæus*, of the Gratitude of an *Elephant* toward a Woman, who had done him some piece of Service: She laid her Child by him, when it was only Thirty Days Old, but afterward the Woman being Dead, he fell so in Love with the Child, that he could not endure it to be absent from him, being most uneasy when he did not see it; there-

Their Love, Fidelity and Gratitude.

Lib. 13.

therefore when at any time the Nurſe had ſatisfy'd the Child, ſhe laid it in a Cradle between his Feet; which if ſhe had not done, he would not eat any; but when ſhe did it, he would eat pleaſantly by the Child the whole Day. When the Child ſlept, he chas'd away the Flees with the *Proboſcis*; and when it cry'd, he would toſs or rock the Cradle, and thereby ſet the Child aſleep again. Several Inſtances of this Nature might be given from Authors, but theſe may ſuffice.

Wrath and Revenge.

Annal. Par.

But as their Love and Gratitude is great, ſo likewiſe are they ſubject to Wrath and Revenge. *Michael Glycas* tells, that when an *Elephant* at a time was brought into a Theater, he ſaw as he came along a Keeper of Wild Beaſts ſitting in the Market Place, whom in Paſſion he ſuddenly kill'd; and that the occaſion of this Revenge was, becauſe the ſaid Keeper about Ten Years before had ſtricken him with a Sword in that ſame Place. And *Acoſta* writes, that a Soldier in the Town of *Cochina* had thrown the Kernel of a Nut at an *Elephant*, which the *Elephant* took up, and carefully hid. Some Days after, the *Elephant* ſeeing the Soldier paſſing by, threw it into his Face, made a great Noiſe, and went away leaping and dancing. In that ſame Town another Soldier meeting an *Elephant* with his Keeper, would not give way to them, whereupon the Keeper complain'd to the *Elephant* of the Affront, who ſome Days after ſtanding on the River *Mangata*, which runs through the Town, and ſeeing the Soldier ſtanding idle, run haſtily toward him, liſted him up on the *Proboſcis*, and plung'd him ſeveral times in the River; after which he drew him out (having thus aveng'd himſelf) and left him where he found him.

The Metkod of taking them.

The manner of Taking them is; firſt, they dig deep Ditches, and cover them with Branches of Trees, *&c.* which, tho' the *Elephants* may ſometimes perceive, as is ſaid, yet they are frequently enſnar'd therein: When any fall in, the reſt are ready to throw in Branches of Trees, and ſuch other Materials as they can get, to ſee, if by any means, they can rid their Companion. Another Method us'd by the King of *Pegu* is, he builds Priſons for them of Wooden Pillars, at ſuch a diſtance as to ſuffer a Man to paſs, but not an *Elephant*; then he cauſes to be let go into the Woods ſome tame Females, whoſe *Pudenda* are anointed with a certain Oyl, for enticing the Male; and taking care that they do not copulate, they drive all together toward the Priſon, whence they convey the Females into Stables, which can contain no more but

but one at once; and the Males hot in purſuit are caught among the Pillars, and immediately ſome By-ſtanders lay acroſs Pales of Wood to hinder their Return. When they perceive the Cheat, they turn all in a Rage and Fury, and fall a groaning even to the ſhedding of Tears, and run up and down till they be all in a Sweat. When the Hunters deſign to put them in Stables, they let them ſee the Females again, whom they lead foremoſt, and the Males follow them to the intended place, which is ſo little, that it admits no more but one at once: Then they remove the Female, and tye the Male by the Neck to the Stall, till being wearied both by Hunger and Grief, they become more Tame, which is uſually after 8 Days faſting, and then the Keeper learns and manages them as he pleaſes. A third Method of taking them us'd by the ſaid King is this: He gathers a vaſt number of Men, by which he ſurrounds the whole Foreſt where the *Elephants* haunt, and having enclos'd them within a narrow bounds, he picks and chuſes ſuch as he has a mind for, and lets the reſt go. *Garzias ab Orta* ſays, that at one of theſe Huntings there were taken 4000, but that the King caus'd them all to be let go, except 200, leſt his Country ſhould be depriv'd of them. 'Tis memorable what *Edward Lopez* ſays he ſaw, that when a young *Elephant* was catch'd in one of theſe Snares, the old one run with violence (notwithſtanding of the By-ſtanders) to get it out; whereof being diſappointed, ſhe threw in Earth, Trees and Stones in ſuch abundance, that it fill'd the Ditch, and rather chus'd to deſtroy its own Brood, than let it fall into the Hands of the Enemy.

The manner of Taming them.

But if what Authors have told us of their manner of Taming be true, 'tis a wonderful Token of their Natural Sagacity. After they are taken, they hedge each of them in with great Rafters, till they be encloſed in ſo narrow bounds, that they can ſcarce have place to ſtand: Then they tye their Feet and Tusks ſo together, that they cannot move; their Keepers mount them, being girt about with two Ropes, and ſtriking with their Heels and Clubs, threaten to beat them, and to ſtarve them till they ſhould Die; but if they will be quiet and peaceable, they would be kind to them, anoint them with Oyl, and give them Meat and Drink in abundance. Then they take one of theſe wild ones, and put it in betwixt two Tame ones, and ſo confine it on both ſides till it be Tame enough. *Tavernier* tells, that he ſaw once two Wild *Elephants*, which had been lately taken, each of which had a Tame one plac'd on each ſide. Round about the Wild *Elephants* ſtood

ſtood 6 Men, every one having an half Pike in his Hand, and a lighted Torch faſtned at the end of the Pike, and talking to the Beaſts gave them Meat, and cry'd out in their Language, *Take it, Eat it.* The Food which they gave them was a little Bottle of Hay, ſome pieces of brown Sugar, and Rice boil'd in Water, with ſome few Corns of Pepper. If the Wild *Elephants* refus'd to do as they were bidden, the Men made Signs to the Tame *Elephants* to beat them, which they did, banging the refractory one with their Trunks on the Head and Forehead; and if he offer to make any reſiſtance, the others thwart him on the other ſide; ſo that the poor Beaſt not knowing what to do, was conſtrain'd to learn Obedience. 'Tis ſaid theſe Methods ſoon take with the younger ſort, but for the old ones they put them into big Houſes, and treat them very harſhly, by wounding them with Darts, and ſtarving them till they be half Dead; and then by gentle Methods and fair Promiſes they tame them. *Ælianus* ſays, when all other Methods prove ineffectual with an old one, they have a certain kind of Muſical Inſtrument, wherein they play their own Natural Tune, to which they become ſo attentive, that they are ſoon taken with the ſweetneſs of the Melody; and laying aſide their Wildneſs, begin to look to the Meat that's offer'd them, and tho' they ſhould take off the Fetters, forget their ancient rudeneſs, and fall to their Meat with Greedineſs and Appetite. 'Tis indeed very ſurprizing to think, they ſhould underſtand either Flattery, Threatning or Muſick, when Tame, and if when Wild they do it, 'tis much more ſo. However, that it is a moſt docile Creature the Accounts of all agree, and Authors tell you wonderful Stories of them, ſuch as their Dancing to a Pipe, and keeping Time, Leaping, Skipping, Gathering and Strowing Flowers, exerciſing Fuzee and Pike, like a Soldier, and caſting of Colours, playing a great many antick Tricks in Theaters, and even Writing too, and underſtanding Human Speech. When it is in Sorrow, it hangs the *Proboſcis* low to the Ground, and 'tis by the ſame it makes its Gladneſs appear. It is an Animal very deſirous of vain Glory, and very Proud, when finely dreſt and richly adorn'd.

A brief Deſcription of the External Shape of the Elephant.

But leaving this, I come to the more particular Conſideration of the Creature I am now treating of. I ſhall firſt take notice of its External Shape and Dimenſions, and then of its Internal Parts, with their Structure. That it is *Animal Vaſtiſſimum*, I ſhall readily acknowledge with *Franzius*; but that it is deform'd, ſince thoſe

due

due proportions laid down by the Author of Nature are as well obſerv'd in this as in any other Animal, I can hardly grant; for nothing can be deform'd but what ſwerves from a general Rule. It has a big ſhort Head, ſhort Neck, long Noſe, or *Proboſcis*, hanging almoſt to the Ground; a Back ſomewhat protuberant, a ſhort and round Body, a long Tail, four great round Legs, like ſo many Columns ſupporting ſuch a vaſt weight; and ſhort Feet, thoſe before being broader and rounder, and thoſe behind more long and narrow, each Shod with 4 Hoofes; a little narrow Mouth, with 2 long Tusks proceeding from the Upper Jaw, one on each ſide of the *Proboſcis*; 4 ſtrong Grinders in each Jaw; ſmall, yet piercing Eyes; and large flat Ears.

The particular Dimenſions of the ſtuff'd Skin.

The Dimenſions are as follow: At the fore Leg ſhe was 8 ½ foot high (A. A.) and 9 at the hind (B. B.) in length 10 foot (C C.) and a Tail 4 Foot 3 Inches long (C. D.) round the Belly 14 Foot (E. E.) from the top of the Head to the end of the *Prhboſcis* 8 Foot (F. F.) whereof the *Proboſcis* makes up 4 ½ foot (F. G.) from the Forehead equal with the Eye to the lower Jaw, meaſuring backward, 27 Inches (H. H.) from the top of the Head to the lower Jaw, meaſuring downward, 4 ½ foot (F. I.) The Ear was almoſt ſquare in this Subject, and ſmall in reſpect of thoſe in other Animals. Whether or not this difference might have been in regard of the Sex, I know not. 'Twas in lengh 19 Inches (K K) and in breadth 17 (L L.) The Eye (U) was not ſo ſmall as Dr. *Moulins* would have it; who ſays, they were no bigger in the Subject he treats of than thoſe of a Sheep; whereas in this they are larger than thoſe of an Ox. The diſtance betwixt them, meaſuring acroſs, was 26 Inches; between the *Anus* and *Vagina* 2 ½ foot; between the Dugs 1 foot. The fore Foot, meaſuring round the extremities of the 4 Hoofs, 3 foot 10 ½ Inches (N. N.) whereof the external Hoof running obliquely forward was 5 Inches; the ſecond on the outſide, ſquare before, was 5 Inches, and 6 in breadth, *i. e.* up toward the Skin; as was the third, ſquare alſo before, and 4 ½ half, (*c*) The Internal was more pointed than the External, and of the ſame length; the hind part of the Foot was cover'd with a tough thick Skin: The Diameter of the fore Foot, from the Right to the Left, was 14 ½ Inches; from before to behind, 16 ½ Inches. The Circumference of the fore Leg, at the Upper Joint, was 4 Foot 3 Inches (O. O.) At the Articulation of the *Carpus* 2 foot 6 ½ Inches (P. P.) the Circumference of the hind Foot, round the Hoof, 3 foot 4 Inches (Q. Q.) Its

Diameter from behind to before, 16 ½ Inches; from the Right to the Left, 12 Inches. The breadth of the outer Hoof, 4 ½ Inches (*b.*) the fore Hoof being Semicircular, 3 ½ Inches, (*a.*) the third and fourth Hoof 4 Inches each; both inner and outer Hoof go obliquely forward. The Circumference of the hind Leg is 2 foot 7 Inches, (R. R.) Thus you have the Dimensions of all its External Parts, taken either from the Body, when it lay Dead in the Field, or since from the Stuff'd Skin, wherein for the most part they agree; only that by reason of drying, the Legs are smaller, and the Back not so protuberant.

The Cuticula *and* Cutis *describ'd.*

Now I come to consider the *Cuticula* and *Cutis*, being the first subjected to Enquiry. Dr. *Moulins* has already at large insisted most judiciously on both, and indeed he had good Opportunity to do so; for he had the choice of any part of the Skin he pleas'd, (to view its Structure) that was not defac'd by the Fire; whereas in our Subject, the chief endeavour of Provost *Yeaman* being to preserve the Skin whole, in order to Stuff it, (which is now done to so good purpose and so lively, that it is become a most curious Ornament, as the Figure after the Original, which now stands in our Hall, doth represent) I had not an opportunity of making tryal upon any of it green; for on the *Monday*, while I was oblig'd to go out and take care of the Bones, the Workmen were busied in salting and preparing it, and afterwards I had not time: So that what Accounts I can give you are taken from it, as it now stands dry. But that I may give you all the satisfaction I can, I shall transcribe what of Dr. *Moulin*'s Account I find agreeable to that I see in this Subject, and add my own Observations.

Dr. Moulin's *his Account of the Scabs.*

He says, 'he found the *Cuticula* cover'd all over with a strange 'sort of Scab, in many Places resembling old Wrats, deeply jagged, 'and the carnous Fibres of the Muscles of Beef when much boil'd 'and transversly cut, but of a dirty tawny Colour. These Scabs '(if they may be so call'd) both slit and look like short pieces of 'Whale-bone; they did so firmly stick to the *Cuticula*, that they 'could not be pluck'd from it, nor the Parts of which they con-'sisted (tho' they were much divided) from one another, with-'out tearing it, and yet the *Cuticula* was very tough and 'thick.

This

This is very lively expreſt, and Anſwers exactly to what I find in this Subject. He goes on, and ſays: 'The length of theſe 'Scabs was in ſome above $\frac{1}{3}$ or $\frac{1}{4}$, but in other places not above '$\frac{1}{10}$ or $\frac{1}{12}$ of an Inch. The cauſe of which difference, he takes 'to be the *Elephants* wearing, by rubbing or lying, ſome Parts of 'them, while others were ſlightly, or not at all worn. *Their length in his Subject.*

The Scabs of this Subject were not ſo long; for as the deepeſt I could find upon the *Cuticula* was not above $\frac{1}{6}$, ſo the thinneſt was leſs that $\frac{1}{16}$ of an Inch; but that is not material. As to his Reaſon why they are thicker in ſome Parts than another, tho' it may ſeem pretty good, yet I ſhall offer another by and by, as a no leſs probable Conjecture. *In ours, Tab. 3. A. B.*

He ſays, 'He could find but very few Hairs without this Scab, 'but many within, and even with it. The *Elephants* Inclinati- 'on to Itch, and to rub himſelf againſt whatever came in his 'way, kept thoſe Hairs that were even with the outſide of the 'aforeſaid Scab, from appearing of any conſiderable length. The 'hardneſs of the Scab, by keeping the Roots of the Hairs faſt, 'did very much contribute to their wearing on the outſide, as 'well as to their Preſervation on that within. *The Hairs in his.*

In our Subject the Hairs are every where pretty long, ſome 2, ſome 3 Inches; others (in Places moſt Subject to Rubbing, as the Doctor obſerves) but 1 or $\frac{1}{2}$ Inch, tho' indeed not ſo numerous as I find. There are Paſſages for them through the *Cuticula*. I know not what the Doctor means by diſtinguiſhing between thoſe found in the *Cutis*, and thoſe in the *Cuticula*, ſince I am convinc'd all ariſe from the *Cutis*, and penetrate the *Cuticula*. They are indeed black, and many of them ſtiffer and thicker than thoſe in an Hog. As he by the Fire had occaſion to obſerve ſome pieces of the *Cuticula* rais'd from the *Cutis*, ſo the Skin of this Subject is in many Places depriv'd of it, eſpecially where the Beaſt lay moſt in the Water at its Death; and ſince theſe are means whereby to ſeparate the one from the other, this may give occaſion to enquire by what means they adhere: But I muſt firſt conſider the Structure of the *Cuticula*, and then of the *Cutis*. You know ſome have taken the *Cutis* to be nothing but a certain Cruſt form'd of ſeveral Mucilaginous Particles, obducing the *Cutis*, &c. in the *Uterus*; which after the *Fœtus* is come to greater maturity, is condens'd and form'd into a Skin, ſuch as we ſee *Mucilages* and *Pulteſes* have, when after boiling they are expos'd to the Cold: Others, that the *Cuticula*, as well *In ours. The Structure of the Cuticula.*

as *Cutis*, is compos'd of a *Congeries* of *Membranous Fibres*, intermixt with a great many *Capillaries*, and endued with Pores fit for Perſpiration: And there are Anatomiſts who aſſert, they have injected theſe Cutaneous Veſſels in the *Cuticula* of a *Fœtus*, as well as in the *Cutis*; tho' when the Animal is more adult, theſe *Capillaries* not only eſcape the view of the naked Eye, but even of Opticks. That this has been the Structure of the *Cuticula* in this Animal, is moſt plain and obvious; for tho' I cannot determine its thickneſs, as Dr. *Moulins* might have done in a recent One, yet now as it is dry, it ſeems to be of the thickneſs of, or rather thicker, than common Vellum, with its inner Surface excavated, as you ſee a Woman's Thimble, (the Holes being much about the ſame Bigneſs, and diſpos'd regularly) or in an Honey Comb. Among the Interſtices of theſe Excavations, the Ramifications and Divarications of the Blood Veſſels are obvious. At *Tab.* 3. A. every two Lines or $\frac{1}{6}$ of an Inch diſtance, for the moſt part are to be obſerv'd Protuberances compos'd of 5, 6, or 7 Columns joining, and making up a Pyramid or Cone; in the top whereof is the *Pore* or *Ductus*, mention'd by Dr. *Moulins*, through which the Hairs paſs; they are nothing but the Interſtices of the *Favi*, (ſo to call them) or Depreſſions. which ariſe in the *Cuticula*, and are impacted in the *Cutis*, for the better Reception of the Hair. And 'tis probable, that all the Hairs are cover'd over with thin Membranes, as Dr. *Moulins* obſerves, from the Extremity of their Roots to the *Cuticula*; becauſe having pull'd out ſeveral of the Hairs, I ſaw them included within their proper *Involucra*, and doubt not but it was ſo with all the reſt too, beſide the common one which is both contiguous and continuous to the *Cuticula*. The Hairs are more looſe, and the Pores more patulent and obvious in the *Cuticula* now dry'd, than I ſuppoſe they were when recent; but whether theſe Pores were alſo deſigned for Separation of Vapours by Perſpiration, or only to contain, and convey the Hairs planted in the *Cutis* through the *Cuticula*, is what *The Cauſe of the Scabs.* I ſhall neither contradict not affirm. To the outſide of this *Cuticula* are adherent the Scabs, which I rather take to be a Supervenient Diſtemper incident to this Animal, when out of its own Climate, occaſion'd by the Conſtriction of the Pores from Cold, than any wiſe Natural to it: And to this the Accounts of all Authors agree; who tell us, that there are two kinds of them, one of a more dark Colour, and another duskiſh and ſad, having both their Skins of a very ſmooth and polite Surface; where-

fore

fore the Keepers of this *Elephant* with us, call'd it the *White Elephant*, in oppoſition to the black ones; whereof *Horace*, in the forecited Place, ſays, *Nigris digniſſima Barris*: But after they are affected with the Scab, this Diſtinction of Colours is not obſerv'd. Authors tell us, as you have heard, that the firſt thing they do when they begin to Tame them, is to anoint them with Oyl, whereby they keep their Skin ſmooth, ſoft and flexible, and relax their Pores ſo, that whatever groſs Particles may fly off from their Blood, whoſe Conſtitution is now perhaps worſe by the alteration of Dyet, and hardſhips they undergo at taming, may not ſtick to the Skin, but freely be evaporated. And I am credibly inform'd by ſuch as have liv'd long in the *Indies*, that they take as much care to keep the Skins of the *Elephants* ſmooth and clear, as we do with our fine Horſes. Since then theſe Scabs are a Diſeaſe, and not Natural to the Animal, it is reaſonable I ſhould enquire into the Cauſe of them; which to me ſeems to be *à Craſſitie & Viſcoſitate Sanguinis*, whoſe Particles, becauſe of obſtructed Pores, by a Cold too exceſſive for their Body, do not ſo eaſily fly off; but after they have paſt the *Cuticula*, go no further than its Surface; and becauſe of the *Viſcoſity* of their Texture, do ſo cleave to and heap upon one another, that they appear under the form of a Scab; which by the Evaporation of the more humid Particles, harden by degrees, and by the heat of the Sun are crack'd, rent, and divided: That Coldneſs of the Weather will occaſion groſs and viſcuous Blood, there's none acquainted with the Diſtempers in theſe Northern Countries will readily deny; nor that moſt of theſe Diſtempers proceed from the Obſtructions of *Capillaries* and *Pores*, and that this may be the cauſe of theſe Scabs. I offer only this one Experiment; whatever Pieces of the *Cuticula* I obſerv'd, where the Scabs were thin, there the *Favi* or Depreſſions were large and conſpicuous; but where they were very thick, there the *Favi* were very ſmall, and almoſt imperceptible; which plainly implies, that wherever theſe Particles avolate freely, few adhere to the Surface of the Skin; but when their Force is inhibited by the ſtrictneſs of the Pores, they are unable to remove any further than they adhere to, and augment the *Moles* of the Scab. Theſe, as is ſaid, are divided from one another by ſeveral *Rimæ*, or Rents, which may either be occaſion'd by the afore-mention'd heat of the Sun, or by the different Poſture the Skin is put in by the ſeveral Motions of the Body. Hence it is, that where the Skin

The Scabs divided into ſeveral Rimæ.

Skin is moſt wrinkled, theſe *Rimæ* are moſt frequent. It may be ſaid, that this Reaſoning ſeems to contradict what Dr *Moulins* has aſſerted, *viz.* That this Animal has a very ſubtile Blood, abounding with a penetrating Urinous Salt; which he proves from the Vivacity of the Species, from the Urinous *Effluvia* whieh affected his Noſtrils, and from the ſmarting of his Finger by the Blood, after it was cut. As to the firſt, that it is a very Vivacious and Spirituous Animal, both the foregoing Relation and the Account of all Authors make it apparent; but that does not hinder its Blood from being incraſſated by Cold and bad Dyet, nor that theſe Scabs may proceed from this groſs Blood. As to the ſecond, tho' he might have been ſenſible of an abounding Urinous Salt in that Animal, it does not follow it ſhould be ſo in all, and I am apt to believe it was extraordinary; for without doubt ſuch a burning as the poor Beaſt underwent, even to its Death, muſt have alter'd the Conſtitution of its Blood, and made it quite different from what it was; and 'tis probable, that it was at ſuch places, as were moſt affected with the Burning, where he felt this Urinous Smell, and the ſmarting of his Finger. For my part, I obſerv'd the Blood of this Subject to be Styptick and Reſtringent: So that when my Hands were imbru'd in it, I could ſcarce bend a Finger; which Effect I have alſo perceived at the Diſſection of Fiſhes, which all acknowledge to have viſcuous Blood. But it may be objected, that this our Subject dying *Morbid*, and of a languiſhing Diſtemper, the Blood of the one might be groſs and viſcuous, and yet that of the other Spirituous and Subtile. I ſhould be ready to acknowledge the Objection to be valid, if I did not underſtand both were affected with the ſame Scab, and by what appears, the other ſeems to have been more than this.

The Constitution of the Elephant's Blood.

I proceed next to the *Cutis*, whoſe inner Surface Dr. *Moulins* obſerv'd 'To abound with a great many Glands; when cut 'through, at leaſt as far as the Roots of the Hair went, it was 'like the horny or callous part of Brawn, and its outer Sur'face abounded with a great many *Papillæ*. As I ſaid, I had not opportunity to obſerve any of theſe; but am apt to believe all to be true: And firſt, as to the *Papillæ*; I told you already, that the *Cuticula* was endued with a vaſt quantity of *Favi*, or Depreſſions, wherein I doubt not but theſe *Papillæ* were receiv'd, tho' the Surface of the *Cutis*, as now dry'd, is ſmooth; and where the *Papillæ* ſeem'd to have formerly been, there are now rather De-

The Structure of the Cutis.

Depreſſions than Protuberances. This is an Argument that there has been ſome kind of Liquor contain'd in theſe *Papillæ* or Veſſels, as I may call them, which at the drying of the Skin is evaporated; and therefore I ſuppoſe this brawny part of the *Cutis* to be a *Congeries* of *ductus excretorij*, running in a Parallel Line from theſe Glands to the Veſicles, and conveying the Liquor to be contain'd in them, till it be evaporated by Perſpiration; and theſe Veſſels ſeem to have been both ſo big and numerous in this Animal, that they make up at leaſt two parts of the inner Surface of the *Cuticula*; the Blood Veſſels and the Depreſſions together ſcarce make up a third part. They ſeem alſo to be lodg'd in the *Cutis* by the one half, and in the *Cuticula* by the other; for in ſome Places of the *Cutis* I obſerved the Depreſſions as numerous, and ſeemingly Parallel to thoſe in the *Cuticula*; and that, notwithſtanding the *Membranulæ*, where the Humour was included, which now being dry'd and collaps'd, may take up ſome Space in the Depreſſion of the *Cutis*. By this Account both of the *Cuticula* and *Cutis*, I come to enquire Firſt, how the one ſhould ſo firmly adhere to the other, when there ſeems to be no Communication by Fibres betwixt them, as appears by their eaſy Separation both by Fire and Water: Secondly, how conſiderable the Perſpiration may be. As to the Firſt; ſince the *Cutis* and *Cuticula* are two diſtinct Membranes, their Coheſion ſeems to be mutual: Firſt, theſe Pyramids, which receive the Hairs, are impacted in the *Cutis*, and cloſely ſurround their Roots; and then theſe *Papillæ* are impacted in the *Cuticula*, which ſo long as they are diſtended with the humour fit for Perſpiration, will not readily quit the Depreſſions in the *Cuticula*, unleſs the Humour be ſuddenly evaporated by Fire, or the Sides of theſe Depreſſions or *Cellulæ* be relax'd by Water; and there may be a certain Viſcoſity which obduces the Surface of both, as it were ſo much Glue, which either the Fire may dry up too much, or the Water dilate; ſo that the one can be ſoon ſeparated from the other, and the Hairs either be pull'd from their place, or quit their common *Involucrum*. As to the ſecond, *viz.* The Perſpiration, I ſhall offer no other Calculation than what is already made by Dr. *Moulins*: He ſays, 'the Pores muſt be both numerous and 'large for Perſpiration, eſpecially if we conſider *Sanctorius* his 'Statical Obſervations of a Man's inſenſibly perſpiring in a Win-'ters Day $\frac{3}{50}$. and upwards; which is ſomething more than $\frac{1}{54}$ of 'an ordinary Man's weight, ſuppoſing him to be 170 lb. and

at

' at this rate we muſt ſuppoſe an *Elephant*'s Perſpiration to be ' vaſtly more; but (as he ſays) 'tis probable, the Scabs might ' bar it from bearing proportion to that of a Man's: So that whatever the *Elephant* might have perſpir'd in an healthly State, we may reaſonably ſuppoſe it to do much leſs, when attacked with this Diſeaſe; which may be another Argument for the *Craſſities & Viſcoſitas Sanguinis*, wherewith I alledg'd this Animal I diſſected, was endu'd.

I can determine nothing about the thickneſs of the Skin, while recent; but as it is dry, by an Inciſion made upon one of the Hips, it appears to be leſs than ¼ Inch, and of Subſtance not unlike to *Engliſh* Bend or Sole-Leather.

The Cutaneous Veſſels. I had no opportunity to obſerve, whether there were any Cutaneous Veſſels, but doubt not but there have been of them, and that in abundance; 1. from the numerous *Glands* diſpers'd all over its inner Surface, which muſt have had Blood Veſſels inſerted in them; and 2. from the abundance of *Ramifications* diſpers'd in the *Cuticula*, proportionable to which, it is probable, they were alſo in the *Cutis*.

Panniculus Carnoſus. I can ſay nothing about the *Panniculus Carnoſus*, neither am I fully convinc'd of what is related by Dr. *Moulins*, *viz.* That this Animal kills the Flies, by putting itſelf ſuddenly in a Poſture to wrinkle the Skin on that ſide that is attacked by them; ſo that the Cracks are forc'd cloſe together, and the Flies bruis'd; for 'tis hard to conceive ſuch a big Animal ſhould all on a ſudden be ſo nimble. I rather believe, that the *Proboſcis* from before, and the Tail from behind, may ſupply the defect of the *Panniculus Carnoſus*, (if it be wanting:) For if we conſider the length of each, we ſhall find they come near to meet about the middle; for the Body of this Subject being 10 foot in length, the *Proboſcis* and Tail make up between them near 9 of it; and what is wanting, the Air, by the force of their motion, is enongh to expel the Flies, even when without their reach.

Fat. As to the *Fat*, whether by reaſon of the extraordinary Leanneſs of this Subject, or if it be ordinary for *Elephants* to be endued but with little of it, I know not, but I could not have believed ſo little Fat to have been in any Animal as was here; for beſide that there was neither a *Membrana Adipoſa*, or conſpicuous *Omentum*, there was not one Grain of Fat, either among the Interſtices of the Muſcles ſurrounding the Kidneys, nor round the *Anus* and *Vagina*, where 'tis uſually found; and what is more, when

when I had ſpent near a whole Day in boiling the Bones in a Dyers Veſſel, without changing the Water, except that I ſupply'd what was evaporated, there was not ſo much as a Drop of Oyl that did ſwim upon the Liquor.

Dr. *Moulins* takes Notice of a very ſtrong Nervous Membrane, (which I ingenuouſly confeſs I had not time to remark, and therefore you have it in his own Words) which obliquely deſcended from the *Spina Dorſi* to the *Sternum* and *Linea alba*. 'This Membrane was very tough, and near as hard to be cut as Whale-bone of the ſame thickneſs; which all along the Back-bone was about $\frac{1}{6}$ Inch, but nearer the end I try'd it, the thinner I found it. This Membrane ſeem'd to terminate in the *Linea alba*, as the Tendons of the Muſcles of the *Abdomen* uſually do. Its Nervous Fibres were very diſtinguiſhable, and might eaſily be ſeparated throughout their whole length. This doubtleſs was to ſtrengthen the Creature, and perhaps that the weight of the *Viſcera* contain'd in the *Abdomen*, ſhould not diſtend the *Peritonæum* and Muſcles adjoyning, ſo as to let them hang lower than was convenient. A like piece of Mechaniſm you may remember I communicated to you not long ago, in my Obſervations made upon the Diſſection of a *Porpeſs*. *Dr. Moulin's Account of the* Membrana Nervoſa.

After the Skin was wholly remov'd, there being no Time to examine all the Muſcles of this huge Body, I apply'd my ſelf particularly to thoſe of the *Proboſcis*, as being of greateſt Moment. Wherefore the Body being Supine, I firſt conſider'd the Neck, and upper or fore-part of the *Sternum*, where I obſerv'd two Pair of Muſcles to ariſe ſharp and fleſhy; whereof two in the middle, from a ſmall Origin, were extended into large Muſcles, running ſtrait forward, and diſtinguiſh'd from each other by a white Line, till they came to the point of the lower Jaw; their other ſide running obliquely outward, till they came over againſt the Articulation of the Lower Jaw with the Upper: From thence keeping the lower part of the Lower Jaw, they return'd to the foreſaid point, in Figure not unlike the *Cucullaris* in Human Subjects, with their Fibres running obliquely forward from this middle Line toward their external part. This Pair ſerv'd to draw back the Lower Jaw, and like the *Platyſma Myoides*, cover'd all its other Muſcles, with thoſe of the *Larynx*, Tongue, and *Pharynx*. On the outſide of this Pair aroſe two other Muſcles, ſmall at their beginning, and in their Progreſs paſſing in betwixt the *Os Zygomaticum* and Scull, adhering to the *Muſculus Temporalis*, and *Deſcription of the Muſcles of the* Proboſcis. Retractores Prob. cidis.

 ak end-

aſcending run up below the *Meatus Auditorius*, half way betwixt the Orbit of the Eye and Top of the Head; where becoming very thick and round, it paſt over a ſharp Angle of the Scull toward the Forehead; whence deſcending from above the Eye, it came, and with its Partner fill'd up that hollowneſs in the *Os Palati* (k.) and coming ſtill lowe, made up the back part of the Trunk or *Proboſcis*. Afterwards the Body being turn'd over, I had opportunity to ſee the *Tax Wax* mention'd by Dr. *Moulins*; which ariſes from a *Spina* in the back part of the Scull (c c.) whence running backward along the Sides of the ſeven *Vertebræ* of the Neck, it terminated betwixt the 6th and 7th *Vertebræ* of the Back, becoming ſtill thinner in its Progreſs. It was about ſix Inches broad, pretty thick, and deſcended obliquely from the Top of the *Spinæ Vertebrarum* to above the Ribs, and cover'd all the Muſcles which ariſe from the Neck, and ſupport the Head; aſſiſting them, (as Dr. *Moulins* rightly obſerves) becauſe the Heads of Quadrupeds, eſpecially of this Animal, being more pendent, have more need of Supporters than the Head of a Man, where this Contrivance is wanting. Dr. *Moulins* tells us, that it was plac'd edgewiſe; the Reaſon of which may be, becauſe of the *Spines* of the four firſt *Vetebræ* of the Back, which are 4 Inches broad; whence the *Tax-Wax*, running forward (where the Spines are narrow, or where there are no Spines at all, as in the three firſt *Vertebræ* of the Neck) in a ſtreight Line to the Scull, the ſpace below it for the Muſcles to move in, muſt be the ſame at the Neck as at the *Spina*, where the *Epiphyſes* keep their Upper Sides at ſuch a diſtance. From above this *Tax-Wax* in the Neck, do ariſe two Muſcles, thinner and narrower at firſt, but thicker and broader as they go to the Scull, where they firmly adhere to the Sides of a large *Sinus* in its back-part (b b.) whence aſcending, being lodg'd in the Depreſſion upon the top of the Head, and betwixt the Eminencies (d d.) they deſcend till they come over againſt the Hole for the Root of the Trunk (a.) and become thicker and round, and in their whole Deſcent make up the forepart of the Trunk with extremity.

Tab. 3. *Fig.* 1.

Tax Wax. *Fig.* 6.

Elevatores Proboſcides. *Fig.* 6. *Fig.* 1.

Thus you have the *Proboſcis* trac'd from its Origin; *viz.* That 'tis compos'd of two Pair of Muſcles; one whereof makes up its back-part, which ariſes from the *Sternum*, and paſſes with ſtreight Fibres in below the *Os Zygomaticum*; and from thence forward, till it makes up the Body of the Trunk itſelf. Another Pair, which ariſing from the Neck paſſes over the Head, and deſcending makes

up

up its forepart. The Fibres of this Muſcle deſcend in a ſtreight Line, till they make up the Body of the Trunk, and then begins a ſtrong tendinous Interſtice, by which they are ſeparated from their Copartners; whence their Fibres deſcend obliquely to another ſtrong Interſtice, by which on each ſide they are ſeparated from their Antagoniſts, where the ſame oblique Courſe of Fibres is again to be obſerv'd, that is to ſay, that the *Erectores Proboſcidis*, (for ſo we may call theſe which make up the forepart of the *Proboſcis*) (g g) unite in a tendinous Interſtice (c c) *Fig.* 7. from whence the Fibres on each ſide obliquely deſcend: So likewiſe the *Retractores Proboſcidis*, for ſo we may call theſe which make up the back-part of the *Proboſcis*, have their tendinous Interſtices running down the middle of its back part; from whence the Fibres obliquely deſcend, almoſt making an Angle of a *Demirhombus* on each ſide in another longitudinal tendinous Interſtice, whereby the Fibres of the antagoniſt Muſcles are conjoin'd.

Thus you ſee a wonderful Contexture of 4 Muſcles, ſo contriv'd as to perform all kind of Motions; for as either in the *Femora* or *Humerus*, from Flection, Extention, Adduction and Abduction, proceeds a circular Motion; ſo here when the Elevator and Depreſſor, or Retractor act together on either ſide, then there is a lateral Motion: And when the Congener *Elevatores* and *Retractores* act, then there is either Elevation or Depreſſion; and from theſe two, with lateral Motions on both Sides ſucceſſively perform'd, proceeds a circular Motion. But this is not all; we ſee that any part of the Trunk, either Root or Extremity, or both at once, can be bended either upwards or downwards; and this I conceive is perform'd after this manner. Theſe Fibres thus obliquely ſituated, are divided into ſeveral *Faſciculi*, which are ſeparated by ſeveral tendinous Interſections; and that at the beginning of each Interſection, there is a conſiderable Branch of a Nerve from the hard Portion, inſerted, by which one, two, or more of theſe *Faſciculi* may be ſet in Motion, without any other part of the *Proboſcis* being concern'd.

Dr. *Moulins*, and not unfitly, calls the *Proboſcis* a Prolonged Noſe, both from its Situation and Uſe in Smelling and Breathing. And I think I may with good Reaſon make an Analogy betwixt it and the Tongue: For beſides there is a great Affinity betwixt the Smelling and Taſting, ſince what's unpleaſing to the Noſe, cannot but nauſeate the Tongue and Palate; inſomuch, that the Noſe may

be call'd a Taster to the Taste: They likewise agree in this Animal, by reason of the Diversity of Motions in both, and few Muscles that perform them, tho elegantly express'd by the famous *Bellini*: '*Quis credat*, says he, *huic tantummodo Universæ* '*Linguæ* (*Proboscidi*) *munia deberi, ita ut pauciſſimis donata Muſ-* '*culis innumeras prope dixeram obire Motiones*; *Extenditur, Contra-* '*hitur, Dilatatur, Exeritur, Atollitur, Deprimitur, Incurvatur, modò* '*in Cavum aptat ſeſe, modò in Convexum, modò uſque ad Palati For-* '*nicem* (*Surſum*) *erigitur, modò ad Frænulum uſque* (*Deorſum*) '*reflectitur, quandoque Duplicatur, aliàs Extenuatur, modò tremit.* By which only the Variation of *Proboscidi* for *Linguæ*, *Surſum* for *Uſque ad Palati Fornicem*, and *Deorſum* (that is downward, when it is brought in betwixt the Fore-Limbs, or conveys any thing to the Mouth) for *Frænulum uſque*, all the Motions of the one are compatible to the other. And *Schotto* gives a brief Account of the Motion of the *Proboscis*: '*Circumvolvit eum undique & max-* '*ima cum celeritate, eâ capit Potum & Cibum atque in Os mittit*; '*nam Proboscide non edit, ſed Ore*; *nec Ore nec edere aut bibere* '*poteſt abſque Promuſcide*; *hinc Manus Naſuta vocatur. Suo enim* '*Rectori erigit & offert ut conſcendat*; *eâ Arbores proſternit*; *eam,* '*cùm Aquis immergit, erigit*; *eâque reflat atque reſpirat.* Now to make a further Analogy with the Tongue and it: As the *Geneogloſſis*, by lengthening its Fibres from the fore and inner part of the Lower Jaw, whence it ariſes, to the Root of the Tongue, where it is inſerted, ſtretches it forth; So the *Levatores Proboſcidis*, by lengthning their Fibres from the *Tax-Wax* all along the Top of the Head to the Root of the Trunk, ſtretches it forth alſo: And as the *Retractores Proboſcidis* can very well perform the Motions of pulling it in, *Analogous* to the *Styloglosſis*; ſo the two Antagoniſts on either ſide can pull it to the adverſe ſide, that it may perform the Actions of the *Ceratogloſſis*, while the Congener *Retractores* can pull it to that ſame ſide, where they act, as is ſaid. When I ſay, that the Fibres from before and behind deſcend obliquely from the tendinous Inſertions at the middle to thoſe at the ſide, I do not mean that they run ſimply ſo, but that the Fibres of each Muſcle are diſpos'd into different *Strata*, and that theſe *Strata* do interſect each other, like Lozenges, or as we ſee the Fibres in the *Muſculus oblique Aſcendens* interſecting thoſe in the *Muſculus oblique Deſcendens Abdominis*, and ſo on; that is to ſay, whereas one Series of Fibres ſeems to deſcend obliquely, the next underneath that aſcends again, and ſo contin-

Mirab. Animal. Terreſt. lib. 8.

nues

nues throughout the whole thickneſs of each Muſcle. As to the circular Fibres ſpoken of by Dr. *Moulins*, I do not know I ſaw any, neither do I think them neceſſary for pulling up the Trunk, or diminiſhing it as to its length: For the great diſtance betwixt the Origin of theſe Muſcles, and their Inſertion at the Extremity of the Trunk, the longitudinal Poſition of their Fibres till they come to make a part of it, and the ſpace they have to act it, and to ſmell their Belly, and their oblique Inſertion in theſe tendinous Lines, may be look'd upon as ſufficient to perform this motion; and 'tis obſervable for this end, that the Skin is divided into ſeveral *Plicæ* or *Links*, as we ſee in a Worm, when ſhe draws up and ſhortens herſelf. Thus I conceive the forenam'd *Faſciculi* may at the beginning extreamly begin to be contracted, then the *Faſciculi* next to them, and ſo in order till they come to the Root of the Trunk; by which ſucceſſive Contractions the Bellies of all the Muſcles begin to ſwell, and ſo their Fibres diminiſh as to their length: And there needs no more for ſtretching forth the *Proboſcis* thus contracted, but the Fibres to reſile to their former Poſition; which it may do with the ſame ſwiftneſs, as we ſee a Bow doth by its Elaſticity when once it is ſhot.

The Cavities of the Proboſcis.

Theſe Muſcles ſurround two large Cavities 2 Inches Diameter from the Right to the Left, and 3 Inches each from above to below, about the middle of the *Proboſcis*; for as they proceed from the Scull they are very wide, according to the Capacity of the Hole in the fore part of the Scull, whence the *Proboſcis* proceeds; of which hereafter. They are divided by a ſtrong *Cartilaginous Septum*, which runs ſtreight from before to behind, along the middle of the *Proboſcis*. This is the *Septum* whereinto the Muſcles ſituated in the fore and back part are inſerted. Theſe Holes are Cartilaginous, all round obduced with ſeveral Nerves, whereof hereafter; and endued with a great many Glands for ſeparating a certain *Mucus*, wherewith the inner Surface is always bedew'd, to keep it moiſt and preſerve it from injuries of the Air it ſucks in at Breathing. Theſe two Cavities are of great uſe, for they draw up and contain as much Water as ſerves the Animal at once, which afterward it emptieth into the Mouth, as it were from a Tunnel: They ſerve alſo for Breathing, Smelling, and uttering the Voice. The *Proboſcis* is not equally great, but from 38 Inches in Circumference at the beginning, it becomes gradually ſmaller till it be 20 Inches at the middle, and at the Extremity 11 Inches. It has an hollow Cartilage, where-

theſe Paſſages terminate. Round this is a Cartilaginous Margin, which extends itſelf 1 ½ Inch before, and terminates in a Point; and behind it has, as it were, an hollowneſs, wherein this Point fixes itſelf, and takes hold of any thing, as it were a Thumb paſſing in betwixt two Fingers, and keeps it during Pleaſure. This Cartilage is of great Strength, and by it the *Elephant* can take up any thing of great weight.

Tab. 3. *Fig.* 13.

Its Blood Veſſels.

I come next to examine the Veſſels and Nerves of the *Proboſcis*. I do not find this Animal endu'd with any particular Veſſels for this part; but theſe here, Analagous to thoſe in other Animals, ſeem to be adapted for peculiar Uſes. In ſearching for the Origin of the *Proboſcis*, and how it proceeded from the Head, I ſeparated the *Relevatores Proboſcidis*; below which I obſerv'd four conſiderable Blood Veſſels, a Vein and an Artery from each ſide, lying upon and deſcending in a ſtreight Line above the aforemention'd Cartilages, and diſperſing their Branches *hinc inde* throughout the Subſtance of the Muſcles, with two large Nerves accompanying them. I had not time to trace their Origin, but do offer theſe probable Conjectures about them. The External Carotid Artery, which furniſhes Blood to the Muſcles of the Face and lower Jaw, has already ſuffer'd ſo many Diviſions and Subdiviſions in the vaſt Maſs of large Muſcles in this Animal, that 'tis not probable there ſhould yet remain a Branch ſo large and of ſo ſtreight a Courſe, as to be thus diſtributed in this part; and the Capillaries of the External Jugular are uſually ſo diſperſed throughout the extream Parts whence it receives the Blood, that 'tis not to be ſuppos'd they ſhould ſo ſoon form ſo conſiderable Branches, and theſe again unite into one Trunk at ſuch diſtance from the *Baſis* of the Scull, where the two Jugulars are conjoin'd: And beſides this, the Situation of the Carotid Artery and Jugular Vein is ſo low, and thoſe Branches I ſaw were ſituated ſo high, that I can ſcarce think the one proceeds from the other. It remains then, that I ſhould enquire from whence they come. 'Tis obſervable both in Human Subjects and Quadrupeds, that there is an Hole below the Orbit of the Eye in the *Os Maxillæ Superioris*, through which the Superior Branch of the ſecond Diviſion of the 5th Pair of Nerves paſſes, ſurrounding in its Progreſs a Vein and an Artery; all which are diſperſed in the Muſcles of the Cheeks, Lips and Noſe, and furniſh Branches for the Roots of the Teeth of the Upper Jaw. This Hole is not ſo conſiderable in Human Subjects, but larger in Quadrupeds, eſpecially

ally ſuch as feed upon Graſs or Hay; inſomuch, that by the bigneſs of this Branch of the 5th Pair in an Oxe or Hart, we may reaſonably conjecture they have a partial Taſte, and a moſt acute Smell by the Upper Lip, the better to enable them to chuſe their Food: For at the Diſſection of a Calfs Head, you'll perceive both this Nerve and the Blood Veſſels much bigger than what might be thought requiſite for furniſhing either Blood or Spirits to this part, were there not ſome extraordinary uſe for both. Now in this our Subject there is an Hole in the *Os Maxillæ Superioris* (u) Fig. 1. (m) Fig. 2. (8.8.) Fig. 3. ſo remarkable for its bigneſs, ſo commodiouſly ſituated, and ſo well guarded, that I have good Reaſon to believe it may be deſigned for Tranſmiſſion of the afore-mentioned Artery, Vein, and Nerve, and that all theſe are diſtributed into the Trunk: For if we conſider the largeneſs of this Hole for this Branch of the 5th Pair, as it is to be ſeen in the inner Surface of the *Baſis* of the Scull, whoſe Capacity is ſuch as to contain a Nerve of above twice the bigneſs of what we ſuppoſe it to have been; if we again conſider the *Crena* (x x) which paſſes betwixt the Hole for the ſecond Branch of this 5th Pair and the 3d (i i,) and how the Hole for the *Arteria duræ Matris* (k k) is only ſeparated from the Hole for the third Branch (i i) by a ſmall Boney *Septum*; we may ſuppoſe that this *Arteria duræ Matris* enters where the third Branch of the 5th Pair goes out, and ſends up one Branch (k k) which immediately enters the *dura Mater*, and another which runs forward in this *Crena* to the Hole for the ſecond Branch of the 5th Pair (h h.) and goes along with it, and paſſes out below the *Lamina*, which frames the upper part of the *Sinus* for the Orbit of the Eye (S) (2) and runs forward along with the ſecond Branch to this large Oval Hole; where after it is come, it aſcends obliquely in a *Crena* to be ſtill ſeen in the Bone, till it comes to the Root of the *Proboſcis*, where it is diſperſed as above; and the Vein returning by the ſame Hole runs along with the other two, tho' it does not enter the Scull; but running backward, paſſes in below the foreſaid *Lamina*, and deſcends where the *Arteria duræ Matris* aſcends. I cannot poſitively determine the Capacity of theſe Blood Veſſels at the Root of the *Proboſcis*; but they were very conſpicuous, and could admit of a Gooſe Quill, tho' they were empty; and when they were full, I doubt not but they were above twice as big. *Tab.* 3.

This

Its Nerves. This extraordinary part did not want for Nerves ſufficient for it, no more than Blood Veſſels: For firſt, it has the *Nervus Olfactorius*, whereof hereafter; whereby 'tis endu'd with a moſt acute Senſation of Smelling. 2dly, the aforeſaid ſecond Branch of the 5th Pair; which accompanying the Blood Veſſels, is with them diſpe s'd throughout the whole Subſtance of the *Proboſcis*; by which it has ſo acute a Senſation of Touching or Feeling, wherewith this Member is more ſignally endued; and by which it avoids whatever is hurtful to it, as appears by that memorable Inſtance of Dr. *Moulins*; who tells us, that ſuch was the Care, in that ſubject he treats of, for the *Proboſcis*, that it thruſt it two foot into hard Ground to preſerve it from the Fire. 3dly, the hard Portion of the *Nervus Auditorius*; which tho' it be diſpers'd in the Muſcles of the Face in Human Subjects, yet in Quadrupeds, ſuch as Oxen, it continues undivided, till it comes to the Angle of the Lips; and here we trac'd it a good way, running forward above the Temporal Muſcle, a little below the Ear, till it came to the Upper Lip; whence it proceeded to the fore-mention'd tendinous Interſtice, which runs down on each ſide of the *Proboſcis*, diſperſing a Branch to each of the *Faſciculi* of *Fibres* already nam'd. This ſeems to be chiefly adapted for the different Motions of the *Proboſcis*; for as we ſee in the *Muſculus Rectus Abdominus*, that at each of the tendinous Interſtices, whereby its Fibres are ſeveral times gather'd together, a Nerve enters at the beginning of each *Faſciculus*; So here the Muſcles of the *Proboſcis* being divided into ſeveral *Faſciculi*, each of them have a Branch of this Nerve diſpers'd in them; and 'tis ſituated on each ſide, that it may the more conveniently diſperſe its Branches both to the *Faſciculi* of the *Elevatores* and *Retractores* alternatively. The Head was ſo mangled at the taking it off, that we could not well find its Origin, as it proceeded from the proper Hole; but its Situation here, Analogous to that in other Quadrupeds, removes the ſuſpicion of its being any other than the hard Portion; tho' when I conſider'd its bigneſs, being as great as one of my Fingers, and the ſmall Hole through which it paſſes from the *Proceſſus Petroſus*, I was in ſome doubt about it; but when again I began to conſider its Texture, I was ſoon convinc'd it muſt be that and no other. 'Twas indeed very pleaſant to behold it, (for ſeveral Phyſitians and Surgeons of us being together, we cut off a Portion of it to know its Structure) how that ſeveral ſmall Fibres were knit together into one Bundle; and how ſeveral of theſe

these again were involved by common *Membranulæ* into different *Fasciculi*, till at length all were included in one common Tunicle. We indeavour'd by Microscopes to view the Cavity of the Fibres, but could observe none: That which I suppose made it bigger, was, that when it past through the Bone, the *Fasciculi* were more strictly coherent to one another, whereby they occupied a lesser space; but no sooner had they past it, than they began to be more loosely conjoined within the common Tunicle, by which the whole Nerve appeared to be bigger.

An Analogy betwixt the Proboscis and the Nose in other Animals, Eye, and Tongue.

Thus you see how signally this Member is endued with Instruments for the Performance of its different Functions. 'Tis the principal Seat of two of the Senses, and partially partakes of the third: For by it the Animal swell'd; by it Feeling is perform'd, as by the Hands with us, wherefore the *Proboscis* is not improperly call'd *Manus Nasuta*, as before we observ'd; and by it the 5th Pair of Nerves affords a partial Idea of the Taste, to what Food it takes hold of, before it conveys it to the Mouth; and it has a great Analogy to the other two Senses, *viz.* to the Eye, by its 3 Pair of Nerves, namely, one for its Seeing, analogous to the other for Smelling; one for its pathetical Motions, analogous to the acute Sensation, afforded to the other by the 5th Pair; and one for the Motion of its other Muscles, analogous to the hard Portion of the other; and to the Tongue, as we have already shew'd at large, by its different Motions, and by its partial Taste.

The Abdomen.

I come now to the *Abdomen*. Without having time to consider its Muscles, I caus'd it to be opened longitudinally; whereupon the Intestines jeated out in a confus'd Mass; first the Paunches or Trypes, as I may call them, (being not unlike the *Omasum* and *Abomasum* of an Ox;) and then the smaller Intestines. Being earnest to employ what Time I had in viewing the other Parts, I let these alone after they were extracted, till *Monday*: But then, as I told you, (by reason of their leanness, heat of the Weather, and emptiness, there being nothing in them but a little chew'd Hay or Grass) they were all spoiled; so that I could not receive any satisfaction of them, either as to their Structure, Figure, Dimensions, or Number. The Figure Dr *Moulins* gives of a part of the *Colon* and *Rectum*, seems to be pretty good; for I took a great deal of them, and stretched them out upon the Ground: They were about $\frac{1}{2}$ foot Diameter; but I had not time to take notice of their precise length.

The Description of the Uterus. I next apply'd my self to the Extraction of the *Uterus* and *Bladder*, because the *Partes Generationi Inservientes* are the most taken notice of in Comparative Anatomy. I could not get the *Vasa Præparantia* preserv'd; and only got out the *Uterus* itself, with the *Cornua*, *Ovaria*, and part of the *Ligamenta Lata*, (*a.a.*) of all which see the Figure. 'Tis not unlike the *Uterus* of such Animals as bring forth several at one Litter, as they call it; for when I had inflated it, I perceiv'd several Protuberances to arise, (*e.e.*) as if they had been so many *Cellules*, such as Bitches, Cats, Hares, *&c.* have, for containing the several *Fœtus's* with their proper *Placentæ* and *Involucra*; which might have determin'd me to believe they bring forth more than one at a time, had not Authors affirm'd the contrary. For whereas the *Uterus* of such as bring forth but one at a time, is proportionably large, and the *Cornua* small; here the Body of the *Uterus* was so small (*c.*) that one would think it were nothing but a *Bivium* to the 2 *Cornua*: For after the Tube had past the *Corona*, which is pretty strong and close, I observ'd the *Cornua* (*f.f.*) to swell on every side by Inflation, leaving a *Sulcus* in the middle (*d.*) and these different Protuberances to arise with Depressions, as so many Interstices betwixt them. This Furrow (*d.*) seem'd to me to point out the *Septum*, whereby the *Cornua* were divided from each other; and these Interstices to denote, as it were, so many Membranes, whereby these Protuberances were bounded and form'd into *Cellules*, each communicating with one another. These Protuberances (*e.e.*) were regularly dispos'd, 2 or 3 in Number on each side of the *Septum*; and tho' some of them be obliterated, yet the *Vestigia* of others do still remain obvious in the dry'd *Uterus*, as it is now reposited in our Hall. I had a great Inclination to open one of these *Cornua* or *Cellules*, to know the truth of what I suspected; but would not adventure, for fear of spoiling the Preparation. Each of the *Ovaria* was as big as a large Apple, with the *Ova* fitly distinguish'd by their proper Membranes; being for the most part about the bigness of a small Pea, and all involv'd within a common thin and pellucid Tunicle, through which they Shone; but to defend them there was provided a loose thick wrinkled Tunicle, (*i.*) which I could remove at pleasure, it no wise adhering to the *Ovaria*; but fluctuated above them, and proceeded from the *Cornua* (*g.*) I open'd one or two of these *Ova*, and found them filled with a thin Limpid Substance, not unlike to *Hydatides*, but

Tab. 3. Fig. 15.

Cornua.

Cellules.

Ovaria.

but that the Humour was more viſcuous; which is now evaporated in the dryed *Uterus*, and the *Ovaria* quite collaps'd. The Extremities of the *Cornua* which received the *Ova* were very narrow; for when I had inflated the *Uterus*, it retain'd the Air for ſome time, without paſſing immediately out by the *Cornua*; tho' afterwards when I had ſtrictly ty'd the *Vagina*, I obſerv'd the Air did inſenſibly ſlide out, and now and then I could ſee ſmall *Bullulæ* ariſe toward the *Ovaria*. I could not ſee any fluctuating *Alæ Veſpertilionum*, nor *Morſus Diaboli*; but do ſuppoſe, that the *Ova* are received into the Extremities of the *Cornua* by an *Hiatus*, below this looſe *Involucrum*, which I told you defended the *Ovaria*. I cannot determine the preciſe length of the *Vagina* (*b.*) becauſe I know not how much of it might have been cut off; nor Situation of the *Uterus*, becauſe the Body lay ſupine, and I was obliged to take the Aſſiſtance of Butchers at the taking it out. The *Vagina* was very ſmall and narrow, not admitting above two or three Fingers. Its Inner Surface was whitiſh, and moiſtned by a certain kind of *Mucus*, and all full of *Plicæ*, or Wrinkles. *Ova.*

The *Bladder* is rounder than that of an Oxe, and much larger than Dr. *Moulins* would have it; for he ſays, 'tis much about the ſize of an Ox Bladder; but I find, when inflated, it can contain ſix or ſeven *Engliſh* Gallons: And I doubt not but I might have ſtretched it out larger, had I had ſufficient Inſtruments for inflating, for this I only did with my Mouth and Tube. 'Tis indeed very ſtrong, and the Veſſels appear very prettily diſpers'd through the Tunicles, which I could have eaſily ſeparated, but did not deſign to loſe it. The Ureters were about $\frac{1}{2}$ of an Inch Diameter, and I could have eaſily diſcover'd their Inſertion, if I had not deſigned to preſerve the Bladder. Both *Uterus* and Bladder were involv'd within a Duplicature of the *Peritonæum*, ſo that I had much ado to get them ſeparated. *The Bladder.*

Since I have gone ſo far in giving an Account of the Parts for Generation in the Female, I hope it will not be unpleaſing, if I give Dr. *Moulin*'s Account of them in the Male, with my own Thoughts about them.

Dr. Moulin's Account of the Male Elephant he diſſected.

'In ſearching for the *Teſtes*, he found two Muſcles very like 'them, which he ſuppos'd to have been them, till he had trac'd 'them to the inner and lower ſide of the *Iſchion*, where he found 'them implanted: He trac'd the Tendons likewiſe, and found, 'that when they had gone ſingly near upon 4 Inches, they join'd

Muſculi du. Retractores Penis *D.* Moulins. *Pag.* 15.

'in one, which went directly under the middle of the *Penis*, 'and reach'd beyond a Crookedneſs he obſerv'd in it. This 'was in length about 8 Inches, and terminated within 6 or 7 'Inches of the *Glans*, having expanded itſelf into a Membrane. 'There was beſide theſe a Nervous Body, that began underneath 'near the aforeſaid Tendons, about 8 Inches from the Root of 'the *Penis*, and reach'd (diſtinct from the Yard) 9 Inches, be-'fore it was inſerted again in it, at a place 5 ½ Inches from 'the *Glans*.

Their Uſe.

'He is of Opinion, theſe Muſcles in that Nervous Body be-'ing ſo conveniently plac'd for that purpoſe, that the *Elephant* 'is a Retromingent and probably Retrocoient Animal. The 'crookedneſs and bending downwards he obſerv'd in the *Penis*, 'ſomewhat ſhort of the end of the Tendon, and the confeſſion 'of thoſe that were his Attendants, who told him, that when 'the *Elephant* would make Water, they obſerv'd him to unſheath 'the *Penis*, and bend it backwards, and ſo Piſs between his 'Legs outwards, confirm'd him in that Opinion; by which, 'he ſays, Nature ſeems to prevent this unweildy Animal's wal-'lowing in its own Excrements.

Remarks upon his Obſervations.

Had our Author had the good Fortune to obſerve the *Erectores Penis*, as well as its *Retractores*, it might have been of Service: For admitting there be ſuch, (as I have no reaſon to call ſo Ingenious a Gentleman's Authority in queſtion), 'tis probable there muſt have been *Erectores* alſo, and that upon the following Accounts. Firſt, becauſe 'tis requiſite the *Penis* of the *Elephant* be freed of this Retraction; that whereas it is brought back at the *Mictus*, it may be brought forward at the *Coitus*. 2*dly*, Becauſe it is requiſite that the *Penis* at the *Coitus*, be brought (if not altogether, yet) obliquely upwards: As we ſee when a Horſe Piſſes, he firſt unſheaths the *Penis*, which by its own Gravity declines, and if aſſiſted by a more than ordinary Supply of Spirits, it tends a little forward; but in the *Elephant* there is always a Supply of Spirits required at the *Mictus*, both to make the *Penis* penetrate the Sheath, (whoſe inner Orifice, as our Author ſays, was ſhut ſo cloſe, that there was not room for a Man's little Finger to get in, ſo that he was forc'd to divide it before he could come at the Yard) and endue it with a certain Rigidity, and to ſwell the *Retractores*, whereby the *Penis* being render'd a little ſtiff, may be drawn back. Suppoſing then there be ſuch *Erectores Penis*, we muſt likewiſe conceive them to be of a far

greater

greater force and bulk than the *Retractores*; for if, as according to our Author, the *Penis* at the *Minctus* be brought back far beyond the usual Posture of the *Penis* in other Animals, we may believe it also to be endued not only with Antagonist Muscles to these *Retractores*, whereby to bring the *Penis* to such a Posture as we see in Horses, but also to make it ascend so far as is requisite for the *Coitus*. And if what I have elsewhere advanc'd be not sufficient to prove this to be no Retrocoient Animal, I shall add the following Arguments: First, The *Vagina* is not plac'd behind a little below the *Anus*, as in a Mare, but below, in a direct Line with the rest of the Belly, whereby there is a Necessity for the *Penis* to ascend. 2*dly*, The *Ossa innominata* ascend obliquely, which must oblige the *Penis* to do so too. 3*dly*, The Author's Account of the *Penis* itself, (for he says 'tis bigger than that of a Horse but not so long) so that it can hardly be suppos'd both to bend backwards, ascend again, and enter the *Vagina* so far as is requisite.

'The *Testes*, he says, were not contain'd in a *Scrotum* or *Capsula*, but lay in the *Perinæum*, close joined on each side to the *Penis*. They were neither of the usual shape, bigness, nor included in a *Processus* of the *Peritonæum*. Their Shape was very like that of a Chestnut. They were thicker on the side that grew to the *Penis*, than on the opposite. They were flat and round, and not suitable to the other Parts of his Body, being no more than about 3 or 4 Ounces in weight. They were joined to the *Penis* by a great many, at least 100 Seminal Tubes, which may be properly call'd *Vasa deferentia*, and which deposited the elaborated *Semen* in several *Rhomboid Cells*, plac'd in the Body of the *Penis*, which in this Creature was the common and only Repository, where the Seed could be found. These Cells were turgid with Sperm, and so were the Tubes: The latter were very large, receiving a Block-Tin Wire of an equal thickness with the biggest ordinary Pins, or above an Inch, when the Tube was streight, as most were; but being pursu'd further into the Body of the *Testes*, they became smaller and smaller, till they disappear'd. The Blood came into the *Testes* by the *Vasa deferentia*.' *His Account of the Testes.*

Our Author, as he proceeds, is somewhat perplex'd; and therefore I chuse to continue in his own Words, that you may the better know his Thoughts of this part. He says, 'Though these were small and disproportionable, yet he took them to

'be

' be the *Teſtes*, nothing elſe outwardly appearing that contain'd ' Seminary Veſſels; until he underſtood by the Curious and ' Learned Dr. *Needham*, that his Deſcription of the *Teſtes* of the ' *Elephant* did agree to the *Proſtatæ* of a Bear: Upon which he ' miſtook the *Teſtes* for the *Proſtatæ*, there being a great Re- ' ſemblance between theſe Animals; and having found two Sub- ' ſtances betwixt the Kidneys and Neck of the Bladder, which ' might very well be *Teſtes*, and which, till he diſcours'd that ' Ingenious Gentleman, he did not know what to make of. And then he proceeds:

Venæ Præparantes.

' The *Venæ Præparantes* were large: He divided that which ' was inſerted into the Emulgent lengthwiſe; and within a lit- ' tle more than an Inch of its Inſertion he found many Valves, ' to the Number of about 8 or 10, of divers Shapes, all fitted to ' hinder the return of the Blood into the variouſly divided Sper- ' matick Vein, which here from 8 or 10 Rivulets became one ' great Channel. Within about an Inch of this, and ſomewhat ' more than two from the Kidneys, he found a Subſtance of ' the Shape of a Pear, but near three times the bigneſs of a ve- ' ry large one. He was at a loſs to know what this might be, ' and confeſſes he can give but an imperfect Account of it, ſince ' the Butchers cut it out, and ſo its Continuation with the *Te-* ' *ſtes*, *Penis*, and other Parts, could not be diſcovered.

' What he obſerv'd in it was, that the Spermatick Veſſels ' entred but a little way into this Subſtance; but below the ' middle of it he found them more deeply plac'd, and their ' Branches grew ſo ſmall, and leſs numerous to the Sight, as if ' here the Veins began. The inner part of this Subſtance look'd ' of a paliſh, but ſomewhat muddy red Colour. 'Twas very ' Spongy, not much more compact than the Lungs of young ' Animals. He doubts not but this Subſtance was deſigned to ' prepare the *Semen*; but by what Veſſels it was brought to the ' *Penis* or any other Repoſitory, (itſelf containing none) he could ' not diſcover; neither could he find any peculiar Veſſel, or ' *Ductus*, or any thing that reſembled that before-mentioned ' Subſtance, by which he might be directed in his Enquiry. It ' lies lengthwiſe from the Kidney to the *Teſtes*, with the biggeſt ' end loweſt. He is of Opinion, from what he has heard from ' Dr. *Needham* of theſe Parts, that theſe two Pear-faſhion'd, ' now deſcrib'd Subſtances, were *Teſtes*; their Place, Size, Fi-

' gure,

' gure, and occaſional Cutting the *Vaſa deferentia*, being the ' Occaſion of his former Ignorance in this Point.

' He could obſerve no *Veſiculæ Seminales*, nor any common Re- ' ceptacle for the *Semen*, except the formerly mention'd Rhom- ' boid Cells in the *Penis* itſelf; but doubted not there might be ' ſome ſtill, tho' his being intent upon other things made him ' neglect the Diſcovery of them. Thus He, as you find, ingenuouſly confeſſes his miſtake of the *Teſtes* twice, and he leaves them in doubt the third time: However, this may ſerve as a Precaution to ſuch as may have occaſion to diſſect ſuch a Subject as this hereafter, and therefore I thought fit to give you his Account in his own Words.

The *Inteſtines*, *Uterus*, and *Veſica*, being extracted, I laid aſide the two laſt, in order to a future Preparation, and went to extract the Liver, which you know takes time in other, and much more in this great Animal. Whether by the haſte made in taking it out, or not, the Liver of this Subject had any ſuch *Membrana Hepar inveſtiens*, as Dr. *Moulins* ſpeaks of, I ſhall not be too poſitive; but am ready to believe it had none, and that the *Membrana* mention'd by him is nothing but the proper Tunicle of the Liver, raiſed by Fire, as we ſhall ſee hereafter; and my Reaſon for thinking ſo, is, that I was very careful to have it taken out whole. 'Tis true, the Inteſtines being taken out in haſte, I had not ſo ſoon an opportunity of obſerving the *Ductus Cummunis*; but I viewed the reſt of the Liver exactly, and cauſed the Figure and Dimenſions of it upon the Place to be took, (being 36 Inches long, and 22 at the broadeſt part) becauſe it would not keep. I was indeed in great doubt, what to think of the *Veſicula Fellis*, when I did not find it. Both the *Vena cava* and *Porta* were very large, and had their *Exit* and Entrance in the concave Part of the Liver, as you ſee. This had only one Lob; but both the Veins diſpers'd themſelves, firſt into two large Branches, and then were ſubdivided there, as in the ordinary manner. I open'd ſeveral, and found them differ in nothing from other Animals; the Subſtance being firm, as is uſual, and *Glands* large and conſpicuous; the external Surface ſmooth, and its proper Tunicle firmly adhering to the *Glands*; which is all I obſerv'd in it. See the Figure. *Tab. 4. Fig.* 10.

The Liver.

But becauſe Dr. *Moulins* does tell us of a *Membrana Hepar inveſtiens*, I ſhall give you his Account of it; as alſo of the *Bile* and *Porus biliarius*, which I can give no Account of my ſelf. He ſays,

' The

'The Membrane that inveſted the Liver, was raiſed from it 'a conſiderable way, as if it had been joined to it. Though 'this Membrane ſeem'd to be whole, and look'd like the *Cuti-* 'cula raiſed by a Bliſtring Plaiſter, yet there was no *Serum* con- 'tain'd in it; and where it ſeem'd to be intimately joyn'd to the 'Liver, by a gentle pull it came off, without tearing any thing 'that I could take notice of, as if it had been but very ſlightly 'faſtned to the Liver; or rather as a Bag, which contained and 'exactly fitted it. He takes the uſe of this to be chiefly to ter- 'minate the Capillary Veſſels, and prevent the gleeting of Serous 'Humours; and concludes, that he muſt wholly impute the clear 'in ſome Places, and in others that eaſy Separation of the Mem- 'brane from the Liver, to the Fire: By all which this ſeems to be nothing different from the proper Membrane which I obſerv'd, and you ſee the Circumſtance of firmly adhering and looſely in- veſting.

His Account of the Bile.

The *Bile*, as he gives an Account, was depoſited at the end of the firſt Gut, 4 ½ Inches below the *Pylorus*; from whence he trac'd the *Ductus Communis* to the Liver, to ſee the *Veſicula Fellea*; but it was wanting, and in the place of it he found the *Porus biliarius* coming out of the Liver, as the *Ductus hepaticus* uſually does. He obſerv'd likewiſe, that the *Bilis* found in that, differ'd both in Colour and Conſiſtence from that he found in the *Ductus hepaticus*; for the latter was of a clear light yellow Colour, congeal'd like a Jelly, and the former of a dark Green, and ſomewhat more fluid than the Gall of an Ox. He hopes Time will diſcover ſuch a difference in the Galls of moſt Animals, and that diſcerning Men will be excited to find out their Uſes.

I fail'd alſo to obſerve the *Pancreas*, becauſe it was taken away *in Cumulo*, with the reſt of the Inteſtines; and therefore ſhall give you Dr. *Moulin*'s Account of it too.

Of the Pancreas.

'The *Pancreas* was very long and large; for it reach'd from 'about the middle of the Stomach to the *Jejunum*, which ſpace 'could not be leſs than 6 Foot. 'Twas a *Glandula Conglomerata*, 'as the *Pancreas* always is, and had its *Ductus* ſo wide, that it 'could without force contain ones little Finger. It open'd into 'the Gut, where the *Ductus felleus* did. Whether both the Paſ- 'ſages join'd into one before their Aperture into the Inteſtines 'or not, he has forgot. The *Succus* in the *Ductus* was not limpid, 'as it uſually appears, but of a very dark Green Colour, and yet 'very fluid; ſeeming to contain no viſcuous Phlegm.

The

The *Spleen*, of which I had not time to take the Figure, was in this Subject 3 ½ Foot long: On the backside its Edge was somewhat curv'd, almost in Shape of an unbended Bow: On the fore-side, from a narrow Point at each end, it enlarg'd itself by degrees, till it came toward the middle where the Vessels entred, where it was broadest. Whether the *Vena Splenica* went forth by one, two, or more Orifices, I cannot positively determine, it being cut off in haste; and when cut off, I saw it ragged for the space of 4 or 5 Inches; which I conceive to be because of the Orifices of so many Veins. It was thin and flaccid; what Blood was press'd out of it, was blacker than any I had seen throughout the rest of the Body. If it had not been unwarily cut by several slashes of the Butcher's Knives, I design'd to have blown it up and prepar'd it. I cut off a little of it, and press'd out of it Venal grumous Blood from several of its *Cellules*. It was in breadth from 3 Inches toward the Extremities, to 8 Inches about the middle. *Of the Spleen.*

The *Glandulæ Renales* were plac'd after the usual manner: They were about 5 Inches long, 2 Inches broad, and Oval, with a loose outer Coat, which I remov'd, as it had been a Sheath; within which was contain'd the *Gland* itself, being divided into several Lobes, like the Kidney of an Ox; from whose Interstices there pass'd several thin *Membranes*, which passing to the loose *Vagina*, kept it fast; and by which this *Vagina* was only coherent with it. Its Vessels were cut off so short, that I could make nothing of them. I cut it longitudinally, and found in it a Cavity, which could contain about 2 Ounces, all full of a black grumous Blood, in Colour much like that I observ'd in the Spleen. I shall not much insist upon the Use of these two *Viscera*, about which there is so much debate; but only tell in short, that it is probable, as the Spleen is to the Liver, so are these *Glandulæ Renales* to the Kidneys; that is to say, whereas the Blood after it is distributed into the Intestines by the several Arteries, which proceed from the *Aorta*, is receiv'd by the Orifices of so many Veins, as serve to make up so many *Radices Venæ Portæ*; it is convenient this Blood should be animated by a new Supply of Spirits, the better to enable it to continue its Circulation in the *Porta* through the Liver, and dispose it for the better Separation of the Bile; for which Use the Spleen seems to be adapted, both from its Situation in respect of the Liver, the Venal Blood of the one entring the *Porta* for the other; its Structure; *Mora* of the Venal Blood, Glandulæ Renales.

after discharg'd from the Arteries; and a considerable Branch of a Nerve furnish'd to it: So the Kidney being a *Viscus* where there is a vast Separation of *Serum* required, these *Renes Succenturiati* seem to be design'd for furnishing a new Supply of Spirits to the Venal Blood, after it has passed the Kidneys, and undergone this Secretion. Both which Uses I doubt not may appear from their Structure, as you have it at large declared by those accurate Anatomists, who have flourish'd in this Age.

Kidneys. The *Kidneys* were of a large and proportionable size, being one Foot in length and ½ Foot in breadth of the usual Figure, much like that of a Man; their external Surface smooth, and equal with their external Coat, closely adherent to the inner Substance, without any perspicuous Lobes to be seen externally; but when I open'd one of them, I perceiv'd 6 large *Carunculi Urinarij*. Its Substance was very obvious, and correspondent to the Structure usually observ'd in the Kidneys; *i. e.* the Glandulous Substance externally was very conspicuous, for the space of about ½ Inch in Circumference; then began to appear the *Tubuli Urinarij*, first smaller and less obvious; then another Series larger, and a third still larger, till they began to surround each of the *Carunculi*, like so many Rays of the Sun. I had no Assistance of Microscopes, (for I open'd it in the Field on *Monday*) and therefore did not see so clearly the *Coalition* of the smaller *Tubuli* into the larger Ducts: But as it happens in all these Excretory Vessels, they did not appear branched and divaricated, as Blood Vessels usually are; but continued parallel to each other, till from the lesser to the greater, they at last emptied themselves into the common Receptacles. I am not positive, whether there was one common Ureter, into which all the six *Carunculi* did empty themselves, or if each had a particular Branch of an Ureter, into which they were discharg'd; only I remember I saw no *Pelvis*, which for the most part happens where the *Carunculi* are very large. The Reason of my uncertainty about the Ureters, is, that after I caus'd the *Thorax* and *Abdomen* to be open'd on the *Saturday*, I let alone the Kidneys till the *Monday*; but they being involv'd within a Duplicature of the *Peritonæum*, and no Fat surrounding them, that Membrane was so dry'd up and stiff, that even the Butchers Knives were scarce able to pierce it: So that requiring the help of a Butcher, who assisted at the Excarnating of the Bones, he took out the Kidneys without any regard to the Vessels; for the *Renes Succenturiati* were luckily taken out the

Day

Day before, when all the Parts were ſoft and flexible. And here in general I muſt tell you, that the Fleſh of this Animal was for the moſt part ſo ſtrong, that no Launcet I had, how keen or ſtrong ſoever, could do any Service: So that I was forc'd to make uſe of Butcher's Knive, when I could not admit of their Hands; and how unfit ſuch Inſtruments are for Anatomical Preparations, I leave you to judge.

I come next to the *Thorax*; where there was ſcarce any thing remarkable. I think I need not tell, that the *Viſcera* here were large and ſtrong. One of the Lobes of the Lungs was open'd by the Butchers, and the other had nothing obſervable, but its bigneſs, which was proportionable enough. It did not adhere to the Ribs, as in Dr. *Moulin*'s Subject; but lay flaccid on the one ſide of the Heart, as the other had done, before it was mangled, on the other ſide; ſo that I look upon this Adheſion of Dr. *Moulins* to have been in a morbid State. At firſt I deſigned to have taken out the whole *Viſcera Thoracis*, till the Butcher prevented me; and as I began to direct him between the two firſt Ribs, I ſaw two large Glands, one ſituated on the outſide of each of the *Carotides*, as they paſſed out of the *Thorax*; they were round, and near the bigneſs of a Turky Hen's Egg, each having a conſpicuous Artery inſerted, and a Vein paſſing from them. Theſe I took to be the *Thymus*; which, tho' ſeldom obſerv'd in adult Subjects, yet perhaps may at all times be ſeen in ſuch a large Animal as this. I cut off one of them with part of the adherent Artery; and could obſerve nothing at the opening of it, but ſeveral looſe thin Membranes without, which I ſuppoſe to have ſupported and contained in the Cavity (whoſe ſides they deſcribe as they run to and fro') a great deal of Fat, when the Animal was in good caſe; and a firm glandulous Subſtance within, without any Cavity. I ſhall not poſitively determine, whether theſe were actually the *Thymus*, or only adventitious Glands; but becauſe they were regularly ſituated, which ſeldom happens to adventitious Glands, 'tis probable they were. Their Veſſels were proportionable to their bigneſs, but I can ſay nothing to their Uſe. When I ſaw I could not extract the *Viſcera Thoracis* whole, I trac'd one of the Branches of the *Aorta aſcendens* down to the Heart; and was ſurpriz'd, when I cut it above, to ſee a fat-like Subſtance jeat out of it; and pulling it, I got upwards of 2 Foot in length of a *Polypus* adapted to the Capacity of the Artery, which was about 2 ¼ of an Inch Diameter. This *Polypus* was no

Thymus.

A Polypus *in the* Aorta.

wiſe fibrous, but as it were ſo much Fat moulded after ſuch a manner, being not unlike the Blade of a broad Sword, near to ¼ of an Inch at the middle, and much thinner at the Edges, tough and flexible, with ſome grumous Blood not ſo firmly compacted at the Extremity.

Heart. When I came to the *Heart*, I ſaw all its Veſſels very large; the *Bivium Aortæ* very conſiderably thick and ſtrong. There was nothing about the Heart remarkable, except the bigneſs, which was proportionable to the Body. The *Auricles* were large, and the Left as well as the Right full of grumous Blood At the opening of the *Ventricles*, I found them both fill'd with the ſame *Polypus*; which ſtrangely twiſted itſelf in among the Valves, both *Tricuſpides* and *Semilunares*, and alſo among the fleſhy Columns at the bottom of each *Ventricle*; which here ſeem'd to be ſo many little ſtrong round Muſcles, ſome ¼, others ½, and oth rs near one Inch long, with a round fleſhy Belly, and two Tendons variouſly ſituated, as you ſee in the Hearts of other Animals. Theſe *Polypus's*, from a maſſy Subſtance in the middle of the Ventricle, ſent forth to all Parts their Branches, which here and there twiſted themſelves round theſe fleſhy Columns, their tendinous Inſertions, and the tendinous Fibres of the Valves, with a wonderful Intricacy. In a word, there was no Angle, no Corner or Cavity, which the *Polypus* did not occupy: And yet ſo much was it diſengag'd from the Subſtance of the Heart, and 'twas ſo ſtrong and tough, that by pulling its groſſer part in the middle, all the other Branches mov'd; and by cutting a few Parts of it, where it was moſt engag'd, and where the fleſhy Columns were thickeſt, I got it out altogether; and having ſtretch'd it out, did pleaſantly behold theſe Ramifications, proceeding from its groſſer part like ſo many Thongs or Laces whereinto a piece of Leather had been cut, ſome broad and ſome narrower; but none very thick; of a yellow Colour, and fat Subſtance; each of them weighing 1 ℔ which I may ſafely ſay, was more Fat than was upon all the Body beſide. From whence I may reaſonably conclude, that altho' it had not met with the formerly mention'd Hardſhips, however it might have liv'd ſometime, yet it could not live long, it being evident, that this *Polypus* would at length have prov'd its Ruin.

Polypus Cordis.

The Mouth Having, as I told you, but little time to take Notice of the external Parts of the Head, either in reſpect of the Muſcles which move it, the *Larynx*, *Pharynx*, or Tongue, or in reſpect of the Salivatory

Salivatory Veſſels, which empty themſelves in the Mouth; I ſhall only tell you, that the Mouth is very little and narrow, in proportion to the Body, and that upon theſe Accounts: 1. Becauſe neither Lips nor Teeth are employ'd in gathering the Food, as in other Quadrupeds; ſo that the Mouth only ſerves to receive the Aliments from the *Proboſcis*, which both gathereth and conveyeth them into it. 2. The *Dentes Maxillares* are of ſuch a thickneſs, both in the Upper and Lower Jaw, but eſpecially the latter, that they ſerve to render the Mouth narrow; nor need it be broader, becauſe the Strength of the Grinders is ſuch, that that they can at once render the Aliments ſo ſmall, that there is no need for the Tongue to move them to and fro' in the Mouth in order to have them further maſticated, as in other Animals; therefore is the Tongue ſmall, ſhort and round, terminating in a Point, thick, and not thin and flat as in Oxen, with a ſoft ſmooth Surface, without any perſpicuous *Papillæ*; by which it ſeems not to chew the Cud.

The ſhort View I took of the Tongue hindred me from obſerving that ſingular Structure mention'd by Dr. *Moulins*. All I took notice of peculiar to it, was the firm Adheſion of the *Thyroides* to the *Os Hyoides*, which made me ſeparate and preſerve both; whereof ſee the Figure. As to what Dr. *Moulins* ſays, it ſeems to me very improbable; and I am ſorry the Head ſhould have been ſo mangled at the cutting off, that I was neither able to receive, nor to give you any ſatisfaction about it. However, I ſhall give you his Account, and acquaint you with my doubts. *Tab.* 4. *Fig.* 11.

An Obſervation of Dr. Moulin's, concerning the Paſſage from the Larynx to the Proboſcis.

'The Paſſage, ſays he, to the Ventricle, was through a peculiar Hole, near the Root of the Tongue, and exactly in the middle of that part; which Hole was the beginning of the *Æſophagus*: There was no Communication between this and the Paſſage into the Lungs, contrary to what happens in other Animals; for the *Membrana Pituitaria anterior* reach'd to the very Root of the Tongue, below the *Æſophagus*; ſo that it could emit no Voice by the Mouth, but by the Trunk. This *Membrana* had many Paſſages for the *Saliva* uſually ſeparated there. There was between the end of the *Proboſcis* and the *Larynx*, a *Membrana Pituitaria poſterior*, which had many of the ſame ſort of *Ductus*.

This, I confeſs, ſeems to depend upon particular Obſervation, and yet I cannot ſee how it can well happen; for every one is ſenſible, that the *Larynx* occupies the fore part, and the *Æſophagus*

phagus lies behind between the *Vertebræ* and *Larynx*. Now how the *Æsophagus* can lye thus behind, and yet have such a Communication with the Mouth, as to hinder the *Larynx* from communicating with it, also is to me a very great doubt.

Remarks upon the foresaid Observation.

He proceeds; 'The *Aspera Arteria* was very large, and destitute of an *Epiglottis*, there being no danger of any thing falling into the Lungs from Eating and Drinking, seeing there was no Communication between the *Æsophagus* and it. Here the difficulty still remains; for how can Aliments be ingested into the Mouth, and not pass over by the *Larynx*, as is said, before they enter the *Æsophagus*; that would emply that the *Æsophagus* lies before, and the *Larynx* behind, which would quite invert all the Rules of the *Occonomy* of Animals: Since then the *Æsopagus* must have in its descent pass'd in betwixt the Head and Lungs, and then penetrated the *Diaphragma* or otherwise, and after it had descended a little, must have turn'd aside and past behind the *Larynx*, as the *Arteriæ Iliacæ* do over the *Venæ Iliacæ*, which, tho' by cutting off the Head, I could not observe, yet is what seems improbable to me; because then at the Deglutition, by the Pressure of the *Æsophagus* on the one side, and *Vertebræ* of the Neck on the other, ever and anon would the Animal be oppress with a difficulty of breathing when it took Food.

He says further: 'To the outside of these Catilages he found 'another grow, which was fastned to them, but so as to be capable of moving up and down, by the help of some Muscles 'which were implanted in it. 'Twas strong on both sides of the '*Aspera Arteria*; but opposite to the *Æsophagus*, or on the under-side it was very Limber. This wanted about 2 ½ Inches of coming round the aforesaid Cartilages, (*viz.* the *Cartilagines Aritænoides*, which made a *Glottis*, in length about 3 ¼ Inches, and 'in breadth about 1 ½ Inch about the middle, whose Aperture 'was somewhat Oval) on the upper side, or that next to the '*Æsophagus*. This seem'd to supply in some measure the want 'of an *Epiglottis*, in lessening the *Glottis*, to prevent the creeping 'of Animals into it.

The Head.

Being come to the *Head*, I have very little remarkable to add in this Place: For the Brain itself very little differeth from that of an Human one, except in bigness, and somewhat in Figure; the other being somewhat Oval, and this more round. The *Dura Mater* was a strong thick Membrane, every where disengag'd from the *Pia Mater*; which together with all the Substance of

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the Brain, was much more tender, soft, and flaccid, than could have been expected. Whether this proceeded from keeping the Head 2 or 3 Days after the Animal dy'd, before it was dissected, the Weather being then very hot, or from the languid Distemper whereof it dy'd, I know not. Its Substance, Ventricles, and other Parts, were the same as in other Animals. The *Cerebrum* had three large Productions at the *Basis*, one anterior, from whence the Nerve *Olfactorij* proceed, and two lateral on each side of the *Cella Turcica*, reaching from the *Processus Petrosus* behind to the above named Production before: For the Blood Vessels and Nerves, which enter in and proceed from the Brain, we shall discourse of them more particularly, when we come to the Holes of the Scull. I must not forget to tell you, that at the opening of the longitudinal *Sinus*, there were also *Polypus's*, which proceeded from the Orifices whereby the Blood emptieth itself in the *Sinus*.

Thus far the Anatomical Account of the softer Parts of this Animal; which I acknowledge to be deficient in many things, and those considerable. I rather chose to give you a lame Account of what consisted with my own Knowledge, than intrude upon you meer Conjectures for positive Truths, in order to render it more compleat.

I come now to the Fifth Thing I propos'd, wherein I hope to be more happy, as having more time to consider the Bones than formerly I had to Survey the softer Parts; and doubt not to render this Description satisfactory to such as shall be willing to know more particularly the Structure and the Parts of the Bones of an *Elephant*. The Animal is big, the Bones large, and there be several things to be consider'd in them, which do not readily happen in the *Osteology* of other Animals; therefore I hope you will excuse me, if I prove more tedious than might be wish'd, My chief design is to satisfy your Honourable Society, your self, and *Tentzelius*; and if I do that, I have my aim.

The Osteological Accounts of the Elephant.

I shall begin at the Head, as is usual in *Osteology*; where I shall first take Notice of its External Shape in general; next give an Account of the Bones whereof 'tis compos'd; and lastly, give you a particular Description, first of its External, then of its Internal Parts; shewing their particular Dimensions and Weight, and ascribing their Uses to each of them as they occur, and as we can probably conjecture.

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A brief Description of the Scull.

The Head (A.) being compos'd of the Bones of the Upper and Lower Jaw, on its upper Part is almost round, having two Eminencies with a Depression in the middle before; which Depression, as it runs back, becomes a deep *Sinus*; and these Eminencies drawing nearer to one another, and as they ascend behind, inclining obliquely forward, are not unfitly compar'd by Mr *Ray* to a Man's Buttocks: About its middle part it is almost Quadrangular, being flat before, till it comes to the Root of the Trunk (*a*) where it is depress't, for the more convenient Lodging of the *Proboscis*, till it has past over the Mouth (*b.*) At each side 'tis much contracted for the moving of the Muscles of the Lower Jaw (*c.*) at its back Part it becomes very narrow, with several Eminencies, *Sinus's* and Holes; of all which in order. At its lower and fore part, the Bone of the Palate is narrow, where the *Proboscis* hangs over: On each side of which are the *Alveoli* for the Tusks; and behind, the Lower makes up all the rest of the Head, as to its External view.

Tab. 2.

Description of the fore-part of the Scull.

Tab. 3. *Fig.* 1.

We shall begin the particular Description of the External Parts of the Head at its fore-part; the Diameter of whose upper part is 3 Foot, the two Eminencies are almost round (*a. d.*) and the *Sinus* in the middle is 10 Inches from the Right to the Left, and 2 Inches deep (*e.*) from thence descending 5 Inches, the Bone is flat before, and begins to form an Angle on each side for the Cavity, which contains the Muscles of the Lower Jaw and *Proboscis*, between which Angles 'tis 11 Inches (*f. f.*) thence descending gradually the Angles tend outward, till they come to the upper Production for the Orbit of the Eye (*g. g.*) where they are 17 Inches; betwixt which is situated the Hole for the Root of the Trunk (*a.*) This Hole runs across the Head, being from the Right to the Left 12 Inches, and from below to above on each side 7 Inches; for in the middle it has a Protuberance where the *Cartilaginous Septum* arose, which descends 2 Inches, and terminates in an obtuse Point. Within this Hole are to be seen several of the *Laminæ*, whereof the *Cellules* which run betwixt the two Tables of the Scull are compos'd (*h. h.*) of which hereafter, with the *Vomer* in the middle (*i.*) whence the *Septum* of the Trunk arises. 'Tis pretty thick here, and is compos'd of two *Laminæ*, with a spongy Bone in the middle. At is upper and fore part it communicates with the *Os cribosum*, and you may see the several Perforations, through which a great many Branches of the *Nervus Olfactorius* pass, and cover the Surface of the *Cartilaginous Septum*.

tum. At its lower and back-part, where it becomes gradually thinner, it divides the *Choana* into two; whereof hereafter. At the lower part of this Hole the Bone becomes Concave (*k.*) ſo that meaſuring from the middle of the Orbit of the Eye on both ſides, which are 3 ½ Inches diſtant, the Depreſſion becomes 2 Inches deep. At the middle of the lower part of this Hole begins a Suture, which runs down to the extremity of the Bone (*m. m*) Theſe two Bones are articulated *per Symphyſin.* Dr. *Moulins* calls theſe *Oſſa Maxillæ Superioris*; but I rather incline to call them *Oſſa Palati.* They are 5 Inches broad at the upper part, where they are articulated with the *Oſſa Maxillæ Superioris*, by Dr. *Moulins Oſſa Malæ*, by the ſame kind of Suture (*n n.*) From the upper part o the lower extremity of this *Os Palati* (*b.*) it is 15 Inches. After they have quitted the *Os Maxillæ Superioris* on each ſide, they run down with an obtuſe Angle; being Protuberant on their outer ſide, they incline gradually toward the Suture in the middle (*m. m.*) forming a Cavity 2 ½ Inches deep at the lower extremity, which is not ſo deep as at the middle. 'Tis deſign'd for the *Proboſcis* to reſt upon, and the Eminencies on each ſide are for granting ſpace for the *Alveoli*; whence the Tusks proceed (*o. o*) which are improperly call'd Teeth, (and therefore this Bone which contains them ſhould not be call'd *Os Maxillæ*) ſince they only ſerve for a Defence to this Animal, and ſhould rather be call'd its Horns. They are of different bigneſs in different Animals, and the Male ſeems to have them bigger than the Female; *v. g.* The *Elephant* which was burnt at *Dublin*, had them much bigger than this which died here; which conſiſts with the Knowledge of ſeveral in this Place, who remember to have ſeen both: And the Figure which Dr. *Moulins* gives of them, even tho' broke, ſeems to repreſent them much larger than thoſe in the Subject we have; which are very ſmall, not exceeding the bigneſs of an ordinary Cane, or not above one Inch Diameter, and ſtreight, ſo far as they remain unbroke: So that I am not in a Capacity to affirm or deny the Aſſertion of *Ariſtotle*, who ſays, *Mares grandiores reſimatoſque habent; Fœminæ minores, & contra quàm Mares, vergunt enim deorſum, pronique deviant.* Perhaps it might have been ſo with theſe; and that the Keepers (that the difference of the Sex might not be known, by their bending downward or upward) might have deſignedly broke them. Indeed there is great difference between the weight and length of theſe, had they been entire, and thoſe wonderful big ones whereof Authors give us an Account. *Tentzelius* tells us,

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that the length of those described by him is 8 Foot; and he, with several others, tells us, that there are of them which weigh 100 Pound and upwards, some 140, others 150, and those he talks of were above 100 Pound; insomuch, that *Tavernier* tells us, that in the *Indies* they make Posts of Doors and huge Pales of them: And 'tis memorable, which he says also, that the *Elephants* of the Isle of *Ceyland* have no Tusks, but the first which the Female produces: And this we have confirm'd by Mr *Knox* in his Relation of this Island, that few of the *Elephants* there have Tusks, and those only Males. There is a great debate among Authors, whether these shall be call'd Horns or Teeth. Those who would have them be Horns, say; 1st. Because they rise from the Scull. 2. Because they can be polish'd, and brought into any form, which 'tis difficult to do with Teeth. 3. Because they fall off and grow up again, which the Teeth of no Animal do, except of Man. Such as would have them to be Teeth, tell us, that 'tis peculiar to such Animals as have the Hoof divided into two, to have Horns; and that Horns are always cavous or spongy within; whereas these are altogether solid. For the first Reason, that they rise from the Scull, tho' it be granted, yet it is after a different manner from Horns; for they always either adhere to the Scull by a certain Articulation, if not cavous, as in Harts, or have a Protuberance arising from it, and filling up their Capacity, if cavous, commonly call'd the Flint. For the second, tho' it be granted they can be polish'd, *&c.* yet they are not capable of such Alterations, as Horns are by Boiling, or burning in the Fire, such as being made flexible. Indeed they seem more to agree by their Structure with Teeth; for they proceed from the Scull, and are planted in it *per Gomphosin*; having in these we are speaking of a large Cavity, about two Inches long, large according to the Diameter of the Tusks, at first, but as they descend tapering gradually, till they terminate in a Point analogous to the Cavities in the Roots of the Teeth, and filled up with the same kind of Substance, whereby they are kept firm in their Places. And as to their Structure, I doubt not but they have been compos'd of a mucilaginous Substance at first, as Teeth are; and that afterwards they augment by the apposition of several *Laminæ*, or *Strata*, according as the Animal encreases in Years. Hence 'tis, that I suppose *Tentzelius* his Friend came to be convinc'd, that those Bones he treats of, were of an *Elephant* 200 Years Old, by such Marks as these *Laminæ*, which might have been taken from the Teeth.

Description of the Tusks.

Teeth. Theſe *Laminæ* are very obvious in the Subject we have, and the ſmallneſs of the Tusks ſeems to be another Argument of her being Young, according to their term of Life. Whether they be call'd Teeth or Horns it matters not much; for if from their Subſtance we take their Deſignation, they may be call'd Teeth; and if from their uſe in puſhing, we may call them Horns; and to avoid any debate, let them be call'd Tusks or Defences. They run in this Subject about 6 Inches high in the *Os Palati*, and adhere by a ſtrong Ligament, as is already ſaid.

The ſide of the Head.

We proceed to conſider the ſide of the Head. We told, that deſcending 5 Inches from the middle of the Depreſſion in the fore part of the Head, which is 7 Inches from the Top of any of theſe Eminences, it begins to form an Angle (*a.*) and the ſide of the Head becomes conſiderably depreſs'd, where the Muſcle of the Lower Jaw and *Proboſcis* is lodg'd. This Depreſſion from its beginning (*a.*) to the *Os Zygomaticum* (*b.*) (where it is 8 ½ Inches deep) is 14 ½ Inches diſtant; and from the fore-part (*g.* Fig. 1.) to the *Orificium Meatus Auditorij* (*k.* Fig. 2.) is 13 Inches; alſo from the upper Protuberance of the Orbit of the Eye (*f.*) to the Articulation of the *Os Zygomaticum* with the *Os Temporale* (*i.*) is 9 ½ Inches. At the fore-part of this Depreſſion is ſituated the *Sinus* for lodging the Eye; for 'tis improperly call'd Orbit, ſince only the half of the part where the Eye is lodged is boney: It has 3 remarkable Protuberances; one at the upper and fore-part (*f.*) whence a ſtrong Cartilage ariſes, and is inſerted in another 7 Inches diſtant (meaſuring obliquely) form'd by the Articulation of the *Os Zygomaticum* with the *Os Maxillæ* (*g.*) and a third in the middle (*e.*) at 3 ½ Inches diſtant from each of the former. This Protuberance ſerves for the Inſertion of the *Trochlea* of the *Muſculus obliquus major*. The bottom of the Orbit has another *Sinus* (*s.*) which conveys the *Nervus Opticus* to the bottom of the Eye, the upper part whereof is compos'd of a *Lamina* of the *Os frontis*, which lies over the *Os Maxillæ*: From beneath this *Lamina* not only proceeds the *Nervus Opticus*, *Motorius* and *Patheticus*, but alſo a conſiderable Branch of an Artery, Vein, and 5th Pair of Nerves, which running forward, paſs through a large Hole in the *Os Maxillæ* (*m.*) and are diſpers'd in the *Proboſcis*; whereof hereafter. This *Sinus* (*s.*) whoſe lower ſide is form'd by a *Spine* running along the *Os Maxillæ*, is 9 Inches long, 1 ½ Inch broad at the middle, and one Inch deep; but as it comes forward, 'tis enlarg'd as the Globe of the Eye encreaſes.

Tab. 3. Fig. 2.

Sinus *for the Eye.*

The Os Maxillæ Superiores. *Fig. 1.*

The *Os Maxillæ* is a very irregular Bone. At the fore-part of the Scull it begins with a sharp Point (*p.p.*) having that part of the *Os frontis* which forms part of the Orbit (*d.* Fig. 2.) on the one side, and that part of the *Os Palati* (*m.*) which forms the Hole for the Root of the Trunk on the other; whence running 6 Inches, and inclining inward by a crooked Suture, it terminates in a Protuberance; beneath which is a small *Sinus* ascending obliquely to the Hole for the Root of the Trunk (*n.*) fram'd by the Blood Vessels (whereof above) as they go to the nourishment of the Trunk; from thence it runs obliquely backward, and is articulated with the *Os Palati* by a broad squamous Sutyre. From the middle Protuberance of the *Sinus* for the Eye (*d.*) it runs streight backward, being articulated with that part of the *Os frontis* which forms the aforesaid lower Edge of the *Sinus* for the *Nervus Opticus* (*s*) for the space of 18 Inches, where it begins to be overlaid with a *Lamina* of the Bone, which forms the upper and back-part; whence it descends 9 Inches, till it comes to the Root of the Teeth (*n.*) where we shall leave it, and return to the fore-nam'd Protuberance; from whence having made up a part of the *Sinus* for the Globe of the Eye, as is said, it runs backward 6 Inches, and is articulated (by a flat Suture (*g.*) which first descends $\frac{1}{2}$ Inch, then runs obliquely backward 2 $\frac{1}{2}$ Inches) with the *Os Zygomaticum.* At its beginning its 2 $\frac{1}{2}$ Inches broad; plain on its inner, and convex on its outer Surface; bended, as it descends, like a Horn, and terminating in a Point. From the lower part of this Suture it becomes much thicker; and having fram'd a *Sinus* about 4 Inches long, it runs toward the fore-part of the Scull. From this *Sinus*, as it has returned 3 Inches, is form'd the side of an Oval Hole, which running from before to behind is about 3 $\frac{1}{2}$ Inches long, and from the one side to the other two Inches. At that side which is fram'd by the *Os Maxillæ*, and toward the *Processus Zygomaticus*, 'tis two Inches thick; and at its other side, it runs streight backward from the *Os Maxillæ*, in a direct Line, with the great Cavity, which contains the Muscles that move the Lower Jaw and *Proboscis*. This Hole is analogous to that in a Human Sceleton in the *Os Maxillæ*, beneath the Orbit of the Eye; and is larger in Quadrupeds, being destinated for transmission of a Vein, Artery, and the superior Branch of the second Division of the 5th Pair of Nerves, which in those go to the Upper Lip and Jaw; but in this Subject, as I have already shewn at large, 'tis probable they serve for the Nourishment

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and other Functions of the *Proboscis*. Tho' it be very observable, and of signal Use, yet 'tis so situated, that I was not capable to give such a View, as might afford a true Idea of it, in any of the Figures of the Head: However, I have mark'd it (*r.r.* Fig. 1.) and (*m.m.* Fig. 2.) (S.S. Fig. 3.). From this Hole the *Os Maxillæ* inclines 6 Inches, toward the Root of the Teeth (*n.*) where we leave it, and return to

The *Os Zygomaticum* (*s.*) (*h.*) (*i.*) which, as in all other Animals, serves for a Guard to the Muscles which move the Lower Jaw. In Men, and several other Animals, 'tis form'd of a Production of the *Os Temporale*, articulated with another from the *Os Malæ*, by a particular Suture, call'd *Sutura transversa*; but here 'tis the most distinguish'd Bone of all the Head; for being 12 Inches long and two Inches broad, 'tis articulated with the *Os Maxillæ* before, and running backward 6 Inches, it meets at its upper part with a Production of the *Os Calvariæ* (*f.*) as we may call it, which accompanies its lower part other 6 Inches, and then terminates in an obtuse Angle. 'Tis loosely join'd with this Production, and 'tis probable, that 'tis capable of considerable Motion, upon the following Accounts. 1. The *Sinus* in the back-part of the Scull, as shall be shewn, for receiving the *Condyles* of the Lower Jaw, are larger than the *Condyles* themselves, by which they have a pretty good space to move from the Right to the Left; and the extremity of the *Os Zygomaticum* being their Guard on each side at the outer part, which way they move, these may be suppos'd to yield. 2. The Lower Jaw is of such weight, that its Muscles must require a great space to act in, and that may be conciliated by the Motion and Yeilding of this Bone. 3. The Grinders of the Lower Jaw are much longer than those of the Upper, and therefore they require a greater space to move in, for the better Performance of Mastication, (because the Upper Jaw in this, as in most other Animals, is immovable) to which the Motion of this Bone must very much assist. Add to these, the manner of its Articulation; for it rests upon the Production of the *Os Maxillæ* before; and behind it moves, as it were, to and fro, upon the Production of the *Os Calvariæ*, which rests upon it

The Os Zygomaticum.
Fig. 1.
Fig. 2.
Fig. 1.
Fig. 2.

The back-part of the Scull is next to be consider'd: At its upper part the two Eminences formerly mention'd now appear more considerable, because of the intervening *Sinus*, which from two Inches deep, and 10 Inches from the Right to the Left, becomes

The back-part of the Head.

comes 4 Inches deep; for the Eminences (*a. a.*) approach (as they run backward) much nearer to one another, and the *Sinus* running obliquely downward becomes ſtill deeper, having a *Spina* (*c.*) 6 Inches long and one Inch deep. This *Spina* ſerves for Inſertion of the Muſcles, which move the Head. The Bone on each ſide of it is very rugous; which ſeems to be an excellent Contrivance, becauſe there is ſuch a deal of Strength requir'd here in the Tendons, for ſupporting the weight of the Head of this great Animal, 'twas requiſite the Surface of the Bone whence they ariſe ſhould be very unequal, that their Fibres may be the more firmly impacted therein. Here 'tis alſo that the *Tax-Wax* formerly mention'd was inſerted. By means of this *Spina* in the middle, and the Eminences on both ſides of the *Sinus*, the Surface of the Bone is much more enlarg'd, and the Muſcles with their Tendons are more capable to move the Head, either directly or obliquely to either ſide, than if the Bone had been plain. After the *Spina* of the *Sinus* is ended, the Bone ſwells out toward the back-part 3 Inches, and then deſcends 1 ½ Inch till it comes to the Hole for the Spinal Marrow (*d. d.*) and here the Bone from above the *Orificium Meatus Auditorij* (*f.*) on each ſide, becomes Protuberant 10 Inches (*e. e.*) till it comes to the *Proceſſus Condyloides* (*c. c.*) This Protuberance has the ſame Office as the *Apophyſis Maſtoides* in other Animals, *viz.* for Inſertion of the Muſcles which bend the Head inward. The *Proceſſus Condyloides* (*c c.*) are 7 ½ Inches diſtant incluſive; each of the *Condyles* being 2 ½ Inches broad from the Right to the Left, as they ariſe gradually from their outer ſide, and from below to above ariſing (as it were Semicircularly) 5 Inches long. The Hole for the Spinal Marrow (*d. d.*) at the upper part betwixt the *Condyles* is 3 Inches broad, 2 ½ Inches at the middle, and 2 Inches at the lower part, till at laſt it terminates in a Point. 'Tis 3 ¼ Inches long, and its Margin about the middle of the *Condyle* is 2 Inches thick. Below theſe *Condyles* the Bone becomes more flat; inſomuch, that tending inward there is a *Sinus* fram'd, above which the *Proceſſus Styloides* ariſes (*g.*) being there articulated *per Synchondroſin*. This *Proceſſus Styloides* is cartilaginous about one Inch (*h.*) at its Baſe; whence ariſing hard and ſolid 4 Inches (*k.*) flat on its inſide, and convex on its outſide, being one Inch broad, it is afterwards divided, ſending out another Bone 5 ½ Inches long (*i.*) which bending toward the Scull, but outward from that place whence it proceeded for the ſpace of two Inches, it becomes gradually

Fig. 3. *Fig.* 6. *Fig.* 3.

gradually ſmaller, till it terminates in a Point not unlike that part of a Pen wherewith we write. This Bone is ſo ſituated in the *Baſis* of the Scull, that 'twas impoſſible to give any Idea of it *in Situ*, and therefore I caus'd them to take the Figure of it apart. Betwixt the *Sinus* below the *Proceſſus Styloides* and the *Condyles*, at 1 ½ Inch diſtant, is ſituated the Hole for the jugular Vein (*m.m.*) through which alſo paſſes the *Par vagum* (See *n.* Fig. 14.) which being Oval, is 1 ¼ Inch long, and ½ Inch broad. On the outſide of the *Proceſſus Styloides*, is to be ſeen the Hole for the hard Portion of the *Nervus Auditorius* (*l.*) This is ſo near to the Root of the *Sinus*, that it could not be well ſhewn in the Figure. Betwixt the Origin of the *Proceſſus Styloides* (*g.g.*) and the Hole for the jugular Vein (*m.m.*) is lodg'd the boney part of the *Aqueduct* (*n.n.*) which deſcends 5 Inches; 'tis ½ Inch broad, and ſo flat that it could ſcarce be repreſented in the Figure. From thence is a *Crena*, whoſe Orifice is repreſented by (*o.o.*) where its fleſhy part was contain'd, which communicated with the Palate; it deſcends 3 Inches obliquely inward. From the foreſaid Hole for the jugular Vein (*m.m.*) is ſituated the Hole for the Carotid Artery, which is ſo large as to admit the Point of ones Little Finger (*p.p.*) Deſcending in a ſtreight Line from the *Proceſſus Styloides* (*g.*) 3 ½ Inches, you come to the Hole where the *Arteria duræ Matris* enters the Scull, and by which the 3*d* Branch of the 5th Pair of Nerves paſſes out: Here alſo the Vein, which returns by the great Hole in the *Os Maxillare* from the *Proboſcis*, (after it has paſt ſome ſpace beneath the *Lamina*, which makes up the upper edge of the *Sinus* for the Orbit of the Eye,) paſſes out, and runs back to be joined with the jugular Vein. Theſe Holes are ſituated on each ſide, betwixt the *Aqueduct* and the *Sinus* for reception of the Lower Jaw (*y.*) and are both receiv'd within a like *Sinus*, ſo that they could not be repreſented by an Orifice. The Bone for Reception of the *Proceſſus Styloides*, as I have ſaid, is depreſt; and from thence for the ſpace of two Inches, till you come to the Hole for the Carotid Artery (*p.p.*) it is rais'd for the *Aqueduct* (*n.n.*) From thence, betwixt the two Holes, 'tis gradually Protuberant to the *Condyle*: From below this Hole (*p.p.*) ſtreight downward, during the Progreſs of the two *Aqueducts* (*n.n.*) which are 3 Inches diſtant, 'tis depreſt, till you come to the *Choana*, or Paſſage betwixt the Palate (*t.*) and the Root of the Trunk (*i.*) Between the two Holes for the *Arteria duræ matris* 'tis 6 Inches (*q.q.*) The length of the *Sinus*, called in Human

Fig. 1.

man Subjects the *Glenoid* Cavity, measuring from that part of it which is toward the Hole for the *Arteria duræ matris* (*q. q.*) till you come to the extremity of the *Os Zygomaticum*, is 5 ½ Inches long. This *Sinus* is scarce at all depreſt; 'tis rather Protuberant, with a Semicircular Surface from above to below: 'Tis well enough guarded on both ſides; ſo that notwithſtanding this Protuberant Reception for the *Condyles*, yet their Diſlocation is prevented by the extremity of the *Os Zygomaticum* on the outſide (*x.*) and on the inſide, firſt by an hollowneſs, and then by a Riſing in the Bone. And this Contrivance ſeems to facilitate the Motion of the Jaw very much; for had this *Sinus* been proportionably ſo deep (however Superficial it may be) as in Human Subjects, its Motion had not been ſo very free, as we ſee it is: For by this half round Surface, the *Condyles* have the more ſpace to move backward, and the Lower Jaw to be depreſt, that it may move forward, and preſs the Aliment againſt the Upper Teeth with the greater Force; the Muſcles alſo prevent its falling too much back, and the *Os Zygomaticum* its inclining too much to either ſide, as is obſerv'd. Above the big Proceſs of the *Os Maxillæ*, which is articulated with the *Os Zygomaticum*, is the *Orificium meatus Auditorij* (*k.*) which being Oval, is one Inch long, and ½ Inch broad. Betwixt this external Orifice and the *Proceſſus Petroſus*, the *Meatus* is 8 Inches long; whereof hereafter. By means of this great *Sinus* on each ſide, the *Baſis* of the Scull is ſo contracted, that from the Hole (*q.*) down toward the Root of the Teeth (3. 4.) which is 9 Inches long, the breadth is but 7 ½ Inches. From the extremity of the boney part of the *Aqueduct* downward, the Baſe of the Scull is compos'd of two cavous Bones, about 2 ½ Inches thick, and a large *Sinus* in the middle 3 ½ Inches Diameter (*S.*) at the end of the *Sinus* for the fleſhy part of the *Aqueduct*, and at the Root of the Teeth 4 ½ Inches. This *Sinus*, after 'tis become 2 Inches deep, terminates in the *Choana*. This Paſſage is 8 Inches long, and 2 ½ Inches broad, with the *Vomer* in the middle (*u.*) extending from hence to the Root of the Trunk 8 Inches. The back part of this *Vomer* is ſharp and thin, but its fore-part thicker, conſiſting of two *Laminæ*. Dr. *Moulins* is of Opinion upon Obſervation of the Tongue, whereof before, that the *Elephant* only Breaths by this Paſſage, and not by the Mouth. I do not find that this Paſſage is proportionally more Patulent in this Animal than in any other, only it ſeems to be more direct; for as in other Animals this Hole communicates

Fig. 2.

municates with the Root of the Nose, and the Bone gives the Air at its *exit* another direction; so here the fore and back-part of the *Choana* are directly opposite, but then the Trunk itself gives the Air a quite other direction than in the Bones of other Animals. Indeed there is one Argument which seems to strengthen Dr. *Moulin*'s Opinion, *viz.* That by the Trunk the *Elephant* sucks up any Liquor it has occasion for, which it afterwards empties into the Mouth; and so by drawing in of the Air, it is able to keep in its Extremity any thing it takes hold of. However, the Objections advanc'd against this Opinion formerly, seem to be of greater Moment, than these Arguments here propos'd, are for it. These two cavous Bones on each side the *Choana*, are fill'd up from the two firm, solid, white, weighty Teeth (3. 4.) the back one whereof does not grind, but serves, as it were a wedge, to keep that before firm in its Place (5.) This Tooth runs obliquely backward 3 Inches from the fore Tooth. That part of it which is without the Jaw Bone is half round, being 6 Inches in Surface from its Root on the one side to that on the other, very polite, as *Tentzelius* is pleased to term it, and smooth like Glass. How far this Tooth or the other may go up, I cannot positively determine, neither give any Account of the Figure within the Bone, unless I had broke the Scull However, I shall insist more upon the Teeth, when I come to the lower Jaw; all I shall add at present is, that their *Alveoli*, especially that which contains the hind Tooth, are as thin as can be imagin'd. The length of each of the Teeth is 7 Inches. These Teeth are not alike on both sides; for that on the Right is but one Inch without the *Alveolus*, throughout its whole extent, on the outer side; and on its inner, 'tis one Inch Protuberant at its fore, and two Inches at its back-part; whereas that on the Left side is only one Inch Protuberant before on the outside, and 3 Inches behind, where it forms a kind of Angle, as it is join'd with the hind Tooth; and on the outside 'tis ½ Inch Protuberant before, and 2 Inches behind. The Tooth on the Right Side (2.) grinds with that of the lower Jaw, throughout its whole extent; whereas that of the Left, after it has run back 6 Inches, runs up with an half round Surface two Inches (5.) before 'tis join'd with the hind Tooth. It would seem, that this difference betwixt the Shape, Situation, and Dimensions of the Right Tooth from the Left is not singular here, for Dr. *Moulins* doth likewise take notice of it, in that which dy'd at *Dublin*; for he says, 'The length of the Teeth of the Right Upper Jaw is 4 Inches, but that of the opposite was but 3: The

Teeth, or Grinders of the Upper Jaw.

' two outward or fore Teeth of the Upper Jaw, were somewhat ' longer than those of the Under. He takes no notice whether the hind Teeth of the Upper Jaw grind or not; but here, as I have said, not only both the hind Teeth are free from grinding, but also part of the fore Teeth of the Left side. These Teeth, as Dr. *Moulins* well observes, are all *Molares*, being 2 Inches broad; that part of them wherewith they Grind is 6 ½ Inches on the Right Side, and 5 ½ on the Left. Their Surface, tho' flat, yet is very unequal; for they have alternatively plac'd (running from the Right to the Left) an hollowness, and then an Eminence; and this Eminence is surrounded by a rough Protuberant Border. There are nine of each of the Hollownesses, and as many Eminences, undulated, as they use to paint Sea Waves; which seems to quadrate with what Mr *Ray* says, *viz.* That these Teeth have 8 or 9 ' parallel undulate Lines in their Surface. The Situation of these Teeth, for what I know, is peculiar to this Animal; for instead of running from above to below, as in other Quadrupeds, they run from before to behind, as in human Subjects, being plac'd at ... Inches distance at the beginning, or fore-part, and ... Inches at their hind part. From the fore-part of these Teeth the *Os Palati* runs down ... Inches, having that division in the middle (whereof formerly) much enlarg'd (10.) This Bone, as to its thickness in this Subject, is correspondent to the Tusks, which are implanted in each side of it, as is said. It seems to be thus plac'd upon two Accounts; 1. That it may answer to the distance, or cover that part of the Lower Jaw which runs betwixt the fore-part of the Grinders above (*c.c.*) and the Process at its lower
Fig. 7. and middle part (*e.*) 2. That it may afford space, as we formerly observ'd, for the Trunk to rest upon, lest it should be obnoxious to the Mouth.

The Lower Jaw. The Lower Jaw is the only External Part of the Head, which comes now to be consider'd, consisting of one big Bone, and compos'd of its fore and hind part, and five Processes, *viz.* two
Fig. 7. 8. *Condyles* (*a.a.*) two *Processus Coronæ* (*b.b.*) and one *Processus Menti* (*e.*) 'tis articulated with the Upper Jaw, as in all other Animals, by a double *Arthrodia*. The two *Condyles* (*a.a.*) are 12 Inches distant inclusive; their Surfaces Convex, both from the Right to the Left, which is 3 ½ Inches, and from before to behind, which is 2 Inches. They are received into the *Sinus* of the Upper Jaw
Fig. 3. (*x.*) which, as I have said, is 5 ½ Inches: So that they have space enough to move at Mastication. The Neck below the *Condyle* is 3 Inches from before to behind at its smallest part, whence descend-

descending 3 Inches, it becomes 6 Inches broad (*b.*) and two Inches thick at its back-part, where it forms an obtuse Angle; whence running forward at its outer side 2 Inches, it begins to form a *Sinus* for Insertion of the Muscles which move the Jaw. This *Sinus* running forward 4 Inches more, terminates in a sharp edge of the Bone, which descends to make up the *Processus Coronæ* (*b. b.*) This *Sinus* is 8 Inches from above to below: At the upper part of the *Processus Coronæ*, 'tis 8 Inches broad from before, where 'tis sharp, to behind, where tis thick and obtuse, and at its middle 9 ½ Inches (*b. b.*) the *Processus Coronæ* from above to below 6 Inches, with, as it were, a Semicircular edge, but somewhat more Protuberant, where 'tis not so sharp as the Margin above. How we come to the inner side of the same part of the Bone, where we find that descending 7 Inches from the *Condyle*, till we come a little below the foresaid obtuse Angle, there are the beginnings of a large Hole (*b. b.*) 3 ½ Inches long, *viz.* from the first framing of its *Sinus* to its lower part, and 1 ⅛ Inch broad. This Hole is for receiving the Vessels fit for forming and nourishing the Teeth; whereof hereafter: Here the Jaw begins to be about 4 Inches thick behind, being convex in its back-part; whence running 4 Inches forward, it inclines about 2 ½ Inches inward, where it forms a large *Sinus* for insertion of the *Musculus Masseter*, and whereof no *Idea* could be given in the Figure; for the outside always obstructed the view of the inside. This *Sinus* descends obliquely from the Neck of the *Condyle*, till it comes to the Root of the Teeth (*c.*) 9 Inches, which space does not appear so large in the Figure, because of the Position of the Jaw; and from the fore-part of the *Coronæ* backward, till the Jaw become thick, 5 ⅛ Inches: From the back-part of the Jaw at the foresaid obtuse Angle, till you come to the Point of the *Processus menti* (*b.*) in a streight Line, is 27 Inches. The Arch of the back Surface from the same Angle, till you come equal with the beginning of the Teeth, or lower part of the *Coronæ* (*c.*) is 14 ½ Inches; from whence measuring outward from the Root of the Teeth, it is 3 Inches to the foresaid lower part of the *Coronæ*; from thence to the middle of the back part 5 Inches; and from the Root of the Teeth at the External to the same place at the Internal Part, is 16 Inches; and here the Jaw is about 4 Inches thick behind. At the joining of the two Teeth streight downward, 'tis 6 ½ Inches; and here it inclines gradually outward for above 3 Inches; whereas its inner Surface is almost plain, or at least for the space of 4 Inches, and then inclines 3

Fig. 8.

Fig. 9.

Fig. 8.

gradually outward below, forming an Arch in its Progreſs. Streight downward from the loweſt part of the *Coronæ*, the Jaw is at the thickeſt *(c.)* and here it begins to run obliquely forward, till meeting with the ſame part of the Bone from the other ſide, it terminates in the *Proceſſus Menti (h.* Fig. 9. *e.* Fig. 7) which about 2 Inches runs obliquely outward, and ſeems very convenient for defending the Mouth from the Inconveniencies of the Trunk; which by its weight would preſs too much upon it, were it not defended both by that part of the *Os Palati*, which runs down from the Teeth in the Upper Jaw, upon which it leans; and by this *Symphyſis* or *Proceſſus Menti*, *h.e.* which keeps it ſtill inclining downward, and ſuffers it not to bend inward: Add alſo, that this Proceſs may aſſiſt the *Proboſcis* ſomewhat in its Elevation, when the Animal bending the Head a little forward, may make the Point puſh or bear up the *Proboſcis* from above it. As the lower part of the Jaw in its Progreſs forward runs obliquely downward, ſo its upper part of the Root of the Teeth runs ſtreight forward, or rather inclines a little upward *(c.e)* ſo that whereas 'tis only 6 ½ Inches from above to below at the joining of the Teeth, now 'tis 7 ½ Inches ſtreight downward, (and here its Surface is more plain, for before 'twas convex, and as it were half round) but along the edge of the *Sinus* for lodging the Tongue *(d.e.)* to the outmoſt point of the *Proceſſus Menti*, 'tis 9 Inches. Now we conſider the inner part from the Place where we left it, and find it ſtill more plain; where meaſuring from below the foreſaid joining of the two Teeth ſtreight forward, 'tis 4 Inches on each ſide, till both meet in a Semicircle *(f.)* about 3 Inches Diameter at the lower part, and ſomewhat nearer at the Root of the Teeth. After it has run 2 Inches upward, it runs ſtreight forward with a convex Surface 4 Inches thick; thence it aſcends 4 Inches more to the Root of the Teeth *(d.)* This *Sinus* is for lifting the Tongue, which is very narrow and pointed. Thus having given a particular Account of the External Figure and Shape of the Lower Jaw, we ſhall conſider it in general. The *Condyles* are 12 Inches incluſive diſtant; whence the Bone running downward, and ſomewhat backward 3 Inches, forms an obtuſe Angle, which is 17 Inches excluſive diſtant from its oppoſite; and here the Bone begins to ſwell to a conſiderable thickneſs by degrees: From thence deſcending gradually 8 Inches, 'tis 18 Inches diſtant; thence inclining obliquely forward 6 Inches more, 'tis 14 ½ Inches diſtant; inclining ſtill more forward to the Baſe where the two Bones meet, the Bone ſtill becoming thinner,

Proceſſus Menti.

Fig. 7.

Fig. 7. 8.

Sinus *for lodging the Tongue.* *Fig.* 8.

Fig. 9.

'tis

'tis 9 Inches; from which on each side, till you come to the *Processus Menti*, 'tis 7 Inches: Thus far as to its back-part. Now to its fore-part: First, there is the *Condyle (a. a.)* then there is a sharp Spine which runs obliquely to the *Coronæ (b. b.)* whence to the Root of the Teeth 'tis thicker and of a Semicircular form: Opposite to this, the Bone begins to swell at its outer side, and becomes plain at its inner; that is to say, as to that which regards the Mouth, and that which doth not. Its Surface on both sides is very polite and smooth, having a great many Holes for immission and egress of the Blood Vessels, which nourish the Bone; and at its fore-part, it has two large Holes for the *Maxillaris inferior* (Z. A.) or Branch of the 5th Pair of Nerves, which are dispers'd at the Roots of the Teeth. Next we come to the inner Substance of the Bones, so far as can be guess'd, because the preserving of the Sceleton entire, has kept me from penetrating so far into the Knowledge of it, as my Inclination might have led me. Every one is sensible, who knows any thing in *Osteology*, as well Human as Brutal, that immediately below the *Coronæ*, or thereby, there is a pretty large Hole in proportion to the Animal, for the emission of a Branch of the External Carotid Artery, Jugular Vein, and 5th Pair of Nerves, call'd *Maxillaris inferior*, which are dispers'd in the Roots of the Teeth for their Nourishment, and for conciliating to them that lively Idea of Pain, which those affected with the Tooth-ach are very sensible of; and that in this Hole in Sheep, Calves, and other Quadrupeds, especially such as are young, as also in Children before the 7th Year, and even afterwards for some time, in the cavous part of the Bone, where the Teeth do not penetrate the Jaw, there are Rudiments of Teeth to be seen cavous in that extremity, which is toward the Base, (in which the Ligaments that keep the Root fix'd are firmly impacted) and solid at the other extremity; so in this Animal from the fore-mention'd big Hole, I observ'd several of these Rudiments of Teeth lying *Stratum super stratum*, or rather placed perpendicularly across the Bone of each others side, from the Hole *(b. b.)* till the Teeth began to appear. Those that were plac'd neareſt the Hole were smaller, not above one Inch in breadth, and $\frac{1}{2}$ Inch in length, *i. e.* from above to below, cavous, as is observ'd, at the lower or back-part, (for reception of the Ligament, which is guarded by two thin hard *Laminæ)* and solid at the other. Those neareſt the Hole were two or three times interfected by Membranes, whereby they could be disjoin'd. But after I had taken out several, I found no more such a Separat on.

Fig. 9.

T. b. 2.

Maxillaris inferior.

The Rudiments of the Teeth.

Fig. 8.

ration, but that from the Right to the Left, they were wholly cavous: Each of them was inveſted by a membranous Tunicle, as it were a *Perioſteum*, and had ſomething like a Cartilaginous Subſtance betwixt the two. Their Surface is very unequal at the Orifice, where they receive the Ligaments and Veſſels (*c.*) and as if they had been folded into ſeveral *Plicæ*, and afterward taken aſunder, from which there run ſeveral Ridges and *Sulci* (*b.*) from one extremity to the other; where the Ligaments ceaſe, they become extreamly ſolid and ponderous, and at their upper Extremities half round, and ſometimes form'd into Digitations (*a.*) *Tab.* 3. *Fig.* 9. When they approach to that part of the Bone at which the Teeth appear, they begin to quit the *Perioſteum*, by which they were diſtinguiſh'd, and unite cloſe together, ſo as to form one Bone. 'Tis obſervable, that at their upper Extremity there is a *Lamina*, which being Convex toward the Jaw, and Concave toward theſe Rudiments of Teeth, do as it were knit their ſolid Extremities together, from which 'tis alſo ſeparated by an intermediate Membrane at the beginning; but afterward that ceaſing, this *Lamina* conjoins them at the Extremities, as they are at the Sides, before they appear without the Jaw. And thus I conceive theſe Teeth to be form'd, and 'tis by theſe I am perſwaded the Jaw becomes ſo ponderous and thick; and that which ſtrengthens this Opinion is, that the hind Teeth of both Jaws (for I doubt not but the'e *Rudimenta Dentium* are in the Upper Jaw alſo) before they come to grind, have their Upper Parts Semicircular; and that both before and after the Grinders are form'd, the Lineaments of theſe *Rudimenta* appear plainly like ſo many Ridges (*d. e.*) having intervening Furrows, where they formerly had *Fig.* 9. been diſtinguiſh'd by Membranes: And I ſuppoſe tho' at the upper Extremity they are united into one compact Bone, yet at their lower Extremity they have ſtill the ſame Hollowneſſes for Reception of the Ligaments and Veſſels as formerly; which Opinion is confirm'd by *Tentzelius*'s Account. The Lower Jaw has 4 Teeth, 2 on each ſide (*d. e.*) as well as the Upper, all Grinders, but no Inciſors, or fore Teeth. The hind Teeth are 8 Inches diſtant, and the Fore not 4, betwixt which is plac'd the *Sinus* for the Tongue (*d. e.*) and 'tis obſervable, that from thence to the bottom the *Sinus* is ſo contracted, as only to be one Inch *Fig.* 7. 8. broad (*f.*) The hind Tooth on the Right Side is 4 Inches, on the Left 5. The one half of their Surface, where they begin to appear, is Semicircular, with the fore mention'd Ridges and *Sulci* running tranſverſely, 4 on the Right Side, and 5 on the Left. The other

other half has 5 of those Eminences, where it Grinds, (whereof formerly, when speaking of the Upper Jaw,) and 4 on the Left. Each of the fore Teeth is 6 Inches long, and has 6 or 7 of the fore-mention'd Eminences, and as many Depressions. The hind Teeth of Dr. *Moulin*'s Elephant seem to have been of an equal length on both sides, and much longer than the fore Teeth. 'Tis observable, that the Ridges at the sides are correspondent to the Eminences where they Grind, and the *Sulci* to the Depressions. The Teeth of the Lower Jaw exceed those of the Upper about 2 Inches in length; by which it appears, that the motion of the Lower Jaw must be very great in Mastication, and that the *Elephant* for the most part moveth the Jaw from behind to before; and scarcely from one side to the other, as in Animals that ruminate, or chew the Cud. These Teeth are the most firm, solid, and weighty Bones of any Aninal yet known, and are as good Ivory as the Tusks themselves. Before we quit the Lower Jaw, I hope it will not be impertinent to enquire, whether or no these *Rudimenta Dentium* may be suppos'd in proces of Time to descend and expell those Teeth already form'd, and succeed in their place; and if not, what may be their Use. For the first question, 'tis true, Children have two ranges of Teeth, tho' not equally solid, the second whereof expels the first at or about 7 Years of Age, and succeeds them, the first being only so many Sheaths or Covers, whereby the second, being yet but a soft Mucilaginous Substance, are defended from External Injuries, till in process of time they have attain'd to a convenient hardness; and that there is a great difference in the Teeth of some Quadrupeds, such as young Horses, whose Fole or Colt Teeth, as they are call'd, have some Marks, which are obliterated after a certain period of Years (well enough known to Jockies;) so that it would appear, if these Teeth are not expell'd, yet their Surface by degrees is abraded, and instead of that their Roots are augmented, and the Teeth receive such an alteration, as their Age is no more known by these Marks. I have already observ'd, that there are several Ridges and Furrows in the Teeth of this Animal, which seem to be an Evidence, that these *Rudimenta* have grown together and become one Tooth; but whether the *Rudimenta*, which have not as yet appeared without the Jaw, do ever expel these which have appeared, and succeed them, is the question; no Experiment yet being made concerning the Production of those in this Animal. The period of the Time that *Elephants* live, and the Age of this we treat of being unknown, we can give no positive determination in this Matter:

The Teeth, or Grinders of the Lower Jaw.

ter: Yet I am apt to believe, these Teeth as well as the *Rudimenta*, have been *à prima formatione*, and that because, 1. The Jaw Bone so firmly adheres to the Teeth on both sides, so soon as they appear, and the place of their Roots is so well known (by the Protuberance on the outside of the Jaw) to be enlarg'd within the *Alveoli*, that I do not see how they can be expell'd by a succeeding Set. 2. When one Set of Teeth expels the other, the second is usually below the first, and not plac'd in the same Rank, as these are; which obliges me to enquire, what may be the use of these *Rudimenta:* Which I suppose to be, 1. To fill up the Cavity of the Lower Jaw. 2. By their Weight to add Strength in Mastication. 3. That there may be so many different Bones to assist the Teeth in their motion; and 4thly, To serve instead of a Wedge for keeping the Teeth firm in their Place. For the first, 'twas convenient the Lower Jaw should bear an equal proportion in its bigness to the Upper, and have sufficient space for Insertion of the Muscles fit for its Motion; and if a proportionable bigness, than either the Bone must be altogether solid, or cavous and stuff'd with some other ponderous Substance; for if spongy or cellulous, then would it have been too light, which would have been very inconvenient. As to the second, the Weight is of considerable Moment, for the more exact Attrition of the Aliment, which is here requisite, because the Tongue of this Animal is both small and polite on its Surface without those sharp cartilaginous *Papillæ* those Animals are endued with, whose Teeth are not sufficient to grind their Food. As to the third, I conceive that these *Rudimenta*, with their intermediate Membranes, may be the more helpful to the Teeth in their Motion, if they have any, or Pressure, than if the surrounding Jaw had been one whole continued solid Bone. For the fourth, a hard and soft Substance alternatively plac'd, is certainly more convenient for keeping any thing firm than either of the two alone; for had they been hard Substances that lay upon one another, then neither would yield to Pressure; and if soft, tho' they yielded, yet would they not so well retain the Pressure they receive, and keep any thing firm thereby, as if they had some intermediate Substance: In a word, be the use of these *Rudimenta* what it will, the Teeth and they together have rendered this so ponderous as to amount to 45 ℔ Weight. And thus have we ended the External Parts of the Head.

N. B. *The remaining Part of this Discourse (with the Figures) will be inserted in the following* Transaction.

PHILOSOPHICAL TRANSACTIONS.

For the Months of July, August, *and* September, 1710.

A Continuation of the Osteographia Elephantina:

OR,

A full and exact Description of all the Bones of an *Elephant*, which dy'd near *Dundee*, *April* the 27*th*, 1706. with their several Dimensions.

To which are premis'd,

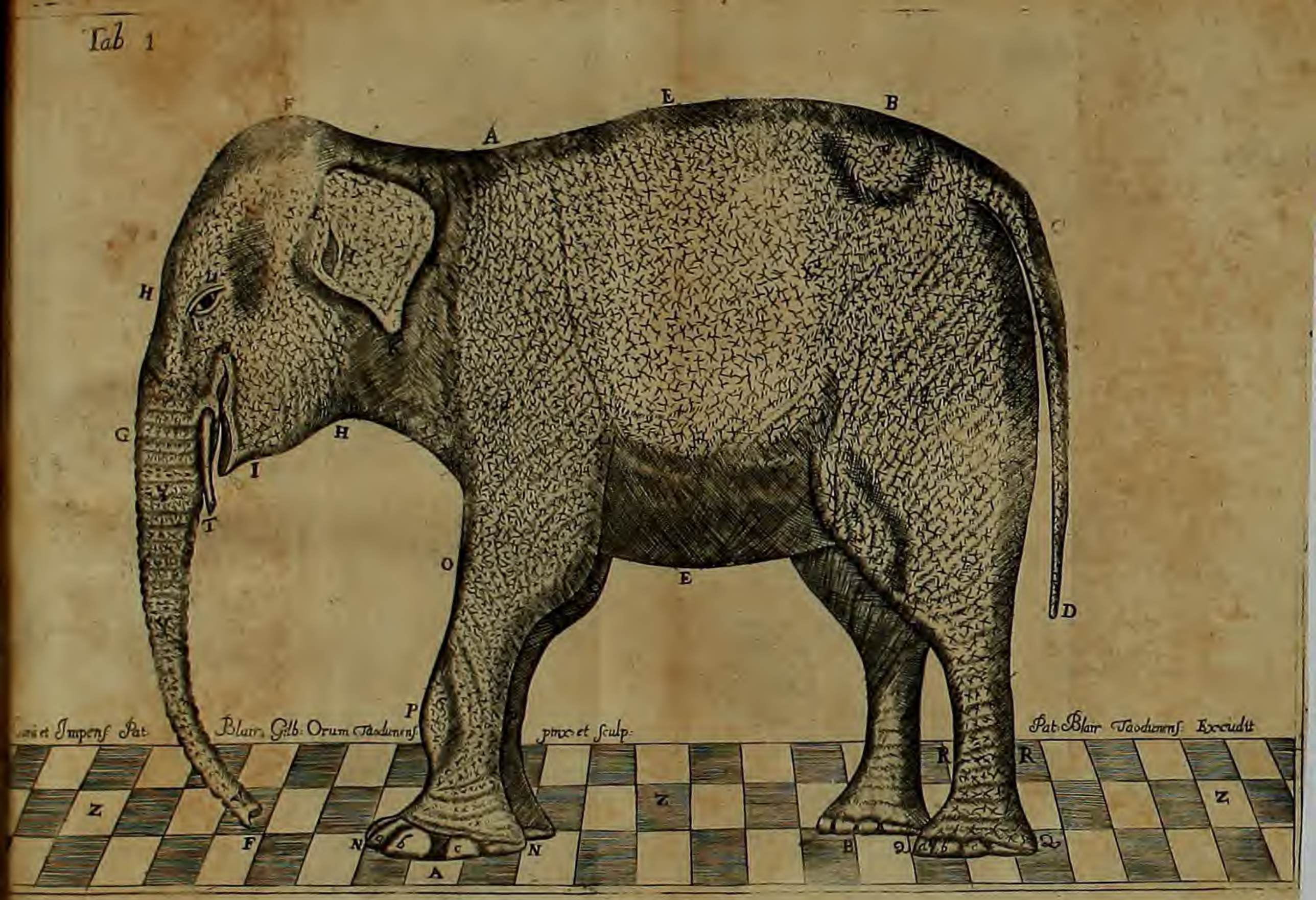
1. *An Historical Account of the Natural Endowments, and several wonderful Performances of* Elephants, *with the manner of Taking and Taming them.*
2. *A short Anatomical Account of its Parts.*

And added,

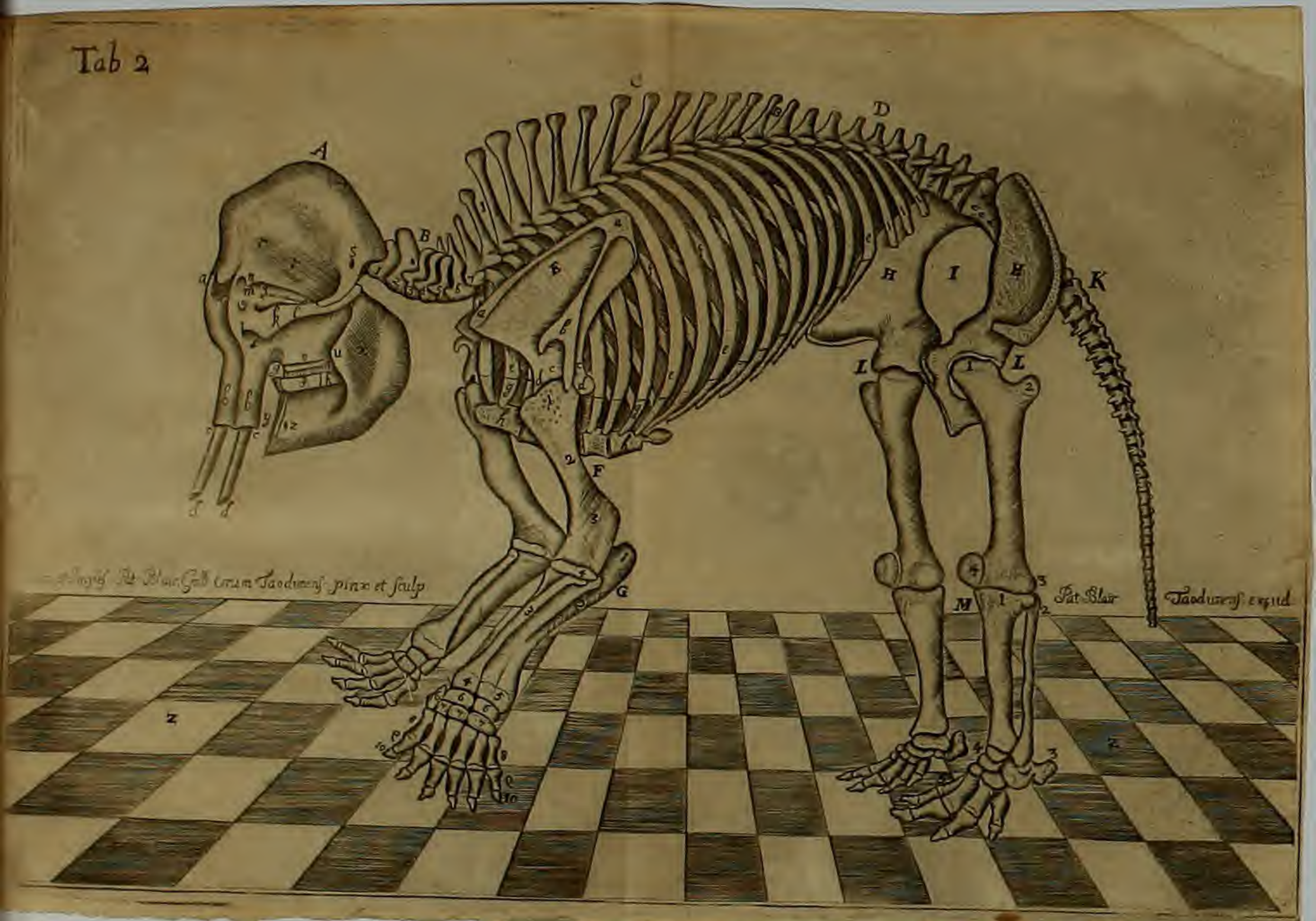
1. *An exact Account of the Weight of all the Bones in this Subject.*
2. *The Method I us'd in preparing the Sceleton.*
3. *Four large Copper Plates, wherein are represented the Figures of the Stuff'd Skin, and prepared Sceleton, as they now stand in the Publick Hall of Rarities at* Dundee; *with the separated Bones in several Views, and other Parts of this* Elephant.

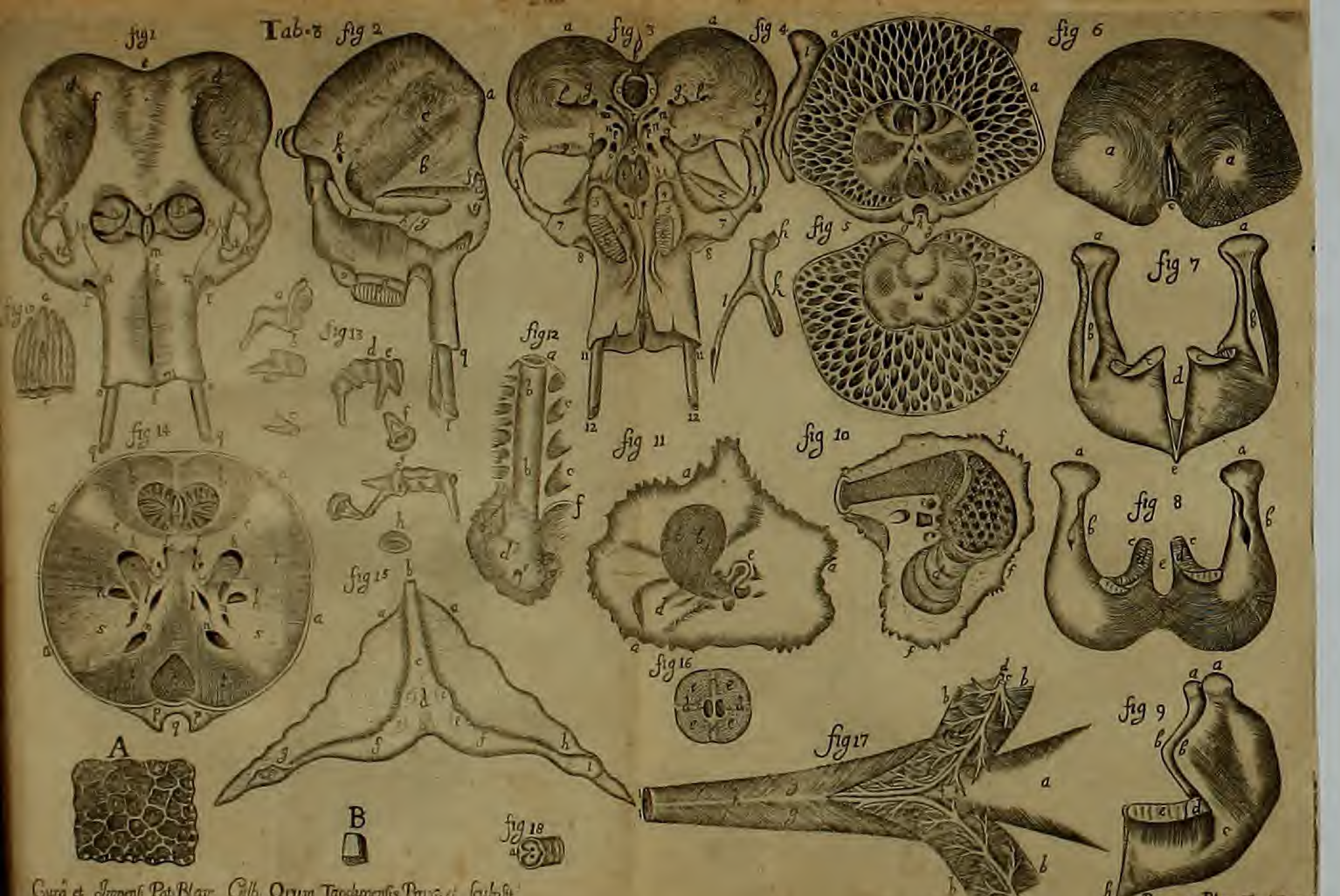
Communicated in a Letrer to Dr. *Hans Sloane*, R. S. Secr. By Mr. *Patrick Blair*, Surgeon, *&c.*

Tab 1



Tab 2





Tab. 8
fig 1
fig 2
fig 3
fig 4
fig 5
fig 6
fig 7
fig 8
fig 9
fig 10
fig 11
fig 12
fig 13
fig 14
fig 15
fig 16
fig 17
fig 18
A
B
Curâ et Impens. Pat. Blair Gilb. Orum Taodunensis Pinx. et sculpsit
Patricius Blair Taod. Exc.

fig 1

fig 2

fig 3

fig 4

fig 5

Curæ et Impensis Patricij Blair

fig 6

fig 7

fig 8

fig 9

fig 10

fig 11

Gilb. Ormen Taodunens. Pict. et Sculp.

Pat. Blair Taodunens. Exc.

A Continuation of the Osteographia Elephantina: *Or, a Description of the Bones of an* Elephant, *which died near* Dundee, April *the 27th*, 1706. *By Mr.* Patrick Blair.

BEing come to the Internal Parts of the Head, we shall proceed as in Treatises of *Osteology*, by taking Notice of its Structure, two Tables, *Diploe*, Figure and Extent of the inner Table, *Fossæ*, Eminences and *Foramina*; of all which in their order. As there is no Animal in proportion that is endued with a greater quantity of Brains than Man, so there is none that seems to have less than the *Elephant*. In the one, 'twas so order'd by the Wise Governor of all Things, that they might be sufficient for the Generation of so many Spirits, as are requisite for the Performance of the Rational and Animal Functions; and in the other, had the quantity of Brains been greater, the *Principia Nervorum* had been more divided; so that instead of being requisite, they had been vastly inconvenient, because the Nerves could not so well receive the Spirits dispers'd in a greater Mass, as now, when contracted within lesser bounds: And such a contrivance as this being requisite, the interposing of such a vast distance betwixt the two Tables of the Scull, as we shall come to give an Account of, is a stupendious Piece of Mechanism. *Inner Parts of the Head.*

As we before observed, in the bottom of the Hole for the Root of the Trunk there are several *Laminæ (h. h.)* to be seen. These *Laminæ*, taking their Origin from hence, run backward in a Parallel, and sometimes oblique Line, to the second Table of the Scull, or that part of it which invests the Brain: And these *Laminæ* being either horizontally, perpendicularly, or obliquely plac'd, meet with and intersect each other, forming intermediate Cavities or *Cellules (c. c.)* of different Magnitudes, Positions and Figures, according to the Intergerine Walls or Sides, whereof they are compos'd: So that although Dr. *Moulins*, and after him *Tentzelius*, seem to assert, that they were for the most part triangular, yet I have observ'd them quadrangular, pentagonal, hexagonal, and rectangular, and even sometimes irregular. These Cells run, as I said, from the outer Table, or External Parts of the Scull *(a. a.)* to the inner Table or Seat of the Brain *(b. b)* and communicate with one another by pretty large Holes, either *Tab.* 3. *Fig.* 1. Cellules *of the Head.* *Fig.* 4.

toward the inner or outer Table, and ſometimes two meeting together in the middle frame a third. In a word, as there is no certain Rule obſerv'd in their Figure, ſo neither is there any in their Communication. The diſtance they fill up between the two Tables before is 11 Inches, at the Sides 8 Inches, toward the back-part but 3 Inches, and at the Hole for the Spinal Marrow *(o.)* both Tables meet together; for the Brain is plac'd in the lower and back-part of the Scull (Fig. 5.) All theſe *Cellules* were empty, and only obduc'd with a thin Membrane. And here I cannot but take Notice of what Dr. *Moulins* obſerves, namely, that there are ſeveral Blood Veſſels pleaſantly diſſeminated throughout the Surface of theſe *Cellules* with different Divarications; and *Tentzelius* ſays, he obſerv'd ſeveral Lineaments of Veſſels after the ſame manner. This was not to be obſerv'd in ours at all, nor ſo much as the *Veſtigium* of a Veſſel to be ſeen; the reaſon whereof, I ſuppoſe to be this: When the one was burnt in *Ireland*, and the other over-whelm'd with Earth in *Germany*, both ſuffering violent Deaths, could not but have vaſt Struglings and Wreſtlings, ſuch as Dr. *Moulins* ſays his had, and ſuch as *Tentzelius* ſuppoſes that in *Germany* to have had alſo. By theſe violent Motions, the Blood could not but be propell'd with a vaſt force from the greater Trunks to the ſmaller Capillaries, where it diſtended the Veſſels, and rendred them ſo perceptible to the view after the Death of the Animal; whereas this we treat of, having labour'd of a languiſhing Diſtemper for ſometime, as appears by the *Polypus's* found in the Heart and other Veſſels, the Blood could not but be very languid, and ſcarce convey itſelf to theſe Capillaries; So that the Sides of the Veſſels being collaps'd, they were rendred imperceptible: But that which is more remarkable is, that not ſo much as any of the *Sulci*, which theſe Veſſels might have made in the *Laminæ*, do at all appear; and yet the *Sulci* were ſtill very evident in the Bones found in *Germany*, with the Blood Veſſels containing the dry Blood ſtrictly glued to them, and chang'd into a yellowiſh Colour, and that perhaps after thouſands of Years, as the ſame Author obſerves. Indeed upon viewing more narrowly the *Cellules*, I find all of their *Laminæ* endued with ſmall Holes of an indefinite Number, and irregularly plac'd, through which theſe Veſſels ſeem to have paſt from one *Cellule* to another: So that tho' not ſo obſervable, yet no doubt they have been diſpers'd through them in this as well as in other *Elephants*.

We

We come next to enquire what may be the Uſe of the *Cellules*. There have been ſeveral Opinions advanc'd about them; as 1ſt. That ſince the *Elephant* has been obſerv'd to ſuck up a great deal of Water by the *Proboſcis*, that the Water perhaps is received into theſe *Cellules*, becauſe of the Communication they ſeem to have with the *Proboſcis*, and that thereby they cool their Brain in hot Countries, where they abound. 2. That ſince the *Elephant* has a very acute Senſation of Smelling, they think the *Nervus Olfactorius* is diſpers'd (after it has paſs'd the *Os Ethmoides*) throughout the fine Membranes that obduce the *Laminæ*, which deſcribe theſe *Cellules*. 3. That theſe *Cellules* being interpos'd betwixt the two Tables of the Scull, they only ſerve to keep the Head from being too weighty. As to the firſt; admit the Water could be receiv'd into theſe *Cellules*, which from their Poſition at the Root of the Trunk, 'tis plain they cannot, there being no muſcular Subſtance to expel theſe Waters, we cannot ſuppoſe this is their Uſe. As to the ſecond; the *Nervus Olfactorius*, after it has paſs'd the *Ethmoides*, does not at all communicate with theſe *Laminæ*, but penetrates the *Os Vomeris*, whence the *cartilaginous Septum* of the *Proboſcis* ariſes: So that theſe *Cellules* can be no ways aſſiſting for that end, the Senſation of Smelling being chiefly perform'd in the *Proboſcis*, and not by the Fibres of the *Nervus Olfactorius* diſpers'd in theſe *Laminæ*, which are quite otherwiſe diſpos'd here, than in Men, Dogs, *&c.* whoſe *Laminæ Spongioſæ* are ſituated in the Root of the Noſe; ſo that the Air muſt touch them before it reach the *Os Cribroſum*; whereas here the *Laminæ* are ſo ſituated, that the Air touches the *Nervus Olfactorius* as ſoon as it can touch them. The third is to me more probable, and Dr. *Moulins* is of the ſame Thought, and that upon ſeveral Accounts; ſuch as the Conſideration of the ſmall extent of the Seat of the Brain, to which had the reſt of the Head been correſpondent, it would have had no proportion to the Body; nor could the Muſcles, fit for moving the Head, have ſufficient ſpace for their Inſertion, nor the *Proboſcis* for its Origin; ſo that there was a a Neceſſity for interpoſing ſome diſtance betwixt the inner and outer Table of the Scull. Now this diſtance muſt be fill'd up with ſome intermediate Subſtance, and had that either been carnous or oſſeous, whether ſpongious or ſolid, or (as ſome think the *Sinus Frontales, Maxillares & Baſilares* in human Sculls are) Mucous; ſhould either of theſe have occupy'd ſuch vaſt bounds, the Head would have been rendered too

Uſe of the Cellules.

weighty. Therefore it is wisely order'd by Providence, that there shall be only thin *Laminæ* of Bones, so dispers'd, that the outer Table of the Scull may be more strengthened for supporting the Weight of the Muscle of the Head, Lower Jaw, and *Proboscis* adhering thereto, that it may have a Communication with the inner Table, and that the space betwixt these *Laminæ* may be empty; lest by any intermediate Substance, the Head had been too heavy, as is said, and the inner Table so burthen'd as to press too much upon the Brain, which might have disturbed the *Æconomia Animalis*. Analogous to this Structure we find in Oxen, which have the same *Cellules* betwixt the two Tables of their Scull, especially toward the Horns, whose Flints, as they are call'd with us, or the boney Substance, whereby that part of the Horn, which is t ward the Head, is fill'd, is likewise cellulous, lest by their Weight, together with that of the Horns, they should prove uneasy to the Head: But lest by reason of these Vacuities, which are all plac'd in the upper and fore-part of the Head of the *Elephant*, (for the Brain and *Elevatores Capitis* are sufficient to depress its back-parts) it should be rendred so light, that it could not be equally pois'd or kept steady, the Teeth, both in the Upper and Lower Jaw, are rendred thus weighty to counterballance it.

Inner Surface of the Scull.

We come next to consider the inner Surface of the Scull, where the Brain is lodg'd: 'tis in Figure like an Human one, but more Spherical, being from the Right to the Left 10 Inches, from before to behind 9 Inches, and from above to below at the *anterior Fossa* 7 Inches, betwixt the middle 5 Inches, and at the *posterior*, or Seat of the *Cerebellum*, 4 ½ Inches. It has 4 *Fossæ*, and 5 Eminences. The *anterior Fossa* (*b.b*) is circumscrib'd by the fore-part of the inner Table of the Scull before, and by the two *anterior* Eminences (*c.c.*) behind. Here the Brain sends forth its greatest Productions; for at the hind part this *anterior Fossa* is depress'd streight down near 2 Inches, where the *Os Ethmoides* begins, which is of a singular Figure and Structure; for from the fore-part of the Seat of the Brain in the middle, there is here, as in most Sculls, an Eminence which runs obliquely downward, till it begins to form the *Crista Galli* (*d.*) so call'd in Human Subjects. This *Crista Galli* divides the *Os Ethmoides* into its right and left Part; 'tis pretty thick and broad at the Base, whence it arises from each side, till it begins to form a *Crena*, which is perforated by 3 Pair of Holes; and then there arises,

Tab. 3. *Fig.* 14.

a

a ſmall *Spina* in the middle *(d.)* at the fore Extremity whereof, it being further extended than the *Ethmoides*, there is another Hole. From this *Criſta Galli* run on each ſide ſeveral prominent convex Lines, ſome obliquely forward, o hers obliquely backward, others tranſverſely; each of which is branch'd out twice or thrice toward the Circumference, which 'twas impoſſible to expreſs very lively in ſo ſmall a Figure. Theſe Lines have ſome few Perforations running from their higheſt part, but moſt of them are betwixt their Interſtices, where they are pleaſantly diſpers'd after ſome kind of order, which alſo we could not expreſs in the Figure. The *Os Ethmoides* is not unlike a Heart, as they uſually repreſent it, being narrower at the hind part, where the *anterior Foſſa* runs ſtreight down from the fore-part of the *Sella Turcica (u.)* and broader at the fore-part of the Bone, which runs obliquely upward from it; 'tis from before to behind 3 ½ Inches, and from the right to the left 4 Inches: Its Circumference is not altogether circular. The Speciality of this Structure gives ground to enquire into its Reaſon, and the acute Senſation of Smelling, wherewith, according to all Authors, this Animal is endued. In moſt of other Animals, neither is this *anterior* Production of the Brain ſo great, the Perforations of the *Os Cribroſum* ſo many, nor its extent ſo large: But in Animals of an acute Smelling, beſides the Perforations of the *Os Cribroſum*, there are ſeveral ſpongious *Laminæ* which ariſe from its lower part; each whereof are endued with Tunicles, wherein are variouſly diſpers'd ſeveral Branches of the *Nervus Olfactorius*; and theſe *Laminæ* are ſet very near to one another, as it were the Teeth in a Comb, or the *Lamellæ* in the lower Part of ſome Muſhromes. Both the Contrivance of the *Laminæ* and their thick diſpoſal, are very uſeful for Senſation; for whereas, had this *Nervus Olfactorius* been ſtill in one Trunk, the Volatile Saline Particles would have only acted upon ſuch Filaments as compoſe the Surface; whereas the Nerve being variouſly diſpers'd into divers Branches, and theſe Branches differently diſpos'd into ſeveral Surfaces, 'tis capable to receive Impreſſion from as many Saline Particles, as there are different Branches and Surfaces, whereinto theſe are diſpos'd: Add alſo, that the ſharp Edges of theſe *Laminæ* being toward the Air, they are more capable to divide the *Columna Aeris* ſuck'd in by the Noſe, and give a greater tenſion to the Nervous Filaments diſpers'd in them; whereby the Senſation is communicated the more lively to the *Senſorium Commune*; and

Os Ethmoides.

and 'tis obſervable, that ſuch Creatures as have moſt of theſe *Laminæ* have their Smelling the more acute. Now this Structure is only to be ſeen in thoſe Animals, whoſe *Septum intermedium* and two ſides of the Noſe conſiſt of Bones, at leaſt ſo far as their *Laminæ* are extended; but it fares otherwiſe with our *Elephant*, whoſe *Os Ethmoides* is very thin, and has no *Laminæ Spongioſæ* adhering to its outſide, nor a Bone for the *Septum*, or Sides to guard theſe *Laminæ*, which would have been inconvenient, for then the *Proboſcis* could not have mov'd with the ſame Facility, e'en from its Root, as it doth. Therefore to ſupply this defect, and ſtill to continue the Smelling ſo acute, if not more in this than in many other Animals, 'tis provided, that the *anterior Foſſæ* ſhould be very deep, that the Production of the Brain in it might be the greater; and leſt its Surface ſhould ſtill be too ſmall, there ſhould be eminent Lines both in the *Vomer* and throughout the reſt of the Bone, that there might ſtill be more ſpace for branching out the Nerve, as it proceeds from its Origin. There may alſo be another Reaſon alledg'd for theſe Protuberances, *viz.* becauſe the Brain is more pendent here than elſewhere, they may ſerve as ſo many Columns to ſupport it, leſt by its Weight it ſhould lean too much upon the *Os Cribroſum*, ſo that the Origin of the *Nervus Olfactorius* being too much preſs'd, inſtead of a clear, might afford a very confus'd Idea of Smelling; and, that even within the Scull it may be ſo divided and diſpers'd in this Animal, as it uſeth to be without it in others: So that the defect of the *Laminæ Spongioſæ* without, is ſupply'd by this diverſity of Perforations and Eminences in the *Os Cribroſum* within. Indeed in Horſes there is ſomewhat of this Structure to be obſerv'd: The *Os Cribroſum* ſeems to be proportionally as large; its Perforations as frequent; and the *Laminæ Spongioſæ* without, both few and thin ſet; by which that Creature has but an ordinary Senſation of Smelling, and only ſuch as is convenient for the choice of its Food; becauſe the *Nervus Olfactorius* has not ſuch a ſpace wherein to be diſpers'd, as the *Septum* and Cartilaginous Sides of the *Proboſcis*; which is ſo great, that ſcarce can a Particle of any odoriferous Subſtance eſcape the touching of ſome one or other of the Nervous Filaments: Whereas in Horſes, there being but a ſhort ſpace betwixt the *Os Cribroſum* and the Noſe, the additional Surfaces of the *Laminæ Spongioſæ*, and the tenſion of the Bone of the Noſe on both ſides, otherwiſe than in the *Elephant*, who has no Bone there at all, are very convenient to ſupply that defect; for you

know

know the more extended a Nerve is, the greater is its Senſation, and a Bone is fitter for tenſion than either a Cartilage or other ſoft Subſtances are. The *anterior Foſſa* (*b. b.*) is from the Right to the Left 8 Inches, and from before to the *Nervus Opticus* behind 4 ½ Inches, and of depth, *i. e.* ſtreight down from the *Sella Turcica*, or in the middle betwixt the foreſaid Holes to the bottom of the *Os Ethmoides* on each ſide, 2 ½ Inches The two middle *Foſſæ* are bounded before by the two *anterior* Eminences (*e. e.*) and behind by the two *Proceſſus Petroſi* (*s. s.*) The Seat of the Brain is here 12 Inches Diameter (*r. r.*) In the Center between the two *anterior Proceſſes* is the firſt Pair of Holes (*f. f.*) at an Inch diſtance. Theſe run obliquely between two ſmall Eminences, where the *Glandula Pituitaria* was lodg'd, call'd the *Sella Turcica* (*u.*) and theſe two *Proceſſes* are call'd in Human Subjects *Clinoides*. This Pair of Nerves runs obliquely downward 6 Inches, and paſſes out below the *Lamina* on each ſide of the Head (*s.*) which frames the upper Edge of the *Sinus* for the Globe of the Eye, being the ſecond Pair, call'd the *Optick Nerves*. Theſe two *Proceſſes* running ½ Inch back on each ſide, at the ſame diſtance afford two more Holes paſſing in below them, which could not be ſhewn in the Figure; this is call'd the *Foramen lacerum*, and through it paſs the third Pair, or *Oculorum Motorij*; the 4th Pair, or *Pathetici*; the *Opthalmic*, or firſt Branch of the 5th Pair, and all the ſixth Pair (*g. g.*) The third Pair of Holes is at the back of the two *anterior* Eminences, betwixt the firſt Pair and the External Part of the Seat of the Brain, 4 Inches diſtant from each other (*h. h.*) They are the largeſt of all thoſe in the bottom of the Scull, except that for the Spinal Marrow, and have a peculiar Uſe, which is at large declared, Pages 82 and 83, when ſpeaking of the Veſſels and Nerves of the *Proboſcis*; *viz.* that they are for the tranſmiſſion of the *ſuperior* Branch of the ſecond Diviſion of the 5th Pair of Nerves, and a Branch of an Artery which proceeds from the *Arteria duræ Matris* (*k. k.*) being ſeparated from it by the boney *Septum*, which paſſes betwixt it and the Hole for the third Branch of the 5th Pair (*i. i.*) runs along the *Crena* (*x. x.*) and paſſes out with the foreſaid ſecond Branch (*g. g.*) The fourth Pair of Holes then is for the Egreſs of the third Branch of the 5th Pair (*i. i.*) and Ingreſs of a Branch from the *Arteria duræ Matris*; and the 5th Pair is for the *Arteria duræ Matris* itſelf (*k. k.*) The ſixth Pair is for the Carotid Artery (*l. l.*) which is otherwiſe ſituated here than in Human Subjects; for in them it

Anterior Foſſa *of the Scull.*

Middle Foſſæ.

Firſt Pair of Holes.

Fig. 2.

Second Pair.

Fig. 14.

Third Pair.

Fourth Pair.

Fifth Pair.

Sixth Pair.

is

is betwixt the *Proceſſus Petroſus*, and two *poſterior Proceſſus Clinoides*; whereas here 'tis betwixt the *Proceſſus Petroſus* and Center of the Baſe of the Scull, on each ſide about 3 Inches diſtant from each other. The ſeventh Pair is for the *Nervus Auditorius* (*m. m.*) being ſituated in the *Proceſſus Petroſus* (*S. S.*) And here 'tis obſervable, that from the ſide of the Hole where the Carotid Artery (*l. l.*) paſſes toward the *Os Petroſum*, there is an Hole which runs about 1 ½ Inch outward, forms an Angle, and then paſſing by the Sides of the *Cavitas Tympani* (*e.*) runs ſtreight downward and penetrates the Scull (*l.*) This I take to be the Hole for the hard Portion of the *Nervus Auditorius*, which does not here as in other Animals, paſs in at the Hole of the *Proceſſus Petroſus* with the ſoft Portion; but as it proceeds from the Brain, goes along the Sides of the Carotid Artery to this Hole. This hard Portion, as I told you, was much bigger as we trac'd it running forward above the Temporal Muſcle, and going to the upper Lip to be afterward diſpers'd in the *Proboſcis*. The eight Pair is for the Internal Jugular Vein, and *par vagum*, which paſſes out at the ſame Hole (*n. n.*) And the Ninth *Impar*, is for the Spinal Marrow; of which already. And thus we have given an Account of all the Parts of the inner Surface of the Scull. Now we come to the Conſideration of

Seventh Pair.

Eighth Pair.

A Hole for the Spinal Marrow.

The *Ear*, whoſe Parts are, 1ſt. The *Meatus Auditorius*, or that *Duct* which runs from an Orifice on each ſide of the Head (*k.*) whereof formerly, to the inner Table of the Scull, terminating in the *Os Petroſum* (*S.*) being of a Cylindrical Figure (*b. b.*) having the *Cellules* ariſing from it on all ſides (*c. c.* &c.) 'Tis in length from the External Orifice to the *Crena* for the *Membrana Tympani* (*b.*) 9 ½ Inches, and about 1 Inch Diameter throughout the whole Extent. Its Sides are compos'd of a firm ſolid Bone, and little thicker than an Halfpenny. Next is obſervable the *Crena* for the *Membrana Tympani*, in Circumference 2 Inches ½: After which is to be ſeen the *Cavitas Tympani*, conſiſting of two Parts; the firſt whereof (*c. c.*) is ½ Inch deep, ſtreight down from the foreſaid *Crena*, endued with a great many *Cellules*, diſtinguiſh'd from each other by ſeveral oſſeous ſolid *Lamina*, irregularly diſpos'd, which could not be ſo well repreſented in the Figure. Theſe Excavations were about two or three Lines, or ⅛, or ¼ Inch deep. The next Cavity (*d.*) is of a Surface more ſmooth, ariſes much higher than the former, and runs toward the outer Table, having ſeveral Semicircular Lines running acroſs.

Tab 3. Fig. 2.
Fig. 13.
Fig. 12.
Fig. 10.

acroſs. The firſt Cavity is from the Right to the Left 1 $\frac{1}{3}$ Inch, and from before to behind 1 $\frac{1}{4}$ Inch. The ſecond Cavity 1 Inch in length, and $\frac{1}{2}$ Inch at its broadeſt part. The *Officles*, *viz.* the *Malleolus* (*a*) *Incus* (*b.*) *Stapes* (*f.*) are of a proportional bigneſs, as you ſee in the Figure, where they are ſhewn in their true Dimenſions, running from the *Malleolus*, which touches the *Membrana Tympani*, to the *Baſis* of the *Stapes*, which ſhuts the *Foramen Ovale* (*c.*) It has but a ſmall *Cochlea* in proportion (*d.*) whereinto a Branch of the Soft Portion enters, and another Branch of the ſaid Portion goes into the *Cavitas Tympani*, whoſe upper part is covered by the lower ſide of the *Os Petroſum* (*b. b.*) I was at ſome Pains to file down a great part of the *Os Petroſum*, where I obſerv'd how the Hard Portion paſt outward from the Hole for the Carotid Artery, as is ſaid, and how the Soft Portion after it had entred the *Proceſſus Petroſus* (*e.*) did divide itſelf into theſe two juſt now mention'd Portions, to the *Cochlea*, and *Cavitas Tympani*. I ſearch'd for the *Labyrinth*, or *Lineæ Semilunares*, but could find none; by which I concluded, that theſe Caverns in the bottom of the *Cavitas Tympani* did ſerve for the ſame Uſes in this Animal, as the *Meanders* of the *Labyrinth* do in others; and that this ſecond Cavity did ſerve for receiving and continuing the Undulations of the Air, for the longer retaining of the Sound, as we ſee the cavous *Apophyſis Maſtoides* does in Sheep, Cats, Dogs, *&c.* and the Spongious one in Men. The *Foramen Ovale* is but little, and the Baſe of the *Stapes* very thin and ſlender (*h.*) whereby I ſuppoſe the Senſation of Hearing is rather perform'd by the Vibrations of the Air upon the *Cavitas Tympani*, than by any aſſiſtance it had from the *Cochlea*. The upper part of the *Septa* which circumſcrib'd the Caverns in the *Cavitas Tympani*, is thicker, and the lower part very ſlender; and I doubt not but they communicate with one another by ſeveral *hiatus*, whereby what humidity is in the bottom of the Caverns may be convey'd from each other, till it come to the Oriſice of the *Aqueduct* parallel to it, and thereby diſcharge it into the Mouth; for the boney part of this *Aqueduct* deſcends in a ſtreight Line, from the fore part of the bottom of this *Cavitas Tympani* 5 $\frac{1}{2}$ Inches flat, being from the Right to the Left about $\frac{1}{2}$ Inch, and from before to behind 3 Lines, or $\frac{1}{4}$ of an Inch. I am ſorry I did not know the *Os Petroſum* would ſo eaſily ſeparate for I might have obſerv'd more narrowly the Structure of the Ear before the Scull was boil'd; and 'tis by an accidental Separation of this

Fig. 13.

Fig. 11.

Bone, after the Head was taken out of the Caldron, that I have now come to give this Account of it.

From the Head we go to the Trunk, which consists of the Spine, Ribs, and *Sternum*. The *Spine* is divided into the *Vertebræ* of the Neck, Back, Loins, *Os Sacrum*, and *Tail*. The *Vertebræ* of the Neck differing from each other in several things material, I shall speak of them separately: Whereof

The first Vertebra *of the Neck.* *Tab.* 4. *Fig.* 1.

The first call'd *Atlas*, has four considerable Cavities; two at the fore part (*b. b.*) whereby it receives the *Condyles* of the Scull, and two at the back-part (*c. c.*) whereby it receives the Base of the following *Vertebra*; the first two are 2 ½ Inches from above to below, and 2 Inches from the Right to the Left. It has a large Hole in the middle, divided into its larger part (*a.*) 3 Inches Diameter, which is for receiving the Spinal Marrow, and Lesser, which receives the Tooth of the following (*b.*) Four Perforations, or two Pair of Holes at the Sides; one at its lower and fore-part (*c. c.*) which receives the *Arteria Cervicalis*, or *Vertebralis* from the side of the Spinal Marrow, and conveys it to a *Crena* (*c. e.*) along which it runs, till it again penetrates the same Bone (*d. d.*) and goes out at the back part; after which in its Progress it perforates all the transverse Processes of the rest of the *Vertebræ* of the Neck, as is usual in other Animals. This *Crena* is guarded on its outside, or at the Extremity of the transverse Processes by a Protuberance, which runs toward the Scull 1 ½ Inch (*a. a.*) till it be equal to the Sides of the Hole for the Spinal Marrow. At its upper and fore-part it inclines obliquely (*f.*) where 'tis 3 Inches thick, and at its lower and back-part (*e.*) it has a Protuberance which is extended where it embraces the Tooth. This *Vertebra* is in Diameter 12 Inches (*a. a.*) The transverse Processes are in breadth from above to below 2 Inches, and in length at their lower part 3 Inches.

A.

A. 1.

The second. A. 2.

The second *Vertebra* has remarkable in it, 1st. A large Protuberance called the Tooth (*d.*) which is received by an Hole in the former, and serves as an Axis upon which the Head is turn'd round. This Tooth runs forward from the Body of the *Vertebra* 2 Inches above, and 2 ½ Inches below, tapering and terminating in an obtuse Point. 2. A large Protuberance arising from its upper and middle part (*a. a.*) (like the *Processus Spinosus* in others, 4 Inches from the beginning of the transverse Processes, two Inches broad at the top, terminating in two obtuse Points, with a *Sinus* (*b.*) larger at the back than the fore-part) in the middle.

This

This Protuberance inclines forward toward the firſt *Vertebra*. 3. Its Body or back part, and Baſe of the Tooth (*f.*) tranſverſely 4 ½ Inches, perpendicularly 4 Inches. 4. Two oblique Proceſſes, by which 'tis articulated with thoſe of the following, and betwixt which there are 4 Inches (*h. h.*) 5. Two tranſverſe Proceſſes (*g. g.*) each 2 Inches long. At its fore part on each ſide of the Tooth (*d.*) are two Protuberances (*e. e*) which are received by the two hind Cavities of the firſt *Vertebra*. This *Vertebra* is two Inches thick from before to behind, the Hole for the Spinal Marrow 2 Inches Diameter, thoſe for the Cervical Artery (*f. f.*) ½ Inch Diameter. Between the oblique and extremity of the tranſverſe Proceſſes, 'tis 6 Inches. B. 2. A. 2.

The third and fourth *Vertebræ* differ from this, 1ſt. In their four oblique Proceſſes (*e. e.*) *viz.* two by which they are articulated with the preceding, and two with the following, which is common to thoſe of the Neck, Back and Loins. 2. In their Convex Body before (*b. b.*) and concave behind (*c. c.*) where they are receiv'd by, and do receive the preceding and following, which is alſo common to the other *Vertebræ*. 3. In their Eminences at the Top (betwixt the oblique Proceſſes) at 4 ½ Inches diſtance (*e. e.*) betwixt which there is a Depreſſion in the third, and a ſmall Protuberance in the midſt of this Depreſſion in the fourth. Their tranſverſe Proceſſes (*f f.*) are 2 Inches broad at the Extremity, from which they deſcend obliquely 3 Inches, having a Protuberance on each ſide, betwixt which and the Body of the preceding *Vertebra* (*h. h.*) does proceed a Branch of the Cervical Artery, which it continues to do from betwixt all the other *Vertebræ* of the Neck, till it comes to betwixt the Seventh of the Neck and firſt of the Back, where 'tis wholly ſpent. Betwixt the oblique Proceſſes (*e. e.*) and tranſverſe (*f. f.*) it is 4 Inches. The Hole for the Cervical Artery (*d. d.*) is here Oval. The Bodies of theſe *Vertebræ* are thinner below than the former: They are 4 Inches in Diameter, being of the ſame Dimenſions with all the other *Vertebræ* of the *Spine*, till you come to the *Os Sacrum*. Thoſe in the Neck are more flat before, and thoſe in the Back more Protuberant. Beſides thoſe *Sinus's* in the inſide of the fore-mention'd Protuberances in the Neck, there is likewiſe a *Sinus* betwixt the tranſverſe Proceſſes of each *Vertebra* and its Body, throughout the whole *Spine*, for tranſmiſſion of the ſeveral Conjugations of Nerves from the Spinal Marrow. *The third and fourth* Vertebræ. A. 3. A. 4. *Fig.* 3.

The fifth. A. 5. The fifth *Vertebra* is of the same Dimensions with the other two, and differs in nothing from them but by its Spinal Process, which from ½ Inch in the former arises to 1 ½ in this, being ½ Inch broad, and thin at the Extremity.

The sixth. A. 6. The sixth *Vertebra* differs from all the rest in its transverse Process, which is as far forward as the rest, and sends out another Process, which runs as backward; so that from the Extremity at the fore-part to that at the back-part, 'tis ; Inches. It *Fig.* 3. also sends another Protuberance obliquely outward 1 ½ Inch (*i. i.*) At this Process the Cervical Artery passes out from the transverse Process of the *Vertebra*, and only send a Twig to the

The seventh. Seventh *Vertebra*, or last of the Neck, which differs from all the rest, 1st. In the length of its Spinal Process, which is augmented from 2 Inches in the former to 5 in this (*g. g.*) 2. In the smallness of the Hole for the Cervical Artery (*d. d.*) this being the last perforated transverse Process, as is said. 3. In a *Sinus* on each side of its Body behind (*i. i.*) whereinto it receives part of the first Rib.

The Thorax. The *Thorax* is divided into the *Vertebræ*, Ribs, and *Sternum*: There are 19 *Vertebræ*, correspondent to so many Pair of Ribs; they differ nothing from the former, except that their Body is more Protuberant, that their Spinal Processes are augmented and diminished in their length, according to their Situation, and that they have a *Sinus* in each side, both before and behind, for Reception of their respective Ribs: For the Weight and Dimensions of their Spinal Processes see the following Table.

Ribs. The Ribs are divided into the true (which are articulated with the *Sternum*) and false ones, with and without Cartilages. There are 8 Pair of true Ribs, 8 Pair false with, and 3 without Cartilages. The Cartilages here are soft, as in Human Subjects, and not boney, as in Oxen, Harts, *&c.* The length of the Ribs both from the one Extremity to the other, and along their inner Surface, that you may the better know how much they are bended, with their breadth at the Extremity and Weight of each Pair, shall be given in the following Table.

Sternum. The *Sternum* consists of four Bones; they are plac'd edgewise, being two Inches thick above, and sharp below: From the fore-part to the Point of the *Cartilago Ensiformis* 'tis 25 Inches; whereof the first is 88 Inches long, and 4 ½ Inches broad at the Articulation of the first Rib; the second 4 ½ Inches long, and 3 Inches broad; the third 3 ½ Inches long, and 3 Inches broad; the 4th

4 In-

4 Inches long, and 2 ½ Inches broad; the reſt of the length is made out by the *Cartilago Enſiformis*.

The *Loins* conſiſt of three *Vertebræ*, whoſe Spinal Proceſſes are but ſhort; their tranſverſe Proceſſes a little longer than thoſe in the Back; which beſide their Weight, (for which ſee the Table) is all that is material about them. *The Vertebræ of the Loins.*

The *Os Sacrum* conſiſts of five Bones; they are of a flat Surface before (B) each having three Proceſſes (*viz.* two oblique, and one Spinal, under which the Spinal Marrow deſcends) behind. They are perforated before by 4 Pair of Holes, plac'd at their Interſtices on each ſide. It is 12 Inches long and 7 ½ broad, where 'tis articulated with the *Oſſa innominata* above, and 6 Inches broad at the lower part. See Fig. 4 and 5. Os Sacrum. *Tab.* 4 *Fig.* 4.

The *Tail* conſiſts of twenty nine *Vertebræ*, whoſe differences are to be ſeen in the following Tables. From the *Os Sacrum* to the Eight they have five Proceſſes, *viz.* two tranſverſe, two oblique, and one Spinal, under which the Spinal Marrow deſcends, ſending forth a Conjugation of Nerves from betwixt each of them. From the Eighth to the Sixteenth each has 4 Proceſſes, *viz.* two longitudinal behind, betwixt which the remainder of the Spinal Marrow ſtill deſcends, and two tranſverſe: The reſt have no Proceſs at all, but are of a kind of quadrangular Figure, having a Ridge which deſcends before and behind, and on each ſide; being ſomewhat bigger at each end, and ſmaller at the middle. All the *Vertebræ*, as well in the Neck and Back, as Tail, had Cartilages, which run betwixt each of them; they were about ½ Inch thick in the Back, thinner in the Neck, and thicker proportionably in the Tail. Theſe Cartilages I was obliged to ſupply with Leather in mounting the Sceleton, as ſhall be ſhewn. So much for the Trunk. *The Vertebræ of the Tail.*

Becauſe this is a Quadruped, we ſhall divide the Extremities into the fore and hind ones. We begin the fore Extremities at the *Scapula*, which is uſually divided into its Head, Neck, *Spine*, Proceſſes, fore and hind Cavities, (*i. e.* theſe Parts before and behind the *Spine*) its concave part, which lies upon the Ribs, and its convex or outer part, and its Margin. The Head (*a.*) which receives the *Os humeri*, is oblong, (becauſe the motion of the *Humerus* perform'd by this Animal, is rather Flexion and Extenſion, than Adduction or Abduction) wherefore the Cavity being 5 ½ Inches long, is only 3 ½ Inches broad, and the Margin of the Bone ariſing from the fore and back-part (*b. b.*) makes it *The Fore Extremities.* Scapula.

2 In-

2 Inches deep; for at the ſides the Margin is equal to the Cavity. At the back-part there are two Proceſſes; that which regards its convex part is 2 Inches long, rugous, thick and obtuſe; that which regards the concave, runs two Inches backward, where it forms an obtuſe Angle; whence it aſcends 3 Inches to the Neck: This has a ſharper Edge than the former, being ſomewhat incurvated. Betwixt theſe two Proceſſes is a rugous *Sinus* two Inches broad, aſcending from the Cavity of the Head 3 Inches to the Neck, and riſing ſomewhat in the middle of its Progreſs. The Neck *(c. c.)* is flat, being more obtuſe at its back-part, and where is the laſt nam'd Protuberance, and ſharper at its fore, where is a little Protuberance toward the *Spina* on the convex ſide, being more plain on the concave. Betwixt the firſt of the fore nam'd Protuberances *(b.)* and the *Spina*, there is a *Sinus* which aſcends 4 Inches *(d.)* and from the ſame Protuberance *(b.)* to the Extremity of the *Proceſſus Coracoides* *(e.)* is 3 ½ Inches. This *Proceſſus Coracoides* is that part of the *Spina (e.)* which runs toward the Neck of the *Scapula*, but does not, as in Men, defend the *Humerus* from Diſlocation. 'Tis very rugous and convex before, but concave at its back part, being 3 ½ Inches broad at the Point it aſcends 11 Inches, where 'tis raiſed 5 Inches from the Body of the *Scapula* *(f.)* it inclines a little backwards and aſcends 12 Inches more, till it be loſt where the *Epiphyſis* begins *(g.)* being ſtill concave at the fore, and convex at the back-part. From the *Spina (f.)* it ſends forward a Production 8 Inches long *(h.)* 3 Inches broad at its upper part, two Inches about the middle where 'tis crooked, and 1 ½ Inch at its lower Extremity where 'tis thin and ſharp; but at its upper part thicker and rugous, concave at the inner, and convex at the outer ſide. This Proceſs ſerves to keep the *Muſculi ſupra-ſpinati* within their bounds, when they pull up ſuch a vaſt Weight as the fore Leg. As the *Spina* runs up 5 Inches from this Production, 'tis rugous and thick in its edge, from thence it becomes gradually thinner till it comes to the *Epiphyſis*. The Back and upper part of the *Scapula* is very thin, and ſharp from the Neck *(c.)* 16 Inches upward to *(m.)* from thence it aſcends 5 Inches to the place where the *Spina* ends, and forms a very rugous and ſpongious *Epiphyſis*, thick at the upper end *(l.)* thence it deſcends obliquely two Foot *(i.)* whence its fore edge runs obliquely in toward the Neck 10 Inches, being ſharp; thence it tends outwards and deſcends other 5 Inches till it comes to the Neck. All the upper part of the

Scapula

Scapula from (*m*) to (*l*) where 'tis thickeſt, and from (*l.*) to (*i.*) where 'tis thinner, except towards its lower part, is covered with an *Epiphyſis* (as is ſaid) ſpongious and rugous, which ſeperated by the boiling, and is a further Argument that this Animal was Young, according to their term of Life; 'tis otherwiſe a very thin Bone and ſolid, except where the *Epiphiſes* are.

The *Humerus* is a very irregular Bone; it's Head is in Circumference 2 Foot, having 2 remarkable *Epiphiſes*, one whereby 'tis articulated with the *Scapula* from before to behind with a convex Surface 8 Inches, and from the right to the left 4 ½ Inches, and another on the outſide riſing higher and ſharp about 1 ½ Inches. Round this *Epiphyſis* is 11 Inches, and from before to behind with a flat outſide 6 ½ Inches. Betwixt the *Epiphyſis*, which receives the *Scapula*, and this Protuberance is a *Sinus* about 3 ½ Inches broad, and about 1 ¼ Inches deep; as it deſcends toward the inſide it becomes deeper, and only 2 Inches broad: 'Tis for lodging the external Tendon of the *Biceps*, analogous to a *Crena* for the ſame purpoſe in human Subjects. The Neck of the *Humerus* is in Circumference 19 Inches, flat behind for the ſpace of 4 Inches, then forming an Angle, and running obliquely outward 3 Inches, then paſſing foreward below the utmoſt Protuberance 5 Inches, thence croſſing the forenam'd *Sinus* it runs back, firſt flat, then a little convex, 7 Inches. Below this outward Protuberance there is a rugoſity for the Inſertion of the *Flexores Cubiti* 6 ½ Inches long, and 3 ½ Inches broad at the upper part, and thence deſcending gradually it terminats in a Point. At the lower part of this rugoſity the Bone is 13 ½ Inches in Circumference, having 3 Faces; one at its Back part 5 Inches broad, ſomewhat depreſs'd from the inſide, then a little Proteberant, as it tends outward; a ſecond on the outſide, and 4 Inches broad; and the third on the inſide, 4 ½ Inches broad, flat alſo. Here begins another conſiderable rugoſity, ſmall and oblique from the back part of the utmoſt Protuberance of the *Humerus*, and becoming very rugous at this Place, continuing 6 Inches obliquely downward, and 2 Inches broad about the middle. At the lower part of this rugoſity the Bone is 18 Inches in Circumference, with its three Faces otherwiſe diſpoſed; that which was before terminated in an obtuſe *Spina*, and where it was an obtuſe *Spina* behind, now becoming flat. On the outſide begins a conſiderable *Sinus*, being the Continuation of the *Sinus* formerly mention'd betwixt the *Epiphyſis Humeri* and outer

The Humerus.

Pro-

Protuberance, whence in its descent the Bone became depress'd; and now the *Sinus* is conspicuous (3) being fram'd by an obtuse *Spina*, descending obliquely forward from the foresaid rugosity on the one side, and another obtuse *Spina* descending obliquely outward on the other. This *Sinus* (3) is 4 Inches broad from before to behind; thence measuring backward the Bone is flat 3 $\frac{1}{2}$ Inches; measuring from thence on the inside, the Bone having form'd an obtuse Angle, is 5 $\frac{1}{2}$ Inches flat also. The *Spina* on the fore side, after it has descended 5 $\frac{1}{2}$ Inches, the Bone becomes flat; that on the outside terminating in a considerable Protuberance, 4 $\frac{1}{2}$ Inches long, where the Bone has only two Faces, convex before and concave behind, and 17 Inches round. Behind its foresaid outward Protuberance is 7 Inches; it becomes 1 $\frac{1}{2}$ Inches depress'd in the middle, where the *Sinus* for receiving the *Cubitus* begins. From the foresaid external Protuberance it descends in a streight Line 8 Inches, and from its opposite part at the inside it descends obliquely backwards 5 Inches; and here the lower *Epiphysis* begins, where 'tis receiv'd by the *Cubitus* and *Radius*. This *Epiphysis* is 1 Foot 10 $\frac{1}{2}$ Inches round being 4 Inches thick at the outside and flat, and 7 Inches at the inside and Protuberant; betwixt which behind is a considerable *Sinus* 3 $\frac{1}{2}$ Inches broad, and 2 $\frac{1}{2}$ Inches deep, and before, another *Sinus* 7 Inches broad, of the same deepness. This *Epiphysis* is at its lower extremity and inside, where it receives the *Cubitus*, 5 $\frac{1}{2}$ Inches from before to behind; of a convex Surface and 6 Inches at its outside, where 'tis receiv'd by the *Radius*. At its fore part the *Sinus* is not very considerable, but at its back part deeper and arrower for receiving the *Olecranon*. At the extremity of the *Epiphysis*, 'tis narrower, being only 6 Inches from the right to the left before, and 7 $\frac{1}{2}$ Inches behind. And thus you have an Account of the most irregular Bone of the Body, being at it's external part 30 Inches in length, and 26 at its internal; having a large Head consisting of an *Epiphysis* receiv'd by the *Scapula*, a large Protuberance on the outside defending it from Dislocation, and a *Sinus* betwixt the two reaching a good way back, thence descending to its Neck, whence the Bone becomes flat (2) to about the middle, descending on the outside, flat also, with two rugosities for the Insertion of the Tendons. Betwixt this outside and back part, is a very large *Sinus* for the *Biceps*, which oblique situation (3) is an admirable contrivance for adding Strength and conciliating length to this Muscle. Now the shape of the Bone begins to be

chang'd,

chang'd, for whereas it formerly reach'd from before to behind, now it reaches from the right to the left, and its lower extremity (4) becomes broader, whereas at its upper extremity it was rounder.

The *Cubitus* and *Radius* are two Bones of a singular Figure, the one lying above the other: We shall begin with the *Cubitus*, which is in length from the top of the *Olecranon* to its Articulation with the Bones of the *Carpus* (5) 28 Inches. The *Olecranon* (1) from the right to the left, with a Surface somewhat convex, is 9 ½ Inches; and from before, where it is articulated with the *Humerus*, to its utmost point behind, in a ſtreight line 7 Inches. This *Olecranon* as it deſcends, becomes narrower by degrees, till it forms a *Spine*, which runs obliquely forward 13 Inches, where 'tis contracted from the foreſaid 9 ½ Inches to 3 in breadth. Afterwards the Bone is enlarg'd on each ſide, till it forms a convex Surface, which is received by, and articulated with the *Humerus*. This Articulation is a *Ginglymus*, as in all other Animals; *viz.* the *Cubitus* and *Radius* together receive the *Humerus* on the outſide before, which on the inſide the *Cubitus* doth alone. Betwixt theſe two is a large Protuberance riſing 2 ½ Inches, which is alſo received by the *Humerus*. Meaſuring from the extremity of the *Cubitus* and *Radius*, which receive the *Humerus*, on the outſide to its oppoſite part on the inſide, including the back part of the *Olecranon*, it is 10 Inches. Both the Bones from the right to the left, at the articulation before, are 7 Inches. Then meaſuring round the *Cubitus*, below the Articulation, is 16 ½ Inches. Here the Bone is flat before, from the right to the left 7 Inches; from thence obliquely backward to the forementioned *Spine* beneath the *Olecranon* is 5 Inches on the outſide, and 6 ½ on the inſide. At the lower part of the foreſaid *Spine* the *Cubitus* is in Circumference 11 Inches; *viz.* flat before 4 Inches, where it forms an Angle; thence running obliquely backward 2 Inches, forming another Angle; thence 1 ½ Inch obliquely backward, where 'tis a little Protuberant; and from thence obliquely inward 3 ½ Inches. Round the lower extremity of the *Cubitus*, and 3 Inches above the *Epiphyſis*, it is 12 Inches; *viz.* from the *Radius* 2 ½ Inches; thence obliquely outward, with another flat Surface, 3 ½ Inches; and from thence, with a convex Surface, round the back part 6 Inches. The *Cubitus* at the *Epiphyſis*, from the *Radius* on the fore part to its oppoſite ſide on the back part, is 13 Inches; from the upper part of the lower *Epihyſis*, where 'tis articulated with the external Bone of the *Carpus*, obliquely in-

The Cubitus *and* Radius.

The Olecranon.

Its Surface behind is unequal for the reception of Tendons. It is articulated above with the first Bone of the first Rank, and with 3 Bones of the *Metacarpus* below, and at its inside with its Partner of the same Rank. Its articulation above is *per Ginglymum*, as is said; *i. e.* before and behind 'tis receiv'd by that above, and at the middle it receives it: It is 2 ½ Inches thick before. It weighs 6 ℥.

The second The second (4) which is much like to it, as being received by the second above after the same manner, is 3 Inches on its convex Surface, and 2 ½ Inches transversely at its middle. At its outside, being the inside of the Foot, it mutually receives the

The third Third (5) which runs obliquely backward 2 Inches from the former: It has four Surfaces for Articulation; one where tis join'd with the third Bone of the former Rank; the second where it is join'd with the last nam'd Bone: In conjunction with the former it receives the 5th Bone of the *Metacarpus*; and at its outside the 6th. It terminates in an obtuse point behind, and has a *Sinus* betwixt the Articulation of the Bone of the *Metacarpus* and its extremity. The 2d weighs 6 ℥, and this 4.

Bones of the Metacarpus, Tab. 2. G. 8. There are Six Bones in the *Metacarpus, per Ginglymum longum*; *viz.* they are receiv'd above by the Bones of the second Rank of the *Carpus*, and below by the Toes. They are all of much about the same Figure, but not of an equal length; somewhat flat before, and both convex behind; broader at the upper and lower extremity where they touch one another, and narrow in the middle.

The first on the outside is 3 Inches long, and 4 ½ Inches round its middle, and articulated with the external part of the outer Bone of the second Rank of the *Carpus*; in weight 3 ℥.

The second is 4 Inches long, and 5 ½ Inches round its middle; flat before, and more convex behind; and articulated with the middle of the foresaid Bone of the *Carpus*. It weighs 4 ℥.

The third is 5 Inches long, flat also before, and 7 Inches round its middle; articulated with the foresaid Bone of the *Carpus*, and occupying most of its inner Surface. It weighs 6 ℥.

The 4th is 5 Inches long, and 6 round its middle. This occupies the largest part of the middle Bone of the second Rank of the *Carpus*. It weighs 6 ℥.

The 5th is 4 ½ Inches long, of the same bigness with the former; and occupies a part both of the middle and of the internal Bone of the second Rank of the *Carpus*; and weighs 4 ℥.

The

The sixth is 3 ½ Inches long, and 5 ½ Inches round its middle; and occupies the external part of the second Bone of the *Carpus*, and weighs 3 ℥.

Each of the Toes of the Fore Foot consists of two thick short Bones; whereof the first of the external Toe is 5 ½ Inches round, and 1 ¾ Inch long; the second about 1 Inch broad, and ½ Inch long; weighing 2 ℥. The first Bone of the second Toe is 2 Inches long, and 6 ½ Inch round; the second is 1 ¾ Inch from the right to the left, and ½ Inch from above to below; weighing 3 ℥. The first Bone of the third Toe is 2 Inches long, and 7 ½ Inches round: The second Bone is divided into two in this Subject, in figure not unlike an Oxes Hoof, whether it be a *Lusus Naturæ*, or peculiar to all other Animals of this Species I know not. Weigh 4 ℥. The first Bone of the fourth Toe is 2 ½ Inches long, and 5 ½ Inches round: The second Bone is in figure not unlike the former, but not divided; from the right to the left 2 Inches, and from above to behind 1 Inch. Weigh 4 ℥. The first Bone of the fifth Toe is 2 ½ Inches long, and 4 ½ Inches round: Its second Bone is in figure like the former, but less, and divided. Weigh 3 ℥. The first Bone of the sixth Toe is 2 Inches long, and 4 ½ Inches round; bigger at the upper and becoming narrower at its lower extremity, wherewith a very small Bone is articulated, and weighs 1 ½ ℥.

The Bones of the Toes of the Fore-Foot. Tab. 2. G. e.

All these are besides two *Ossa Sesamoidea*, which were affix'd to the lower part of the lower extremity of each Bone of the *Metacarpus*; each being about 1 Inch long, ½ half Inch broad, Protuberant at the lower part, and concave at their upper or that side whereby they are articulated with the *Metacarpus*; seperated from each other by an *Cartilage*, which did run down in the middle of this lower *Epiphysis* of the Bone in the *Metacarpus* These *Ossa Sesamoidea* were very useful for supporting the Foot; for about their middle did all the four Hoofes of the Fore Foot terminate. They weigh each ℥ij.

The Ossa Sesamoidea.

The Hind Extremities consist of the *Ossa Innominata*, the Thigh Bone, the two Bones of the Leg, and the Foot.

The *Ossa Innominata* consisting, as in other Animals, of two large Bones, articulated behind with the *Os Sacrum* on each side, and before with each other *per Synchondrosin*, as 'tis call'd, each may be divided, as in Human Subjects, into the *Ilion*, or upper and external part, *Os Pubis*, or lower and fore part, and *Ischion*, or lower and back part: Though strictly speaking, these Bones here should only be divided into the *Ilion* and *Pubis*, there being no

The Ossa Innominata Fig. 4. 5.

remarkable part about them which deserves to be pointed out by the Name of *Ischion*. Both these *Ossa Innominata* join'd together, make up the *Pelvis*, which in Circumference is 4 Foot 6 Inches. From the *Os Sacrum* above B. to the upper part of the *Os Pubis* below C. it is 18 Inches, and from the Right D to the Left E. 17 Inches. The *Os Pubis* at the Articulation is from above C. to below F. 12 Inches; betwixt the two outer and lower Extremities of the *Ilion*, from the Right G. to the Left H. is 1 Foot; from the *Os Sacrum* above, along the Margin of the *Os Ilion*, down to the fore-mention'd utmost Point is 2 foot 9 ½ Inches G. H. and from that same Point H. to the *Acetabulum* which receives the *Femur* K. 1 foot. This *Acetabulum* is in Circumference, round the External Edge, 18 Inches. The breadth of the *Os Ilion* from the External Edge H. to the side of the *Pelvis* E. is 13 Inches. Ronnd the Neck of the *Ilion* above the *Acetabulum* M. M. is 14 Inches. The height of the *Ossa Innominata*, from the upper part of the *Ilion* to the *Acetabulum*, 22 Inches. The breadth of the *Os Pubis* from the Articulation with its Partner, to the outside N. N. 8 Inches. The length of the Oval Hole for the *Musculus Marsupialis* O. O. 5 ½, its breadth 4, its Circumference 13 Inches. Betwixt the lower and utmost Extremities of the *Os Pubis* behind, R. R. 17 Inches. These *Ossa Innominata* are flat before, standing almost perpendicular with the two lower and utmost Extremities of the *Os Ilion* G. H. bending forward, having the *Os Pubis* ascending obliquely, convex before, where join'd together, and concave behind. This ascent of the *Os Pubis* is a further Argument, that this is no Retrocoient Animal.

The Pelvis.

Femur. *Tab.* 2. L.

The *Femur* is 3 foot long with its upper *Epiphysis* (1.) in circumference 15 Inches; the Neck below it is 13 Inches; the breadth from the great *Trochanter* (2.) on each side 10 Inches; below this *Trochanter* in circumference 18 Inches; about the middle 12 Inches; round above the lower *Epiphysis* 16 Inches; round the lower *Epiphysis* itself (3.) from the *Patella* (4.) on the outside to its opposite part on the inside, 18 ½ Inches. Its Diameter, where articulated with the *Tibia* behind, is 7 Inches; having two Protuberances, whereof the External is 2 ½, and the Internal 3 ½ Inches. The Internal *Epiphysis*, which is received by the *Tibia*, is from before to behind 7 Inches, and the External 5 ½ Inches. The *Femur* is in general a long streight Bone, having a big round Head (which in this Subject is separated from its Body

Body by a Cartilage, ſtill an Argument of the Youth of the Animal) receiv'd by the *Oſſa Innominata* (1.) A large *Trochanter* on the outſide, where the Bone is broadeſt; from thence in its deſcent it becomes ſmaller, flat before and behind, and thicker on the inſide than the outſide, near to an equal bigneſs, till it comes to the lower Extremity, where 'tis enlarg'd into two big *Epiphyſes*, which are receiv'd by the *Tibia*, with a *Sinus* in the middle about one Inch deep, and as much Diameter. It ſends forth a large Protuberance before, which is received by the

Rotula, or *Patella*, a Bone of a very rugous Surface, conſiderably Protuberant on the outſide, being from above to below 8 Inches, and from the Right to the Left 6 Inches. It is articulated with the *Femur per Ginglymum*, having a Cavity on each ſide which receives, and a Protuberance in the middle receiv'd by the *Femur*. Rotula

The *Tibia* is in length, meaſuring behind, 22 Inches; its circumference at the upper *Epiphyſis* 19 Inches, and at the Neck 17 Inches. Before it has a large Depreſſion for facilitating the Motion of the *Patella*; of a very rugous Surface, for Inſertion of the *Extenſores Tibiæ*. 'Tis almoſt Semicircular before, and flat behind: Its circumference about the middle is 9 ½ Inches, and at the lower Extremity, where it again meets with the *Fibula*, and where it receives the *Aſtragalus*, 12 Inches. Tibia.

The *Fibula* is 21 Inches long; 5 ½ Inches round above, where receiv'd by the *Tibia*; 3 Inches about the middle; and 5 Inches at the lower part, where it receives the *Tibia*. Its *Epiphyſis* which forms the External Ancle, or *Maleolus*, meaſuring from before to behind along its outer Surface, is 5 ½ Inches. Fibula.

The Bones of the hind Foot conſiſt of thoſe of the *Tarſus*, *Metatarſus*, and Toes. The *Tarſus* conſiſts of 6 Bones, whereof *The Bones of the Hind Foot.*

The firſt is call'd *Aſtragalus* (1.) This is articulated above with the *Tibia*, having a Depreſſion in the middle 3 Inches, which receives, and two Protuberances at the Sides, which are receiv'd by the *Tibia*, 3 ½ Inches. It receives the *Talus* below with a Surface 4 Inches Diameter. On the inſide it ſends forth a large Protuberance; and on the outſide both it and the *Talus* are received by the External *Maleolus* for the ſpace of 2 Inches. Before, 'tis receiv'd by the *Os Naviculare* during the ſpace of 4 ½ Inches. It is in Weight 6 ⅗. Aſtragalus. *Tab.* 4. *Fig.* 9.

The

Talus. *Fig.* 7. The *Talus* (*a.*) is a very irregular Bone; it is Protuberant behind from the *Aſtragalus* 4 ½ Inches. This Protuberance is in circumference at the Extremity 10 Inches, and at its Neck 8 Inches: Below it is very rugous on the inſide. It ſends forth a Protuberance, which is received by the *Aſtragalus*, as in Human Subjects. It has three remarkable Surfaces; *viz.* one upon which the *Aſtragalus* reſts, at its upper ſide; one at the fore-part, articulated with the *Oſſa Cuneiformia*; and the outſide, for the *Fibula*. It weighs 1 ℔.

Os Naviculare. *Fig.* 9. The *Os Naviculare* is 10 ½ Inches in Circumference, one Inch thick, concave behind (2.) where it receives the *Aſtragalus*, and convex before, with its different Surfaces (3.) *viz.* one whereby it is articulated with the Bone of the Toe on the inſide, and one for each of the three *Wedge-like* Bones. It weighs 4 ℥.

Oſſa Cuneiformia. The Bones of the ſecond Rank of the *Tarſus* are call'd the Three *Wedge-like* Bones, two of which are articulated at the back-part with the *Os Naviculare*, as is ſaid, and the third partly with the *Talus*, and partly with the *Os Naviculare*; each of them is about 1 Inch thick: That on the inner Side (4.) is the leaſt, being from the Right to the Left one Inch thick, in Weight ℥*iß*: The middle 2 Inches (5.) in weight ℥*ij*; and that on the outſide (6.) 3 ½ Inches, in weight ℥*iij*. This laſt has two Surfaces at the fore-part, whereby 'tis articulated with the two utmoſt Bones of the *Metatarſus*. The middle Bone of the *Tarſus* being only receiv'd by the middle Bone of the *Metatarſus*.

The Bones of the Metatarſus. The External Bone of the *Metatarſus* is very irregular: It is articulated behind with the External *Os Cuneiforme*, where 'tis about 2 Inches from above to below; from whence (its External Surface being very rugous) it becomes gradually ſmaller; being ſomewhat Concave below, and Protuberant above, till it terminates in a round Extremity. In Weight ℥*ijß*.

The ſecond is a ſhort thick Bone, 8 Inches in Circumference, and 2 ½ Inches long; in weight ℥*ijß*. This receives the firſt Bone of the Toe, which is 4 ½ Inches in Circumference, and 2 long; and receives the ſecond Bone of the ſame Toe, being 3 in Circumference, and 1 ½ long; greater at its upper, and ſmaller at its lower Extremity, to which is affix'd a ſmall Bone. Theſe Weigh ℥*iijß*.

The middle Bone of the *Metatarſus* is the largeſt of all thoſe belonging to the Toe, being 7 Inches round, and 5 long; ℥*iiij* in Weight. It receives the firſt Bone of the Toe, which is 4 ½ Inches round, and 2 ½ long; to which alſo is join'd another ſmall Bone to make up the Extremity: In Weight both ℥*iiij*.

The

The two Bones of the *Metatarsus* remaining are thin, broad, and irregular; the first whereof is 2 ½ Inches broad, and 2 ¾ long; weighing each ℥*j*. to which also adheres a small Bone, as in the former Toe, but less. The second and last of the *Metatarsus* on the inside is two Inches broad, and as much long, thin like the former, having a small Protuberance adjoin'd instead of a Toe. The Bones of the 4th Toe weigh ℥*j*ß, and the 5th ℥*j*.

I once designed to have compar'd more particularly the Bones now describ'd, with those of *Tentzelius* and Dr. *Moulins*: But since both these Treatises have been already communicated to the *R. S.* and I doubt not are in the Hands of most of the Honourable Members thereof; and since I have already insisted longer upon these, than I suppose you expected, I shall only put you in mind in few Words, that *Tentzelius* tells his Friend, that in digging in a Hill near *Erfurt* in *Germany* for a fine white Sand, there were found several huge Bones, first mistaken for a Giants; but upon tryal, and the perusal of Dr. *Moulins*'s Treatises, known to be the Bones of an *Elephant*: And that among the rest there were found the Head 42 Inches Diameter; two Tusks 2 ½ Spans large, and 8 foot long; four Grinders, each 12 ℔. the *Humerus* 4 foot 2 ½ Spans; the *Vertebræ* of the Neck, each 4 Spans in Circumference, and 2 Spans high; the *Ossa innominata* 2 ½ foot long; with the Head of the *Femur* inserted in the *Acetabulum*, and part of the *Tibia* 22 Inches at the biggest, and 17 at the smallest part: That they were obliged to dig 24 foot deep, before they could get out the Head; that the Bones lay in such a Posture, as betoken its being over-whelm'd, or having had great Struglings while a dying; *viz.* the Left fore Foot stretch'd forward to the side of the Head, which lay toward the North, the Right inclining backward under the Body; the Left hind Foot drawn in toward the Body, and the Right distorted here and there, out of its Natural Posture. From all which he concludes this to have been the largest *Elephant* that ever was seen in *Europe*; and that it could be brought hither by no other means than the Flood, both from the Preternatural posture of the Body, and from the different *Strata* of Earth lying above it, without the least sign of having been digg'd to bury it.

Comparison of these Bones with those treated of by Tentzelius.

A Table containing the particular Dimensions of the Vertebræ *and* Ribs, *and Weight of all the Bones of the* Elephant.

The Bones of the Head.	lb
Upper Jaw	66
Lower Jaw	45

The *Vertebræ* of the Neck.

Numb.	Weight. lb	oz.	dr.	Length of Spinal Process. Inch.
1	1	13		
2	1	6	4	
3		13	4	¾
4		13	4	½
5		14	4	1½
6		14	6	3
7	1			5
	7	10	6	

The *Vertebræ* of the Tail.

Numb.	oz.	Length. Inch.	Breadth. Inch.
1	10	2	6
2	8		5 2/1
3			5
4	6		4 1/2
7			4
8	5		
9	4		3½
10			3
11	3		2½
13	2⅔		
14	2½		1⅔
15			1
16	1¼		2½
17	1		
18		1⅔	
20		1½	
21		1¼	
22		1	2¼
23	⅔		2
24			1¾
25	½	½	
29	⅔		

The *Vertebræ* of the Back.

Num. No.	Weight. lb	oz.	dr.	Length of Spinal Process. Inch.	Breadth of Extrem. Inch.
1	2	4		8	2
2	2	2		12	3½
3	2			13	4½
4	1	5			
5	1	4	2	12	3½
6	1	2	3	11½	3
7		15	6	11	
8		14		10½	2½
9		14		10	
10					
11					
12		13		9½	2
13				9	
14					½
15				6½	1½
16				6	2
17				5	
18			2	4½	
19			4	3	
	20	8	7		

The *Vertebræ* of the Loyns.

1	13	4	3.
2	12	7	
3	11		
	2	5	3

The Ribs.

Weight. lb	oz.	dr.	L. of inner Surface. Feet.	Inch.	L. between Extrem. Feet.	Inch.	Breadth of Extre. Inch.
1	13		1	5	1	4	4
	12	4		9		8	3
1	1	2		11½		10	
	5		2	2	2		
	8	4		6		3	2½
	2	3				3½	
	1	5		8		3¼	2¼
	4	6		10		4½	
	3					5	
	15			9		3	
	14	4		7			
	13	4		5		1	
	12			4			
	10	6		½	1	11½	
	9					10	1
	5	5	1	9		8	
	5			8		7	
	3	2		5		4½	
	2	1					
16	15	6					
16	15	6					

Weight of Ribs 33 15 4

Tail 4 2 7 1 3

The

The Sceleton of the Elephant consists of the Bones of

		lb	℥	ʒ	℈
The Head divided into those of the					
Upper Jaw, *viz.*					
Calvaria, or upper and back part	1				
Frons, or upper and fore part	1				
Two *Maxillary* Bones	2				
Two Bones of the Palate	2				
Two *Zygomatic* Bones	2				
Two *Styloid* Processes	2				
Two Tusks	2				
Four Grinders	4	66			
Lower Jaw	1				
Four Grinders	4	45			
	21	111			
The Trunk composed of the					
Spine consisting of the *Vertebræ* of the					
Neck	7	7	10	6	
Back	19	20	8	7	
Loyns	3	2	5	3	
Os Sacrum	5	4	0	0	
Tail	29	4	2	7	1
Ribs, 19 Pairs	38	33	15	4	
Sternum	4	3	00	0	
	105	75	11	3	1
The Fore Extremities					
Scapula	2	19	08	0	0
Humerus	2	16			
Cubitus and *Radius*	4	15			
Carpus, Six on each Foot	12	3	12		
Metacarpus	12	3	4		
Toes	24	2	3		
Ossa Sesamoidea	24		6		
	80	69	1		
The Hind Extremities					
Ossa Innominata, viz.					
Ilion	2	28	00		
Pubis					
Femur, or Thigh Bone	2	16			
Tibia and *Fibula*, or Leg and Spit Bone	4	13	4		
Patella, or Knee Pan,	2		12		
Tarsus	12	5	10		
Metatarsus	12	1	06		
Toes.	20	1	02 ½		
	54	66	2	½	
Summa Totalis	260	312	14	7	1

This is the Total Sum of the weight of the Bones.

indifferenter certamen finiatur post $n+p$ ludos, probabilitas est $\frac{1}{2}r+\frac{1}{4}s+\frac{1}{8}t+\frac{1}{16}u+\&c.=q$. Q. E. D.

Corollarium 1.

Facile hinc invenitur quænam sit probabilitas ut certamen finiatur intra datum quemvis ludorum numerum. Series enim fractionum incipientium à fractione $\frac{1}{2^{n-1}}$, quarum denominatores crescant in continua proportione dupla, numerator autem cujusque fractionis sit summa numeratorum tot fractionum immediate præcedentium quot sunt unitates in $n-1$, dabit omnes successive probabilitates, ut certamen finiatur peractis præcise n, $n+1$, $n+2$, $n+3$ &c. ludis: & per consequens si addantur tot termini hujus seriei quot sunt unitates in $p+1$, summa ipsorum exprimet probabilitatem ut certamen finiatur ad minimum ludis $n+p$ peractis. *Ex. gr.* Si sint collusores 4, adeoque $n=3$, habebitur hæc series $\frac{1}{4}, \frac{1}{8}, \frac{2}{16}, \frac{3}{32}, \frac{5}{64}, \frac{8}{128}$ $\frac{13}{256}, \frac{21}{512}$ &c. E qua si fiat alia $\frac{1}{4}, \frac{3}{8}, \frac{8}{16}, \frac{19}{32}, \frac{43}{64}, \frac{94}{128}, \frac{201}{256}$, *&c.* cujus termini sint summæ terminorum præcedentis seriei, denotabunt iidem termini qualis sit probabilitas ut certamen finiatur ad minimum 3, 4, 5, 6, *&c.* ludis.

Corollarium 2.

Potest terminus quicunque prioris seriei (excepto primo termino,) ut & summa omnium terminorum, *id est*, terminus quicunque posterioris seriei, per formulam generalem exprimi hoc modo. Si $n+1$ sit numerus collusorum, & p sit numerus terminorum, erit ultimus terminus prioris seriei $\frac{1}{2^n}$

$$\frac{1}{2^n} - \frac{p-n+1}{1\times 2^{2n}} + \frac{p-2n\times p-2n+3}{1\times 2\times 2^{3n}} - \frac{p-3n\times p-3n+1\times p-3n+5}{1\times 2\times 3\times 2^{4n}} + \frac{p-4n\times p-4n+1\times p-4n+2\times p-4n+7}{1\times 2\times 3\times 4\times 2^{5n}}, \text{ -\&c. Et}$$

ſumma omnium terminorum ſive ultimus terminus poſterioris

$$\text{ſeriei} = \frac{p+1}{1\times 2^n} - \frac{p-n\times p-n+3}{1\times 2\times 2^{2n}} + \frac{p-2n\times p-2n+1\times p-2n+5}{1\times 2\times 3\times 2^{3n}} - \frac{p-3n\times p-3n+1\times p-3n+2\times p-3n+7}{1\times 2\times 3\times 4\times 2^{4n}} + \text{ \&c.}$$

Tabula I.

Intrat		Exit.		N°. 1
	Sors		Sors	
0	z	1	h	$a = z$
1	y	2	k	$c = y$
2	x	3	l	$d = \frac{1}{2}x + \frac{1}{2}y$
3	u	4	m	$e = \frac{1}{4}u + \frac{1}{4}x + \frac{1}{2}y$
4	t			$f = \frac{1}{8}t + \frac{1}{8}u + \frac{1}{4}x + \frac{1}{2}y$

N°. 2.

$$z = \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \ldots \frac{1}{2^n} \times h + \frac{1}{2^n} \times 1$$

$$y = \frac{1}{2}k + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \ldots \frac{1}{2^n} \times h + \frac{1}{2^n} \times 1.$$

$$x = \frac{1}{2}l + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \ldots \frac{1}{2^n} \times h + \frac{1}{2^n} \times 1.$$

$$u = \frac{1}{2}m + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \ldots \frac{1}{2^n} \times h + \frac{1}{2^n} \times 1$$

No. 3.

The Method of mounting the Sceleton.

I come now to the laſt thing I propos'd, which is the Method I us'd in mounting the Sceleton; and becauſe Dr. *Moulins*'s way of nailing a Plate of Iron to the Roof of the Mouth, in which the Iron Rod that run through the *Vertebræ* of the Neck was faſtned, would have been inconvenient, by ſpoiling the back-part of the Scull, obſtructing its View, and making the Head look too much forward, which was the fault of his Sceleton, as repreſented by the Figure, I contriv'd another, which is as follows.

Connexion of the Head.

There was an Iron Rod made about the bigneſs of one for a Bed, as long as the *Elephant*, from the Forehead to the Point of the Tail, being 14 Foot, which paſs'd in at the fore-part of the Scull above the Hole for the Root of the Trunk, and run back amidſt the fore *Cellules*, paſſing along the lower part of the Seat of the Brain, and going out at the lower part of the Hole for the Spinal Marrow; and leſt the inconveniency of its Weight (as Dr. *Moulins* fear'd) ſhould happen to break the tender *Laminæ*, there was another Rod of the ſame bigneſs, which paſs'd in at the one ſide of the Head, where the Depreſſion is for Inſertion of the Muſcles of the Lower Jaw and *Proboſcis*, and run through the *Cellules* at the ſide, going tranſverſely along the lower part of the Seat of the Brain below the former, and paſſing out at the other ſide; by which this Rod, from the Right to the Left, eaſes the Burthen of the other, in ſupporting the Head on both ſides, as well as the other did before. And leaſt any of theſe ſhould ſlide out, I caus'd to be ſcrew'd a Piece of Iron upon each Extremity of that which paſs'd from the Right to the Left, and upon the fore end of that which did run from before to behind. Afterwards the ſecond *Vertebra* in the middle of its Tooth, and all the other following *Vertebræ* were perforated in the Center of their Bodies; and to make the Head ſtill more ſteady, the Baſe of the Scull was twice perforated on each ſide of the Hole for the Spinal Marrow; and a ſtrong Wire being paſs'd through theſe Holes, it run from the Right to the Left above the Rod, and kept it firm, leſt it ſhould have bended, and ſuffer'd the Head to incline too much downward by its Weight.

Connexion of the lower Jaw.

The joining of the Lower Jaw, which is perhaps the moſt ponderous Bone in any Land Animal, was next to be conſider'd; therefore two Wires were paſs'd in at about one Inch diſtant from each other, running from above to below, to that part of the

the Base of the Scull (*y.*) which is for Reception of the *Condyles*; and the same two Wires having pass'd through two Holes, made from before to behind in the *Condyles* themselves, both Extremities of the Wires were made to meet together at the upper and outer part of the *Condyles*, and so twisted and made firm. Being still suspicious that this would not be sufficient to support such a vast Weight, and fearing lest either the Base of the Scull or the *Condyles* might come to suffer, there was a Wire brought round the Margin of the so often mention'd great Hole in the *Os Maxillæ Superioris*, which being folded, was twisted several times toward the *Processus Coronæ* in the lower Jaw (*b.*) where there were two Latchets, or Foldings of Wire plac'd in the inner side; the folded Wire from the *Os Maxillæ* was brought in betwixt them, and a Pin pass'd through all three, to be taken out at pleasure. And lest these should not still be sufficient to support its Weight, there was provided in the third place a folded Wire from behind to before in the *Symphysis Menti* (*b.*) which passing in betwixt the two *Ossa Palati* (*b.*) a Pin was put across them, to be taken out at pleasure; which is such a Relief to the *Condyles*, that without making use of the Wires running from the *Os Maxillæ* to the *Processus Coronæ*, we found it sufficient to support the Weight of the Jaw; and 'tis so much the more convenient, that by pulling out this Pin, the lower Jaw can be brought back and forward, to shew the Spectators its considerable Weight. *Tab.* 3. *F.* 3. *Fig.* 9. *Fig* 1.

Being obliged to saw the Scull, in order to take out the Brains, for fastning the upper part of it, there were two Wires plac'd at the back-part of that which is below the Division; into which are linked two other Wires, which reach to that part above the Division, and are there receiv'd into two foldings of Wire plac'd there on purpose. The same Contrivance is also observ'd before; so that this upper part may either be laid back, to shew the Structure and Contrivance of the *Cellules*, or taken altogether off, as seems good. *Connexion of the upper part of the Scull.*

The *Vertebræ* being all perforated, my next Care was to have the Ribs match'd and join'd; in order to which, having first suited them in Pairs, and fitted each Pair for its *Vertebra*, I caus'd to be perforated each of their *Epiphyses* twice from above to below, (once toward the fore, and once toward the back part) and the transverse *Processes* of the proper *Vertebræ* opposite to the Holes of the Ribs, after the same manner; and then perforated the Ribs at the Extremity toward the *Vertebræ*, and the *Sinus* of the *Vertebræ*. *The Joining of the Vertebræ and Ribs.*

Vertebræ (corresponding to the Rib) in toward its Body: After which a Wire two Inches long was fastned in the Body of the *Vertebra*, and Extremity of the Rib, and then both were brought together; which being done, the Wires were put into their respective Holes in the transverse *Processes* and Ribs, and both the ends of each of the two last Wires, being brought together at the upper part and Interstice betwixt the Ribs and transverse *Processes*, were twisted and made firm. Thus I continued to do throughout all the Nineteen Pairs.

Leather, instead of Cartilages.

After this I provided some Jumps, or Leather, such as Shoemakers use for the Heels of Shoes, because the Bend or Sole Leather us'd in mounting the Sceletons of other Animals, could not be so conveniently fitted as to its thickness. Having wetted and beat this Leather, it was shapen'd according to the bigness of each *Vertebra*, perforated in the middle, and put upon the Rod alternatively, first the *Vertebra*, and then the Leather, to supply the defect of the Cartilages, which were all lost in boiling, as usually happens, and was beat so close, that the oblique *Processes* of the *Vertebræ* might meet. This was continued till all the *Vertebræ* were upon the Rod, all along to the *Os Sacrum*; and because the first *Vertebra* is nothing concern'd with the Rod, 'twas convenient to pass a Wire betwixt the Scull and it on each side, that it might not remain loose, but be fix'd to the *Condyles*, by twisting and making fast the Wire.

Connexion of the Ossa Innominata.

I came next to the *Ossa innominata*, which had been disjoin'd in Boiling, both before or below at the *Os Pubis*, and above or behind at the *Os Sacrum*. I made two Rods of Iron to pass transversely from the one side (the one above, and the other below) through the *Os Sacrum* to the other. These were riveted on the back side at both ends; and then having perforated the *Os Sacrum* from above to below through the middle of its Body, it was also put upon the Rod for the Spine, which was a very difficult Task, because the Rod being thick was uneasy to bend, and the Situation of the *Os Sacrum* requir'd it to be bended precisely, betwixt the last of the *Vertebræ Lumborum*, and the *Os Sacrum*. Neither was it easy to perforate the *Os Sacrum* itself, being obliged to make a Drill on purpose, there being no other Bone in the Body that requir'd one so long. After this I proceeded to put on the Bones of the Tail, and their Sham Cartilages alternatively, as they followed in order, till all the Rod was fill'd,

on

on whose Extremity another Piece of Iron was screw'd, to keep all firm and secure.

Afterwards a large Wire was passed from the fore to the hind part of the *Sternum*, whereby all its Bones were fix'd to one another; and to them were joined pieces of Bend Leather to supply the Cartilages, which had been first mangled by the Butchers, and then lost in the boiling. These I fitted to the Articulation of each Rib, whereto they were join'd; and perforating the Extremities of the Ribs twice, I past two Wires betwixt the Sham Cartilages and them, bringing the two ends together, twisting and fastening them on the inside, by which all the *Thorax* was mounted. And lest the Ribs thus fix'd at both Extremities should be too ready to move from before to behind, and *è contra*, each of the Ribs was perforated above toward the Back, and below toward the Belly, for receiving of Foldings and Latchets of Wires to be fastned in them. Then I provided two big Wires, each being folded twice, the length of the *Thorax*; one of which being pass'd through the last Rib, its two Parts being brought together, they were twisted several times, till it was brought opposite to the Latchet in the next Rib, within which the one part was pass'd, the other continuing without, and then twisting again, till it came to the third; it was so continued throughout all the Ribs, both above and below, to keep them firm and at a due distance. And thus you have the whole Trunk mounted. *Connexion of the* Sternum, *and mounting the* Thorax.

Next, I took the two *Scapulæ*, as belonging to the upper Extremities; and lest they should be too weighty for the Ribs, if nail'd to them, as is usually done in other Sceletons, I thought fit to perforate both of them opposite to one another at their upper Margin, and to pass a good big Wire through one of the Perforations, which being folded, was twisted for the space of 20 Inches, *i. e.* from the *Scapula* on the one side, streight over the Back, passing in betwixt two of the *Vertebræ*, till it came to that on the other, where it was fastned. Afterward both the *Scapulæ* were fastned, by bringing two folded Wires from the outside of each *Scapula*, through the first and third Rib, in whose inside they were fix'd; then was the Head of the *Scapula* perforated through the Margin which guards the *Humerus* at the fore and back-part. *The Joining of the* Scapulæ.

The

Connexion of the Humerus.

The Head of the *Humerus* oppoſite to the middle of the Concave part in the *Epiphyſis* of the *Scapula*, was four times perforated, twice toward the inſide, and twice toward the outſide; whereinto were put two folded Wires, whoſe Extremities were fix'd below at the foreſaid inner and outer part, and into whoſe Foldings a large Pin paſs'd from the Margin of the *Scapula* on the one ſide, to that on the other, (to be pull'd out at pleaſure) for ſuſpending of the *Humerus*.

Cubitus and Radius.

The *Cubitus* and *Radius* were join'd with the *Humerus*, thus: The *Cubitus* was perforated twice in the back part, at the beginning of the *Olecranon* on each ſide; where two Extremities of Wires being fix'd and riveted, they were brought through the upper part of the ſaid *Olecranon*, and then twiſted, till they came to the *Humerus*, which was perforated from the back-part, where the Depreſſion for receiving the *Olecranon* is, to the fore part above the *Epiphyſis* received by the *Cubitus* and *Radius*; through which Holes made pretty large, the Wires thus twiſted were paſs'd, the one to the *Radius* on the outſide, and the other to the *Radius* on the inſide; where they were introduc'd, and brought out at the back-part of the *Cubitus* below the *Olecranon* on each ſide, where their Extremities were riveted 2 ½ Inches below their Inſertion: By which means the Flexion and Extenſion can be eaſily ſhewn, becauſe the Wires have ſufficient ſpace to move in their Paſſage through the *Humerus*, theſe Holes being made bigger on purpoſe, as is ſaid. The lower *Epiphyſis* of both *Cubitus* and *Radius* having been ſeparated by boiling, as I have formerly obſerv'd, I was forc'd to perforate each of them below toward the *Carpus*, and paſs a Wire obliquely upward, whereby to ſecure them: And becauſe the *Radius* is diſtinct from the *Cubitus* below, there was a Wire paſſed from the one to the other, and riveted at each outſide.

The Fore Foot.

In joining the Bones of the Foot, I took ſpecial care to hide the Wires, ſo that none might appear to the Beholders. For doing whereof the *Cubitus* was twice perforated in the back-part of the *Epiphyſis*, about 1 Inch above the Articulation with the Bone of the *Carpus* on the outſide, and the *Radius* in the inſide and and back-part, after the ſame manner: Both which Perforations were continued through the two Bones of the firſt Rank of the *Carpus*. Afterwards the External Bone was perforated a third time; all which run from above to below, to the firſt, ſecond, and third Bone of the ſecond Rank. Which being done, two folded

folded Wires were paſs'd in at the four Holes of the back part of the *Cubitus* and *Radius*, where their Duplicatures were formed; and the fifth Wire put into the Hole made in the middle of the External Bone of the firſt Rank of the *Carpus*, was continued with the reſt through the Bones of the ſecond Rank to thoſe of the *Metacarpus*, where they run from one Extremity to another; that is to ſay, the outer part of the folded Wire from the *Cubitus*, did run down the outſide of the External Bones of the firſt and ſecond Rank of the *Carpus*, to the External Bone of the *Metacarpus*, all along, till it was brought out at the Extremity of the furtheſt Bone of the Toe belonging thereto; and the inner part of the ſame Wire paſſing from the *Cubitus* through the ſame two Bones of the *Carpus*, ran down to the third Bone of the *Metacarpus* from the outſide, from whence 'twas convey'd to the Extremity of its Toe, and there riveted. The third Wire paſs'd from its entry in the middle of the External Bone of the firſt rank of the *Carpus*, to that of the ſecond, and from thence down to the ſecond Bone of the *Metacarpus*, from the outſide, to the Extremty of its Toe, where it was faſtned; and the folded Wire from the back-part of the *Radius* paſs'd down at two Places through the middle Bone of the firſt rank of the *Carpus*, to that of the ſecond rank, and from thence to the fourth and fifth Bones of the *Metacarpus* from the outſide, and ſtill forward to the Extremities of their Toes, where they were fix'd. This done, I caus'd to be perforated the External Bones of the *Carpus* twice, *i. e.* toward their fore and back part, as alſo the *Metacarpus* at the upper and lower Extremity; paſſing the Drills from the outſide to the inner of each Bone, or from the Right to the Left, by which the Bones above were as well join'd with their Sides, as with thoſe below them; ſo that each was kept ſecure in its Place, eſpecially the Bones of the *Metacarpus*, which would have too readily ſeparated from each other, and endanger'd the breaking the Wires, by which they were join'd with thoſe above. Since the third Bone of the firſt rank of the *Carpus* lies, as it were, at the ſide of both Ranks, therefore I thought it convenient to paſs the two Extremities of the Wire, which run from the right to the left, in the firſt Rank, that ſo it might be faſtned with its Partner on the inſide; and ſince the Internal Bone of the *Metacarpus* yet remain'd to be join'd, this inner Bone of the *Carpus* was again perforated, and a Wire brought from it to the inner Bone of the ſecond Rank, and from

thence to the ſaid Bone of the *Metacarpus* with its Toe, where it was faſtned.

Connexion of the Femur. The upper *Epiphyſis* of the *Femur* having alſo ſeparated by boiling, it was requiſite to perforate its Head four times, for the immiſſion of two folded Wires, which were brought obliquely down the inner and outer ſide to its Neck, where their Extremities were twiſted and ſecured. Afterward it was perforated in the middle four times more, for two other folded Wires, which were once or twice twiſted, and their Extremities put through the foreſaid Holes to the inner and outer part of the Neck of the *Femur*, as before, there to be made faſt. The *Acetabulum* was perforated in the bottom, and theſe two Foldings paſs'd through it; whereinto was put a Pin, at the back-part of the *Oſſa innominata*, to be pull'd out at pleaſure, and the Thigh ſuſpended as the *Humerus*.

Of the Tibia *and* Fibula. Two folded and twiſted Wires were paſs'd in at the *Epiphyſis*, on each ſide of the *Spina*, in the middle of the *Tibia*, and their Extremities brought out at its upper and back-part, where they were riveted: Afterward the lower *Epiphyſis* at the *Femur* was perforated from the right to the left, and a Pin paſſed from the out-ſide, through the Foldings of the Wires from the *Tibia*, to the in-ſide, (whereby the Flexion and Extenſion is moſt conveniently ſhewn,) to be taken out at pleaſure. The *Perone* was fix'd to the *Tibia* at the upper part, by a Pin paſſing obliquely upward from the one to the other; and the *Patella* faſtned to the fore-part of the *Femur*, by a Pin paſſing directly inward from before to behind.

Of the Hind Foot. The lower part of the *Perone* forming the External *Malleolus*, is perforated from without to within, as is the oppoſite part of the *Tibia* forming the Internal one; likewiſe the *Aſtragalus* is perforated from the right to the left, correſponding to theſe two Holes, for the immiſſion of a Pin, whereby the Foot is join'd to the *Tibia*, to be pull'd out at pleaſure. The *Aſtragalus* is join'd to the *Talus* by a Pin, paſs'd from the upper and middle part of the one, to the lower part of the other, where it is riveted. The *Aſtragalus* is thrice perforated before; into two of which Holes a folded Wire is paſs'd, which goes forward through the *Os Naviculare* to the Bones of the *Metacarpus* of the ſecond and third Toe from the inſide, at whoſe Extremities they are fix'd. The third Wire runs from the *Aſtragalus* to the *Os Naviculare*, and the third *Os Cuneiforme*, to the fourth Toe. The ſaid *Os Naviculare* is

is perforated on the inside for a Wire, which runs through the Bone of the *Metacarpus* and inner Toe. The third *Os Cuneiforme* is perforated for a Wire which passes through the Bone of the *Metacarpus* and outer Toe. The three *Ossa Cuneiformia* are join'd to each other by a folded Wire, which runs twice from their outside to the inside, where they are secured.

Sir, By the Opportunity I have had of preparing and joining these Bones, it may be expected I should give some Account of their Structure: But as the design of preserving the Sceleton entire gave me no Liberty to go any further than their External Surface, so it cannot be expected I could dive any deeper in the Knowledge of them. *Tentzelius* says, *Omnia isthæc Ossa porosa sunt & rimosa*; and I may add, *Levia* too: For there is nothing about them to be seen of that Solidity and Compactness, that smoothness of Surface, and Whiteness, which is observable in other Quadrupeds of the larger size, such as Oxen, Horses, Harts, *&c.* or smaller, as Sheep, Dogs, Cats, *&c.* And I should have readily attributed this to the Youth of the Animal, had not *Tentzelius* from his Subject, suppos'd to be 200 Years Old, told the same. And this differs much from the Account of the *Behemoth* in *Job*, whose Bones are said to be as strong pieces of Brass, and Bars of Iron. The *Laminæ* of the Head were thin and solid; the External Table thin and more ponderous; the Teeth exceeding solid and ponderous: So that from the computation of the Weight of the upper part, which was taken off by the Saw, as in *Tab.* 3. *Fig.* 5. and 6. which is only 6 ℔. weight, I may reckon all the Head, which weighs 66 ℔. beside the Teeth, not to weigh above 24 ℔. at most; which well agrees with what *Tentzelius* says, that each of the *Dentes Molares* were 12 ℔. weight, and that of all the 45 ℔. which the Lower Jaw weighs, the rest of the Bone beside the Grinders do not exceed 12 or 16 ℔. For its External Surface seems to be both porous and rimous, as is said; and at perforating the *Condyles* seem'd to be very spongy, as were the Ribs, *Femur*, *Tibia*, *&c.* where, after the Drill had pass'd the External *Lamina*, which was very thin, it would have run forward as if it had been through so much Moss. When the *Epiphysis* came off the Thigh Bone, it resembled very much the *Epiphysis* of the *Femur* in Man; its minute *Cellules* were not so big as those of an Oxe, and the *Laminæ* which circumscrib'd them, not by much so solid. The *Humerus* indeed both above and below was

much harder; it did heat the Drill in passing: And there may be some reason for that too; *viz.* that since the Progression of most Quadrupeds chiefly depends upon a more frequent motion of the Fore than Hind Limbs, it does much more here, where the Head is proportionably more heavy than in other Animals. And this perhaps is the reason too, why the Fore Limbs in this Animal are brought so far forward; for measuring in a streight Line from the *Humerus* above to the *Carpus* below, and bringing another Line directly backward at the Articulation betwixt the *Humerus* and *Cubitus*, from the perpendicular Line before to the point of the *Olecranon* behind, it is 20 Inches; which is the reason why some believe my Engraver has made the fore Limbs of the Sceleton to bend too much at the Articulation. The Bones of the *Carpus* are pretty solid, and by Perforation they seem only to have a little spongiosity about the middle: All the rest of the Bones of the fore Foot are spongy. The *Astragalus*, *Os Naviculare*, and *Ossa Cuneiformia*, are more solid; but the *Talus* and other Bones of the hind Foot spongious. The Spine was spongy, as is usual; the *Ossa Innominata* of a middle Consistence; and the *Scapula* very thin, but solid toward its Neck. I cannot positively determine the Cavities for the Marrow, nor quantity of it; but by comparing the Dimensions with the Weight and small quantity of Fat to be seen at the boiling, we may suppose it not to have been much in this Animal: I know not how it may be in others of this Species.

I must not forget to tell you, that when I weighed the Bones, it was immediately before they were joined; so that their weight was much diminish'd, in respect of what it was when they were newly boil'd. The weight is ℥16. to 1 ℔. and the measure, according to the *English* Yard, 12 Inches to a Foot, and 12 Lines to an Inch.

And thus, *Sir*, I have finish'd these my Weak Endeavours: The Undertaking, I doubt, will seem bold to some, and rash to others, and the Performance mean. But the many Obligations you have laid upon me, and the frequent Marks of Esteem I have received in your several Letters, made me pass over all Obstacles, Reflections, and Discouragements, when to serve you and your Honourable Society was my only Design. I have rather chosen to address you in a plain and common Stile, than give the least suspicion of Disingenuity in a finer Language; especially since

ſince it is Hiſtory I have written, where Matter of Fact, and not Romance, where Eloquence, is the chief Deſign.

The Copper Plates, which at my own Charges I have cauſed to be engraven here, I acknowledge might have been done finer in *London*; but ſince I had the Original by me, whereby I was able from time to time to correct in the Ingraving what Errors happen'd in drawing the Figures, I rather choſe to have them done by me here: And tho' the Draughts of the Engraver be courſe, yet I have endeavoured what in me lay to have the Figures true and well proportion'd. Wiſhing all Health and Happineſs to your ſelf, Proſperity and Succeſs to your Honourable and Famous Society. I continue,

Sir,

Your moſt humble, and

moſt obliged Servant,

From my Houſe at
Dundee, April 27.
1709.

PATRICK BLAIR.

The

The Explication of the Tables.

TABULA I.

Repreſents the ſtuff'd Skin of the Elephant, as it now ſtands in our Hall, with an Account of its particular Dimenſions.

	Feet.	Inches.
A. A. The Height of the *Elephant* at the Fore Feet.	8	6
B. B. Its Height at the Hind Feet.	9	
C. C. Its Length.	10	
C. D. The Length of the Tail.	4	3
E E. The Circumference of the Belly.	14	
F. F. From the top of the Head to the Point of the *Proboſcis.*	8	
G. F. The length of the *Proboſcis.*	4	6
H. H. The diſtance between the Forehead and lower Jaw.	2	3
F. I. From the top of the Head to the lower Jaw.	4	6
K. K. The length of the Ear.	1	7
L. L. Its breadth.	1	5
M. The Orifice of the *Meatus Auditorius.*		
N. N. The Circumference of the fore Foot round the Hoofs.	3	10½
a. The Fore Hoof fore-ſhortned.		5
b. The middle External Hoof.		5
c. The third External Hoof.		4½
Note, That neither the Diameter of the fore Foot from before to behind, which was———	1	4½
nor from the right to the left, which was——	1	2
can be ſo here.		
O. O. The Circumference of the fore Foot at the upper Joint.	4	3
P. P. At the Articulation with the *Carpus.*	2	6½
Q. Q. The Circumference of the hind Foot round the Hoofs.	3	4
The Diameter from before to behind.		
From the right to the left.		
a. The breadth of the fore Hoof.		3½
b. The breadth of the outer Hoof.		4
c. The breadth of the third Hoof.		4
R. R. The Circumference of the hind Leg.	2	2

S.

S. The Mouth.
T. The Tusks broken off by the middle.
U. The Eye.
X. Represents the Scabs about the Belly.
Y. Y. The Depressions in the Skin through the folding of the *Proboscis*.
a. A Protuberance first occasion'd by the *Ossa Innominata*, when the Animal was alive and very lean, and still remaining in the Skin.
b. A Protuberance in the forepart of the Thigh.
c. The lower Joint of the fore Foot, where there is a Depression in the Skin.
d. d. Several Wrinkles in the stuff'd Skin.

Tabula II.

Represents the Sceleton of the Elephant, as it was mounted by my Direction, and now stands in the Repository of Rarities in Dundee.

A. The Scull taken in Prophile, whereby a part of the fore side is foreshortned.
a. The Hole for the Root of the Trunk foreshortned.
b. b. The two *Ossa Palati*.
c. c. The Two Tusks as they proceed from the *Ossa Palati*.
d. d. The broken off Extremities of the Tusks.
e. The Grinders of the Upper Jaw.
f. The fore Grinder of the Lower Jaw.
g. The undulating Lines of the lower Surface of the Grinders of the Upper Jaw.
h. The inner Grinder of the Lower Jaw.
i. Part of the *Os Malæ*.
k. Its Articulation with the *Os Zygomaticum*.
l. The *Os Zygomaticum*.
m. The Orbit of the Eye.
n. Its upper Protuberance.
o. Its middle Protuberance where the *Trochlea* is inserted.
p. Its lower Protuberance.
q. A *Sinus* at the bottom of the Orbit.
r. r. A Depression fit for lodging the Muscles of the lower Jaw and *Proboscis*.
s. The Orifice of the *Meatus Auditorius*.
t. t. The Articulation of the *Os Calvariæ* with the *Os Zygomaticum*.
u. The *Processus Coronæ* of the lower Jaw.

x. The

x. The Insertion of the *Musculus Masseter*

y. The space for the Mouth betwixt the *Os Palati* and lower Jaw.

z. An Orifice from which the *Nervus Maxillaris inferior* proceeds.

B. The *Vertebræ* of the Neck.

1. The first *Vertebra.*

2. The second *Vertebra*, or Tooth which rises higher than the rest.

3. The third *Vertebra* having scarce any Spinal Process.

4. The 4th, whose Spinal Process is not yet seen.

5. The 5th, with the Spinal Process beginning to appear.

6. The 6th, whose Spinal Process ascends higher, and is remarkable at its fore-part, as in *Tab.* 4.

7. The 7th, whose Spinal Process still ascends, and with whose back-part the first Rib is articulated.

C. The *Vertebræ* of the Back.

1.——13. Their *Processus Spinosi*, which have no Protuberance at their Extremity, whereof 1——C. are the longest, and C.——13. become gradually shorter.

D The Spinal Processes of all the rest of the *Vertebræ* to the *Os Sacrum* which are shorned by degrees.

xxxxx &c. the oblique Processes of the *Vertebræ.*

E. The *Scapula.*

a. a. The spongious Margin of the *Scapula.*

b. b. Its *Processus Spinosus* sending forward a Protuberance.

c. c. Its Neck.

d. d. The *Epiphysis* which receives the *Humerus.*

e. e. &c. The Ribs.

f. f. &c. The Ribs which appear on the opposite side.

g. g. The Cartilages of the *Sternum.*

h. h. The Bones of the *Sternum.*

i. i. i. The three Ribs which have no Cartilages.

l. l. l. The Bodies of the three *Vertebræ Lumborum.*

F. The *Humerus.*

1. Its upper part, spongious and rugous, for the Insertion of Tendons.

2. Its middle part more solid.

3. A large oblique *Sinus* for lodging the *Biceps.*

4. Its lower Extremity articulated with the *Cubitus* and *Radius.*

G. The *Cubitus* and *Radius.*

1. The *Olecranon.*

2. An hallowness on the outside of the *Cubitus.*

3. The *Radius.*

4. Its lower *Epiphysis*, rugous, and separated from it by a Suture,

5. The lower *Epiphysis* of the *Cubitus*, separated likewise by a Suture.

666. Three Bones of the first Rank of the *Carpus.*

777.

7. 7. 7. Three Bones of the second Rank.
8——8. The Bones of the *Metacarpus*.
9——9. The first Bones of the Toes.
10——10. The second Bones of the Toes.
H. H. The *Ossa Innominata* represented in *Profile*.
I. The *Pelvis*.
K. The Tail.
L. L. The two Thigh Bones.
1. The *Epiphysis* receiv'd by the *Ossa Innominata*, and articulated with the *Femur* by a Suture.
2. The *Trochanter major*.
3. The lower *Epiphysis*.
4. The *Patella*.
M. The *Tibia*.
1. *Perone*.
2. The *Talus*.
3. The Bones of the *Tarsus*.
4. The Bones of the *Metatarsus*.
5. The Bones of the Toes.

Tabula III.

Represents the Head in different Views, Parts of the Ear, Proboscis, *and* Uterus.

Figure 1. Represents the fore-part of the Head.
a. The Hole for the Root of the Trunk.
b. The lower part of the *Os Palati*, over which hangs the *Proboscis*.
c. c. A Depression of the Bone on each side, for lodging of the Muscles of the lower Jaw.
d. d. The two Eminences on each side at the top of the Head.
e. A Depression in the middle betwixt these two Eminences.
f. f. Two Beginnings of the Angles for forming the Depressions for the Muscles of the lower Jaw, betwixt which the Surface of the Bone begins to be plain.
g. The upper Production of the *Sinus* where the Eye is lodg'd.
h. The Beginnings of the *Laminæ* which run betwixt the two Tables of the Scull, and here appear in the bottom of the Hole for the Root of the *Proboscis*.
i. The *Os Vomeris* to which the *Cartilaginous Septum* of the *Proboscis* was adherent.
k. The beginning of the Depression of the *Os Palati*.
l. The middle of the *Sinus* for the Orbit of the Eye.
m. The Articulation of the two *Ossa Palati*.
n. n. The Articulation of the *Os Maxillæ* with the *Os Palati*; where also is a *Crena* for containing the Blood Vessels, as

 they

they go to the nouriſhment of the *Proboſcis*.

o. o. The Place where the Tusks proceed from the *Os Palati*.

p. p. The upper part of the Articulation of the *Os Maxillæ* with the *Os Palati*.

q. q. The broken Extremities of the Tusks.

r. r. A great Oval Hole in the *Os Maxillæ*, through which a conſiderable Branch of the 5th Pair of Nerves, and a large Artery from the *Arteria duræ Matris* paſs to and are diſpers'd in the *Proboſcis*, and by which a big Vein returns and joins to the *Vena jugularis*.

s. The *Os Zygomaticum*.

t. The middle Production for the Orbit of the Eye.

Figure 2. repreſents the Side of the Head.

a. The beginning of the Depreſſion for the Muſcles of the lower Jaw and *Proboſcis*.

b. The Inſertion of the *Retractores Proboſcidis*.

c. The Inſertion of the *Muſculus Temporalis*.

d. The bottom of the Orbit of the Eye.

e. Its upper Production.

f. Its lower Production.

g. The Articulation of the *Os Maxillæ* with the *Os Zygomaticum*.

h. The *Os Zygomaticum*.

i. The Articulation of the *Os Zygomaticum* with the *Os Calvariæ*.

k. The Orifice of the *Meatus Auditorius*

l. One of the *Condyles* of the *Occiput*, which is articulated with the firſt *Vertebra*.

m. The Orifice of the large Oval Hole in the *Os Maxillæ*.

n. The fore Grinder in the upper Jaw.

o. The hind Grinder, or rather Wedge for keeping the fore Grinder faſt.

p. The undulate Lines in the lower Surface of the Teeth.

q. The beginning of the Tusks as they proceed from the *Os Palati*.

r. Their broken off Extremities.

s. The *Sinus* in the bottom of the Orbit of the Eye for the *Nervus Opticus*.

Fig 3. repreſents the back-part of the Head.

a. a. The two Eminences at the upper part of the Head enlarg'd, whereby the *Sinus* betwixt them becomes narrower and deeper.

b. The *Sinus* betwixt theſe Eminences ſhortned.

c. c. The two *Condyles* which are receiv'd by the firſt *Vertebra*.

d. The Hole for the Spinal Marrow.

e e. Two Protuberances above the *Meatus Auditorius*.

f. The

f. The Orifice of the *Meatus Auditorius.*

g. A *Sinus* whence the *Proceſſus Styloides* ariſes, which is ſhewn by itſelf.

h. The Cartilage whereby the *Proceſſus Styloides* is articulated with the Scull.

i. Its longeſt and ſmalleſt part.

k. Its ſhorteſt and biggeſt part.

l. The Orifice for the *hard Portion.*

m. m. The Hole for the Jugular Vein and *Par vagum.*

n. n. The bony part of the *Aqueduct.*

o. o. The Extremity of the *Aqueduct* where the fleſhy part begins.

p. p. The Hole for the Carotid Artery.

q. q. The Hole for the *Arteria duræ Matris*, and 3d Branch of the 5th Pair.

r. The middle of the Baſe of the Scull beneath the Hole for the Spinal Marrow, where the Bone is ſomewhat raiſed.

s. A Depreſſion on the Baſe of the Scull before the *Choana* begins.

t. The *Choana*, or Paſſage between the Root of the Trunk and the Mouth.

u. A Production of the *Vomer*, or *Septum*, which divides the *Choana* in two.

x. The Articulation of the *Os Zygomaticum* with the *Os Occipitale.*

y. The *Glenoid* Cavity for Reception of the lower *Condylus* of the lower Jaw.

z. The *Sinus* for the Globe of the Eye.

1. The *Os Zygomaticum.*

2. The fore Grinder on the right ſide.

3. The hind Grinder on the right ſide.

4. The hind Teeth on the left ſide, which not grinding at all, only ſerve as a Wedge.

5. The fore Teeth on the left ſide, the back-part of which does not Grind.

6. 6. The lower Surface of the Grinders, where their undulate Lines appear.

7. 7. Part of the *Os Maxillæ*, where it is articulated with the *Os Zygomaticum.*

8. 8. The great Oval Hole in the *Os Maxillæ.*

9. 9. The back-part of the *Os Palati.*

10. The Interſtice between the the *Oſſa Palati* on the back-ſide.

11. 11. The Tusks as they proceed from the *Os Palati.*

12. 12. The two broken off Extremities of the Tusks.

Fig. 4. repreſents the Scull ſaw'd tranſverſely, ſo that its lower part with the Baſe appear.

a. a. The outward Table of the Scull.

b. b. The inner Table.

 c. c. The

c. c. The *Laminæ* which pass betwixt the two Tables.
d. d. the *Cells* form'd by these *Laminæ*.
e. e. The Orifices for Vessels which penetrate the *Laminæ*.
f. The Seat of the Brain, represented at more length in *Fig.* 3.
g. g. The two *Condyles* which are receiv'd by the first *Vertebra*.
h. The Hole for the Spinal Marrow.
i. The *Os Zygomaticum*.

Fig. 5. represents the upper part of the Scull saw'd transversely, with the *Cells* running betwixt the two Tables and *Laminæ* which cover the Seat of the Brain.

Fig. 6. represents the outside of the upper part of the Scull saw'd transversely.
a. a. Two Eminences on the top of the Scull.
b. A *Sinus* betwixt these two Eminences.
c. A long *Spina* in the bottom of the *Sinus*.

Fig. 7. represents the fore-part of the lower Jaw.
a. a. The two *Condyles*.
b. b. The two *Processus Coronæ* shortned by the opposite view.
c. c. The fore Grinders of the lower Jaw.
d. The distance between the two Jaws for lodging the Tongue.
e. The *Symphysis Menti*.

Fig. 8. represents the back parts of the lower Jaw.
a. a. Two *Condyles*.
b. b. Two large Orifices of a Cavity, wherein enter the Vessels for nourishing the Teeth, and wherein are lodg'd the *Rudimenta dentium*, as in Fig 19.
c. c. The two fore Grinders of the lower Jaw.
d. d. The undulate Lines in their upper Surface.
e. The distance between them for lodging the Tongue.
f. The Concave part of the lower Jaw.

Fig. 9. represents one side of the lower Jaw.
a. a. The two *Condyles*.
b. b. The two *Processus Coronæ*.
c. A Protuberant part of the lower Jaw where the *Rudimenta dentium* are lodg'd.
d. The inner Grinder of the lower Jaw.
e. The outward Grinder, where are represented the Ridges and Interstices of the sides of the Teeth.
h. The *Symphysis Menti*.

Fig. 10. represents the lower part of the *Processus Petrosus*, wherein are shewn
a. a. A part of the *Meatus Auditorius* opened.

b. The

b. The *Crena* for the *Membrana Tympani.*

c. The *Cavitas Tympani*, endued with several *Cells*, and Interstices betwixt them.

d. A Continuation of the same Cavity.

e. The Orifice of the hard Portion of the *Nervus Auditorius.*

f. The ragged Margin of the Bone.

Fig. 11. represents the inner Surface of the upper part of the *Processus Petrosus.*

a. a. The ragged Margin of the Bone.

b. b. The upper part of the *Cavitas Tympani.*

c. The *Foramen Ovale.*

d. A Protuberance, within which is the Cavity of the *Cochlea.*

e. The Orifice for the hard Portion of the *Nervus Auditorius.*

Fig. 12. represents the *Meatus Auditorius* with the *Processus Petrosus.*

a. The External Orifice of the *Processus Petrosus.*

b. b. The *Meatus Auditorius* deriv'd from the *Laminæ* above, and running from the outer Table to the *Processus Petrosus.*

c. c. The *Laminæ* and *Cellules*, as they proceed from the *Processus Petrosus* on each side.

d. The *Processus Petrosus.*

e. Orificium Foraminis Nervi Auditorij.

f. Part of the inner Table of the Scull.

Fig. 13. represents the Bones of the Ear in their proper Dimensions and different Views,

a. The *Malleolus.*

b. The *Incus.*

c. The *Stapes* without the Base.

d. e. The back-part of the *Malleolus* and *Incus* articulated together.

f. The *Stapes* with its Base.

g. The *Malleolus*, *Stapes*, and *Incus* articulated together; whereby is shewn the true distance betwixt the *Membrana Basis Tympani*, and the *Foramen Ovale*, which the Base of the *Stapes* shuts.

h. The Base of the *Stapes.*

Fig. 14. represents the Seat of the Brain enlarg'd, that the Orifices for the Blood Vessels and Nerves may be the more obvious.

a. a. The inner Table depriv'd of the surrounding *Cellules.*

b. b. The anterior *Sinus.*

c. c. The *Os Ethmoides*, with its Eminences, *Sulci*, and *Foramina* for the *Nervus Olfactorius.*

d. The *Crista Galli.*

e. e. The anterior Eminences.

f. f. The Orifice for the *Nervus Opticus.*

g. g. The Hole called the *Foramen Lacerum*, through which pass the *Nervi Motorij Pathetici Ophthalmici*, or first Branch of the 5th and the 6th Pair.

h. h. The 2d Branch of the 5th Pair.

i. i. The third Branch of the 5th Pair.
k. k. The Hole for the *Arteria duræ Matris.*
l. l. The Hole for the Carotid Artery.
m. m. The Hole of the *Nervus Auditorius.*
n. n. The Hole for the Jugular Vein.
o. The Hole for the Spinal Marrow.
p. p. Part of the two *Condyles.*
q. The External Hole for the Spinal Marrow.
r. r. The two middle *Fossæ.*
s. s. The *Processus Petrosus.*
t. t. The *posterior Fossa,* or Seat of the *Cerebellum.*
u. The Seat of the *Glandula Pituitaria.*

Fig. 15. represents the *Uterus.*
a. a. Part of the *Ligamenta lata Uteri.*
b. Part of the *Vagina* cut off.
c. The beginning of the Body of the *Uterus,*
d. Divided into two Portions, with an Interstice in the middle.
e. e. Several Eminences representing the External part of so many *Cellules.*
f. f. The *Cornua Uteri.*
g. A loose Membrane wrapt up, that the *Ovaria* below may appear.
h. The *Ovarium* depriv'd of the thick loose Membrane which fluctuates above it.
i. The *Ovarium* covered with the Membrane.

Fig. 16. represents the *Proboscis* cut transversly.
a. a. The two Cavities of the *Proboscis.*
b. The *Septum* which divides the Cavities.
c. c. The tendinous Intersection which runs from before to behind.
d. d. The tendinous Intersection which runs from the Right to the Left.
e. e. e. e. The Insertion of the 4 Muscles into the tendinous Intersection, whereby the Fibres of the one ascend, and the other descend obliquely.

Fig. 17. represents the dissected *Proboscis.*
a. The External part of the Cartilage which surrounds the Cavity of the *Probiscis,* as it arises from the Hole in the fore-part of the Scull.
b. b. That Pair of Muscles call'd the *Levatores Proboscidis,* rais'd from above the foresaid Cartilages, with their inner Surface turn'd up, that the Divarications from the Blood Vessels in them may appear.
c c. The Orifices of the Veins dispers'd in these Muscles.
d. d. The Orifices of the Arteries.
e. e. Their several Branchings.
f. The descent streight along above the Cavity of the *Proboscis.*

g. g. The oblique descent of the Fibres of the *Erectores* of the *Proboscis*.

h. The tendinous Intersection running down the middle of the *Proboscis*.

i. i. The Orifices of the Cavities of the *Proboscis*.

Fig. 18. represents the Extremity of the *Proboscis* cut off.

a. A Protuberance arising from the fore-part of the Extremity of the *Proboscis*, and is extended into a Cavity in the back-part *b.* whereby the Animal catches hold of any thing.

Fig. 19. represents one of the Rudiments of the Teeth, which was taken out of the great Hole in the inner side of the lower Jaw, as represented (*b. Fig.* 8.) but much enlarg'd in the proportion.

a. Its upper part, which is hard, solid, and white.

b. Its middle part distinguished by several Furrows and Ridges.

c. Its lower part, which is hollow, and whereinto both the Blood Vesse's that serve for its Nourishment, and a Branch of the Nerve call'd *Maxillaris Inferior*, proceeding from the 5th Pair, enters.

A. Represents a Portion of the *Cuticula*, wherein is shewn its inner Surface, and usual thickness; at its Margin at the left hand and lower part are several white lines, which I take to be the Lineaments of so many Blood Vessels; the Pyramids, from whence the Hairs proceed, with the several *Favi* or Depressions.

B. Represents one of the Scabs adhering to the *Cuticula*, where they are thickest.

TAB.

TABULA IV.

Repreſents the Vertebræ *of the Neck both ſeparate and conjoin'd,* Oſſa Innominata, Scapula, *the back-part of the fore and hind Feet, ſeparate Bones of the* Carpus *and* Tarſus, *concave part of the Liver, and* Os Hyoides.

Figure 1. Repreſents the fore and back part of all the ſeven *Vertebræ* of the Neck.

A. The firſt *Vertebra* of the Neck with its upper part in Profile, to ſhew the Holes for the *Arteria Vertebralis.*

a. a. Two Protuberances, which reach on each ſide to the Scull.

b. b. Two Cavities foreſhortned, which receive the *Condyles* of the Scull.

c. c. The two Holes whereby the *Arteria Vertebralis* proceeds from the Scull, and perforates this *Vertebra.*

d. d. Two Holes through which the Artery paſſes out from this *Vertebra.*

e. e. A *Crena* betwixt the two foreſaid Holes, where the Artery is lodg'd.

A. 1. The fore-part of the firſt *Vertebra* ſhewn at large.

a. The Hole for the Spinal Marrow.

b. The Hole for receiving the Tooth of the following *Vertebra.*

c. c. Two Cavities for receiving the *Condyles* of the Scull.

d. d. Two Holes for the Cervical Artery.

e. The upper part of the *Vertebra.*

f. Its lower part.

g. g. The tranſverſe Proceſſes, whoſe Protuberances at the Extremities are repreſented, A. *a. a.*

B. 1. The back-part of the firſt *Vertebra* ſhewn at large.

a. The Hole for the Spinal Marrow.

b. The Hole for the Tooth of the following *Vertebra.*

c. c. The Cavities which receive the body of the following *Vertebra.*

d. The lower part of the *Vertebra.*

e. e. The Holes for the Cervical Artery.

f. f. The two tranſverſe Proceſſes.

A. 2. The fore part of the ſecond *Vertebra.*

a. a. The forked Extremities of the Protuberance, which ariſes inſtead of the *Proceſſus Spinoſus.*

b. A *Sinus* betwixt them.
c. The Hole for the Spinal Marrow.
d. The Tooth which is receiv'd by the firſt *Vertebra.*
e. e. The two convex Surfaces which are receiv'd into the hind Cavities of the firſt *Vertebra.*
f. f. The two Holes for the Cervical Artery.
g. g. Two tranſverſe Proceſſes.
h. The lower part of the *Vertebra.*
B. 2. The back-part of the ſame *Vertebra.*
a. a. The Protuberances of the *Proceſſus Spinoſus.*
b. The *Sinus* betwixt them enlarg'd on the ſide.
c. The Hole for the Spinal Marrow.
d. The Point of the Tooth appearing from the other ſide.
e. e. The Holes for the Cervical Artery.
f. The concave Body of the *Vertebra,* which receives the convex Surface of the following *Vertebra.*
g. g. The *tranſverſe Proceſſes.*
h. h. The two oblique Proceſſes which receive the oblique Proceſſes of the following *Vertebra.*

Note, That the five following *Vertebræ* are repreſented by A. B. 3, 4, 5, 6, 7; whereof A. repreſents the fore-part, B. the back-part; all the reſt of the ſmall Letters ſhowing as follows.

a. a. &c. The Hole for the Spinal Marrow.
b. b. &c. Their convex Bodies, which are received by the concave Surfaces of the following.
c. c. &c. Their concave Bodies, which receive the convex Surfaces of the former.
d. d. &c. The Holes for the Cervical Artery.
e. e. &c. The oblique Proceſſes.
f. f. &c. The tranſverſe Proceſſes.
g. g. &c. The Spinal Proceſſes, which in the fore-part of 3, 4, ſcarcely appear, but in their back-part appear a little, in 5 ariſe to 1 ½ Inch, and in 6 to 3 Inches.
h. h. In 6, 7, are Protuberances, which run back to guard the Cervical Artery as it paſſes from between the bodies of the *Vertebræ,* and quits the Perforation in their tranſverſe Proceſſes.
i. i. Two *Sinus's* in the back-part of the ſeventh *Vertebra,* which with the like Surfaces in the following make up a Cavity, whereinto the *Condyles* of the firſt Ribs are receiv'd.

Figure 2. Represents the *Scapula.*

a. The Head of the *Scapula*, whereby it is articulated with the *Humerus.*

b. b. The two Protuberances on each side of its Head.

c. The Neck of the *Scapula.*

d. A *Sinus* between the *Processus Coracoides* and the Neck of the *Scapula.*

e. The *Processus Coracoides* of the *Scapula.*

f. The *Processus Spinosus.*

g. The Extremity of the *Processus Spinosus.*

h. A Protuberance running forward from the *Processus Spinosus.*

i. The forepart of the upper edge of the *Scapula.*

l. A thick spongy *Epiphysis*, which (at the upper edge of the *Scapula*) was separated by boiling.

m. The Angle at the back-part of the *Scapula.*

Figure 3. Represents the lower or fore-part of the seven *Vertebræ* of the Neck.

a. b. c. &c. The lower or fore-part of the bodies of all the *Vertebræ.*

h. h. The transverse Processes, which run obliquely forward.

i. i. The transverse Processes of the 6th *Vertebra*, running both before and behind to guard the *Arteria Cervicalis.*

k. A *Sinus* in the Body of the seventh *Vertebra*, for receiving a part of the first Rib.

Fig.

Figure 4. represents the fore-part of the *Ossa Innominata.*

	Feet.	Inches.
A. The *Pelvis* in Circumference	4	6
B. The *Os Sacrum.*		
C. The upper part of the *Os Pubis.*		
B C. Between the *Os Sacrum* and the *Os Pubis.*	1	6
D. E. From the Right to the Left of the *Pelvis.*	1	5
C. F. From the upper to the lower part of the *Os Ilium.*	1	
G. H. Betwixt the two outward Extremities of the *Ossa Innominata.*	3	6
B. H. From the *Os Sacrum* above to the foresaid Point.	2	9½
From H. to K.	1	
L. The Circumference of the *Acetabulum.*	1	6
E. H. Breadth of the *Os Ilium.*	1	1
M. M. Circumference of the Neck of the *Ilium.*	1	2
N. N. Breadth of the *Os Pubis.*		8
O. O. The length of the *Foramen Ovale* for the *Musculus Marsupialis.*		5½
P. P. Its Breadth.		4
Q. Q. Its Circumference.	1	1
R. R. The Breadth of the *Ossa Pubis* before.	1	5
S. T. The length of the *Os Sacrum*, from whence it is join'd with the *Vertebræ Lumborum*, to where 'tis join'd with the Tail.		

Fig. 5. represents the back-part of the *Ossa Innominata.*

A. The *Pelvis.*

B. The back-part of the *Ossa Pubis* at their Articulation, where there is large Cavity.

C. C. The Oval Hole for the *Musculus Marsupialis* foreshortned.

D. The Cavity for the *Acetabulum.*

E. E. The Margin of the *Os Ilium*, which separated by boiling.

F. The back-part of the *Ossa Innominata*, shewing their Spinal and oblique Processes.

Fig. 6. represents the back part of the Fore Foot.

a. a. The Bones of the *Carpus.*

b. b. The Bones of the *Metacarpus.*

c. c. The *Ossa Sesamoidea*, whereof there are two upon the lower Extremity of each Bone of the *Metacarpus.*

d. d. The Bones of the Toes.

Fig.

Fig. 7. represents the back part of the Hind Foot.

a. The *Talus.*
b. Part of the *Aſtragalus.*
c, c. Bones of the *Tarſus.*
d. d. Bones of the *Metatarſus.*
e, e. Bones of the Toes.

Fig. 8. repreſents the Bones of the *Carpus* ſeparately.

1. The upper Surface of the External Bone of the firſt Rank of the *Carpus.*
2. The middle Bone.
3. The third Bone of the firſt Rank.
5. 6. The upper Surface of the three Bones of the ſecond Rank.

Fig. 9. repreſents the Bones of the *Tarſus* ſeparately.

1. The upper Surface of the *Aſtragalus.*
2. The upper Surface of the *Os Naviculare,* much enlarg'd in proportion to the reſt.
3. Its lower Surface.
4. 5. 6. The upper Surface of the *Oſſa Cuneiformia.*

Fig. 10. repreſents the concave ſide of the Liver.

a. The *Vena Porta.*
b. The *Vena Cava.*

Fig. 11. repreſents the *Os Hyoides.*

a. The fore-part.
b. The back-part.
d. d. The *Cartilago Scutiformis.*
e. e. The lateral *Oſſa Hyoidea.*
f. f. The Bones of the Baſe of the *Os Hyoides.*

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Fig: 1a. *Philosoph: Transact: N° 328.*

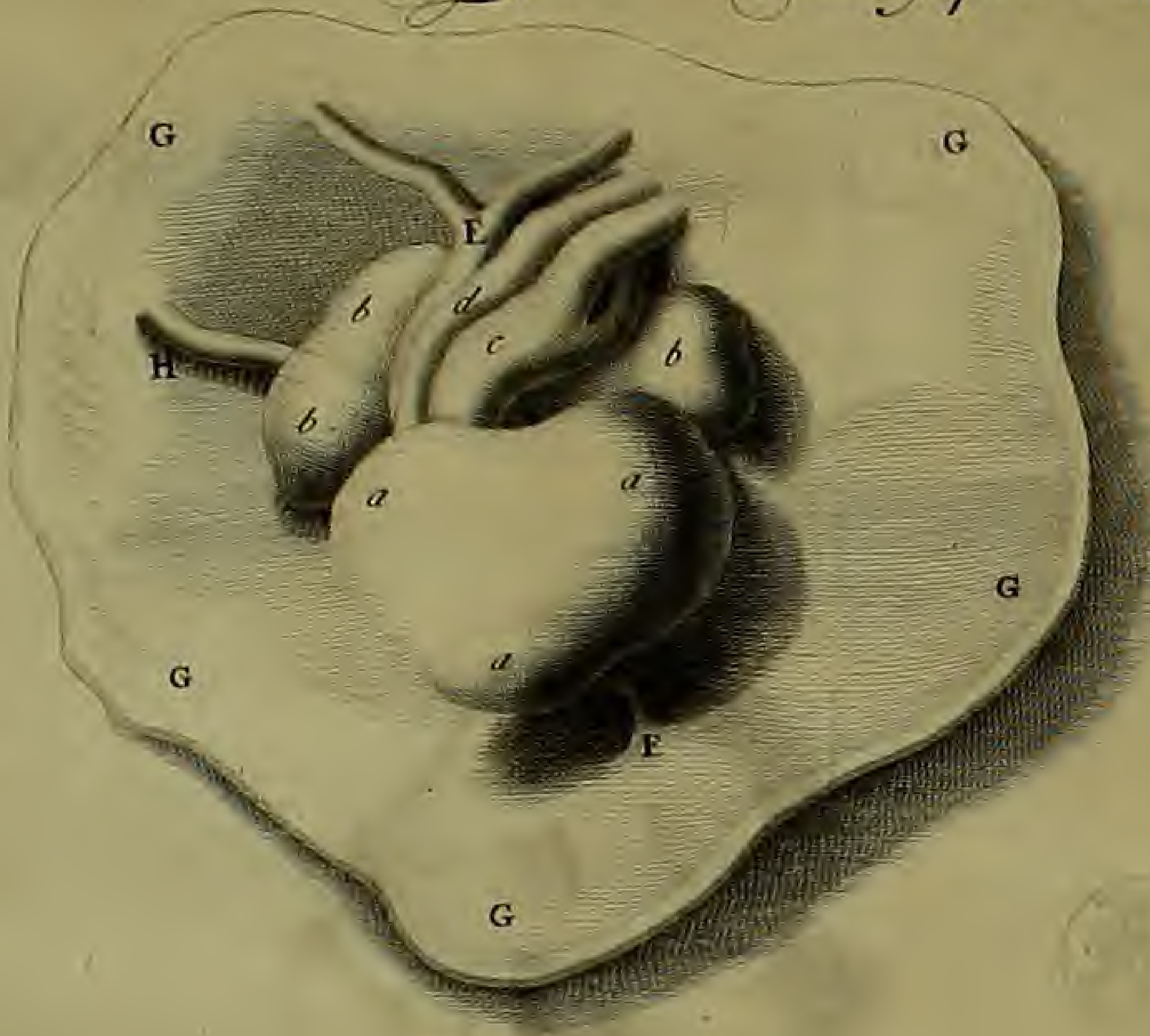
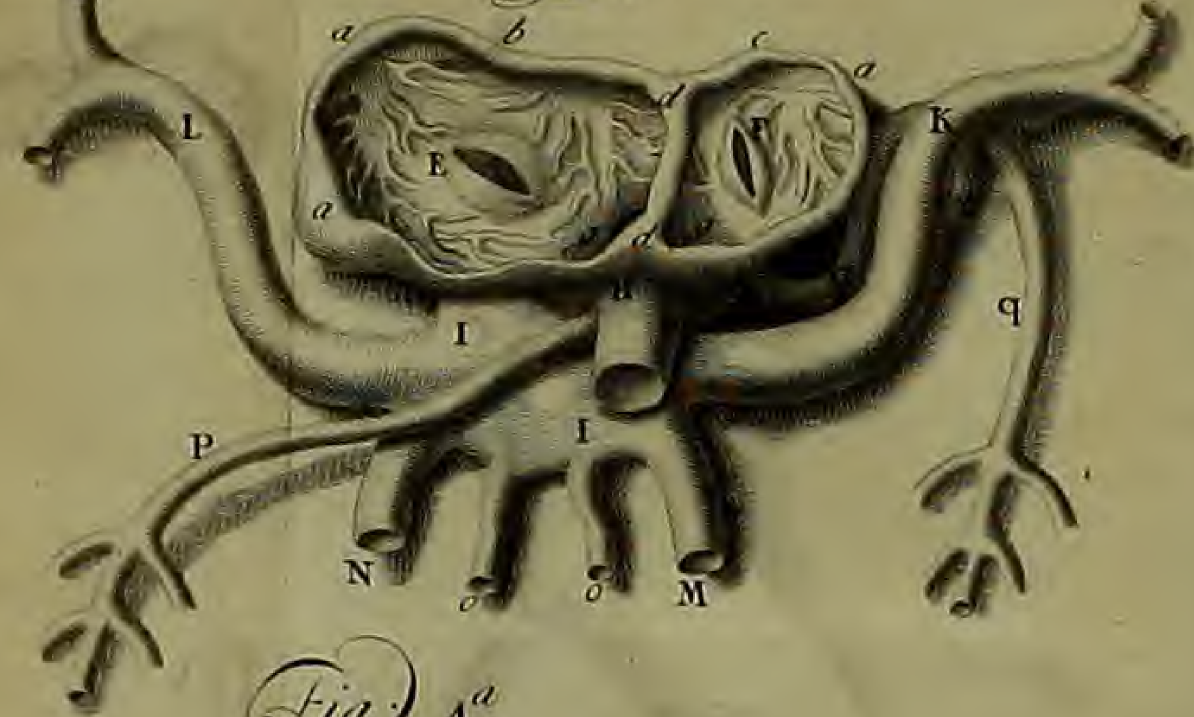


Fig: 3a.



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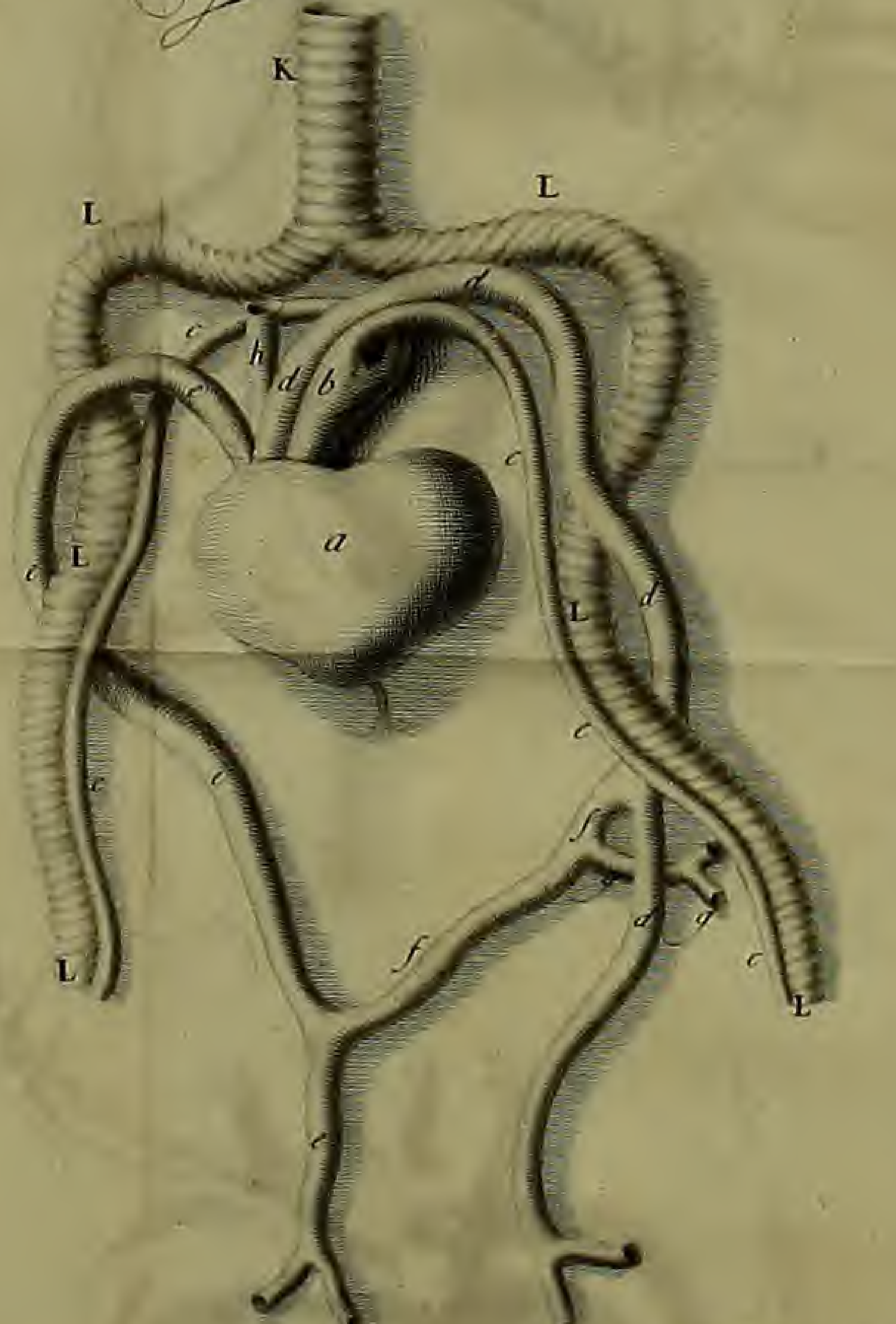

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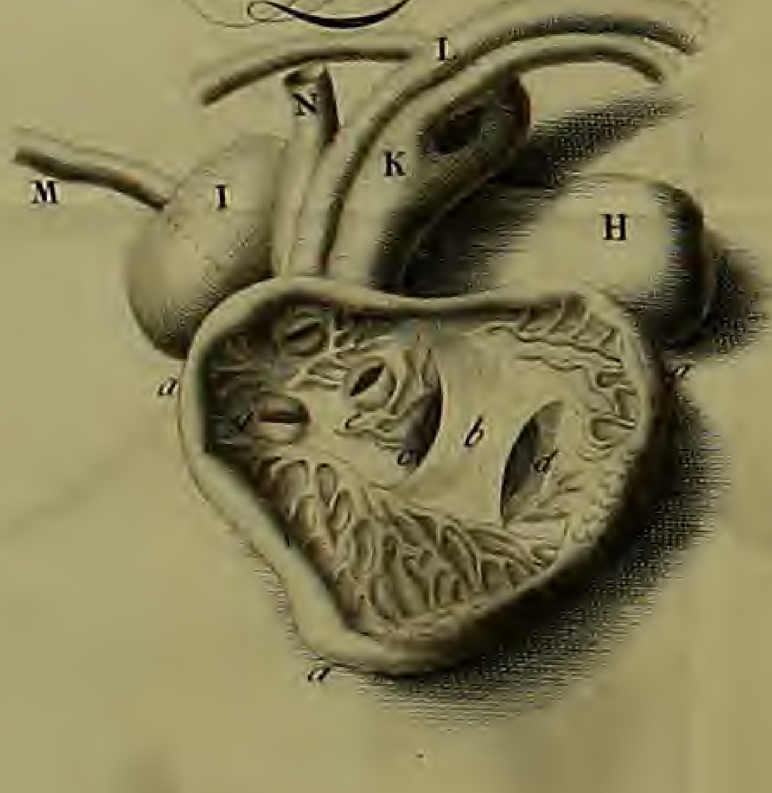

M: V^dr Gucht Sculp.

(Numb. 328.)

PHILOSOPHICAL TRANSACTIONS.

For the Months of October, November, *and* Decem' er, 1710.

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I. *An Anatomical Deſcription of the Heart of Land Tortoiſes from* America. *By Mr.* Paul Buſſiere, *Surgeon, F. R. S.*

IN the Deſcription that I give of the Heart of theſe Animals, I have in no wiſe any deſign to criticiſe upon what Mr. *Mery* hath publiſhed in the Memoirs of the Royal Academy of Sciences, *Anno* 1703. but leave it to the Determination of the Publick. I never was a friend to Diſputation, it contributing oftentimes more to intangle the Subjects that are treated, than to explain the Veracity of the Facts that are ſearched after; and I had entirely abandoned this, which hath been ſome Years between Mr. *Mery* and myſelf, concerning the Uſe of the *Valves*, which cover the *Foramen Ovale* in the Heart of an Human *Fœtus*, if Mr. *Mery* had not pretended to maintain his Opinion by the compariſon of the pretended *Valves*, which he imagines to be in the Heart of the Land Tortoiſes of *America*, (apparently that he hath invented them himſelf) in the pretended *Ventricles* of the Heart of that Animal; and if at the ſame time three Commiſſaries of Reputation deputed by that Academy, had not given an Authentick Approbation to what is advanced by that Anatomiſt. This ſort of Authority might impoſe on the Publick, the greateſt part whereof believe every thing upon ſuch teſtimony, and the others remain in ſuſpenſe for want of the neceſſary means to inform themſelves of the truth; the Land Tortoiſes of *America* being very rare in *Europe*, and the greateſt part of Anatomiſts wanting either the Means or Conveniencies to get them. I have

have then Reaſon to hope, that thoſe who concern themſelves in theſe Matters, will not diſapprove the Care I have taken to have ſome brought from *America*; and to let them know the Structure of the Heart of this Animal, which, of all that might have been choſen, is the moſt proper to convince Mr. *Mery* of his miſtake, and confirm the uſe of the *Valve* of the *Foramen Ovale* in the Heart of an Human *Fœtus*, eſtabliſh'd firſt by Dr. *Harvey*, and confirmed and demonſtrated by all Anatomiſts ſince his time. The Structure of the Heart of this Animal being very ſimple, and the uſe of the double *Valve*, which covers the two *Foramina* of the *Auricle*, in the *Sole Ventricule* of the Heart, ſo plain and ſo manifeſt, that 'tis not poſſible to miſtake, as it will be acknowledg'd by the Deſcription of its Parts and its principal Veſſels. I diſſected three ſucceſſively of the five I received from *Jamaica* in *September* laſt, being yet alive, in the Preſence of Dr. *Sloane*, Dr. *Sylveſtre*, Mr. *Pujolas*, and Mr. *Lafage*, an able Surgeon of *London*; all being occular Witneſſes of what I aſſert. The other two being dead by that time, I cauſed their Hearts to be taken out entire; one of which I ſent to be diſſected in *Paris*, and I kept the other to ſatisfy the Curioſity of thoſe who will ſee it.

A Deſcription of the Heart of a Land Tortoiſe *of* America.

The Heart in this Animal is ſituated in the *anterior* part of the capacity that maketh the *Abdomen*, ſeparated from all the other *Viſcera* by a large *Pericardium*, which encloſeth it. This *Pericardium* is faſtned by its *ſuperior* part to the Spine of the Back, by the *anterior* to the Muſcles of the Neck; which is the cauſe that the Heart moveth forward when the Animal putteth forth his Head out of the Shell, and backward when he

he draws it in: By the *Inferior* part it adheres to the *Peritoneum*, which is fastned to the lower Shell; so that by all these Ligaments the *Pericardium* is kept distended sufficiently, that the Heart hath an entire liberty in it.

In this *Pericardium* there is found a good quantity of a very clear and transparent Water, which hath the same use there, as that which is found in the *Pericardium* of other Animals.

'Tis in the middle of this *Pericardium* that the Heart is suspended; to wit, at its *Basis* by the Arteries, and at its Inferior part by a little Tendon, or a very thin Ligament, which from the Point or Cone of the Heart, ascendeth to insert it self to that part of the *Pericardium* which adheres to the Back.

This little Ligament is very remarkable in this, that by its means the Point of the Heart is suspended on the Level of its *Basis*; without which 'tis visible that the Point of the Heart would fall lower, and bend the Vessels of the *Basis*, which might have interrupted the free Circulation of the Blood, and by consequence would have endanger'd the Life of the Animal.

The *Pericardium* being opened, the Heart appeareth as if it was standing by itself, being only fix'd to the Arteries which go out of it (supposing the Animal turned upon its Back) its *Auricles* being separated and hid under its *Basis* and Arteries, towards the Back of the Animal; which is very different from the Sea Tortoises, where the *Auricles* are situated on the Right and Left Angle of its *Basis*, by which way they push the Blood into the Heart.

The Figure of the Heart of this Animal is almost lenticular; making nevertheless three obtuse Angles, two on the *Basis*, one to the Right, and the other to the Left; the third is at the Inferior part, where the little Tendon, which suspendeth the Heart on the Level of its *Basis*, is inserted.

If

If this Animal be opened alive, you have the satisfaction to see the Circulation of the Blood, by reason of the transparency of the Membranes of the Veins, and the Alternative Motions, or Dilatations of the Heart and Auricles, and the Arteries and Veins, which are very slow in this Animal.

From the *Basis* of the Heart pass out four great Arteries, that appear distinctly separated one from the other; whereas in that of the Sea Tortoise, these Arteries are involved, for the length of an Inch, in a *capsula* common to them all, which maketh them to appear as if they were but one Trunk. If these four Arteries be entirely cut, the Heart is no more suspended, but by the conjunction of the two *musculous Conduits* of the *Auricles*, which pierce the Heart in its *posterior* part, towards the middle of the Heart, on the Left side; by which the Blood runneth from the Auricles into the *Ventricle* of the Heart.

These Arteries being thus divided, and the Heart turned over, the *Auricles* appear lying transversely against the Back, in the capacity of the *Pericardium*: They make but one continued fleshy Body, a little extended, about two thirds inclining to the Left side. 'Tis in this Body that the Cavities of the *Auricles* are separated the one from the other, by a *muscular Septum*, situated Internally to that Place, which appears contracted Externally. These *Auricles* make a *muscular* Production about six Lines long, which uniteth them to the Heart, towards the middle and left of its backside. This Production is composed of two Conduits, separated only from one another by the Extension of the *Septum*, which divideth the two Auricles: It is by these two Conduits that the Blood floweth from the Auricles into the Heart. The Body of these *Auricles* hath no adherence to the *Pericardium*, nor any support but that of the Veins, which end in it; for if you divide these

Veins, the Heart and *Auricles* comes out of the Body; and then if you ſuſpend the Heart by the *Auricles*, they reſemble two Funnels joyned together, the little end of which opens into the *Ventricle* of the Heart, to pour the Blood into it: And 'tis in this manner we are to conceive them, in the Natural Situation of the Animal.

After having thus conſidered the External Parts of the Heart and its *Auricles*, we are to proceed to the Examination of the inſide of both of them. In order to that, it muſt be opened at its Inferior Surface, (ſuppoſing the Animal turned upon its Back) becauſe all the Orifices of either the Arteries and Veins, and their *Valves*, are in the oppoſite ſide: Therefore a Probe may be introduced through one of the Arteries into the Heart, and it opened upon it; after that, you cut all this ſide round about the Inferior Circumference, from one Angle to the other, and then turn over all that part which is cut on the *Baſis* of the Heart: For then it is eaſy to remark and view all the Internal Parts of an Heart, and obſerve that there is but one ſole *Ventricle*, which comprehends the whole extent of the Heart, and is as uniform and plain as either of the *Ventricles* of the Human Heart, or of any other Animal whatſoever; and that it is impoſſible to remark any kind of *Septum*, either Muſculous or Membranous, that might make any Diviſion or *Cellule* in this *Ventricule*: And 'tis very ſurprizing, that the Anatomiſts of the Royal Academy of *Paris* have ſhewn, the one three, and the other four *Ventricles*, in the Heart of a Land Tortoiſe of *America*. I confeſs this Difficulty is to me and the Gentlemen who have ſeen them diſſected, a Myſtery, which theſe Anatomiſts and their Approvers will diſcover to us when they ſhall think fit.

After

After having conſidered the extent of the Cavity of the Heart, there remain two things to be examined. The firſt is, that in its back-part there are five Holes or Orifices, two whereof are on the Left Side: Theſe are the Orifices of the two Funnels of the *Auricles*: They are covered by a large *Valve* lying flat upon them, ſupported in its middle by the Prolongation of the *Septum*, which divides the *Auricles*, in ſuch a manner, that half of it covers the Orifice of the Right *Auricle*, and the other half that of the Left; ſo that this *Valve* reſembles two folding Doors of a Porch, which have the ſame ſupport, and whereof one opens or ſhuts to the Right, and the other to the Left. It is viſible, that this *Valve* permits the Entrance of the Blood into the *Ventricle* of the Heart, but oppoſes its return into the *Auricles*; becauſe this Blood being once in the Heart, preſſes by its own weight upon this double *Valve*, and keeps it cloſe and flat upon theſe Orifices: Which confirms perfectly well the Office of the *Valve*, which is in the *Foramen Ovale* in the Heart of an Human *Fœtus*, the Diſpoſition being entirely the ſame. The other three Holes lying on the Right ſide of the *Ventricle* of the Heart, are the Orifices of the four Arteries which come out of the *Baſis*: Of theſe three Holes, that which is the moſt Left is the Orifice of the Pulmonary Artery; that which is the higheſt, is the Orifice of the *Aorta ſiniſtra deſcendens*; and that which is the moſt to the Right ſide, is common to the *Arteria Aorta dextra*, and to the *ſuperior Aorta*. Each of theſe Orifices is furniſhed with two Semilunary *Valves*, which permit the Blood to paſs without difficulty from the *Ventricle* of the Heart into the Arteries, but hinder its return into the Heart. 'Tis a pure Illuſion, to place theſe Holes in different *Ventricles*; they are all in one and the ſame Cavity; ſo that the Blood enters into this only Gavity, by the two Holes which are on the Left

Side, and goes out of this ſame *Ventricle*, by the three Holes which are on the Right Side.

The ſecond thing remarkable in this Ventricle is the Fibres of the Heart. They are of two ſorts; ſome are External, diſpoſed under the common Membrane in ſeveral Plans, very ſmall, but obliquely circular, extending from the *Baſis*, but particularly about the Arteries, which ſerve them inſtead of Tendons or Points of ſupport, towards the Inferior Circumference of the Heart: The other Muſculous Fibres which compoſe the Heart, are in the manner of ſeveral Columns, as thoſe of the Human Heart; they are ſituated Internally in both ſides, lying obliquely from the Right, where their Tendons are about the Arteries, to the Left; which demonſtrates that their action is from the Left to the Right Side, where the Orifices of the Arteries lye open, to let the Blood paſs out.

It has been ſaid before, that the two *Auricles* of the Heart of the Land Tortoiſe of *America*, make Externally but one continued Body; but that it has Internally two Cavities, ſeparated from one another by a Muſculous *Septum*. This *Septum* ſeparates them ſo exactly, that there is not the leaſt Communication of the one with the other; ſo that the Blood of either *Auricle* does not mix with that of the other, but in the Ventricle of the Heart. The Right Auricle is as big again as the Left; all the Blood of the Animal (that of the Lungs excepted) paſſing through it to go into the Heart; the Left Auricle receiving only the Blood which cometh from the Lungs, the Pulmonary Veins being very ſmall. The Internal Part, of the *Auricles* are furniſhed with little Muſculous Columns, but particularly at their Extremities, ſituated in ſuch a manner, that it is viſible their action tends to puſh the Blood againſt the *Septum*, where the Conduits, which convey it into the Heart, are ſituated.

There

There is in the bottom of the Right Auricle an oblong Orifice, by which the Blood cometh into its Cavity from the great Reſervoir of the Veins, ſituated on the back-part of the Heart. This Orifice is furniſhed with two Semilunar oblong *Valves*, diſpoſed in ſuch manner, that when the Auricle is relaxed, the Blood enters its Cavity, but when contracted, they ſhut cloſe to hinder the Blood from returning into the Veins: The Orifice of the Funnel, or the Conduit into the Heart, is to be ſeen againſt the *Septum*. The Left Auricle hath exactly the ſame Structure as the Right: 'Tis in the bottom of this Auricle, that the Orifice, common to the two Pulmonary Veins, is to be obſerved, furniſhed with two Semilunar *Valves*; and againſt the *Septum* to the Right, that the Funnel or Conduit into the Heart is ſituated, joining with the Funnel of the Right Auricle. Theſe two Conduits are ſeparated from one another by the continuation of the *Septum*, which divides the Auricles to the very *Ventricule* of the Heart, and is as a ſupport to the middle of the double *Valve* which covers their Orifices in the Heart.

Of the Veſſels of the Heart.

IT has been ſaid before, that from the *Baſis* of the Heart of the Land Tortoiſe of *America*, there goes out four great Arteries. Of theſe, the firſt which preſents itſelf, (the Tortoiſe being turned upon his Back) is the Pulmonary Artery: It is more on the Left Side than the others, and is much bigger for the ſpace of an Inch; then it divides itſelf into two Branches, the moſt apparent whereof cometh from the Right Side of its Trunk, and turns itſelf over towards the Left Side, accompanying the *Aorta inferior ſiniſtra*, till it hath pierced the *Pericardium*; after that it unites with the Left Branch of the *Trachea Arteria*, which it accompanies through

through all the Extent of the Left Lobe of the Lungs. The other Pulmonary Branch going out of the Left side of its Trunk, turns itself over immediately cross upon the other Arteries, from the Right to the Left, to joyn the *Aorta Inferior dextra*, till it has pierced the *Pericardium*, where it joyns to the Right Branch of the *Trachea Arteria*, which it accompanies through the whole extent of the Right Lobe of the Lungs.

One thing seems to me very remarkable in this Pulmonary Artery; it is this, that though its Trunk, in going out of the Heart, hath more than twice the Diameter of the *Arteria Aorta sinistra*, yet the two Branches which it sends to the Lungs, have not either of them one third of the Diameter of the *Aorta sinistra*. In the Arteries, which I have fill'd with Wax, the Trunk of the Pulmonary Artery hath between seven and eight Lines Diameter; the *Aorta sinistra* four and a half; and the Pulmonary Branches, after having pierced the *Pericardium*, have not either of them but one Line and a half Diameter: Nevertheless this Artery doth not produce any other Branch; all the Blood, which enters from the Heart into its Trunk, is carried into the two Lobes of the Lungs, and no where else. The reason of such disproportion I cannot guess; but this is matter of Fact, since it is the same in all: Nevertheless, if I may be permitted to conjecture, it seems to me that it may be attributed to the alteration that happens to the Branches of the *Trachea Arteria*, when the Tortoise stretcheth forth his Head out of the Shell; for these Pulmonary Branches making an half Circle before they joyn with the *Trachea Arteria*, when the Animals Head is drawn in, the Extension which happens to the Branches of the *Trachea Arteria* when the Animal goes out of the Shell, turns these half Circles into sharp Angles; insomuch, that thereby the Passage of the Blood is somewhat Interrupted, and consequently the Blood, which

passes

paſſes continually from the Heart into the Trunk, not being capable to return back, becauſe of its Valves, muſt out of neceſſity dilate this Trunk more than the other Arteries, in which the Blood paſſes in an equal Paſſage.

And that which perſwades me that there doth not go into the Lungs of this Animal, more Blood than that quantity which the Pulmonary Branches can admit by their ſmall Diameter, and not the quantity which the Diameter of their Trunk could furniſh, is, that the Pulmonary Veins, which bring back all the Blood of the Lungs into the Left Auricle of the Heart, have not either of them entirely two Lines Diameter, which is very proportionable to the bigneſs of the two Pulmonary Branches of the Arteries.

The ſecond Artery which goes out from the *Baſis* of the Heart, is that which I call *Aorta ſiniſtra*: It aſcends, as it comes out of the Heart, together with the Left Pulmonary, till they have pierced the *Pericardium*; after which it makes a large turning, without any ſupport, towards the Left Side, which gives it the liberty to extend itſelf when the Animal ſtretches out of its Shell, and to refold itſelf when it retires into it; after that, this Artery deſcends againſt the Back, where it gives ſome ſmall Branches to the *Medulla Spinalis*; after that, it returns through the Lungs into the *Abdomen*, and it is here that it produceth a conſiderable Branch, which divides into two, of which one is diſtributed to the Liver, the Stomach, and the Inteſtines, and the other turning towards the Right in the middle of the *Abdomen*, unites to the *Aorta dextra*; ſo that theſe two Arteries are but one and the ſame Branch divided into two. This ſame *Aorta ſiniſtra* continues afterwards to the lower Belly, to be diſtributed to the Kidneys, Thighs, and the Parts that are below. This Left *Aorta* is much longer than the Right, becauſe of the great Circle

Circle it makes when it cometh out of the Heart, to accommodate itſelf to the motions of the Animal, and to make room for its Head, which is placed under this Artery in the Left Side, when he draws it into his Shell: And 'tis for that reaſon that the Left Branch of the *Trachea Arteria* is longer than the Right. This Artery is alſo bigger than the Right *Aorta*, becauſe that it furniſheth a greater number of Parts with Blood. It hath a diſtinct Orifice into the Ventricle of the Heart, and hath not the leaſt Communication with the Pulmonary Arteries, neither in the Heart nor in any other Part. This does not reſemble at all to the *Ductus Arterioſus*, or, as a certain Modern is pleaſed to call it, the Canal of Communication, in the Heart of an Human *Fœtus*.

The third Artery going out from the *Baſis* of the Heart of this Animal, is that which I call *Aorta deſcendens dextra*: After having pierced the *Pericardium* it ſinks towards the Back; then returning through the Lungs into the *Abdomen*, where it receives the Branch of the *Aorta ſiniſtra*, it is diſtributed to the Right Kidney, Thighs, Bladder, and Parts of Generation: So that I call theſe two Arteries, *Arteriæ Aortæ deſcendentes*, becauſe they diſtribute the Blood to all the Inferior Parts of this Animal, the ſame as the *Aorta deſcendens* doth in all other Animals.

The fourth Artery going out from the Heart, is the *Aorta aſcendens*. It hath an Orifice in the Ventricle of the Heart, common with the *Aorta deſcendens dextra*: It appears in part under the *Aorta ſiniſtra* coming out of the Heart, and aſcendeth in a ſtrait Line till it hath pierced the *Pericardium*; after which it divideth into three principal Branches, whereof the two lateral go to the fore Legs, and make the Carotid; the third aſcends all along the *Trachea Arteria* towards the *Larynx*, and gives Branches to all the Parts of the Neck.

The

The Disposition of the Arteries which go out of the Heart being examined, there remains only the Veins which bring the Blood into it from all the Parts of the Animal: But first one must observe, that there is no Veins which terminate in the Heart; for all the Veins open themselves into the Auricles, which are, as hath been said, separated from the Heart.

There are two ways to show these Veins without Dissection: The first is to fill them with Wax, by Syringing it into them by their Orifices in the Auricles; for if one syringeth by the oblong Orifice in he *Auricula dextra*, all the Veins of the Body (except those of the Lungs) will be entirely fill'd; and afterward by Syringing into the Oval Orifice in the *Auricula sinistra*, the two Veins of the Lungs will be full at once thro' the whole extent of *Trachea Arteria* in the Lungs.

The other way is to wait till the Animal is expired; because the Heart losing insensibly its Vigour, (it beating for the space of 24 hours,) it has not then the force to discharge itself of the Blood which comes from all Parts into these Veins, which then grow very turgid by the coagulated Blood collected in them: Then you need only to turn over the Heart towards the Neck, cutting only the little Cororary Vein which comes out of the Substance of the Heart, for to observe all the great Veins without Dissection; because they all come and end in a common Reservatory, situated across in the capacity of the *Pericardium*, joining to the Auricles. And here one may observe a great Vein, or an Irregular Reservatory: In the Tortoises I have dissected of 18 and 20 Inches long, this Reservatory was 10 Inches broad, and 18 Inches long. In this Reservatory the two Axillary Veins which come from the upper Parts of the Body, joyn one another, after having pierced the *Pericardium*, one on the Right side, and the other on the Left. From the Inferior Parts there joyn two large Veins, one

on the Right ſide, and the other on the Left of the Inferior Part of this Reſervatory; the firſt whereof is made up of all the Branches which come out of the Right Lobe of the Liver, which is very big; and the other conſiſts not only of the Veins of the Left Lobe of the Liver, but alſo of a Vein which ſupplies the place of the *Vena Cava*, and which I call the *Vena Inteſtinalis*, becauſe after it has received all the Veins of the Inferior Parts of the Animal, it runs all along the Inteſtines, from which it receives the Veins; and being arrived at the *Pylorus*, it paſſes croſs the Left Lobe of the Liver, and terminates in the common Reſervatory.

Beſides theſe four great Veins, there are three, and ſometimes but two, coming from the middle part of the Liver, which are inſerted into the bottom of the Reſervatory; as alſo the little Coronary Vein from the Heart.

All theſe Veins being thus re-united in one common place, this Reſervatory terminates upwards in a Conduit, which is inſerted into the Poſterior Part of the Right Auricle, and opens into its cavity by an oblong Orifice, furniſhed with two long Semilunar Valves, which permit the Blood of the Reſervatory to enter into the Auricles, but hinder its returning from the Auricles into the Reſervatory.

A little above the Reſervatory, under the Left Auricle, the two Pulmonary Veins are ſeen: The Left, after having entered the *Pericardium*, is hid under the Axillary Vein, and does not ſeparate itſelf from it but a little above the Auricles; from thence it bends to go and inſert itſelf into the Poſterior Part of the Auricles. The Right Pulmonary Vein follows after the ſame manner the Right Axillary, which it quits after it has entered the *Pericardium*, to traverſe almoſt all the length of the Reſervatory, and meet the Left Pulmonary about two Lines diſtance from the Auricles. Theſe two Veins thus united,

ted, open themſelves in the Poſterior Part of the *Auricula ſiniſtra*, by a common Oval Orifice furniſhed with two Semilunar Valves; by which means they pour into this Auricle all the Blood that comes from the Lungs to the Heart.

By all that has been obſerved concerning the Structure of the Heart of the Land Tortoiſe of *America*, and the Diſpoſition of both its Auricles and Veſſels, how extraordinary ſoever it may appear, it is impoſſible to find out the leaſt thing which may injure the Opinion of Dr. *Harvey*, and all other Anatomiſts, about the manner that the Blood Circulates in the Heart of an Human *Fœtus*, and the uſe of the Valve which is at the *Foramen Ovale*; which is, to permit the Blood to paſs from the Right Auricle through this Hole into the Left, and to hinder the Blood's paſſing from the Left Auricle by this Hole into the Right. And I add further, that amongſt all the known Animals, one could not chuſe one whoſe Heart may be more proper to confirm this Opinion, than the Land Tortoiſe of *America*, by reaſon of the ſimplicity of its Structure, and of the plain and diſtinct manner in which all the Parts appear. Therefore there is room to hope, that if Mr. *Mery* would give himſelf the trouble to examine a ſecond time the Structure of the Heart of this Animal, with that Honeſty and Candour he would make us believe he has, he will acknowledge his Miſtake and Errors: But if after that, he perſiſts ſtill in his Opinion, I have done with him; and ſhall leave him to enjoy peaceably the agreable ſatisfaction he takes in his Opinion, and ſhall not trouble my ſelf any farther, to convince him, or his Followers of their Error.

AN

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Fig. 4. a. *The Heart of the Tortoiſe.*
b. *The Trunk of the* Arteria Pulmonalis.
c. c. c. &. *The Branches of the* Arteria Pulmonalis, *accompanying the* Bronchia *in the Lungs.*
d. d. d. d. *The* Arteria Aorta deſcendens ſiniſtra.
e. e. e. e. Arteria Aorta deſcendens dextra.
f. f. *One Branch of the* Aorta ſiniſtra, *which communicates with the* Aorta dextra.
g. g. Arteria Inteſtinalis.
h. Arteria Aorta ſuperior, *or* aſcendens.
i. *The Ligament that ſuſpends the Heart.*
K. *The* Trachea Arteria.
L. L. L. L. *&c. The two Branches of the* Trachea Arteria *going to the Lungs.*

II. *An Argument for Divine Providence, taken from the conſtant Regularity obſerv'd in the Births of both Sexes. By Dr.* John Arbuthnott, *Phyſitian in Ordinary to Her Majeſty, and Fellow of the College of Phyſitians and the Royal Society.*

AMong innumerable Footſteps of Divine Providence to be found in the Works of Nature, there is a very remarkable one to be obſerved in the exact Ballance that is maintained, between the Numbers of Men and Women; for by this means it is provided, that the Species may never fail, nor periſh, ſince every Male may have its Female, and of a proportionable Age. This Equality of Males and Females is not the Effect of Chance but Divine Providence, working for a good End, which I thus demonſtrate:

Let there be a Die of Two ſides, M and F, (which denote Croſs and Pile), now to find all the Chances of any determinate Number of ſuch Dice, let the Binome M+F be raiſed to the Power, whoſe Exponent is the Number of Dice given; the Coefficients of the Terms will ſhew all the Chances ſought. For Example, in Two Dice of Two ſides M+F the Chances are $M^2+2\,MF+F^2$, that is, One Chance for M double, One for F double, and Two for M ſingle and F ſingle; in Four ſuch Dice there are Chances $M^4+4\,M^3F+6\,M^2F^2+4\,MF^3+F^4$, that is, One Chance for M quadruple, One for F quadruple, Four for triple M and ſingle F, Four for ſingle M and triple F, and Six for M double and F double; and univerſally, if the Number of Dice be n, all their Chances will be expreſſed in this Series

M^n+

$M^n + \frac{n}{1} \times M^{n-1}F + \frac{n}{1} \times \frac{n-1}{2} \times M^{n-2}F^2 + \frac{n}{1} \times \frac{n-1}{2} \times \frac{n-2}{3} \times M^{n-3}F^3 +$, &c.

It appears plainly, that when the Number of Dice is even there are as many M's as F's in the middle Term of this Series, and in all the other Terms there are moſt M's or moſt F's.

If therefore a Man undertake with an even Number of Dice to throw as many M's as F's, he has all the Terms but the middle Term againſt him; and his Lot is to the Sum of all the Chances, as the coefficient of the middle Term is to the power of 2 raiſed to an exponent equal to the Number of Dice: ſo in Two Dice his Lot is $\frac{2}{4}$ or $\frac{1}{2}$, in Three Dice $\frac{6}{8}$ or $\frac{3}{8}$, in Six Dice $\frac{20}{64}$ or $\frac{5}{16}$, in Eight $\frac{70}{256}$ or $\frac{35}{128}$, &c.

To find this middle Term in any given Power or Number of Dice, continue the Series $\frac{n}{1} \times \frac{n-1}{2} \times \frac{n-2}{3}$, &c. till the number of terms are equal to $\frac{1}{2}n$. For Example, the coefficient of the middle Term of the tenth Power is $\frac{10}{1} \times \frac{9}{2} \times \frac{8}{3} \times \frac{7}{4} \times \frac{6}{5} = 252$, the tenth Power uf 2 is 1024, if therefore A undertakes to throw with Ten Dice in one throw an equal Number of M's and F's, he has 252 Chances out of 1024 for him, that is his Lot is $\frac{252}{1024}$ or $\frac{63}{256}$, which is leſs than $\frac{1}{4}$.

It will be eaſy by the help of Logarithms, to extend this Calculation to a very great Number, but that is not my preſent Deſign. It is viſible from what has been ſaid, that with a very great Number of Dice, A's Lot would become very ſmall; and conſequently (ſuppoſing M to denote Male and F Female) that in the vaſt Number of Mortals, there would be but a ſmall part of all the poſſible Chances, for its happening at any aſſignable time, that an equal Number of Males and Females ſhould be born.

It is indeed to be confeſſed that this Equality of Males and Females is not Mathematical but Phyſical, which alters much the foregoing Calculation; for in this Caſe the

the middle Term will not exactly give A's Chances, but his Chances will take in some of the Terms next the middle one, and will lean to one side or the other. But it is very improbable (if mere Chance govern'd) that they would never reach as far as the Extremities: But this Event is wisely prevented by the wise Oeconomy of Nature; and to judge of the wisdom of the Contrivance, we must observe that the external Accidents to which are Males subject (who must seek their Food with danger) do make a great havock of them, and that this loss exceeds far that of the other Sex, occasioned by Diseases incident to it, as Experience convinces us. To repair that Loss, provident Nature, by the Disposal of its wise Creator, brings forth more Males than Females; and that in almost a constant proportion. This appears from the annexed Tables, which contain Observations for 82 Years of the Births in *London*. Now, to reduce the Whole to a Calculation, I propose this.

Problem. A lays against B, that every Year there shall be born more Males than Females: To find A's Lot, or the Value of his Expectation.

It is evident from what has been said, that A's Lot for each Year is less than $\frac{1}{2}$; (but that the Argument may be stronger) let his Lot be equal to $\frac{1}{2}$ for one Year. If he undertakes to do the same thing 82 times running, his Lot will be $\frac{1}{2}|^{82}$, which will be found easily by the Table of Logarithms to be $\frac{1}{4836\ 0000\ 0000\ 0000\ 0000\ 0000}$. But if A wager with B, not only that the Number of Males shall exceed that of Females, every Year, but that this Excess shall happen in a constant Proportion, and the Difference lye within fix'd limits; and this not only for 82 Years, but for Ages of Ages, and not only at *London*, but all over the World; (which 'tis highly probable is Fact, and designed that every Male may have a Female of the same Country and suitable Age) then A's Chance will be near an infinitely small Quantity, at least

less

less than any assignable Fraction. From whence it follows, that it is Art, not Chance, that governs.

There seems no more probable Cause to be assigned in Physicks for this Equality of the Births, than that in our first Parents Seed there were at first formed an equal Number of both Sexes.

Scholium. From hence it follows, that Polygamy is contrary to the Law of Nature and Justice, and to the Propagation of Human Race; for where Males and and Females are in equal number, if one *Man* takes Twenty Wives, Nineteen Men must live in Celibacy, which is repugnant to the Design of Nature; nor is it probable that Twenty Women will be so well impregnated by one Man as by Twenty.

	Christened.	
Anno.	*Males.*	*Females.*
1629	5218	4683
30	4858	4457
31	4422	4102
32	4994	4590
33	5158	4839
34	5035	4820
35	5106	4928
36	4917	4605
37	4703	4457
38	5359	4952
39	5366	4784
40	5518	5332
41	5470	5200
42	5460	4910
43	4793	4617
44	4107	3997
45	4047	3919
46	3768	3395
47	3796	3536

	Christened.	
Anno.	*Males.*	*Females.*
1648	3363	3181
49	3079	2746
50	2890	2722
51	3231	2840
52	3220	2908
53	3196	2959
54	3441	3179
55	3655	3349
56	3668	3382
57	3396	3289
58	3157	3013
59	3209	2781
60	3724	3247
61	4748	4107
62	5216	4803
63	5411	4881
64	6041	5681
65	5114	4858
66	4678	4319

Anno.	Christened. Males.	Females.	Anno.	Christened. Males.	Females.
1667	5616	5322	1689	7604	7167
68	6073	5560	90	7909	7302
69	6506	5829	91	7662	7392
70	6278	5719	92	7602	7316
71	6449	6061	93	7676	7483
72	6443	6120	94	6985	6647
73	6073	5822	95	7263	6713
74	6113	5738	96	7632	7229
75	6058	5717	97	8062	7767
76	6552	5847	98	8426	7626
77	6423	6203	99	7911	7452
78	6568	6033	1700	7578	7061
79	6247	6041	1701	8102	7514
80	6548	6299	1702	8031	7656
81	6822	6533	1703	7765	7683
82	6909	6744	1704	6113	5738
83	7577	7158	1705	8366	7779
84	7575	7127	1706	7952	7417
85	7484	7246	1707	8379	7687
86	7575	7119	1708	8239	7623
87	7737	7214	1709	7840	7380
88	7487	7101	1710	7640	7288

III. *Logarithmotechnia Generalis. Authore* Jo. Craig.

ILluſtriſſimi noſtratis Jo. Nepairi incomparabile Logarithmorum inventum egregiis ſuis laboribus plurimùm promoverunt Viri eruditiſſimi, quorum Methodi Logarithmos conſtruendi præfixæ ſunt Logarithmorum Tabulis longé optimis à D. Henrico Sherwino publicatis. Adeo ut ad utiliſſimam hanc Arithmeticæ partem perficiendam, hoc tantùm inveniendum ſupereſſe videatur; ut ſcil. omnes Series Logarithmicas inveniendi Methodum habeamus generalem; talis autem eſt hæc quæ ſequitur, facilis quidem illa & genuina, utpote ex ipſâ Logarithmorum Naturâ deducta.

Per literam l numero cuilibet præfixam denotetur (ut vulgo ſolet) iſtius Numeri Logarithmus. Jam quoniam Numeri cujuſvis propoſiti Logarithmus duobus modis inveſtigari poteſt, ideo Logarithmotechniæ hujus duas partes conſtituemus: In priori Logarithmum immediaté ex ipſo numero deducimus; in poſteriori vero Numerorum aliquot antecedentium Logarithmi adhibentur, ut ex iis propoſiti Numeri Logarithmus inveniatur.

Pars Prior. Sit $a+1$ numerus quilibet propoſitus, & x ejus Logarithmus inveniendus. Jam ex hypotheſi $x=l.\overline{a+1}$, quæ æquatio vocetur Canon generalis. (1.) Fiat æquatio inter terminos ex a & y utcunq; compoſitos & cum aliis quibuſvis numeris quovis modo per Additionem, Subſtractionem, Multiplicationem, Diviſionem aut Radicum extractionem combinatos. (2.) Ope æquationis ſic ad libitum aſſumptæ exterminetur a ex Canone generali, & habebitur æquatio exprimens relationem inter

indeterminatos x, y. (3.) Hujus æquationis (per regulam Bernoullianam) inveniatur Differentialis, & hujus Integralis (per methodos notissimas) per Seriem Infinitam expressa dabit Logarithmi quæsiti x valorem cognitum.

Exemplum 1. Assumatur $a=y$, unde per Canonem generalem $x=l.\overline{1+y}$, cujus differentialis est $\dot{x}=\frac{\dot{y}}{1+y}$, & hujus integralis per Seriem infinitam expressa dat

$$x=y-\tfrac{1}{2}y^2+\tfrac{1}{3}y^3-\tfrac{1}{4}y^4+\tfrac{1}{5}y^5-\tfrac{1}{6}y^6+\tfrac{1}{7}y^7 \text{ &c.}$$

Exemplum 2. Assumatur $y=\frac{a}{a+2}$, unde $a+1=\frac{1+y}{1-y}$, ideoq; per Canonem generalem $x=l.\frac{1+y}{1-y}$, cujus Differentialis est $\dot{x}=\frac{2\dot{y}}{1-yy}$; & hujus Integralis in Seriem resoluta dat

$$x=2\times y+\tfrac{2}{3}y^3+\tfrac{2}{5}y^5+\tfrac{2}{7}y^7+\tfrac{2}{9}y^9 \text{ &c.}$$

Ubi numerus 2 Seriei præfixus multiplicari supponitur in singulos Seriei terminos. Nec plura addere exempla opus hic erit, cum ex his pateat Methodus inveniendi innumeras Series Logarithmicas, quæ, absq; ullo ad aliorum numerorum Logarithmos respectu, exhibent numeri propositi Logarithmum. Q. E. I.

Lemma 1. Sit z Logarithmus cujusvis fractionis $\frac{b}{a+1}$, x Logarithmus denominatoris $a+1$; erit $lb-z=x$: Vel si sit z Logarithmus fractionis $\frac{a+1}{b}$, erit $lb+z=x$.

Lemma

Lemma 2. Sit e exponens cujuſvis poteſtatis numeri b, erit $l.\, b^e = e \times l.\, b$; ideoque datis Logarithmo numeri b^e & exponente e, datur ipſius b Logarithmus: Et ex Natura Logarithmorum conſtat utrumq; Lemma.

Pars Poſterior. Sit (ut prius) $a+1$ Numerus cujus Logarithmus x eſt inveniendus, ſitq; b^e Numerus productus ex Multiplicatione Numerorum, quorum maximus eſt minor quam $a+1$; & z Logarithmus fractionis $\frac{b}{a+1}$, id eſt $z = l.\, \frac{b}{a+1}$; quæ æquatio vocetur Canon generalis. Tum (1.) pro b ſumatur quantitas ex a & numeris quibuſvis determinatis utcunq; compoſita, & hic valor numeri b ſic ad libitum ſumptus ſubſtituatur in fractione $\frac{b}{a+1}$, unde illa per a & numeros datos exprimetur. (2.) Fiat quælibet æquatio inter y & a cum numeris ad libitum ſumendis; & ope hujus exterminetur a ex Canone generali, unde habetur æquatio exprimens relationem inter indeterminatos z, y. (3.) Hujus æquationis invertatur (per Regulam Bernoullianam) Differentialis, hujuſq; Integralis (juxta Methodos notiſſimas) per Seriem infinitam expreſſa dabit fractionis $\frac{b}{a+1}$ Logarithmum z; & ex invento z habebitur (per Lem. 1.) numeri propoſiti $a+1$ Logarithmus $x = l.\, b - z$. Nam ex hypotheſi b^e producitur ex Multiplicatione Numerorum quorum maximus eſt minor quam $a+1$; & ex hypotheſi dantur Logarithmi omnium numerorum propoſito $a+1$ minorum, ergo & Logarithmus Numeri ex omnibus producti ſeu b^e, & proinde (per Lem. 2.) ipſius b Logarithmus datur.

Exemplum 1. Sumatur ſi placet $b = a$, unde $z = l.\, \frac{a}{a+1}$: Dein (per art. 2) fiat ad libitum $y = 2a+1$, per

hanc

hanc exterminetur a, & erit $z = l.\frac{y-1}{y+1}$, cujus Differentialis est $\dot{z} = \frac{2\dot{y}}{yy-1}$; cujus Integralis per Seriem expressa dat $z = -2 \times \frac{1}{y} + \frac{1}{3y^3} + \frac{1}{5y^5} + \frac{1}{7y^7}$ &c. Unde per Lemma 1.

$$x = lb + 2 \times \frac{1}{y} + \frac{1}{3y^3} + \frac{1}{5y^5} + \frac{1}{7y^7} + \frac{1}{9y^9} \text{ &c.}$$

Exemplum 2. Fiat $b = \sqrt{aa+2a}$, unde $z = l.\frac{\sqrt{aa+2a}}{a+1}$, sumatur etiam ad libitum $y = 2a+2a$, unde $z = l.\frac{1}{y}\sqrt{yy-4}$, cujus Differentialis est $\dot{z} = 4\dot{y} \times \overline{y^3-4y}|^{-1}$, & hujus Integralis est $\dot{z} = -2 \times \frac{1}{y^2} + \frac{2^2}{2y^4} + \frac{2^4}{3y^6} + \frac{2^6}{4y^8}$ &c. Unde Lemma 1.

$$x = l.b + 2 \times \frac{1}{y^2} + \frac{2^2}{2y^4} + \frac{2^4}{3y^6} + \frac{2^6}{4y^8} + \frac{2^8}{5y^{10}} \text{ &c.}$$

Exemplum 3. Fiat $b = \sqrt{aa+2a}$, ut in præcedenti, sed jam assumatur $y^2 = 2aa+4a+1$; Si per has duas æquationes exterminentur b & a ex Canone generali, erit $z = l\frac{\sqrt{yy-1}}{\sqrt{yy}+1}$, cujus Differentialis est $\dot{z} = 2yy \times \overline{y^4-1}|^{-1}$; & hujus Integralis per Seriem expressa est $z = -\frac{1}{y^2} - \frac{1}{3y^6} - \frac{1}{5y^{10}} - \frac{1}{7y^{14}}$ &c. Unde per Lem. 1.

$$x = l.b + \frac{1}{y^2} + \frac{1}{3y^6} + \frac{1}{5y^{10}} + \frac{1}{7y^{14}} + \frac{1}{9y^{18}} \text{ &c.}$$

Notan-

Notandum verò est quod numerus 2. Seriebus Exemp. 1. & 2. præfixus multiplicari supponitur in singulos Serierum terminos: Similesq; Series deduci possunt eodem modo ex $z=l.\frac{a+1}{b}$, atqui tum $x=l.\ b+z$, ut constat ex Lemmatis 1. parte secundâ. Ex his itaq; satis superque constat Logarithmotechniam jam expositam esse facillimam & maxime genuinam, nec-non adeo generalem ut duobus modis innumeræ Series inveniri possint Numeri cujusvis propositi Logarithmum exhibentes: Nam innumeras (ad libitum) assumere licet æquationes relationem inter y & a exprimentes, quarum unaquæq; novam exhibet Seriem Logarithmicam. Summa tamen adhibenda est cura, ut tales assumantur, quæ efficient ut Serierum termini quam celerrimé convergant, i. e. ut Logarithmus quam minimo Calculi labore inveniatur: Ad hoc præstandum perquam apta est Series in Exemplo postremo exhibita, & quæ eadem est cum illâ quam primus exhibuit Celeberrimus D. Ed. Hallejus in eleganti suâ Logarithmos construendi Methodo.

Obiter Lectorem hic monitum volo, quod Curva, quæ ex nostrâ Problematis de Longitudine linearum Curvarum Analysi in Actis Phil. R. S. Anni 1708. editâ eadem sit cum propositâ. Ego quidem de rectè institutâ Analysi tantum sollicitus hanc Curvæ propositæ & inventæ coincidentiam minime observabam, priusquam de eâ me certiorem fecerit Clarisſ: D. Jo. Bernoulli in literis suis ad D. Guil. Burnetum, R. S. S. missis; in quibus etiam Celeberrimum virum meis contra *Motum* suum *Reptorium* objectionibus plenè satisfeciſſe ex puro (quam colo) Veritatis amore libenter agnosco.

IV. *Experi-*

Now Dr. *Barrow*, in his Method of Tangents, draws two Ordinates indefinitely near to one another, and puts the Letter *a* for the Difference of the Ordinates, and the Letter *e* for the Difference of the *Abſciſſa*'s, and for drawing the Tangent gives theſe Three Rules 1. *Inter computandum*, ſaith he, *omnes abjicio terminos in quibus ipſarum* a *vel* e *poteſtas habeatur, vel in quibus ipſæ ducuntur in ſe. Etenim iſti termini nihil valebunt.* 2. *Poſt æquationem conſtitutam omnes abjicio terminos literis conſtantes quantitates notas ſeu determinatas ſignificantibus, aut in quibus non habentur* a *vel* e. *Etenim illi termini ſemper ad unam æquationis partem adducti nihilum adæquabunt.* 3. *Pro* a *Ordinatam, & pro* e *Subtangentem ſubſtituo. Hinc demum Subtangentis quantitas dignoſcetur.* Thus far Dr. *Barrow*.

And Mr. *Leibnitz* in his Letter of *June* 21. 1677 above-mentioned, wherein he firſt began to propoſe his Differential Method, has followed this Method of Tangents exactly, excepting that he has changed the Letters *a* and *e* of Dr. *Barrow* into *dx* and *dy*. For in the Example which he there gives, he draws two parallel Lines and ſets all the Terms below the under Line, in which *dx* and *dy* are (ſeverally or jointly) of more than one Dimenſion, and all the Terms above the upper Line, in which *dx* and *dy* are wanting, and for the Reaſons given by Dr. *Barrow*, makes all theſe Terms vaniſh. And by the Terms in which *dx* and *dy* are but of one Dimenſion, and which he ſets between the two Lines, he determines the Proportion of the Subtangent to the Ordinate. Well therefore did the Marquiſs *de l'Hoſpital* obſerve that where Dr. *Barrow* left off Mr. *Leibnitz* began: for their Methods of Tangents are exactly the ſame.

But Mr. *Leibnitz* adds this Improvement of the Method, that the Concluſion of this Calculus is coincident with the Rule of *Sluſius*, and ſhews how that Rule preſently occurs to any one who underſtands this Method. For Mr. *Newton* had repreſented in his Letters, that this Rule was a Corollary of his general Method.

And-

And whereas Mr. *Newton* had ſaid that his Method in drawing of Tangents, and determining *Maxima* and *Minima*, &c. proceeded without ſticking at Surds: Mr. *Leibnitz* in the next Place, ſhews how this Method of Tangents may be improved ſo as not to ſtick at Surds or Fractions, and then adds: *Arbitror quæ celare voluit* Newtonus *de Tangentibus ducendis ab his non abludere. Quod addit, ex hoc eodem fundamento Quadraturas quoque reddi faciliores me in hac ſententia confirmat; nimirum ſemper figuræ illæ ſunt quadrabiles quæ ſunt ad æquationem differentialem.* By which Words, compared with the preceding Calculation, its manifeſt that Mr. *Leibnitz* at this time underſtood that Mr. *Newton* had a Method which would do all theſe things, and had been examining whether Dr. *Barrow*'s Differential Method of Tangents might not be extended to the ſame Performances.

In *November* 1684 Mr. *Leibnitz* publiſhed the Elements of this Differential Method in the *Acta Eruditorum*, and illuſtrated it with Examples of drawing Tangents and determining *Maxima* and *Minima*, and then added. *Et hæc quidem initia ſunt Geometriæ cujuſdam multo ſublimioris, ad difficillima & pulcherrima quæque etiam miſtæ* Matheſeos *Problemata pertingentis, quæ ſine calculo differentiali* AUT SIMILI *non temere quiſquam pari facilitate tractabit.* The Words AUT SIMILI plainly relate to Mr. *Newton*'s Method. And the whole Sentence contains nothing more than what Mr. *Newton* had affirmed of his general Method in his Letters of 1672 and 1676.

And in the *Acta Eruditorum* of *June* 1686, *pag.* 297. Mr. *Leibnitz* added: *Malo autem* dx *& ſimilia adhibere quam literas pro illis, quia iſtud* dx *eſt modificatio quædam ipſius* x, &c. He knew that in this Method he might have uſed Letters with Dr. *Barrow*, but choſe rather to uſe the new Symbols *dx* and *dy*, though there is nothing which can be done by theſe Symbols, but may be done by ſingle Letters with more brevity.

which they descended (which at that time was covered with Deal Boards) notwithstanding their Weight and Velocity of Descent.

The following Experiments on the Descent of Bodies in Air, were made in the same manner, at the Place before mentioned, answering very exactly with the former.

Quickſilver Balls.			Large thin Glaſs Balls.		
Weight in Grains.	Diam. 10ths of Inch.	Time of falling in ½ Seconds.	Wt. in Gr.	Diam. Inch. 10ths.	Time of falling in ½ Seconds.
908	.8	8	510	5.1	17
993	.8	8 a little leſs.	642	5.2	16
866	.8	8	599	5.1	16
747	.7½	8 a little more.	515	5.0	16½
868	.7½	8	483	5.0	17
784	.7½	8 a little more.	641	5.2	16

Theſe Experiments were made *June* the *9th* 1710. at which time the Height of the Quickſilver in the Barometer was 29.7 Inches, and the Thermometer 60 Degrees above the Freezing Point.

Note, That the Quickſilver Balls, and the large thin Glaſs Balls, were dropt together as they are ranged in their ſeveral Lines.

V. *Experi-*

V. *Experiments concerning the Effects of Air paſs'd through red hot Mettals*, &c. *By Mr* F. Hauksbee, *F. R. S.*

IN order to find what Effect ſuch a *Medium*, as Air paſſed thro' red hot Mettals, might have on the Lives of Animals, I contrived the following Method. I took a large Receiver open at top, in Diameter about 4 Inches, which was covered with a Braſs Plate and wet Leather, as uſual in Glaſſes of ſuch a make. To this Plate at top (which had a Screw with a ſmall Perforation) belonged a Cock, and from that Cock proceeded a ſmall hollow Wire, about 3 feet in length: That End of this hollow Wire, which was remote from the Receiver, was put into a hollow Piece of Caſt Braſs, pretty thick in ſubſtance, but the Hole was not quite through: And the Hole being larger than the ſmall hollow Wire, it was wedg'd into the ſame with Pieces of Steel Wire, till the Caſt Braſs was fill'd as full as it could contain. In this manner it was put into a Charcoal Fire, and there it lay till it was throughly red hot. The Receiver being then exhauſted of its Air, the Cock on the upper part of it was turn'd, which gave liberty for that Air only, which of neceſſity muſt paſs thro' the red hot Mettals, to ſucceed. This Air firſt paſſing down thro' the ſmall Ducts between the red hot Wires, before it could come to enter the red hot hollow Braſs Wire, muſt of neceſſity ſuffer or undergo ſuch a Change, as Fire or the Fumes of ſuch red hot Mettals would give it. When the Receiver was fill'd with this Air, and had ſtood ſome little time, the Braſs Cover was taken off, and

a pretty large Cat immediately plung'd into it: The Cover being laid on again, the Cat immediately fell into Convulsions, and in less than a Minute appeared without any sign of Life. Then being taken out of the Receiver and laid on the Floor, she continued as Dead; but in less that a Minute of time she began to discover Life by motion in her Eyes, and after 2 or 3 hideous Squalls, she began to recover apace; but was very fierce, and did spit and fly (as well as her Weakness would suffer her) at any one that offer'd to touch her; and it seem'd hazardous for any one then to attempt it. But after half an hours time, or thereabouts, as her Strength and Ease recovered, so her former Temper encreased upon her, suffering herself to be handled without any sign of fierceness, as before.

As to the Effect, which the same sort of Factitious Air has upon Flame, take as follows.

I no sooner came to plunge a lighted Candle into it, but it was immediately extinguish'd: And this I several times observ'd, that when the Candle was slowly immers'd, so much of the Wick (which before was lighted) as came but within the verge of the Glass, died; and so the rest successively, as it descended to the same place: And this upon several repetitions, answer'd much the same. But in some time, as the common Air came to mix with it, one might plunge the lighted Candle lower and lower, before it did go out, till at last it would remain burning at bottom.

As to the Elasticity and Specifick Gravity of the fore-mention'd *Medium*, I have made several tryals, (and I think very accurate,) but find it no ways differing from Common Air, in respect to those Properties.

Hence it follows,

That the foregoing Effect, is no ways assisted from any Imperfection or defect in the last mentionod Properties: There-

Therefore the following Queries ſeem to offer themſelves.

Query 1. Whether Air itſelf may ſo ſuffer in its own Nature, by any ſort of Fire, as to be diveſted of the Power of ſubſiſting Life or Flame: Or,

Query 2. Whether the *Effluvia*, or Steems, proceeding from the red hot Mettals, which the Air may take along with it in its Paſſage near them, do not very much contribute, if not wholly occaſion the Effect.

If the latter takes place, I preſume it may in ſome meaſure be applied to account for the Effect, that the Damps, or Steems, which ariſe from Subterraneous Caverns, impregnated with Mettaline *Effluvia*, have on the Lives of Animals: And yet at the ſame time, the ſame Air may ſuffer no Change in reſpect to its other Properties, I mean its Elaſticity and Specifick Gravity, in compariſion with other Air in the ſame Region.

Experiments concerning the Effect of Air paſs'd thro' a Degree of Heat, equal to that of boiling Water.

I Contriv'd a Braſs Box, about 4 Inches long, and an Inch and half over: At one end, which I ſoder'd up, I fix'd two ſmall Braſs Tubes; one of which went thro', and reach'd the Remoter end nearly; the other Tube was but juſt inſerted in it, but each of them long enough to reach ſufficiently above the Surface of the Water in which they were to be put. Theſe Tubes were to convey the Air into a Receiver exhauſted of its Air: It paſs'd firſt into that Tube which nearly reach'd its oppoſite end, and ſo into the other which lead to the exhauſted Receiver. But the Box, with that part of the

the Tube that was within it, was first prefſed full of Braſs Duſt ; which I had the conveniency to do by means of a Braſs Cap, which ſcrew'd on to the end, not before mentioned. This Braſs Duſt I moiſtned with a little Water, thinking thereby to exert a more than ordinary Steam, or *Effluvia*, from the Mettal, which the Air might take along with it, as it paſs'd through ſuch ſtrait and narrow Avenues, as it muſt do between the Braſs Duſt. In this manner it was put into the Water when Cold, and continued in it till it had boil'd a conſiderable time ; by which means it muſt, in all its Parts, be of the ſame Degree of Heat (at leaſt) as the boiling Water. Thus it was taken out, and applied to the exhauſted Receiver ; where, upon turning a Cock, I gave the liberty for that Air only to paſs into it, which muſt ſucceed through the Braſs Box and Duſt, under the Circumſtances before mentioned. When the Receiver was full of this Air, the Cover was taken off, and a lighted Candle plung'd into it, where it continued burning, even at the bottom, as if it had paſs'd through no ſuch *Medium*, but had been full of Common Air. I took that Method to try it, believing the Flame of a Candle to be the moſt tender way of diſcovering a Change in Air. Afterwards I repeated the ſame Experiment over again, with dry Braſs Duſt inſtead of the former ; but the Succeſs was the ſame. Therefore it ſeems to me, that ſuch a Degree of Heat, as that of boiling Water, is not ſufficient to cauſe any conſiderable Change (if any at all) in the Air ; nor ſuch a Degree of Heat, able to ſtrike any Injurious, or ſuffocating *Effluvia*, out of the Metalline Particles.

Some

Some other Experiments on the foregoing Head.

THE paſſing of Air through a red hot Glaſs Tube into an exhauſted Receiver, had no manner of influence on a Sparrow put into the ſame: But upon paſſing of Air through red hot Charcoal, before it enter'd the Tube that convey'd it into the exhauſted Receiver, the fore-mentioned Animal, in that *Medium* in about a quarter of a Minute, gave ſigns of preſently expiring; but being taken out at the ſame time did recover, and continued living and well for ſome Days after. Yet it was concluded, had the Birds continuance in the Receiver been but double that time, her recovery would have been very doubtful. I have likewiſe try'd Air paſs'd through the Flames of Spirit of Wine, and Oil of Turpentine: The Effect was much the ſame as to the Spirit of Wine, the Flame of a Candle being immediately extinguiſh'd upon its being plung'd into it: But the Air which paſs'd through the Flame of the Oil of Turpentine took ſome Unctious Fumes along with it into the exhauſted Receiver; which Fumes, upon the near approach a lighted Candle, ſuddenly took fire, and continued to burn on the upper Surface, till they were ſtifled by covering cloſe the Receiver: And upon ſeveral Repetitions it anſwer'd much the ſame, till the whole quantity of Fume was conſum'd.

VI. *A Description of the* Apparatus *for making Experiments on the Refractions of Fluids: With a Table of the Specifick Gravities, Angles of Observations, and Ratio of Refractions of several Fluids. By Mr* Fra. Hauksbee, *F. R. S.*

THE whole *Apparatus* is fix'd on a Table, parallel to its Surface. On one and the same *Axis* is fix'd a Sextant, of a *Radius* of 4 Feet, and a moving Limb to bear the Object. The Sextant is divided into Degrees and Minutes by a Diagonal, and remains always fixt. The Object, which is plac'd on the moving Limb, is seen parallel with the Table when observ'd through the Prism, and at no Degrees on the Sextant; but when any Transparent Liquid is put into the same, the Object must be elevated till it appears to the Eye: Then observing how many Degres and Minutes the *Index* on the Limb cuts on the Sextant, we note it, and call it the Angle of Observation. Thus for different Liquids you have different Elevations of the Object, as you will find by the following Table. The Sight-Slit (if I may call it so) is composed of two pieces of Box Wood, plan'd parallel to one another: These Pieces are separated only by 3 slender Slips of common Cards; and with that Intervention are screw'd down one upon the other, exactly parallel with the *Axis* of the moving Leg and Sextant. The Prizm, thro' which it directs the Sight, is plac'd pretty near it, and consists of an Angle of 44.54, which Angle is fix'd Perpendicular to the Plane of the Table, its

d. '

its upper side being parallel with the same. The Object is a Piece of white Paper, in form of a Cross, pasted on a black Board, and is fix'd at the end of the moving Limb, which is in length about 7 Feet from the Sight; its Diameter is about 2 $\frac{1}{2}$ Inches, which just comprehends the Sight through the Slit; so that when the Object is wholly within view, we conclude the Observation to be exact. With this *Apparatus* the Experiments are made as well by Candle-light as Day-light, (the Presence of the Sun Beams being no ways necessary) and I think they may be depended on as pretty Accurate. I have taken the Specifick Gravity of the several Liquids, where I could obtain a sufficient quantity, as appears by the Table: So that if any Person should have the Curiosity to repeat these Experiments, he must expect a different Angle of Observation, if the Specifick Gravity agree not with the Table; for sometimes it happens, that Liquids of the same Denomination are not always of an equal goodness, and consequently will have a different Specifick Gravity and Refraction.

The Christalline Humour of the Ox Eye I prest into the Angle of the Prism, whereby it received the form of it, and gave the Angle of Obsertvaion, as specify'd in the Table. I could not see the common Object thro' it, but was forc'd to make use of a Candle for that purpose; the Flame whereof appeared very broad, at least 5 or 6 Inches, nearly in the form of a Half Moon: But what should occasion such a Change of Figure, I cannot at present determine. Of all the Fluids I have try'd, I find nothing to Refract a Ray of Light less than Water; yet there are several other Liquids which make the same Angle. I observe Oil of Bees-Wax to be the lightest Fluid, and Butter of Antimony *per Deliquium* to be much the heaviest: The difference of Specifick Gravity between these two Bodies, is as 662 is to 1976, that is, nearly as one to three: And the Ratio

of their Refractions but as 10000 is to 6885 Bees-Wax, ſo is 5941 Antimony to the ſame *Radius*; that is, as one to 1.16, or thereabouts. Likewiſe Oil of Vitriol is in Specifick Gravity to Oil of Saſafras, as 1510 is to 898; yet the *Ratio* of Refraction of the lighteſt is moſt conſiderable, being in proportion as 10000 is to 6475 Saſafras; ſo is the ſame *Radius* to 7011 Vitriol. Thus I find, that a Body doth not Refract in proportion to its Specifick Gravity, but from ſome quality peculiar to its ſelf; whether it be from its Inflammability, or from any different Texture, or Figure of its Component Parts; or whatever elſe it be, I ſhall, with the Application of theſe Experiments, ſubmit to this Honourable Society to determine.

	Specifick Gravities in compariſon with a bulk of Water equal to 820 Grains	Angle of Obſervation. *d. l*	Ratio of Refraction, as 10000 is to
		16.50	7485.3
Oil of *Saſafras*	898	29.20	6475.8
Turpentine	713.5	25.25	6741.8
Bees-Wax	662	23.30	6885.4
Carawayes	752	26.13	6696.5
Oranges	711	25.20	6741 2
Hyſop	769.5	25.10	6757.6
Roſemary	747	24.40	6794.7
Savin	789	25.30	6730.9
Origanum	752	25.00	6770.2
Pennyroyal	783	25.30	6730.9
Mint	780.5	26.00	6706.4
Spike	749	24.30	6807.3
Fennel	798	27.10	6616.5
Juniper	729	25.10	6757.6
Cummin	766.5	27.00	6627.7
Tanſey	757	23.46	6865.1
Dill	795.5	27.40	6582.7

Oil

Oil of *Amber*	783	26.30	6662.3
Cinnamon	828	28.40	6517.7
Cloves	827	27.20	6606.8
Nutmegs	759	25.40	6721.4
Spirit of *Wine*	703.5	18.50	7287.9
Hartshorn	786	17.00	7468.3
Vinegar	824.5	17.00	*As Hartshorn.*
Sal Armoniack	794.5	16.56	7475.2
Acids, Spirit of *Amber*	825	16.56	*As Sal Armon.*
Oil of *Vitriol*	1510	21.56	7011.5
Spirit of *Nitre*	1166	20.50	7104.
Aqua Regis	987	19.50	7195.
Aqua Fortis	1157	2040	7120.5
Aqua Regis from *Aqua Fortis* and *Sal Armoniack*	1034	20.10	71615
Butter of *Antimony*	1976	40.00	5941.3
Spirit of *Raw Silk*	916	20.30	7135.
Spirit of *Honey*	716	16.50	*As Water.*
Tinct. of *Antimony*	693	18.46	7294.3
Jesuits Bark	720	18.46	*As Tinct. of Ant.*
Balsam Tolu	717	19.34	7219.3
Gum Amoniacum	719	19.10	7257.3
Mettals	713	18.54	7281.7
Vitreous Humor of an Oxes Eye		16.50	*As Water.*
Christalline Humor of the Ox Eye		24.10	6832.7
White of an Hens Egg		17.40	7401.3
Jelly of Hartshorn		17.50	7384.7
Human Saliva		16.50	*As Water.*
Human Urin		17.05	7451.9
French Brandy		18.20	7338.6

Oil of Turpentine strongly ting'd Green, with filings of Brass, no ways alters its Refraction.

VIII. *An Account of a Book Intitled,* Dissertatio Epistolaris de Glandulis conglobatis Duræ Meningis humanæ, indeque ortis Lymphaticis ad Piam Meningem productis. Authore Antonio Pacchiono. Romæ 1705. 8vo.

THIS Dissertation seems to be only a Supplement, or *Appendix*, to a Treatise of the *Dura Mater*, which our Author, that Industrious and most Inquisitive Anatomist, *Pacchionus*, had publish'd sometime before. In this his chief Design is to inquire into the Service, and find out the Origin of that Humor, which moistens the Brain and its Membranes in every dead Animal.

He mentions three things, which kept him from engaging in this Inquiry much sooner.

The first was, because the Accurate *Nuchius* very much blamed their freedom, who were too forward in admitting any Lymphatick Vessels in the Brain: For he freely owns, that he could never succeed in this matter, tho' with the greatest exactness he had often attempted it.

The next was, because the Great *Malpighius*, who was so curious and happy in discovering the Glands of the *Thorax* and *Abdomen*, did never take the least notice of any in the *Dura Mater*.

The third Obstacle, that stood in his way, was the texture of the Membrane itself; which is so thick, and composed of Fibres so very strong, that they seem almost

moſt to be Muſcular, and probably altogether unfit for lodging any ſuch bodies as Glands are.

But at laſt the Knife removed all theſe Difficulties, and he happily ſucceeded in the Diſcovery of the following Glands, which are the Subject of this Book.

Before he deſcribes theſe Glandulous Bodies, he premiſes a ſhort Account of the Structure of the Longitudinal and Lateral *Sinus's* of the *Dura Mater*; but adds little or nothing to what the Renowned *Willis*, and the Sagacious *Vieuſſens*, have already ſaid on that Subject.

In examining the Cavity of the Longitudinal *Sinus*, immediately under its membranous Expanſions, in the *Areæ* or middle of its *Cordæ*, mention'd by Dr. *Willis*, (that is, the ſmall tranſverſe Fibres, which like Ropes keep the Walls of this *Sinus* from being over-dilated by the influent Blood) our Author had the good Fortune to diſcover a great number of Conglobate Glands, which are all contained by a fine and proper Membrane, as in a Bag. For the moſt part they appear in Cluſters, and are ſeldom ſcatter'd here and there. Their Figure is roundiſh; and in bigneſs they equal a Silk-worms Egg, if inſpected as ſoon as the Body is opened; but if the *Meninx* be macerated in Vinegar for a Month, or more, they are bigger than a Millet Seed. In Old People, and in thoſe who have died of a lingring Diſeaſe, they may be ſeen by the naked Eye, without any Microſcope, or previous Preparation. They are incompaſſed with fine Carnous Fibres; whence they put on a pale Colour: But when theſe Fibres are much relaxed, as happens in an *Hydrocephalus*, or Comatoſe Diſtempers of the Brain, they become white and very big.

In

In the Lateral *Sinus's* they are ſeldom or never obſerv'd; becauſe in thoſe, he thinks, they would have been more ſubject to the ſuperincumbent weight and preſſure of the Brain, which would much have incommoded their Office; but by their ſituation in the Longitudinal *Sinus*, there could no ſuch inconveniency happen.

From the aforeſaid Glands innumerable fine Threads ariſe, and are only their Excretory Veſſels, which are ſpread all over the inſide of the *Pia Mater*, being accompanied and ſtrengthned in their courſe by Fibres and other Blood Veſſels. It is theſe Fibres which join the *Meninges* to one another: And if you take care that the *Dura Mater* be not hurt in taking off the upper part of the Scull, in dividing theſe Membranes, you may obſerve Liquors of different colours ouze and drop from them when cut.

Our Author is not poſitive that theſe Excretory Ducts penetrate into the Medullary Subſtance of the Brain; but affirms, that they creep along its inner Protuberances and accidental Cavities. This Diſcovery confirms what *Bohn* and ſome others have ſaid about the Lymphaticks of the Brain; but before our Induſtrious Author, none did ever ſo much as pretend to fix their Origination, which he has traced from the Glands lodged in the Longitudinal *Sinus*, as above.

The Uſe he aſſigns to theſe Glands, is to ſeparate and ſtrain a particular kind of Humor from the Blood; which, in his Opinion, may ſerve to keep the Membranes and Surfaces of the Cavities and Protuberances of the Brain from growing too dry by their continued Motion. When this Humor becomes either deficient and wanting, or exuberant and in too great a quantity,

tity, the Parts above-named are unfit for the Natural discharge of their respective Offices, whence several dangerous Distempers must necessarily follow: He adds some Cases of this kind, which he has observed in the Dissection of morbid Bodies.

Advertisement.

ALL Persons who have any thing to communicate to the Royal Society, *are desired to direct it to be left at their House in* Crane-Court, *in* Fleet-street, London.

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(Numb. 329.)

PHILOSOPHICAL TRANSACTIONS.

For the Months of January, February, *and* March, 1711.

DE MENSURA SORTIS, SEU, DE Probabilitate Eventuum in Ludis a Casu Fortuito Pendentibus.

Autore Abr. De Moivre, *R. S. S.*

Nobilissimo Viro

J. Francisco Robartes,

Mathematicarum Scientiarum Fautori summo.

HORTATU tuo, *Vir Nobilissime, Problemata quædam ad Aleam spectantia solvi, principiaque exposui quibus eorum solutio imitatur; nunc autem ex Regalis Societatis jussu in lucem emitto.* Hugenius, *primus quod sciam regulas tradidit ad istius generis Problematum Solutionem, quas nuperrimus autor Gallus variis exemplis pulchre illustravit; sed non videntur viri clarissimi ea simplicitate ac generalitate usi fuisse quam natura rei postulabat: etenim dum plures quantitates incognitas usurpant, ut varias Collusorum conditiones repræsentent, calculum suum nimis perplexum reddunt; dumque Collusorum dexteritatem semper æqualem ponunt, doctrinam hanc ludorum intra limites nimis arctos continent. Methodus qua potissimum utor, est Doctrina Combinationum, qua probe intellecta, facilis se prodit. Solutio plurium Problematum aliorumque difficillimorum; verum huic methodo non ita memet adstrinxi, quin aliquando Series infinitas etiam adhibuerim, præsertim ubi prioritus ludendi considerandæ venit. Series autem istæ vel facile abrumpuntur, vel summantur exacte, vel ad verum convergunt. Problemata* *triâ quæ tu, *Vir Clarissime, mihi solvenda proposuisti, non sine magna voluptate confeci; & si quid laudis, ex his rebus mihi sit accessurum, eorum Solutioni, credo, præcipue debebitur. Si tibi liceret, per tempus quod in Reipublicæ emolumentum tam utiliter impendis, ea prosequi quæ tibi animi oblectandi gratia tentata sunt & felici admodum successu comperta, nihil ad perfectionem hujus doctrinæ desideraretur; simulque pateret quam singulari ingenii acumine emineas, quamque hujusmodi contemplationes cum severioribus & majoris momenti studiis minime sint incongruæ.*

Vir Honoratissime,

Tui Observantissimus,

atque Obsequentissimus,

Abr. De Moivre.

* Prob. 16, 17, 18.

SI p sit numerus casuum quibus eventus aliquis contingere possit, & q numerus casuum quibus possit non-contingere; tam contingentia quam non-contingentia eventus suum habent probabilitatis gradum: Quod si casus omnes quibus eventus contingere vel non-contingere potest, sint æque faciles; probabilitas contingentiæ, erit ad probabilitatem non-contingentiæ ut p ad q.

Si A & B, colluſores duo ita de eventibus certent, ut ſi caſus p contingant, A vicerit; ſin caſus q contingant, B vicerit, atq; ſit a ſumma depoſita, ſors ſeu expectatio ipſius A erit $\frac{pa}{p+q}$, ſors vero ſeu expectatio ipſius B erit $\frac{qa}{p+q}$, adeoque ſi A vel B expectationes ſuas vendant, æquum eſt ut pro illis recipiant $\frac{pa}{p+q}$ & $\frac{qa}{p+q}$ reſpective.

Si præmium aliquod a proponatur victori concedendum, ita ut ſi caſus p contigerint, præmium concedatur ipſi A, ſin vero caſus q contigerint, præmium ipſi B concedatur, atque A & B hoc pactum ineant, ut ante eventum, præmium dividatur pro ratione ſortium, A debebit ſumere partem $\frac{pa}{p+q}$, B vero partem $\frac{qa}{p+q}$.

Si eventus duo nullo modo ex ſe invicem pendeant, ita ut p ſit numerus caſuum quibus eventus primus contingere poſſit, & q numerus caſuum quibus poſſit non-contingere; & ſit r numerus caſuum quibus eventus ſecundus contingere poſſit, & s numerus caſuum quibus poſſit non-contingere: Multiplicetur $p+q$ per $r+s$, & Productum Multiplicationis, *viz.* $pr+qr+ps+qs$ erit numerus caſuum omnium quibus contingentia & non-contingentia eventuum inter ſe variari poſſunt.

Ergo ſi A & B inter ſe ita de his eventibus certent, ut A contendat fore ut uterque contingat, ratio ſortium erit ut pr ad $qr+ps+qs$.

Sed si A contendat fore ut alteruter contingat, ratio sortium erit ut $pr + qr + ps$ ad qs.

Si vero A contendat fore ut eventus primus contingat, secundus autem non contingat, ratio sortium erit ut ps ad $pr + qr + qs$.

Et eodem argumentandi modo, si tres vel plures sint eventus de quibus, A & B certent, ratio sortium invenietur Multiplicatione sola.

Si eventus omnes habeant datum numerum casuum quibus contingere possint, & datum itidem numerum casuum quibus possint non-contingere, & sit a numerus casuum quibus eventus aliquis possit contingere, & b numerus casuum omnium quibus possit non-contingere, & sit n numerus eventuum omnium; elevetur $a + b$ ad potestatem n.

Et si A cum B certet ea conditione ut si eventus unus vel plures contigerint, ipse A vicerit; sin nullus, tum B vicerit; ratio sortium erit ut $\overline{a + b}|^n - b^n$ ad b^n; etenim terminus unicus, in quo a non reperitur est b^n.

Si A cum B certet ea conditione, ut si eventus duo vel plures contigerint, A vicerit; sin nullus vel unus, tum B vicerit; ratio sortium erit ut $\overline{a + b}|^n - b^n - nab^{n-1}$, ad $b^n + nab^{n-1}$: Etenim termini duo in quibus aa non reperitur, sunt b^n & nab^{n-1}; & sic deinceps de cæteris.

PROB. I.

A & B una tessera ludunt, ea conditione, ut si A bis vel pluries, octo jactibus tesseræ monada jecerit, ipse A vincat; sin semel tantum, vel non omnino, B vincat; quænam erit ratio sortium?

SOLUTIO.

Quoniam est casus unicus quo monas contingere potest, & quinque casus quibus potest non-contingere, fiat $a = 1$, & $b = 5$.

Rursus

Rursus quoniam sunt octo jactus tesseræ, fiat $n = 8$, & erit $\overline{a+b}|^n - b^n - nab^{n-1}$ ad $b^n + nab^{n-1}$ ut 663991 ad 1015625, hoc est, ut 2 ad 3 circiter.

PROB. II.

A & B singulis globis ea conditione certant, ut qui globum propius ad metam miserit, unum ludum vincat; jam post ludos aliquot peractos, ipsi A desunt ludi 4 quo minus victor abeat, ipsi vero B, 6; at ea est ipsius A in mittendis globis dexteritas, ut sors illius foret ad sortem ipsius B ut 3 ad 2, si de unico ludo contenderent; quænam est ratio sortium in casu proposito?

SOLUTIO.

Quoniam ipsi A desunt 4 ludi quominus victor abeat, ipsi vero B 6, sequitur fore ut certamen futuris concludatur ludis ad plurimum 9, videlicet summa deficientium ludorum minus unitate; ergo elevetur $a + b$ ad potestatem nonam, hæc erit, $a^9 + 9a^8b + 36a^7bb + 84a^6b^3 + 126a^5b^4 + 126a^4b^5 + 84a^3b^6 + 36aab^7 + 9ab^8 + b^9$. Et sumantur pro A termini omnes in quibus a habet 4 vel plures dimensiones, & pro B termini omnes in quibus B habet 6 vel plures dimensiones, ergo ratio sortium erit ut $a^9 + 9a^8b + 36a^7bb + 84a^6b^3 + 126a^5b^4 + 126a^4b^5$ ad $84a^3b^6 + 36aab^7 + 9ab^8 + b^9$. Exponatur a per 3, & b per 2, & habebitur ratio sortium in numeris, videlicet 1759077 ad 194048.

Et generaliter, posito quod p & q sint numeri deficientium ludorum respective; elevetur $a + b$ ad potestatem $p + q - 1$, & sumantur pro A & B respective tot termini quot ipsis desunt ludi reciproce, hoc est, pro A sumantur tot termini quot sunt unitates in q, pro B vero tot termini quot sunt unitates in p.

PROB.

PROB. III.

Si A *&* B *singulis globis ludant, & ea sit ipsius* A *in mittendis globis dexteritas, ut possit ipsi* B *duos ludos ex tribus largiri; quæritur quænam foret ratio sortium si de ludo uno contenderent.*

SOLUTIO.

Sint sortes quæsitæ ut z ad 1, & elevetur $z+1$ ad Cubum; hic erit, $z^3+3zz+3z+1$. Jam cum A possit duos ludos ex tribus ipsi B largiri, A in se id susciperе poterit, ut tres ludos continuos vincat, adeoque sortes hoc in casu erunt ut z^3 ad $3zz+3z+1$. Ergo $z^3=3zz+3z+1$. Sive $2z^3=z^3+3zz+3z+1$. Ergo $z\sqrt[3]{2}=z+1$, adeoque $z=\frac{1}{\sqrt[3]{2}-1}$: Igitur sortes quæsitæ erunt $\frac{1}{\sqrt[3]{2}-1}$ & 1 respective.

Et generaliter, si ea sit ipsius A dexteritas, ut possit æquali sorte in se susciperе ut n vices continuas vincat, A poterit deponere $\frac{1}{\sqrt[n]{2}-1}$ contra 1, fore ut semel vincat.

PROB. IV.

Si A *possit æqua sorte unum ex tribus ludis ipsi* B *largiri, quæritur ratio sortium ipsorum* A *&* B *cum de ludo unico contendunt, hoc est requiritur ratio dexteritatum.*

SOLUTIO.

Sit ratio dexteritatum ut z ad 1. Si autem *A* unum ludum ex tribus ipsi *B* largiatur, ergo suscipit *A* se ter victurum, priusquam *B* bis vicerit; elevetur itaque $z+1$ ad potestatem quartam,

quartam, videlicet, $z^4 + 4z^3 + 6zz + 4z + 1$, ergo ratio sortium erit ut $z^4 + 4z^3$ ad $6zz + 4z + 1$; Ergo cum æqua sorte contendant, fiat $z^4 + 4z^3 = 6zz + 4z + 1$; Qua æquatione soluta, obtinebitur $z = 1.6$ prope. Ergo ratio dexteritatum erit circiter ut 8 ad 5.

PROB. V.

Invenire quotenis tentaminibus futurum sit probabile eventus ut aliquis contingat, posito quid sint casus a *quibus primo tentamine contingere possit, & casus* b *quibus possit non-contingere, ita ut si* A *&* B *de eventu contendant, possint* A *&* B *æqua sorte eventum affirmare & negare.*

SOLUTIO.

Sit x numerus tentaminum quibus eventus aliquis possit æquali expectatione contingere vel non-contingere, ergo per jam demonstrata erit $\overline{a+b}|^x - b^x = b^x$, sive $\overline{a+b}|^x = 2b^x$, ergo $x = \frac{\text{Log. } 2}{\text{Log. } \overline{a+b} - \text{Log. } b}$.

Insuper resumatur æquatio $\overline{a+b}|^x = 2b^x$, & sit $a : b :: 1 : q$, & æquatio migrat in istam, $\overline{1+\frac{1}{q}}|^x = 2$. Elevetur $1+\frac{1}{q}$ ad potestatem x, ope Theorematis *Neutoniani*, & fiet $1 + \frac{x}{q} + \frac{x}{1} \times \frac{x-1}{2qq} + \frac{x}{1} \times \frac{x-1}{2} \times \frac{x-2}{3q^3}$ &c. $= 2$. In hac æquatione si sit $q = 1$, erit $x = 1$; si q sit infinita, erit x infinita. Sit x infinita, ergo æquatio superior fiet, $1 + \frac{x}{q} + \frac{xx}{2qq} + \frac{x^3}{6q^3}$ &c. $= 2$. Iterum sit $\frac{x}{q} = z$, & erit $1 + z + \frac{1}{2}zz + \frac{1}{6}z^3$ &c. $= 2$. Sed $1 + z + \frac{1}{2}zz + \frac{1}{6}z^3$ &c. est numerus cujus Logarithmus Hyperbolicus est z, ergo $z = \text{Log. } 2$. Sed Logarithmus Hyperbolicus ipsius 2 est .7 proxime, ergo $z = .7$ proxime.

Igitur ubi q est 1, erit $x = 1q$; & ubi q est infinita, erit $x = .7q$ proxime.

Jam ergo definivimus limitas arctissimos intra quos ratio x ad q consistet, etenim ratio illa orditur ab æqualitate, & cum ad infinitum est provecta, definit tandem in ratione 7 ad 10 proxime.

EXEMP. I.

Inveniendum sit quotenis jactibus A suscipere in se possit, ut duas monadas duabus tesseris jaciat.

SOLUTIO.

Quoniam *A* habet casum unicum quo duas monadas jacere possit, & 35 quibus illas non jaciat, erit $q = 35$; Multiplicetur igitur 35 per .7, & productum 24.5 indicabit numerum jactuum quæsitum fore inter 24 & 25.

EXEMP. II.

Inveniendum sit quotenis jactibus A suscipere in se possit, ut tres monadas tribus tesseris jaciat.

SOLUTIO.

Quoniam *A* habet casum unicum quo monadas tres, tribus tesseris jacere possit, & casus 215 quibus illas non jaciat; Multipliceter 215 per .7, & productum 150.5 indicabit numerum jactuum quæsitum fore inter 150 & 151.

LEMMA.

Invenire numerum casuum quibus datus punctorum numerus dato tesserarum numero, jaci possit.

SOLUTIO.

Sit $p + 1$ datus punctorum numerus, n numerus tesserarum, f numerus facierum in tessera: fiat $p - f = q$, $q - f = r$, $r - f$

$r - f = s$, $s - f = t$, &c. Numerus casuum quæsitus erit,

$$+ \frac{p}{1} \times \frac{p-1}{2} \times \frac{p-2}{3} \text{ &c.}$$
$$- \frac{q}{1} \times \frac{q-1}{2} \times \frac{q-2}{3} \text{ &c.} \times \frac{n}{1}.$$
$$+ \frac{r}{1} \times \frac{r-1}{2} \times \frac{r-2}{3} \text{ &c.} \times \frac{n}{1} \times \frac{n-1}{2}.$$
$$- \frac{s}{1} \times \frac{s-1}{2} \times \frac{s-2}{3} \text{ &c.} \times \frac{n}{1} \times \frac{n-1}{2} \times \frac{n-2}{3}.$$
&c.

Quam seriem continuari oportebit, donec aliqui factorum fiant vel æquales nihilo, vel negativi.

N. B. Tot factores singulorum productorum, $\frac{q}{1} \times \frac{q-1}{2} \times \frac{q-2}{3}$ &c. $\frac{r}{1} \times \frac{r-1}{2} \times \frac{r-2}{3}$ &c. $\frac{s}{1} \times \frac{s-1}{2} \times \frac{s-2}{3}$ &c. sumendi sunt, quot sunt unitates in $n - 1$.

PRAXIS.

Requiratur, v. g. numerus casuum, quibus 16 puncta 4 tesseris jaci possint.

$$+ \frac{15}{1} \times \frac{14}{2} \times \frac{13}{3} = + 455$$
$$- \frac{9}{1} \times \frac{8}{2} \times \frac{7}{3} \times \frac{4}{1} = - 336$$
$$+ \frac{3}{1} \times \frac{2}{2} \times \frac{1}{3} \times \frac{4}{1} \times \frac{3}{2} = + 6$$

Jam $455 - 336 + 6 = 125$. Ergo 125 est numerus casuum quæsitus.

Requiratur numerus casuum quibus 15 puncta 6 tesseris jaci possint.

$$+ \frac{14}{1} \times \frac{13}{2} \times \frac{12}{3} \times \frac{11}{4} \times \frac{10}{5} = + 2002$$
$$- \frac{8}{1} \times \frac{7}{2} \times \frac{6}{3} \times \frac{5}{4} \times \frac{4}{5} \times \frac{6}{1} = - 336$$

Jam $2002 - 336 = 1666$ numerus casuum quæsitus.

Requi-

Requiratur numerus casuum quibus 27 puncta 6 tesseris jaci possint.

$$+\frac{26}{1}\times\frac{25}{2}\times\frac{24}{3}\times\frac{23}{4}\times\frac{22}{5} = +65780$$

$$-\frac{20}{1}\times\frac{19}{2}\times\frac{18}{3}\times\frac{17}{4}\times\frac{16}{5}\times\frac{6}{1} = -93024$$

$$+\frac{14}{1}\times\frac{13}{2}\times\frac{12}{3}\times\frac{11}{4}\times\frac{10}{5}\times\frac{6}{1}\times\frac{5}{2} = +30030$$

$$-\frac{8}{1}\times\frac{7}{2}\times\frac{6}{3}\times\frac{5}{4}\times\frac{4}{5}\times\frac{6}{1}\times\frac{5}{2}\times\frac{4}{3} = -1120$$

Jam $65780 - 93024 + 30030 - 1120 = 1666$ numerus casuum quæsitus.

COROLLARIUM.

Puncta omnia æqualiter ab extremis distantia habent eundem numerum casuum quibus producantur, adeoque si numerus punctorum datus vicinior sit majori extremo quam minori, subtrahatur numerus iste ex summa extremorum, & inveniatur numerus casuum quibus residuus numerus producatur, & fiet operatio brevior.

EXEMP. III.

Invenire quotenis jactibus A suscipere in se possit ut 15 puncta 6 tesseris jaciat.

SOLUTIO.

Quoniam *A* habet casus 1666 quibus jacere possit 15 puncta, & 44990 quibus illa non jaciat, dividatur 44990 per 1666, & quotus 27 erit = *q*. Ergo multiplicetur 27 per 7, & productum multiplicationis 189 indicabit numerum jactuum quæsitum esse 19 fere.

PROB.

PROB. VI.

Invenire quotenis tentaminibus futurum sit probabile, ut eventus aliquis bis contingat, posito quod sint casus a *quibus primo tentamine contingere possit, & casus* b *quibus possit non-contingere; ita ut si* A *&* B *de eventu contendant, possint* A *&* B *æqua sorte eventum affirmare & negare.*

SOLUTIO.

Sit x numerus tentaminum, ergo per jam demonstrata patebit fore $\overline{a+b}|^x = 2b^x + 2axb^{x-1}$. Sive faciendo $a:b::1:q$, $\overline{1+\frac{1}{q}}|^x = 2 + \frac{2x}{q}$. 1°. Sit $q = 1$, & erit $x = 3$. 2°. Sit q infinita, & erit x infinita : Pone x infinitam, & $\frac{x}{q} = z$, & erit $1 + z + \frac{1}{2}z^2 + \frac{1}{6}z^3$, &c. $= 2 + 2z$, adeoque z = Log. 2. + Log. $\overline{1+z}$; jam si Log. 2. vocetur y, æquatio ista in hanc Fluxionalem transformabitur $\frac{z\dot{z}}{1+z} = \dot{y}$. Si autem valor ipsius z investigetur per Potestates ipsius y, invenietur $z = 1.678$ proxime, ergo x semper consistet intra limites $3q$ & $1.678q$; sed x citissime converget ad $1.678q$, adeoque si q ad 1 habuerit rationem non adeo parvam, poterit assumi $x = 1.678q$. Si vero sit aliqua suspicio ne x sit justo minor, substituatur ipsius valor in æquatione $\overline{1+\frac{1}{q}}|^x = 2 + \frac{2x}{q}$, & notetur error, si quis sit notatu dignus, tunc augeatur x aliquantulum, & substituatur valor sic auctus pro x in prædicta æquatione, & notetur novus error, & ope duorum errorum, valor ipsius x poterit satis accurate corrigi.

EXEMP. I.

Inveniendum sit quotenis vicibus, A in se suscipere possit, ut tres monadas, tribus tesseris bis jaciat.

SOLUTIO.

Quoniam A casum habet unicum quo tres monadas jaciat, & 215 quibus illas non jaciat, erit $q = 215$: Ergo multiplicetur 215 per 1.678, & productum multiplicationis 360.7 indicabit numerum jactuum quæsitum, fore inter 360 & 361.

EXEMP. II.

Inveniendum sit quotenis vicibus, A in se suscipere possit ut 15 puncta, 6 tesseris bis jaciat.

SOLUTIO.

Quoniam A habet casus 1666 quibus jacere possit 15 puncta, & 44990 quibus illa non jaciat ; dividatur 44990 per 1666, & quotus 27 erit $= q$: Ergo multiplicetur 27 per 1.678, & productum multiplicationis 45.3, indicabit numerum jactuum quæsitum, fore inter 45 & 46.

PROB. VII.

Invenire quotenis tentaminibus futurum sit probabile, ut eventus aliquis, ter, quater, quinquies, &c. contingat, posito quod sint casus a *quibus primo tentamine contingere possit, & casus* b *quibus possit non contingere.*

SOLUTIO.

Sit x numerus tentaminum quæsitus ; & ex jam demonstratis si de triplici eventu contendatur, facto $a : b :: 1 : g$, erit

$1 +$

$\overline{1+\frac{1}{q}}\Big|^x = 2 \times \overline{1+\frac{x}{q}+\frac{x}{1}\times\frac{x-1}{2qq}}$. Si de quadruplici, $\overline{1+\frac{1}{q}}\Big|^x = 2 \times \overline{1+\frac{x}{q}+\frac{x}{1}\times\frac{x-1}{2qq}+\frac{x}{1}\times\frac{x-1}{2}\times\frac{x-2}{3q^3}}$. Et continuatio istarum æquationum est manifesta. Jam in priori æquatione, si sit $q = 1$, erit $x = 5q$; si vero q sit infinita, vel ad unitatem habuerit rationem satis magnam, æquatio prædicta, ponendo $\frac{x}{q} = z$, migrabit in istam $z = \text{Log. } 2 + \text{Log. } 1 + z + \frac{1}{2}z^2$, vel in istam Fluxionalem posito Log. $2 = y$, $\frac{\frac{1}{2}z^2\dot{z}}{1+z+\frac{1}{2}zz} = \dot{y}$; ubi reperietur $z = 2.675$ proxime; ergo x semper consistet intra $5q$ & $2.675q$.

In æquatione posteriori, si q sit $= 1$, erit $x = 7q$; si vero x sit infinita, vel ad unitatem habuerit rationem satis magnam, erit $z = \text{Log. } 2 + \text{Log. } 1 + z + \frac{1}{2}z^2 + \frac{1}{6}z^3$, vel $\frac{\frac{1}{6}z^3\dot{z}}{1+z+\frac{1}{2}zz+\frac{1}{6}z^3} = \dot{y}$, ubi reperietur $z = 3.6719q$ proxime; & par est ratio omnium sequentium, & limites semper approximant ad rationem numeri binarii ad unitatem.

TABELLA LIMITUM.

Si de eventu simplici contendatur, numerus tentaminum erit intra $1q$ & $0.693q$

Si de duplici, intra	$3q$ & $1.678q$
Si de triplici, intra	$5q$ & $2.675q$
Si de quadruplici, intra	$7q$ & $3.6719q$
Si de quintuplici, intra	$9q$ & $4.67q$.
Si de sextuplici, intra	$11q$ & $5.668q$

Si de pluribus, quorum numerus sit n, contendatur; modo n & q ad unitatem habuerint rationem satis magnam, conjectura de numero tentaminum non multum a vero aberrans facile fiet, ponendo numerum tentaminum $= \frac{2n-1}{2}q$. Etenim x cito converget ad limitem minorem.

PROB.


Pectus Cygni
Philosoph. Trans.
N.o 343
Nova Anni 1600
Nova Anni 1686
Nova Anni 1670
Fig. A
I. Senex sculp.

Numb. 343.

PHILOSOPHICAL TRANSACTIONS.

For the Months of *March*, *April* and *May*, 1715.

The CONTENTS.

B nummos p lucretur, erunt ſortes ut $a^q \times \overline{a^p - b^p}$, ad $b^p \times \overline{a^q - b^q}$. Fingatur enim A nummos habere E, F, G, H, &c. quorum numerus p; & B nummos habere I, K, L, &c. quorum numerus q; fingatur inſuper, valorem cujuſlibet nummi eſſe ad valorem ſequentis ut a ad b, ita ut E, F, G, H, I, K, L, ſint in progreſſione Geometrica; his ita poſitis, poterunt A & B qualibet vice deponere nummos quorum valor ſit proportionalis numero caſuum quibus alter alterum vincere poſſit; etenim prima vice poterit A deponere H, B vero I; at H ad I ex hypotheſis eſt ut a ad b; ergo jam A & B æquali conditione certant; ſi vicerit A, poterit ille deponere I, B vero K; ſed I ad K ex Hypotheſi eſt ut a ad b; ſin B vicerit, poterit A deponere G, B vero H, quorum ipſorum G & H ratio eſt ut a ad b, & ſic deinceps. Ergo quamdiu A & B certant, ſemper certant æquali conditione: Igitur eorum expectationes ſunt inter ſe ut ſumma terminorum E, F, G, H, &c. quorum numerus eſt p, ad ſummam terminorum I, K, L, quorum numerus eſt q; hoc eſt, ut $a^q \times \overline{a^p - b^p}$ ad $b^p \times \overline{a^q - b^q}$, quod facile conſtabit, ſi ſummentur progreſſiones iſtæ Geometricæ: Jam poſito, quemlibet nummum eſſe ad ſequentem ut a ad b, non exinde mutantur probabilitates vincendi, ergo poſito, valorem nummorum eſſe æqualem, probabilitates vincendi, ſeu ſortes ipſorum A & B etiamnum erunt in illa ipſa ratione quam determinavimus.

Maxime cavendum eſt ne Problemata propter ſpeciem aliquam affinitatis inter ſe confundantur. Problema ſequens videtur affine ſuperiori.

PROB.

PROB. X.

C *assumptis* 24 *calculis, tres tesseras jaciat; jam quoties* 27 *puncta jecerit, tradat calculum unum ipsi* A, *quoties vero* 14 *puncta jecerit, tradat calculum unum ipsi* B, *at* A *&* B *hoc pacto certent, ut qui prior calculos* 12 *habuerit, depositum obtineat; quæritur ratio expectationum.*

Problema istud a superiore in hoc differt, quod 23 ad plurimum tesserarum jactibus, ludus necessario finietur; cum ludus ex lege superioris problematis, posset in æternum continuari, propter reciprocationem lucri & jacturæ se invicem perpetuo destruentium.

SOLUTIO.

Elevetur $a + b$ ad potestatem 23^{am}, & termini 12 priores erunt ad 12 posteriores, ut expectatio ipsius A ad expectationem ipsius B.

PROB. XI.

Tres collusores A,B,C, *assumentes duodecim calculos, quorum* 4 *albi, &* 8 *nigri sint, ludant hac conditione, ut qui primus ipsorum, velatis oculis, album calculum elegerit, vincat; & ut prima electio sit penes* A, *secunda penes* B, *tertia penes* C; *& tum sequens rursus penes* A, *& sic deinceps ordine: Quæritur quænam futura sit ratio sortium ipsorum* A, B, C.

SOLUTIO.

Sit n numerus calculorum omnium, a numerus alborum, b numerus nigrorum, 1 summa deposita, seu præmium victori concedendum.

1°. A

1°. A habet casus a quibus album, & casus b quibus nigrum eligat, adeoque ejus expectatio ex prima electione oriunda est $\frac{a}{a+b}$ sive $\frac{a}{n}$. Igitur si $\frac{a}{n}$ ex 1 subtrahatur, valor residuarum expectationum erit $1 - \frac{a}{n} = \frac{n-a}{n} = \frac{b}{n}$.

2°. B habet casus a quibus album, & casus $b-1$ quibus nigrum eligat; sed prima electio est penes A, & incertum est utrum ille victurus sit nec ne, adeoque præmium respectu ipsius B non est 1, sed tantummodo $\frac{b}{n}$, igitur illius expectatio ex secunda electione oriunda est $\frac{a}{a+b-1} \times \frac{b}{n} = \frac{ab}{n \times n-1}$. Subtrahatur $\frac{ab}{n \times n-1}$ ex $\frac{b}{n}$, & valor residuarum expectationum erit $\frac{nb-b-ab}{n \times n-1} = \frac{b \times \overline{b-1}}{n \times n-1}$.

3°. C habet casus a quibus album, & casus $b-2$, quibus nigrum eligat, adeoque ejus expectatio ex tertia electione est $\frac{a \times b \times \overline{b-1}}{n \times \overline{n-1} \times \overline{n-2}}$.

4°. Eodem modo A habet casus a quibus album, & casus $b-3$ quibus nigrum eligat, adeoque ejus expectatio ex quarta electione erit $\frac{a \times b \times \overline{b-1} \times \overline{b-2}}{n \times \overline{n-1} \times \overline{n-2} \times \overline{n-3}}$. Et sic deinceps de cæteris.

Scribatur ergo series

$\frac{a}{n} + \frac{b}{n-1} P + \frac{b-1}{n-2} Q + \frac{b-2}{n-3} R + \frac{b-3}{n-4} S$ &c. ubi P, Q, R, S, &c. denotant terminos præcedentes cum suis signis; & sumantur tot termini hujus seriei quot sunt unitates in $b+1$ (etenim non plures erunt electiones quam sunt unitates in $b+1$) Et summa tertiorum omnium, intermissis binis, terminorum, inci-

incipiendo ab $\frac{a}{n}$, erit tota expectatio ipsius A, summa tertiorum itidem omnium incipiendo a $\frac{b}{n-1}$ P, erit tota expectatio ipsius B; summa tertiorum omnium incipiendo a $\frac{b-1}{n-2}$ Q, erit tota expectatio ipsius C.

Si plures sint collusores, A, B, C, D, &c. sive calculum unum, sive plures, sive eundem calculorum numerum, sive diversum unaquaque vice elegerint, illorum expectationes, ope præcedentis seriei, facili negotio itidem determinabuntur.

Sed ut ad casum in Problemate propositum revertamur, fiat $a = 4$, $b = 8$, $n = 12$, & series generalis jam in istam migrabit, $\frac{4}{12} + \frac{8}{11}P + \frac{7}{10}Q + \frac{6}{9}R + \frac{5}{8}S + \frac{4}{7}T + \frac{3}{6}V + \frac{2}{5}X + \frac{1}{4}Y$.

Sive in alteram istam (multiplicando terminos omnes per numerum istum qui tollendis fractionibus magis idoneus judicabitur, nempe hoc in casu per 450)

$$115 + 120 + 84 + 56 + 35 + 20 + 10 + 4 + 1.$$

adeoque tribuantur ipsi A, $115 + 56 + 10 = 231$; ipsi B, $120 + 35 + 4 = 159$; ipsi C, $84 + 20 + 1 = 105$. Adeoque expectationes erunt ut 231, 159, 105; sive ut 77, 53, 35.

COROLLARIUM

Si numerus casuum quibus A, B, C, vel collusores quotcunque vincere possunt, tandem aliquando exhauriatur, expressiones sortium erunt finitæ.

PROB. XII.

Si colluſores tres, A, B, C, vicibus ſuis Dodecaedron 4 albis facietibus, & 8 nigris, jaciant, ea conditione ut qui primus faciem albam jecerit, vincat; quæritur ratio expectationum.

SOLUTIO.

Ratiocinia circa hanc Propoſitionem eadem ſunt atque illa quibus uti ſumus in præcedenti, ſed cum jactus Dodecaedri nihil detrahant de numero facierum, pro $b=1$, $b=2$, $b=3$, $b=4$, &c. $n=1$, $n=2$, $n=3$, $n=4$, &c. ſubſtituantur b & n reſpective, & ſeries præcedentis Problematis evadet $\frac{a}{n}+\frac{ab}{nn}+\frac{abb}{n^3}+\frac{ab^3}{n^4}+\frac{ab^4}{n^5}+\frac{ab^5}{n^6}$ &c. quæ ſeries in infinitum eſt continuanda. Et ſumendo tertios quoſque terminos, expectationes erunt

$$\frac{a}{n}+\frac{ab^3}{n^4}+\frac{ab^6}{n^7}\ \&c.$$

$$\frac{ab}{nn}+\frac{ab^4}{n^5}+\frac{ab^7}{n^8}\ \&c.$$

$$\frac{abb}{n^3}+\frac{ab^5}{n^6}+\frac{ab^8}{n^9}\ \&c.$$

Sed termini ex quibus expectationes ſingulæ componuntur ſunt in progreſſione geometrica, & ratio cujuſlibet termini ad ſequentem eadem eſt in ſingulis ſeriebus, nempe ut n^3 ad b^3; ergo ſummæ ſerierum ſunt ut primi ſerierum termini, nempe ut $\frac{a}{n}$, $\frac{ab}{nn}$, $\frac{abb}{n^3}$, ſive ut nn, bn, bb. Hoc eſt, in caſu iſtius Problematis, ut 9, 6, 4.

COROLLARIUM.

Si plures ſint colluſores, A, B, C, D, &c. iiſdem conditionibus ac ſupra certantes, ſumantur tot termini in ratione n ad b, quot ſunt colluſores, & termini illi denotabunt expectationes colluſorum reſpective.

PROB.

PROB. XIII.

A & B ludant binis tesseris, hac conditione, ut A vincat si punctum senarium jecerit; B, si septenarium. A primo jactum unum instituat, deinde B duos jactus simul; tum rursus A duos jactus, atque sic deinceps, donec hic vel ille victor evadat: Quæritur ratio sortis ipsius A, ad sortem ipsius B.

SOLUTIO.

Ponatur a numerus casuum quibus A vincere possit, & b numerus casuum quibus B vincere possit, n numerus variationum in tesseris datis; sit insuper $n - a = d$, & $n - b = e$; sit etiam 1 præmium victori concedendum.

1°. A habet casus a quibus vincere possit, & casus $n - a$ quibus non vincat, adeoque illius expectatio ex primo jactu oriunda est $\frac{a}{n}$; igitur si $\frac{a}{n}$ ex 1 subtrahatur, valor residuarum expectationum erit $1 - \frac{a}{n} = \frac{n-a}{n} = \frac{d}{n}$.

2°. Si B ad jactum suum perveniat, ejus expectatio ex jactu ipsius oriunda, erit $\frac{b}{n}$; sed quoniam incertum est utrum ille ad jactum suum sit perventurus nec ne, expectatio $\frac{b}{n}$ minuenda est in ratione d ad n; Etenim præmium illius respectu, non 1, sed tantummodo $\frac{d}{n}$ censendum est, adeoque expectatio ipsius B priusquam A jactum suum instituat, erit $\frac{bd}{nn}$; subtrahatur $\frac{bd}{nn}$ ex $\frac{d}{n}$, & valor residuarum expectationum erit $\frac{d}{n} - \frac{bd}{nn} = \frac{nd-bd}{nn} = \frac{ed}{nn}$.

3°. Eodem argumentandi modo, expectatio ipsius B huic novissimæ deinceps subsequens, est $\frac{bed}{n^3}$.

4°. Et

14. *Bobart's* Venice *Chamomil* Ray 3. p. 223. 15.
Cotula Veneta *Sophiæ* folio *Nobis.*
Chamæmelum annuum ramosum *Cotulæ fœtidæ* fol. ampliori-
bus capitulis spinosis *Bob.* H. Ox. 3. p. 36. 12. *Sect.*
VI. Tab. 8. fig.

We are obliged to Mr. *Jacob Bobart* for the first Knowledge of this Plant.

15. *Distaff-Thistle* Ray 304. 4.
Atractylis *Offic.* Dale 168. 3. *Ger.* 1008. Ic. 1. *Jonst.* 1171.
Ic. 1.
Atractylis lutea C. B. 379. 1. fl. luteo *Park.* 963. Ic. 1.
Atractylis *veterum* f. vera, fl. luteo *Chabr.* 353. Ic. 4. I B. 3. l.
25. p. 85. fig.
Atractylis *Theophrasti* & *Dioscor.* sanguineo succo *Col.* 19.
fig. 23.

Mr. *Ray* has given a large *Description* of this *Thistle* p. 304. from the accurate *Columna,* and it is remarkable for its bloody Juice.

Its said to have the same *Vertues* with the *Carduus Benedictus.*

Grows in *France, Spain* and *Italy* as also about *Geneva* in Path-ways and Borders of Fields.

16. Cobweb *Distaff-Thistle.*
Atractylis ramulis araneosis.
an *Chameleon* niger verus *Park.*?

This differs from the *Distaff-Thistle* in having its upper Stalks woolly like *Cobwebs.* It was many Years since raised in Mr. *Charles Dubois* his Garden at *Mitcham,* from Seed I gave him brought me by Mr. *Samuel Daniel,* Surgeon, from the *Island* Coos.

17. *Clusius* his *Salamanca* Welted Thistle, Ray 315.
Acarna major caule folioso C B. 379. 6. *Park.* 966. f. 6.
Acarnæ similis fl. purp. *Chameleon* Salmant *Clus.* I. B. 3. l.
25. p. 91. fig. *Chabr.* 155. Ic. 6.
Chameleon *Salmanticensis* Clus. *Hist.* 155. f. 1. *Jonst.* 1160.
fig. 2.

Clusius

Cluſius firſt obſerved this about *Salamanca* in *Spain*, it hath ſince been found in *Languedoc* and other places.

18. *Theophraſtus* his *Fiſh Thiſtle* Ray 315. 4. *Dale* Suppl. 74. 4.

Acarna *Theophraſti* Ger. 1012. fig. 7. Jonſt. 1175. f. 7.

Acarna di *Theophraſto* Imperati 669. fig. opt.

Acarna major caule non folioſo C. B. 273. 7. *Park.* 966. f. 7.

Acarna *Theophr.* Imperati *Ilvenſis* ſ. *Italica* Barrel. 912. Ic. 1211.

Acarnæ ſimilis, *Carduus* polyacanthus *Chabr.* 356. Ic. 2.

Polyacanthus Cauſabona *Acarnæ* ſimilis I. B. 3. l. 25. p. 92. fig.

Imperatus his *Figure*, which *Barrelier* has copied, very well repreſents this elegant Thiſtle. *Chabr.* & I B. are alſo better than *Lobel*'s, which *Park.* and moſt others have followed.

Grows on the Hills, North of *Rio* near the Iron Mines in the Iſland of *Ilva.*

19. Dwarf *Narbone* Artichoke. Ray 329. 29.

Centaurium majus incanum humile, cap. *Pini.* El. Bot. 355. *Inſtit.* 449.

Chameleon non aculeatus *Lob.* Ic. p. 2. *p.* 7. *Ad.* 367. fig.

Jacea montana incana *Pini* capite C. B. 272.

- humilis mont. cap. *Pino* ſimili C. B. phyt. 531. 13.

Jacea pumila *Narbonenſis* Park. 471. fig. 6.

Jacea mont. capite magno *Stroboli* I. B. 3. l. 25. p. 30. fig. Chabr. 343. *Ic.* 3.

Stœbe *Pinea* amplo capite *Barrel.* 970. Ic. opt. 138.

Some of the bottom *Leaves* of this are whole, which are not expreſt in any Figure yet extant. I have received very fair Specimens of this elegant Plant from that *Accurate Botaniſt* Dr. *John Salvadore* at *Barcelona*. It *Grows* plentifully about *Narbone* and *Montpelier*, where it *Flowers* in *June*, as it did this Summer in *Chelſea* Garden.

Quoniam autem 4 ſunt caſus quibus 3 albi ex 4 poſſint eligi, multiplicetur 70 per 4, adeoque caſus erunt 280, quibus 3 albi cum 4 nigris poſſint eximi.

3°. Ex lege ludorum, ille qui in ſe ſuſcipit ut effectum aliquem producat, etiamnum victor cenſetur, ſi effectum pluries produxerit quam in ſe ſuſceperit, niſi contrarium expreſſe ſit cautum, adeoque ſi 4 albi cum 3 nigris eximantur, A victor cenſendus erit; Igitur ſeponantur 4 albi, & inveniantur caſus omnes quibus 3 nigri ex 8, 4 albis adjungi poſſint; caſus illi erunt 56.

$$\frac{8}{1} \times \frac{7}{2} \times \frac{6}{3} = 56.$$

4°. Igitur A caſus habet $280 + 56 = 336$, quibus victor evadat : Subtrahantur caſus illi ex 792, & caſus reſidui erunt 456 quibus B victor evadere poſſit : Ergo ratio ſortis ipſius A, ad ſortem ipſius B, erit ut 336 and 456, ſive ut 14 ad 19.

GENERALITER.

Sit n numerus calculorum omnium, a numerus alborum, b numerus nigrorum, c numerus quem A eximat; & erit:

Numerus Caſuum omnium

$$\frac{n}{1} \times \frac{n-1}{2} \times \frac{n-2}{3} \times \frac{n-3}{4} \times \frac{n-4}{5} \times \frac{n-5}{6} \text{ &c.}$$ quæ ſeries continuari debet ad tot terminos quot ſunt unitates in c.

Numerus caſuum quibus A calculos c eximere poteſt abſque ullo albo

$$\frac{b}{1} \times \frac{b-1}{2} \times \frac{b-2}{3} \times \frac{b-3}{4} \times \frac{b-4}{5} \times \frac{b-5}{6} \text{ &c.}$$

Numerus caſuum quibus A calculum unum album eximere poteſt

$$\frac{b}{1} \times \frac{b-1}{2} \times \frac{b-2}{3} \times \frac{b-3}{4} \times \frac{b-4}{5} \text{ &c.} \times \frac{a}{1}.$$

Numerus

Numerus casuum quibus A calculos duos albos eximere potest

$$\frac{b}{1} \times \frac{b-1}{2} \times \frac{b-2}{3} \times \frac{b-3}{4} \text{ &c. } \times \frac{a}{1} \times \frac{a-1}{2}.$$

Numerus casuum quibus A calculos tres albos eximere potest

$$\frac{b}{1} \times \frac{b-1}{2} \times \frac{b-2}{3} \text{ &c. } \times \frac{a}{1} \times \frac{a-1}{2} \times \frac{a-2}{3}.$$

Numerus casuum quibus A calculos quatuor albos eximere potest

$$\frac{b}{1} \times \frac{b-1}{2} \text{ &c. } \times \frac{a}{1} \times \frac{a-1}{2} \times \frac{a-2}{3} \times \frac{a-3}{4}.$$

Et sic deinceps.

PROB. XV.

A, B, C, *tres collusores, quorum dexteritas sint æquales, deponant singuli* 1, *& istis conditionibus certent* ; 1°. *Ut illorum duo ludum incipiant* ; 2°. *Ut victus locum suum tertio cedat, ita ut ille tertius jam cum victore contendat, quæ conditio in posterum semper sit observanda* ; 3°. *Ut victus semper multetur summa* p *quæ depositio augendo inserviat* ; 4°. *Ut ille depositum sic gradatim auctum, totum obtineat, qui alteros duos successive vicerit. Quæritur quanto melior vel deterior sit sors ipsorum* A *&* B, *quos ludum incipere ponimus, quam ipsius* C.

SOLUTIO.

Ponatur ludum in infinitum continuari posse, hoc pacto.

A vin-

A vincit B		$3 + p$
C vincit A		$3 + 2p$
B vincit C		$3 + 3p$
A vincit B		$3 + 4p$
C vincit A		$3 + 5p$
B vincit C	Depositum	$3 + 6p$
A vincit B		$3 + 7p$
C vincit A		$3 + 8p$
B vincit C		$3 + 9p$
&c.		&c.

Sit R spectator aliquis, qui postquam A vicerit B semel, roget A an velit summas quas se obtenturum sperat ipsi vendere, & quanti illas æstimet, cui A annuens respondeat.

Cum jam vicerim B, est mihi æqua sors utrum obtineam vel non obtineam $3 + 2p$, adeoque summa ista valet $\frac{3+2p}{2}$.

Si jam acciderit ut C me vincat, sed tamen vices meæ certandi cum C revertantur, erit tunc mihi sors æqua utrum obtineam, vel non obtineam $3 + 5p$, adeoque expectatio vincendi ipsum C tunc temporis valebit $\frac{3+5p}{2}$. Sed cum sint 7 adversus 1 fore ut vices illæ non revertantur (etenim C vincere me debet, B vincere C, ego B rursus,) summa ista quam me obtenturum spero valet $\frac{3+5p}{2\times 8}$.

Ad eundem modum, A computatione rursus inita deprehendet, valorem deinceps summæ quam se obtenturum sperat, esse $\frac{3+8p}{2\times 8\times 8}$.

Et sequentis $\frac{3+11p}{2\times 8\times 8\times 8}$. Et sic in infinitum.

R com-

R computationem hanc juſtam eſſe comperiens, pendat ipſi A ſummas, $\frac{3+2p}{2}$, $\frac{3+5p}{2\times 8}$, $\frac{3+8p}{2\times 8\times 8}$, $\frac{3+11p}{2\times 8\times 8\times 8}$, &c. quæ ope ſequentis Theorematis in ſummam unam redigantur.

THEOREMA.

$$\frac{n}{b}+\frac{n+d}{bb}+\frac{n+2d}{b^3}+\frac{n+3d}{b^4}\ \&c.\ \text{ad inf.}=\frac{n}{b-1}+\frac{d}{b-1^2}.$$

Diſtinguatur ſeries $\frac{3+2p}{2}+\frac{3+5p}{2\times 8}$ &c. in partes duas

$$\frac{3}{2}\times\overline{1+\frac{1}{8}+\frac{1}{8\times 8}+\frac{1}{8\times 8\times 8}+\frac{1}{8\times 8\times 8\times 8}\ \&c.}$$

$$+\frac{p}{1}\times\overline{2+\frac{5}{8}+\frac{8}{8\times 8}+\frac{11}{8\times 8\times 8}+\frac{14}{8\times 8\times 8\times 8}\ \&c.}$$

Pars 1ª conſtituit progreſſionem geometricam, cujus ſumma eſt $\frac{12}{7}$.

Pars 2ª ſepoſitis communi multiplicatore $\frac{p}{2}$, & termino primo 2, ſummatur per Theorema præmiſſum, & fit $\frac{5}{7}+\frac{3}{49}=\frac{38}{49}$, cui jam addito primo 2, ſumma erit $\frac{136}{49}$, qua multiplicata per $\frac{p}{2}$, productum $\frac{68}{49}p$, exhibebit ſummam ſecundæ ſeriei. Ergo R pendet ipſi A $\frac{12}{7}+\frac{68}{49}p$.

Eodem modo R ad B ſe convertens, illum roget utrum velit ſummas quas ille ſe obtenturum ſperat, ipſi vendere, cui B aſſentiens, & eadem innixus ratione qua ipſe A, requirat ſummam $\frac{3}{7}+\frac{31}{49}p$, quam R juſtam eſſe deprehendens, ipſi B pendat.

Denique R eodem cum C pacto inito, pendat ipſi pro ſummis quas ille ſe obtenturum ſperat, $\frac{6}{7}+\frac{48}{49}p$.

Sit S ſpectator alius, quem A roget (poſtquam vicerit B ſemel) utrum velit ipſius jacturas ſuſtinere, hoc eſt utrum velit multari ſummis p, pro ipſo A, quoties acciderit ut ipſe ſit multandus, & quanto pretio velit hanc in ſe ſortem ſuſcipere, cui S reſpondeat.

Quoniam tibi ſors eſt æqua utrum vincas C vel non, adeoque utrum multeris ſumma p, vel non, hujus multæ ſortem, ſi in manum mihi dederis $\frac{1}{2}p$, ſuſtinebo.

Quod ſi illud evenerit ut C ite vincat, & B vincat C, adeo ut ſecunda vice tibi cum C certandum ſit, tunc multæ ejuſdem ſortem ſi dederis mihi $\frac{1}{2}p$, pariter ſuſtinebo: Verum cum ſint 3 adverſus 1 fore ut illud non eveniat, hujus multæ ſortem, nunc ſi mihi in manum dederis $\frac{1}{8}p$, ſuſtinebo.

Et eodem argumentandi modo, huic proximam ſortem ſi mihi dederis $\frac{1}{16}p$.

Et huic deinceps proximam, ſi dederis $\frac{1}{64}p$, &c.

Jam A ipſi S aſſentiens, tradat ipſi S ſummas, $\frac{1}{2}p * + \frac{1}{8}p + \frac{1}{16}p * + \frac{1}{64}p + \frac{1}{128}p * + \frac{1}{512}p + \frac{1}{1024}p$, &c. quæ ſummæ in unam redactæ fiunt $\frac{5}{7}p$.

Et eodem modo B & C pacto inito cum S, ipſi tradant $\frac{3}{7}p$ & $\frac{6}{7}p$, reſpective, ut ſuas multarum ſortes ſuſtineat.

A recipit ab R $\frac{12}{7} + \frac{68}{49}p$.

A tradit ipſi S $\frac{35}{49}p$.

Ipſi A ſupereſt $\frac{12}{7} + \frac{33}{49}p$.

Sed A depoſuerat 1, priuſquam ludus inciperetur: Ergo lucratur A $\frac{5}{7} + \frac{33}{49}p$.

B reci-

B recipit ab R $\frac{3}{7} + \frac{31}{49} p.$

B tradit ipſi S $\frac{21}{49} p = \frac{3}{7} p.$

Ipſi B ſupereſt $\frac{3}{7} + \frac{10}{49} p.$

Sed B depoſuerat $1 + p$, (videlicet 1 priuſquam ludus inciperetur, & p poſtquam ſemel victus fuerat ab A,) ergo B lucratur $- \frac{4}{7} - \frac{39}{49} p.$

Summa igitur lucrorum ipſorum A & B eſt $\frac{1}{7} - \frac{6}{49} p.$

Jam poſueramus A viciſſe ipſum B ſemel, priuſquam colluſores pacta inirent cum R & S; ſed priuſquam ludus inchoaretur, B poterat æqua ſorte expectare ut vinceret ipſum A; adeoque ſumma lucrorum $\frac{1}{7} - \frac{6}{49} p$ in duas partes æquales dividenda, adeo ut utriuſque lucrum cenſendum ſit $\frac{1}{14} - \frac{3}{49} p.$

Ergo concludere jam licet, jacturam ipſius C, eſſe $\frac{1}{7} - \frac{6}{49} p$, ſive lucrum $- \frac{1}{7} + \frac{6}{49} p.$

Sed ut corroboretur computatio noſtra, videamus quale futurum ſit lucrum ipſius C, eadem methodo qua uſi fuimus pro invienendis lucris ipſorum A & B.

C recipit ab R $\frac{6}{7} + \frac{48}{49} p.$

C tradit ipſi B $\frac{42}{49} p.$

Ipſi C ſupereſt $\frac{6}{7} + \frac{6}{49} p.$

Sed C depoſuerat $\frac{7}{7}$

Ergo C lucratur $- \frac{1}{7} + \frac{6}{49} p.$

Jam

Jam fiat $\frac{1}{7} - \frac{6}{49}p = 0$, & invenietur $p = \frac{7}{6}$, ergo si multa ad ſummam quam ſinguli deponunt ſit ut 7 ad 6, colluſores æquali conditione certant.

Si multa ſit ad ſummam quam ſinguli deponunt in minori ratione quam 7 ad 6, A & B potiori conditione certabunt, C deteriori.

Si multa ſit ad ſummam quam ſinguli deponunt in majori ratione quam 7 ad 6, A & B deteriori conditione certant, C potiori.

COROL. I.

Poſtquam A vicerit B ſemel, probabilitates vincendi erunt ut $\frac{12}{7}$, $\frac{6}{7}$, $\frac{3}{7}$, ſive ut 4, 2, 1; ita ut maxima probabilitas ſit ipſius A, proxima ipſius C, minima ipſius B.

COROL. II.

Spectator R priuſquam ludus inchoetur, id ſuſcipere in ſe poterit, ut ſumma 3 de qua colluſores contendunt, & multas omnes pendat, ſi ſibi initio in manus datum ſit $3 + 3p$.

COROL. III.

Si dexteritates colluſorum ſint in ratione data, ſortes colluſorum eadem ratiocinatione determinabuntur.

COROL. IV.

Si multa ſit negativa, ita ut victus portiunculam depoſiti 3 ſumat, v. g. $\frac{3}{10}$, & ludus ſit finiendus ſtatim atque depoſitum exhauſtum fuerit, ſortes colluſorum eadem ratiocinatione determinabuntur.

COROL. V.

Si plures ſint colluſores, A, B, C, D, &c. & non prius ludo deſiſtant quam illorum unus alios omnes ſucceſſive vicerit, ratio ſortium etiam invenietur.

COROL.

COROL. VI.

Si multa non ſit definita, ſed continuo creſcat vel decreſcat, qua libuerit lege, ratio ſortium etiam determinabitur, ſi non per expreſſiones finitas, at ſaltem per ſeries ad verum perpetuo convergentes.

PROB. XVI.

A & B, *quorum dexteritates ſint æquales inter ſe, dato Globorum numero certent; jam poſt ludos aliquot peractos, deſit ipſi* A *ludus* 1 *quominus victor evadat, ipſi* B *vero* 2 : *Quæritur ratio illorum ſortium.*

SOLUTIO.

Sit m numerus globorum omnium, ita ut uterque habeat $\frac{1}{2}m$; ſit p numerus caſuum quibus duo vel plures ex globis ipſius B propius ad metam accidere poſſint; ſit q numerus caſuum quibus unus vel plures ex globis ipſius B propius ad metam accidere poſſint, adeo ut $q-p$ ſit numerus caſuum quibus unus ex globis ipſius B (excluſive pluribus) poſſit ad metam propius accidere; ſit s numerus variationum omnium quas globi omnes ſubire poſſint; ſit 1 depoſitum totum.

Patet B habere caſus p quibus obtineat 1, & caſus $q-p$ quibus obtineat $\frac{1}{2}$, adeoque illius expectationem eſſe $\frac{p+\frac{1}{2}q-\frac{1}{2}p}{s} = \frac{\frac{1}{2}p+\frac{1}{2}q}{s}$.

Jam conſtat ex Doctrina combinationum, globos omnes m variari poſſe vicibus, $m \times \overline{m-1} \times \overline{m-2} \times \overline{m-3}$, &c. quæ ſeries continuari debet, donec ultimus terminus fiat æqualis unitati, adeoque eſſe $s = m \times \overline{m-1} \times \overline{m-2} \times \overline{m-3}$ &c.

Conſtat ex eadem Doctrina globos numero $\frac{1}{2}m$, poſſe permutari binos, vicibus $\frac{1}{2}m \times \frac{1}{2}\overline{m-1}$, dum globi reliqui omnes

 ipſorum

ipsorum A & B, quorum numerus $m-2$ possunt variari vicibus $\overline{m-2} \times \overline{m-3} \times \overline{m-4}$, &c. adeoque esse $p = \frac{1}{2}m \times \overline{\frac{1}{2}m-1} \times \overline{m-2} \times \overline{m-3} \times \overline{m-4}$, &c. Igitur $s : p :: m \times \overline{m-1} : \frac{1}{2}m \times \frac{1}{2}\overline{m-1} :: m-1 : \frac{1}{4}m - \frac{1}{2}$, & $p = \frac{\frac{1}{2}ms - \frac{1}{2}s}{m-1}$.

Liquet globos numero $\frac{1}{2}m$, posse sumi sigillatim vicibus $\frac{1}{2}m$, dum globi reliqui omnes ipsorum A & B quorum numerus $m-1$, variari possunt vicibus $\overline{m-1} \times \overline{m-2} \times \overline{m-3} \times \overline{m-4}$, &c. adeoque esse $s : q :: m : \frac{1}{2}m :: 1 : \frac{1}{2}$. Est igitur $q = \frac{1}{2}s = \frac{\frac{1}{2}ms - \frac{1}{2}s}{m-1}$.

Ergo $\frac{\frac{1}{2}p + \frac{1}{2}q}{s} = \frac{\frac{3}{8}m - \frac{1}{2}}{m-1}$, subtrahatur hoc ex 1, & residuum $\frac{\frac{5}{8}m - \frac{1}{2}}{m-1}$ erit expectatio ipsius A, adeoque ratio sortium ipsorum A & B erit ut $\frac{5}{8}m - \frac{1}{2}$ ad $\frac{3}{8}m - \frac{1}{2}$, sive ut $5m-4$ ad $3m-4$.

COROL. I.

Si numerus globorum esset infinitus, ratio sortium fieret tandem ut 5 ad 3.

COROL. II.

Si dexteritates sint in ratione data, ratio sortium eadem ratiocinatione invenietur.

PROB.

PROB. XVII.

A & B quorum dexteritates sint æquales inter se, dato globorum numero certent; jam post ludos aliquot peractos, desit ipsi A *ludus* 1 *quominus victor evadat, ipsi vero* B 3: *Requiritur ratio sortium ipsorum* A *&* B.

SOLUTIO.

Sit ut in præcedenti Problemate m numerus globorum omnium; sit r numerus casuum quibus 3 vel plures ex globis ipsius B ad metam propius accidere possint, p numerus casuum quibus 2 vel plures, q numerus casuum quibus 1 vel plures propius ad metam possint accidere; sit s numerus variationum omnium quas globi omnes possint subire.

Ergo B casus habet r quibus obtineat 1, casus $p-r$ quibus obtineat $\frac{1}{2}$, & casus $q-p$ quibus obtineat $\frac{3m-4}{8m-8}$, ut patet ex præcedenti, adeoque summa illius expectationum erit $\frac{r\times 1+\overline{p-r}\times\frac{1}{2}+\overline{q-p}\times\frac{3m-4}{8m-8}}{s}=\frac{\frac{1}{2}r+\frac{1}{2}p+\overline{q-p}\times\frac{3m-4}{8m-8}}{s}$.

Jam globi numero $\frac{1}{2}m$ possunt permutari terni, vicibus $\frac{1}{2}m\times\overline{\frac{1}{2}m-1}\times\overline{\frac{1}{2}m-2}$, dum globi omnes reliqui ipsorum A & B quorum numerus $m-3$, possunt variari vicibus $\overline{m-3}\times\overline{m-4}$, &c. Igitur est $r=\frac{1}{2}m\times\overline{\frac{1}{2}m-1}\times\overline{\frac{1}{2}m-2}\times\overline{m-3}\times\overline{m-4}$, &c. Sed est $s=m\times\overline{m-1}\times\overline{m-2}\times\overline{m-3}\times\overline{m-4}$, &c. ergo $r=\frac{\frac{1}{8}ms-\frac{1}{2}s}{m-1}$.

Sed ex precedenti Problemate est $p=\frac{\frac{1}{4}ms-\frac{1}{2}s}{m-1}$, & $q=\frac{\frac{1}{2}ms-\frac{1}{2}s}{m-1}$.

Sub-

Subſtitutis igitur valoribus iſtis pro r, p, q, fiet expectatio ipſius B $= \frac{9mm - 26m + 16}{32mm - 64m + 32}$. Subtrahatur hæc ab 1, & erit expectatio ipſius A $= \frac{23mm - 38m + 16}{32mm - 64m + 32}$; adeoque ratio ſortium ipſorum A & B, erit ut $23mm - 38m + 16$ ad $9mm - 26m + 16$, quæ convenit numero globorum cuicunque, binario excepto.

Verum ut ratio ſortium ipſorum A & B quum ſingulis globis certant, ſive quum numerus globorum eſt 2, inveniatur; reſumatur expreſſio generalis expectationis ipſius B, videlicet $\frac{\frac{1}{2}r + \frac{1}{2}p + \overline{q - p} \times \frac{3m-4}{8m-8}}{s}$, & ponantur r & $p = 0$, & erit expectatio ipſius B $= \frac{q \times \frac{3m-4}{8m-8}}{s} = \frac{\frac{1}{2}m - \frac{1}{2}}{m - 1} \times \frac{3m - 4}{8m - 8} = \frac{1}{2} \times \frac{1}{8} = \frac{1}{8}$, qua ſubſtracta ex 1, erit expectatio ipſius A $= \frac{7}{8}$, ergo ratio ſortium ipſorum A & B hoc in caſu erit ut 7 ad 1, quod aliunde conſtat ex principiis jamdudum expoſitis.

COROL. I.

Si numerus globorum eſſet infinitus, ratio ſortium fieret tandem ut 23 ad 9.

COROL. II.

Si deſint ipſi A ludi quotvis quominus victor evadat, & ipſi B ludi itidem quotvis, ratio ſortium eadem ratiocinatione invenietur.

COROL. III.

Si dexteritates ſint in ratione data, ratio ſortium etiam invenietur.

PROB.

PROB. XVIII.

Certet A *cum* B, *fore ut ipſe, dato tentaminum numero, teſſera dato facierum numero conſtante, facies quaſcunque datas jecerit : Quæritur expectatio ipſius* A.

SOLUTIO.

Sit $p+1$ numerus facierum in teſſera, n numerus tentaminum datus, f numerus facierum quas jaci oporteat.

Numerus caſuum quibus A monada ſemel vel pluries, tentaminibus numero n, jacere poſſit, eſt $\overline{p+1}|^n - p^n$, ut patet ex jam demonſtratis.

Expungatur binarius e numero facierum, ita ut numerus facierum reducatur ad p; & erit numerus caſuum quibus A monada ſemel vel pluries, tentaminibus numero n, jacere poſſit $p^n - \overline{p-1}|^n$.

Ergo, jam reſtituto binario, numerus caſuum quibus A monada & binarium jacere poſſit, eſt differentia iſtorum caſuum, videlicet $\overline{p+1}|^n - 2p^n + \overline{p-1}|^n$.

Expungatur nunc ternarius, & erit numerus caſuum quibus A monada & binarium jacere poſſit, $p^n - 2 \times \overline{p-1}|^n + \overline{p-2}|^n$.

Ergo, jam reſtituto ternario, numerus caſuum quibus A monada, binarium, & ternarium jacere poſſit, eſt $\overline{p+1}|^n - 3 \times p^n + 3 \times \overline{p-1}|^n - \overline{p-2}|^n$. Et ſic deinceps de cæteris.

Scribantur ergo ordine poteſtates omnes, (mutatis alternatim ſignis) $\overline{p+1}|^n - p^n + \overline{p-1}|^n - \overline{p-2}|^n + \overline{p-3}|^n$ &c. Et præfigantur illis coefficientes poteſtatis deſignatæ per f, & ſumma terminorum erit numerator expectationis ipſius A, cujus denominator erit $\overline{p+1}|^n$.

EXEMP. I.

Sit 6 numerus facierum in teſſera, & 2 numerus facierum datarum quas jaci oporteat tentaminibus 8, & erit expectatio ipſius A, $\frac{6^8 - 2 \times 5^8 + 4^8}{6^8}$.

EXEMP. II.

Sit 6 numerus facierum in teſſera, & 6 numerus facierum quas jaci oporteat tentaminibus 12, & erit expectatio ipſius A, $\frac{6^{12} - 6 \times 5^{12} + 15 \times 4^{12} - 20 \times 3^{12} + 15 \times 2^{12} - 6 \times 1^{12}}{6^{12}}$.

EXEMP. III.

Contendat A cum B fore ut ipſe, tentaminibus numero 43, teſſera faciebus 36 conſtante, facies duas datas jecerit, ſive ut binis teſſeris vulgaribus jecerit duas monadas ſimul, atque etiam duos binarios ſimul, & erit expectatio ipſius A $\frac{36^{43} - 2 \times 35^{43} + 34^{43}}{36^{43}}$.

N. B. Facilis erit additio & ſubtractio partium ex quibus expectationes iſtæ componuntur, ope Tabulæ Logarithmorum.

PROB. XIX.

Invenire quotenis tentaminibus futurum ſit probabile ut colluſorum alter A *facies quaſcunque datas jaciat, teſſera conſtante dato facierum numero.*

SOLUTIO.

Sit ut prius $p + 1$ numerus facierum in teſſera, n numerus tentaminum datus, f numerus facierum quæſitus. Ponatur

$\text{Log.} \frac{1}{1 - \sqrt[f]{\frac{1}{2}}} = \alpha$, & $\text{Log.} \frac{p+1}{p} = \beta$, & erit $n = \frac{\alpha}{\beta}$ prope.

DE-

DEMONSTRATIO.

Si numerus facierum quas jaci oporteat fit 6, expectatio ipsius A erit $\frac{\overline{p+1}|^n - 6p^n + 15\times\overline{p-1}|^n - 20\times\overline{p-2}|^n + 15\times\overline{p-3}|^n - 6\times\overline{p-4}|^n + \overline{p-5}|^n}{\overline{p+1}|^n}$

Fingatur terminos $p+1$, p, $p-1$, $p-2$, &c. esse in progressione Geometrica, quæ suppositio non multum a vero aberrabit, si præsertim p ad 1 habuerit rationem satis magnam, & ponatur $\frac{p^n}{\overline{p+1}|^n} = \frac{1}{r^n}$; ergo expectatio ipsius A erit

$$1 - \frac{6}{r^n} + \frac{15}{r^{2n}} - \frac{20}{r^{3n}} + \frac{15}{r^{4n}} - \frac{6}{r^{5n}} + \frac{1}{r^n} = \frac{1}{2}.$$

Extrahatur utrinque radix sexta, & fiet $1 - \frac{1}{r^n} = \sqrt[6]{\frac{1}{2}}$,

ergo $r^n = \frac{1}{1-\sqrt[6]{\frac{1}{2}}}$, ponatur jam Log. $r = \beta$, & Log. $\frac{1}{1-\sqrt[6]{\frac{1}{2}}} = \alpha$, & erit $n\beta = \alpha$, adeoque $n = \frac{\alpha}{\beta}$, & eadem erit demonstratio de cæteris casibus.

Si sit aliqua suspicio ne valor indicis n sic inventus non sit satis accuratus, tunc substituatur valor iste pro n, & notetur error, tunc mutetur aliquantulum valor iste, & notetur novus error, & ope duorum errorum valor indicis n satis accurate corrigetur, si Regula falsi adhibeatur.

Potest valor indicis n sic inventus corrigi per seriem infinitam, ex natura Problematis depromptam, talem ut primus terminus hujus seriei sit valor iste quem assignavimus; sed correctio per differentiam errorum sufficit ad usus practicos.

EXEMP. I.

Invenire quotenis jactibus vulgaris tesseræ, probabile sit ut A facies omnes jaciat.

Log.

Log. $\frac{1}{1-\sqrt[6]{\frac{1}{2}}}$ = 0.9621753, Log. $\frac{6}{5}$ = 0.0791812,

ergo $n = \frac{0.9621753}{0.0791812} = 12+$. Ergo concludere jam licet numerum jactuum quæsitum fore 12 circiter, si vero 12 substituatur pro n in æquatione casui huic competente, invenietur expectatio ipsius A .437 prope, quæ aliquanto debita nempe .5 minor est; ergo ponatur 13 pro n, & invenietur expectatio ipsius A .513, quæ est debita major; ergo poterit A in se suscipere ut facies omnes tentaminibus 13 jaciat, idque potiori conditione.

EXEMP. II.

Invenire quotenis tentaminibus futurum sit probabile ut A tessera faciebus 216 constante, facies sex datas jaciat, sive ut tribus tesseris vulgaribus * *Triadas* omnes jaciat.

Log. $\frac{1}{1-\sqrt[6]{\frac{1}{2}}}$ = 0.9621753, Log. $\frac{216}{215}$ = 0.0020152, ergo $n = \frac{0.9621753}{0.0020152} = 477$ prope.

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* *Raffles.*

DE

DE
Duratione Ludorum.

PROB. XX.

A & B *quorum dexteritates sint in ratione data, videlicet, ut* a *ad* b, *ea conditione ludant, ut quoties* A *ludum unum vicerit,* B *tradat ipsi nummum unum; quoties vero* B *vicerit,* A *ipsi tradat nummum unum: & non prius ludo desistant, quam eorum alter nummos omnes alterius lucratus fuerit. Adstent vero spectatores duo* R & S, *quorum* R *affirmet certamen finitum iri intra datum ludorum numerum,* S *neget: Quæritur expectatio ipsius* S.

SOLUTIO.

Casus I.

Sit 2 numerus nummorum quos uterque colluforum habeat; sit etiam 2, numerus de quo R & S contendant: Jam propter 2, numerum ludorum de quo contenditur, elevetur $a + b$ ad potestatem 2, quæ erit $aa + 2ab + bb$: terminus $2ab$ ipsi S favet, reliqui adversantur, adeoque illius expectatio erit $\frac{2ab}{a+b|^2}$.

Casus II.

Sit 2 numerus nummorum quos uterque colluſorum habeat, & ſit 3 numerus ludorum de quo R & S contendant; elevetur itaq; $a+b$ ad poteſtatem 3^{am}, quæ erit $a^3+3aab+3abb+b^3$. Jam termini duo $+a^3+b^3$, omnino ipſi S adverſantur, reliqui duo $3aab+3abb$, partim favent, partim adverſantur; dividantur ergo termini iſti in partes ſuas, videlicet $3aab$ in aab, aba, baa, atque $3abb$ in abb, bab, bba, & partes $aba+baa+abb+bab$, ſive $2aab+2abb$ ipſe S favent, reliquæ adverſantur. Adeoque expectatio ipſius S erit $\frac{2aab+2abb}{a+b|^3}$, ſive (diviſis numeratore & denominatore per $a+b$) $\frac{2ab}{a+b|^2}$, quæ eadem eſt ac in caſu præcedenti.

Casus III.

Sit 2 numerus nummorum quos uterque colluſorum habeat, & 4 numerus ludorum de quo ſpectatores contendant; elevetur itaque $a+b$ ad poteſtatem 4^{am}, quæ erit $a^4+4a^3b+6aabb+4ab^3+b^4$; termini $a^4+4a^3b+4ab^3+b^4$ omnino ipſi S adverſantur, terminus unicus $6aabb$ partim favet, partim adverſatur: dividatur ergo terminus iſte in partes ſuas, $aabb$, $abab$, $abba$, $baab$, $baba$, $bbaa$, & partes quatuor, $abab$, $abba$, $baab$, $baba$, ſive $4aabb$, ipſi S favent; adeoque illius expectatio erit $\frac{4aabb}{a+b|^2}$.

Casus IV.

Sit 2 numerus nummorum quos uterque colluſorum habeat, & 5 numerus ludorum de quo ſpectatores contendant, & expectatio ipſius S invenietur eadem ac in præcedenti caſu.

Casus

Casus V.

Sit 2 numerus nummorum quos uterque colluſorum habeat, & 6 numerus ludorum de quo ſpectatores contendant, & expectatio ipſius S invenietur $\frac{8a^3b^3}{\overline{a+b}|^6}$.

Generalius.

Sit 2 numerus nummorum quos uterque colluſorum habeat, & $2+d$ numerus ludorum de quo ſpectatores contendant, erit $\frac{\overline{2ab}|^{1+\frac{1}{2}d}}{\overline{a+b}|^{2+d}}$ expectatio ipſius S.

Ubi nota d numerum eſſe parem; quod ſi d ſit numerus impar, expectatio ipſius S eadem erit ac ſi numerus ille unitate eſſet diminutus.

Casus VI.

Sit 3 numerus nummorum quos uterque colluſorum habeat, & $3+d$ numerus ludorum de quo ſpectatores contendant, & invenietur expectatio ipſius $S = \frac{\overline{3ab}|^{1+\frac{1}{2}d}}{\overline{a+b}|^{2+d}}$.

Ubi nota d numerum eſſe parem; quod ſi d ſit numerus impar, expectatio ipſius S eadem erit ac ſi numerus ille unitate eſſet diminutus.

Casus VII.

Sit 4 numerus nummorum quos uterque colluſorum habeat, & 4 numerus ludorum de quo ſpectatores contendant, & invenietur expectatio ipſius S $\frac{4a^3b+6aabb+4ab^3}{\overline{a+b}|^4}$.

Casus

Casus VIII.

Sit 4 numerus nummorum quos uterque colluſorum habeat, & 6 numerus ludorum de quo ſpectatores contendant, & invenietur expectatio ipſius S $\frac{14a^4bb+20a^3b^3+14aab^4}{\overline{a+b}|^6}$.

Tabula expectationum ipſius S, pro numero nummorum 4.

4. $\left|\ \frac{4a^3b+6aabb+4ab^3}{\overline{a+b}|^4}\right.$

6. $\left|\ \frac{14a^4bb+20a^3b^3+14aab^4}{\overline{a+b}|^6}\right.$

8. $\left|\ \frac{48a^5b^3+68a^4b^4+48a^3b^5}{\overline{a+b}|^8}\right.$

10. $\left|\ \frac{164a^6b^4+232a^5b^5+164a^4b^6}{\overline{a+b}|^{10}}\right.$

12. $\left|\ \frac{560a^7b^5+792a^6b^6+560a^5b^7}{\overline{a+b}|^{12}}\right.$

&c.

Tabula iſte facile continuabitur, ſi ſequentia adnotentur.

1°. Coefficientem termini primi in quolibet numeratore eſſe ſummam coefficientem terminorum omnium in numeratore præcedenti. 2°. Coefficientem termini ſecundi eſſe aggregatum ſummæ iſtius, & coefficientis termini ſecundi præcedentis. 3°. Coefficientem termini tertii eundem eſſe, ac coefficientem termini primi. 4°. Producta literalia, ex præcedentibus, prima ex primis, ſecunda ex ſecundis, formari, multiplicatis præcedentibus per *ab*. 5°. Denominatores omnes eſſe poteſtatem illam binomii $a+b$, quæ deſignatur per numerum ludorum de quo R. & S contendunt.

Hic

Hic obiter venit obſervandum coefficientes omnes, primi ex primis, ſecundi ex ſecundis, generati poſſe. Etenim ſi ex ultimo præcedente quadruplicato, ſubtrahatur penultimus duplicatus, orietur coefficiens quæſitus.

Regula generalis.

Sit n numerus nummorum quos uterque colluſorum habeat, $n + d$ numerus ludorum de quo ſpectatores contendant.

Elevetur $a + b$ ad poteſtatem n, & reſecentur termini duo extremi; multiplicetur reſiduum per $aa + 2ab + bb$, & rejiciantur termini extremi; fiat rurſus multiplicatio reſidui per $aa + 2ab + bb$, & rejiciantur extremi, & ſic deinceps fiant tot multiplicationes quot ſunt unitates in $\frac{1}{2}d$; & productum ultimum erit numerator expectationis ipſius S; denominator vero ſemper erit $\overline{a+b}|^{n+d}$.

N. B. Si d ſit numerus impar, ſubſtituatur $d-1$ pro d.

Si n ſit numerus impar, dividi poterunt numerator & denominator expectationis per $a + b$, & fiet expectatio ſimplicior.

EXEMP. I.

Sit 4 numerus nummorum quos uterque colluſorum habeat, & 10 numerus ludorum de quo ſpectatores contendant, ſint autem dexteritates in ratione æqualitatis; quæritur expectatio ipſius S.

Eſt $n = 4$, & $n + d = 10$; igitur eſt $d = 6$, & $\frac{1}{2}d = 3$. Elevetur itaque $a + b$ ad poteſtatem 4^{am}, & reſectis ſemper extremis, fiant 3 multiplicationes per $aa + 2ab + bb$.

$$a^4 \mid + 4a^3b + 6aabb + 4ab^3 \mid + b^4$$
$$aa + 2ab + bb$$

$$4a^5b \mid + 6a^4bb + 4a^3b^3$$
$$+ 8a^4bb + 12a^3b^3 + 8aab^4$$
$$+ 4a^3b^3 + 6aab^4 \mid + 4ab^5$$

$$14a^4bb + 20a^3b^3 + 14aab^4$$
$$aa + 2ab + bb$$

$$14a^6bb \mid + 20a^5b^3 + 14a^4b^4$$
$$+ 28a^5b^3 + 40a^4b^4 + 28a^3b^5$$
$$+ 14a^4b^4 + 20a^3b^5 \mid 14aab^6$$

$$48a^5b^3 + 68a^4b^4 + 48a^3b^5$$
$$aa + 2ab + bb$$

$$48a^7b^5 \mid + 68a^6b^4 + 48a^5b^5$$
$$+ 96a^6b^4 + 136a^5b^5 + 96a^4b^6$$
$$+ 48a^5b^5 + 68a^4b^6 \mid + 48a^3b^7$$

$$164a^6b^4 + 232a^5b^5 + 164a^4b^6$$

Et erit expectatio ipsius S $= \frac{164a^6b^4 + 232a^5b^5 + 164a^4b^6}{a+b|^{10}}$, & propter a & b æquales, erit ista expectatio $\frac{164+232+164}{2^{10}} = \frac{560}{1024} = \frac{35}{64}$.

EXEMP. II.

Sit 5 numerus nummorum quos uterque colluſorum habeat, & 10 numerus ludorum de quo ſpectatores contendant, ita ut S neget certamen finitum iri intra ludos 10; ſit autem dexteritas ipſius A ad dexteritatem ipſius B ut 2 ad 1.

Eſt $n = 5$, & $n + d = 10$; eſt igitur $d = 5$. Et propter d imparem, fingatur $d = 4$, ergo $\frac{1}{2}d = 2$. Elevetur itaque $a + b$ ad poteſtatem 5^{am}, & reſectis ſemper extremis, fiant 2 multiplicationes per $aa + 2ab + bb$.

$$a^5 \mid + 5a^4b + 10a^3bb + 10a^2b^3 + 5ab^4 \mid + b^5$$
$$aa + 2ab + bb$$

$$5a^6b \mid + 10a^5bb + 10a^4b^3 + 5a^3b^4$$
$$+ 10a^5bb + 20a^4b^3 + 20a^3b^4 + 10aab^5$$
$$+ 5a^4b^3 + 10a^3b^4 + 10aab^5 \mid + 5ab^6$$

$$20a^5bb + 35a^4b^3 + 35a^3b^4 + 20aab^5$$
$$aa + 2ab + bb$$

$$20a^7bb \mid + 35a^6b^3 + 35a^5b^4 + 20a^4b^5$$
$$+ 40a^6b^3 + 70a^5b^4 + 70a^4b^5 + 40a^3b^6$$
$$+ 20a^5b^4 + 35a^4b^5 + 35a^3b^6 \mid + 20a^2b^7$$

$$75a^6b^3 + 125a^5b^4 + 125a^4b^5 + 75a^3b^6$$

Ergo expectatio ipsius S erit $\frac{75a^6b^3 + 125a^5b^4 + 125a^4b^5 + 75a^3b^6}{a+b|^9}$

Sive divisis numeratore & denominatore per $a + b$, propter numerum n imparem, fiet expectatio $= \frac{75a^5b^3 + 50a^4b^4 + 75a^3b^5}{a+b|^8}$

$= 25a^3b^3 \times \frac{3aa + 2ab + 3bb}{a+b|^8}$.

Et positis 2 & 1 pro a & b respective, fiet expectatio $= \frac{8 \times 25 \times 19}{0561} = \frac{3800}{6561}$.

PROB.

PROB. XXI.

Sit 4 *numerus nummorum quos uterque colluſorum habeat; Requiritur ratio dexteritatum quæ faciat ut* R *poſſit æqua ſorte affirmare certamen finitum iri intra ludos* 4, S *negare.*

SOLUTIO.

Expectatio ipſius S, jam inventa, eſt $\frac{4a^3b + 6aabb + 4ab^3}{a+b|^4}$, & quoniam, ex Hypotheſi, R & S æqua ſorte contendunt, ponatur $\frac{4a^3b + 6aabb + 4ab^3}{a+b|^4} = \frac{1}{2}$, ſive $a^4 - 4a^3b - 6aabb - 4ab^3 + b^4 = 0$. Addatur $12aabb$ utrobique, & fiet $a^4 - 4a^3b + 6aabb - 4ab^3 + b^4 = 0$. Extrahatur hinc inde radix quadratica, & erit $aa - 2ab + bb = ab\sqrt{12}$, ſive facto $a : b :: z : 1$, $zz - 2z + 1 = z\sqrt{12}$, ubi invenietur radix duplex $z = 5.274$, & $\frac{1}{5.274}$. Ergo ſive ratio dexteritatis ipſius A ad dexteritatem ipſius B ſit ut 5.274 ad 1, vel ut 1 ad 5.274, R & S æqua ſorte contendent.

PROB. XXII.

Sit 4 *numerus nummorum quos uterque colluſorum habeat; Requiritur ratio dexteritatum talis, ut poſſit* R *affirmare finitum iri certamen intra* 4 *ludos,* S *negare, atque ſint ſortes ipſorum* R *&* S *in ratione data, videlicet ut* 3 *ad* 1.

SOLUTIO.

Expectatio ipſius S ex numero ludorum 4, & ratione dexteritatum oriunda eſt $\frac{4a^3b + 6aabb + 4ab^3}{a+b|^4}$. Eadem expectatio propter datam rationem ſortium eſt $\frac{1}{4}$. Ergo fit $\frac{4a^3b + 6aabb + 4ab^3}{a+b|^4} = \frac{1}{4}$.

$= \frac{1}{4}$; sive $a^4 - 12a^3b - 18aabb - 12ab^3 + b^4 = 0$. Jam facto $a : b :: z : 1$, erit $z^4 - 12z^3 - 18zz - 12z + 1 = 0$. Supponatur hæc æquatio ex binis istis quadraticis formari, $zz + yz + 1 = 0$. Et $z^2 + pz + 1 = 0$.

$$\text{Ergo } z^4 \overset{+y}{+p} z^3 \overset{+py}{+2} zz \overset{+y}{+p} z + 1 = 0.$$

Comparentur coefficientes terminorum Homologorum, & erit $y + p = -12$, & $py + 2 = -18$, sive $py = -20$; unde orietur æquatio $yy + 12y = 20$, cujus radix negativa erit $= -13.483$. Substituatur valor iste in locum ipsius y, & erit $zz - 13.483z + 1 = 0$, cujus æquationis radix duplex invenietur 13.407, & $\frac{1}{13.407}$ prope, ergo sive a ad b sit ut 13.407 ad 1, sive ut 1 ad 13.407, ratio sortium ipsorum R & S erit ut 3 ad 1.

PROB. XXIII.

Sit 4 numerus nummorum quos uterque colluforum habeat; Requiritur ratio dexteritatum quæ faciat ut R *possit æqua sorte affirmare certamen finitum iri intra ludos 6,* S *negare.*

SOLUTIO.

Expectatio ipsius S ex numero ludorum, & ratione dexteritatum oriunda, erit $\frac{14a^4bb + 20a^3b^3 + 14aab^4}{\overline{a+b}|^6}$. Ejusdem expectatio propter datam sortium æqualitatem erit $= \frac{1}{2}$. Ergo erit $\frac{14a^4bb + 20a^3b^3 + 14aab^4}{\overline{a+b}|^6} = \frac{1}{2}$, sive $a^6 + 6a^5b - 13a^4bb - 20a^3b^3 - 13aab^4 + 6ab^5 + b^6 = 0$, & facto $a : b :: z : 1$.

$$z^6 + 6z^5 - 13z^4 - 20z^3 - 13zz + 6z + 1 = 0.$$

Ponatur hæc æquatio ex binis istis formari.

$$z^2 + yz + 1 = 0.$$
$$\& \; z^4 + pz^3 + qz^2 + pz + 1 = 0.$$

Ergo $z^6 + yz^5 + z^4$
$+ pz^5 + pyz^4 + pz^3$
$+ qz^4 + qyz^3 + qzz$
$+ pz^3 + pyzz + pz$
$+ zz + yz + 1.$

Sive $z^6 + \begin{matrix} y \\ +p \end{matrix} z^5 + \begin{matrix} +1 \\ py \\ +q \end{matrix} z^4 + \begin{matrix} 2p \\ +qy \end{matrix} z^3 + \begin{matrix} +1 \\ py \\ +q \end{matrix} zz + \begin{matrix} p \\ +y \end{matrix} z + 1 = 0.$

Et comparatis coefficientibus erit $y+p=6$, $1+py+q=-13$, seu $py+q=-14$, $2p+qy=-20$. Unde orietur æquatio $y^3 - 6yy - 16y + 32 = 0$, cujus una radicum erit -2.9644, qua substituta in locum ipsius y, in æquatione $z^2 + yz + 1 = 0$, habebitur æquatio nova $z^2 - 2.9644z + 1 = 0$. Ubi invenietur radix duplex 2.576, & $\frac{1}{2.576}$; ergo sive dexteritas ipsius A ad dexteritatem ipsius B sit ut 2.576 ad 1, seu ut 1 ad 2.576, R & S æqua sorte contendent.

COROLLARIUM.

Omnes hujus generis æquationes, in quibus ratio dexteritatum determinanda venit ex datis numero nummorum & numero ludorum, ad dimensiones dimidio saltem pauciores, quam sit numerus ludorum datus semper reducentur; etenim coefficientes terminorum hinc inde ab extremis æqualiter distantium semper iidem erunt, adeoque si fingatur æquationes istas formari ex $yy + yz + 1 = 0$, & æquatione altera cujus coefficientes hinc inde ab extremis æqualiter distantes sint iidem, comparationes terminorum homologorum non erunt plures quam est dimidius ludorum numerus, adeoque dimensiones quantitatis y dimidio saltem pauciores erunt quam dimensiones quantitatis z.

PROB.

PROB. XXIV.

Positis iisdem ac in Prob. 20. *habeat* A *nummos* p, B *vero nummos* q : *Quæritur expectatio ipsius* S.

SOLUTIO.

Sumatur Binomium $a+b$, & rejectis semper terminis in quibus dimensiones quantitatis a excedunt dimensiones quantitatis b per q, & terminis in quibus dimensiones quantitatis b excedunt dimensiones quantitatis a per p, multiplicentur continuo termini residui per $a+b$, & fiant tot multiplicationes quot sunt unitates in dato ludorum numero unitate diminuto, & habebitur numerator expectationis ipsius S, cujus denominator erit potestas binomii $a+b$ designata per numerum ludorum.

EXEMPLUM.

Sit $p = 3$, & $q = 2$; numerus ludorum 7.

$$\begin{array}{l} a+b \\ a+b \\ \hline aa \mid +2ab+bb \\ \qquad a+b \\ \hline 2aab+3abb \mid +b^3 \\ \qquad a+b \\ \hline 2a^3b \mid +5aabb+3ab^3 \\ \qquad a+b \\ \hline 5a^3bb+8aab^3 \mid +3ab^4 \\ \qquad a+b \\ \hline 5a^4bb \mid +13a^3b^3+8aab^4 \\ \qquad a+b \\ \hline 13a^4b^3+21a^3b^4 \mid +8aab^5 \end{array}$$

Ergo erit expectatio ipsius S $= \frac{13a^4b^3+21a^3b^4}{a+b|^7}$.

PROB.

PROB. XXV.

A & B collusores duo, quorum dexteritates sint in ratione data, hoc pactum ineant, ut non prius ludo desistant quam datus numerorum ludus sit transactus ; sint R *&* S *spectatores duo, quorum* R *contendat fore ut aliquando ante conclusum certanen vel expirante certamine,* A *victorem se præstiterit plaries quam* B *dato ludorum numero ; Quæritur expectatio ipsius* R.

SOLUTIO.

Sit n numerus ludorum transigendus priusquam A & B ludo desistant, sit $n - d$ numerus ludorum de quo R & S contendant, sit ratio dexteritatum ut a ad b. Elevetur $a + b$ ad potestatem n, tunc si d sit numerus impar, sumantur tot termini istius potestatis quot sunt unitates in $\frac{d+1}{2}$; sumantur etiam tot termini sequentes quot jam sumpti fuerunt, sed mutentur illorum coefficientes, iisque præfigantur coefficientes terminorum præcedentium ordine retrogrado : Si vero d sit numerus par, sumantur tot termini potestatis $\overline{a+b}|^n$ quot sunt unitates in $\frac{d+2}{2}$, sumantur etiam tot termini sequentes quot sunt unitates in $\frac{1}{2}d$, sed præfigantur illis coefficientes terminorum præcedentium ordine retrogrado, omisso ultimo præcedentium, & habebitur numerator expectationis ipsius R, quorum denominator erit $\overline{a+b}|^n$.

EXEMP. I.

Sit 10 numerus ludorum transigendus priusquam A & B ludo desistant, sit 3 numerus ludorum quibus aliquando A superaturus est ipsum B, sit ratio dexteritatum ut 1 ad 1 : Elevetur $a + b$ ad potestatem 10^{ma}, videlicet $a^{10} + 10a^9b + 45a^8bb + 120a^7b^3 + 210a^6b^4 + 252a^5b^5 + 210a^4b^6 + 120a^3b^7 + 45aab^8 + 10ab^9 + b^{10}$.

Est

1°. Est $n = 10$; 2°. $n - d = 3$; ergo est $d = 7$, & $\frac{d+1}{2} = 4$. Sumantur ergo 4 termini istius potestatis, videlicet $a^{10} + 10a^9b + 45a^8bb + 120a^7b^3$; sumantur etiam 4 termini sequentes, illisque præfigantur coefficientes terminorum præcedentium ordine retrogrado, & termini sequentes evadent $120a^6b^4 + 45a^5b^5 + 10a^4b^6 + a^3b^7$. Ergo erit expectatio ipsius R $= \frac{a^{10} + 10a^9b + 45a^8bb + 120a^7b^3 + 120a^6b^4 + 45a^5b^5 + 10a^4b^6 + 1a^3b^7}{\overline{a+b}|^{10}} = \frac{352}{1024}$.

EXEMP. II.

Sit $n = 6$, & $n - d = 4$; ergo est $d = 2$, & $\frac{d+2}{2} = 2$. Ergo expectatio ipsius R erit $\frac{a^6 + 6a^5b + a^4bb}{\overline{a+b}|^6}$.

N. B. Si d sit numerus impar, poterunt numerator & denominator expectationis ipsius R dividi per $a + b$.

PROB. XXVI.

Collusores duo, A *&* B, *quorum dexteritates sint in ratione data, videlicet ut* a *ad* b, *hoc pactum ineant, ut non prius ludo desistant quam datus ludorum numerus sit transactus: Adsint spectatores duo* R *&* S, *quorum* R *affirmet*, S *neget, fore ut aliquando ante finitum certamen, vel expirante certamine*, A *sit superaturus ipsum* B *dato ludorum numero* q; *& fore etiam ut aliquando* B *sit superaturus ipsum* A *data ludorum numero* p: *Quæritur expectatio ipsius* R.

SOLUTIO.

Inveniatur numerus casuum quibus A superare possit ipsum B dato ludorum numero q, per *Prob.* 25.

Inveniatur numerus casuum quibus B superare possit ipsum A dato ludorum numero p, per idem.

Inveniatur denique numerus casuum quibus neuter superare possit alterum datis ludorum numeris, per *Prob.* 24.

Addantur hi casus simul, & ex eorum aggregato subtrahatur $\overline{a+b}|^n$, & habebitur numerator expectationis ipsius R, cujus denominator erit $\overline{a+b}|^n$.

EXEMPLUM.

Contendat R fore ut aliquando A sit superaturus ipsum B 2 ludis, & fore etiam ut aliquando B sit superaturus ipsum A 3 ludis, & sit numerus ludorum transigendus 7.

Numerus casuum quibus possit A superare ipsum B 2 ludis, est $a^7 + 7a^6b + 21a^5bb + 21a^4b^3 + 7a^3b^4 + aab^5$.

Numerus casuum quibus possit B superare ipsum A 3 ludis, est $1a^4b^3 + 7a^3b^4 + 21aab^5 + 7ab^6 + b^7$.

Numerus casuum quibus neuter alterum superare possit datis ludorum numeris, est $13a^4b^3 + 21a^3b^4$.

Summa omnium istorum casuum erit
$a^7 + 7a^6b + 21a^5bb + 35a^4b^3 + 35a^3b^4 + 22aab^5 + 7ab^6 + b^7$.
Subtrahatur $\overline{a+b}|^7$ seu
$a^7 + 7a^6b + 21a^5bb + 35a^4b^3 + 35a^3b^4 + 21aab^5 + 7ab^6 + b^7$
Residuum erit $1aab^5$.

Ergo expectatio ipsius R erit $\frac{aab^5}{\overline{a+b}|^7}$.

ERRATA.

Pag. 216. *lin.* 12. *dele* omnium. *Pag.* 218. *lin.* 16. *pro* simul, *lege* prima vice. *Pag.* 219. *lin.* 7. *lege* ut eventus aliquis. *Pag.* 220. *lin.* 3. *lege* limites. *Pag.* 231. *lin.* 15. *pro* 450, *lege* 495. *Lin.* 16 & 17. *pro* 115, *lege* 165. *Pag.* 239. *lin.* 8. *pro* $\frac{p}{1}$, *lege* $\frac{p}{2}$. *Pag.* 258. *lin.* 10. *pro* $=0$, *lege* $=12aabb$. *Pag.* 262. *lin.* 4. *pro* numerorum ludus, *lege* ludorum numerus.

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Tab. I.

Philosoph. Transact. N°. 330.

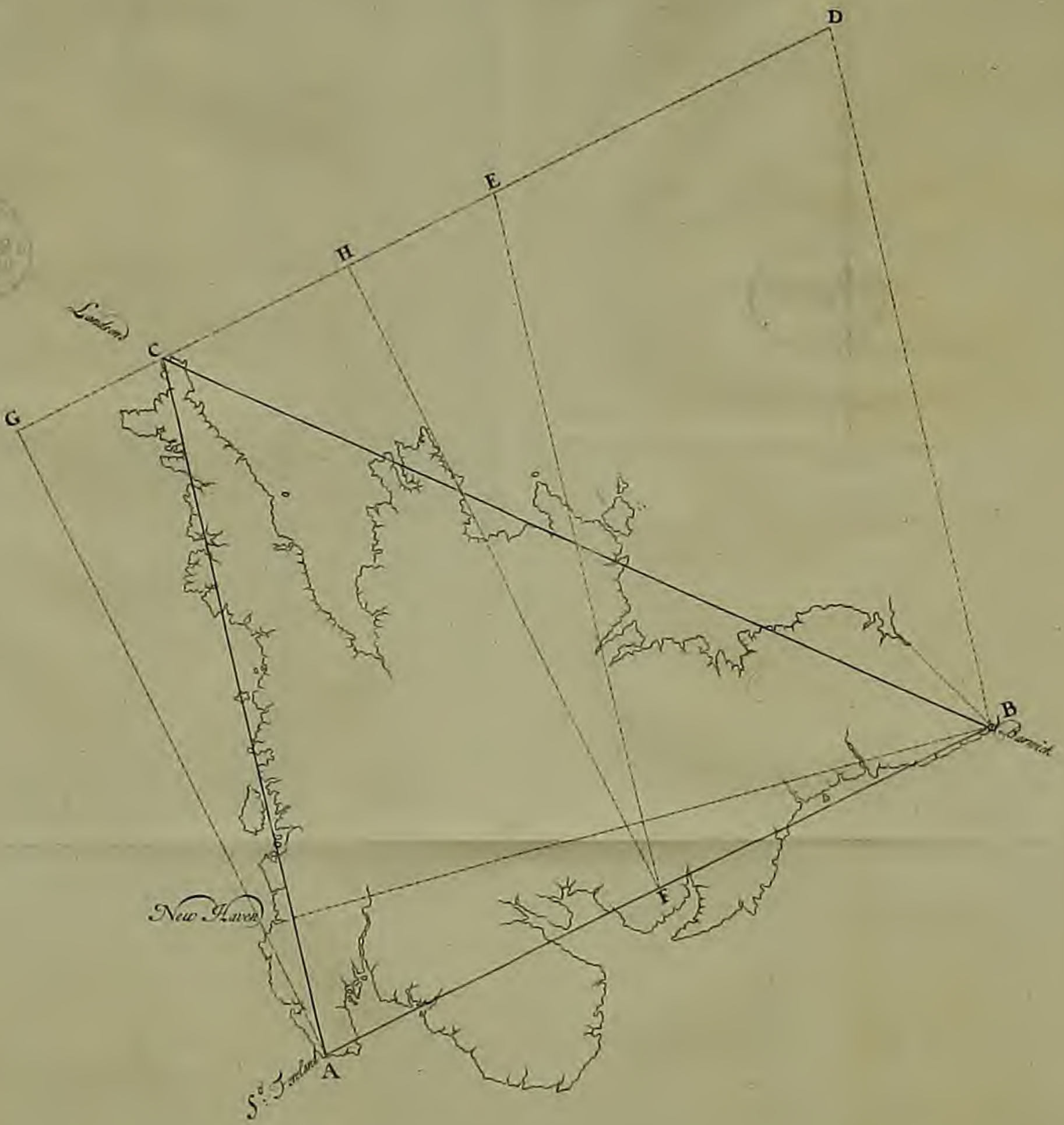

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Fig: 4.

Fig: 3.

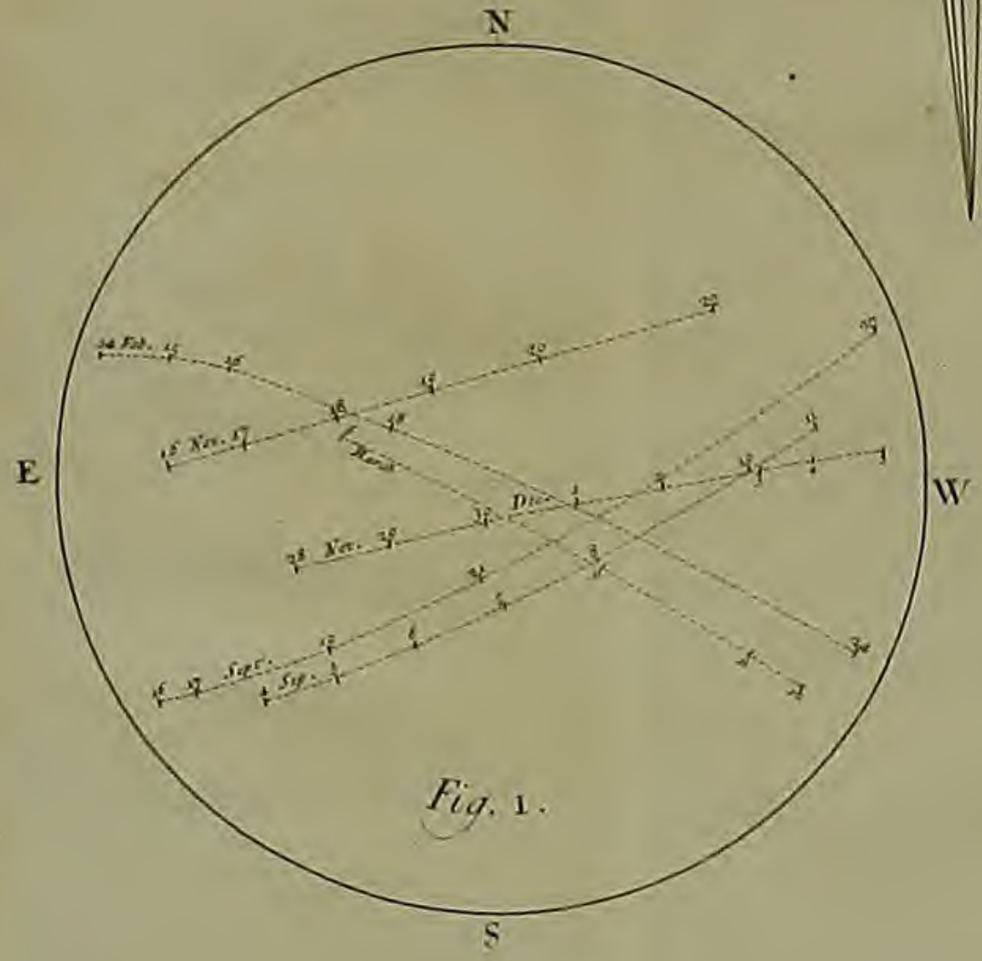


Fig. 1.

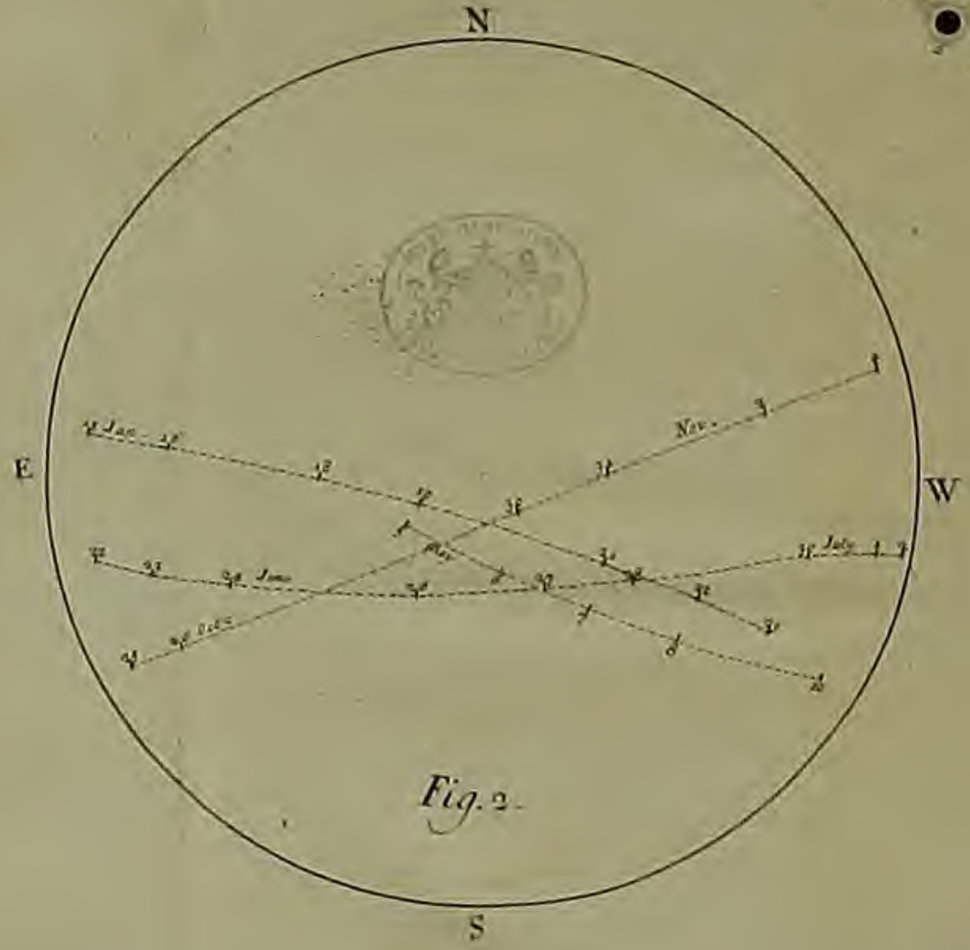


Fig. 2.

(Numb. 330.

PHILOSOPHICAL TRANSACTIONS.

For the Months of April, May, *and* June, 1711.

The CONTENTS.

I. *A Demonſtration of the Number of Acres contained in* England, *or* South-Britain; *and the Uſe which may be made of it. By Dr.* Nehemiah Grew, *Fellow of the Royal Society, and of the College of Phyſicians.*

SEveral Perſons, and ſome of great Abilities, have given us, as they have ſuppoſed, the juſt Number of Acres contained in *England*, or *South Britain*, or very near it. The Excellent Sir *William Petty* reckons about 28 Millions: Others, 29 Millions; others, a few more. But I humbly affirm, they have all been miſtaken in under-reckoning.

And the reaſon of their miſtake ſeems to have been, their reckoning only by the Maps; that is, by computed, and not by meaſured Miles; by which only the Number of Acres can be known.

I have ſeen an Account of the Number of Acres in each County: Which Account, whether taken from Dooms-Day Book, or from any other Regiſtry, cannot be True. For tho' we have loſt ſome Land, yet there is a great deal more now gained, which in the Conqueror's time lay under Sea. Within 120 Years, very much has been recovered out of the Seas, and maintained by Banks, in the Marſhes and Fenns of *Eſſex*, *Kent*, and the Iſle of *Ely*. And in ſome Parts of *Lincolnſhire*, the Land has gained of the Sea, 4 Miles in a direct Line from Land to Sea, in the memory of Men now Living.

Nor

Nor is it the Truer, for having been taken from any other Record: For if the Numbers of Acres, according to the ſaid Account, in each Shire, be put together, they exceed not 39 Millions and a quarter: Which Number, tho' it comes much nearer to the Truth than any of the former, yet is a great deal ſhort of it.

For however, according to vulgar Computation, *England*, or *South Britain*, is reckon'd in length but 305 Miles; and in breadth, about 290 Miles: Nevertheleſs, it appears by an exact Wheel-Meaſure, That from New *Haven* in the *South* of *England* to *London*, are 56 meaſured Miles; and that from thence by a ſtrait Line continued to *Berwick* in the *North*, are 339 of the ſame meaſured Miles; in all 395 meaſured Miles, the True length of *England*. And again, that from the South Foreland in the *Eaſt*, to the Lands-end in *Cornwall*, are about 367 Miles of the ſame Wheel-Meaſure, the True breadth of *England*.

This being known, it is eaſy without any laborious and coſtly Survey, to know alſo, how many Square Miles, and conſequently how many Acres are contained in *England*, or *Great Britain*; to wit, in the following manner.

If a Line be drawn on a Chart of *England*, from the South Foreland in *Kent* to *Berwick*; and from the two Ends of this Line, two more Lines meeting at the Lands End in *Cornwal*, they will make the Triangle A B C: Which Triangle, in that it excludeth as much more of the Land, as it includeth of the Sea, as may anſwer the ſmall Number of Miles obtained by the Curvity of the Roads; it may therefore be allow'd to be equal to the *Area* of *England* or *South Britain*. *See* Tab. I.

Next, if to the Triangle A B C, another Similar and Equal Triangle B C D be added; both together make the Rhomboid A B D C. Which being divided at E F, maketh the Rhomboids A C E F, and B D E F, Equal one

one to another. One of which is therefore Equal to the Triangle A B C. And the Rectangle A G H F, ſtanding upon the ſame Baſe, and between the ſame Parallel Lines with the Rhomboid A C E F, by the 35th of the 1ſt of *Euclide*, is Equal to the ſaid A C E F: Equal to the Triangle A B C: Equal to the *Area* of *England*, or *South Britain*.

Now the length between *Berwick* and the South Foreland in *Kent*, being about 5 Miles more than between *Berwick* and *New Haven*, which is 395 Miles: Therefore the Line A B, may be taken for 400 Miles; and ſo the Line A F, for 200. And the Line A G being leſs by about 7 Miles, than between the South Foreland in *Kent*, and the Lands End in *Cornwall*, which is 367 Miles, the ſaid A G, may be taken for 360 Miles. Therefore A G, 360, being multiply'd by A F, 200, produceth 72000 Square Miles: And 72000 being multiply'd by 640, the Number of Acres contained in one Square Mile, produceth 46 Millions and 80000, the Number of Acres contained in *England*, or *South Britain*.

Whence it appears,

Firſt, that if the Province of *Holland* contains, as is computed, but one Million of Acres, then *England* is more, by a Fraction of 80000 Acres, than 45 times as big as *Holland*.

Next, if in the Province of *Holland*, containing but one Million of Acres, are two Millions and 400 Thouſand Souls, or two Millions and 4 10ths, as they are ſaid to be; then *England*, which contains 46 Millions of Acres, to be proportionably Populous, ſhould have twice 46 Millions of People, and 4 10ths of 46; that is, about 110 Millions.

But to allow room enough for Perſons of all Degrees under our *Britiſh* Monarchy, if *England* were half as Populous as *Holland*, with only 55 Millions, it were a good

good Proportion, and would be near 5 times our present Number: And about 22 times as many, as in the Province of *Holland*.

To People *England*, in a competent Time, with this Number; there are ſundry ways very practicable. By which, I have computed, the preſent Number may be doubled in 24 or 25 Years. And probably quadrupled in about 36 Years.

One of theſe Ways, tho' not the ſpeedieſt, would be the introducing of Strangers: Yet to make uſe of this, or of any other Way, to multiply the People, before we have provided the Means of Employing them, (as was lately done) would be prepoſterous.

But when we ſhall once, in good earneſt, mind our True Intereſt, in Employing, and Encouraging, every where, our own Hands, and the Hands of other Nations, as the *French* and *Dutch* do, in all the ſorts of Husbandry, Manufactury, and Merchantry: When our Nobility and Gentry themſelves, ſhall, as in ſome other Countries, be Examples in ſome or other of theſe Particulars: When we ſhall hereby be univerſally engag'd to Incloſe, and to Improve, every Foot of our Land; to make the utmoſt Uſe of all our Home Growths, above and under Ground; and of all our Ports, (about 200 great and ſmall,) more than in all the Kingdoms and States of *Europe* put together: And when *Scotland* and *Ireland*, ſhall both of them afterwards be Improved in like manner: When all Mens Heads and Hands ſhall be thus Employed, about ſome one Honeſt and Profitable Buſineſs; as it will naturally promote every where Peace and Friendſhip among us; ſo is it eaſy for any conſidering Man to foreſee, how highly it will advance the *Britiſh* Monarchy and People, at Home and all over the World, in Beauty, Strength, and Glory.

II. *Observations upon the Spots that have been upon the* Sun, *from the Year* 1703 *to* 1711. *With a Letter of Mr.* Crabtrie, *in the Year* 1640. *upon the same Subject. By the Reverend Mr* William Derham, *F. R. S.*

WHEN Spots on the Sun were more rare, than for these three or four Years last past they have been, this most Illustrious Society was pleased to accept of my Account of some of the first that for divers Years had been seen: Which for their Novelty were published, with some others, in the *Phil. Transact.* No. 288. But for as much as those Observations of mine were imperfect, as I there confess'd, therefore to make some amends, I will give a better Account of the *Spots* and *Faculæ* that have been seen on the Sun since; there having, I suppose, few of those Appearances escap'd my Sight, since their first being seen in 1703; and because I am now better provided with competently good Instruments to take their Places on the Sun, *viz.* a *Micrometer* (after Mr. *Gascoign*'s manner) to take their distance from the Suns Northern or Southern Limb, which is parallel with the Pole of the Earth; and an *Half-Seconds Movement*, to measure their distance from the Suns Eastern or Western Limb.

In this following Table, may be seen at one view, what *Spots* or *Faculæ* fell under my cognizance.

A Table of all the Spots *and* Faculæ *on the* Sun, *visible at* Upminster, *since* July 1703.

1703.	*Jun.* 23, *none*	* 22	30	1707.	27
Octob. 9	*Some* 24	* 23	*April* 2	*Feb.* 14	*No Spot nor* * 28
10	*Vanished* 25	*June* 22	*Vanished* 3	15	*Octob.* 31
11	*July* 18	23	*June* 7	16	*Nov.* 1
Nov. 19	20	24	8	18	4
22	21	26	*July* 24	24	8
1704	* 23	27	25	*March* 6	10
Jan. 16	*Sept.* * 10	28	*Sept.* 4	9	15
17	*nothing* 14	30	5	11	16
18	* 18	*July* * 1	6	12	17
19	* 21	* 3	7	14	18
21	*Nov.* 17	24	8	18	19
22	18	*Sept.* 30	10	21	20
23	21	*Octob.* 2	*Faint* 11	*Jun.* * 29	22
Jan. 30	*Dec.* * 2	3	Extinct 12	*Extinct* 30	N.B. *This* Nov. 15, *another Spot arose on the Eastern side of the Disk, whilst this was on the Western.*
Feb. 23	1705.	5	*Oct.* * 29	*July* 1	
25	*Jan.* 1	6	*Nov.* 5	Languid 2	
Mar. 7	2	7	*Faint* 6	Scarce visible 4	
8	3	25	* 8	More visible 5	
9	5	26	28	Extinct 6	
10	* 25	30	29	*Appears* 8	
11	*Feb.* * 19	31	30	* 10	
13	*March* 14	*Nov.* 2	*Dec.* 1	*Aug.* * 31	
April 11	16	4	2	*Sept.* * 12	
12	*April* 1	* 21	3	16	
13	*May* 5	1706.	4	*Spot* &* 17	
May 1	6	*Feb.* 7	5	19	
* 11	7	*Mar.* * 7	* 22	21	
	8	27	* 31		
	* 10				

In this Table the *Faculæ* are noted with an Asterisk; and the duration of every Appearance of the same Spots or *Faculæ*, or the time they disappeared; with a Line: And where any thing remarkable occur'd, that could be briefly noted, I have taken notice of it in the Table.

There are many other things that I took notice of in viewing the Spots and *Faculæ*, which would be troublesome to the Society, and indeed needless to particularly mention, since so many Accounts have been already given of them. But some things I shall select, as may be of use to, and gratify such as are curious in these Matters.

And first, as to the Figure of the Spots. They are well known to change frequently; and therefore I think it of little use to give their Figures every time I observ'd them. But it is somewhat remarkable, that the Spots generally appear longish near the extreme Parts of the Disk. If they are never so round near the middle of the Disk, they become longer and longer towards the Extremes, till (at going off) they seem to be nearly a strait Line, nearly parallel to the Suns Limb. Which is a manifest Argument, that the Sun is a Globe, and that these Spots are on, or very near its Surface.

Another thing remarkable is, The Mutability of the Shape of the Spots. I have more than once manifestly perceived them to change in the very time I have been looking upon them. Thus *Nov.* 19. 1703. I saw three or more Spots not far off the middle of the Disk; and whilst I was looking upon them, they seemed to vary, both as to their Shape and Strength; sometimes seeming longer, sometimes shorter; sometimes spifs, sometimes languid. And this they seemed to do, not only through my 16 Feet Tube, (which I thought at first was from the different Disposition of my Eye) but also when I received the Suns Image through a Six Feet Te-

leſcope,

leſcope, on a white Paper, in a darkened Room. Theſe mutable Spots the Weather hindred me from ſeeing again till *November* the 22d. following; and then they were become only like a thin Smoak, or *Nebula*.

So again *April* 11. 1704. there were divers Spots with *Umbræ* about them. Theſe *Umbræ*, or *Nebulæ*, I could plainly perceive, whilſt I was looking on them, to be ſometimes very faint and thin, and ſometimes much darker and thicker. Theſe *Maculæ* and *Umbræ* I obſerved ſuddenly brake out in the Sun: For, on *April* 9. the Disk was free. But this *April* 11. laſt mentioned, I perceived them advanced near a quarter part on the Disk: And conſequently they brake out in the Sun within 48 hours before. On *April* 13. the *Spots* were become *Umbræ*, in the Morning; and at Four of Clock in the Afternoon, there were no Remains of either *Maculæ* or *Umbræ*.

From this ſhort continuance of theſe Spots on the Sun, it is more than probable, they were in a perpetual Flux and Change; and that thoſe Mutations which I perceived in them, whilſt I was looking on them, were real, not imaginary.

Alſo it may be farther remarked, (which I have frequently obſerved, and which as I remember *Scheiner* obſerv'd long ago) That thoſe *Spots* and *Umbræ* which ſuddenly ariſe, do as ſuddenly decay, and are ſoon extinct. And ſuch Spots, I have farther obſerved, do ſeldom turn to *Faculæ*, as they commonly do when longer on the Sun, as I ſhall obſerve by and by.

Again, *May* 5. 1705. I could perceive two Spurs or Branches (running from a Spot) to change, and be ſometimes darker, ſometimes thinner.

So *March* 30. 1706. I obſerv'd ſuch another Variation. This Day, or but little before, *Spots* with *Faculæ* aroſe in the Sun, which remained not above three Days on him. One of theſe Spots I could manifeſtly perceive

ceive to be sometimes quite extinct, and then again immediately to appear: And the *Faculæ* also, in half an hours time, had plainly alter'd their Shapes.

October 29. the same Year, I could plainly perceive the *Maculæ* and *Faculæ* both to change: And whilst I was carefully viewing them, I saw a Spot arise in one of the brightest *Faculæ*, and again nearly disappear; and then again appear strong and spiss. I should have been glad to have seen how they appear'd next Day; but the Weather was Stormy, Cloudy, and Wet for several Days after.

Another thing I have observed (and not having the Book by me, I forget whether *Scheiner* observed the same or not) is, That the *Maculæ* do generally, if not always, become *Nebulæ* or *Umbræ* before they quite vanish; and after that, very frequently turn to *Faculæ*, or bright golden Spots, more illustrious and fulgid than the other Parts of that glorious Globe. If the Spots are of short duration, *Faculæ* seldom ensue: Or if they do, they are commonly the Remains of some Spots that had before been on the Sun, and vanish'd perhaps on the side opposite to us. But Spots that long continue, if they vanish before that part of the Sun revolveth out of our sight, do very often become *Faculæ*. Of which the Table affordeth several Instances, particularly *July* 3. 1705.

From these preceding Particulars, and their congruity to what we perceive in our own Globe, I cannot forbear to gather, *That the Spots on the Sun are caused by the Eruption of some new Vulcano therein*; which at first, pouring out a prodigious quantity of Smoak, and other opacous Matter, causeth the Spots: And as that fuliginous Matter decayeth and spendeth itself, and the Vulcano at last becomes more torrid and flaming, so the *Spots* decay and grow to *Umbræ*, and at last to *Faculæ*; which *Faculæ* I take to be no other than more flaming brighter

brighter Parts than any other Parts of the Sun. These *Faculæ* I have obſerv'd never continue long on the Sun: And the reaſon I conceive is, becauſe the *Vulcano*, after its Smoak is over, doth not long emit its Flames; by reaſon the fiery *Pabulum* is then near ſpent, when once it begins to flame: After which the torrid *Vulcano* ſoon returneth to the Natural Temperature of the Sun, ſo nearly at leaſt as to eſcape our ſight, at ſo vaſt a diſtance as the Sun is from us.

Another thing that may be accounted for, and indeed doth in ſome meaſure confirm alſo what I have ſaid, is the *Nuclei*, or darker part of the Spots; generally in moſt Spots, and towards the middle of them. Now it is very uſual in Culinary Fires in this our Globe, when they emit Smoak, that the middle is the darkeſt part. If, for Inſtance, we were from aloft in the Air, to ſee a thick Smoak come tumbling out of a *Chimney*, or the Mouth of a *Vulcano* juſt kindled, we ſhould find the middle part, juſt over the Mouth of the *Chimney*, or *Vulcano*, to be the moſt ſpiſs and dark, and towards the extremes clearer and thinner. And ſo I take it to be in the Eruptions of the Sun; that the *Nucleus* is juſt over the Mouth of the ignivomous Cavern, and that the miſty Parts of the Spot are the thinner Parts of the Smoak, ſwimming about in that Fluid, or *Atmoſphere*; which I ſuppoſe doth ſurround the Sun, as well as our Globe, and the Moon manifeſtly; yea, and in all probability, every Planet of this our Solar Syſtem.

From what hath been ſaid, we may give a reaſon why there are ſometimes Spots frequently on the Sun, and ſometimes none in many Years. One thing I believe there is in this, That there may be Spots, but not always ſeen. But there are doubtleſs great Intervals ſometimes when the Sun is free; as between the Years 1660 and 1671, 1676 and 1684. In which time Spots could hardly eſcape the ſight of ſo many curious Obſervers.

ſervers of the Sun, as were then perpetually peeping upon him with their Teleſcopes in *England*, *France*, *Germany*, *Italy*, and all the World over; whatever might be before, from *Scheiner*'s time. The reaſon, I ſay, of this long diſappearance of the Spots, I take to be from the want of extraordinary Eruptions in that fiery Globe. The Sulphureous, or other Matter, or *Pabulum* of thoſe Eruptions, is ſpent or diſſipated, and that Globe continues in its natural ordinary burning State, till there happens to be a freſh Collection of Smoaking, Diſploſive, and extraordinary Matter, that cauſeth a new Eruption. Which Eruptions generally happen between what we may call the Suns Tropicks, or in his Torrid Zone: For I never obſerv'd any Spots to be near the Suns Poles. And if I miſremember not, the Spots in *Scheiner*'s Cuts are all about the middle Zone of the Disk. The greateſt Evagation I ever obſerved of them was *March* 8. 170$\frac{3}{4}$. On which Day, beſides the dark Spots in the uſual Zone, I perceived ſome faint Spots, ſcarce viſible, much nearer the Southern Pole than I ever had ſeen them. But this was, no doubt, in ſome meaſure owing to the Poſition of the Earth in reſpect of the Sun, as well as to the Southerly Place of the Spots on him: For, about the Equinoxes, the Spots ſeem to march pretty far towards the Poles of the Sun, as may be ſeen by the annexed Schemes. (*Tab.* II.)

Having thus obſerv'd what part of the Sun the Spots commonly poſſeſs, I ſhall next take notice of their *Stages* and *Path* over the Sun. That the Sun moveth round his own *Axis*, is manifeſt, beyond doubt, from the Motion of the Spots. And that the Spots ſeem to traverſe the Sun, ſometimes in Strait Lines, ſometimes in Curve Lines, curved this way, and that way, is as manifeſt alſo, and well known to the Curious, and is ſet forth in the annexed two Figures: Which Figures ſhew the Stages of the Spots every Day that I obſerv'd them,

and

and the Lines they deſcribe in ſeveral Months of the Year. The daily Stages in both Figures are exact; or if they ſeem otherwiſe, it is by reaſon the Obſervations were made at different times of the Day; as one in the Morning, the other ſome following Day in the Evening, or Afternoon. But the Declinations of the Spots, or their diſtances from the Suns Northern or Southern Limb, are leſs exact in the ſecond Figure than the firſt; in which latter they are very near the truth.

And the Cauſes of the Defects in the 2d Scheme I ſhall mention, to prevent the ſame Errors in others I my ſelf ran into.

1. The Diminution of the Suns vertical Diameter by the Refractions was the principal cauſe of my Errors. This, altho' I was ſufficiently aware of, yet I did not think had been ſo conſiderable, for want of experimenting, or well conſidering the Matter: For I have ſometimes found the perpendicular, or vertical Diameter of the Sun diminiſhed, from 32′ 21″ on the Meridian, to 26′ 3″ at the Horizon, in one and the ſame Day.

2. For the ſame reaſon I was not aware of the time being ſo long before the Sun goes round, as I found it.

3. Another Error was meaſuring the Suns Image on the Scene of white Paper, with the Shade of the Micrometer; and not by looking through the Tube, and ſo claſping the Limb of the Disk with the parallel edges of the Micrometer. The former, altho' practiſed by ſome eminent Aſtronomers, is a far more eaſy and indulgent, than accurate way.

A further Account of the Solar Spots to the Year 1711.

SINCE my foregoing Account was drawn up, I have seen other Spots on the Sun, whose times are expressed in this following Table.

1707.	1709.
Decemb. 4	*Jan.* 15
10	21
* 29	22
* 30	*August* 13
1708.	* 17
July. 31	*Octob.* 8
August. 1	*Novemb.* 1
5	2
6	4
22	5
23	6
24	1710.
28	*Jan.* 22
Septemb. 1	*April* * 6
Novemb. 5	*Octob.* 14
Dec. 14	* 18
26	

From the Spots in this Table I had frequent occasions to be assured of my Opinion, in the foregoing Paper. Particularly in viewing the Spots of *August* 1. 1708. (represented in *Tab.* II. *Fig.* 3.) where some were large and dark, others

others leſs and thinner, and all encompaſs'd with *Nebulæ*: In viewing theſe, I ſay, I obſerv'd great alterations at the very time I was looking on them. Sometimes the *Nuclei* were very dark and black, ſometimes leſs ſo; and the ſame thing I obſerved alſo in the *Nebulæ* encompaſſing them. One of the leſſer Spots *b.* in *Fig.* 3. which the Day before was ſufficiently viſible and ſtrong, was this Day, now thick and ſtrong, and anon languid and leſs viſible. And from the two Spots *a.* and *d.* I could plainly ſee a Smoak iſſuing out to *c.* and *f.* ſometimes viſible for 5 or 6 Minutes, and then diſappearing for a quarter of an Hour, or more; and then again ſmoaking out, and again diſappearing, as before. All which Particulars, I ſaw over and over again repeated, for a good while together, till I was weary of the Obſervation.

Theſe Spots I was hindered from viewing until *Aug.* 5. following: And then I found the Spot *b.* quite extinct, (as I expected,) as alſo ſome of the other Spots; together with the *Nebulæ* grown leſs. But the great Spot *a.* continued dark and ſtrong, only ſometimes fainter, and then again ſtronger; and ſometimes like a half, or horned Moon; ſometimes roundiſh, or rather of an Oval Figure; of which latter Figure they commonly are, when they are near the Suns Limb, which this Spot was not far off at this time.

Theſe particulars are Confirmations of what I ſaid, *That the Solar-Spots are no other than a Smoak riſing out of the body of the Sun.* Of which Opinion I have been almoſt ever ſince I firſt obſerv'd them, and find that I am not ſingular in this Opinion, as I ſhall ſhew from a Letter (which with ſome others is lately fallen into my Hands) from the admirable Mr. *Crabtrie* to the no leſs admirable Mr. *Gaſcoigne*, the Inventor of the Micrometer; which I preſume will hardly be ungrately to this moſt illuſtrious Society.

The beginning of the Letter hath been torn off; but I find by that part of it that is left, it was Mr. *Crabtrie's* first Letter to Mr. *Gascoigne*, and that the torn part was only Compliments for his Writing to him, being a Stranger, *&c.* After which it follows in these Words.

" I writ also to Mr. *Townley* at that time my Opinion " in brief of the Suns Spots, (which you conceive to be " Stars,) and it seems he, or Mr. *Kay*, writ to the same " purpose to you, desiring your Opinion: Which you " freely deliver; for which I cannot but commend you, " and especially for prefering Reason before any Mans " Authority. Yet give me leave (*pace tua Amice desidera-* " *tissime*) to speak my mind likewise freely concerning " these Appearances. I do not value the Authority " of *Galilæus* (though reputed the greatest Speculative " Mathematician in *Europe*) nor yet *Kepler* (though " *Astronomorum facilé princeps*) further than either De- " monstrative, or the most probable Reasons confirm " their Opinions. Nor will I stick to subscribe to the " Man whosoever shall bring better Reasons for his O- " pinion. I must acknowledge you say more for the " stellifying of these Solar Obscurities, than I have heard " before; yet I conceive not sufficient, either demon- " stratively or probably to countermand those which " *Galilæus*, *Kepler*, and others have produced to the " contrary; nor yet such as can be cleared from such " Objections, as Reason, Demonstration, and Observa- " tion may lay against them. My Occasions will not " admit a full Disquisition hereof at this time; yet " something I would say for the present, the better to " furnish you where to object when I see you; that " so by diligent Inquisition, the desired truth may " (may we have that happiness) be better found out " by us.

" I

" I have often obſerved theſe Spots; yet from all " my Obſervations cannot find one Argument to prove " them other than fading Bodies. But that they are " no Stars, but unconſtant (in regard of their Genera- " tion) and irregular Excreſcences ariſing out of, or " proceeding from the Suns Body, many things ſeem to " me to make it more than probable.

" For firſt, for their Form; they are ſeldom round, " but of irregular Shapes, and, as I have often ſeen, one " ſide, or end of the Spot more thin than the reſt, like " to a certain miſty darkneſs, and by degrees thicker, " groſſer, and darker, nearer to the main body of the " Spot; juſt as the Smoak of ſome pitchy Fire, which " is in one part very groſs, and in another more rare " and thin, turning at laſt into meer Air: Or like a " Cloud, Fog, or Miſt, more thick, dark, and groſs in " the midſt; and more thin, fluid, penetrable, and tran- " ſparent towards the ſides; which I ſuppoſe is not " compatible with any of the Stars.

" Secondly, for their Colour: The lightneſs thereof " differenceth them from Stars, or Planets; they being " never of ſuch abſolute darkneſs as I obſerved *Venus* " the 24th of *November* laſt: Tho' I have ſeen ſpots " ſometimes little leſs than ſhe, yet always of a far " paler and whiter Colour, looking (at leaſt in ſome " Parts) like ſome thin diſſipated ſubſtance.

" Thirdly, for the manner of their appearance. I " have ſeen many Spots, which in the middle of the " Sun appear of a round body, but coming towards the " ſide of the Sun, appear long. Which (if you rightly " conſider it) is a demonſtrative Argument that they are " not Globes, as all the Planets and Stars are: For " Globes always appear of one form (round) in every " Poſition; but Exhalations, or ſuch like fluid Sub- " ſtances, extended to a broad flat form, like our Clouds, " which being over our Heads, and ſo in their full

breadth,

" breadth, appear large and broad; but driven with " the Wind, till they turn one edge upon us, ſeem of " a long ſhape. So theſe Solar-Clouds, being turned " about the Sun, may in the middle ſhew their full " breadth to us, and about both edges of the Sun, turn " their edges to us: Which anſwereth to the appear- " ance.

" Fourthly, for their continuance. Some of theſe " Spots, ariſing at the Eaſt-ſide of the Sun, vaniſh be- " fore they come to the midſt of the Sun. Others ap- " pear firſt in the middle of the Sun, and vaniſh before " they come to the Weſtern Limb; and for the moſt " part they vaniſh before they have made a full revo- " lution about the Sun. Which argues them to be but " thin, vaniſhing, fading Subſtances, not like the perma- " nent bodies of the Stars.

" But to take off theſe Reaſons, you anſwer, That " you conceive theſe Spots to be Stars moving regularly " in their own Orbes, which are many, though none of " greater extent than about $\frac{1}{10}$ of the ☉ Semidiameter " from its Circumference; and that the ſwifter Movers " in the lower Orbes, overtaking the ſlower in the " higher Orbes, cauſe an appearance. You ſeem there- " fore to think, that they being ſo thin bodies, the " Suns Rayes paſs through them, and ſo one cannot " be ſeen alone, till more being together, one heaped " behind another, they ſtop the light of the Suns Rayes, " and ſo cauſe an appearance. This I conceive is you " meaning: Or elſe (as you ſeem to inſinuate afterwards) " that the Higher reflects the Suns Rayes ſtrongly e- " nough upon the Lower (when they come within the " Angle of Reflection) to make the interjacent Planet " indiſcernable.

" But to theſe I anſwer,

1. " If it be by their coming within the Angle of " Reflection, that the light of the Sun reflected from

" the

" the outer Planet upon the inner, doth make it (as you " ſpeak) indiſcernable, then that Light ſo reflected is re- " flected either upon all places, as the Moons and Pla- " nets Light; or but upon one, as is the Reflection " of a plain Looking-Glaſs. If the firſt, there would " never be many ſeen (ſeldom above one or two) be- " cauſe the outermoſt would continually make the in- " ner undiſcernable. But *Gaſſendus* affirms, there are " ſeen ſometimes 40 at once in the Suns body. If the " 2d, there would always be many ſeen, becauſe the " reflected Light would but occupy a little room, and " that but for a ſmall time, till the ſwifter were paſt " the place of Reflection: Whereas many Days there " are none at all ſeen in the Suns Hemiſphere: And in " both theſe caſes, the outermoſt Planet of all would " always in the ſpace of 27 Days, be ſeen in the ſame " place, being never obſcured, none of the inferior be- " ing able to reflect Light upon it. Add hereunto, if " any kind of Reflection ſhould make them to appear " bright like the Sun, and ſo not diſtinguiſhable from " the Light of the Sun, what ſhould (*a*) hinder, but " we ſhould ſee them alſo bright Bodies by the ſide of " the Sun, when they are paſſing either by the Weſt, " or Eaſt-ſide of the Suns Body? The Light being " then reflected upon them by the inferior Planets as " well as at other times, and that alſo upon much of " that ſide of them which we ſhould behold.

(*a*) N. B. *Mr* Gaſcoigne *having, againſt theſe Words, inſerted a rough-drawn Figure in the Margin of Mr* Crabtrie's *Letter, I have alſo repreſented it in* Tab. 2. Fig. 4. *imagining it may ſomewhat explain Mr* Gaſcoigne's *Hypotheſis, and what Mr.* Crabtrie *ſaith againſt it.*

But

" But if you wave this conceit, as insufficient, and fly " to your former, That the swifter Movers in the " lower Orbes, overtaking the slower in the higher " Orbes, cause an appearance. To this I answer. " 1. The thing you suppose seems to me neither ne- " cessary nor probable, nor do I conceive why they " should not be seen, being themselves alone, as well as " conjoined, seeing all other Stars and Planets are so. " 2. If it be because they are of a thin, transparent " Substance, till many, being one behind another, make " them to seem grosser; Then they are not of the " nature of other Planets, as is proved in ☿ and ♀, " who of themselves appear dark Bodies, when they " come between us and the Sun; nay, they must be " more thin than our Clouds, which will easily be seen " between us and the Sun, and hides it from us. 3. If " it be because they are so little, that the Imperfection " of our Glasses cannot discover one alone, there must " be, without doubt, many Millions of them; which " how they can be included within the compass of $\frac{1}{10}$ " of the ☉ Semidiameter, we shall consider anon. I " have seen one of an ordinary darkness, (yea darker " than many greater) yet not above 5" Diameter. If " this consist of two, or many, of themselves invisible, " how many were in those which *Gassendus* saw of $1'\frac{1}{2}$ " Diameter? 4. The Figure of these great ones (being " necessarily composed of Stars of such different Orbes " and Motions) would quickly vary, by reason of the " diversity of their Motions; like as we see in a Flock " of small Birds. But 5thly, you say the furthest of " these Orbes is not above $\frac{1}{10}$ of the Suns Semidiameter " from its Circumference. But there would not, in that " small space, be room enough for so many Orbes of " Planets, as have been seen at once. Which I prove " thus. 1. *Gassendus* affirms there are sometimes some " of about the $\frac{1}{10}$ part of the ☉ Semidiameter; which

" is

" the whole ſpace allowed by you for them all. And
" I my ſelf have ſeen of $\frac{1}{15}$ of the ☉ Semidiameter: And
" yet you muſt confeſs theſe great ones could only be
" the Conjunctions of ſome, not all. 2. There are
" many times ſeen in the ☉ Superficies, a great number
" of Spots, whoſe Diameters added together, would
" do more than twice fill the ſpace you ſpeak of. I my
" ſelf have ſeen it, and ſo I believe have you. *Gaſ-*
" *ſendus* affirms, there are ſometimes 40 ſeen at once:
" If this was by Conjunction of Planets, in every Ap-
" pearance, there was at leaſt 80 Bodies at once on this
" ſide the ☉; it may be as many on the other ſide,
" beſides thoſe unſeen (by your Reflection or other-
" wiſe) which doubtleſs muſt be far more than ſeen.
" For it is a moſt rare, and I think unheard of thing
" to ſee but 3 (which is leſs than the half) of our
" Planets, conjoin'd in viſible ♂ at once: So that with-
" out queſtion, if they be Planets, they are many hun-
" dreds; which muſt have ſo many ſeveral Orbes, and
" which certainly cannot be done in ſo narrow a com-
" paſs, as the $\frac{1}{10}$ of the ☉ Semidiameter. And that
" they cannot have any larger (I ſuppoſe not ſo large
" an) extent from the ☉ Superficies, may be proved by
" their motion through the viſible Hemiſphere of the
" Suns Spherical Body, by comparing the ſwiftneſs of
" their motion towards the middle and ſides together.
" 6. If one of theſe (imagined) Planets be ſwifter than
" another, as they muſt needs be, then the ♂ of 2 or
" 3 ſwifter ones would make a Spot of ſpeedier motion
" than the ♂ of 2 ſlower ones: But the motion of all
" about the ☉ Center, is always equal; yea, and the
" Spots retain the ſame Poſition one to another, (con-
" ſidering the Suns Sphericity, and the Angle of their
" appearance to us) juſt like the Fixed-Stars. So affirms
" *Gaſſendus, Moveri omnes eodem & uniformi motu, adeo*
" *ut, cum plures fuerint, nulla antevertat aliam, ſed eun-*

" *dem tenorem in disco* ⊙, *perinde servent inter se, ac*
" *servant Fixæ in firmamento.*

" As for that other annual Motion of the Spots, you
" speak of, from West to East, upon their Axis inclin-
" ed above 8 Degrees to the Ecliptick; I suppose it is
" not any real Motion of the Orbes of those Solar Pla-
" nets or Spots, but only a visible Motion so appear-
" ing, caused (in *Kepler*'s Systeme) by the Suns rolling
" upon its own Center in the midst of all the Orbes,
" not exactly in the way of the *Temporary* Ecliptick,
" but in the *Via regia* (as *Kepler* calls it) inclined certain
" Degrees to the *Temporary*; thereby turning about with
" him, the same way, his Adventitious, or Excrementi-
" tious Parts, the Spots, by his *Magnetical* or *Sympathe-*
" *tical Rayes*. And hence may be demonstrated the
" appearance of that Annual Motion in the Suns Spots
" you speak of. See *Galilæus*, *Syst. Cosm. p.* 339, *& seq.*
" So also in *Ptolemie*'s and *Tycho*'s Systeme, the same Ap-
" pearance may be demonstrated, supposing the ⊖ fixed
" in the middle of the Universe, and the ⊙ rolling
" round upon the same Poles of that *Via regia* (or way
" of the Spots) and keeping his Axis in Parallelism con-
" tinually towards one and the same Part of the Uni-
" verse. This may be certainly demonstrated, altho'
" *Galilæus* there affirms the contrary. Other *Hypothe-*
" *ses* of that Motion may be feigned, as by the annual
" conversion of the Poles of the *Via regia* about the
" Poles of the Ecliptick in the Suns Body: But none I
" conceive so compendious, as the one of the former.
" For my part, I incline to the first: Yet if when we
" see you, you shew us any more likely Theory, for
" my part I shall be ready to consent to you in any
" thing with reason.

" Thus you have, what for the present, I conceive
" of these *Maculæ Solares*. *Fromundus* mentions one
" *Jo. Tarde Gallus*, who thinks them to be Secondary
" Planets;

" Planets; who hath written a Book of that Subject, " and calls them *Astra Borbonia*: But I could never yet " see it. What you, or he, or others may alledge for " that Opinion, I know not. In the mean time it " were too much levity in me, against my Judgment, " to acknowledge them Stars; unless I see at least " some possibility how they may be so, or some pro- " bability why they should not rather be Spots. Which " when you, or they do produce from better grounded " Reasons, Optical Experiments, or Demonstrations, I " shall willingly recant my Opinion.

" In the mean time, let me encourage you to pro- " ceed in your noble Optical Speculations. I do be- " lieve there are as rare Inventions as *Galilæus Tele-* " *scope*, yet undiscover'd. My living in a place void " of apt Materials for that purpose, makes me almost " Ignorant in those Secrets; only what I have from " Reason, or the reading of *Kepler*'s *Astron. Opt.* and " *Galilæus*. If you impart unto us any of your Op- " tical Secrets, we shall be thankful, and obliged to " you, and ready to requite you in any thing we " can.

" It is true which you say, That I found *Venus* " Diameter much less than any Theory extant made " it. *Kepler* came neerest, yet makes her Diameter 5 " times too much. *Tycho*, *Lansberge*, and the Ancients, " about 10 times greater than it was. So also they dif- " fer in the time of the ♂, as far from the truth. By " *Lansberg* the ♂ should have been 16^h 31′ before we " observ'd it: By *Tycho* and *Longomontane* 1^d 8^h 25′ be- " fore. By *Kepler*, (who is still neerest the truth) 9^h 46′ " before. So that had not our own Observations, and " Study, taught us a better Theory than any of these, " we had never attended at that time for that *rare* " *Spectacle*. You shall have the Observation of it, " when we see you. The Clouds depriv'd me of part

Temp. per Horolog.	Tempora correcta.	Die Jovis Novemb. 5. 1713.	Distantiæ a Vertice
h. ′ ″	h. ′ ″		° ′ ″
18 22 00	18 15 37	Leonis π in genu seq. transf	42 4 00
30 8	23 45	Cor Leonis transiit	38 7 5
54 35	48 12	Leonis in Axilla ρ transiit	40 42 0
19 11 5	19 4 42	Leonis in ventre *l* transiit	39 25 15
19 26 23	19 20 00	Saturni centrum transiit	42 10 40
		Ascensio rect. ♄ 162 23 20	
		Distantia à Polo 80 43 00	
		Longitudo ♍ 10 13 40	
		Latitudo Bor. 1 39 37	

Observationes JOVIS.

Anno MDCCXIII.

Temp. per Horolog.	Tempora correcta.	Die Solis Augusti 9.	Distantiæ a Vertice.
h ′ ″	h ′ ″		° ′ ″
12 40 4	12 37 27	Aquarii λ in effusione Aquæ transiit	60 32 50
12 48 37	12 46 0	Jovis centrum transiit	60 48 35
12 52 36	12 49 59	Aquarii 73*ta Cat. Brit.* prima ad *h* transiit	60 46 20
13 4 21	13 1 44	Aquarii in aqua χ transiit	60 49 10
		Ascens. rect. ♐ 341 33 5	
		Dist. a Polo Bor. 99 21 40	
		Longitudo ♓ 9 26 00	
		Latitudo Aust. 1 25 8	

Die

Temp. per Horolog.	Tempora correcta	Die Lunæ Auguſti 10. 1713.	Diſtantiæ a Vertice.
h. ′ ″	h.		° ′ ″
12 36 21	12 33 55	Aquarii λ tranſiit	60 32 50
12 44 26	12 42 00	Jovis centrum tranſiit	60 52 00
12 48 53	12 46 27	Aquarii 73*ia* tranſiit	
		Aſcenſ. rect. ♐ 341 26 5	
		Diſtant. a Polo 99 25 5	
		Longitud. Jov. ♓ 9 18 17	
		Latitudo Auſt. 1 25 40	
		Die Lunæ Octobris 26.	
7 29 16	7 28 42	Aquarii in Clune σ tranſiit	63 34 40
7 36 34	7 36 0	Jovis centrum tranſiit	63 00 5
8 14 34	8 14 0	Aquarii 80*ma* prima ad ♄ tr	62 5 20
8 17 45	8 17 11	Aquarii 84*ta* ſeq. ad ♄ tranſ.	62 37 5
		Aſcenſio recta ♐ 335 41 30	
		Diſtantia a Polo 101 33 20	
		Longitudo Jovis ♓ 3 16 00	
		Latitudo Auſt. 1 19 8	
		Die Martis Octob. 27.	
7 25 40	7 23 34	Aquarii Clunis σ tranſiit	63 34 35
7 33 6	7 31 00	Jovis centrum tranſiit	62 59 15
8 11 00	8 8 54	Aquarii prima ad ♄ tranſiit	62 5 15
8 14 10	8 12 4	Sequens ad ♄ tranſiit	62 37 10
		Aſcenſio rect. ♐ 335 43 20	
		Diſtantia a Polo 101 32 30	
		Longitudo ♓ 3 17 58	
		Latitudo Auſt. 1 19 00	
		Die Jovis Octob. 29.	
7 18 29	7 15 19	Aquarii σ tranſiit	63 34 40
26 10	7 23 00	Jovis centrum traſiit	62 57 20
8 3 47	8 0 37	Prima ad ♄ tranſiit	62 5 20
6 55	8 3 45	Sequens ad ♄ tranſiit	62 37 10

This with moſt of the Letters between Mr. *Crabtrie* and Mr. *Gaſcoigne*, together with other very valuable Papers of Mr. *Horrox*, Mr. *Towneley* himſelf, Mr. *Collins*, Mr. *Shuſe*, and other great Men, were imparted unto me, the laſt Month, by the great favour of *Charles Towneley* Eſq; Son of the late moſt Ingenious *Rich. Townley* Eſq; of *Lancaſhire*.

And foraſmuch as every thing of Mr. *Crabtrie*'s is valuable, I have taken this occaſion from my own Obſervations of the Solar Spots (for the moſt part drawn up near 4 Years ago) to give Mr. *Crabtrie*'s Letter at large, containing as well ſome things of another Nature, as what relates to the Spots; not doubting but the one will be acceptable to the Curious, as well as the other. I have two other of his Letters concerning the Spots (with Mr. *Gaſcoigne*'s Anſwers.) One contains his Theory of their Motion and Appearances; the other his way of obſerving them. But being long, I have not time at preſent to fit them up for the Societies Uſe; but intend (God willing) to do it as ſoon as may be, if this Specimen be acceptable.

N. B. Tab. II. Fig. I. *Shows the Stages and Lines deſcribed by the Spots upon the Sun in* Sept. *and* Novemb. 1706. *and in* Feb. *and* March, $170\frac{6}{7}$. *and in* Sept. *and* Novemb. 1707.

Fig. II. *Shows the Stages and Lines deſcribed by the Spots upon the Sun in* Jan. $170\frac{3}{4}$. *and in* May, June, *and* Octob. 1705.

The other Figures *in this* Table *are explained in the foregoing Diſcourſe.*

III. *A Letter from the Reverend Dr.* Hugh Todd (*S. T. P.*) *Sub-Dean and Prebendary of* Carliſle, *to Dr.* Edmund Halley (*L. L. D.*) Savilian *Profeſſor of Geometry in* Oxford, *and Fellow of the* Royal Society; *Giving an Account of ſome Antiquities lately found at* Corbridge *in* Northumberland.

SIR,

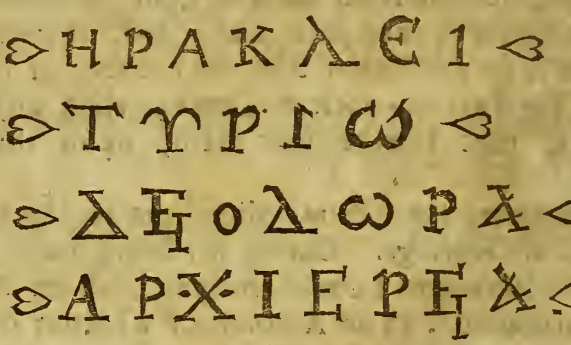
SOME Years ago, when I was in Town, You were pleaſed to deſire me, when my Occaſions might carry me into that Country, to give You a particular Account of the Truth of a Relation, which was ſent up to the *Athenian Society*, of the entire Skeleton of a prodigious Monſter, of Humane Form, above 22 Foot in length; which was diſcover'd upon the Banks of the River *Tyne*, not far from *Corbridge*, in *Northumberland*. The Relation was very particular; and, if it had been true, ſeem'd to go farther towards a Proof of ſuch ſtupendous Figures, in ancient Times; than any other Argument, that I have met with, upon that Subject.

Laſt Summer, my Affairs obliged me to ſtay three or four Days at *Corbridge*. During my being there, I made the beſt Obſervations I could, to give both my Self and Others Satisfaction, in an Account of a Matter of Fact; which had amuſed the Nation, ſo much, as that had done.

That

That I may be more Exact and Satisfactory, in what I have to offer, I shall give You an Account, I. Of the Place itself, and of the Antiquities, that are there. II. Of the Bones and Teeth, which are discovered there; and said to be of so prodigious a Bigness. III. I shall offer my Thoughts of the Matter; with Submission to Your, and Other, better Judgments.

I. The Place where the Bones were found is not *Corbridge*, but *Colchester*, a Mile West of it, upon the N. Banks of the River *Tyne*: formerly a Roman Colony; but, at present, a Field of Corn; nothing of Antiquity remaining, but some Walls and Rubbish; which shew it to have been a very large Fortress. Stones, which have been dug up, with Figures and Inscriptions upon them, have been All remov'd to *Corbridge*, which has rise out of its Ruins. There, I saw Altars inscrib'd; One IMP. M. AVRELIO.... Another LEG. II. AVG. COH. IIII. But That, which is most Remarkable, is that which stands in a corner of the Church-yard, Dedicated to *Hercules*, in Old Capital, *Greek* Characters; the like to which, is not to be met with, I think, in any other Part of this Island. The Characters, are indifferent plain; and, as I could read them, thus;



i. e. *Herculi Tyrio Divina Dona, Archi-Sacerdotalia*; vel, *per Summum Sacerdotem offerenda.* The Altar seems to have been

been Erected, by ſome of the *Aſiatick*, *Phœnician*, Auxiliaries; who might be in Garriſon here, near the Frontier, under *Urbicus Lollius*, in the Time of *M. Aur. Antoninus*, about *A. D.* 140. The Altar is very large; hollow at the Top, (as uſual) for Incenſe: On the Sides, are ingrav'd a Bull's Head; with Garlands, and Sacrificing Inſtruments.

II. The Teeth and Bones, which were diſcover'd, by the River *Tyne*'s breaking in upon the Bank, were found near the Foundations of the Old Fort; and neither higher up, nor lower down, than the Ruines of it ſeem to reach. I examin'd the Perſon who made the firſt Diſcovery; and had Money for preſenting ſome of the Bones, from ſome Gentlemen in the Neighbourhood; who, in all probability, gave in the Account, and their Queries upon it, to the Gentlemen of the *Athenian* Society: And I was as exact, as poſſible, in the Remarks, which I made my ſelf upon the Spot. Upon the whole, it appear'd to me: That there never was an entire Skeleton found in that Place. The Teeth and Bones, lye in the Bank, in *Strata*'s; ſometimes at one, ſometimes at two Yards depth, for above 200 Yards in length. In ſome places, there appears to have been a ſort of Pavement or Foundation of Stone; which runs along with the Bones, *ſtratum ſuper ſtratum*; ſometimes above, ſometimes below them. The Bones are of different Sizes: The Teeth, which are moſt perfect and entire, are very large; ſome three or four Inches in compaſs: Ribs, Shank-Bones, *&c.* (many of them) not exceeding the ordinary Dimenſions of thoſe of Sheep and Oxen. I could meet with no Remains of Horns; thoſe being more eaſily corrupted, than the Bones, which are of a harder Subſtance. The Teeth look as if they were Humane; but I cannot affirm them to be ſo: And they lye, ſometimes, at ſo great a diſtance from the Ribs and Shank-Bones; that ſhould any One compute (as I ſup-

poſe the Queriſts might do) the Length of the Monſter, from One to the Other, they might calculate his Longitude, to 200, or 300 Yards, as reaſonably, as to 22 Foot. The Teeth and Bones, are in ſuch Quantities; that, with the help of a Labourer or two, You might in a few Hours, gather a Buſhel of them.

III. From the Account I have given, it may not be unreaſonable to infer: That the Altar, here Dedicated to the *Tyrian Hercules*, was very famous and much frequented: That, Oxen, and ſuch like Creatures, as Biſons and Bonaſſus, (with which the Country hereabouts did anciently abound: The entire Head and Horns of One, being lately dug up, in a marſhy Ground; reſembling exactly thoſe Creatures, as they are deſcrib'd by *Geſner*, and Others,) were Sacrificed thereon: And, that their Bones being All thrown together; and, according to the Superſtition of thoſe Times, laid under the Foundation and Pavement of the Fort, are the very ſame Bones, Teeth, Skulls, Ribs; *&c.* which, by the Rivers waſhing away the Bank, are now diſcover'd, and brought to Light. And, if I might be allow'd to gueſs a little farther; I might think it not impoſſible, That (as *Erkelens* in *Gelderland*, is *Herculis Caſtra*; and *Hertland* in *Cornwall*, was *Herculis Promontorium*, So) upon the Receſs of the *Romans*, the *Saxons* who ſucceeded them, might call this Noted Station *Hercul-ceaſter*, and by corruption, *Colceaſter*; or *Colcheſter*, it's Modern Name. And, what may ſomewhat confirm the Conjecture, the adjacent Town of *Corbridge*, which, as I ſaid, has riſen out of its Ruins, is called in the Charter of *H.* I. (whereby that King gave it to the Secular Canons of *Carliſle*, before the Erection, either of the Priory or Biſhoprick,) *Colbrugge*, and *Colburgh*, the ſame as *Col-ceaſter*: The Bridge, from whence it may ſeem to take its Denomination, being of a much later Erection. That Oxen

uſed

uſed to be Sacrificed to *Hercules*, there needs no other Evidence, than the Altar itſelf; whereon an Ox's Head, with Sacrificing Inſtruments, are delineated. You will receive by the *Oxford* Carrier, a great many Teeth and Bones; whereby You may be able to give a much better Judgment, whether they are Humane or no, than I can: only, I would obſerve this, That if it do not appear that they agree perfectly with the Teeth and Bones of Oxen, it will not follow that therefore they muſt be Humane, and that there were Men of prodigious Stature who made uſe of them; ſeeing, as I ſaid, there were in theſe Parts, other Creatures of very great Size, to whom they might belong, and of whoſe Teeth and Bones, we have, now, very few Specimens, to compare them with. Thus, with ſome trouble both to You and my Self, I have perform'd my Promiſe; and ſhewn, what I ſhall be ready to do upon all Occaſions, that I am with great Eſteem,

Your very affectionate Friend

Carliſle, Febr. 17.
1710-11.

And humble Servant,

HUGH TODD.

IV. *An Account of the Moſſes in* Scotland. *In a Letter from the Right Honourable* George *Earl of* Cromertie, *&c. Fellow of the Royal Society, to Dr.* Hans Sloane, *R. S. Secr.*

November 15. 1710.

SIR,

WHEN we were ſpeaking lately of the Oak and Firr Trees, which are found under Ground, in many Places of *Britain*, but more frequently in the Northern Parts; you was pleaſed to take notice of ſome things, which I told you, relating to this Subject: And in order to farther Obſervation, I thought you might have wiſh'd them to be put in Writing; and here you have them.

There are many Grounds in *Scotland*, which we call Moſſes; from whence the Country-People dig Turf, and Peats. The Surface is covered with a heathy, and, (as they call it) a heathery Scurf: And under that Scurf, there is a black, moiſt, ſpongy Earth; in ſome Places ſhallower, and in other ſome deeper; from three, or four, to ſeven, or eight Foot deep: And in ſome Places, but not in many, to twice, or thrice that depth. They cut the Heathy Scurf, with a flat kind of Spade, which they force Horrizontally, betwixt the Scurf and the foreſaid ſpongy Earth; and ſo turn up the Scurf in flat thin Flakes, which they call Turffs. It is readily over-runn'd with the ſmall Roots of Heath, or Heather; and when dried, makes a healthy brisk Fire; but with much Aſhes, of a whitiſh, duskiſh, or reddiſh Colour; always the whiter, as it contains the more of the woody Roots.

The

The black ſpongy Earth, which is under the Turf, they cut out in oblong Squares, with Iron-Spades made of that Shape, about 8 or 9 Inches long, and about 4 or 5 Inches broad: And as the Men cut them up, the weaker Men, Women and Children, carry them in ſmall Wheel-barrows, ſcattering them on ſome dry Ground, to be dried by Sun and Wind: Some become harder, ſome ſofter, according to the Nature of the Mould, or Earth; the more ſolid, the better Fire; and they are leſs eſteemed, which are more ſpungy. And when they have cut off one Surface, of four, or five Inches deep, they proceed downward to another; until at laſt, they come to the hard Channel, unleſs they be ſtopped by Water; which alſo they ordinarily remove by making a Channel to ſome Deſcent, if they can; and if they cannot, there the Water ſtagnates.

And in ſuch waſted Pits, where Water hinders to cut the ſpungy Earth to the bottom; The Pits will be filled up again, in a good number of Years, with new Ground, of ſpungy Earth; which in progreſs of Time, will come to the Conſiſtence of Peat-Moſs, as at firſt, and a Scurfy Heath Turf will at laſt grow on the Top of it.

I have obſerv'd, That Peat-Pits, which have been digged, ſince I remember, to have grown up again with new Peats; and that ſometimes oftner than once, in the ſame Pits; ſome Moſſes growing in ſhorter time than others. But I have obſerv'd alſo, That when they dig the Peats to the Channel, and in Places where the Water runs off, and doth not ſtagnate, that the Moſſes did not grow, nor renew there again. Which moved me to order my Tenants, not to cut the Moſſes to the Channel, nor in very large Openings; but rather in ſmaller Pits, that they may grow again more haſtily: And the Event hath anſwer'd my Deſign. But within theſe few Days, ſpeaking with Sir *Robert Adaire*, (a moſt Ingenious Gentleman)

tleman) he told me, That without cutting the Moſſes, in the Method of Pits; but by cutting in fully to the Channel, and by laying the heathy Turf, which is cut off the Top of the Moſs; he ſaid, by laying it on the Channel, ſo as to cover the Channel over, that in progreſs of Time a Moſs would grow there again; but not ſo haſtily as in the Pits.

I never obſerved any of theſe Moſſes, which did not ſtand on Plains: Albeit the heathy, or heathry Turf, do over-ſpread the Faces and Declivities of the *Scots* Mountains, for the moſt part; there are many Moſſes, which ſtand very high on theſe Hills; yea ſometimes not very far from the Top. But the Peat Moſſes are always in a Plain, tho' there be Deſcents to them, and Deſcents from them; yet I never obſerved them to ſtand on ſuch a Plain, as the Water might ſtagnate on: And they always have a Deſcent to them, from ſome higher Grounds, whereby Water did deſcend to that Plain; which I take to be the Parent of Peat. Thus much of the Moſſes in general.

In many of theſe Moſſes, there is found quantities of Firr and Oak Wood; for, as I ſaid, I never obſerved nor heard of other Woods in them. Theſe are ordinarily found in whole Trees; but the ſmaller Branches are ſeldom found unconſumed. I have ſeen very many, and very great Trees of both kinds: But generally ſpeaking, the Oak is always black; the Firr ſometimes whiter, ſometimes redder, as is obſerv'd in all Firr Woods: But neither Firr nor Oak, are found with any Bark upon them. The Firr is generally as freſh and tuff, and as fit for any Uſe, as any other old Wood is: Only the Wood of theſe found in Moſſes, has ſo imbibed the Water, that it takes a long time to dry, and fit it for Uſe, eſpecially the Oak; inſomuch, that when it is put into any ſmall Work, it readily warps and changes its Figure. We never find any of the

the Oaks ſtanding in the Woods, have that Blackneſs; ſo that, I preſume, the Blackneſs accrues from the Water.

There are many Places, where Woods do not now grow; albeit, People endeavour to Cultivate them; and yet the Moſſes in theſe Places are well ſtored with this kind of under-ground Timber, both Oak and Firr, but eſpecially Firr; ſuch are *Orkney*, the *Lewes* (which are Iſles,) *Cathneſs*, *Tarbartneſs*, and the Coaſt of *Buchan*. But yet it would appear, that there have been Woods of Old in theſe Places, or how elſe could they come to theſe Moſſes: And for a farther Proof of this Inference, be pleaſed to take Notice of the following Account, which gave occaſion to this Letter.

In the Year 1651. I being then about 19 Years Old, and occaſionally in the Pariſh of *Lochbrun*, paſſing from a Place called *Achadiſcald*, to *Gonnazd*, I went by a very high Hill, which did riſe in a conſtant ſteepneſs from the Sea; only in leſs than half a Mile up from the Sea, there is a Plain about half a Mile round; and from thence the Hill riſes in a conſtant ſteepneſs, for more than a Mile in Aſcent. This little Plain was at that time all covered over with a firm ſtanding Wood; which was ſo very Old, that not only the Trees had no green Leaves, but the Bark was totally thrown off; which the Old Countrymen, who were in my Company, told me, was the univerſal manner in which Firr Woods did terminate; and that in 20, or 30 Years after, the Trees would ordinarily caſt themſelves up from the Root; and that they would lie in heaps, till the People would cut them, and carry them away. They likewiſe did let me ſee, that the outſide of theſe ſtanding white Trees, and for the ſpace of one Inch inward, was dead white Timber; but what was within that, was good ſolid Timber, even to the very Pith, and as full of Rozin as it could ſtand in the Wood.

Some

Some Fifteen Years after, or thereabouts, I had occaſion to come the ſame way; and call'd to mind the Old Woods which I had ſeen. Then there was not ſo much as a Tree, or appearance of the Root of any; but in place thereof, the whole Bounds, where the Wood had ſtood, was all over a plain green ground, covered with a plain green Moſs. I asked the Country-People, who were with me, what became of the Wood, and who carried it away? They told me, no body was at the Pains to carry it away; but that it being all overturn'd from the Roots by Winds, the Trees did lie ſo thick and ſwarving over one another, that the green Moſs (there, in the *Britiſh* Language called Fog) had over-grown the whole Timber; which, they ſaid, was occaſion'd by the moiſture that came down from the high Hill, which was above it, and did ſtagnate upon that Plain; and they ſaid none could paſs over it, becauſe the Scurf of the Fog would not ſupport them. I would needs try it; and accordingly I fell in to the Arm-Pits, but was immediately pull'd up by them. Before the Year 1699. that whole Piece of Ground was turn'd into a common Moſs; where the Country-People are digging Turf and Peats, and continue ſo to do. The Peats as yet are not of the beſt, and are ſoft and ſpungy, but grow better and better; and as I am inform'd, it does now afford good Peats.

This Matter of Fact, did diſcover the Generation of Moſſes; and whence it is, that many Moſſes are furniſh'd with ſuch Timber.

Theſe Highland Woods are ordinarily ſtored with other kind of Timber, as Birch, Alder, Aſh, beſides Shrubs, and Thorns; yet we never find any of thoſe Woods remaining in the Moſſes.

What the Reaſon may be, That the Firr and Oak do not now grow in ſeveral Countries, where they are found ſo plentifully in the Moſſes, *Inquirendum eſt.*

Whilſt

Whilſt I ſpeak of Moſſes, allow me to add this, which ſeems to me notable, (*viz.*) That in a Moſs near the Town of *Elgin* in *Murray*, tho' there be no River or Water that runs into the Moſs, yet three or four Feet in the Moſs, there is a ſort of little Shell-Fiſh reſembling Oyſters, found numerouſly in the very body of the Peats, and the Fiſh alive within them; tho' no ſuch Fiſh be found in any Water near to that Moſs, nor in any adjacent River; no, nor in the ſtagnating Pits, that are in that Moſs; but only in the very ſubſtance of the Turf: Some of which were ſent to me from the place, a little before I came from *Scotland*. Sir, your own command will excuſe this trouble given by

Your moſt humble Servant,

CROMERTIE.

V. *A Letter from Dr.* Hans Sloane, *R. S. Secr. to the Right Honourable the Earl of* Cromertie, *in Answer to the foregoing Letter*, &c.

My Lord,

I Had the Honour to receive your Lordship's very obliging and instructing Letter, relating to Turf Boggs, or Mosses in *Scotland*, and the Wood found in them; which I have communicated to the *Royal Society*, who commanded me to return your Lordship their most humble Thanks. I have seen many such in the North of *Ireland*, and know your Lordship's Account of them to be very exact and true. I have likewise been an Eye-witness there, that when the Turf diggers have come to the bottom, or firm Ground, by having dug out all the Earth proper to make Turf or Peat, and come to the Clay or other Soil, by draining off the Water, that then there have appeared Roots of Firr Trees, with their Stumps standing a Foot or two strait upright, and their Branches spread out on every side horizontally on that firm Surface; as if that had been formerly the outward Face of the Ground, and place of their Growth. And I remember to have observ'd these Roots to be sometimes so near one another, as that their Branches were, as it were, matted, grew over, and gave place to one another, as we every Day see in Roots of Trees where they grow too close. I saw once the body of a Firr Tree dug up so big, as to be judg'd fit for the main Post of a Wind-Mill; which was discover'd, as many of them, which are not found in digging Turf, are, by the

the Graſs, which grew over it being, in a very dry Summer, of a yellowiſh colour.

The Reverend Mr. *de la Pryme* ſent me ſome of the Cones found with this Timber in the great Fenns of *Lincolnſhire*, which differed in nothing from thoſe of the *Scotch* Firr, which your Lordſhip has ſo plentifully growing in *Scotland* at this Day, and which ſome Years ſince were judged ſo proper by ſome to afford Maſts for the Navy Royal, that I think ſome Perſons were ſent thither for that purpoſe. But they were not able to bring about what they intended, by reaſon of the Difficulties in the Roads by which they were to be conveyed to the Sea; which in *Norway* I have heard is in a great meaſure effected by the Rivers. *Cæſar*, indeed, in his Commentaries ſays, that the ſorts of Timber in this Iſland are the ſame as in *France*, *præter fagum & abietem*, except Beach and Firr. Your Lordſhip is a ſufficient Witneſs of his miſtake as to one ſort of theſe Trees, and the Beaches in the *Chiltern* Countries near *London*, prove the ſame as to the other. For the uſes of this under-ground Timber, beſides thoſe of other Wood, it is ſplit into pieces; and being lighted, ſupplies the uſe of Candles. It is alſo made into Ropes; as may be ſeen in the *Muſæum* of the Royal Society, by a long piece of ſuch Rope, bought by the Honourable *Edward Southwell* Eſq; in *Newry* Market in *Ireland*, and preſented by him to the Royal Society; the long ſoaking in Water having render'd the Wood of thoſe Trees fit to be made into Ropes. This ſeems to prove, that as the ſoaking of Hemp, Flax, Aloe Leaves, *&c.* in Water, diſſolves the pulpy part, and leaves the fibrous fit for making into Threads and Ropes, ſo the long ſoaking of Trees may make in length of Time the ſame, or an analogous change in thoſe of Wood and Timber. There are ſome things remarkable which I will beg leave to acquaint

your Lordſhip with, relating to this Subject, and which, I think, are worth your Lordſhip's knowledge. One is, that I have ſeen what I thought had been pieces of Wood, not only in Clay Pits, but even in Quaries or Stone Pits, in the Blocks of Stone raiſed out of their *Strata*, or Layers; and have been aſſured by Mr. *Bellers*, he hath ſeen large pieces of Wood in the Stone Pits in *Glouceſterſhire*; and alſo that in *Lancaſhire* there is a Moſs, or Turf Bogg, where the black ſpungy Mould, made uſe of for Peats, ſmells very ſtrong of *Bitumen*, or *Petroleum*; of the Oil of which it yields a very great quantity by Diſtillation. And likewiſe, what the late Sir *Edward Hannes* told me, namely, that near the Lord *Bleſſington*'s Houſe at *Bleſſington* in *Ireland*, there appeared a Light where the Horſes trampled with their Feet on a certain ſpace of ſoft Ground. On my deſire he procured me ſome of this Mould, which I have yet by me, and which agrees exactly in its dark colour, lightneſs, *&c:* with Peat Earth. And on Examination of this by a Microſcope, I found the light proceeded from many ſmall half tranſparent whitiſh live Worms, which lay in it.

The Blackneſs of the Oak, which your Lordſhip mentions, comes, in my Opinion, from the Vitriolic Juices of the Earth ſoak'd into the Oak, which being aſtringent is turn'd black by them. Your Lordſhip knows that Ink is made of Galls, an aſtringent Excreſcence of a ſort of Oak in *Turkey*, made by an Inſect there; and of green Vitriol, which is made of the Pyrites diſſolv'd by Rain Water, and Iron. Earth of all ſorts, and even Human Calculi, and the Aſhes of Vegetables, have in them Particles of Iron, in greater or leſſer quantities. The Pyrites is alſo very common. The Particles of Iron coming to be diſſolv'd by this Pyrites, Subacid, or other Salts diſſolv'd by Water, or perhaps by Water itſelf, and carried into theſe Boggs, there faſtens to the Tree, ſoaks into it, and turns it black.

Theſe

These Particles in some River Water, fastening to the Oak Timber floated in it, give the same a darkish colour; taken notice of by Mr. *Pepys* in his Naval Memoirs of *England*, p. 71. where we are told by the most famous Ship-Builders of *England*, "That the "best Foreign Plank for the Royal Navy was brought "either from *Dantzick*, *Quinborow*, (that is *Koningsberg*,) "or *Riga*, of the Growth of *Poland* and *Prussia*, or from "*Hamburgh*; namely, that sort thereof which is Shipp'd "from thence of the Growth of *Bohemia*, distinguish'd "by its Colour, as being much more black than the "other, and rendred so (as is said) by its long sobbing "in the Water during its Passage thither.

In the Turf Boggs of *Ireland* 14 Foot deep, are found not only the Mouse-Deers Horns, mentioned in one of these Transactions, but likewise their whole Sceletons, wherein the Bones bear the same proportion to the like Bones of other Deer, as the Horns bear to their Horns, There are also found therein Gold Chains, Pieces of Money, and Roots of Heath, several *musci*, and Branches of Trees so soft, as to give no resistance to the Turf Spade: And I was told, that in cutting Turf in one, they at several Feet deep cut thro' what the *Irish* call a Ruskin of Butter (which was a Firkin, or Vessel, made of the Barks of Trees, used by the Old *Irish* for putting up their Butter.) And I remember, that in digging the wet Dock at *Deptford*, there were found at the bottom, about Nine Foot deep, Grass Leaves, Hazle Nuts, and Roots of Trees: And there also was found a Piece of Money, as they call'd it; which esteeming a Rarity, they sent to Sir *Josiah Child*. I had the Favour to have it sent me by Mrs. *Willoughby*, and it prov'd to be a Leaden Seal to some Bull of Pope *Gregory* the IX. who continued Pope from the Year of our Lord 1227 to 1241.

I have nothing farther to trouble your Lordship with, but some few Passages I took notice of in *Leland's* *Itine-*

Itinerary, Vol. V. which have a near relation to these Matters, and shew the common Opinion in his Days of the cause of the destruction of Woods, the growing of Mosses and Pools; and that, at that time, in *Wales*, the sence of the Inhabitants was, that the under-ground Trees found there had formerly grown there; which, because they were writ by so Inquisitive and Learned a Person, and at such a distance of Time as that of the Reign of *Henry* the VIII. Your Lordship will Pardon me to subjoin them in his own Words, the Language of that time.

I am,

Your Lordship's most Obedient,

and most humble Servant,

HANS SLOANE.

Leland's *Itinerary*, *Vol. V.* p. 13.

" In these Deyes in *Mone* wher they digge Turves be " founde greate Rootes of Trees that serve Men for " Wood. For after the Trees wer cut doune sogging " Yerth and Mosse overcoverid them, and now the " same Yerth parid away for Turves the old mayne " Rootes appere.

" Likewise at Low Water about al the shores of both " Shores of *Aberdein* and *Towen Merioneth* appere like " Rootes of Trees.

p. 67.

" I saw hard by on the lift Honde a great Fenny " More, owt of wich the Inhabitantes therabout digge " Turfes for Fier, and by the same Fenne is a fair " *LLin* cawllid *LLinridde* ii Miles from *Strateflur*.

p. 68.

" *Strateflure* is set round about with Montanes not far " distant, except on the West Parte, wher *Diffrin Tyue* " is. Many Hilles therabout hath bene well woddid, " as evidently by old Rotes apperith, but now in " them is almost no Woode.

" The Cauſſes be theſe ; Firſt the Wood cutt doun " was never copiſid, and this hath beene a great Cauſe " of Deſtruction of Wood thorough *Wales*. Secondly " after cutting doun of Wooddys the Gottys hath " ſo bytten the young Spring that it never grew but " lyke Shrubbes. Thirddely Men for the nonys de- " ſtroied the great Woddis that thei ſhuld not harborow " Theves.

" From *Whitchirch* a Mile and a half of I cam by the p. 75. " Pale of the large Parke of *Blakmer* longging to the " Erle of *Shreusbiri*, wherin is a very fair Place or Loge. " The Park hath both redde Dere and falow. In the " Park (as I hard ſay) be iii. faire Poles, of the wich " I ſaw by the Pale the largeſt caullid *Blakein*, wherof " the Park is namid.

" It is to be ſuppoſid that thes Pooles for the moſt " part in Moriſch Groundes, and lying ſumwhat in " low Groundes dreane the moiſt Places about them, " and ſo having no Place to iſſue owt ſtagne there.

" Sum be likelyhod have begon of Marle Pittes. For " the Sandy Grounde of ſum Partes of *Shropſhire*, and " eſpecially of *Cheſtreſhire* and *Lancaſtreſhire*, wille not " bere Corne plentifully but it be merlyd.

" From *Blakemere* to *Byklem* in a Foſſe iii. Miles of Sand " hard by *Cholmeley*. firſt I ſaw the great numbre of " Firre Trees, the wiche the Inhabitantes thereby " communely digge up for Fier Wood, but ther did " I ſe no Fyrre Trees grouing. Oftentimes in diggin " in this Moſſe or More for Petes or Turves they finde " the hole Trees of the firſt, ſum ſhort and ſum veri " long, without Twike or Bow, lying ſumtime not a " Foote, ſumtime iii. or iiii. Foote depe in the Ground " but how or when thes Trees cam doune other be " Cutting or Wind Faulle no Manne ther can telle. " The Wood of them in Burning ſavorith of Re- " ſine.

" *Morle*

P. 79. " *Morle* (in *Darbyſhire*) Mr. *Lelandes* Place is buildid " ſaving the Fundation of Stone ſquarid that riſith with- " in a great Moote a vi. Foote above the Water, al of " Tymbre after the commune ſort of building of Houſes " of the Gentilmen for moſt of *Lancaſtreſhire*. Ther is " as much Pleaſur of Orchardes of great Varite of Frute " and fair made Walkes and Gardines as ther is in any " place of *Lancaſtreſhire*. He brennith al Turfes and " Petes for the Commodite of Moſſes and Mores at " hand. For *Chateley* Moſſe that with breking up of " Abundance of Water yn hid did much hurt to Landes " thereabout, and Rivers with wandering Moſſe and " corrupte Water is within leſs than a Mile of *Morle*. " And yet by *Morle* as in Hegge Rowes and Grovettes " is meately good Plenti of Wood, but good Husbandes " keep hit for a Jewell.

" Syr *John Holcroftes* Houſe within a Mile or more " of *Morle* ſtoode in jeopardi with fleting of the " Moſſe.

" Riding a Mile and more beyond *Morle* I ſaw on " the right hond a Place nere by of Mr. *Adderton*, and " ſo a ii. Miles of to *Lidiate Moſſe*, in the right ſide " wherof my Gide ſaid that ther were Rootes of Fyrre " Wood.

P. 81. " Al *Aunderneſſe* for the moſt parte in time paſt hath " beene ful of Wood, and many of the Moores reple- " niſhid with hy Fyrre Trees.

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BRITISH MUSEUM
NATURAL HISTORY.

PHILOSOPHICAL TRANSACTIONS.

For the Months of July, August, *and* September, 1711.

The CONTENTS.

I. *De* Araneis & Scarabæis Philippensibus. *Ex MSS. R. P.* Geo. Jos. Camelli. *Communicavit* Jacobus Petiver, *S. R. S.*

De Araneis *Crustaceis* Philippensibus.

ARaneos *fila* deducere non ab intrinseco, tanquam excremento, ut ait *Democritus* & *Plinius*; sed extrinsecus de suo corpore, veluti cortice, asserit cum *Aristotele Aldrovandus* & *Forerus*.

a GAZ. Nat. Tab. 26. fig. 7. Verum *Anno* 1695. (*a*) Araneos *Crustaceos* nitidissimè nigro & flavo picturatos, formæ *Tribuli*, vel potius *Paguri*, in Horto domestico in *Acacia* & *Fagara* cæpi. Unde *Democriti*, *Plinij*, *Josephi Blancani* & aliorum sententia, *Araneos* ab intrinseco fila sua ducere vindicanda videtur.

b GAZ. Nat. Tab. 26. fig. 6. Alios *testaceos* (*b*) sexangulares dein Anno inveni subsequenti, *flavo* & *nigro*; *alios* (*c*) albo & nigro variatos, & sex aculeis spinosos: *Alium* (*d*) item postea

c GAZ. Nat. Tab. 26. fig. 8. *flavo* & *nigro* variegatum, majorem, & formæ Lunaris. *an* Hoitztocatl *Niremberg.* seu *Araneus spinosus?* morsu de-

d GAZ. Nat. Tab. 26. fig. 5. mentans, superiore & media corporis portione niger, cætera luteus, formæ aculeatæ & similis *Tribulo*. Aranei *crustacei* ictui medetur *Tambalquisay*, *Camaæsa* & *Piligpoc*. Nidum vel Ovarium texit electé sericeum, *flavum* vel etiam *virentem*, in qua ova reponit *candida*.

1 1. Araneus *Luzon.* crustaceus, cornu lunulato. GAZ. NATUR. Tab. 26. Fig. 7.

2 2. Araneus *Luzon.* testaceus, trilunatus. GAZOPHYL. NAT. Tab. 26. fig. 6.

3 3. Araneus *Luzon.* Bovinus. GAZ. NATUR. Tab. 26. fig. 5.

4. Araneus

4. Araneus *Luzon.* teſtaceus, anguſtus, trilunatus. GAZ. NAT. Tab. 26. fig. 8. 4

De *Araneis* alijs *Luzonenſibus.*

5. *Araneus* Banayau 1. *Kamel.* Aran. *Luzon.* mortiferus Smaragdino-aureus. GAZ. NAT. Tab. 29. fig. 4. Hic ictu ſoporem & mortem cauſat Hominibus & Brutis: gaudet *Syringæ* ſeu *Sambach Arabum* convolutis in folijs habitare: hujus ictui medetur decoctum *Dauvæ* & Ignis. *an* Araneus aureus, *Lavalava* Nirembergij, ſtuporem & inſaniam inducens? 5

6. *Araneus* parvus brevipes, coloris chermeſini, mortiferus. *Banayau* 2 Kamel. 6

7. *Araneus* gibboſus *Luz.* ſubfuſcus, gibbo oblongo, per totum dorſum protracto, elevato & flavo *Kamel.* GAZ. NATUR. Tab. 29. fig. 12. *Ova* recondit in orbicularibus, flavis & ſericeis nidis, *candidula.* 7

8. *Araneus* gibboſus *alter.* Corpore eſt *Piſo* ſuppari, dorſo proprie in altum gibbum elevato, de reliquo picturatus eſt aureo fulgente, argenteo relucente & nigro aterrimo. 8

9. *Araneus* longipes 1. *Kamel.* Ar. *Luz.* longipes *domeſticus.* GAZ. NAT. Tab. 50. fig. 1. Corpore eſt Muſcæ tenuiori, domeſticus, retiarius, rete varium, quod præda adveniente totum concutit. Communiter Mas & Fæmina in eodem degunt *Fæmina* habitior eſt, & una nocte *Ova* excluſit, quæ mane in Piſo pari racemulo congeſta ore pendentia gerebat; die 3 à capturâ piloſa aparuere, 4 magis piloſa, 5 frequentes aranei per vitrum diſperſi ſunt, remanente inani & candido ovario ab ore matris pendente. 9

10. Araneus longipes alter *Kamel.* Araneus *Luzon.* ongipes, ſem. Ricino æmulans. GAZ. NATUR. Tab. 50. ig. 4. Habitior eſt priore, ventre Piſo pari ſplendido, ut ſemen Ricini picturato, mucronato. 10

11. Araneus longipes *Luzon.* 3. Domeſticus eſt, hirutus & innocuus. 11

12. Araneus

12 12. *Araneus* longipes *Trojanus* sive 4. Bagua & Gambagamba *Indis.* Tarantula *Luzon.* innocuus. GAZ. NAT. Tab 50. fig. 2. & A. Corporis mole Avellanam æquat, sericeum, albicans, folliculosum, globoso-subplanum ovarium ad ventrem gerens, ex quo mille prodeunt Araneorum. Cæterum fuscus, domesticus, innocuus, vescens Proscarabæis. *an* Araneus 10 *Hernandi*?

13 13. Araneus longipes 5. *Gagamba* Luzonensibus. Corpore minor, quod cinereo & nigro picturatum est.

14 14. *Araneus* longipes 6. Araneus *Luzon.* telarius, argenteo, flavo, & nigro transversim striatus. GAZ. NAT. Tab. 50. fig. 3. Subdialis est. Ejus sericeum album & planum ovarium, in quo ut puto 2000 ovorum alborum latebant. *vid.* Tab. 50. fig. B.

15 15. Araneus *Luzon.* oblongus, lutescens, longipes, ventre tenui, geniculo in caudam distincto. GAZ. NATUR. Tab. 43. fig. 14.

16 16. *Araneus* maximus, fuscus, pilosus; *Damang* Luzon. *Corpore* craſtitudinis est pollicaris. *Degit* locis humidis: pernicioſus ut *Vipera.* an *Species* Tarantulæ?

17 17. Araneus *Luzon.* ex argenteo, flavo & fusco pulchre mixto, pedibus nigris. GAZ. Nat. 29. fig. 6. *Araneus* pulchrè picturatus: Caput, Pectus, corporis binæ striæ laterales, & illa per medium excurrens, argenteo relucente colore obducta: Binæ striæ inter argenteas excurrentes fuscæ, 4 flavis transversim secantibus strijs cancellatæ: pedes longi, nigri.

18 18. Araneus *Luzon.* torosus, pilosus, totus fuscus. GAZ. NAT. Tab. 29. fig. 10.

19 19. Araneus *Luzon.* torosus, pilosus minor, dorso nigro variegatus.

20 20. *Araneus* rarus, niger, splendens; forficulas habens ipso ventre compares; nec primo intuitu facile dictu, quisnam venter, aut quæ sint forficulæ. GAZ. NATUR. Tab. 54. fig. 3.

21. Araneus

21. Araneus venator Muſcarum, in parietum rimis degens, albo & griſeo variegatus: Saltu Muſcis inſidians. *Hiſpanis* Cayman de las *Moſcas*. GAZ. Nat. Tab. 54. 4. 21

22. Cotocoto. Araneus eſt Aquaticus. 22

23. Laura vel Lavalava. Araneus eſt Domeſticus. 23

De *Scarabæis* Luzonenſibus.

Cantharis Luzon. *Cetonia* praſino-aurea, luteo-albicantibus maculis variata, ad ventrem ejuſdem coloris, ſed ſtriatim picturata. GAZOPHYL. NAT. Tab. 26. fig. 9. 1 GAZ. NAT. Tab. 26. f. 9.

Cantharis *Luzon.* pulcherrima, vaginâ integrâ non fiſſâ, quinis aureo-cyaneis maculis ornatâ, ipſa flavo-aurea; venter medius ſuperne ſmaragdino-aureus & tribus aureo-cyaneis maculis notatus ut vagina dorſi: Inferior venter aureis & aureo-virentibus ſtrijs tranſverſim virgatus eſt. 2 G. N. 37. 7.

Stockerus Luzon. viridis, ſcapulâ maculiſq; purpureis. GAZ. NATUR. Tab. 37. fig. 7.

Cantharis Luzon. *minima*, magnitudinis eſt hujatis Cicindelæ, ſmaragdino-aurea, capite & pedibus cyaneis, collo luteo, corniculis plumatis. *Indis* Alibamban & Paranparan. 3

Cantharis Catunduana & Bicolana *major*, palmo longior, auriluca, ſmaragdina. *Indis* Olaniban & Baſangoban. 4

Cantharis oblonga communis, nitidiſſime tota, aureoviridis, *Camarinenſium.* Diao, Giao, Laniban & Salibat *Indis*. GAZ. NAT. Tab. 48. fig 5. 5 G. N. 48. 5.

Cantharis cæruleo-aurea, elytris ad medium luteo-aureis maculis notatis. GAZ. NAT. Tab. 49. 7. 7 G. N. 41. 2.

Cantharis merè viridis, *Indis* Ticpaclong. GAZ. NAT. Tab. 41. fig. 2.

Cantharis auriluca, viridante & rubente ſtriatim varia. 8

Cochinella *Luzon*. major, è cupreo viridique eleganter ſtriata. GAZ. NAT. Tab. 41. fig. 3. G. N. 41. 3.

Cantharis *Luzonis* nona & maxima, perpolita, tota multò ſplendidior quintâ, colore aureo-ſmaragdino per- 9 G. N. 28. 5.

 petuante

petuante. Differt a Quintâ, capite, quod longius; mustacis, qui curti & subplani; scapulari, quod longius anguloſè protensum, & pedibus, quorum ultima articulatio spinosa, uropygio, quod coloris est cuprei. *Oculi* nigri sunt.

Scarabæus pectinatus *Luzon.* aureo-smaragdinus. GAZ. NAT. Tab. 28. fig. 3.

9 G. N. 37. 6. Capricornus *Luzonicus*, seu *Carabus*, sive *Cerambix*, facie *Tauri.* Antennis articulatim nodosis; coloris in fusco, cinereo-luteſcente undulatus, capite valido, facie Tauri, duobus majoribus & aduncis dentibus instructus. GAZ. NAT. Tab. 37. fig. 6.

10 G. N. 37. 12. Capricornus alter, atratus est & striatus. GAZ. NAT. Tab. 37. fig. 12.

11 G. N. 28. 5. Capricornus *Luzon.* 3. Totus ex atro & pomi aurei colore picturatus est. GAZ. NAT. Tab. 28. fig. 5.

12 G. N. 47. 1. Capricornus seu Cerambix *Luzon.* maxima. GAZ. NAT. Tab. 47. fig. 1.

13 G. N. 49. 8. Buceros Nasicornis 1. *Luzon.* Hoang. GAZ. NAT. Tab. 49. fig. 8. & Kamel. in Append. *Ray* Hist. Plant. V. 3. p. 44.

14 G. N. 29. 2. Buceros Nasicornis alter *Bogang* Luzon. GAZ. NAT. Tab 29. fig. 2. & Kamel in App. Ray. p. 44.

15 *Melolonthes* seu *Cantharis* merè viridis major. *Indis* Salaguinto. *Germanis* Gruner, *May-Koffer*, & S. Joannis *Koffer.*

16 G. N. 41. 2. *Melolonthes* seu *Cantharis* merè viridis *minor.* Indis *Ticpaclong*, Germ. *Gold Koffer*, id No. 7. G. N. 41. 2.

N. B. Inveniuntur & Flavæ, Rubeæ, Ceruleæ, & variè picturatæ.

17 G. N. 38. 11. Scarabæus *arboreus*, seu Bruchus *Majalis* subluſtris, in fusco cinereis punctis notatus, Europæo compar & major. *Indis* Salibamban & Salagubat, *Germ.* Mayen-Koffer & Baum-Koffer. GAZ. NAT. Tab. 38. fig. 11.

18 G. N. 38. 6. Scarabæus *arboreus* 2. luteo-fuscus, tenuissimè striatus. GAZ. NAT. Tab. 38. 6.

19 G. N. 38. 5. Scarabæus *arboreus* 3 subplanus, subluſtris, luride èrugiноsè maculosus. G. N. Tab. 38. fig. 5.

Scarabæus

Scarabæus atratus, elytris ſtriatis, forcipulâ validâ bifurcatâ, quâ arbores atterebrat, donatus. G. N. Tab. 42. 3. 20 G. N. 42. 3.

Scarabæus mirabilis, caput lato & denticulato ſcuto contegente. Gaudens *Scilla*. GAZ. NAT. Tab. 42. fig. 2. 21 G. N. 42. 2.

Scarabæus *pilularis* toroſus, niger, *Luzonis* minimus. *Germ.* Roſs-Koffer. GAZ. NAT. Tab. 42. fig. 5. 22 G. N. 42. 5.

Scarabæus *Luz.* elaſticus, vaginis ſtriatis. GAZ. NAT. Tab. 27. fig. 10. 23 G. N. 27. 10.

Scarabæus ſaltator *Luz. Germ.* Springer. *Indis* Dangdo. Hujas Europæo major eſt, ſubluſtris, coloris terreo-fuſci, non ater ut ille; ad Pectus habet ſolidum ſtimulum, quo ſupinè poſitus nititur in altum vibrari. Elytra ſtriata, caput parvulum.

Scarabæus *Saltator*, ſeu ille parvus, oblongus, niger, qui ſupinè poſitus e latere intenſo in altum vibratur; in *Luzone* ſordidè niger eſt & ſeſquiuncialis. *Hiſp.* Batecavezi. *Germ.* Springer & Schueſter. *Indis* Baldoc bondoc. *Tagal* Dangdo. 24

Scarabæus *Saltator* alter parvulus. Europæo minor eſt, luteus, & ad extremum niger. 25

Proſcarabæus nocturnus domeſticus *Kameli*.

Blatta domeſtica *Luzon.* nocturna. GAZ. NAT. Tab. 48. fig. 9. *Cucca* & *Cuccaracha* Hiſpan. *Schioabem* Germ. *Luſit.* Barata. Ipis & Bangcocang *Indis*. hujus eſt Species *Gukiana*. 26 G. N. 48. 9.

Inſectum eſt malè olens, elytris tenuibus, omnia depaſcens & arrodens. *Mas* coloris griſei, aliquibus nigris punctis variegatus. *Fœmina* tota coloris caſtanei, & *minor* mare, ova excludens oblongo-compreſſa ad latus acuta. *Mas* & *Fœmina* depoſitâ ſenectâ candidi ſunt & tenelli. Utuntur *Indi* cinere poto in Aſtmate, contuſis cum Saccharo, & impoſitis in *Cancro* & *Panaritio* & ulceribus ſuppurandis. Aſſos No. 6 vel 8. exhibent *Pueris* lumbricis laborantibus, quos enecant.

II. *Part of a Letter from Mr.* Anthony van Leeuwenhock, *F.R.S. to Mr.* James Petiver, *F.R.S.. Containing ſome Microſcopical Obſervations upon the* Animalcula in Semine *of Young Rams.*

Delft in *Holland*, *Auguſt* 18. 1711.

SIR,

HAving about the time that you call'd upon me, employed my ſelf in Diſſecting the Teſticles of a young Ram, I take the Liberty to communicate to you my Obſervations thereupon. At the latter end of the Month of *June*, I procured two Teſticles of a young Sheep, to which they ſtill gave the name of a Lamb, and I made a ſmall Inciſion in the lower part of each of them, where there was a Protuberant roundneſs, and from whence proceeded the *Vaſa Semen deferentia*: Then I ſqueez'd a little whitiſh Matter out of them, which I immediately placed before a Microſcope; and having very clearly obſerv'd a vaſt number of *Animalcula* living and moving, I was reſolved not to ingroſs the Spectacle to my ſelf alone, but I call'd four ſeveral Perſons to be Eye-witneſſes of the ſame; which I did the rather, becauſe I have been charged by ſome Learned People, but not of our Town, that what I have affirmed upon this matter was not true: And becauſe the *Animalcula* could not be ſeen ſo diſtinctly, by reaſon of the vaſt number and the quick Motion of 'em in the little ſlimy Matter, in which they ſwam among one another, I took a little Rain Water, about the quantity of

of a great Pins head, and mixed it with an equal quantity of the ſaid Matter; whereby it being very much Diluted, I placed it again before the Microſcope, and then we could ſee very clearly the dead Bodies of thoſe *Animalcula* lying in the Liquor.

About 10 or 12 Days after, I got two other Teſticles of a young Sheep, otherwiſe call'd a Ram, but they were ſomething ſmaller than the former; and I proceeded with them as I had done with the reſt, but found that the whitiſh Matter was much more fluid than the former; and that there was floating in it a vaſt number of very clear little Globular Bodies, of which I could not diſcover any of the leaſt Particles to be like thoſe living *Animalcula* above-mention'd. From which Obſervation I thought with my ſelf, that as the unborn Creatures lie in their Mothers Womb, in ſuch a Globular Figure, as is conſiſtent with our Bodies; ſo in like manner, theſe round Bodies or Globules, which I ſaw, were *Animalcula* proceeding from the *Semen Maſculinum*, that were not yet arrived to their compleat Figures.

Eight Days after, I got two more Teſticles of a young Ram, which were ſmaller than the former; which having open'd in the like manner, as I did the other, I found not only no *Animalcula* that appeared to be living, but the tranſparent Globules were not the fourth part ſo big, according as I could gueſs with my Eye, as the above-mention'd.

Upon the 13th of *July*, I again cauſed two Teſticles to be brought me of a ſucking Ram; which, tho' it was a young Ram, they call it a ſucking Lamb, becauſe it had ſuck'd its Dam a little before it was killed. I was inform'd, that this Lamb was about 3 Months and a Fortnight old; and its Teſticles were a little more than half as big as the firſt. Having opened theſe likewiſe, in that part where the *Vaſa Semen deferentia* were

thickeſt,

thickeſt, and having taken one of them out, and view'd it with the Microſcope, I judged that thoſe Globules which I obſerv'd therein were ſo ſmall, that 25 of them were not equal to one of the great ones above mention'd.

Upon the 18th of *July*, I made an Experiment of the ſame nature with the former, the Lamb being almoſt as old as the preceding; but I could not diſcover any Globules bigger than the laſt mention'd, nor any thing that appeared to be living.

Upon the 20th of *July*, I repeated my Experiment upon the Teſticles of a young Ram, which was very near as big as the firſt of all; which having open'd in the uſual Place, I ſaw great Numbers of *Animalcula* living: I diſcover'd likewiſe in the fluid Matter, which I had taken out, ſeveral Globules floating, which I imagined likewiſe might be ſome of thoſe imperfect *Animalcula* above-mention'd. All theſe young Rams were killed the Day before their Teſticles were brought to me.

Upon the 25th of *July* at Nine a Clock, they brought me two Teſticles of a young Ram, which they had killed the Day before at Eleven a Clock at Noon: Theſe were bigger than any I had ſeen this Year.

I immediately examined one of them, opening the part before mention'd, and I diſcover'd the *Animalcula* in ſo great a number, and like Clouds moving amongſt one another, that it was no ſmall Pleaſure to me to have ſo many Objects before my Eye: And this I continued to do till the Clock ſtruck 12; and conſequently till the Teſticles had been 25 hours out of the Body of the Ram, and had lain wrapt up in a Paper upon an earthen Diſh, and were expoſed to the Cold of the whole Night. Then I took a ſecond Teſticle, upon which I had as yet made no Remarks, and I bound it up in a Linnen Cloth, and kept it in a warm place, in order to view it the next Day; and I obſerv'd the firſt Teſticle

till

till 5 a Clock in the Afternoon, at which time I saw some *Animalcula* living; but at 12 a Clock before, I discover'd a hundred living *Animalcula* for one that I saw at 5 a Clock: for between 12 and 5 a Clock, I had made 25 several Observations, and those almost always by making new Incisions with a Knife into the Testicles, and by squeezing the Matter out of the Incision, tho' no bigger than a Pins head.

Now while these *Animalcula* were swimming in the aforesaid fluid Matter, I observ'd often thro' the Microscope, that the first part of their Bodies had a very bright glance with it; just as we see in small Fishes swimming in the Water, when they turn upon their Sides or Bellies, and cast a glittering brightness to the Eye: from which I imagin'd, that the upper part of the little Bodies of the *Animalcula in Semine Masculino* of the Rams were flattish, and that that brightness proceeded from their exposing those flattish Sides to the sight in swimming.

The next Morning at 7 a Clock, I viewed the Matter of the second Testicle, which I had bound up in a Cloth, with my Microscope; but I could not perceive any thing that had the least Life in it; and the Testicle had begun to be corrupted, for an ugly smell proceeded from it.

Now since we perceive that the *Animalcula* in the Testicles of a Ram, can live 32 hours after the Ram is dead; we may very well conclude, that the said *Animalcula* in *Semine Masculino* of a Ram, being admitted into that part of the Womb of the Ewe, which is call'd *Tuba Fallopiana*, will live much longer, that being the place which Nature has provided for them. From whence it may follow, that after the Copulation of the Male and Female, the *Animalcula* may be 2 or 3 Days in coming into that part of the Womb, where they receive their Nourishment, and consequently before the

Female

Female is Impregnated; and the ſame may be applied to other Creatures. Theſe are all the Obſervations I ſhall trouble you with at preſent, and remain,

Sir,

Yours to ſerve you,

Anthony van Leeuwenhock.

III. *A Letter from Mr* Ralph Thoresby, *F. R. S. to Dr.* Hans Sloane, *R. S. Secr. Giving an Account of a Lunar Rain-Bow ſeen in* Darbyſhire, *and of a Storm of Thunder and Lightning which happened near* Leedes *in* Yorkſhire.

Honoured Sir,

THE *Iris Lunaris* being ſo rarely ſeen, that the Ingenious Dr. *Plott* tells us (Nat Hiſt. of Oxf. cap. 1. §. 7.) that ſeveral Learned and Obſerving Men never ſaw one in their Lives, and that even *Ariſtotle* himſelf obſerv'd but two in above 50 Years; the enſuing Account, which I had from a Gentleman of great Veracity and Ingenuity, will be the more acceptable. He is now in this Town, but was lately in *Darbyſhire*, where, upon *Chriſtmas* laſt, he was at *Glapwell Hall*; and walking towards *Patterton-Green*, about Eight in the Evening, he obſerv'd with great Satisfaction the Bow, which the Moon had fixed in the Clouds: She had then paſs'd her Full about 24 Hours; the Evening had been

been rainy, but the Clouds were diſpers'd, and the Moon ſhin'd pretty clear. This *Iris* was more remarkable than that which Dr. *Plot* obſerv'd at *Oxford*, the 23d of *November* 1675. that being only of a white Colour, but this had all the Colours of the *Iris Solaris*, exceeding pleaſant, diſtinct, and grateful to look upon; only faint, comparatively to thoſe we ſee in the Day; as muſt neceſſarily follow, both from the different Beams that cauſe it, and the diſpoſition of the Medium. What puzled him the moſt, he ſaid, was the largeneſs of the Arc, which was not ſo much leſs than that of the Sun, as the different Dimenſions of their Bodies, and their reſpective diſtances from the Earth, ſeem to require: But as to its entireneſs, and beauty of its Colour, it was admirable and ſurprizing. It continued about ten Minutes, before the Interpoſition of a Cloud hindred his further Obſervation. This from my *Darbyſhire* Friend.

The beginning of the ſame Month had been remarkable here in *Yorkſhire*, for ſuch Thunder and *Lightnings*, as are not common here at that time of the year; particularly the Evening of the 5th Day, and the Morning of that Day Sevennight; when *John Sainor* of *Bramham*, Gardner, and two Women, deſigning early for this Market, were ſo furiouſly encountred, that the Females took up at the firſt Houſe they came at; but he proceeded on his Journey, tho' the Lightning was ſo ſevere, as he was riding over *Bramham*-Moor, that he thought his Hair had been burnt, and Face ſcorch'd, at one Flaſh; which being more ſevere than the reſt, did actually ſet on Fire the Stick he had in his Hand, as he was ready to depoſe upon Oath before *John Dodgſon* Eſq; Mayor of *Leedes*, who preſented me with the ſaid Hazel Rod which the Gardner had given him: It yet retains part of the blackneſs, tho' the Man had beat off much of the end of the Rod (little minding it

as a Curiosity) by forcing the Horse forward, to get the sooner out of the fiery Incalescence. I am,

Sir,

Leedes, Jan. 20. 1710-11.

Your most humble Servant,

RALPH THORESBY.

IV. *Another Letter from Mr.* Ralph Thoresby, *F. R. S. to Dr.* Hans Sloane, *R. S. Secr. Giving an Account of a* Meteor, *which was seen in* Yorkshire, *and other Neighbouring Countries, upon* May 18. 1710.

Honoured Sir,

YOU would think me remiss, if you should hear from any other hand, that a flaming Sword (as 'twas call'd) was brandish'd over this Town on *Holy Thursday* last (one of the ȝang-ȝagar or *Ambarvalia*, when the Inhabitants had been perambulating a neighbouring Mannor;) and yet I thought it not worth your Notice, looking upon it only as a hot, and dry, sulphurous Exhalation, the natural effect of so great a drought: But having since been with some who saw it, not only in the neighbouring Towns, but a great way North, as others did above 50 Miles South of this place, I think it not amiss to acquaint you therewith, and to enquire whether any such Meteor was in your Parts. It appeared here at a quarter past Ten at Night, and took its

its courſe from South to North: It was broad at one end, and ſmall at the other; and was by ſome thought to reſemble a Trumpet, and moved with the broad end foremoſt. I cannot give ſo particular an Account as I could wiſh; for having drawn the Curtain of the Window where I was reading, I ſaw nothing, ſave a ſudden flaſh of Light, which I took no notice of (ſuch Coruſcations being frequent in Summer Evenings without Thunder, which I at firſt expected) till the next Day, that many Perſons were talking of the Appearance; which was ſo ſudden and bright, that they were ſtartled to ſee their own Shadows, when neither Sun or Moon ſhone upon them. This is pretty odd, that all Perſons (tho' at many Miles diſtance from each other, when they ſaw it) thought it fell within three or four Furlongs of them, and that it went out with bright Sparklings at the ſmall end. An Ingenious Clergyman told me, that it was the ſtrangeſt *deceptio viſus* he was ever ſenſible of, if it was not abſolutely extinguiſh'd within a few paces of him; and yet others ſaw it many Miles off, further North, in a few Moments. Pardon, good Sir, this imperfect Account, it being all that came to the notice of,

Sir,

Your very humble and moſt

Obedient Servant,

RALPH THORESBY.

Leedes, May 31. 1710.

P. S. It has been likewiſe ſeen in the Counties of *Nottingham* and *Derby*, as well as *York* and *Lancaſter*.

V. *Part of a Letter from the Reverend Mr.* Samuel Carte, *Rector of St.* Margaret's *Parish in* Leicester, *to Mr.* Humfrey Wanley, *F. R. S. Concerning an Ancient* Tessellated, *or* Mosaic *Work, at* Leicester.

SIR,

I Take this Opportunity to send you a draught, made by one *Benjamin Garland*, of the *Opus Tessellatum*, still extant in a Cellar here, over against the Elm Trees, near *All-Saints* Church. It is generally called *Actæon*, by such Authors as mention it; but the bare Inspection of it will convince you, that it is a Representation of the Fable, which says, that a Person having found fault with *Venus*, she, to be revenged of him, engaged her Son *Cupid* to make him fall in Love with a Monster.

It was first discovered about 40 Years ago, upon digging of the Cellar, at about a Yard and half under the common present Surface of the Earth. What extent the whole Pavement was of is not known; but this Figure, which, by order of the Master of the House, was preserved, is an *Octogon*, surrounded by a List, as you see in part represented in the corners of the Picture herewith sent you. Without this, tho' not here represented, is a Twist or Wreath of various Colours; and round that, is a second List like the former. These two Lists, with the Wreath between them, are 6 Inches and a $\frac{1}{4}$ broad. The downright and transverse Diameters of the *Area* are just a Yard; but the others, leading from corner to corner, are a Yard and two Inches and an half. The Man, from Head to Foot, is two Foot and 4 $\frac{1}{2}$ Inches. *Cupid* seems

See the Figure.

ſeems to be two Foot; but his Feet, as well as the bottom of the Monſter, are ſpoiled, the *Teſſellæ* repreſenting them being gone. You will eaſily underſtand, that the whole *Area* of the Figure, which is here left blank, ought to be fill'd up with white *Teſſellæ*, in like manner as you ſee ſome Intervals of the Figures here. I hope, that what foregoes, will ſerve to give you a juſt Idea of this Piece of Antiquity, but forbear to make any Reflections on it, as knowing that your Genius and Studies qualify you for that much better than my ſelf. I am,

Sir,

Your Affectionate Friend and humble Servant,

SAMUEL CARTE.

Leiceſter, Auguſt 7. 1710.

VI. *An Account of the* Repetition *of an Experiment of the late Dr.* Hooke's, *concerning two Liquors, which, when mixt together, will poſſeſs leſs ſpace, than when ſeparate: With another Experiment confirming the ſame. By Mr.* F. Hauksbee, *F. R. S.*

THE Experiment related by the late Ingenious Experimentor Dr. *Hooke*, in one of his Papers (delivered to me by Mr. *Waller*) is concerning two Liquors, which, when mixt together, would poſſeſs leſs ſpace than when ſeparate; which he calls a Penetration of Dimenſions: And adds further, that this Penetration is the cauſe of Heat, of Fire, of Flame, of the Power of Heat,

Heat, Fire, and Gun powder, and ſeveral other *Phænomena*, which ſeem to be moſt prodigious and wonderful in Nature. And ſince the Experiment ſeem'd ſo conſiderable, as to account for ſeveral ſurprizing Operations in Nature, I thought it very worthy an Examination, by a Repetition of the ſame.

Accordingly I procur'd a Bolt-Head (ſuch as he there deſcribes) with a long ſmall Stem, which I fill'd nearly full of common Water. The Stem was mark'd into ſeveral Diviſions, on a piece of Paper paſted along it; by which means, I diligently obſerv'd the heigth of the Surface of the Water. Then pouring as much of it out as fill'd a certain Meaſure, which being thrown away, I fill'd the ſame Meaſure, as nicely as poſſible, to the ſame height, with ſtrong Oil of Vitriol; which I return'd into the Bolt-Head, in the room of ſo much Water taken from thence: Upon the mixing of theſe Liquors enſued a pretty ſtrong Ebullition; and abundance of airy Particles were viſibly extricated, and the Surface was not ſo high in the Stem conſiderably, as when it was poſſeſt only by Water. But here I muſt take notice, that two or or three Drops of Oil of Vitriol were accidentally ſpilt, in putting it into the bolt Head; but yet the Experiment was very manifeſt, in the gradual decreaſe of the Dimenſions of the Liquors. And 'tis to be obſerved, that altho' they became very warm, yet, contrary to the Nature of moſt Liquors in ſuch a State, they continued to poſſeſs leſs and leſs ſpace; which was viſible by the ſinking of the Surface in the Stem of the Bolt-Head; and in about half an Hours time, it had deſcended above an Inch: And when I viſited it on the *Monday* following (for the Experiment was made on the *Thurſday*) I found it had ſubſided at leaſt two Inches below the mark I had left it at. Now whether the Ebullition produced by the Heat, might not evaporate that quantity, which it ſeem'd to loſe in ſpace; or whether, in ſo many Hours time,

time, as it had been ſince the Experiment was made, there might not be ſuch an Evaporation of the parts of the Fluid, as to become equal in bulk to the quantity of the diſpoſſeſs ſpace; and whether it was ſo or not, I gave my ſelf the ſatisfaction after the following manner. Into an upright Glaſs, that would hold about 3 Ounces of Water, I put a quantity of the ſame Fluid equal to 885 Grains: Into another Glaſs of the ſame form, but ſmaller, I put a quantity of Oil of Vitriol equal to 456 Grains; which, with their reſpective Glaſſes, I weighed altogether in a nice ballance: After which, I put the Oil of Vitriol, Glaſs and all, into that which held the Water; where immediately a very great Ebullition began, and the Glaſs that contained them became ſo hot, as to be but juſt endured in the Hand. I found in two Minutes time it had loſt of its weight about two Grains: And at the end of an Hour, or better, it had decreaſed in all but 6 Grains and a half; by that time the Conflict was wholly ceas'd, it being then nearly reduced to the Temperature of the outward Air. After that, I weighed them at ſeveral times, but found them in the ſame State, as to their weight, as laſt mentioned. I continued them in the Scale till the next Morning, when I likewiſe could diſtinguiſh no manner of alteration in the fore mention'd weight. From whence it plainly appears, that the decreaſe of bulk upon the mixing of theſe Liquors, does not proceed wholly from an Evaporation of their Parts; ſince by the laſt Experiment, the Evaporation continued no longer than the Fermentation laſted; but the decreaſe of the bulk of the Bodies, ſeems not to be performed all at once, or in ſo ſhort a time, as may be taken notice of in the firſt Experiment.

VII. *An*

VII. *An Account of an Experiment, concerning an Endeavour to produce Light thro' a Metallick Body, under the Circumſtances of a* Vacuum *and Attrition. By Mr.* Fr. Hauksbee, *F.R.S.*

IT may be remembred, what ſucceſs I had in producing Light through Bodies, ſuch as Sealing Wax, Pitch, and common Sulphur; which gave me ſome probabitity, that under the ſame Circumſtances I might likewiſe make ſome ſuch Diſcovery thro' a Metallick Body. Accordingly I cauſed a Glaſs Hemiſphere to be made very ſtrong: To this Hemiſphere I procured another, of Burniſh Braſs, exactly made, to fall with its Brim about an Inch within the Glaſs, that I might the better cement them together; which I did ſecurely from any ingreſs of the Air in that part. Thus, when joined, it became nearly a Globe; only the Diameter thro' its *Axis*, was ſomewhat more than its tranſverſe Diameter, which was a diſadvantage to its Strength, as the ſequel of this relation will diſcover. In this manner I exhauſted all its Air, as leaſt nearly ſo, and then put it on the Machine to give it a circular Motion, as uſual in ſuch Experiments. I applyed my Hand to the Braſs Hemiſphere in Motion, but no Light could be diſcover'd within: I then rubb'd it with a Deal Stick, but the ſucceſs was the ſame. Afterwards I applied a piece of Sealing Wax, which has in itſelf a very Electrical Quality: This Wax, rubbing roughly on the Braſs, ſeem'd to ſhake the Parts of it; nevertheleſs there did not any the leaſt glimpſe of Light appear. I then held the Flame of a Candle to the Braſs in Motion, which ſomething more than warm'd

a Circle on it; hoping by this means, to excite or obtain ſome Diſcovery from it. Yet, notwithſtanding a ſmart Attrition was made on that part, it was altogether unſucceſsful. Being tir'd, I let in the Air, and ſuſpended my farther tryals till the following Night. At which time, when I had exhauſted the Air from within the Globe, I began the Attrition with a Coal Cinder; which being ſomewhat rough, I thought it might ſhake the Parts of the Mettal, and put them into ſuch a State or Mode, as to exhibit an Appearance of Light: But this, and whatever elſe I then did try, was to no purpoſe. In this exhauſted State I left the Globe on the Engine, to conſider a little what farther tryals to make; with what Bodies, and in what manner to proceed with them: But to my great ſurprize, in about an Hour after (being in the next Room) I heard a Noiſe almoſt as loud as a Muſket when fir'd; and I immediately coming into the Room, found the Globe broken all to pieces (I mean the Glaſs half of it) and the Braſs Hemiſphere on the Ground; which I took up, and found ſeveral bruiſes it had received from the violent ſtrokes of the broken Glaſs, which had diſperſed itſelf in pieces all over the Room. A large looking Glaſs, at leaſt three Yards diſtant from it, was crack'd almoſt from top to bottom, and quite croſs the middle, by a blow it received from a fragment of it; for where it ſtruck the Glaſs, the Cracks proceeded from it every way, like ſo many *Radii* drawn from a Center. Thus were the Experiments ended; and, as I hinted before, this Accident I believe proceeded from the unconformableneſs that the Figure of the compounded Globe had to a perfect Sphere, altho' it did not differ ſo much to ſight, as to make me ſuſpect any ſuch Conſequence. From theſe Experiments I may ſafely conclude, that if there be any ſuch Quality as Light to be excited from a Braſs Body, under the fore-mention'd Circumſtances, all the Attritions of

the ſeveral Bodies uſed for that purpoſe, have been too weak to force it from it. And indeed, conſidering the cloſeneſs of the Parts of Mettal, and with what firmneſs they adhere, entangle, or attract one another, a ſmall degree of Attrition is not ſufficient to put their Parts into ſuch a Motion, as to produce an Electrical Quality; which Quality, under the fore-mention'd Circumſtances, I take to be the Appearance of Light in ſuch a *Medium*.

VIII. *Johannis Freind*, M. D. *Oxon. Prælectionum Chymicarum Vindiciæ, in quibus Objectiones, in* Actis Lipſienſibus *Anno* 1710. *Menſe Septembri, contrà Vim materiæ Attractricem allatæ, diluuntur.*

EMittenti mihi Lectiones *Chymicas*, ſuſpicio fuit, ne in *Chymicorum* offenſionem caderem, quod nullo Authore artem utiliſſimam Fabulis atque Opinionum commentis, quibus iſti quidem jam nimium diu eam incluſerant, exuere auſus ſim, ſuâque in luce integram collocare: Eos autem, qui aliquo veritatis Studio ducerentur, ita æquos fore confiſus ſum, ut Scriptori gratiam habituri eſſent, qui in hâc Philoſophiæ parte novum aliquid ediderit; ipſamque primus ad naturæ principia, firma ſcilicet atque indubia, revocarit. Sed res ea, ſecus atq; ego exiſtimaveram, accidit: *Actorum* quippe *Lipſienſium Editores*, qui neque Experimenta à me prolata, neque modum, quo ea ad naturæ leges perpendere aggreſſus ſum, ne attingunt quidem; principia ipſa, quæ jamdiu pro certiſſimis habita ſunt, quibúſque innititur mea omnis rerum *Chymicarum* explicatio, convellere ſunt conati: Hocque primo impetu faciunt, poſthabitâ libri ipſius enar-

enarratione, ne quis ad legendum non præoccupatus accederet. Et certè minus æque ferenda est hæc eorum cavillatio, quoniam extra Provinciæ suæ fines evagati sunt; id enim unicè præ se ferunt isti Literatores & quasi Indices Librorum, ut quid in quoque Scripto contineatur, compendiariâ quâdam operâ simpliciter fideliterq; recenseant, legentis interim Judicium relinquant integrum ac liberum. Pro fundamentis Theoriæ *Chymicæ* habui principia, ipsamq; argumentandi Methodum, quam Mathematicorum Princeps in Philosophiam intulit *Newtonus*: Qui quidem Vir, admirabili quo est ingenio, ad res Physicas promovendas certam patefecit viam, naturalemq; Scientiam tanto rationum pondere stabilivit, tam incredibili rerum inventione locupletavit, ut ad eam illustrandam plura præstiterit quàm omnes omnium gentium Philosophi. Hoc itaque sagaciſſimi Viri institutum, quia *Editores* latere visum est, paucis aperiam: Ostendamque totum id, quodcunque est quod jam in hoc cognitionis genere exploratum atque perspectum habemus, ex hâc ipsâ ratione ac viâ fluxisse. Porrò etiam Argumenta, quibus ad hanc Physicæ Doctrinam refutandam usi sunt, ex falsis, quas de hâc re imbiberint, Opinionibus promanâsse planum faciam; pluresque istiusmodi, quas adducunt, ratiunculas contra illa, quæ ipsi amplectuntur principia, quàm contra *Newtoniana* proferri posse.

Carteſiani, ijque fere omnes, qui se magistros Philosophiæ *Mechanicæ* dici volunt, rationem hanc perpetuò tenuerunt, ut Hypothesin aliquam sumerent seu figmentum, quod nullibi nisi cogitatione fingentium existit: Deinde, ut verbis neque perspicuis neque definitis comminiscerentur, quo demum modo omnia ad hujusce Hypotheseos normam efficiat natura. Aliam omnino *Newtonus* insistit viam: Nihil ille fingit, nihil pro arbitrio suo assumit; id solum quod Experimento & Observatione notatum, sensibus omnium patet, pro rato habet: Ex his principiis certissimas Mathematicâ ἀναβάσει elicit

concluſiones, quas deinde ad alia Naturæ Phænomena explicanda feliciſſimè accommodat. Hanc inſiſtens viam elegantiſſimè demonſtravit, Planetas motu Elliptico circa Solem verſari, areaſque temporibus uſque reſpondentes deſcribere: Satellites itidem ad eandem normam circa Planetas, quos ut comites perpetuò conſequuntur, volvi. Hinc extra dubium omne poſuit Planetas ad Solem, Satellites autem ad Planetas primarios ſe inclinare & tendere: Hanc autem inclinationem in ratione Diſtantiarum duplicatâ decreſcere: Ineſſe porrò immutabilem quibuſcunq; corporibus vim, quâ itidem in ſeſe mutuò ferantur: Et inde fieri, ut Lunæ in Terram inflectio, idem planè valeat ac gravitatis vis, atq; acceſſum receſſumque Maris efficiat. Inclinationem hanc ſive attractionem quidam, ſi ita lubet, *qualitatem occultam* nuncupent, & erit credo ſemper occulta: neq; enim adhuc ex *Editoribus* quemquam extitiſſe video ita in penitiore Philoſophiâ perſpicacem, qui docere in ſe ſuſceperit, quo modo, quâ vi Mechanicâ Attractionem illam exerceat natura. Sed utcunq; hæc Naturæ vis, ſi cauſam ſpectemus, occulta ſit, minimè tamen figmentum, ſive Hypotheſis (quod in eorum principia, ipſis etiam fatentibus, cadit) appellari poteſt; cum eam æquè revera exiſtere ac Solem aut Planetas, luculentiſſimis Argumentis confirmetur. Quòd ſi ſit hujuſmodi principium, quod in materiâ omni perpetuò inſidet, quid vetat quo minus id ad rem ſuam accommodent Philoſophi, explicentq; nobis quo modo effectus plurimi, quos quotidianâ animadverſione notamus, vim inde ſuam atque Originem derivent.

Pariter obſervatione diuturnâ clariſſimiſq; Experimentis varium illum, quo radij Lucis refringi ſolent, modum exploravit idem *Newtonus*; hincq; ita feliciter lucis colorumq; naturam admirabilem aperuit, ut hanc Optices partem ante eum non niſi tenuiter admodum & nugatoriè pertractatam fuiſſe omnes ultrò agnoſcant.

Hanc

Hanc adeo rectiſſimam eſſe conſtat, quam Philoſophi in Scientiæ perveſtigatione tenere poſſunt, rationem, ut primùm multiplici experimento corporum naturas vireſq; perquirant, deinde poſthabitâ omni cauſarum, unde eæ fluxerint, indagatione, Phænomena, quæ cujuſq; virtutem ingenitam ſequuntur, enucleent atq; exponant. Hâc ipſâ viâ ingreſſus Divinus ille *Archimedes* leges tum *Mechanicas* tum *Hydroſtaticas* exquiſivit, dum interim neque Gravitatis neque Liquoris cauſam aut ſtatueret aut inveſtigaret; ea ſolummodo quæ ſenſuum cognitione percipiuntur pro principijs habens, utriuſq; Scientiæ rationem pulcherrimè evolvit. Ita etiam *Galilæus*, quanquam nullam de Gravitatis cauſâ Hypotheſin commentus eſt, motûs tamen celeritatem, quam gravia corpora cadendo acquirunt, inveſtigavit, projectorum impetum & curſum, pendulorumq; reciprocationes primus explicuit: Eaque Scientiæ fundamenta poſuit, quibus celeberrima Phyſicorum inventa hodiè innituntur. Quid? an non in Opticâ illuſtrandâ ampliſſimo cum fructu progreſſi ſunt Mathematici, duobus principijs, altero Refractionis, Reflectionis altero, conceſſis; utcunq; alterutrius cauſæ pauciſſimis adhuc innotuerit?

Si quid ponderis *Editorum* Authoritas habeat, præclara hæc acutiſſimorum hominum inventa omnino repudianda ſunt, quia ſcilicet ex ijs corporum virtutibus, quarum initia cauſæq; prorſus incognita ſunt, ducuntur; *nec ſine qualitate illâ occultâ veræ Philoſophiæ principia confundente, & in antiquum Chaos reducente, commodè explicari poſſunt.* Video clariſ. Wolfium in *Aerometriâ*, gravitate Aeris, tanquam conceſſo principio, uſum eſſe; atque eo quidem multa Naturæ Phænomena haud abſurdè expediviſſe: Qui tamen gravitatis cauſam Mechanicam ratiocinatione ne attingit quidem; nec credo ullam unquam Hypotheſin ad cauſam hanc explicandam accommodatam fuiſſe, quam ipſe Wolfius à vero alieniſſimam eſſe non facillimè probare poſſit. An huic igi-

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tur objicient Editores, quód Scientiæ Phyſicæ *occultam qualitatem* invexerit? In hâc quidem Gravitate explicandâ, quam ſenſu percipimus, longiſſime omnium proceſſit *Newtonus:* Eam quippe à vi attractrice, quæ per omnem ſe undequaque materiam diſſeminat, oriri commonſtrat. Vim hanc *Editores*, pro ſuâ in rebus Philoſophicis authoritate, *figmenti* vocabulo appellant; ſed quo demum loquendi Jure id, quod in rerum natura exiſtere oſtenditur, *figmentum* dici queat, ne intelligi quidem poteſt. Illam certe Attractionis Speciem, quemadmodum in toto Planetarum Orbe dominatur, luculentiſſimè expoſuit *Newtonus*; neque adhuc videre contigit, quid contra Viri perſpicaciſſimi Demonſtrationes objectari poſſit. Alterum hoc Attractionis Genus, quæ in Diſtantiæ ratione magis quàm duplicatâ decreſcit, & revera exiſtere, & vim ſuam in minutiſſimis corpuſculis acriter exercere, plura mihi præſto ſunt quæ probent Experimenta, quàm unquam ad demonſtrandam Aeris Gravitatem allaturus eſt Wolfius. Quorſum igirur Principia, quibus ratiocinatio hæc omnis nititur, in altero Argumento pro commentitijs habere licet, in altero non item? Experientiâ comprobatum eſt, radios lucis quæ à Sole, ſtellis inerrantibus, vel etiam ab eo, quo utimur igne, dimanat, verſus oras ſolidorum corporum æqualiter allici; ea autem immutabilis naturæ lex eſt, ut ubicunq; ſit Actio, ibi unà non poſſit non eſſe Reactio: Itaq; verè & jure concluſuri videmur, Principium hoc, quod Attractionis nomine vocamus, tum revera exiſtere, tum per univerſam omnino materiam diffundi. Quod licet in omni materia inhæreſcat, id tamen in minutiſſimis corpuſculis vim ſuam ad ſenſum magis patefacere demonſtravit Vir in Phyſiologiâ acutiſſimus D. *Keillus.*

At aiunt, *Talibus ſemel admiſſis, apertâq; fingendi licentiâ, mox erunt qui alias qualitates occultas, ſeu quas ipſi agnoſcunt abſolute inexplicabiles, comminiſcentur, & paulatim ad vetera ignorantiæ aſyla redibunt. Si detur vis attrahendi,*

hendi, seu Sympathia, quidni pari jure detur vis repellendi, seu Antipathia? Ita facile etiam dabitur Antiperistasis, dabuntur qualitates emissæ per modum specierum cum suis Actu potentialibus, dabitur funiculus Lini *Attractivus, dabitur in Materiâ eâdem Variatio Extensionis, non apparentis tantum, sed etiam veræ.* Itáne incœptant, *si detur vis Attrahendi*; cum eam dari Experientia ipsa apertissimè demonstrat? Non est hoc Opinionis commentum ad alia Phænomena explicanda excogitatum, sed est per se constitutum à Naturâ Phænomenon; adeoque quanquam sibi plaudant *Editores*, quod hujusce Sententiæ fautores ad absurdum quid deduxerint, omnis tamen illa, de qua se ita fidenter jactant, huc tandem redit Argumentatio; nempe si unum aliquod Principium, quod in rerum naturâ existere observatione certâ compertum est, concedimus, ideo etiam oportet alia, quæ nusquam extiterunt, approbare; uti verbi gratiâ. si Gravitatem agnoscimus, quam corporibus quibuscunq; inesse certò animadvertimus, quanquam illius causam prorsus nescimus, idcirco fabulas Philosophorum omnes & commenta amplecti necesse est, quæ nec Experientiâ ullâ confirmari, nec ratione Explicari queunt. Si hoc sit Mathematicorum more ratiocinari, satius est profectò *ad vetera quævis ignorantiæ asyla redire*, quam hanc argumentandi *licentiam aperire.*

Sed vim Attractricem in eo maximè oppugnant, quod rationibus Mechanicis minimè illustrari possit. An igitur volunt, ut nihil in rem Physicam introduci debeat, nisi cujus ratio & causa perspecta sit? An *Editorum* aliquis *Elaterem* aeris, quâ vi Mechanicâ constitutus sit, unquam explicuit? Eum tamen & Philosophi omnes ultrò concedunt, & ad multa Naturæ Phænomena enodanda feliciſſimè accommodari unâ mente consentiunt. Fabro, utiq; id libenter damus, ut Horologij artificium intelligat, quanquam interim gravitatis Elaterisque, ex quibus quidem pendet omnis rotarum conversio, rationem penitùs ignoret: Hoc idem Physico denegabimus? Qui *vim*

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illam, quâ universa corpora aguntur, & suo quæq; motu atque ordine diriguntur, investigarit, qui potentiæ hujusce motricis Leges definire, easq, ad præcipua Naturæ Phænomena explicanda adhibere poterit, tametsi cuinam causæ vis illa omnium gubernatrix ortum debet, plane se nescire fateatur, illum de naturæ viribus & Machinatione nihil prorsus scire, nihil animo percipere dicemus? Quod si hoc Attractionis principium ad fontes usque suos persequendi studio teneantur *Editores*, faciant quod lubet; hanc ijs gloriam ultro relinquit *Newtonus*, satis præclarè secum agi ratus, si modo eorum offensionem effugiat, quod involutum longeq; difficillimum problema explicandum in se non susceperit.

Non me latet quod Cl. *L.* quem quasi Numen aliquod suspiciunt *Editores*, in *Specimine* illo, quod *vocabulâ Eleganter sonante* nuncupat, *Dynamicum*, planissimè scripserit, *Vim Activam seu nisum intimam corporum Naturam constituere.* Vis hæc sive Nisus, si quid velit rectè intelligo, idem est ac propensio illa mutua, quam corporibus quibuscunq; insitam diximus; quàmque multò ante patefecerat *Newtonus*, quanquam eâ materiæ naturam contineri nuspiam asseverarit. Si vera sit *L—ij* sententia, nobis æquo jure Extensionis Soliditatisq; causa quærenda est, ac Attrahentis hujusce, quod omni materiæ inest, Principij ratio excutienda. Hoc autem posito fundamento, effectus omnes quos in hâc universâ mundi Machinâ contemplamur, ab ipsâ materiæ constitutione necessariam originem deducunt. At mihi quidem *intima corporum natura* ita parùm explorata est, ut longissime absim, qui affirmem vim hanc æterno rerum fœdere illis intermisceri, & eâdem naturali colligatione, ac Extensionem Soliditatemq; inhærescere. Sane ita valde laborare videtur hæc Sententia, ut Argumenta, quæ in contrarium afferre proclive esset, vix recenseri, nedum refelli possint. Quod si cum Cl. *L—o* sentiant *Editores*, non video cur amplecti nolint principium, quod

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ille ita apprimè neceſſarium judicat, ut id in *intimâ corporum naturâ* conſtitutum eſſe pronunciet. Cum verò ex motu corporum omnium conſtet, Attractricem hanc potentiam revera exiſtere, ſi eam neque Materiæ neceſſariò ingenitam, neque rationibus Mechanicis explicandam eſſe cenſeant, haud *abſurdum aliquid* credo aut Phyſico alienum facturi ſumus, ſi eam in *Voluntatem Dei reſolvimus*: Legemq; univerſam eſſe ſtatuimus, quâ omnis hæc Mundi Moles gubernatur & regitur, corporumq; vario utcunq; motu labentium convenientia atq; concentus ſervatur: quanquam quidem hæc ipſa potentia, non minus quam naturæ conſtructio omnis, à divinâ voluntate unicè manaverit. Illi verò, qui nullam hujuſmodi legem agnoſcunt, ſed univerſum Phyſices negotium, non modò quoad proximas, ſed remotiſſimas etiam cauſas, ſuâpte naturâ & mechanicâ quâdam ratione geri volunt, ita ut nihil ſit quod non ab ipſâ materiæ vi immutabiliq; motûs conditione proficiſci putent, quid aliud agunt, niſi ut cum *Epicuro* notionem ex animo hominum evellant cuncta providentis atque moderantis Dei; argumentaque ſuppeditent, quæ in rem ſuam traducant impij?

Quicquid verò de hâc Attractrice virtute ſtatuendum ſit, minime dubium eſt, rerum naturam ſine principio quodam actuoſo non poſſe conſiſtere: Quippe corpora, utcunq; in motum ſemel excitata, ſi deinde ijs ſuo more uti liceret, viciſſitudines ſuas certo tempore haud ita conſtanter conficerent. Hoc cum ita neceſſarium perceperit acutiſſimus *L*—, pereleganter concluſit, quod *agere ſit character Subſtantiarum.* Ubicunq; autem vis hæc omnia ciens atque agitans motibus ſuis ſita ſit, in *occultam quandam qualitatem reſolvatur* neceſſe eſt; aliam enim illius cauſam, quam divini numinis voluntatem, fruſtra hactenus quæſivimus. Nonnulli autem, qui ſibi in rebus Mechanicis acutiùs cernere videntur, vim hanc in *Æthere* vel in Fluido quodam admodum ſubtili collocant; quos ſane interrogare velim, quid tandem ſit,

quod illum æthera agat, & in motione perenni continuatâque tueatur? Unde fit, ut motus omnino contrarij se invicem non extinguant? Quid sit porrò, quod motus hosce eâ facultate instruat, ut suum singuli opus proprium sibiq; aptum efficiant? Hæc omnia ex *occultâ qualitate*, quam in æthere sitam esse volunt, oriri necesse est. Etenim si hanc Hypothesin ad naturam revocamus, facilè patebit plures ab ijs intromitti *occultas qualitates*, quàm sunt quæ explicanda suscipiunt Phænomena. Quanto rectiùs ille in Philosophiâ suâ *Newtonus?* Qui principium non nisi unum, idq; simplex maximè, & observatione confirmatum sibi dari postulat, —— Et speciosa dehinc miracula promit.

Sed quantâ obscuritate laboret, quamque infirmis rationibus sulta sit tota illa æthereæ cujusdam virtutis, aut subtilis fluidi Hypothesis, nullum clarius, quàm ex ijs quæ de hâc re differunt *Editores*, peti potest argumentum. Aiunt quippe, *Hæc omnia sine qualitate illâ occultâ attractrice, vera Philosophiæ principia confundente, & in antiquum Chaos redigente, commode explicari posse, partim etiam à viris doctis explicata esse.* Hunc adeo ob finem, *statuunt plurimas materiæ particulas Sphærâ quâdam magneticâ fluidi Subtilioris esse circundatas, cujus motu (ut in Magnetibus nostris fieri videmus) attrahant se invicem, aut repellant, aut ad situm convenientem disponant, quoties scilicet libertatem aliquam sint nactæ.* Quid quæso est *Sphæra quædam magnetica*, nisi aliquid admodum *occultum?* cui utiq; adscisitur quid adhuc occultius, scilicet *Magnetismus.* Unde fit, ut hæc materiæ subtilis Sphæra corpori, cui circundata est, perpetuò comitem se præbeat? Res quidem ipsa postulare videtur, ut corpus, cum semel motu impresso locum mutaverit, Sphæram hanc itidem ambientem post se relinquat: quippe si terra novo aliquo impetu acta alium prorsus cursum iniret, ex legibus Mechanicis satis liquet, quòd non Atmosphæra modò, sed quicquid à Terrâ liberum solutumq; esset, facto dissidio, suâ se in sede contineret. Quid igitur in hoc rerum

rerum ſtatu concludendum eſt? An quòd occultâ quâdam qualitate Atmoſphæra hæc motum corporis continuò ſequatur? An quòd vi etiam occultâ, altera materiæ ſubtilis Sphæra de novo gignatur? Utut ſit, libenter diſcere velim, quænam demum ea qualitas ſit, quæ Sphæram hanc Magneticam in motum cieat? cujus generis motus ille ſit, & quâ potiſſimùm ratione excitetur, qui efficit, ut *materiæ particulæ attrahant ſe invicem, aut repellant, aut ad ſitum convenientem diſponant?* Quot tandem *occultas qualitates* ad ſingula Phænomena explicanda accerſere coacti ſunt, dum unam illam & ſimplicem rejiciunt, quæ per univerſam naturæ fabricam ſe diffundit, & plurimis Phænomenis ſolvendis tam præclarè inſervit. Id verò in *Editoribus* ſatis mirari nequeo, quod qui contra vim attractricem ita acriter dimicant, & ſine eâ omnia commode explicari poſſe contendunt, eam tamen in hoc ſuum de rebus Phyſicis commentum ipſi transferant: Nec ab *attractionis Voculâ*, quæ quidem ijs ita *eleganter ſonare* viſa eſt, *abſtineant*, ut *ignorantiam ſuam palliare* poſſint: Loquuntur enim de Sphærâ quâdam fluidâ, quæ *ATTRAHIT, repellit*, & ad *ſitum convenientem diſponit.* Cum nihil veri ſit in hâc Sphæræ ſubtilis fabulâ, cavendum certè fuit, ne deſideraretur iſta, quæ rem veriſimilem redderet, convenientia. Facillimum profectò eſſet, naturæ Phænomena omnia ad hunc modum illuſtrare; mirificè quippe rerum cauſas expedit *Sphæra Magnetica fluidumq; ſubtile*, atq; etiam maxime inter ſe pugnantia conciliat. Atq; hoc quidem quod de *materiâ ſubtili* Viq; *Magneticâ* excogitarunt figmento (dum agendi ratio ab inventoribus ferè intacta relinquitur) nullum præſentius *ignorantiæ aſylum*; etenim omnes illas occultas qualitates, quæ hactenus in Philoſophiam irrepſerunt, longè multumq; ſuperat. Nemo certè non videt, quàm ficta hæc omnia atq; commentitia ſint, cùm neq; quale ſit hoc ſubtile fluidum, neq; etiam ſi ullum omnino ſit, aut obſervatione animadverti, aut ratione colligi poſſit. Diſpiciat itaque

Lector, an non ea quæ in veram, h. e. *Newtonianam* Physicen intentant argumentandi tela, in hanc ipsorum *infelicem Philosophandi rationem* fortiùs retorqueri queant. Ea omnia quæ pro certis atq; ratis jactanter satis venditant, vana prorsus sunt & fabulis referta, nullâ observatione aut Experimento nitentia; quæ etiam si pro veris concessa fuerint, eo occultarum reconditissimarumq; virtutum agmine stipantur, ut facilius multò sit *Sympathiæ*, *Antipathiæ* & *Antiperistaseos* naturam cogitatione complecti. Hujusmodi nimirum Hypotheses hoc vitio laborare semper comperi, ut obscurius quid magisq; difficiles explicatus habeant, quam res ipsæ, quibus eæ explicandis accommodantur. In illâ *vorticum* Hypothesi, quæ ijs ante cæteras omnes arridet, rationem nullam afferunt, cur materia fluida curvam semitam affectet, seseq; circa centrum torqueat, cùm ea sit corporum omnium natura, ut rectis lineis ferantur: unde tot vorticibus cautum est, ne in cursibus suis se invicem perturbent & impediant; unde per eos transeant Cometæ, motuq; prorsus contrario, ac ipse vortex, versentur; tantumq; abest, ut illius incitatissima conversio eos interpellet, ut in suis, quos circa Solem conficiunt, orbibus, ad eandem ac Planetæ normam dirigantur, seseq; versus eum pari modo inflectant. Hâc adeo Vorticum Hypothesi in eos se laqueos inducunt isti *Philosophandi artifices*, à quibus nunquam expedire se possunt: in quâ tamen positum est omne hujusmodi Philosophiæ fundamentum. Quùm ad Phænomenon aliquod explicandum accedunt, ad illorum nutum præsto est subtilis materia, quæ modo motúq; admodum ignoto atq; inexplicabili rem quam velint efficiat. Num Philosophiam magis sapiunt hæc, quàm si quis dixerit id à *Sympathiâ, Antipathiâ, vel occultâ aliquâ qualitate proficisci?* Num hæc Philosophandi ratio non æquè ac illa quam vellicant, in *Asylum ignorantiæ* cessura est? Et si consuetudini fictis hisce fabulis indulgenti obsequimur, quidni

quidni cætera etiam, quæ ab hominibus ad comminiſcendum ingenioſis fingi poſſunt, amplectamur?

Quàm longè alia diſſimiliſque eſt vera Philoſophiæ inſtituendæ via! in quâ nihil ponitur, niſi quod in ipſâ rerum naturâ conſtitutum eſſe obſervatio evidentiſſima declarat; & quanquam principii, quo utimur, cauſa & origo deliteſcat, ex eo tamen multa, quæ quotidiano uſu animadvertimus, fluere & pendere poſſunt: Itaque ingenui eſt Philoſophi primò corporum virtutes experimentis elicere; deinde, ubi eæ diligenter exploratæ ſtabilitæque ſint, diſtinctè & perſpicuè commonſtrare, quinam illas effectus ſuâ ſponte conſequantur. Néq; ulla credo tanti eſſe Adverſantium argumenta, quæ hanc veri inveſtigandi rationem evertant. Etenim ſi principia & poſtulata vim ſuam omnem in Experimentis poſitam obtineant; ſi propoſitionibus conceſſis & ritè præmiſſis, nihil contra Dialectices leges conficiatur, concluſio non poteſt non eſſe certiſſima: Ita ut quicquid hâc methodo evolutum explicatúmq; habemus, rem Phyſicam inventis augere atq; amplificare meritò cenſendum ſit. Igitur vim hanc Attractricem, utcunq; eam labefactare conentur *Editores*, firmam nos ſtabilemq; tenere confidimus.

Eſt & alterum axioma, quod conſenſu ſuo non approbant *Editores*, viz. *Corporum momenta ſeu quantitates motuum oriri ex ratione quantitatis materiæ & celeritatis compoſitâ*: quæ qui ſic *æſtimant in communi errore verſantur, uti paſſim in illorum Actis notatum eſt.* In ijs quidem video de hâc re unum aut alterum clariſſimi *L*—— Commentariolum; qui tamen ita parum rationibus pugnat, ut nihil niſi fallaces concluſiunculas, nihil niſi in verbis captiones ſectetur: igitur ea quæ de hoc argumento protulit, unâ fere Mathematicorum voce atq; ſententiâ improbantur: Quorum nonnulli hoc ipſum Axioma exquiſitè confirmârunt. Hos itaq; adeat Lector; nam illa Diſceptatio, uti per ſe ſatis magna eſt, ita etiam huic inſtituto nimis aliena.

Sed

Sed jam *Editores*, ſicut æquum eſt, cum bonâ gratiâ dimittamus: hanc enim eorum humanitatem libenter agnoſco, quòd principia, quibus uſus ſum, modò vera fuerint, me ſatis aptè atq; appoſitè ad rem meam accommodaſſe etiam, non inficiando confiteri videantur.

IX. *An Account of a Book, entituled,* Gazophylacii *Naturæ & Artis.* Vol. I. In V. Decadibus. *In quo* Animalia, *viz.* Quadrupeda, Aves, Piſces, Reptilia, Inſecta, Vegitabilia; *item* Foſſilia, *corpora* Marina & Stirpes *Minerales è* Terrâ *eruta*, Lapides *figurâ inſignes*, &c. Deſcriptionibus *brevibus* & Iconibus *illuſtrantur.* A Jacobo Petiver, *Pharmacop.* Londin. & *Reg. Societ. Soc.*

THIS *Volume* which the *Curious Author* has now finiſh'd, contains 50 *Tables* of the *Figures* of divers rare *Beaſts*, *Birds*, *Fiſhes*, *Serpents*, and other *Reptiles*; as alſo ſeveral *Rare Inſects*, *Shells*, *Plants* and *Foſſils*, many of which he has obtained from the *Cabinets* of divers *Curious Perſons*, and procured others with no ſmall Expence from all Parts of the World, as the following Account will teſtify.

An *Abſtract* of the *firſt Decade* has already been given in theſe *Tranſactions* No. 284; the *ſecond* in the *Memoirs* for the *Curious* for the Month of *December* 1707; and the *third* in the ſame *Memoirs* in *July* 1709. We now proceed to the *fourth* and *fifth*.

The

The first *Figure* in this *Table* presents you with a large *Bill* of a *Helmet-headed Philippine Bird*, called *Calao*: Its *Description*, *Nature*, &c. may be seen in these *Philosoph. Transact.* No. 285. p. 1394. 17. and in *Table* 28 aforegoing, is an entire *Bird* of this kind, there figured. *Fig.* 8 and 12. are two very beautiful *Sponge-Coralls* from the same Islands. *Fig.* 6 and 11. are two *Plants* from *Madraspatan*, or *Fort St George*. *Fig.* 9. A remarkable *Shell* called *Pectunculus Venereus* from those Parts. The rest are divers small *Insects* and *Shells* of our *own Island*, and not common. TAB. XXXI.

Fig. 1. Represents a very curious sort of *Sea-Feather*, from the *Philippine Isles*, doubly netted with black Threads. 3. Another *Submarine* from the same Shoars: compos'd of many tangle-netted Filaments in a Globular Ball; both these sent to the *Author*, from the Learned Father *George Joseph Kamel*. *Fig.* 2 and 9. are *Luzone Shells*, the last a *Bivalve* called *Ducks bill* from its Shape. You have a particular Accounts of it in these *Transact.* No. p. 2402. 33. *Fig.* 10, 11 and 12. are 3 rare *Plants* which the Curious Dr. *Edward Buckley* collected about *Fort St. George*. *Fig.* 5 and 8. are two new *Kinds* of *Exotick Insects*, between a *Moth* and *Butterfly*; some part of their Wings, and commonly that near the middle, are transparent; the *Horns* of the first end crooked, the other thick and strait: Both these from *Carolina*, where there are divers kinds of them. *Fig.* 4, 6 and 8. are *English* Insects. TAB. XXXII.

This *Table* begins with a very odd sort of *Lentil* from *Madraspatan*, with spotted round *Leaves*. *Fig.* 4. is a large sort of *Tea*, with red Flowers as big as a *Rose*; in *China*, from whence it comes, they call it *Swa Tea*. vid. *Act. Phil.* No. 246. p. 396. *Fig.* 8. An elegant sort of *Androsace* from *Chusan*. *Fig.* 3, 5, 9, and 11. are *American* Insects from *Carolina*, *Maryland*, and *Virginia*. *Fig.* 7. A Moth from *Guiney*; its body girdled with Gold, Silver, Black, and changeable, so beautiful I never yet from TAB. XXXIII.

from that part have ſeen its like. *Fig.* 10 and 12. are two varieties of very curious *Engliſh* Moths, which for their Beauty and Spots are call'd *Royal Leopards.*

TAB. XXXIV. The 3d Icon in this *Table* gives you the Figure of the famous *China Tallow Tree*, of which *Father le Compte*, p. 101. gives the Deſcription, in his *Hiſtory* of thoſe Parts: Here you ſee it both in *Flower* and *Fruit.* The 1ſt and 2d are two *Cape Plants. Fig.* 10. is a ſtrange Fruit found on the Shoars of the *Orkney Iſles*, and is the ſame with another the Author received from the *Philippines*; but the Plant that produces it is not yet known. *Fig.* 11. An odd ſort of *Agnus Caſtus*, with round hoary Leaves, from *Chuſan* and the *Crocodile Iſles.* To theſe are added 3 *Engliſh Butterflies*, and as many *Sea* Nerit *Shells.*

TAB. XXXV. The four firſt are the *Figures* of as many ſmall *Engliſh* (and for the moſt part blueiſh) occulated *Butterflies. Fig.* 6, 8, 9, and 10. are alſo *Native* Shells and Foſſils. *Fig.* 5. gives you one of the largeſt kind of *Curculio* or *Pipe-Beetles* yet ſeen, from the Bay of *Bengal. Fig.* 7 and 11. are two Trees from the Iſland *Cheuxan*, or *Chuſan*, communicated to the Author by that Worthy Phyſitian, and Curious Collector of all Rarities, Dr. *Hans Sloane*, Secretary to the *Royal Society.* The *laſt* in this Table is a rare ſort of *Sea Plant*, which *Father Kamel*, that Sagacious and Learned Naturaliſt, ſent the Author from the *Philippine Iſles.*

TAB. XXXVI. The bulk of this *Plate* is taken up with the Figures of 3 or 4 *Chuſan* Plants, the laſt of which, No. 8. is a very elegant kind of *Fagara* with welted Stalks. This Induſtrious Author has alſo diſcover'd ſeveral other ſorts of this rare and Medicinal Plant from thoſe Parts. *Fig* 4. repreſents a very ſtrange ſerrated Bone, ſomewhat reſembling the *Priſtis* ſive *Serra Cluſij*, and is ſuppoſed to belong to ſome Fiſh. *Fig.* 3, 4, 5, 6, 9, and 10, are *Engliſh Inſects*, the laſt very rare and of a peculiar

liar Species. The laſt is a flat round ſtellated *Echinus*, found on the Coaſts of *China* by that Curious Naturaliſt and Surgeon Mr. *James Cunningham*.

TAB. XXXVII

The largeſt Figure in this Table, is the *true Turmerick* of the *Shopps*, which is here very neatly delineated from a deſign of *Father Kamel*, who (contrary to the Opinion of *Matthiolus*, *Cordus*, and even ſome later Writers) ſays, that the *Long* and *Round rooted* are the ſame Plant, *viz.* the *laſt* is the Parent or tuberous Glands, and the *Long* its Branches or Off-ſprings: The ſundry *Names* and *Vertues* are largely deſcribed by him in the *Appendix* to Mr. *Ray*'s 3d Volume, p. 23. *Fig.* 4. gives you a large *Broom-rape* with a purple Flower, found wild in the ſandy Places of *Barbary*, where its call'd by the Inhabitants there *Danoon*: And in the laſt place you have the Figure of the *Broom* itſelf, to which it grows: Its call'd in their *Arabick* Language *Rorum*: It bears a whitiſh Flower, and probably is the ſame which the *Spaniards* call *Retama*. The ſmaller Figures are of divers *Eaſt-India Inſects*, chiefly from *Luzone*, with ſome *Fruits* from thence, and one from *Guiney*.

TAB. XXXVIII.

The beginning of this *Table* continues the *Figures* of other Fruits from *Guiney*, *Jamaica*, and *Luzone*, with 3 rare *Beetles* and a *Butterfly* from the laſt Place. The reſt are ſeveral *Plants* obſerv'd in *Barbary*, and delineated there by Mr. *John James*, a Surgeon, about *A. D.* 1680. where he had been a *Captive* near 20 Years, and in that time had made ſeveral Remarks on the *Plants* of thoſe Parts, and has deſign'd the chief of them; a *Manuſcript* of which, with his Obſervations on them, Mr. *James Petiver*, the Author, has ſtill by him. *Fig.* 7. is a *wild Oat* from thence, which the *Moors* call *Khortan*; it is ripe in *May*. *Fig.* 8. *Mitiniam*, which ſignifies *ſtreng*, is a Plant with a yellow *Flower*, and Leaves like *Tyme*; of its *Bark* they make *Cords* and *Ropes*, as we do of *Hemp*. *Fig.* 9. is a yellow pentapetalous *Flower*, with

red with their proper Integrals or with their proper Fluents or not; to find the Relations of the Integrals or of the Fluents, freed from their Increments or from their Fluxions. The Direction I have given for finding the Solution in finite Terms is but tentative. And I muſt confeſs I know of no other Method that is general for all Caſes. For I can find no certain Rule to judge in general, whether any propoſed Equation, involving Increments or involving Fluxions, can be reſolved in finite Terms. For this Reaſon we are obliged to ſeek the general Solution in infinite Serieſes; which when they break off, or when they can any way be reduced to finite Terms, they then contain the Solutions which we always hope for. The Method of finding theſe Serieſes is explain'd in the eighth Propoſition, and that is by means of a Series that is demonſtrated in the ſeventh Propoſition. And this I take to be the only genuine and general Solution of the inverſe Methods. For in this Solution you always have thoſe indetermined Coefficients, which are neceſſary to adapt the Equation that is found to the Conditions of the Problem propoſed. For want of this Circumſtance all other Methods are imperfect; and particularly Sir *Iſaac Newton*'s Method of finding Serieſes by a Rular and Parallelograms labours under this Difficulty, becauſe it brings no new Coefficients into the reſulting Equation, which may afterwards be determined by the Conditions of the Problem. However becauſe this Method is very ingenious and very elegant, I thought it proper to explain it in the following (*viz.* the *9th*) Prop. The *10th*. *11th*, and *12th* Propoſitions conclude the firſt Part, and in them I treat of the manner of finding the Integral or the Fluent, having given the Expreſſion of a particular Increment, or of a particular Fluxion of it; without being involved with the Integrals, or with the Fluents, or with any other Increments, or with any other Fluxions of it.

it. This is a particular Case of the Inverse Method, but for its great usefulness I thought it deserved particularly to be taken notice of. This Problem is treated of in general in the 10*th* Proposition. The Method of solving it in finite Terms is only tentative; and when that does not succeed, recourse must necessarily be had to the Solution by a Series in the 8*th* Proposition. In the 11*th* and 12*th* Propositions I have shew'd how Series may be conveniently found, in some particular Cases when Fluxions are proposed.

In the second Part I have endeavour'd to shew the Usefulness of these Methods in the Solution of several Problems; The 13*th* Proposition is much the same with Sir *Isaac Newton*'s *Methodus Differentialis*, when the Ordinates are at equal Distances: and in an Example at the End of this Proposition I have shew'd how easily Sir *Isaac Newton*'s Series for expressing the Dignity of a Binomial may be found by this Incremental Method. The 14*th* Proposition shews in some measure how this Method may be of use in summing up of Arithmetical Series. In the 15*th* Proposition I shew by some Examples how the Proportions of the Fluxions are to be found in Geometrical Figures; from whence immediately flows the Method of finding the Radiuses of their inosculating Circles, the Invention of the Points of contrary Flexure, and the Solution of other Problems of the like nature. In the 16*th* Proposition I shew how the Method of Fluxions is to be applied to the Quadrature of all sorts of Curves. In the following Proposition I give a general Solution of the Problem of the *Isoperimeter*, which has been treated of by the two famous Mathematical Brothers the *Bernoulli*'s. In the 18*th* Proposition I give the Solution of the Problem about the *Catenaria*, not only when the Chain is of a given Thickness every where, but in general, when its Thickness alters according to any given Law. In the

fol-

following Propoſition I ſhew the *Fornix* or Arch which ſupports its own Weight to be the ſame with the *Catenaria*. In the two next Propoſitions I ſhew how to find the Figures of pliable Surfaces which are charged with the Weight of a Fluid. In the 22*d* and 23*d* Propoſitions I treat of the Motion of a Muſical String, and give the Solution of this Problem: To find the Number of Vibrations that a String will make in a certain time, having given its Length, its Weight, and the Weight that ſtretches it. This Problem I take to be entirely new, and in the Solution of it (in the laſt part of Prop. 23.) there is a remarkable Inſtance of the Uſefulneſs of the Method of firſt and laſt Ratio's. The 24*th* Propoſition gives the Invention of the Center of Oſcillation of all Bodies; and in the 25*th* Propoſition I have given the Inveſtigation of the Center of Percuſſion. It is known that this Problem is ſolved by the ſame *Calculus* as the foregoing; wherefore it is generally thought that theſe two Centers are the ſame. But that is a Miſtake, becauſe the Center of Oſcillation can be but one Point; but the Center of Percuſſion may be any where in a certain Line, which this Propoſition ſhews how to find. There is an Error in this Propoſition, which I was not ſenſible of till after the Book was publiſh'd, wherefore I take this Opportunity of correcting of it. It does not affect the Reaſoning by which I find the Diſtance of the Center of Percuſſion from the Axis of Rotation; but it is this, that I ſuppoſed the Center of Percuſſion to be in the Plane paſſing thro' the Center of Gravity, and perpendicular to the Axis of Rotation: which is a Miſtake. It is corrected by the following Propoſition.

PROP.

PROP. PROB.

To find the Distance of the Center of Percussion from the Plane passing thro' the Center of Gravity and perpendicular to the Axis of Rotation.

SOLUTION.

Let the sixth Figure be supposed in the Plane passing thro' the Axis of Rotation, and in which the Center of Percussion is sought.

Let AB be the Axis of Rotation, AGC be the Intersection of this Figure with the Plane passing thro' the Center of Gravity, and perpendicular to the Axis of Rotation, G be the Point whereon a Line, rais'd perpendicular to this Figure, will pass thro' the Center of Gravity; BE be a Line parallel to AG wherein is the Center of *Percussion*. Then to find the Distance AB, let p stand for an Element of the Body proposed standing perpendicularly on any point D Draw DC perpendicular to AGC. and AB will be equal to the Summ of all the Quantities $p \times GC \times CD$ taken with their proper Signs, divided by the Body it self multiplied into the Distance AG.

Having thus found the Distance AB, suppose the Plane of the Figure in *Prop.* 25. to cut the present Figure at right Angles in the Line BE, and the Center of Percussion will be rightly determined by that Proposition.

The 26*th* Proposition shews how to determine the Density of the Air at any Distance from the Center of the Earth, supposing the Density always to be proportional to the compressing Force, and that the Power of Gravitation is reciprocally as the Distances from the Center of the Earth.

like a *Birds foot* growing out of it. 9. is a ſprig of the *Cortex Peru*, or *Jeſuits Bark*, as figured by Monſieur *Pomet*. Here the Author promiſes a *Guinea* to the firſt Perſon that brings or ſends him a fair Specimen or Branch of its Leaves, with Flower and Fruit on it, which, 'tis now hop'd, the *South-Sea Trade* may eaſily diſcover and bring over. *Fig* 12. and 13 are 2 very beautiful *Surinam Birds*, copied from the Paintings of that great *Naturaliſt* and *Artiſt* Madam *Sybilla Merian*. The reſt are *Weſt India Inſects*, and a curious Piece of *Foſſil* flat *Echinus* from *Carolina*.

TAB. XLVIII. This *Table* begins with a very large *Capricorn Beetle*, accurately *figur'd* from a deſign which *F. Kamel* ſent from *Luzone*, with the Inſect itſelf very curiouſly preſerved, to the Author Mr. *Petiver*, which he has ſtill by him: As alſo the Head of another ſtrange one, which they call *Ololo*, and comes next to our *Corvus volans*, or *Flying Buckbeetle*. *Fig.* 8. is a particular ſort of creeping *Oſmund* or *Flowring Fern*, with ſmall *Fumitory* Leaves, with two others of leſs Note. Here is alſo figured from the ſame hand a neat *Rhombus*, ſpotted with black and white, call'd therefore by ſome the *Leopard Shell*. To theſe the *Author* has added 4 *Engliſh Inſects* of a new *genus*, approaching next to the *Locuſtæ* or *Graſhoppers*, but differ in their ſhape, and are in bulk much leſs; theſe he calls *Ranatræ*, or *Froghoppers*, from their form and motion. *Fig.* 12 and 13. are the different Poſitions of a wonderful *Foſſil*, call'd by *Wormius* and others, *Lapis Hyſterolithos*. Theſe Dr. *G. Kiſner*, a Curious Phyſitian at *Frankfort*, ſent to the *Author*, who found them in the *Vineyards* of *Lohenſtein*; he has alſo received them from Dr. *Heigel*, with the *Figures* of divers other ſorts, which he deſigns to publiſh.

TAB. XLVII. *Fig.* 1. is a ſcarlet *Muſhroom*, which grows to a Tree call'd in *Luzone* Molavin, whoſe *Wood* is famed for its extraordinary hardneſs. *Fig.* 2, 3. and 4. is a red *Cow-*

lady

lady from the ſame place, with its changes, *viz.* Catterpillar and Coffin. *Fig.* 6, 7, and 8 another ſomewhat bigger, of a Golden luſtre, with its Mutations. 5. is alſo a ſmooth green *Cantharus* or *long Beetle*; with 9. a houſe *Cock-roach*, very like ours, which the Natives there give inwardly to kill Worms in Children; they drink alſo their Aſhes, bruiſed and mixt with Sugar: They lay them to Ulcers and Cancers to ſuppurate. *Fig.* 11 and 12. are *Philippine Plants*; the firſt a *Fern*; the other, tho' rank'd amonſt them, is ſuppoſed to be a *Scandent* bacciferous Herb. 13. is a fine rib'd *Indian Shell*, call'd there *Binga*. The two next from *Pulo Condore*; one a ſmall black Warty *Welk*, the other a pretty marbled *Cockle*. The *Author* has lately found *fig.* 16. to be a Native of *Jamaica*, from whence it was brought, with divers others by Mr. *Carter*, *Surgeon*, a Perſon Curious in collecting *Shells*, &c.

The 3 firſt are the remaining *Ranatræ*, or *Froghoppers*, of *Tab.* 47. which the Curious Mr. *Dandridge* and the *Author* had obſerved. TAB. XLIX. *Fig.* 4 and 5 are broad leaved *Luzone Ferns*; the one notch'd, the other plain. *Fig.* 6. is an *American* foraminous ſandy *Sponge*, preſented to the Author by Dr. *Lewis*, M. D. The two next are *Luzone Beetles*; the laſt very large and fair, with 2 *Horns* like an *Oxe*, and a ſhorter in the middle, with one much bigger from the lower Jaw, which turns up like the Trunk of an *Elephant*. Fig 12. A ſort of bacciferous *Dodder*, which climbs about Shrubs, and frequently the *Agnus Caſtus*: it bears a ſmall tripetalous, or three-l aved Flower in *April*. The laſt is a very particular and rare *Scallop*; for, contrary to all others, it is ſmooth on the outſide, and the Valves within only ſtriated. This the Curious Mr. *Cunningham* obſerv'd, with ſeveral others, on the Shoars of *Pulo Condore*.

The 4 firſt Figures are *Luzone Spiders*, very exactly delineated. TAB. L. *Fig.* 1. A long Web-ſpinning houſe Spider. 2. A harmleſs *Tarantula*, its body of a *Filbert ſize*, and brown: Here is alſo ſhewn a flattiſh round *ſilken Egg-bag*, which

which he carries under his Belly, and out of it was produced 1000 young ones. 3. A web-spinning *Spider*, with Silver, yellow and black girdles, with its white, flat, Silk Bag, in which Fat er *Kamel* believes there were 2000 Eggs. *Fig.* 4. Another long-leg'd one, with a marbled Body. 5. A green *Beetle*. very finely mark'd, which Mr. *Cunningham* brough. from *Chusan*, and is one of the most beautiful of its kind from those Parts. 6. 7. 8 and 9. are small *English Pipers*, or *long-snouted Beetles*; the two last of Mr. *Dandridg*'s discovering, and not common. 10 and 11 are *Bug-flies* observed in the Woods about *Hampsted Heath*. 12. an *Indian Flowring Fern*, with an *Arum*-like Leaf; the Seed-leaves higher and more erect than the rest, standing on longer foot-stalkes than the green ones next the Root. They use this Plant instead of the *Spleenwort* of the *Shops*. 13. is a sort of *Diping Shell*, very common on the Shoars of *Jamaica* and *Barbadoes*. The last is very like our *English Hedge Snail*, but without Girdles, and has a small Navel: This is often met with in our *Gardens*, and sometimes in *Hedges*.

N. B. The *Second Volume*, containing 50 more *Tables*, is just now finish'd, in which there are many other things no less Curious or Strange than the former; and are ready to be delivered as soon as Ten more *Subscribers* shall send a *Guinea* each to the Author Mr. *James Petiver*, or Mr. *Christopher Bateman*, Bookseller in *Paternoster Row*, where the *First Volume* may be had, and the *Second* as soon as *Subscribed* for.

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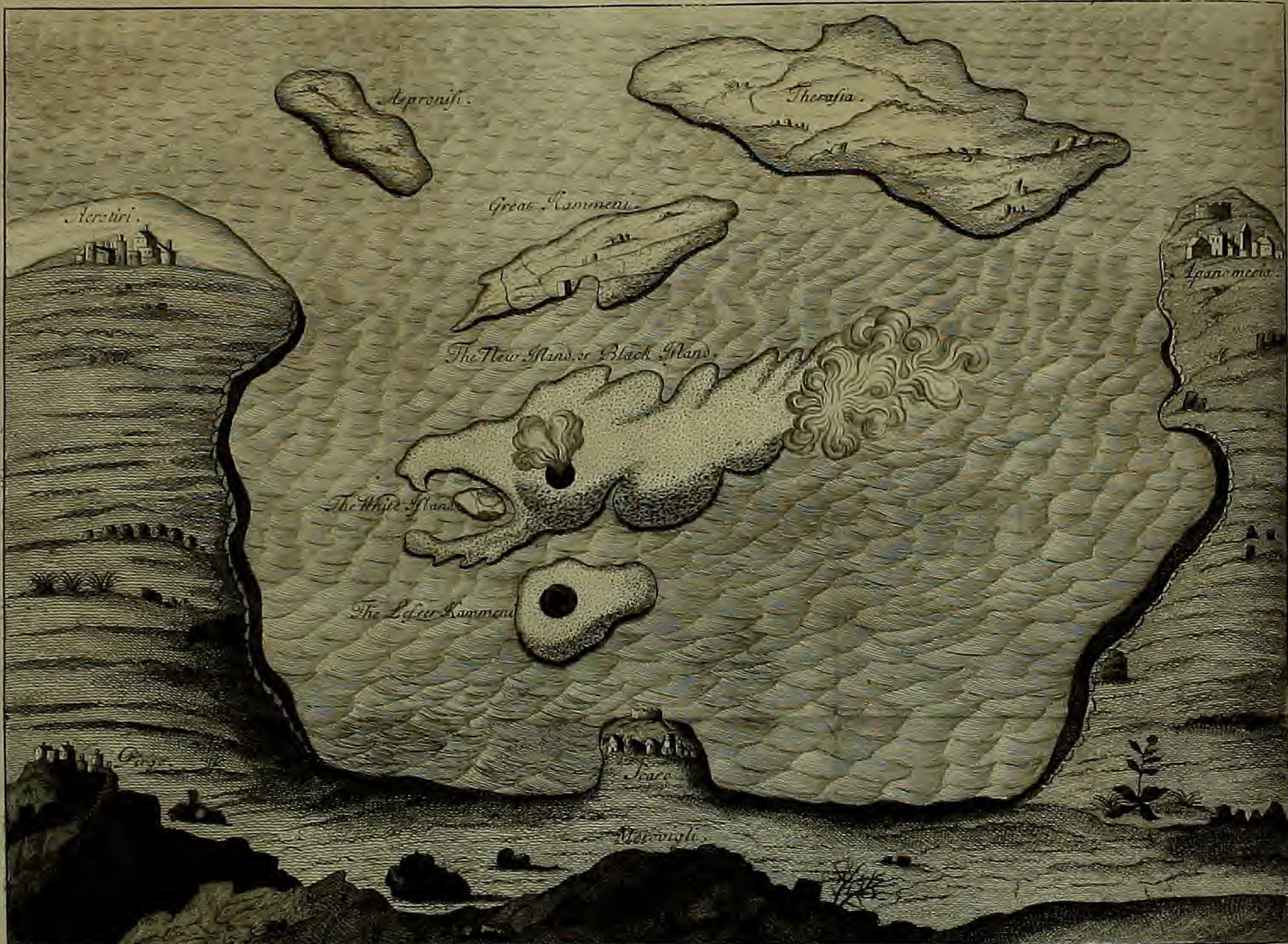
Aspronisi.
Therasia.
Acrotiri.
Great Kammeni.
Apanomeria.
The New Island, or Black Island.
The White Island
The Lesser Kammeni
Scaro
Merovigli.

(Numb. 332.)

PHILOSOPHICAL TRANSACTIONS.

For the Months of October, November, *and* December, 1711.

The CONTENTS.

I. *A Relation of a New Iſland, which was raiſed up from the Bottom of the Sea, on the 23d of* May *1707. in the Bay of* Santorini, *in the* Archipelago. *Written by Father* Goree (*a Jeſuit*) *an Eye-witneſs.*

AMONG the Prodigies of Nature, and the moſt ſurprizing things which She has at any time produc'd, we may, in my Opinion, very juſtly reckon an Iſland which roſe up from the Bottom of the Sea, about 4 Years ago, in the Bay which makes the Harbour of the Iſle of *Santorini* in the *Archipelago*; eſpecially if we conſider the Situation, Manner, and all the other Circumſtances of the Formation of this New Iſland. For what can be more ſurprizing, than to ſee Fire, not only break out of the Bowels of the Earth, but alſo to make itſelf a Paſſage through the Waters of the Sea, without being extinguiſhed? Or what can be more extraordinary, or foreign to our common Notions of things, than to ſee the Bottom of the Sea riſe up into a Mountain above the Water, and to become ſo firm an Iſland, as to be able to reſiſt the violence of the greateſt Storms? I know very well, that Subterraneous Fires, when pent in a narrow Paſſage, are able to raiſe up a Maſs of Earth as large as an Iſland: But that this ſhould be done in ſo regular and exact a manner, that the Water of the Sea cannot any ways penetrate to, and extinguiſh them; that the Fire itſelf, after having made ſo many Vent-holes and Paſſages, ſhould notwithſtanding retain a force ſufficient to raiſe up ſo great a Maſs; and in fine, after the Fire is extinct, that this great Maſs ſhould not fall or ſink down again thro' its own weight,

but

but ſtill remain of the ſame Height that the Fire had raiſed it; This is what to me ſeems more ſurprizing than any thing that has been related of Mount *Gibel*, *Veſuvius*, or any other *Volcano*.

Yet this is not the firſt time that theſe Prodigies in Nature have been ſeen at *Santorini*: For, if it be not true, that this Iſland itſelf, which was anciently call'd *Thera*, was in like manner raiſed out of the Sea (as *Pliny* aſſures us it was,) it is at leaſt moſt certain, that three other ſmall Iſlands (two of which lye within the Bay of *Santorini*, and the third a little without it) have been formed and raiſed up above the Sea by Subterraneous Fires.

The firſt of theſe Iſlands, which was anciently call'd *Hiera*, becauſe it was (as is thought) dedicated to *Pluto*, is now named *Megali Kammeni*, that is to ſay, the *Great Burnt Iſland*. *Juſtin* (*l.* 30. *c.* 4) ſpeaking of the firſt War of the *Romans* with the *Macedonians*, and of the two Months Truce which *Philip* King of *Macedon*, and Father of *Perſes*, then demanded, and which he obtain'd, according to *Salianus*, the 4th Year of the 145th Olympiad, and the 196th Year before the Birth of our Lord, tells us, that this Iſland roſe up from the Bottom of the Sea this very Year after an Earthquake. His Words are theſe. *Eodem anno inter Inſulas Theramenem & Therafiam, medio utriuſque ripæ & maris ſpatio, terræ motus fuit; in quo, cum admiratione navigantium, repentè ex profundo cum calidis aquis inſula emerſit.*

It became half as big again, in the Year of our Lord 726, by the joyning of another Iſland to it; which, according to the Relation of *Theophanes*, a *Greek* Author, cited by *Baronius*, roſe alſo out of the Sea, and raiſed itſelf exactly to the ſame height as the Iſland *Hiera*, and united ſo well to it, that at this time there remains no other mark of its joyning, than only a Cleft or Fiſſure, which reaches from one end of the Iſland to the

the other, and in ſeveral Places is not half a Foot broad.

The ſame thing happened a ſecond time in the Year 1457. as appears by a *Latin* Inſcription upon a Marble at *Santorini:* But with this difference, that the Subterraneous Fire, after having raiſed to the height of 5 or 6 Foot above the Water a vaſt quantity of Rocks, which formed a ſpace about a Mile in Circumference, opened a Paſſage for the Sea-Water to enter, by which it was extinguiſh'd; and the middle of that ſpace remain'd ſo low, that the Sea flowing into it by a Subterraneous Canal, made there a ſmall Lake, which continues to this Day.

As to the ſecond Iſland, which is a little without the Bay, and is call'd in *Greek Aſproniſi*, or the *White Iſland*, becauſe the Earth, with which it is covered, is white like Lime; *Pliny*, who lived in the time of the Emperor *Veſpaſian*, ſays, that it roſe out of the Sea, and appeared in his time.

The third Iſland, which is the leaſt, and is called by the *Greeks Mikri Kammeni*, or the *Leſſer Burnt Iſland*, was formed in the Year 1573. according to the relation of ſeveral Old People, who learned it of their Anceſtors: And it is between this little Iſland and the Great *Kammeni*, that on the 23d of *May* (New Stile) in the Year 1707. at break of Day, the New Iſland, of which I am now going to ſpeak, was firſt diſcovered.

Five Days before it appeared, *viz.* on the 18th of *May*, between one and two of the Clock in the Afternoon, there was at *Santorini* an Earthquake, which was not violent, and continued but a Moment: And in the Night between the 22d and 23d, there was alſo another, which was yet leſs ſenſible than the former.

It is natural to imagine, that it was then, that the New Iſland firſt began to move and raiſe itſelf from the Bottom of the Sea: Yet, if we conſider, that theſe two

Earth-

Earthquakes were not violent, and lasted but a Moment; and that the Bottom of the Sea was in this Place from 80 to 100 Fathom deep, it seems difficult to believe, that in 5 Days time, it could rise to this Height. What inclines me to think the contrary, is, that the Height it is at present above the Surface of the Sea, and which it did not arrive to in less than 3 Years time, is much less than that from the Bottom of the Sea to the Surface of the Water, as I shall show hereafter. Add to this, that a long time before these Earthquakes, the Fishermen perceived an ill Smell every time they passed by that place; which shows that the Island had then begun to move: Notwithstanding it is very certain, that there have not been any other Earthquakes at *Santorini*, than those, which, 14 or 15 Years ago, continued for several Days, and were very violent. However it was, some Seamen discover'd this Island early in the Morning; but not being able to distinguish what it was, they imagined it to be some Vessel that had suffered Shipwrack, and was driven thither by the Sea. In hopes of making an Advantage to themselves by it, they went immediately to it; but as soon as they found that it was a New Island, they grew afraid, and returning as hastily back again, spread the report over the whole Island; which was the more readily credited, because all the Inhabitants knew, and several of them had themselves seen, what happened in the Year 1650. There was then a New Island, like to the present, which, between the Islands of *Santorini*, *Nio*, and *Andro*, rose up by means of Subterraneous Fires, which caused several violent Earthquakes, accompanied with a roaring Noise under ground, Sulphureous Exhalations, an insupportable Stench, and a black Smoak, which rose out of the Sea with Flames to the height of 10 or 12 Cubits. The Sea was then so tossed backwards and forwards by the terrible Shocks of the Earth, that it overflowed and

deſtroyed 30000 Perches of Land in *Santorini*; and the Air was ſo infected with Exhalations which came from the Fire, that 25 Perſons, and a great many Beaſts, were ſtifled. At laſt, when this Iſland had not above 8 or 10 Fathom of Water to riſe, ſo as to appear above the Surface of the Sea, the force of the Subterraneous Fire was ſo violent, as to open a Paſſage before its time, by which the Water of the Sea entring in like a Torrent, extinguiſhed the Fire, and this Maſs of Earth and Stones did not riſe any higher. Let us now return to our new Phænomenon.

How great ſoever the Fright of the Inhabitants of *Santorini* was, at the firſt ſight of this New Iſland, yet a few Days after, not ſeeing any appearance either of Fire or Smoak, ſome of them, more bold that the reſt, took a reſolution to go and view the Situation of it: Which they did accordingly; and not imagining any Danger, went on Shore upon it. As they had no other deſign, but to ſatisfy their Curioſity, they paſſed from one Rock to another, upon which they met with ſeveral very remarkable Curioſities; among which we may reckon a ſort of White Stone, which cuts like Bread, and reſembles it ſo well in form, colour, and conſiſtence, that were it not for its taſte any one would take it for real Bread. But what pleaſed them more, was a great number of freſh Oyſters which they found ſticking to the Rocks; which being very ſcarce in that Country, by reaſon of the depth of the Sea, they got as many of them as they could.

While they were buſy about this, they perceived the Iſland move and ſhake under their Feet. This was ſufficient to make them leave it immediately, and to return back faſter than they came. In ſhort, the riſing of the Iſland was viſible to the Eye, and it encreaſed not only in Height, but alſo in Length and Bredth. Tho' it was already between 15 and 20 Foot high above the Sea, it could

could not yet be ſeen from the Mountain *Merovigli*, or the Caſtle of *Scaro*, which ſtands upon the Shore, by reaſon the Leſſer *Kammeni*, above mentioned, lay between, and hinder'd the ſight: But at 15 Days end, they began to ſee it from *Merovigli*, and in a few Days after, from the Caſtle of *Scaro* ſituated upon another Mountain, which, tho' it be very high, in reſpect to the Sea, yet it is much lower than that of *Merovigli*, to which it joyns. From whence we may judge how much this New Iſland grew in Height in a few Days.

As the motion, by which this Iſland increaſed every Day in Height, was ſometimes equal, and at other times unequal, in reſpect to all the Parts of ſo great a Maſs; ſo it did not always riſe equally on every ſide. It often happened, that while it grew in Height and Length on one ſide, it ſunk down and decreaſed on the other. I one Day ſaw a Rock riſe out of the Sea, at 40 or 50 Paces diſtant from the Iſland, which I continued to obſerve for 4 Days together; at the end of which time it ſunk again into the Sea, and did not appear any more: But this was different from what happened to ſome others; which having diſappeared, at this did, they reappeared again ſome time after.

The Leſſer *Kammeni*, which lies very near, was often ſhaken with the Motion which raiſed this New Iſland. From a ſmall Cleft, which we obſerved upon the top of this little Iſland, ſometimes Stones would break looſe; which rolling down its ſides into the Sea, would raiſe, as it were, a Cloud of Duſt, which ſome People took to be Smoak, but in reality it was not ſo.

At this time, the Sea, which is contained within the Gulf or Bay of *Santorini*, ſeveral times changed its Colour: At firſt it appeared Green, afterwards Rediſh, and ſometime after of a Yellowiſh Colour; with a Stink, which ſpreading itſelf over great part of *Santorini*, made us imagine that this Colour proceeded from

nothing elſe but the Sulphur with which the Sea was covered.

The Smoak appeared firſt upon the 16th of *July*: At which time, from a place in the Sea, where (they aſſured me) they could never before find any Bottom, and which was above 60 Paces diſtant from the New Iſland (which they then called the White Iſland) there roſe up a Ridge of Black Stones, which the *Greeks*, by reaſon of their hardneſs, call *Sideropetres*, or Iron-Stones, which formed another Iſland, named by the Inhabitants the Black Iſland; and which was afterwards not only the Center of the whole Iſland, but alſo of the Fire, and Smoak, and great Noiſe, that was heard ſome time after.

The Smoak, which iſſued out of this Ridge of Stones, or Black Iſland, was very thick and white, as if it had proceeded from 5 or 6 Lime-Kilns joyned together; and being carried by a North Wind towards the Caſtle of *Acrotiri*, it went into the Houſes of the Inhabitants, but without cauſing any great annoyance, becauſe it had no very ill Smell. Four Days after the Smoak had thus appeared, they ſaw in the Night time Fire iſſuing out from the ſame place.

It was then, that the Inhabitants of *Santorini*, and eſpecially thoſe of the Caſtle of *Scaro*, began to be in good earneſt afraid. They conſidered that their Caſtle was ſituated upon a Promontory, that was very narrow, and near to the Black Iſland; and that the time drew near, in which they muſt expect it either to be blown up into the Air, or overturn'd by ſome Shock of the Earth. They had continually before their Eyes Fire and Smoak; and this diſmal Spectacle made them apprehend, that there might be ſeveral Mines of Vitriol and Sulphur in the Iſland of *Santorini*, which would ſoon take Fire; and that therefore the ſafeſt way for them was to abandon the Country, and retire to ſome other Iſland. And indeed ſome took this reſolution; and

and there was no other way left to ſatisfy the reſt, but by telling them, that if they would retire further into the Country, they would be ſafe there; and that if the Caſtle was in Danger, yet they muſt neceſſarily ſee the Leſſer *Kammeni* firſt entirely deſtroyed, not only becauſe it lay between the Caſtle and the Black Iſland, but alſo becauſe it was much nearer to it than to the Caſtle.

The *Turks*, who were then at *Santorini*, collecting the Tribute which this Iſland pays yearly to the *Grand Signior*, were not leſs afraid than the other People: Being amazed to ſee Fire break out of the Sea where it was ſo deep, they intreated the Chriſtians to pray to God, and eſpecially to make their young Children cry *Kirie Eleiſon*; becauſe, as they ſaid, the Children not having offended God, they could more eaſily appeaſe his Anger than older Perſons. The Fire, however, was then but very little, being not above the breadth of the Mouth of a Furnace, and did not appear in the Day time, but only in the Night, from Sun ſetting to Sun riſing; and was ſo far from ſpreading the whole length of the Ridge of Stones above-mention'd, that it poſſeſs'd but one ſmall part of it, which was always afterwards the common Paſſage for the Smoak and Fire, which I ſhall ſpeak of hereafter.

As for the firſt Iſland, or White Iſland, we did not ſee there either Fire or Smoak; yet it continued to grow bigger; but the Black Iſland increaſed much faſter. We ſaw every Day great Rocks riſe up on every ſide of it, which made it ſometimes longer, and at other times broader; and by the Height of them we could very nearly judge how many Foot it roſe up every Day or Night. Sometimes theſe Rocks joyned to the Iſland, and at other times they were at a diſtance from it; ſo that in leſs than a Month, there were four little Black Iſlands, which in a few Days after, united together, and made but one Iſland.

As

As the Smoak encreaſed very much, and there was no Wind ſtirring, it roſe up to the middle Region of the Air, ſo as to be ſeen (as ſeveral credible Perſons aſſured me) at *Candia*, *Naxos*, and other Iſlands; and in the Night time it appear'd of a Flame to 15 or 20 Foot high. The Sea was at that time covered with a Matter or Froath, which in ſome places was reddiſh, and in others yellowiſh; from whence there proceeded ſo great a Stench over the whole Iſland of *Santorini*, that for fear of being infected, ſeveral Perſons were obliged to burn Incenſe, and others to make Fires upon the tops of their Houſes, to diſperſe it and to purify the Air. By good luck it did not continue above a Day and half; for a ſtrong South-Weſt Wind aroſe, which, together with the Motion of the Sea, did indeed diſperſe this froathy Matter, but occaſioned otherways a great damage to the beſt part of the Iſland of *Santorini*. At that time they were in great hopes of having ſhortly a very plentiful Vintage; when this Wind carried all the Smoak on upon their Vineyards, which burnt them up in ſuch a manner, that the Grapes (which were not yet ripe) turned in one Nights time like dryed Raiſons, ſo that they were forced afterwards to throw them away, becauſe of their ſowerneſs; which was a great Grievance to moſt of the Inhabitants, the greateſt part of whoſe Revenue conſiſts in Wines.

The firſt who brought this ſorrowful News was a poor honeſt Man, who fail'd not early every Morning to viſit his ſmall Vineyard, and was not a little rejoyc'd to ſee it ſo well ſtor'd with plenty of good Fruit: He went as uſual, not dreading this unlook'd for Calamity; and finding it all thus unexpectedly blaſted, was ſtruck with ſuch ſudden Aſtoniſhment, that he wandered about a long time like one out of his Senſes, looking for his Vineyard in the Vineyard itſelf; but coming to himſelf, at length returned home, proclaiming

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ing his misfortune in such a Tone, and with such Expressions of Grief and Amazement, as rais'd at once both Pity and Laughter.

Nor was this the only effect occasion'd by this thick Smoak; for it is farther remarkable, that Silver and and Copper were changed black by it: And tho' some People, who were forced to pass thro' the Smoak in going to their Houses, assured me, that it had no very ill smell with it; yet several of them were, that and the next Day after, troubled with great pains of their Head. At this time the White Island, which (as I have said before) seemed to be above the Lesser *Kammeni*, and could be seen from the first Floor of the Houses in the Castle of *Scaro*, sunk down so low, that it could not be seen from the second.

Hitherto the Sea had not been observed to boil up, or any Noise heard upon the Black Island: But upon the 31st of *July*, the Sea was seen to emit Smoak at two several Places; one of which was about 30, and the other above 60 Paces distant from the Island. In these two places, both of which were perfectly round, the Water of the Sea looked like Oyl, and seemed to rise up and bubble: Which is continued to do for more than a Month; in which time there were a great many Fishes found dead on the Shore, occasioned by their happening to have been too near these two Places.

The Night following there was heard a dull hollow Noise, much like that of several Cannons shot off at a distance: And at the same time there was seen to rise out of the midst of the Funnel Flames of Fire, which darted very high into the Air, and disappeared immediately. Next Day there was heard several Returns of the same Noise, which was followed by a Smoak, not white, as usual, but blackish; and which, notwithstanding a very fresh North Wind, rose up in a Moment to a prodigious Height, in form of a Column, and in the Night

Night time would, in all probability, have appeared, as if it were all on Fire.

Auguſt the 7th, the Noiſe alter'd; and from being dull, as before, it became very loud, and reſembled the Noiſe which is made when ſeveral great Stones are thrown all together into a very deep Well: And I really believe that this Great Noiſe was occaſioned by ſeveral large pieces of Rocks, which after having been raiſed up with the Iſland by the violence of the Fire, broke of by reaſon of their weight, and fell back again into the Subterranean Caverns. What confirms me in this thought is, that I ſaw then the Ends of this Iſland in ſo great a Motion, that after having appear'd for ſome Days, they then diſappear'd, and afterwards re-appear'd again a-new. Howſoever it was, this Noiſe after having continued ſo for near a Month, was followed by another much louder and more extraordinary: It ſo nearly reſembled Thunder, that when it did really Thunder, as it happen'd to do 3 or 4 times, there was very little difference between the one and the other.

As the Paſſage, which the Fire had made itſelf by its violence thro' ſo many Rocks, was not, in all probability, in a ſtrait Line, and was in ſome places narrower, and in others larger and more free; ſo it is probable, that the Fire, or rather the Sulphureous and burning Exhalations, cauſed this great Noiſe, by turning from ſide to ſide in theſe winding Caverns, and endeavouring to get a Paſſage out, which was difficult for them to find: Which was the cauſe that the Noiſe of this Subterraneous Thunder was ſometimes not ſo loud, and a little while after grew more violent, and ſometimes was ſo ſtunning, that People talking together could ſcarce hear one another ſpeak; and that the Black Iſland, which was already very high, ſeemed to crack on every ſide; and in ſhort, that the incloſed Fire, after ſeveral Windings and Turnings, having collecting a ſufficient force,

was

was able to break out with a Noiſe equal to that of ſeveral Cannons diſcharged at once.

Auguſt 21. the Smoak deminiſhed conſiderably, as alſo the Fire: There did not appear any in the Night; but the next Day both returned with greater force than at any time before. The Smoak was reddiſh and very thick, and the Fire ſo great, that the Water of the Sea ſmoak'd and bubbled up all round the Black Iſland. I had in the Night the Curioſity to view with a Teleſcope the great Fire that appeared upon the Mountain of this Iſland, and I number'd 60 Openings or Funnels, which threw out all of them a very bright Fire, and were divided from one another by Rocks. In all probability there were others, and perhaps as many, on the other ſide of the Mountain, which I could not ſee. Next Morning I obſerved that the Iſland had been very much raiſed in the Night; that a Range of Rocks about 50 Foot long was roſe out of the Water, which made the Iſland broader than it was before; and that the Sea was almoſt covered over with the reddiſh froathy Matter, above-mentioned. This Matter, or Froth, appeared upon the Sea every time that the Iſland increaſed conſiderably; and occaſioned a ſtink, much like that of the Sink of a Ship: Which we may imagine to ariſe from a ſlimy Earth mixed with Sulphur, which being raiſed up with the Rocks, and coming to be waſhed off by the Waves, was looſened and diluted by the Water, and ſo ſo ſent up to the Surface the Salts with which it was loaded.

The Fire had hitherto appeared but only in one place, upon the Top of the Black Iſland; but on the 5th of *September* it made itſelf another Paſſage, and appeared at the End of that Iſland, on the ſide next *Teraſia*, which is another Iſland which ſome Authors ſay was formerly joyned to that of *Santorini*, and was ſeparated from it by an Earthquake. The Fire did not continue at this

End but a few Days, during which it decreaſed at the place whence it uſed commonly to iſſue out. And here we were very agreeably ſurpriz'd, in ſeeing the Fire ſeveral times dart out from this place without any Noiſe, and riſe up in the Air like a large Rocket. The following Days there was much the ſame Spectacle; for the Subterraneous Thunder, after having made a great Noiſe, broke out from time to time with a Clap as loud as that of a Cannon, (which the Inhabitants were then ſo far from being afraid of, that they took pleaſure in viewing it) and was accompanied with a very beautiful and large Fire, which ſhooting up in an inſtant to a great Height, fell again on the Iſland, and illuminated it almoſt all over. I cannot better repreſent the Figure that the Fire made in the Air, than by comparing it to a certain Artificial Fire-work I have ſeen in *France*, and is there called the *Gerbe*: But with this difference notwithſtanding, that this Fire, of which I am ſpeaking, roſe much higher, and was much larger, but not ſo diſtinct as that of the *Gerbe*. The Pleaſure, however, that they had, in viewing theſe Natural Fires, which ſo nearly reſembled Artificial ones, was not a little diſturbed by a *Phænomenon* which the Inhabitants believed to be an ill Omen to them; for immediately after the Fire was darted out, as I have ſaid, in the manner of a Rocket, there appeared in the Air a Blaze, in the form of a long fiery Sword, which continued ſometime, without moving, over the Caſtle of *Scaro*, and afterwards diſappeared.

At that time alſo, the White Iſland and the Black Iſland, having increaſed in length, in proportion as they roſe in Height, united together; and the End of the Black Iſland, towards the South-Eaſt, began not to increaſe any more, either in Height or Length, while the End toward the Weſt increaſed very ſenſibly to the Sight: Which makes me imagine, that the Mine of Sulphur being at this place, and the Fire not finding any Paſſage out here, had

had force to raiſe up this part and not the other; for in the middle of the Iſland it always found Openings to iſſue out at, together with the Smoak. It had then 4 Paſſages there, which were ſo near one another, that one could not well diſtinguiſh them aſunder, but by the Smoak: I do not mean that Smoak which commonly iſſued out and was continual, but that which roſe up at ſome certain times with a great force; for this Smoak came forth ſometimes from one Paſſage, and ſometimes from another, and oftentimes out of all four together; ſometimes with a great Noiſe, and at other times without any Noiſe at all, tho' then alſo it iſſued out with the ſame impetuoſity.

Out of theſe Paſſages alſo there came a whiſtling Noiſe, like that of an Organ Pipe; which, by the variety of Sound it made, pleaſed the Inhabitants as often as the Subterraneous Thunder ceaſed.

One would think, that the Noiſe of this Thunder ſhould not then be ſo loud, by reaſon of the ſeveral Paſſages of which I have ſpoken; yet, notwithſtanding, it was not at any time ſo great and ſo frequent as it was then, and as it was above ſix Months after. It was then, as I ſaid, like the Report of a Cannon: And there did not paſs a Day or a Night, but we heard 5 or 6, ſometimes 10 or 12 of 'em; and at the ſame time ſeveral great burning Stones were thrown into the Air; ſome of which falling one Day upon the Great *Kammeni*, ſet fire to ſome Thickets of Buſhes upon that little Iſland; and others being caſt a great way into the Sea, had certainly deſtroyed a ſmall Veſſel that paſſed by at above a Miles diſtance, if it had gone by never ſo little later. Theſe Claps were always attended with this Smoak I have mentioned, which was very different from that which iſſued out continnally from the Gulf of Fire almoſt in the middle of the Iſland; for this was much thicker and blacker, and roſe in an inſtant much higher,

and was not diſperſed 'till ſome time after, and then fell in Aſhes upon the Country, or into the Sea; ſome of which the Wind ſometimes carried as far as *Anacuphi*, an Iſland about 25 Miles diſtant from the Bay of *Santorini*.

Some Perſons had the Curioſity to gather ſome of theſe Aſhes, (which were of a Colour between black and white) and put them into the Fire, imagining they would burn like Gun powder, which they very much reſembled; but they produced no other effect, than only making a ſmall hiſſing Noiſe.

September the 18th, two Hours after Midnight, there was an Earthquake at *Santorini*; with which they were the more ſurprized, becauſe they leaſt ſuſpected it, the Subterraneous Fires having had ſo free a Paſſage for ſo long a time. It did not do any damage; and had no other effect than to enlarge very much the Iſland, and to remove for ſome Days the Fire and Smoak into other Places, through new Paſſages which it made, and to increaſe very conſiderably both of em. And in truth, I never ſaw ſo much Fire, or heard ſuch terrible Claps, as after this Earthquake. By the violence of theſe Claps, Houſes were ſhaken at above 3 Miles diſtance; and out of the midſt of a great Smoak, which roſe up and appeared like a Mountain, one might ſee and hear great pieces of Rocks fall down into the Sea and upon the Iſland, which were thrown out with the ſame Violence and Noiſe as a Bullet out of the Mouth of a Cannon.

The Leſſer *Kammeni* was ſeveral times quite covered over with great Stones cover'd with burning Sulphur; ſeveral of which rolling afterwards from the top of this little Iſland into the Sea, made a very bright Light and pleaſant appearance in the Night. I thought at firſt, that the Fire had paſſed under ground from the New Iſland to this; becauſe they are not very far aſunder:

But

But I ſoon found my miſtake, and that this Fire proceeded only from theſe Stones ſulphur'd over; for the Sulphur, with which they were cruſted over, being conſumed, they were all extinguiſh'd in half a quarter of an Hours time, except ſome few which remained alight above half an Hour. One Day, when the Leſſer *Kammeni* was all on Fire, after one of theſe furious Claps, and the Air was ſo too, thro' the frequent Flaſhes of Fire that appeared in the Clouds, we ſaw, by a ſurprizing Accident, three Flaſhes come out of the places where the Fire was, which one could not diſtinguiſh from real Lightning, but that they were formed lower, and were at the two Ends of the Iſland. By the violence of one of theſe Claps, part of the top of the New Iſland was carried off into the Sea, and ſeveral Stones were thrown to above two Miles diſtance: And, as if the Mine had been exhauſted by this great Clap, three or four Days paſſed without any Noiſe, and almoſt without any Fire or Smoak. They thought then, that they ſhould have ſeen an end of it: But the Fire kindled again, and the Iſland became more terrible than before. I was then at a Village 6 Miles diſtant; where we heard ſo diſtinctly (notwithſtanding it lay under a Mountain) the Blaſt of the Mine, that the Inhabitants were ſo frighted at ſuch an extraordinary Clap, that I was forced to put 'em in heart, and they run immediately to Church to ſay their Prayers, and recommend themſelves to God. At my return to the Caſtle of *Scaro*, I found the People much more alarmed than they were in the Village; and was informed immediately, that the Caſtle had ſuffered ſo violent a Shake, that the Doors of the Houſes, and the Windows that were ſhut, were opened by the force and violence of the Clap.

February the 10th 1708. at half an Hour after Eight of the Clock in the Morning, there was another Earth-

quake

quake at *Santorini*; and ſome Perſons aſſured me, that there was another the Night before, but not ſo ſenſible as this. If we may judge by what is paſt, our *Volcano* is ſo far from drawing ſhortly to an end, that it gets new force by other Veins of Sulphur which take Fire at a greater diſtance. We have Inſtances of this in the Fire and Flames which riſe ſo frequ n ly into the Air, and fall again over the whole Iſland, making in the Night time as fine a Spectacle as was ever ſeen in Artificial Fire-Works. Beſides this, ſeveral great Rocks, joyning to the Iſland, which before were even with the Water, have been raiſed much higher; and the Noiſe, Smoak, and boyling of the Sea, increaſe ſo much, that tho' the Inhabitants of *Santorini* have been ſo long accuſtomed to ſee all theſe things, yet they could not help being more afraid than before. And certainly not without reaſon; for the Subterraneous Noiſe was more violent than ever, and continued ſeveral Days together without any Intermiſſion; and in the ſpace of a quarter of an Hour the Mine diſcharged itſelf 5 or 6 times; the Noiſe of which, with the great quantity of Stones it threw into the Air, the Shocks it gave the Houſes, and the Fire which appeared in open Day (which was never ſeen before) very much ſurpaſſes all that I have before ſpoken of it.

The 15th of *April* was remarkable above all other Days, for the great number and violence of the Claps; by one of which, near 100 great Stones were mounted up all at once into the Air, and fell again at above two Miles diſtance in the Sea. Tho' I was then about three Miles off from the New Iſland, I obſerved one, of a ſurprizing greatneſs, which did not riſe ſo high as the reſt, but was driven farther, in a ſtrait Line, like a Cannon Ball. This happened to be *Eaſter-Day* (which was upon *April* the 4th, Old Stile, which is uſed at *Santorini*) and this Circumſtance contributed not a little to confirm

confirm ſeveral ignorant *Greeks* in the ridiculous Opinion they had, that this New Iſland was one of the Mouths of Hell; ſo that they did not ſcruple to ſay, that the Devils, not being able to bear that Day, as being jealous of the Glory of the Reſurrection of our Lord, had made all the Efforts that Day that was poſſible: And their Biſhop himſelf was ſo infatuated with this Opinion, as well as the reſt, that he ſpoke to me very ſeriouſly about it, and asked me my Thoughts of it: But notwithſtanding whatſoever I could ſay to undeceive him, I found that he perſiſted in his Opinion, and would not be perſwaded otherwiſe.

From the 15th of *April* to the 23d of *May*, which was a Year from the Birth of this New Iſland, what I have deſcribed above, continued the ſame; and I did not obſerve any thing more in particular, unleſs it were that the Iſland increaſed in Height and not in Length; and that one furious Clap beat down at once all the top of it; which by means of the Aſhes and Stones of all ſizes that fell upon it Day and Night, was not only repaired, but made much higher than it was before. All particulars began to abate afterwards: The Smoak decreaſed; the Subterraneous Noiſe was not ſo violent; and the Claps, tho' they were very frequent, were not however ſo loud, by reaſon that the Funnels, which gave a Paſſage to the Fire and Smoak, were then much larger than they were before.

Hitherto I had not been to ſee this Iſland, but at a diſtance; for fear the ſame ſhould happen to me, as to *Pliny*, when he went to ſee Mount *Veſuvius*; and leaſt I ſhould be ſuffocated, as he was, with the Flames, or over-whelm'd with the Stones which this New Iſland threw out on every ſide. But ſeeing that there was then no danger, I went in company with the Reverend *Francis Criſpo*, the *Latin* Biſhop of *Santorini*; who, as well as myſelf, had not ſeen it before but a diſtance, and

and had the ſame Curioſity as myſelf to view it and take all the Dimenſions of it. And as our deſign was to go aſhore upon it, if poſſible, we went directly to it; to do which, we were obliged to paſs over a Place, where the Sea ſmoak'd very much, but did not bubble. We were no ſooner come to this Place, but we perceived a Heat ſtrike upon our Faces; which was nothing elſe but the Fumes of the Sulphur, in the midſt of which we were at that time. One of the Perſons that were with us, who was naturally more timerous that the reſt, being ſurpriz'd at this Heat, and not knowing the cauſe of it, asked from whence it proceeded. The Seamen bid him and us put our Hands into the Water; which we did, and found it ſo very hot, that having taken them out again immediately, the Biſhop bid them make what haſte they could away; ſaying pleaſantly, that *that Place was too hot to tarry there long.* What ſurprized and griev'd me at the ſame time, was, that we were then 500 Paces off from the New Iſland, and that I had not time to ſound the Depth of this Place. From hence we went directly over to that part of the Iſland, where it had encreaſed in Length, and where there was more Danger; for ſeeing that the Smoak was very thick, which ſhowed that there was a great Fire all thereabout, we did not think it ſafe to go any nearer, and ſo ſatisfy'd our ſelves with viewing only the ſpace that was between this New Iſland and the *Leſſer Kammeni*; which I found to be broader than I imagined, and judged that a Galley might paſs thro' the narroweſt place of it. After this, we went on Shore upon the *Great Kammeni*, that we might from thence view nearer, and without any Danger, the whole Burning Iſland, and eſpecially that ſide of it which we could ſcarce ſee from the Caſtle of *Scaro*. From hence it was, that after having well examined all Particulars, we judged this New Iſland to be about

200 foot in Height, 5 Miles in Circumference, and a Mile over at its broadeſt part. As to the Form of it, it is oblong, and reſembles in ſome meaſure the Figure of a Dragon; as may be ſeen by the Deſign of it, which I took from this place.

After having tarried ſometime upon the *Great Kammeni* (where we had the pleaſure to ſee often, not far off, a great many Stones thrown violently out of the Gulf of Fire, and fall down again with a terrible Noiſe upon the Iſland) we took a Reſolution to coaſt it round, and to go to the other end of it, not doubting but that we might get on Shore there, becauſe that part of the Iſland had not increaſed for ſeveral Months, and there did not appear any Fire or Smoak there. We were within a hundred Paces of it, when putting my Hand into the Water, I perceived that it was warm, and that the further we went the hotter it grew. At this Inſtant the Mine diſcharged itſelf; and the Wind drove upon us the thick Smoak, which broke out with ſuch violence every time the Mine took Fire: And a Shower of Aſhes and little Stones, not larger than common Hail-Stones, falling upon us, we were forced againſt our will to quit our deſign of going on Shore upon the Iſland at this Place. This Shower of Stones and Aſhes being over, we retired a little by reaſon of the great heat of the Water; and letting down our Plummet, we had at this place 95 Fathom of Water, without finding the Bottom, our Line not being long enough. Viewing afterwards the ſpace that was at this end between the Iſland and the *Leſſer Kammeni*, we found in ſeveral places that it was narrower at this ſide than at the other; and that if the New Iſland ſhould continue to grow bigger, ſeveral Rocks, which were already half above Water, and roſe up nearer to the *Leſſer Kammeni*, would in time ſhut up the Paſſage and joyn both the Iſlands together, ſo as to make a little Port between 'em, which would be very commo-

dious for the Shipping of *Santorini*. In returning afterwards to the Caſtle of *Scaro*, we paſſed by the little Port of the *Leſſer Kammeni*; and (by reaſon of its nearneſs) could ſcarce believe what they there told us, *viz.* That they could not hear there any of the Noiſe that this New Iſland made: Which we found to be true, and that the Height of this little Iſland was the cauſe of it.

During all the reſt of the time that I tarried at *Santorini*, to the 15th of *Auguſt* 1708. (at which time I came away) the Smoak, Fire, Noiſe, &c. continued much the ſame as I have now deſcribed 'em; that is to ſay, they were always pretty moderate.

This is all that I can ſay of this *Phænomenon*; all the Circumſtances of which I have related ſo much the more faithfully, becauſe I was the only Perſon at *Santorini* who kept a Journal of what happened every Day; and of which I had given you an Account ſooner, but that, in order to make it more compleat, I waited a long time in vain, in hopes to have ſeen and given you an Account of the End of it. From my leaving *Santorini*, to this preſent the 6th of *July* 1711. I have received ſeveral Letters, and have ſeen and ſpoken with ſeveral Perſons who have come from thence within theſe few Days, and they all tell me, that the New Iſland grows ſtill in Length on that ſide next *Teraſia*: That it is now about 6 Miles in compaſs: That as to the Fire and Noiſe under ground, they were more moderate than before; which makes the Inhabitants of the Iſland hope, that they ſhall ſhortly ſee an end of it.

As for my part, when I conſider, that the Paſſages which give vent to the Fire, are very large, and almoſt in the middle of the Iſland; and that there is no appearance that the Fire will ever make a Paſſage at the Bottom of the Sea, ſo as to let the Water in to extinguiſh it; I am of Opinion, that it may yet laſt longer

than

than they imagine; and that this *Phænomenon* will not have an end, 'till the Mine of Sulphur is entirely consumed.

II. *An Account of divers Rare Plants, lately observed in several Curious* Gardens *about* London, *and particularly the Company of* Apothecaries Physick Garden *at* Chelsey. *By Mr.* James Petiver, *F. R. S.*

Sect. I. *Rare* English *Plants.*

Polypody of the *Wall.* Polypodium *murale*, pinnulis serratis. *Polypodium* alterum C. B. in *Matthiol.* pag. 887. Fig. Polypodium *Quercinum* Gerard. p. 974. Fig. Polypodium 2. *Tabern.* Histor. 478. Fig. Polypodium 2. Filicula *Ejusd.* Icon. 799. Fig. 1. *Tabernæmontanus*'s *Figure*, which *Caspar Bauhine* upon *Matthiolus* and *Gerard* have coppy'd, seems to resemble this Plant in its somewhat waved Wings, and tip. But the *Polypodium* minus *Dodon.* Pemptad. 464. Polypodium *Quercinum* Jonston. 1132. *Polypodium* 2 Matthioli *Lugd.* Histor. 1230. which *Caspar Bauhine* makes to be the same with this, *viz. Polypodium* minus C. B. pin. 2. 359. is not like it, but a less and slenderer sort of the *Common.* Dr *John Salvadore*, a very *Curious Botanist*, sent this lately from *Barcelona* by the Name of *Polypodium* majus serrato folio *Barrelier Icon.* Instit. Rei Herb. *Tourn.* 540. I gathered this Plant 8 *May* 24. *A. D.* 1709. on the Walls of *Windsor Castle*, in the Apartment of the Reverend Dr. *Manningham*, then *Dean* of that Place, and now Bishop of *Chichester*, whose Son, a very *Nice Botanist*, first observed

1 *Names.*

N. B.

Place.

ſerved and ſhewed it me there; and hath ſince ſent it to *Chelſey Garden.*

2 *Names.* Jagged *Welſh* Polypody *Ray* Hiſt. Plant. 136. 2. *Syn.* 22. 2. *Edit.* 2. p. 45. Polypodium *Cambrobritannicum,* lobis foliorum profundè dentatis *Bobart.* Hiſt. Oxon. 563. 8. Sect. 14. Tab. 2. Fig. 8. Polypodium *Cambrobritannicum,* pinnulis ad margines laciniatis *Ray* Hiſt. Plant, 136. 2. *Synopſ.* 22. 2. *Edit.* 2. p. 45. *Filix* ampliſſima, lobis foliorum laciniatis *Cambrobritannica* Pluk. Tab. 30. *Fig.* 1. Dr. *Hans Sloane* firſt ſent a Specimen of this (then rare) Plant to Mr *Ray,* which he deſcribes in his *Hiſtory.* It differs from the *common Polypody,* in having its *Alæ* or *Wings* deeply jagged or torn: I never yet obſerved any *Seed* on this *Fern.* Mr. *Jacob Bobart,* Botanick Profeſſor at *Oxford,* gives a very lively *Figure* of this *elegant Plant,* which he ſays was firſt diſcover'd *A. D.* 1668. by *Richard Kayſe* of *Briſtol,* on a Rock, in a Wood near *Dennis Powis* Caſtle by *Caerdiff* in *Glamorganſhire.*

Diſtinction.

Diſcovery and Place.

3 *Names.* Orton *Flowring Fern,* or *Small Oſmund.* Ray Hiſt. Plant. 153. 3. Oſmunda *Weſtmorlandica,* folijs tenuiſſimè diſſectis, *Muſ. Petiver.* 792. to whoſe various *Synonyms* I thither refer you. Dr. *Plukenet* has figured this in his *Phytographia,* Tab. 3. Icon 2. and Mr *Jacob Bobart* very elegantly in his 3d Volume *Plantar. Hiſtor. Oxonienſ.* Sect. 14. T. 4. p. 593. 4. Mr *John Ray,* that *Patron* of *Botany,* firſt obſerved this in *England,* about the Pariſh of *Orton,* where it grows plentifully, and in other places in *Weſtmoreland.* Mr *Edward Lhwyd* hath alſo found it on *Snowdon* Hill in *North Wales.* Mr *John Robinſon,* alias *Fitz-Roberts,* a Curious Naturaliſt, ſent up ſeveral of theſe Plants from *Kendal,* which were ſet in *Chelſea Garden* and elſewhere, but after a Winter or two, they often go off.

Place.

Rough-

Rough eard *Fox-tail Graſs*, *Ray* Hiſt. Pl. 1265. 7. *Syn.* 239. ed 251. 5. Gramen *Alopecuroides* aſperâ ſpicâ C. B. *phyt.* 13. Pl. LI. *Gr.* Alop. Spicâ aſperâ C.B. 4. 6. *prodr.* 10. F. *Theatr.* 56. F. 6. *Gr.* Al. ſp. aſp. brevi *Park.* 1558 Fig. 6. Gramen echinatum *Dalechampij* Hiſtor. *Lugdun* 432. *Fig.* Gramen xi *Jonſton* in *Gerard*, l. 1. c. 22. p. 30. *Gramen* cum candâ *Leporis* aſperâ, ſive ſpicâ murinâ *Chabræi* 185. Icon 6. I. B. 3. l. 18. p. 474. Fig. It grows in the dry Borders of ſowed Grounds about *Montpelier* and *Narbon.* Mr *Jezreel Jones* gathered it about *Lisbon.* That Conſummate Botaniſt Dr. *William Sherard*, now Conſul at *Smyrna*, was the firſt who found it in our own Dominions, *viz.* in the Iſland of *Jerſey*, where it grows very common in all the ſandy Grounds. The laſt and the preceding Summer it ſpiked very plentifully in *Chelſea Garden.* 4 *Place.*

Welſh Sorrell, Mr *Petiver's Engliſh* Herbal, *Tab.* 3. *Fig.* 4. *Ray* H. Pl. 180. 11. Syn. edit. 2. p. 57. 10. Acetoſa *Cambrobritannica* montana *Park.* 745. 12. Acetoſa *Cochleariæ* folio, montana *Lhwyd.* Acetoſa *Britannica* rotundifolia fructu & ſemine compreſſo *P. Blair.* *Acetoſa* rotundifolia repens *Eboracenſis*, folio in medio deliquium patiente *Moris* H. Oxon. 583. 10. Sect. 5. *Tab.* 28. fig. 10. *Pluk.* Phyt. *Tab.* 252. fig. 2. Mr *Ray* takes this to be the ſame with the *Acetoſa* ſcutata repens C. B. 114. 10. *Prodr.* 55. 3. *Park.* 744. 6. This rare Plant Mr *John Parkinſon*, that accurate *Botaniſt* and *Apothecary* in his *Theatrum Botanicum* tells you, was found about 80 Years ago on a Mountain in *Wales*, by Mr. *Lloyd* of *Priſtierworth*, and about 20 Years ſince it hath been again obſerved by his Nameſake, that celebrated and known Naturaliſt Mr *Edward Lhwyd*, on the Mountains *Snowdon* and *Caderidris*; and ſoon after by Mr *Tho. Lawſon* and Mr *John Fitz-Roberts*, two other expert Botaniſts, in *Weſtmorland*, where the Curious Dr. *Richard Richardſon* tells me he has alſo found it, as well as in *Wales*, 5 *Names.* *Where and by who firſt diſcover'd in* England.

Wales, but not as yet in *Yorkſhire*, where he lives. Mr *Patrick Blair*, a Curious *Botaniſt* and *Anatomiſt*, hath obſerved it in divers places in *Scotland*.

6 *Names.* *Jerſey* Cudweed. *Engliſh* Herbal, Tab. 18. *Fig.* 5. *Ray* Hiſt. Plant, 284. 17. & 296. 7. Syn. ed. 82. 3. Gnaphalium *Plateau* 2 Clus. H. 329. *Fig. Gnaphal.* majus lato oblongo folio C.B. 263. 9. *Pluk.* Phyt. T. 31. *F* 6. Gnaphalium oblongo folio *Jonſt.* 643. Icon. *Gnaphalium* ſupinum oblongo folio *Park.* 686. *Fig.* 6. Gnaphalium ad *Stechadam citrinam* accedens *Chabr.* 371. Ic. 2. I B. 2. l. 26. p. 160. *Fig. Elychryſum* Sylveſtre latifolium, capitulis conglobatis C. B. 264. 8. *Phyt.* 514 7. By this laſt Name *Places.* Monſieur *Vaillant*, a very Curious Botaniſt, and Secretary to Dr. *Fagon* the *French* King's Chief Phyſician, ſent it me from *Paris*, where he gathered it wild. Dr. *Sloane* in his Voyage to *Jamaica*, found it about *Funchall* in the *Madera* Iſlands, where he obſerved it to ſport very much in the ſhape of its Leaves, Flowers, and Stature. Dr. *Sherard* hath found it nearer home, *viz*, in the Iſle of *Jerſey* on dry Banks and Walls very common.

7 *Common* Yellow *Oxe-eye. Engliſh* Herbal, Tab. 19. *Fig.* 7. *Ray* Hiſt. Plant. 341. 9. Syn. 56. edit. 90. *Buphthalmum* vulgare *Jonſt.* 747. Fig. 3. Buphthalmum *Dioſcoridis* C. B. phyt. 226. 5. *Buphthalmum* Tanaceti minoris folijs C. B. *pin.* 135. 1. Buphthalmum *Matthiol.* vulg. *Millefolij* folijs *Park.* 1370. Chamæmelum *Chryſanthemum* quorundam *Chabr.* 363. Icon. 2. J. B. 2. l. 26. p. 122. Fig. *Character.* Its *Leaves* are like *Tanſey*, but ſmaller and hoary; by which and its ſhort rim'd yellow *Flowers*, its eaſily known from others. It grows in divers parts of *Ger-* *Place.* *many* and *Italy*. Mr *Ray* found this on a Bank near the River *Tees*, not far from *Sogburn* in the *Biſhoprick* of *Dureſm.*

8 *Names.* *Welſh* Yellow Poppy *Ray* Hiſt. Pl. 856 9. *Syn.* 122. 6. ed. 180. 6. Argemone *Cambrobritannica* lutea *Park.* 369. fig. 4. opt. *Argemone* luteum perenne, laciniato folio

Cam-

Cambrobritannicum Ray *Syn.* 122. 6. *edit.* 2. p. 180. 6. Its long ſmooth *Heads*, yellow *Flowers*, and *Leaves* not unlike *Celandine*, diſtinguiſh it from all others. Mr *John Parkinſon*, that laborious Botaniſt, firſt found this elegant Plant in *Wales*; ſince which the Inquiſitive Mr *Ray* and Mr *Lhwyd*, have both obſerved it in divers other Places in thoſe Parts. It Flowers and Heads in *Chelſey Garden* moſt part of the Summer. *Character.*

9. Germander *Whitlowgraſs* Ray 790. 4. Syn. ed. 165. 3: Alyſſon *Veronicæ* folio *Elem. Botan.* 790. *Burſa Paſtoris* major loculo oblongo C.B. 108. *Prodr.* 50. Fig. *Phyt.* 171. 6. deſcr. *Burſæ* P. ſublongo loculo affinis pulchra planta I B. 2. l. 22. p. 938. Fig. *Chabr.* 295. Ic. 5. *Draba* minima muralis diſcoides *Col.* 274. Fig. Thlaſpi *Veronicæ* folio *Park.* 843. *F.* 13. Its *Leaves* reſemble our *wild Germander*, the *Flowers* white and ſmall, and the *Pods* longer than thoſe of *Whitlowgraſs*. It *Flowers* and *Seeds* in *March* and *April*. Grows about *Mompelier*, and in the Hedges between *Luca* and *Piſa*. Mr *Ray* found this on the ſides of the Mountains in ſeveral Parts of *Craven*, *Yorkſhire*; from whence Dr. *Richardſon* in thoſe Parts, has been pleaſed to ſend it to *Chelſey Garden*. Mr *Thomas Pool* of *Nottingham*, a Curious Botaniſt, has obſerv'd it about *Crumford* in *Darbyſhire*. *Names.* *Likeneſs.* *Time.* *Place.*

10. Small Sea *Cranesbill*. *Ray*. 1056 3. Syn. 154. 1. ed. 216. *Geranium* minimum procumbens, folijs *Betonicæ* Mor. H. Ox. Sect. v. p. 512. 8. *Geranium* puſillum ſupinum maritimum *Altheæ* aut *Betonicæ* folio noſtras *Ray* 1056. 3. Syn. 154. 1. edit. 216. *Pluk.* Tab. 31. Fig. 4. The firſt diſcovery of this Plant is owing to Dr. *Moriſſon*, that learned Botaniſt, who found it in Stoney places about *Chadder* in *Somerſetſhire*; and ſince by Mr *Ray* on the Sea Coaſts of *Cornwal* and *Wales* plentifully. *Names.* *When diſcovered.* *Place.*

SECT.

SECT. II. *European* Plants, not *English*.

11 *Names.* SOft, ſhort-ear'd *Fox-tail*. *Ray* Hiſt. Pl. 1265. 6. Alopecuros *Dod.* Pempt. 541. fig. *Ger.* 81. fig. *Jonſt.* 87. Fig. *Alopecuros* genuina *Park.* 1166. *Fig.* 1. Gr. *Alopecuros* ſpicâ brevi *Chabr.* 186. Ic. 2. 1 B. 2. l. 18. p. 474. Fig. Gr. Alop. ſp. breviore C B. *Phyt.* 26. cxx. Gr. *Alopecuroides* ſpicâ rotundiore C. B. 4. 1. *Theatr.* 56. 1. This pretty ſoft headed Graſs is one of the Ornaments of *Chelſey Garden.* *Place.* Grows wild in *Sicily*, *Italy*, *Narbone*, and about *Montpelier*.

12 *Names.* Great *Spaniſh* Cowquakes. *Ray* H. Pl. 1274. 4. Gramen *Tremulum* maximum C. B. 2. 1. *Prodr.* 5. Fig. *Phyt.* 10. 38. *Theatr.* 24. Fig. 2. Gr. *Tremul.* max. *Hiſpanicum* Park. 1165. Fig. 5. *Phalaris* pratenſis altera *Jonſt.* 87. Fig. opt. 3. Grows in *Spain*, *Sicily*, and ſome Parts of *Italy*. Its a very elegant and ornamental Plant in *Gardens*; and if well dryed never decays.

13 *Names.* Canary Graſs. *Ray* Hiſt. Plant. 1248. 1. Phalaris *Dod.* 510. Fig. *Chabr.* 179. Ic. 2 I. B. 2. l. 18. p. 442. Fig. C. B. *Phyt.* 55. *Theatr.* 534. Fig. *Ger.* 80. Fig. 1. *Jonſt.* 86. Fig. 1. *Phalaris* major, ſemine albo C. B. *pin.* 28. *Phalaris* vulgaris *Park.* 1163. Fig. 1. Its call'd *Canary graſs*, becauſe *Place.* brought from thence, and is the common Food of thoſe Birds. It grows not only in the *Canary Iſlands*, but in *Spain*, *Tuſcany*, *Montpelier*, &c. amongſt Corn. This is a beautiful *Corn graſs*, and often found ſcatter'd in many *Old Gardens*.

14 Star-headed *Succory*. *Ray* Hiſt. Plant. 256. cap. 4. Rhagadiolus *Elem. Botan.* 382. Inſtit. *Rei Herbar.* 479. *Rhagadiolus* alter *Cæſalpin.* 151. *Hieracium* ſiliquâ falcatâ C. B. 128. *Phyt.* 2. 12. 19. falcatum *Lobelij* Ger. 225. Fig. 9. *Jonſt.* 298. Fig 8. Hieracium *falcatum* ſeu *ſtellatum* Park. 796. Fig. 2. Hieracium *Stellatum* Chabr. 320. 4. I B. 2. l. 24. p. 1014. This is manifeſtly diſtinguiſh'd from

from all *Succory* and *Hawkweeds*, in having ſtarry Podlike *Heads* and ſmall yellow *Flowers* like *Nipplewort*. Grows about *Montpelier*, *Bononia*, and near *Petracks Tomb* at *Padua*. *Character.* *Place.*

15 Greater *Spaniſh* hoary *Hawkweed*. Ray H. Pl. 231. 3. *Hieracium* lanatum Sonchi vel Erigerontis facie H. *Leyd.* 314. villoſum, *Sonchus* lanatus *Dalechampij* dictum. *Ray* Hiſt. Plant. 231. 3. *Sonchus* lanatus *Dalechampij* Lugd. 1116. Fig. I. B. 2. l. 24. p. 1026. *Fig.* flore aureo *Erigerontis* Chabr. 317. 2. Ic. *Sonchus* villoſus luteus C. B. *Phyt.* 205. xi. *Sonchus* villoſus luteus major C. B. *pin.* 124. *Park.* 809. Fig. 1. *Dalechamp* and *Parkinſons* Figures, were they more procumbent, would better reſemble this Plant than thoſe of I. B. and *Chabreus*. Grows about *Mompelier* and *Meſſina* in *Sicily* plentifully. Dr. *Salvadore* hath alſo found it near *Barcelona*. This *Flowered* in *Chelſea Garden* from *July* till *Autumn*. *Names.* *N. B.* *Place.*

16 Greater *Spaniſh* bearded *Hawkweed*. *Ray* H. Pl. 232. 7. *Hieracium* medio nigrum *Bæticum* majus. *Park* 792. 6. *Hieracium* medio nigrum; fl. majore *Jonſt.* 1625. The peculiarity of this Plant is to have a bearded Head, with Brimſtone *Flowers* and black in the middle. This pretty *Hawkweed* was firſt brought into our *Engliſh Gardens* about the Year 1620 from *Spain* by Mr *William Boel*, a *Fleming*, who communicated the Seeds of this and ſeveral other *Spaniſh* and *Portugueze* Plants to Mr. *Coys*, *Goodyer*, *Jonſton*, and *Parkinſon*, all eminent *Botaniſts* in thoſe Days. *Names.* *Character.*

17 Hoary *Buckſhorn* Chamomil. Chamæmelum *Coronopi* folio tomentoſo. The largeſt of theſe *Leaves* reſemble our *Wart* or *Swines Creſs*, but are very hoary; its a low Plant with hollow Stalks, eſpecially when dry. The *Flowers* of the ſize and ſhape of the *Single Sweet* Chamomil the Branches leafy, but the *Flowers* when full grown, ſtand on Stalks void of Leaves two and ſometimes three Inches bare. *Chelſea* Phyſick Garden is obliged to Mr *Jacob* *Deſcribed*

cob Bobart, Botanick Profeſſor of *Oxford*, for this elegant Plant, and divers others he has been pleaſed to ſend thither.

18 *Names.* Roman *Wormwood Ray* H. Pl. 367. 5. *Abſinthium* Anſtriacum *Sophiæ* folio. *Nobis* Abſinthium *Ponticum* vulgare *Chabr.* 374. Ic. 3. *Clus.* 339. Fig. *opt.* fol. inferius albo I. B. 3. l. 26. p. 175. *Fig.* Abſinthium *Ponticum* tenuifolium incanum C. B. 138. 4. *Phyt.* 235. 6. ſeu *Romanum* vulgare. *Park.* 98. Ic. opt. 3. *Abſinthium* tenuifolium *Ponticum* Galeni. *Jonſt.* 1096. *Fig.* 2. The lower *Leaves* of *Diſtinction.* this *Wormwood* ſo much reſemble thoſe of the *Sophia Chirurgorum*, or *Flixweed*, that its very eaſie to diſtinguiſh *Place.* it from the other ſorts. Grows in divers parts of *Germany*, and near *Vienna*, in Stoney Places. Flowers and Seeds towards Autumn.

19 *Names.* *Bur-Cumin.* Ray Hiſt. Pl. 402. 6. *Cuminoides* vulgare *El. Bot.* 250. *Inſt. Rei Herb.* 301. *Cuminum* Sylveſtre *Dod.* 300. Fig. *Ger.* 908. Fig. opt. 1. *Jonſt.* 1067. Ic. 1. *Park.* 372. Ic. 3. capitulis globoſis C. B. 146. 3. *Phyt.* 253. 2. *Cuminum* Sylv. 1. valde odoratum, globuloſum I. B. 3. l. 27. p. 23. Fig. *Chabr.* 384. Ic. 6. This is a very ſingular Herb, and not eaſie to deſcribe; its lower *Leaves* like *Honewort*, but deeper cut; its flewſey *Heads* grow in round cluſters, with elegant feathered *Seed*. *Tabernæmontanus* his *Figure*, *N. B.* which *Gerard* has coppied, is much the fineſt *Icon.* and by which you will have a good Idea of it. Grows in *Nar-* *Place.* *bone* and other Parts of *France*. I have alſo had it from ſome of the *Mediterranean* Iſles.

20 *Anniſe* Dale 210. *Anis* Pomet. l. 1. p. 13. *F.* Lemery 44. Aniſum C. B. *Phyt.* 2. 9. *Ger.* 880. Fig. 1. *Jonſt.* 1035. Fig. *Park.* 911. Ic. *Aniſum* vulgare *Clus.* l. 6. p. 202. *Fig.* Aniſum *Herbarijs* C. B. 159. 1. *Aniſum* Veteribus *Chabr.* 396. Icon. 1. l. B. 3. l. 29. p. 92. *Fig.* The firſt or lower *N. B.* *Leaves* of this *Umbel* are often ſingle and round, which few or none of the *Figures* expreſs. Mr *Ray* ſays it

ſowed

sowed plentifully in the *Isle* of *Malta*, where they make great profit of it, and call it there *Sweet Cumin*. *Place.*

Aleppo *Ziziforum* or *Rose Basil.* Ray Vol. 3. p. 299. 18. *Clinopodium* humile Syriacum breviori folio *Ziziforum.* Bob. H. Ox. p. 374. 5. S. xi. Tab. 8. *Fig.* 2. *Clinopodium* fistulosum pumilum, *Indiæ Occid.* summo caule floridum *Pluk.* Phytograph. *Tab.* 164. fig. 4. Clinopodium *Alpinum* Roseum *Satureiæ* folijs *Boccon.* Mus. Plant. rar. 135. Tab. 95. This *Icon* seems to be taken from a shriveled Specimen, which the Author found on the Mountains of *Norcia.* Mr *Bobarts* Figure which Dr. *Plukenet* copied, very well resembles this Plant, which from a stringy Root rarely rises a foot high; its two lower *Leaves* resemble our great Stone Basill (or *Clinopodium majus*) with four more at the top; in the midst of these stand a tuft of purplish *Flowers*, set in long pipey *husks*, rough or hairy as is the whole Plant. The Learned Dr. *Huntington* first sent this elegant Plant from *Aleppo* to *Oxford*, from whence our *Physick Garden* has been adorned with it. 21 *Names.* *Form.*

Purple, long-leav'd *Arch-angel.* Ray 559. 2. *Lamium* folio oblongo C. B. *Phyt.* 437. 2. *Lamium* fl. rubro *Park.* 606. 4. *Lamium* purp. non fætens, folio oblongo C. B. 231. 2. *Galeopsis* sive *Urtica iners*, fl. purpurascente majore, fol. non maculato I. B. 3. l. 28. p. 321. *Fig.* This Plant is like the *common white Arch-angel*, but that the *Flowers* are purple and curiously speckled. *J. B.* hath observed this in *Italy*, also about *Geneva* and *Basil.* *Parkinson* says, it is found in some places with us; but the *Herbarists* of this *Century* have not yet met with it. It hath *Flowred* several *Summers* in *Chelsea Garden*, and I presume from the *Physick Garden* at *Oxford*, Mr *Jacob Bobart* having formerly sent me Specimens of it. 22 *Names.* *Place.*

Hemp Mallow. *Ray* H. Pl. 605. 6. Alcea *Cannabina* C. B. 316. v. *Phyt.* 634. 6. *Chabr.* 308. Ic. 1. *Alcea* fruticosa *Cannabina. Jonst.* 934. *Fig.* Alcea *fruticosa* Cannabini 23

bini *folio* Clus. l. iv. p. xxv. *Fig.* opt. *Alcea* Pentaphyllea *Park.* 302. *Fig.* Alcea *Pentaphylli* folio vel *Cannabina.* I. B. 2. l. 23. p. 958. *Fig.* Grows 6 or 7 foot high; its *Hemp-like Leaves*, easily distinguish it from all others. Mr *Ray* has observ'd this at *Mompelier*, as also in *Italy* and *Sicily.*

24 *Names.* Curled Mallow. *Mauve frisée* Gall. *Ray* 597. 1. *Malva* crispa *Ger.* 785. Fig. 3. *Jonst.* 931. *Fig.* 3. opt. I. B. 2. l. 23. p. 952. *Fig.* *Malva* crispatis oris *Lob.* Ic. 2 651. *Malva* crispis folijs *Park.* 298. *Fig.* opt. folij. *Malva* folijs crispis C. B 315. 5. *Phyt.* 628. 4. *Distinction.* The curled *Leaves* and small whitish *Flowers*, clustering about its Stalks, distinguish it from others. This has been so old an Inhabitant in *Gardens*, that its Native place is scarce known.

25 *Names.* Grass-leaved *Crowfoot.* Ray H. Pl. 587. 1. Ranunculus *Gramineus* Park. *parad.* 218. 11. *Fig.* p. 221. 1. Gramineus *Lobelij* Ger. 808. *Fig.* 10. opt. *Gramineus* minimus C. B. *phyt.* 327. 28. *Gramineus* fl. luteo simplici *Park.* 336. *Fig.* Ranunculus 9. *Jonst.* 953. mont. folijs *Gramineo* C. B. 180. v. Pumilus *Gramineis* folijs I. B. 3. p. 850. *Fig.* Minimus *Gramineis* folijs *Chabr.* 470. Ic. 4. This has long blueish *grassey* Leaves, with a single yellow *Flower* and stringey *Root*, by which its known from the *Place.* other narrower leaved *Crowfeet.* Grows in Meadows about *Montpelier*, *Narbone*, and *Provence.* It *Flowers* in *Time.* our *Gardens* in *April* and *May.*

26 Dr. *Covell's* Venus Looking-glass. Speculum *Veneris* fl. ampliss̃imo *Thracicum.* Ray H. Pl. 742: 2. The *Leaves* are broad and long like our great *Stitchwort*, and those about the Flower are hairy edg'd; by which and the specious largeness of its *Flowers*, it differs from the rest. *Discovery and Place.* We owe the first Discovery of this beautiful and ornamental Plant to that Reverend, Curteous and Curious Gentleman Dr. *John Covell*, Master of *Christ Church* in *Cambridge*, who in his Travels to *Constantinople* found this in

in *Thrace*, and brought Seeds of it over, which he gave to Mr *Peter Dent*, an Eminent *Apothecary* and *Botaniſt* in the Univerſity, who communicated the ſame to Mr *Ray*, who raiſed the Plant, as we have lately done at *Chelſey Garden*, where it makes a beautiful Show.

Daſie Rocket. *Ray* H. Pl. 807. 6. *Eruca* Bellidis *folio* Moris. H. *Oxon.* 231. 18. The *Leaves* of this Plant may be taken for the *great Daſie*, were it not for its biting *Radiſh* taſte, the *Flowers* are yellow, and *Pods* long like the *Common*; both theſe appear from *May* till *Auguſt*. 27 *Names.* *Time.*

Dented leaved *Hedge Muſtard*. *Eryſimum* folio dentato, fl. minimo: The Root-leaves of this Plant are long, narrow, and toothed like the *Dandelion*, but more ſlightly; theſe on the Stalk are much leſs, and only ſerrated, the *Flowers* pale, yellow, and very ſmall; theſe are followed by ſlender *Pods* above 3 Inches long, and when ripe ſeem joynted; they ſtand off from the Stalk on very ſhort Pedicles. 28 *Name.* *Deſcription.*

Sciatica Creſſes. Ray Hiſt. Plant. 827. 1. Iberis C. B. *Phyt.* 153. *Iberis* Cardamantica. *Ger.* 197. *Jonſt.* 253. Fig. opt. *Iberis* latiore folio C. B. 97. 2. *Park.* 854. Fig. 2. The Root-leaves ſtand on long footſtalks, are half an Inch broad, two or three long, notch towards the point, but on the Stalks they are long, narrow pointed, and plain, with Pedicles, both of a Greſſey laſt. The *Flowers* ſmall and white, the *capſules* cordated. Grows common in Highways, and untilled places both in *Germany*, *Italy*, *Sicily*, &c. 29 *Names.* *Deſcription.* *Place.*

Boccones *Spangle-Muſtard*. Ray H. Pl. 837. Thlaſpidium *Raphani* folio *El. Bot.* 183. I. R. H. 214. *Thlaſpi* biſcutatum *Raphani* aut *Irionis* folio *Boc.* rar. Pl. 45. Tab. 23. This differs from the common, in having auriculated, or rather ſmall wing'd *Radiſh*-like Leaves. Its an annual Plant, and *Flowers* in our Gardens from *Midſummer* till near *Chriſtmas*. Signior *Paul Boccone*, a Curious Botaniſt, firſt found this Herb about *Marſeilles* and in 30 *Names.* *Character* *Place.*

the

the *Island* of *Sicily*, in rough and uncultivated places plentifully.

31 *Names.* German *Milk-Vetch.* Ray H. Pl. 916. 3. *Astragaloides* Dod. *pempt.* 551. Fig. *Jonst.* 1239. *Fig.* 4. *Astragaloides* altera Herbariorum *Lob.* Ic. 2. p 78. 2. *Belg.* 2. p. 92. Fig. *Astragalus* Herbariorum Park. 1086. Fig. 8. *Astragalus* major *Fuchsio* Chabr. 151. Ic. 5. I. B. 2. l. 17. pag. 334. *Fig.* Orobus *Pannonicus* 2 Clus. l. vi. p. 230. Fig. opt. *Orobus* Sylvaticus folijs Viciæ C. B. 352. 6. *Character.* Grows wild on the hilly Woods about *Geneva*, and in divers places of *Germany*. *Place.* This has the face of a *Vetch*, but grows upright; its *Flowers* and *Pods* resemble our *Wood-Pea*, but differs much in its *Leaves*.

32 *Names.* Broad *or* Flat *Buttons*. Ray Hist. Pl. 961. 2. *Medica* lata *Park.* parad. 339. 8. folliculo lato *Park.* parad 336. *Fig.* 8. *Medica* orbiculata I. B. 3. l. 17. p. 384. *F. Chabr.* 166. Ic. 1. *Trifolium* scutellatum, fructu latiore, folio obtuso C. B. *Phyt.* 659. 19. *N. B.* I. B. and Chabreus, their *Icons* very well resemble this Plant, but the *Leaves* do not always end blunt, as the *Figures* express, tho' they often do. *Distinction.* This differs from the next in being flat headed, and having but 3 or 4 twirls in each; they are single, double, and sometimes 4 or 5 in a cluster. Found on the *Euganian Mountains* and about *Mompelier*. *Place.* Mr *Ray* has observed it in *Sicily*.

33 *Names.* Round *Snails* or *Barbary* Buttons. *Ray* H. Pl. 961. 1. Medica *Cochleata* vulgaris *Park.* parad. 338. 5. Fig. 337. 5. *Medica* Scutellata I. B. 2. l. 17. p 348. Fig. *Chabr.* 165. Ic. opt. 6. Trifolium *Cochleatum* Jonst. 1199. *Fig.* 1. Cochleatum 1. *Dod.* Pempt. 575. Fig. *Cochleatum* fructu latiore C. B. 329. 3. *Cochleat.* fr. latiore folio acuto C.B. *Phyt.* 659. 19. *Description.* The largest of these *Leaves* are somewhat like those of *Roses*, and pointed, but the smaller often obtuse. *Place.* These *Buttons* are round, generally grow single, and have each 6 or 7 *twirls*. Found about *Mompelier* very common amongst *Corn*.

Great

Great *Hedghogs*. Medica magno fructu, aculeis ſurſum & deorſum tendentibus I. R. H. 411. Medica *Cochleata* ſpinoſa major, dicarpos ſeu capſulâ ſpinis longioribus ſurſum & deorſum tendentibus *Mor.* H. Ox. 153. 8 & 9. Tab. 15. Fig. 8 & 9. Medica *Cochleata* ſpinoſa, echinis magnis utrinſq; turbinatis cum ſpinulis reflexis. *Ray* H. Pl. 962. 10. *Medica* ſpinoſa altera *Park.* parad. 339. 7. Fig. 337. 7. Majoris *Bæticæ* ſpecies 1. ſpinulis intortis *Goodyeri* Jonſt. 1200. *Cochleata* capſulâ majore ſpinoſâ, ſpinis ſurſum atque deorſum tendentibus *Flor. Noriberg* 116. Trifolium *Cochleatum* ſpinoſum majus, ſpinis ſurſum & deorſum tendentibus *Hort. Blæs.* 34 *Names.* *Deſcribed:*

These *Leaves* are like thoſe of *Melilot*, and lightly crenated as the *Sun Spurge* the *Fruit* as big as a ſmall Nutmeg, and often 3 or 4 together, thick ſet with long Spines, which lye both ways, *viz.* up and down, cloſe to the head, by which its known from all others. Grows about *Narbone*, flowering early in the Spring. *Place:*

Hard *Bur Hedgehogs*. Medica *Cochleata* fructu duro, ſpinis brevibus rigidis. 35

The *Fruit* of this reſembles our *Xanthium* or *Leſſer Burdock*, and about the ſame ſize; its *Heads* cloſe and hard, with ſtiff ſhort prickles ſomewhat crooked, and often grow 4 together.

Hard *Warty Hedgehog*. Medica *Cochleata* fructu duro verrucoſo. 36 *Names.*

Medica magna *turbinata*. Chabr. 166. Ic. 2. The ſingle *Fruit* at the bottom of the *Figure* is very like theſe *Heads*. Its *Fruit* ſomewhat leſs than the laſt, and hath *Warts* inſtead of *Prickles* grow often ſingle, and are rarely more than two. *N. B.*

Horſe-ſhoes. Ray H. Pl. 966. 31. *Lunaria* radiata *Italorum* Lob. obſ. 498. Fig. 3. *Lunaria* radiata *Italorum*, Medica lunata *ſive* falcata *Lob.* Icon. 2. 38. id. *Belg.* 2. 43. Fig. Medica *lunata* I. B. 2. l. 17. p. 386. Fig. *Park.* 1116. *Fig.* 8. *id.* parad. 337. *Fig.* 9. *Medica* lunata *ſive* falcata *Chabr.* 167. Ic. 2. Sylv. altera lunata *Lugd.* 503. Fig. *Trifolium* ſiliquâ lunatâ *Jonſt.* 1207. Fig. 1. *Trifolium* 37 *Nome.*

Description. *folium* siliquâ falcatâ C. B. 330. 3. *Phyt.* 660. 28. The *Pods* of this elegant *Plant* resemble a *Half moon*, or *Horse-shoe*; they are very thin and transparent, the edges are finely set with hairy thin Spinulæ, and grow sometimes two together.

38 *Names.* *Sooty Clover.* Ray, H. Plant. 943. 1. Trifolium *Aspalatites* sive bituminosum *Park.* 716. *Fig.* 2. *Aspalt.* Bitumin. odoratum I. B. 2. l. 17. p. 366. Fig. *Aspalt.* rot. & longioribus foliis *Lugd.* 504. *Fig. Trifolium* bituminosum *Dod.* 566. Fig. *Ger.* 1019. Fig. *Jonst.* 1187. *Fig. Trifolium* bitumen redolens C. B. 327. 1. The strong sooty smell of its *Leaves* and bluish *Flowers*, distinguish it from others.

Character.

Place. Grows wild all over *France*, *Spain* and *Italy*.

39 *Name.* *Clipeated* Candy *Clover*. *Trifolium Clipeatum* argenteum. P. *Alpin.* Exot. 306. Fig. *Park.* 1108. *Fig.* 2. The *Leaves* of this rare *Clover* are not so pointed as in the *Figure*, but rounder and more approaching to our *Common white Trefoil*, as does its Flowers. The *Seed Vessels* are elegantly represented in *Alpinus*, and by which you will presently know it from all others. This is a *Candy* Plant, and thrives well in *Chelsey* Garden. It *Flowers* about *Midsummer*, and ripens *Seed* in *Autumn*.

Description.

Place.

Time.

40 *Names.* Knotted *Bitter Vetch.* Ray Hist. Plant. 915. 1. *Ervum* Chabr. 148. Ic. 6. *Orobus* sive *Ervum* multis I. B. 2. l. 17. p. 321. *Fig.* Orobus *Lugd.* 468. Fig. *Orobus* siliquis articulatis, semine majore C. B. 346. 1. *Orobus* receptus *Herbariorum* Jonst. 1225. *Fig.* *Orobus* vulgaris *Herbariorum Park.* 1078. Fig. opt. 1. Its blunt-pointed Vetch-like *Leaves*, yellow *Flowers* and knotty *Pods*, distinguish this from other *Pulse*. Its common about *Geneva* and *Mompelier*, as also in *Spain* and *Italy*.

Distinction.

41 *Names.* Saw Vetch. *Ray* Hist. Pl. 939. 16. *Pelecinus* vulgaris *El. Bot.* 331. I. R. H. 417. *Astragalus* purpureus, annuus peregrinus, siliquis utrinque serræ similibus *Moris* H. Ox. 107. 6. Tab. 9. Fig. 6. *Lunaria* radiata *Chabrei* 156. Ic. 1. *Lunaria* radiata *Robini* I. B. 2. l. 17. p. 348. *Fig.* *Securi-*

dica

dica peregrina *Clus.* l. vi. p. 238. Fig. opt. *Park.* 1089. F. 5. *Securidica* siliquis planis utrinque dentatis C. B. 349. 3. *Securidica* siliquis planis dentatis *Jonst.* 1234. *Fig.* 6. The *Leaves* grow often alternate with lunulated tips; its *Pods* elegantly *serrated* on both sides, distinguish it from all others. Grows pretty common about *Messina* in *Sicily*. *Distinction.* *Place.*

42 Small *Sickle-Vetch.* RayH. Pl. 936. pl 7. Securidica minor *Lob.* Ad. 402. *Obs.* 523. *Fig.* 2. Sec. minor. *Astragalus* Monspel. *Hedysarum* alterum *Dodon.* Lob. Ic. 2. 77. 1. *Belg.* 2. p. 90. Ic. 1. minor lutea *Jonst.* 1234. Fig. 5. *Securidica* altera seu minor I. B. 2. l. 17. p. 347. Fig. *Chabr.* 155. Ic. 4. lutea minor, corniculis recurvis C. B. 349. 2. *Astragalus* Mompelianus *Clus.* l. 6. p. 234. *Fig.* *Hedysarum* alterum *Dod.* 546. *Fig.* 2. *Hedysarum* minus *Park.* 1088. *Fig.* 2. Its crooked *Pods* very much resemble a *Sickle*, or *Reaping Hook*, by which it is easily distinguish'd. Mr *Ray* has gathered this about *Messina* and *Mompelier*. *Names.* *Distinction.* *Place.*

43 Cassubian *Vetch.* Ray Hist. *Plant.* Vol. 3. p. 448. 5. *Vicia* multiflora *Cassubica* fruteſcens, *Lentis* siliquâ *Breynij* Prodr. 1. p. 45. Lens *Ungarica* Schuyl *Cat.* H. Leyd. 45. This has a woody Stalk, with hoary *Leaves* and a handsome spikey tuff of Purple reddish *Flowers*, succeeded by short *Pods*, which hang downwards. We are obliged to that celebrated Botanist *Jacobus Breynius* for the first Knowledge of this Plant, who discovered it, by the sides of *Woods* in *Cassubia*, bordering on *Prussia*. *Names.* *Description.* *Place.*

44 Mallow *Cranes-bill.* Ray H. Pl. 1055. 1. Geranium *Altheæ* folio C. B. 318. 3. Geranium *Altheoides* majus *Park.* 709. *Fig.* 6. Geran. *Malvaceum* I. B. 3. l. 30. p. 472. Geran. *Malacoides* Ger. 798. *Fig.* 2. *Jonst.* 943. *F.* 2. Lob. Ic. 662. 1. *Obs.* 738. *Belg.* 808. These last *Figures* very well answer this Plant. Its *Root-Leaves* are whole and not unlike *Violets*; the *Stalk-Leaves* less or more cut, as they approach the top. The *Flowers* grow *umbellicated*, and sometimes six or eight in a Tuft. *Names.* *N. B.* *Description.* *Place.*

Found about *Geneva* and *Mompelier*, flowring early in the *Spring*.

Pyrænean *Cranes-bill*. Geraninm *Columbinum* perenne
45 *Pyrænaicum* maximum *El. Bot.* 231. I. R. H. 268. *Geran.*
Names. Col. perr. *Pyren.* latifolium, magno flore *Schol. Botan.* 227. This in all Parts is much larger than our *Common great Doves foot Cranes-bill*. It *Flowers* and *Seeds* with us in *Gardens* from *Midsummer* till *Autumn*. Monsieur *Tour-*
Place. *nefourt*, the King of *France*'s late *Botanick Professor*, first discovered this on the *Pyrænean* Mountains which divide *France* from *Navarre*.

Candy *Long Cranes-bill*. Ray H. Pl. 1056. 4. Geranium
46. *Creticum* Ger. 798. *Fig.* 1. *Jonst.* 943. 1. *Park* 710. *Fig.*
Names. Geran. *Creticum* annuum hematodes *Lob.* Ic. 662. 2. *Belg.* 809. *Fig. Geranium* latifol. acu longissimâ C. B. 319. 7. *Geran.* Speciosum annuum, longissimis rostris *Creticum* I.B.
N. B. 3. l. 30. p. 479. Fig. *Lobells* Figure and those from him, very exactly resemble this Plant, whose *Leaves* are some-
Place. what like those of *Tordylium*. This grows not only in *Candy*, but also about *Messina*, where Mr *Ray* observed it.

47. *Italian* long Cranesbill. *Ray* H. Pl. 1056. 5. Geranium *Apulum* odorum. *Park.* 709. 3. Ger. *Apulum* Coriandri folio *Col.* 136. c. 40. Geran. *Apul.* Coriandri folio, alterum odorum *Ejusd.* 135. *Fig.* Geranium maximum angustifolium, acu longissimâ C. B. *Phyt.* 639. xx. Geranium *Cicutæ* folio acu longissimâ C. B. 319. 1. *Prodr.* 138. That most accurate Botanist *Fabius Columna*,
N. B. is the only one who has given us a *Figure* of this Plant, which he has done to the nicest Perfection, both in the *Leaves*, *Flowers*, and the natural twisting of its *Bills*.
Leaves. The lower *Leaves* are not unlike the *jagged Celandine*, and those on the Stalks are much more deeper cut. It grows about *Mompelier* in Ditches and Borders of Fields,
Place. as also in *Italy*, where the Curious *Columna* first observed it.

Tall

Tall *Roman* Catch-Fly. *Ray* H. Pl. Vol. 3. p. 488. 65. 48
Lychnis viſcoſa altiſſima, flore muſcoſo, *Ocymaſtri* facie *Name.*
Triumphet. novæ Plantar. *Icon.* & deſcript. p. 58. *Fig.*
The *Root* is as thick as ones Thumb, from whence riſe *Deſcription.*
divers *Stalks* 3 or 4 foot high, with oppoſite *Chickweed*
like *Leaves*; it branches very much towards the top,
each ending in ſingle, whitiſh, deep cut *Flowers*, which
quickly turn into ſmall Pear-faſhioned *Seed Veſſels*, cloſe
ſhut till ripe, and then open with a ſerrated Orifice like
all the reſt. It grows in the Clifts about the *Convent* of *Place.*
the *Brutin Carthuſians*, call'd St. *Bartholomeo di Triſulti*,
where it was not long ſince diſcovered by *John Baptiſt*
Triumfetti, Reader and Super Intendant of the *Phyſick*
Garden at *Rome*. I have obſerved this elegant Plant in *Time.*
Chelſey Garden, where it *Flowers* and *Seeds* from *July*
till *Autumn.*

Candy *Plantain*, Ray H. Pl. 881. 13. *Holoſteum* ſive 49
Leontopodium Creticum C. B. 190. 4. *Prodr.* 98. c. 12. *Names.*
deſcr. Holeſteum *Creticum* alterum C. B. pin. 190. 5.
Holoſteum *Creticum* ſive Leontopodium *Creticum*. Park.
499. Fig. 5. Leontopodium *Alpin. Exot.* c. 51. p. 114.
Fig. *Belli* Epiſt. ad *Clus.* p. 300. *Leontopodium* legitimum
Imperati 672. *Fig.* Leontopodium *Creticum* C. B. *Phyt.*
512. 2. deſcr. & *Fig.* in append. Leontopodium *Cretic.*
Clus. l. v. p. 111. *Fig.* & L. *Cret.* aliud. *Ejuſd.* 112. *Fig.*
Plantago *Cretica* minima tomentoſa, caule adunco *Tourn.*
Coral. 5. *Parkinſon*, that accurate and knowing Botaniſt,
is of the Opinion that all *Cluſius* his *Figures* are only differ- *N. B.*
ing ſtates of the ſame Plant, which I am alſo inclined to
believe, not only of his, but alſo thoſe of *Alpinus*, *Bau-*
hine, and *Imperatus*, which are all different both from
Cluſius and one another, which may ariſe from a pecu-
liarity it has, eſpecially in dry Seaſons, to ſhrink or ſend
its Head towards its Root, the *Flower Stalks* being
ſhort and extream woolly; for which reaſon I look up-
on *Rawlfs Plantain*, which the *Hiſt. Lugd.* app. 21. *Fi-*

gures under the Name of *Planta rara* Plantagini *longe similis*, (which ſome would have the ſame with this) to be another Plant, it rather reſembling the *Plantago* anguſtifolia, paniculis *Lagopi* C. B. *Prodr.* 98. 4. which I know grows alſo in thoſe Parts. This long-loſt Herb I found in her Grace the Dutcheſs of *Beaufort*'s Garden at *Chelſey*, whoſe Nurſing Care ſcarce any Plant (tho' from the moſt diſtant Climates) can wirhſtand. I do not remember that any *Garden* in all *Europe* has yet boaſted of this rare Plant, in the many *Catalogues* hitherto publiſh'd.

50 *Names.* *Rawolphs* Sea Lavander. *Ray* H. Pl. 397. 10. *Limonium* peregrinum folijs *Aſplenij* C. B. 192. 7. Limonium *folijs* Aſplenij C. B. *Phyt.* 356. 4. Rawolphij *Park. parad.* 251. Fig. 6. *Rawolphij* ſ. peregrinum *Clus.* Curæ poſter. 33. *Fig.* elegans genus *Rawolphij* Belg. 314. Fig. H. *Lugd.* app. 35. *Fig.* Quibuſdam rarum I. B. Vol. 3. p. 862. Fig. Rarum *Rawolphij* Chabr. 508. Ic. opt. 3. peregrinum *Rawolphij* Park 1235. Fig. *Cichoria* globulare *Imperati* 660. Fig. The *Character.* Leaves of this Herb are more like thoſe of *Sowthiſtles* (but much ſmaller) than Spleenwort; its Flowers of a glorious blue, and much larger than the common *Limoniums*, growing coyled like *Vipers Bugloſs*. This rare Plant I ſaw in Flower, with the Dutcheſs of *Beaufort* at *Chelſey*. *Rawolph* firſt found this in *Syria*, who travel- *Place.* led into thoſe Parts about the Year 1573. Since that, *Augerius Clutius* obſerved it at *Malaga*, and *William Boel* about *Cales*. I have alſo had it from both theſe Parts of *Spain*. Mr *Ray* obſerved it on the Sea Coaſts of *Sicily* and its Neighbouring Shores.

EUROPEAN *Trees* and *Shrubs*.

51 Holm Oak. *Ray* Hiſt. Plantar. 1391. 1. *Bot. Monſpel.* 140. *Pl.* 1. *Ilex* arbor *Lob.* Icon. 2. p. 154. 1. *Obſ.* 582. Fig. opt. 3. *Ilex* arborea *Chabr.* 57. Icon. 1. I. B. Vol. 1. l.

1. l. 7. p. 95. c. 3. Fig. *Ilex* major *Clus.* 23. Fig. *opt.* 1 & 2. *Ilex* Tab. *Icon.* 968. 2. *Hist.* Vol. 2. p. 675. Fig. 3. *Ilex* Glandifera *Gerar.* 1161 Fig. *Ilex* major *Glandifera* Dod. 829. Fig. *Jonst.* 1344. Fig. 1 & 2. *Ilex* major aculeata & absque aculeis *Park.* 1895. *Fig.* 1 & 2. *Ilex* folio rotundiore molli modiceq; sinuato folio, *Smilax* Theophrasti C. B. 425. 3. This Tree sports mightily in its *Leaves*, as I B. Mr *Ray*, and other Authors, take notice of; they are most prickley whilst young, and as the Trees grow old, they grow plainer. The hoarinesss of Leaves underneath distinguishes it from the *Cork*. These grow frequently near the Sea Coasts in *Spain*, *Italy*, *Narbone*, &c. It is ever green. *N. B.* *Places.*

The *Cork* Tree. *Ray* Hist. Pl. 1393. c. 7. *Suber.* Chabr. 57. Ic. 5. *Suber* latifolia *Lob.* Icon. 159. *id.* Belg. 2. p. 190. Fig. *Suber* latifolium *Ger.* 1163. Fig. 1. I. B. 1. l. 7. p. 103. *Fig.* Tab. Icon. 967. 1. *id.* Hist. 2. p. 674. Fig. 3. *Suber* latifolium perpetuo virens C. B. 422. Suber *Hispan.* latif. perpetuo virens *Clus.* 21. Fig. *Suberifer* latifolia, *Ilex* glande echinato *Adv.* 432. *Fig. Phallos* sive *Suber* Dod. 830. Fig. mediâ. Grows in many Parts of *Spain*, and all over *Portugal*; It is ever green, as are almost all of this kind. 52. *Names.* *Places.*

Great broad *Alatern.* Ray H. Pl. 1608. 1. *Alaternus* 1. Clus. 50. Fig. *Hisp.* 57. Fig. *Ger.* 1212. *Fig.* Tab. Ic. 1042. 2 *id.* Hist. 2. p. 749. Fig. 1. *Alaternus* prior *Clusij* Lugd. 159. *Fig.* 1. *Phylica* elatior C. B. 477. 1. *Bourgespine* Monspelienfium *Adv.* 421. *Fig.* 2. *Lob.* obs. 566. *Fig.* 1. *Spina Burgi* Monspelienfium *Chabr.* 42. Ic. 6. I. B. 1. l. 5. p. 542. *Fig.* *Lobel* in his *Observations* makes the *Alaternus* 2. Clus. 50. the *Bourge Spine* Monsp. contrary to the *Botan Monspel.* p. 203. which says, it is the 1. *Clus.* as above. The largeness of the Tree, and broadness of its Leaves, distinguish it from *Clusius* his 2d sort. This grows wild in *Spain*, *Portugal*, and about *Montpelier*. 53. *Names.* *N. B.* *Places.*

Narrow

54 *Narrow, knagged* Alatern. *Alaternus* folijs anguſtioribus, hinc inde dentatis. This grows a tall ſtrait Tree, with upright Branches; pointed, narrow Leaves, here and there dented.

55 *Names.* The *Maſtick Tree.* Ray H. Pl. 1579. *Bot. Monſp.* 153. *Lentiſcus* Clus. 14. Fig. *Hiſp.* 85. Fig. *Dod.* 875. Fig. *Chabr.* 23. Ic. 5. I. B. 1. l. 3. p. 285. Fig. *Ger.* 1243. *Fig. Jonſt.* 1432. *Fig.* Tab. 2. p. 729 *Icon.* 1026. 2. *Lentiſcus* vulgaris C. B. 399. 1. *Lentiſcus* Dioſcoridis *Lob.* Icon. 2. p. 96. 2. *Belg.* 2. p. 111. *Obſ.* 530. *Fig.* 1. From this Tree we have that celebrated *Gum*, or rather *Roſin* call'd *Form.* MASTICK, which 'tis ſaid the Iſland of *Chio* (where *Hippocrates* was born) is the only place that yields it; altho it grows plentifully alſo in *Italy*, *Spain*, and *Mompelier*.

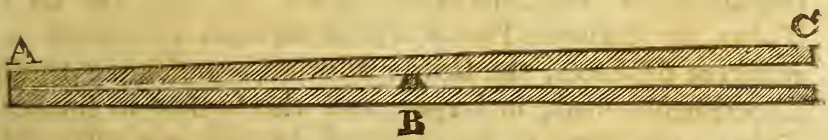
56 *Names:* The *Oriental* Plane-tree. *Ray* H. Pl. 1706. *Platanus* C.B. 431. 1. *Chabr.* 62. Ic. opt. 2. I. B. 1. l. 8. p. 170. *Fig.* Clus. 9. *Fig.* Dod. 842. *Fig.* Matth. 127. *Fig.* 2. Ger. 1304. *Fig.* Lob. *Icon.* 2. p. 198. 2. *Belg.* 2. p. 232. *Fig.* Adv. 442. *F.* Tab. 2. p. 981. *Icon.* 972. 2. *Platanus* Orientalis *verus* Park. 1427. *Fig.* 1. This in its Native Soil grows to be a very large and ſhady Tree. *Bellonius* has obſerved 'em on Mount *Athos* ſo thick about as to cut the *Trunks* into large *Boats* with little charge or trouble. Its *Burry Fruit* and large *Maple* like Leaves, diſtinguiſh it from other Trees. In *Chelſey* Garden it bears *Fruit* yearly, which hang on the Trees moſt part of the *Winter*, long after the Leaves are fallen.

57 *Names.* Common *Spirea* or *Theophraſtus*'s Willow. *Ray* H. Pl. 1699. c. 13. *Spirea* C.B. 475. Spirea *Theophraſti* forte *Cluſij* 84. *Fig.* Chabr. 44. Ic. 6. I. B. 1. l. 5. p. 559. *Fig.* Park. 1437. *Fig.* Spirea *Salicis* folio *El. Bot.* I. R. H. 618. *Frutex* ſpicatus, folijs *Salignis* ſerratis C. B. 475. This ornamental Shrub is common in moſt *Gardens* and eaſily known by its *Willow* or rather *Almond* like ſerrated Leaves, with *Time.* *Spikes* of thick ſet, ſmall, freſh coloured 5 leaved *Flowers*; each *Spike* about a Finger thick and long; theſe towards *Autumn* turn into dry ſtarry *Seed Veſſels* full of yellowiſh Duſt. It *Flowers* in *July* and *Auguſt*.

III. *An*

III. *An Account of an Experiment touching the Direction of a Drop of Oil of Oranges, between two Glaſs Planes, towards any ſide of them that is neareſt preſs'd together.* *By Mr.* Fr. Hauksbee, *F.R.S.*

THE Glaſs Planes which I uſed were about 6 Inches ſquare; and being very clean, a drop or two of Oil of Oranges was let fall on the lower Plane, ſuppoſe at B; then the upper Plane was laid on it, ſo near as to touch the Liquid, that it might become Contiguous



to both their Surfaces. Thus the Planes being made to touch one another at the ſide A, and opened at the ſide C, as in the Scheme above, the lower Plane lying parallel with the Horizon, the drop of Oil would immediately move towards the touching ſide of the Planes; and when it was arrived there, it was but reverſing the Angle, and the Drop would return from A to C; and after the ſame Manner it might be directed to any ſide or part of the ſame. Moreover, if the Planes were elevated 8 or 10 Degrees at A, yet would the Drop aſcend towards the ſide A, tho' not ſo ſwift as when the Planes were in the fore-mentioned Poſition. It was farther to be obſerved, that the nearer the Drop approach'd the touching ſide, ſo would the Velocity of its Motion be encreaſed: The reaſon of which ſeems very

very plain, allowing the Aſcent of Water in ſmall Tubes, and between the Surfaces of nearly contiguous Planes, to be explain'd from the Power of Attraction, that one Surface has to another at ſuch a nearneſs (as I ſee no Reaſon to doubt it:) For the Drop of Oil moving on towards the contiguous Surfaces, comes to enlarge its ſpace, and touches the Planes in more and more Parts, as it approaches nearer and nearer the touching ſide. Thus in the whole Progreſs of its Motion, it is continually encreaſing in its Surface, and conſequently the Power of Attraction muſt encreaſe in proportion to that Surface; ſo that the Celerity of its Motion muſt neceſſarily be augmented. This Experiment ſeems very powerfully to confirm the Experiments made before on the ſame Subject, from the gradual Increaſe of the Motion of the Drop; repreſenting thereby the ſeveral Appearances of the Aſcent of Water in different ſiz'd Tubes, or between Planes whoſe Surfaces are placed at different diſtances, the ſlower Motion repreſenting thoſe Experiments made in larger, and the ſwifter in ſmaller Tubes; the ſame to be obſerved in different diſtanc'd Planes.

I have ſince repeated the ſame Experiment *in vacuo*, where, in all Reſpects, it anſwered as in the open Air; which is a plain Indication, that the Preſence of the Air has nothing at all to do in producing this *Phænomenon*.

ERRATA:

IN Phil. Tranſact. *Numb.* 331. *in the Contents* pag. 309. l. 19. *and* pag. 324. l. 2. *for St.* Margaret's *read St.* Maries.

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BRITISH MUSEUM
NATURAL

Fig: 1.

Fig: 2.

Fig: 3.

Fig: 5.

Fig: 4.

Fig: 6.

(Numb. 333.)

PHILOSOPHICAL TRANSACTIONS.

For the Months of January, February, *and* March, 1712.

The CONTENTS.

I. *Additional Observations upon the Production of Mites, &c. In a Letter from Mr.* Anthony van Leeuwenhoek, *F. R. S.*

Delft, September 22. 1711.

Honourable Gentlemen,

I Did at first intend to have sent you an Extract only of the following Observations; but I have since changed my Mind, and thought fit to Communicate them to you, as I made them from time to time.

I have formerly acquainted you how those little *Animalcula*, which we call Mites, couple and lay their Eggs, and how young Mites are again produced out of those Eggs, as also that I observed the Hair upon their Bodies. And tho' I then imagin'd, that I had observed every thing about the Mite that was to be seen, yet I have thought fit to view one of these *Animalcula* again with a Microscope; and the rather, because that I found in observing those small *Animalcula* that feed upon the Nutmeg, that those Particles upon their Bodies, which one would take to be Hairs, are really not so; for I cannot allow those Particles to be Hair, or Wool, unless they are smooth and even, setting aside the Bark, or Skin of the Hair, which may be the cause of its being a little rough and uneven.

Those

Thoſe ſix or eight long Particles that are upon the Body of the Mite, and which one wou'd call Hairs, are longeſt upon the upper part of the Body, and are twice as long as thoſe upon the ſide of the ſaid little Creature: And when one carefully, and thro' a Microſcope that magnifies very much, obſerves thoſe long Particles, one wou'd judge that ſuch a long Particle conſiſts of fifty Parts, which one wou'd take to be little Joints; and that from each of thoſe Diviſions little hairy Particles do again proceed: Which was ſuch an agreeable Spectacle to me, that I cou'd not forbear ſaying to myſelf, Of what a wonderful Compoſition is ſuch a ſmall Creature, whoſe whole Body is hardly diſcernable by our naked Eyes!

I obſerved with great Attention the aforeſaid long Particles, in order to diſcover whether there were any Motion in thoſe Parts which appeared like Joints: But all that I cou'd diſcover therein, was, that theſe little Creatures had power to move or ſtir thoſe long Particles, which I formerly took to be Hairs, in ſuch a manner, that when they were obliged to creep thro' narrow Paſſages, they cou'd lay theſe little hairy Particles down cloſe to their Bodies; and that theſe Particles had each of 'em but one moving Joint, which was next to that part which was faſtened in the Skin.

Thus we ſee the wonderful Formation of that ſmall Creature call'd a Mite: But what ſhall we ſay to the unſpeakable number of many kinds and particular forms of other *Animalcula*, ſome of which are ſo ſmall, that their whole Body is not only not ſo thick as the Diameter of one long Particle, which is upon the Body of the Mite, but even not ſo big as one of the ſlender Particles, that are upon thoſe joynted Parts of the long hairy Particles, and which *Animalcula* are not to be ſeen but thro' ſome of the moſt magnifying Microſcopes: And if one cou'd ſee the ſmalleſt *Animalcula* ſo big and

ſo clear, as one ſees a Mite, we ſhou'd be more ſurpriz'd I believe at their Figures, than we are at that of a Mite: In ſhort, the ſmallneſs of the Parts, of which all Bodies are compoſed and ſet together, is ſo very Minute, that it is not to be conceived by Man.

Afterwards there was brought to me an earthern Veſſel, in which there was ſome Flower of Wheat, which had been about 14 Days in my Houſe; in which my Servant Maid, who is very ſharp-ſighted, ſaw a great many Mites running about. I took ſome of 'em, and view'd 'em thro' a Microſcope; but I cou'd not perceive, tho' I view'd 'em very nicely, thoſe jointed Parts which are as it were cover'd with Hairs, and are upon the Body and Feet of the Mites, and which are ſo ſmall, that they ſeem themſelves to be nothing but Hairs; and yet I view'd ſeveral of theſe Mites, and but once only I doubted whether I did not ſee thoſe little Hairs that are upon the hairy Parts. The Parts of the aforeſaid Mites, which appear'd to be Hairs behind upon the Body, were not near ſo long as thoſe of ſome other Mites that I had taken out of the dryed Bladder of an Ox: And tho' theſe Mites were dead, yet I cou'd perceive upon thoſe Parts that paſs'd for Hairs, other and much ſmaller Hairs.

From which Obſervation I conſider'd, that as the Flies, which we judge to be of one ſort, are notwithſtanding of very different Kinds; for ſome of them lodge their Eggs in Fleſh, others in Cheeſe, others again in Dung; and accordingly the Worms that are hatch'd from theſe Eggs, receive their Food and Growth from the ſeveral Subſtances in which they lye; ſo likewiſe among the Mites, there be ſome that live upon Fleſh, and others again upon Meal or Bread.

For my farther Satisfaction, I went to a Grocers Shop, and out of a little Barrel took ſome Figs that were of the

the growth of the Year 1707. thinking to find a great many Mites among thoſe Figs; but I met with but three or four Mites that were living, and thoſe had longer hairy Parts upon the hinder part of their Body, than I had ſeen on any before; and thoſe hairy Parts were alſo cover'd with as many ſmall Hairs, as I have ſaid before.

In my ſearch after Mites, I diſcover'd a kind of *Animalcula* that were ſmaller than the afore-mention'd, and of a quite different Figure from the other. The Hairs upon the Body and Feet were very ſhort; the Body, and particularly the Head, were of quite another Make; for theſe had upon the ſide of the Head two ſhort Inſtruments, with which they made a very quick Motion: From whence I conſider'd, whether theſe Inſtruments were not given them by Nature to convey their Food to their Mouths, becauſe their Head was ſhorter than that of a Mite; which laſt Creature is likewiſe the biggeſt. I alſo conſider'd, whether this little *Animalculum* might not be the Production of a very ſmall Fly.

I have thought fit to make a draught of the ſo call'd little Hair of one of the afore-mention'd little Mites, that one might in ſome meaſure be able to judge how compleat and perfect theſe contemptible little Creatures are, which, when they are come to their full growth, the naked Eye can hardly perceive to move.

When I communicated to a Curious Gentleman the ſight of the hairy Parts of a Mite thro' a Microſcope, he compared it to an *Indian* or *Japan* Cane with many Joints; and ſaid it appear'd to him, as if there were ſharp Twiggs ſpouting out of each Joint.

Fig. 1. A. B. repreſents ſuch a Hair of a Mite; together with the hairy Particles branching out of the ſides of it, juſt as it appear'd to the Painter thro' the Microſcope.

Moreover, I placed before 4 distinct Microscopes a great Mite, which I judged to be the Female, and stuck upon the Point of a small Pin, to the end that I might the better view those Parts which are taken for Hairs: and I observed little Joints in each of those hairy Particles; and when I turn'd the Mite a little on one side, I cou'd not see those small Parts any more. From whence I concluded, that those hairy Parts were provided with two very small Hairs, all along opposite to each other: So that when one side was turn'd to the sight, the other cou'd not be seen; but the Painter discover'd 'em better than I could.

I observ'd that one of these Mites, after she was stuck upon the point of a Pin, laid two Eggs; one of which appear'd to the Eye like a great grey Pea, and the other I judged to be like a Sparrows Egg. Another Mite had laid 4 Eggs; and another, which I had newly placed before a Microscope, laid two. The Mite that had laid 4 Eggs, was only fastned by the two hinder Legs of the Left side of her Body; so that she cou'd move the forepart, and even displace it: And I observ'd, that after the said Mite had stuck upon the point of a sharp Pin for the space of 10 Days, she had eaten two of her Eggs.

I have open'd the Bodies of several of these Mites, and took two Eggs out of one of them; and one time I took three Eggs out of the Body of another, which were come to their full growth; but in the most of them I cou'd discover no Eggs: But some of them I imagin'd to be Males. And tho' the Liquid Matter of the Eggs, which I took out of their Bodies, was exhaled in very short time; yet those Eggs, which the Mites had laid, preserv'd their perfect bigness and roundness. The reason of which was, as I imagin'd, that the Shells of those Eggs which I had taken out of their Body, had not yet acquir'd their full hardness, and consequently

quently the Liquor was more eaſily exhaled from them.

The afore-mention'd Mite, that had laid two Eggs, I put into a Box, together with a Microſcope before which it was placed; and on the 17th of *October* 1708. I put it into my Pocket, to ſee how long time was required for the hatching the young Mites from the Eggs.

I view'd theſe Eggs more than once every Day; and after 3 or 4 Days the Mite was dead. And after I had carry'd 'em 9 Days in my Pocket, I obſerv'd, that the Eggs, which were at firſt tranſparent, became dark at one end, and that that darkneſs encreaſed from time to time; ſo that upon the 30th of *October*, I could diſcern but a very ſmall part of the Egg to be clear. And upon the firſt of *November*, I obſerv'd but one Egg; and that which remain'd of it was ſo little, and it lay ſo confuſed, that I could diſcover nothing of certain. And in the ſecond Egg I did not only obſerve the ſame appearances as in the other, but I ſaw likewiſe a little *Animalculum* lying in the Egg, of which I could perceive the Head and ſome of the hairy Parts of the Body. And whereas the *Animalculum* being now compleat, did not entirely fill the Shell of the Egg, ſome part of the ſaid Shell was now tranſparent, by which means I cou'd more plainly diſcover the *Animalculum* and its Hairs in the Egg. Whereupon I reſolv'd to view the ſaid *Animalculum* ſeveral times that Day; and about an Hour after my firſt Diſcovery, I obſerv'd the *Animalculum* had forc'd out about one third part of its Body, and was making a great Motion with four of its Feet. But foraſmuch as the *Animalculum* could not faſten its Legs, which it had put out of the Shell, upon any place, it made a great ſtiring with them the whole Day, without being able to bring its Body farther out of the Shell; and the next Day it was dead.

Upon viewing these Eggs as they were placed before the Microscope with the light of a Candle, we observ'd an unconceivable number of exceeding small Lights or Transparencies in the Egg-shell, which I imagin'd might be occasion'd by the unequal thickness of the Parts of the said Egg-shells; and that the Transparency therein was caused by little Holes that were thinner than the rest, as we see in the Shell of a Hens Egg.

I observ'd likewise that a Mite, which had been stuck thro' his Back with a point of a Pin, had upon the smallest part of one of his Legs an Egg cleaving to it; and tho' he mov'd his Foot very much, yet the Egg stuck fast to it all that Day that I observ'd it. From whence I concluded, that the Eggs of Mites are of the same Nature with those of Caterpillars, and other creeping Creatures; whose Eggs, wherever they fall, stick fast by reason of a slimy or glutinous Matter wherewith they are surrounded; and this was the reason that the Egg of the Mite stuck so fast to its Foot. But the next Day I observ'd that the Mite had work'd the Egg off his Leg, and by the help of his Claws held it in one of his Feet: and tho' he made a great stir with his Legs, and particularly with that which held the Egg, yet he did not let it go, but took it from one Foot into the other; which was a very pleasant sight; but the next Day I could not find the Egg.

Being not content with the aforesaid Observations, I observ'd two other Mites, which I judg'd to be Females, before two Microscopes: One of these Mites had laid two Eggs, and the other three; and as far as I cou'd judge, they were about three Days old.

I carried those Microscopes, together with the Mites, in the Day time about me: And after the space of Ten Days, I observ'd that two of the Eggs, which lay close by each other, had been hatch'd, and that the young Mites were come out of them, and the Shells lay open; but I could

could not find the Mites. As for the other three Eggs, there came a young Mite out of one of them upon the ſame Day; and on the 12th Day came out another Mite, but could not thruſt out his Body above half way, and did not live above a Day; which might proceed, as I imagine, from its being ſtuck faſt in that glutinous Matter, with which the Egg was ſurrounded. As for the third Egg, it lay length-ways to the ſight, and I expected before three Days, that the young one ſhou'd have come out, computing that the *Animalculum* was arriv'd to the full growth in the Egg, and that it had fill'd it in length and breadth; and there was alſo a Tranſparency in the Egg: At laſt, there came a little Mite out of the third Egg, contrary to my Expectation; which Mite, I imagin'd, dy'd in the Shell before it could get quite out of it.

When we conſider, that the Eggs of Mites are laid one after the other; and that in the Copulation of theſe Creatures, a great many of their Eggs are impregnated at the ſame time, according to all probability; and moreover obſerve, that in the diſſecting ſuch an *Animalculum*, the Intrals thereof cannot be exactly diſtinguiſh'd, how ſmall muſt the *Animalcula* be that are found in the *Semen Maſculinum* thereof.

Now ſince there are many People that don't know what a Mite is, and many more that never ſaw the Eggs thereof, I have thought fit to compare the bigneſs of their Eggs, by reckoning a certain number of them againſt a Pidgeon's Egg. Now if one Egg of a Mite be equal to the Diameter of a Hair of ones Head (as it appear'd to me thro' a Microſcope,) and 600 Hairs of a Man's Head laid by one another are equal

600
300
150
450
450
22500
1800
202500
450
10125000
810000
91125000

to

to the length of an Inch, and that the Diameter of a Pidgeons Egg is three fourths of an Inch, then 450 Diameters of a Mites Egg are equal to one Diameter of a Pidgeons; and ſuppoſing their Figures to be alike, we may affirm, that 91125000 Eggs of a Mite are not bigger than one Egg of a Pidgeon.

Upon the 10th of *November* 1708. by the means of glutinous Matter, I ſtuck two Mites, which I judg'd to be Females, upon the point of a ſmall Pin; and upon the 12th of the ſame Month, I found they had laid 3 Eggs between 'em: The next Day there were 4, and ſoon after 6. I did not keep theſe Eggs warm, but let them ſtand upon my Desk, to ſee how long they wou'd be, in that cold Weather, before they were hatch'd.

Upon the 8th of *December*, I could perceive that one of theſe Mites ſtir'd three of her Legs; but after that time I could perceive no more Life in her.

Since the 10th of *November*, I view'd the ſaid 6 Eggs ſeveral times, and obſerv'd, that at the thickeſt end of them (for they ſeem'd to be exactly ſhap'd like Hen Eggs) they ſeem'd darker and darker: And upon the 22d of *December*, I could perceive upon the thickeſt end of one of the Eggs, which ſtuck faſt, a little Mite, that had work'd itſelf ſo far out of the Shell, as to make a continual ſtirring with 4 of its Legs; but not being able to faſten them any where, I did believe that it would ſoon dye.

Upon the 25th of the laſt mention'd Month, I did further obſerve another Mite got out of its Shell. From whence we may conclude, that as of Hens and other Creatures, their Chickens are not encreaſed, nor nouriſh'd in the Eggs, unleſs the Mother ſits on them; and that all their Eggs are hatch'd about the ſame time; ſo here on the contrary, the Eggs of Mites not being ſat upon, but from time to time, and the Eggs laid on ſeveral Days, the young ones muſt conſequently be hatch'd at different times.

From

From theſe Experiments we may obſerve, what an Influence warmth has on the Eggs of Mites; for from thoſe that I carried in my Pocket, young ones were produc'd upon the 11th or 12th Day; but thoſe which I kept in a Box upon my Desk, were not hatch'd in leſs than 7 Weeks time.

Thus we ſee how regular the Production of a Mite is, (which was formerly look'd upon to be the ſmalleſt of Creatures,) and how admirable the Structure is of ſuch a wonderful *Animalculum*: Wherefore thoſe who have hitherto been big of that Vulgar Error, that a great many ſmall *Animalcula* are produc'd of themſelves, or out of Corruption, I doubt not, but now they will be convinc'd of their miſtakes.

I have moreover diſcover'd both in Cheeſe and otherways, a great many empty Husks, or Skins of Mites, which I moſtly imagin'd to be the Skins of dead Mites; but when I now perceiv'd that the dead Mites were not tranſparent, I began to conſider whether theſe Mites might not ſhed their Skins, as well as ſeveral other Creatures: But that Matter demands a further enquiry.

After that we had had for ſome Days more than ordinary cold and froſty Weather, I got ſome Mites that were taken from a Bladder broke in pieces, and view'd them with a Glaſs; and ſaw that ſome of them were dead, and others ſtill alive, but very ſlow in moving.

In the latter end of the Winter, I took a Glaſs Tube of about the length of a Span, and thickneſs of a common Writing Pen; and I put therein three or four Mites, which I judg'd to be Females; and together with them a long ſlice of a dry'd Ox's Bladder, which I had laid in Rain Water for a very ſmall ſpace of Time, becauſe it was very hard and dry; but I preſs'd it again with a clean Cloath, that the Water in it might be no hindrance to the Mites; and then I ſtopt both ends of the

the Tube with little pieces of Cork: But a few Days afterwards, I could perceive that the little moiſture, which had evaporated from the ſmall piece of Bladder, had fixt itſelf to the ſides of the Glaſs in a great number of exceeding ſmall drops of Water; and that the hairy Parts of the Mites had been ſo entangled in that ſmall quantity of Moiſture, that thoſe little Creatures were unable to extricate themſelves from it, and ſo dyed. Thereupon I opened the Glaſs Tube, and wiped it with a clean and dry Cloth; and I again put a little bit of dry Bladder in it, together with four Mites; and viewing them in the great Froſt, I obſerv'd that one of the Mites had compos'd all his Legs ſo exactly under his Body, that as one view'd him on the upper part of his Body, none of 'em could be ſeen; from whence I concluded, that that Mite was dead.

Having again view'd the ſaid Mite a Day or two after the ſecond hard Froſt, I obſerved, that it lay in the ſame place, and in the ſame manner, as it did 2 Months before. The other Mites were alſo very much dryed and ſhrunk up, and their Bodies bent double, and they were alſo dead: However, fancying that the aforeſaid Mite was ſtill living, I view'd her again, and ſaw her begin to move one of her Legs; whereupon I warm'd the Glaſs Tube a little, and then ſaw the little Creature not only ſtretch out all her Legs, but begin to creep very gently along. It ſeem'd to me very wonderful, that ſo ſmall an *Animalculum* ſhould live above two Months ſticking upon the ſides of the Glaſs in ſo ſharp a Froſt; nor was its moiſture evaporated out of its Body; whereas the dead Mites were ſo ſhrunk up, that they were not half ſo big as when they were alive.

Moreover, I cauſed one of thoſe Particles, that appear'd to be Hairs, and are found in great Numbers upon the Bodies of Bees, to be drawn by the Painter juſt as they appear'd thro' the Microſcope; but becauſe the whole

whole length of a Hair would take up too much room upon the Paper, I cauſed the Painter to draw but the half of it, as here in *Fig.* 2. C. D.

In the Month of *Auguſt* I ſtood by a Fiſhmongers Shop, whilſt they were laying their dry Ling in the Water to ſoften it; and I obſerv'd ſeveral little Creatures running about upon the Fiſh: Whereupon I took five of them, and put 'em into a Glaſs Tube, together with a little bit of the ſaid dryed Fiſh, which was Ling, with a deſign to obſerve what ſort of Creatures would be produc'd from them: And after having ſhut them up for ſome Days, I diſcovered that they had changed their Skins, and that they had made a great many Holes in the Cork which ſtopt one end of the Tube, and had inſinuated themſelves ſo far therein, that one cou'd ſee none of their Bodies. And being alſo inform'd, that theſe *Animalcula* are known by the Furriers, and that they do them a great deal of Miſchief, I went to one of that Trade, who ſhew'd me one of thoſe *Animalcula*, but endeavour'd to perſwade me, that they were produced from the Fat which grows upon the Skins of the Furs. Wherefore to remove the popular Prejudices concerning the aforeſaid *Animalcula*, I cauſed my Painter to draw the forſaken Skin of one of thoſe Creatures, juſt as it appear'd to the naked Eye, as you may ſee at *Fig.* 3. between E. and F.

Moreover, I placed a Particle of the ſaid *Animalculum* before a Microſcope, in order to view thoſe Parts which appear like Hairs to the naked Eye; and I obſerv'd that thoſe long Particles were encompaſſed with other Parts, branching or ſpringing out of the ſides of them, in the ſame manner as thoſe of the Mite and the Bee beforementioned; and yet as ſmall as thoſe Parts are, each of them hath a Hole or Cavity, in which thoſe hairy Parts are planted, that ſtand upon the new Skin of the *Animalculum*. Thoſe hairy Particles were upon the

darkeſt part of the Skin, and the whitiſh Parts were the Joints of the *Animalculum*.

Theſe hairy Parts were long, and ſhort; but otherwiſe of the ſame Figure. I cauſed one of the ſhorteſt of them to be drawn, as in *Fig.* 4. between *G.* and *H.* and I judg'd it to be about half as long as the longeſt. I told the Man from whom I procured theſe *Animalcula*, that he muſt not believe they were produced from Fat, but that they were generated from others of the ſame kind, which had their beginning with all other Creatures.

I mention'd above, that theſe *Animalcula* having changed their Skins, had dig'd ſo deep into the Cork, that I could not ſee them; but upon the 8th of *September*, I diſcover'd two flying Creatures like little Beetles, whoſe fore and hinder part of their Bodies was black, and the middle brown, with ſome Speckles: And they had two Shields upon their Bodies, which cover'd their Wings; and the Skins, which they had ſhed after they came out of the Cork, lay about the Glaſs.

Now to ſatisfy my ſelf that the ſaid *Animalcula* were changed from Worms into flying Creatures, I opened two of the Holes that they had made in the Cork; and obſerv'd in one of them an *Animalculum* lying, which indeed had changed its Skin, yet was not become black, but was ſtill white, and was about the bigneſs or ſize of our common ſmall Flies.

Upon the 11th of *September*, two more of the aforemention'd *Animalcula* came out of the Cork; and the Female, which at firſt was all white, and was ſtill like an *Aurelia*, and ſtir'd very much, became red, and then turn'd to a darker red.

Upon the 17th of the ſame Month, the *Aurelia* had ſhed its Skin, which was exceeding thin, and then it ran about the Glaſs; but it was not arrived to that blackneſs which others had, that had run longer about the Glaſs.

Fig.

Fig. 5. I. K. L. repreſents one of thoſe *Animalcula*, and I. L. the two little Shields that cover the Wings when it does not fly. K. is the Tail or hinder Part of the Body; on each ſide of which are the Wings, which were partly folded: For that *Animalculum* cannot ſheath its Wings in the Shields, without partly folding the Ends of them.

Now ſince we ſee that the Worms, whoſe Skin is repreſented at *Fig.* 3. are turn'd into flying Creatures, which lay their Young or Eggs in all Parts of a Houſe; and ſince it is natural to all Creatures to ſtow their Eggs where they can be beſt preſerv'd and hatch'd, it will not appear ſtrange, that theſe Creatures are moſtly found upon Furs that are Fat; and ſo the Furriers themſelves have inform'd me.

I took a little Fat of an Ox, and laid it by theſe *Animalcula*; but I could not perceive that they fed upon it.

About the end of the Month of *May*, I ſought for ſome Mites upon a piece of ſome dry'd Fleſh of a Whale, which hung upon a little String faſtned to a Nail in my Cloſet; and I perceived that ſeveral of the ſaid blackiſh *Animalcula* fell off from the piece of Whales Fleſh; and this happen'd four times one after another upon ſeveral Days: Whereupon I put moſt of the flying Creatures into a Glaſs Tube, which I ſtopt in ſuch a manner as not to exclude the Air; and I put into the ſaid Tube a little bit of Whales Fleſh, upon which I obſerv'd that they fed greedily, and that a great deal of their Excrements lay upon the Glaſs.

Upon the 31ſt of *May*, I ſaw three Eggs lying upon the Glaſs, and they were white; but having none of that Viſcous Matter about them, wherewith the Eggs of moſt of the *Animalcula* are endow'd, theſe Eggs did not ſtick to the Glaſs, but fell among the Excrements; ſo that I could not diſtinguiſh them.

In the first Glass Tube, in which were those *Animalcula* which I had shut up the whole Winter, and were turn'd into flying Creatures, I observ'd two young *Animalcula* running about, whose Skins are described by *Fig.* 3. but how many of them there were I could not discover, because about a Month before I had put into the Tube the Tail of a Pole-Cat, to the end that they might subsist on the Fur, which I was told they used to feed upon; and afterwards I put in a little bit of the Flesh of a Whale into the same Tube.

These Young *Animalcula* were but little bigger than the Eggs before-mention'd.

Since that time, I saw the said *Animalcula* but once; and the Eggs which I saw, in a Day or two after I could discover no more, nor any of the small *Animalcula:* From whence I concluded, that the afore-mention'd flying Creatures had eat up their Eggs and Young ones.

I took the Tail of the Pole-Cat out of the Glass, and examining it, I found a living *Animalculum* in it as small as an Egg, which was very white to the naked Eye. I shut it up in a little Glass, and put a small bit of the Flesh of a Whale into it; and I perceived that, after a few Hours, it had assumed a rosie Colour. I also found three Eggs, in one of which the *Animalculum* was so large, that by the help of a Microscope, I could discover part of the Body through the Shell of the Egg: And two Days after, being the 8th of *June*, I could perceive through a Microscope, upon the wreathed or knotched Parts, red Streaks, upon which were long Hairs; and in the Evening the *Animalculum* was got out of the Egg-shell, and the next Morning it had assumed a rosie Colour.

Upon the 13th of *June*, I saw some few Eggs upon the Glass; upon which I took two out, and put them into a Glass Tube of the length and breadth of a Finger, leaving

leaving 6 or 8 others in the aforesaid Glass; and I took the afore-mention'd blackish *Animalcula* out of the Glass, and I carried the Glass Tube, in which the two Eggs were, about with me in my Pocket, that I might see how much sooner these would be hatch'd, than those which I left upon my Desk in a great Glass Tube: And I discovered upon the 15th of *June* young ones hatch'd from the Eggs which I carried about me; as upon the 20th, were those in the Tube that lay upon my Desk.

Upon the 5th of *July*, I observ'd that in the two several Glasses that contain'd the afore-mention'd Worms (which indeed ought not to be call'd Worms, because they did not creep, but rather running Creatures) that some of these Creatures had left the bit of Whales Flesh, and kept themselves very still upon the Cork; insomuch, that I fancied they were going to be changed into flying Creatures: But I was mistaken; for they only lay upon the Skins they had shed; and then the flying Creatures daily laid their Eggs, out of which also came young ones; but most of the Eggs that had been laid were eaten up; to prevent which, some of those flying Creatures were so cunning, as to thrust their Eggs between the Cork and the Glass, insomuch, that some of the Eggs became flattish; notwithstanding which, young ones came out of them.

Few Days after the 5th of *July*, I perceived that some of the running or creeping Creatures had gnaw'd holes in the Cork; into which they had dug so deep, that one could not see their Bodies.

In the beginning of *August*, I view'd them again, but could not perceive any flying Creatures, as I expected, to be changed from the creeping ones: Wherefore I cut off a little of the Cork in two several Places where those creeping Creatures had been digging; and then I discover'd one *Animalculum*, which had changed its Skin for the last time, and lay still upon the hinder part of its Body,

Body, and was lying in the *Aurelia*, which was white; only upon the knotches of its Body, there were red Streaks; and when I went to touch it with a Needle, it ſtir'd its Body very much.

Upon the 10th of *Auguſt*, I obſerv'd that one of the *Aurelia*'s was ſtript of its little Skin, which was exceeding thin; ſo that it was an agreeable ſight as I view'd it thro' the Microſcope. This *Animalculum* did not ſeem to have any Motion in it, and it was of a dark Colour.

In all my Obſervations I never could perceive any Copulation among thoſe *Animalcula*, when they were changed into flying Creatures: From whence I concluded, that they were all Females, as many other Flies are.

Thus then are thoſe Furriers, who with great Zeal have maintained that the ſaid *Animalcula* were produced out of Fat, convinced of that Error, in which they have ſo long perſiſted; yet I could not convince one of them, till I had left with him a Glaſs Tube, into which I had put ſome of the Eggs of thoſe Creatures, and till he had ſeen the little Worms come out of the Eggs, and daily grow bigger and bigger.

Goedartius de Inſect. Num. 114.

John Goodaart in his 2d part of the Origine and Properties of Worms, Caterpillars, *&c.* calls theſe Creatures, which he deſcribes in Page 168, the *Furriers Plague*, becauſe they do them no ſmall miſchief; and ſays, that he has found of them in the Feathers of a Duck, and ſuppoſes 'em to be produced out of Fat.

From whence it appears, that notwithſtanding all the Pains that the ſaid *Goodaart* beſtow'd in his enquiry after thoſe Creatures, which he calls bloodleſs, he was got yet no further than to maintain, that there were *Animalcula* that were produced of themſelves. But who cares to take ſo much Pains in the Inveſtigation of the Nature

Nature of these Creatures, as I have done: for I have kept them two Winters shut up in Glass Tubes; and I judge that they can secure themselves in Wood against the Winter; because they had dug deep into the Cork; insomuch, that if I had not hinder'd them, they would have bored thro' in several Places.

I threw the said *Animalcula*, as well the Living as the Dead, together with their Food, being dry'd Wales Flesh, into Water, in the Month of *June*, 1711. I shall conclude, and with great Respect remain,

Honourable Gentlemen,

Your Humble Servant,

Anthony van Leeuwenhoek.

II. *Some farther Account of divers Rare* Plants, *lately observed in several Curious* Gardens *about* London, *and particularly in the Company of* Apothecaries *Physick*-Garden *at* Chelsey. *By Mr.* James Petiver, *F. R. S.*

SECT. III. ASIATICK *and* Oriental *Plants.*

INDIAN Plants.

58 *Large-flowered* Oriental *Bawm.* Moldavica *Orientalis* Betonicæ folio, flore magno violaceo *Tournef.* Coral. p. xi. *Ray* 3. app. 106. pl. 36. This differs from the next, in having large blew Sage-like *Flowers*; its bearded Leaves less, but more prickley.

59 *Small-flowered* Oriental *Bawn.* Moldavica *Oriental.* minima, *Ocimj* folio, flore purpurascente *Tourn.* Coral. 11. *Commel.* rar. Plant. Vol. 2. p. 29. Fig. *Ray* 3. ap. 106. 38. This is known from the last, in having smaller *Flowers*, yet larger and round bearded Leaves.

60 *Jagged* Oriental *Figwort.* Scrophularia *Oriental.* supina, folio variè lacerato *Nobis.* This branches and spreads much near the Ground; its *Leaves* thick and differently cut; the *Flowers* and *Seed-Vessels* like the *Common*, but less; neither grows it upright and spiked, but procumbent and racemose.

61 *Rough huskt* Oriental *Campion.* Lychnis *Oriental.* fl. albente, bifido, calycibus pulchrè rugosis *Nobis.* The *Leaves* not unlike our *common white Campion*, but less; its *Flowers* white above, and underneath of a palish green, deeply cut in. These are set in a fine streakt *Husk*, roughest near the Flower, which swell into a rugged *Seed-Vessel.* This and the last, two elegant Plants, I saw in

in *Flower* about the beginning of *October* 1710. in her Grace the Dutcheſs of *Beaufort*'s Garden at *Chelſey*.

China *Schunda*, ot *Thorney* Nightſhade. Schunda *Chinenſis* fol. pannoſo minore *Nobis*. *Solanum* incanum *Chinenſe*, minus ſpinoſum, floribus parvis ferè umbellatis *Pluk.* Tab. 62. fig. 1. *Ray* 3. p. 352. 14. Its ſmall thick woolly *Leaves* very little thorney or waved, diſtinguiſh it from others. I firſt received this from *China*, and communicated it to Dr. *Plukenet*: It *Flowers* and *Fruits* every Year in *Fulham* and *Chelſey* Gardens. 62

China *Sumach*. Rhus *Chinenſis* latifolia, pinnis alatis *Nobis*. Rhus *quinquefolia* Sinarum *lacteſcens*, *rachi medio alata*, *foliis molli hirſutie pubeſcentibus* Pluknet. *Amalth.* 138. pl. 5. Theſe *Leaves* reſemble our *Aſh*, but are broader and deeper ſerrated, very ſoft underneath: Each Stalk is compoſed of three or four Wings, oftner than two; the *Stalk* welted, but more eminently towards the tip Leaf. Mr *James Cunningham*, a very Curious *Naturaliſt* and *Surgeon*, brought me large Specimens of this with ripe *Berries* on it from *China*, which I gave to the Right Reverend my Lord Biſhop of *London*, who has raiſed ſeveral ſmall Trees from them, and with whom they now grow. 63

Chuſan *Musk-Mallow*. Abelmoſch *Chuſanenſis* folio palmato lævi, fructu piloſo *Hort. noſtr. ſicc.* Ray 3. *App.* 241. pl. 1. *Alcea* Sinica *Manihot* ſtellato folio, capſulâ longâ, piloſa, pyramidatâ, quinquefariam diviſâ *Pluk.* Tab. 355. fig 2. *Tchu whei* Chinenſibus. Mr *James Cunningham* brought me this in Seed from *Chuſan*, which grew the laſt Summer in *Chelſey* Garden. 64

SECT. IV. *Canary* Plants.

CAnary *Daſie Pellitory*. Ray 3. p. 221. 22. & p. 223 14. Pyrethrum *Canarienſe* fruteſcens, *Bellidis* flore *Nobis*. Bellis *Canar.* fruteſcens folijs craſſis, *Pyrethri* ſapore. 65

CANARY Plants.

Ray 3. p. 221. pl. 22. Bellis *Canar.* fruteſc. acris, laciniato craſſo folio *Flor. Noriberg.* 60. Buphthalmum *Canarienſe* Leucanthemum *Columæ fœtidæ* foliis craſſioribus, *radice* acri ſapore & fervido *Pluk.* Tab. 272. fig. 6. *Almag. Botan.* 73. Chamæmelum *Canarienſe* ceratophyllon fruticoſius, glauco folio craſſiore, ſapore fervido, *Magala* ab incolis nominatum *Bobart* Hiſt. Oxon. p. 35. 7. Theſe *Leaves* taſte very like the Root of *Pellitory* of *Spain*, by which and its being fruteſcent, diſtinguiſhes it from others; its ever green, and in *Flower* moſt part of the Year. Grows in all the Curious Gardens about *London*, as *Hampton Court*, *Fulham*, *Chelſey*, and *Hoxton*; as alſo with Dr. *Uuedale* at *Enfield*, and Mr. *Charles Dubois* at *Mitcham*.

66 *Trifoliate* Canary *Mint.* Ray V. 3. p. 308. 5. *Mentha* trifoliata *Canarienſis* fragrantiſſima *Nobis*, *Camphoroſma* trifoliata, fl. carneo *Bobart* H. Oxon. 366. c. x. *Sex.* xi. Tab. xi. *Fig.* ult. *Permenta de Tana* Canarienſibus. Cedronella *Canarienſis* viſcoſa, foliis plerunque ex eodem pediculo ternis *Hort. Amſt.* Vol. 2. Tab. 41. p. 81. *Dracocephalo* affinis *Americana*, trifoliata, *Terebinthinæ* odore *Flor. Noriberg.* 145. *Fig.* opt. & *deſcr.* Meliſſa *Canarina* multifido folio ſpicata, odorem *Camphoræ* ſpirans penetratiſſimum *Mantiſſ.* 128. 1. *Meliſſa* fortè *Canarina* triphyllos, odorem *Camphoræ* ſpirans penetrantiſſimam *Pluk.* Tab. 325. Fig. 5. & Tab. 430. *Fig.* 2. Moldavica *Americana* trifolia, odore gravi *Inſt. Rei Herb.* 184. Its Trefoil *Leaves* and fragrant ſmell, diſtinguiſh it from all others.

67 Evergreen *Canary Bindweed*, with hoary Leaves *Ray* 3. p. 377. pl. 63. Convolvulus *Canarienſis* longioribus foliis mollibus & incanis *Pluk.* Tab. 325. Fig. 1. *Almag. Botan.* 114. pl. 8. Convolvulus *Canarienſis* ſempervirens, foliis mollibus & incanis, floribus ex albo purpuraſcentibus *Hort. Amſtel.* Vol. 2. p. 101. Tab. 51. Ahilo porro Salvages *Canarienſibus*. Its Evergreen and perennial, with long cordated hoary Leaves and pale bluſh *Flowers*.

Yellow

Yellow Canary *Cytiſus*, with hoary Leaves. *Ray* 3. p. 471. 5. Cytiſus *Canarienſis* folijs parvis incanis *Nobis*. Cytiſus *Canarienſis* microphyllos, anguſtifolius prorſus incanus. *Pluk.* Tab. 277. *Fig.* 5. Eſta *Inſulanis*. This is an elegant Shrub, with whitiſh hoary *Leaves*. It *Flowers* and *Pods* every Summer in the Biſhop of *London*'s Garden at *Fulham*. 68

SECT. V. *Plants from the* Cape *of* Good Hope.

NArrow-leaved *Cape* yellow Heads. *Ray* V. 3. p. 152. 12 & p. 170. 15. & an 174. pl. 5? Coma aurea *Africana* fruteſcens, folio anguſto *Linariæ* H. Amſt. *Vol.* 2. p. 89. *Tab.* 45. Conyza *Æthiopica* flore bullato aureo, *Pinaſtri* brevioribus *folijs* letè viridibus. *Pluk.* Tab. 327. Fig. 2. *Alm. Bot.* 56 & 400. Elichryſum *African.* folijs & flore *Abretani* viridis *Bobart.* Elichryſum *African.* multiflorum tenuifolium fruteſcens. *Flor. Norib.* 148. Fig. This grows about a Yard high, and ſpreads into many Branches; thick ſet, with long narrow Leaves; at the top grow ſingle yellow naked *Flowers* about *September*, which turn into downey Seed. Its perennial and Evergreen. 69 *CAPE Plants.*

Stoll's *Cape* Silk-Maudlin. Eupatorium *Indicum* flore albo *Act. Med. Hafn.* Vol. 2. pag. 57. *Fig.* Conyza *Africana* humilis, folijs anguſtioribus nervoſis, floribus umbellatis I. R. *Herb.* 455. Mr. *Jeremy Stoll*, a Surgeon, firſt brought this with ſeveral other dryed Specimens, *A. D.* 1673. from the *Cape of Good Hope*, given him by Dr. *Herman*, which *Tho. Bartholine*, that Curious Phyſitian and Anatomiſt, has given the Figure of, in his *Acta Medica Hafnienſia*. Its an ever-green Shrub, with deep dented Leaves, and has been a long ſtandard in *Chelſey* Garden, where it Flowers and Seeds yearly about *Chriſtmas*. Mr. *Cuningham* brought me the firſt Specimen of this near 20 Years ſince, in his return from the *Cape of Good Hope*. 70

71 *Hermans* round-leaved *Cape* Tree Cranes-bill. *Ray* 1897. Geranium *Africanum* arboreſcens, *Ibiſci* folio rotundo, *Carlinæ* odore *Hort.* Boſian. & Lugd. Batav. 275. *Fig.* & deſcr. The *Leaves* are round, ſtiff, hairy and lightly crenated; the *Flowers* freſh coloured, the two upper *Petala* ſtreak'd with red, and larger than the 3 below. Dr. *Paul Herman*, that celebrated Profeſſor in *Botany* and *Phyſick*, has uſed theſe *Leaves* in *Glyſters*, againſt the Cholick, Stone, and difficulty of Urine, with good ſucceſs.

72 *Hermans* Curl-leaved *Cape* Tree Cranes-bill. *Ray* 189. Geranium *Africanum* fruteſcens, *Malvæ* folio laciniato, odorato *Hort. Lugd. Bat.* 278. *Fig.* Geranium *Malvæ* folio odoratum, flore purpuraſcente *Cap. Bonæ Spej* Breyn. *Prodr.* p. 36. *Geranium* Africanum *Malvæ* folio, odore rad. *Cyperi* longi *Hort. Boſian.* This differs from the laſt, in having curled or crumpled *Leaves*, with 6 or 7 ſmaller *Flowers* growing together from one bottom.

73 Cape *Cranes-bill*, with Leaves like *Ladies-mantle*. Ray 1897. *Geranium* Africanum *Alchimillæ* hirſuto folio, floribus albidis *Hort. Lugd. Batav* 283. Fig. *Geranium* African. *Alchimillæ* folio maculoſo & piloſo, floribus ochroleucis roſtris cernuis *Hort. Boſian.* Its *Leaves* hairy and round, ſomewhat cut in, with a blackiſh Circle in the middle; the *Flowers* pale, ſmall, and 5, 6 or more in an umbel-like tuft.

74 Cape *Cranes-bill* with *Columbine* Leaves. *Ray* 1897. Geranium *Africanum* noctu olens tuberoſum & nodoſum *Aquilegiæ* folijs *Hort. Boſian.* & *Lugd. Batav.* 285. *Fig.* Geranium *Æthiopicum* noctu olens, rad. tuberoſâ, *Aquilegiæ* folijs *Breyn. Cent.* 127. From a knotty Fibroſe *Root*, riſes knobby Stalks a foot or higher, with divided *Columbine* Leaves; at the top grow tufts of yellowiſh, and ſometimes bluſh *Flowers*; which after Sun ſet ſmell very ſweet till next Morning, as many others of this kind do. We are highly obliged to that Curious Botaniſt Dr. *Herman*,

Herman, for the Diſcovery of all theſe *beautiful Cranes-bills*, which of late Years have been the greateſt Ornaments in our fineſt Gardens, *viz.* at *Hampton Court*, *Kenſington*, *Fulham*, *Oxford*, *Chelſey*, *Hoxton*, *Enfield*, *Mitcham*, &c.

Great Cape *Honey-Flower*. Ray 1898. pl. 3. *ſeu* vlt. *Melianthus* Africanus *Hort. Lugd. Batav.* 415. Fig. & *deſcr.* Melianthus *Africanus* major fætida, floribus atro-purpureis *Alm. Bot.* 246. *Pimpinella* ſpicata maxima *Africana* Barthol. *Act. Med.* Hafn. V. 2. p. 58. Pimpinella *Afric.* maxima flore purpureo *D. ten Rhyne* Breyn. Cent. 179. This is a very ſpecious tall and ſightly Plant; its *Leaves* very like *Burnet*, but much larger, and of a very pale or blewiſh Green; at the top grows a Spike of ſad red *Flowers*, in which lies a very luſcious Honey Dew, much coveted by the *Hottentots* at the *Cape of Good Hope*, where it grows wild in wet Marſhey Places. 75

Small Cape *Honey-Flower*. Ray 3. Dendr. p. 120. pl. 3. *Melianthus* minor *Hort. noſt. ſicc.* Ray 3. App. 246. M. 14. Melianthus *Africanus* minor fætidus *Comel* Pl. rar. *Icon.* 4. Melianthus *Afric.* minor fætida, floribus obſoleti coloris *Alm. Botan.* 246. Melianthus *Americanus* minor *El. Bot.* 342. I. R. H. 431. Melianthus *Hyſſquanenſis* minor fætidus *Herm.* Prodr. app. Grows 3 or 4 foot high, with ſmaller *Leaves*, green and deeper cut; its *Flowers* of a Saffron colour, with yellow *apices*. 76.

Cape *Spindle* with a ſhining notch'd Leaf. *Ray* 3. app. 229. xi. Euonymus *Capenſis* folio *Arbuti* lucido *Nobis*. Alaternus *Hyſſicanenſis* ſeu *Africana* Lauri ſerratæ odoratæ *Stapelianæ* folijs *Hort. Beaum.* p. 3. *Pluk.* Tab. 126 *Fig.* 1. Alaternoides *Afric.* Lauri ſerratæ folio *Comel.* Rar. Pl. Vol. 1. Fig. xi. Ricinus *Africanus* Salicis folio, flore viridi *Cod. Witſiani*. From a thick ſtringy matted *Root* this riſes 3 or 4 foot high, with thick ſhining notch'd *Leaves*, very green above; its *Flowers* 5 leaved, of a whitiſh or pale Green. At the *Cape* it grows 7 foot high, in watery Grounds and by River ſides, *flowring* in *October*. 77

Cape

78 Cape *Spindle-wort* with *Roſemary* Leaves. *Ray* 3. p. 527. 6. Tetragonocarpos *Africana* fruticans, folijs longis & anguſtis *H. Amſt.* Vol. 2. p. 205. Fig. 103. It riſes about a foot high, each Root dividing into divers *Stalks*, with long thick green *Leaves* not unlike *Roſemary*; at the top grow ſeveral yellowiſh *Flowers* of 4 or 5 petals each. The *Fruit* ſquare and winged: It *Flowers* about *Michaelmas* in *Fulham* and *Chelſey* Gardens.

SECT. VI. AMERICAN *Plants.*

79 Dwarf *American Starwort*, with *Savory* Leaves. *After* pumilus *Americanus* Satureiæ folijs. This grows not above a Yard high; from one Stem it branches towards the top into a buſhy tuft of pale blew *Flowers*, the lower *Leaves* are long and narrow, and thoſe about the *Flowers* very ſmall and ſlender. It ſtands out all the Winter, *flowring* in *October.*

80 *Parkinſon's* ſmall floured white *Virginia Starwort.* After *Virginianus* anguſtifolius ſerotinus, parvo albente flore *Park.* 132. 19. & 1676. Fig. After vulgo *Tradeſcanti* Schol. Botan. 204. 3. After *Virginianus* fruticoſus Jonſt. 489. 12. This agrees pretty well with *Parkinſon's* Deſcription and Figure; its *Leaves* below are long *Willow-like*, and ſcarce dented; thoſe at the ſetting on of the Flower Stalks are much leſs, and thoſe on the Twigs very ſmall. From the boſom of theſe little Leaves, the Flowers grow *ſpicated* in a looſe tuft, of a *pale blewiſh white*, each compoſed of 8 or 10 ſmall Daſie-like *Petals*, theſe, if nicely viewed, ending bifid. It Flowers in *November*, and ſometimes till near *Chriſtmas*, being one of the lateſt *Starworts* that Flowers in our Gardens.

81 Orach-leaved *Virginia* Silver-tufs. *Ray* 1799. 14. *Conyza* Virginiana *Halimi* folio *Inſtit. Rei Herbar.* 455. *Argyrocome* Virginiana *Atriplicis* folio *Gazoph.* Natur. & Artis. Tab. 7. Fig. 4. *See* its other *Synonyms* in the Catalogue

to that Volume, pag. 8. Its thick *Orach-like* jagged *Leaves* and woody *Stalks*, distinguish it from all others of this kind. It hath been a long Inhabitant in *Chelsey Garden*; as also at *Fulham*, *Hampton Court*, *Enfield*, *Mitcham*, &c.

Virginia *Uvedale* with a Vine Leaf. *Ray* 3. p. 216. 84. 82
Uvedalia Virginiana *Platani* folio molli *Mus. Petiver* 800. *Chrysanthemum* angulosis *Platani* folijs, *Virginianum* Pluk. Tab. 83. Fig. 3. *Chrysanthemum* perenne majus, *Platani Orient.* folio *Bobart.* H. Ox. p. 22. Fig. 57. *Sect.* 6. Tab. 7. Fig. opt. *Chrysanthemum* folio *Platani* Pluknet. *Boerhave* Ind. Plant. *H. Leyd.* 33. *Doronicum* maximum *Americanum*, latissimis angulosis folijs, rad. transparenti *Hort. Leyd.* 222. This is a specious Plant and of a particular Genus or Family; it comes nearest the *Sun-Flowers*, but with this difference, *viz.* its Berry-like Seeds grow round the rim of the Flowers, as the others do in the middle. I have therefore chose to distinguish it by the Epithet above, in commemoration of that Patron of Botany, Dr. *Uvedale*, in whose Garden I have seen two others of this kind from the *Cape of Good Hope*.

American *Tree of Life*. Ray 1408. cap. 6. Arbor Vitæ 83
Clus. 36. Fig. *id.* Hisp. 95. Fig. *Dod.* 858. Fig. *Ger.* 1187. Fig. *Jonst.* 1369. Fig. *Park.* 1478. Fig. *Tabern.* Vol. 2. p. 649. Fig. *id.* Icon. 947. 1. Arbor *Vitæ* sive *Paradisiaca.* Chabr. 73. Ic. 1. Arbor Vitæ *sive* Paradisiaca *vulgo* dicta, odorata, ad *Sabinam* accedens I. B. l. 9. p. 286. Fig. *Thuya* Theophrasti C. B. 488. This is a singular *Evergreen*, very frequent in divers Gardens, *flowring* in *April* and *May*, bearing its *Cones* in *August* and *September*. It was first brought into *France* from *Canada* in the Reign of *Francis* the First. *Clusius* says, he first saw it at *Fontainbleau*, and from his Figure all other Authors have copied it. *Parkinson* asserts, that the *Leaves* taken fasting for a few Days together are very good in a purulent Cough and shortness of Breath. I have heard it has been successfull

full in *Agues* uſed Poultiſe-wiſe, or by wearing it in the Shoes.

84 Virginia *Sumach* by ſome *Buckſhorn*. Ray 1591. 2. Rhus *Virginianum* C. B. pin. *app.* 517. *Sumach* ſeu *Rhus* Virginiana *Park.* 1450. Fig. 2. This grows in divers *Country Gardens* about *London* to a midling Tree; it differs from the *European Sumach*, in having longer and narrower *Leaves*; the firſt Branches are very ſoft and velvety, like the *Horns* of a young Deer, for which reaſon its call'd *Buckſhorn* by the *Country People*. The *Root* or *Stalks* broken yields a Milk, which ſmells Reſinoſe, and becomes a hard *Gum*, which is a great Aſtringent and Cures the Tooth-ach, as Mr. *John Smart*, a Surgeon, who liv'd in thoſe Parts informs me. The Pulp of the Fruit and its outer Skin, which is very red, have both a very grateful acidity, of which Mr *John Baniſter*, a very Curious Naturaliſt, and one who long reſided in *Virginia*, ſays, they make Vinegar of it there, and uſe it to ſeaſon their Meat.

85 Great *Virginia* Cockſpur Haw. *Ray* 1795. 60. Meſpilus *Apij* folio, *Virginiana*, ſpinis horrida, fructu amplo coccineo *Pluk.* Tab. 46. Fig. 4. Meſpilus *Apij* folio, *Indica* Schol. Bot. 289. *Meſpilus* ſpinoſa ſeu *Oxyacantha* maxima *Virginiana* H. Leyd. 423. *Oxyacantha* officulis binis fructu magno incluſis *Baniſt.* Cat. Plant. Virgin. *an* Oxyacantha *Americana*, or the *American Hawthorn*. Muſ. Regal. Societ. 182. The *Leaves* of this Tree are as large, and not unlike our *Sorbus Torminalis*, or *wild Serviſe*, and the *Fruit* as big but Scarlet; its Branches are guarded with ſtrong Thorns reſembling a *Cocks-ſpur*. It Fruits yearly in *Chelſey Garden*, where it has been a long Standard, and is now as large as a *Cherry-tree*.

86 Carolina *Poyſon Root*. *Caſtaneæ Equinæ facie*, Arbor *Caroliniana*, flore galeato ſpicato *Nobis*. Arbor pentaphyllos *Virginiana*, floribus ſpicatis monopetalis. *Ray* 1800. 2. Siamouna *Piſonis* ſeu Siliquifera *Braſilianis*, arbor digitatis

tatis folijs ſerratis, floribus *Teucrij* purpureis *Pluk.* Tab. 56. Fig. 4. Under this Title Dr. *Plukenet* has given it a very good *Figure*, yet I cannot believe it to be the *Saamouna Braſilienſium*, ſince this is not a Siliquoſe Tree, neither hath it a thorney ſwelled Trunk. I ſhall be more particular in the Deſcription of all its Parts, when I give you (as I intend) the *Figure* of it, with its *Fruit*. I have ſeen this both with Mr. *Darby* and Mr. *Fairchild*, Gardiners at *Hoxton*, with whom it has *flowred* and ſet for *Fruit*.

Canida *Fox-glove Climer*. Ray 1768. 1. *Bignonia* A- 87
mer. *Fraxini* folio, fl. amplo phæniceo I. R. H. 133. Clematis *Contarini*. Clematis *Amer.* Fraxini folio ſcandens, flore phæniceo *Breyn.* Prodr. 2. p. 34. *Clematis* Hederacea *Bucananthos* ſiliquoſa *Indica* Alm. Bot. 108. *Clematis* Hederacea *Indica* Jaſmini *folijs* H. Leyd. 159. *Clematis* Hederaceo folio *Sorbi*, floribus *Calathi* inſtar oblongis, coloris dilute punicei *Hort. Boſian.* *Gelſeminum* Edera-ceum *Indicum* Cornuti 103. Fig. *Gelſemium* Indicum *maximum* Ferrar. 199. *Jaſminum* purpureum prælongis ſiliquis *H. Blæs.* 103. *Jaſminum* ſpurium *Indicum*, flore magno rubro *Flor. Noriberg.* 227. *Pſeudo-Apocynum* Virginianum *alijs* Gelſeminum *Americ.* maximum, flore phæniceo. *Park.* 285. 6 & 1679. Fig. *Pſeudo-Gelſeminum* ſiliquoſum *Rivini* Flor. monopet. irregular. It would be needleſs here after the quotation of ſo many Authors, to give its Deſcription; it may ſuffice to let you know, that its long hollow Orange *Flowers* with *Aſh-like Leaves*, but deeper jagged, diſtinguiſh it from others of this Family. I take the two *Mexican* Tecomaxochit's *Recchi*, p. 408. & 409. to be of this *Species*, but neither of them this very Plant, altho' the laſt is ſomewhat like it, and Dr. *Plukenet* makes it the ſame. We have an old Tree of this of near 30 Years ſtanding, in *Chelſey Garden*, which of late has annually flowered with us. The *Mother Plant* of this, and the firſt in *England*, Mr. *Kilbank* has

formerly ſhewed me in the Lord *Roberts* his Garden againſt the *Ferry*, to whom both he and his *Father* were *Gardiners*.

88 *Virginia* Plane-tree. *Ray* 1707. Platanus *Occidentalis* aut *Virginenſis*. Park. 1427. Platanus *Occidentalis* pilulis minoribus *Herm.* H. Leyd. 499. Platanus *Novi Orbis* folijs *Veſpertiliorum* alas referentibus, globulis parvis *Alm. Bot.* 300. This differs from the *Oriental Plane* in having its *Leaves* hoary and leſs jagged, with *Fruit* ſmaller and not ſo rough. Mr. *John Tradeſcant* firſt brought this into *England* from *Virginia*, a little before the Year 1640. ſince which time it has been much increaſed, and makes a very Ornamental ſhady Tree, interſpers'd between *Horſe-Cheſtnuts* and *Limes*, to whoſe Magnitude it commonly grows.

III. *A Relation of an Hydropical Caſe, in which the Gall Bladder was diſtended to an unuſual bigneſs. By Mr* James Yonge, *F. R. S. Surgeon at* Plimouth.

MRs. *Dyer* was about 30 Years old, a Mother of ſeveral Children, and very healthful till laſt *January*; when, after frequent watching upon an extraordinary occaſion, ſhe was vexed with a Pain in her Belly, like the Cholick, but proved the Dropſey *Aſcites*; and grew ſo faſt in deſpite of all I could do to help it, that *March* the 9th, being almoſt ſuffocated, I was forc'd to tapp her by an hollow Needle in the uſual Place, and to repeat the Operation ſo often as ſhe filled: And by that way diſcharged the ſeveral Quantities of Water, at the times here under mentioned.

Pints.

		Pints.
March	9th I drew	9
	14	8
April	2	12
	16	10
May	17	14
	31	14
June	14	14
	24	14
July	7	17
	21	16
	30	16
Auguſt	6	14
	17	14
	26	13
Sept.	1, 6, & 22	11½
Octob.	1	3
	30	15
		214½

In the ſpace of Eight Months I drew Two hundred fourteen Pints and an half of Water. All the while I was pumping that out, I endeavour'd by all the means I could to ſtop the leak within, but in vain: She dy'd *November* 4. 1711. and opening her Belly, we found the following remarkable and incredible Things.

From the Belly iſſued 14 Pints of a greeniſh *Serum*, mixt with a very purulent Matter, not a little fetid.

The *Inteſtines*, eſpecially the *Colon*, almoſt every where Livid, and adher'd in many places to the *Peritonæum*, altho' they had been ſo long Immerſed in Water.

The *Omentum* was alſo black, and almoſt conſumed.

The *Liver*, which I expected to be indurated, was free of all Faults, only two Superficial Ulcers on the Left Lobe.

Both that and the *Peritonæum* (which are usually full of *Hydatides* in Dropsical Persons) were wholly free of them; but on the Stomach and Guts were many such.

But we were mightily surpriz'd, to find a great Bladder distended like that of an Ox, to fill up almost the whole Region of the *Liver* and *Ventricle*, and adhering to the adjicent Parts so firmly, that we could not separate them without difficulty, and get it out whole. Our surprize, at such a prodigious Appearance, turned into Astonishment, when we found it the *Gall Bladder*, and that by its Distention it had torn the *Liver* asunder; one part of which adhered to the Left side of this monstrous *Cystis*, and another part behind it, towards the Back; and both expanded with it, and fastened to it, like as the temporal Muscle to the *Scull*.

The whole weighed Ten Pounds and Twelve Ounces. It had no Passage to let out the Matter it contained, altho' we squeez'd it hard to that purpose; nor could we find any by Probes: So that we were forced to make way by a Knife, and so let out of it seven Pints of a black Liquor like *Coffee*; which having stood one Night in a Bason, near a Quart of thick yellow *Fæces* subsided.

The Liquor in this Bladder, and what we found in her Belly after her Death, added to what was evacuated before by *Paracentesis*, amounts to 235 Pints.

Besides the prodigious quantity of Matter which fill'd this great Bag, we found several pieces of Membranes like Gut, or Bladder cut into pieces: What it was, or how it came there, I can't Conjecture.

It was very wonderful, that during the whole time of her Sickness, she ejected by Urine near as much as she drank; and yet by Computation, she leaked into the *Abdomen* near a Pint every 24 Hours, from *March* to *November*.

When

When her Belly was near full, her Thighs and Legs uſed to ſwell, and grew diſcoloured like an approaching *Gangren*; but both went off after tapping, by the help of Friction, and a warm Lotion.

The Bladder, and adhering part of the Liver, is drying, to be ſent you by the firſt opportunity.

There were four of the Faculty preſent with me, who can teſtify the truth of this Report.

IV. *A Deſcription of the Head of a monſtrous Calf. In a Letter from the Reverend Mr.* John Craig, *Vicar of* Gillingham *in* Dorſetſhire, *to* William Burnet, *Eſq; F. R. S.*

SIR,

THE ſtrangeneſs of the following Relation will eaſily excuſe me for troubling you ſo ſoon with another Letter. A Butcher did (this Morning) bring me in the Head of a Calf (which he had taken out of a Cows Belly.) The Upper Jaw was divided into two halfs, as far as to the *Dura Mater*: Each half had a diſtinct Eye and Noſtril: And the Under Jaw was bent round ſo entirely, that it lay exactly between the two halfs of the Upper Jaw, making the Tongue lye upon the Forehead, about two Inches above the Teeth of the Under Jaw, and in the Fiſſure of the Upper Jaw. This Preternatural Diviſion of the Upper Jaw was not covered with Hair, but with a *Cutis* of a florid Colour. The Calf was come to its full time, and made great ſtruglings when the Butcher knock'd the Cow on the Head; which by ſome Symptoms they judg'd would have

See Fig. 6.

have dy'd in the Calving. It was ſo large a Calf, that an old experienc'd Butcher ſays, that he never ſaw but one ſo large at Calving: The Legs and Feet were as big as an ordinary Calf of 6 Weeks old. If the Butcher had had the Senſe to have opened the Cow immediately upon killing her, in all probability the Calf might have been ſaved alive. I have charged him, when he has done ſhowing it about, to let me have the opening of the Head, and then you ſhall have ſuch an account of the Brain, as my little Skill in Anatomy will afford.

Gillingham, March 25. 1712. *Yours,* J. CRAIG.

P. S. I had almoſt forgotten to tell you, that a full Week before the Cow was killed (upon apprehending that ſhe had a Dropſy) the Butcher cut a Hole in her Belly a little above the Udder, and thruſt in his Hand; but finding nothing extraordinary, ſowed up the Hole, and the Cow eat her Hay, and was as well as before.

March 26. This Afternoon the Butcher brought in the Calfs Head to me; and after we had cut the Skin (for there was no *Cranium*) that was expanded over the fore-part of the Cavity containing the Brains, I was ſurpriz'd to find, that there was very little Brains in it; I am ſure not ſo much as in a Rabbit: The whole Cavity is not big enough to hold an ordinary Walnut. This to me is the moſt ſurprizing *Phænomenon* of this monſtrous Head. The Butcher thruſting his Finger raſhly in, ſpoilt any Obſervation I could have made upon the Brains. I have made him cut all the Fleſh off, and hung up the Bones in their natural Poſition, *&c.*

V. *An Account of ſome Experiments touching the keeping of Fiſhes in Water under different Circumſtances. By Mr* Fr. Hauskbee, *F. R. S.*

THE Fiſhes made uſe of in the following Experiments were Gudgeons; which are a ſort of Fiſh very brisk and lively in the Water, and will live a pretty conſiderable time out of it. Three of them I put into a Glaſs Veſſel, to about three Pints of common Water (which Fiſhes were to be a ſtandard to compare the others by.) Into another Glaſs, to a like quantity of Water, I put three more of them, which quantity of Water juſt fill'd this Glaſs to the very Brim; upon which I ſcrew'd down a Braſs Plate with a Leather between, to prevent a Communication with the Water in the Glaſs and the External Air: And that it might the better reſemble a Pond of Water frozen over (on which account this Experiment was made) I ſuffer'd as little Air as poſſible to remain on the Surface of the included Water. The third Glaſs had a like quantity of Water put into it as the former; which Water, firſt by boyling, then by continuing it a whole Night in *Vacuo* on the Air Pump, was purg'd of its Air to the greateſt nicety: Into this Water alſo, I put a like number of Gudgeons as into the other. Thus (the Fiſhes being all put into their reſpective Receivers) I apply'd my ſelf to wait the Event; which was as follows. It was about half an Hour after Ten in the Morning when I began the Experiments; and in about half an Hour from that time, I obſerv'd the Fiſhes in the exhauſted Water, or Water purg'd of its Air, began to diſcover ſome uneaſineſs, by a more than ordinary Motion

Motion in their Mouths and Gills, or Reſpiration, if I may call it ſo, differing from the Fiſhes in the other Glaſſes; the included Fiſhes at the ſame time diſcovering no alteration; only I took notice that they would now and then aſcend to the top of the Water, but ſuddenly ſwim down again: And in this State they continued for ſome conſiderable time, without any ſenſible Alteration. About 5 Hours after the laſt Obſervation, the Fiſhes in the exhauſted Water became not ſo active (upon a Motion given the Glaſs that contain'd them) as before: And thoſe Gudgeons included without any Communication with the outward Air, now began conſiderably to abate of their Vivacy; yet ſtill continued at times their Motions upward and down again. At Seven in the Evening, the included Fiſhes lay all at the bottom of the Glaſs, with their Bellies upwards; nor upon ſhaking the Glaſs, could I put them in Motion, or cauſe them to ſtir their Fins or Tail; only I could obſerve a Motion in their Mouths, which ſhew'd me they were not perfectly dead. In this State they lay for ſome time: But conſidering the Experiment would not be compleat, if I did not attempt their Recovery by taking off the Braſs Cover, being very ſure they muſt have dy'd in ſome ſmall time under the Circumſtances they were then in, accordingly I took off the Cover, and gave the Surface of the Water a free and open Communication with the External Air. At about Ten at Night, I obſerv'd them again; at which time their Recovery was ſo evident, that upon a little diſturbing the Glaſs that contain'd them, they were actually in Motion again: And at this time alſo, the Fiſhes in the Water purg'd of Air, began to appear more brisk and lively than at the laſt Obſervation. Here I cannot but take notice, that notwithſtanding the Water was purg'd of its Air to a very great degree, yet the Fiſhes put into it did not ſo much as once aſcend in it; but continued always at the bottom

bottom, as the Fiſhes did in the common Water. At this time I left them till the next Morning; when about Eight a Clock I found them as perfectly well and lively in all the Glaſſes, as when they were firſt put in. Thoſe in the common Water expos'd to the open Air, ſuffer'd no manner of change during the whole time. After this I was willing to try whether the Air had again inſinuated itſelf into the purg'd Water, and whether that might not be the occaſion of the Fiſhes Recovery. Accordingly I put it on the Plate of my Pump, in the ſame Glaſs with the Fiſhes in it; and being cover'd with another Receiver, the Air was taken from it; yet I could perceive very little Air aſcend in it, and to me it ſeem'd to be much in the ſame State as when the Fiſhes were firſt put in. I continued it *in Vacuo* about an Hour and half; the Fiſhes almoſt all the time continued at the top of the Water, and at that time appeared as dead; for upon letting in the Air, they ſunk haſtily to the bottom, without any Motion of their Fins or Tails.

From the whole Account I obſerve;

Firſt, That Water purg'd of Air, ſo far as the Method here made uſe of, is capable to do it, renders it not altogether unfit to ſupport the Lives of Water Animals. For altho' when the Fiſhes were firſt put in, and for ſome Hours after, they ſeem'd to ſuffer ſome uneaſineſs; yet at length the Water became more familiar to them, or their Conſtitutions in ſome meaſure did ſo conform, as to render the Water to them, and them to the Water more agreeable: Otherwiſe I do not ſee how their Recovery ſhould follow, ſince upon examining, little or no alteration could be found in the Circumſtances of the Water, from the time the Fiſhes were firſt put in.

Secondly, The Fiſhes included with their Water from any Communication with the External Air, plainly demonſtrate, that common Water in its Natural State is

not alone ſufficient to preſerve the lives of its Natural Animals. Hence it follows, that in Ponds, when the Water comes to be frozen over with a pretty thick Ice, the Fiſhes in the ſaid Ponds are very likely, if not certain to periſh, upon the continuance of ſuch a Congelation for ſome time on their Surfaces; unleſs (as in the latter part of the Experiments) the Impediment, which hinder'd the immediate Contact of the Air to the Surface of the Water, be remov'd; that is, by breaking Holes in the Ice, whereby it is reſtored, and undoubtedly will perform the ſame thing as my Removal of the Braſs Plate. This is to be underſtood only in Ponds, where the Water is ſtagnant; for where there are Springs, or a current of Water conſtantly ſucceeding under the Ice, the effect moſt likely will not be the ſame.

VI. *Part of a Letter from Mr.* Patrick Blair *to Dr.* Hans Sloane, *R. S. Secr. Giving an Account of the* Asbeſtos, *or* Lapis Amiantus, *found in the the* High-lands *of* Scotland.

I Take leave to communicate the Relation of a Gentleman in the *High-lands*, not many Miles hence, who has lately built an Houſe of a ſingular kind of Stone, digg'd out of a Quarry not far from him. This Stone, after the Rubbiſh, which is not very deep, is done away, lyes Horizontally in a Bed endu'd with parallel Fibres, with few Interſtices, ſoft at the beginning, and eaſy to be ſmooth'd and poliſh'd without any Tool, but rather with Sand, or an other hard Stone of a blewiſh Colour, which afterwards hardens ſo, that it reſiſteth the injuries of Air or prejudice of Fire. When

firſt

firſt the Quarrier began to dig it, he was at a mighty loſs; for endeavouring to cut and raiſe it after the ordinary manner with Wedges, and other uſual Inſtruments, it broke and crumbled all to pieces: But afterwards, obſerving more narrowly the Duct of its Fibres, ſo to ſpeak, he endeavour'd to cut it with Spades lengthways; and by this means he procured Stones as big as he had a mind, which ſmoothed very eaſily along the Tract of their Fibres; but when cut tranſverſe, no Means nor Methods could render them ſmooth, but their Surface remain'd unequal as the Extremities of a piece of Wood. Although, as I ſaid, this Quarry has but few Interſtices, yet in thoſe it has the true *Asbeſtos*, of a whitiſh Silver Surface, conſiſting of ſeveral *faſciculi* with parallel Fibres, like to thoſe of the muſcular Fibres of ſalted Beef, eaſily ſeparable from each other, pure white, till it becomes ſo ſmall as the fineſt Flax, and ſo ductile, that it may be ſpun into the fineſt Thread, whereof it were eaſy to make the incombuſtible Cloth, ſo famous for Shrines among the Ancients. In other places of thoſe Interſtices, was likewiſe to be obſerved a reddiſh Subſtance, near to the colour of *Sanguis Draconis*; but whether Fibrous or not, I cannot inform you; ſince the Gentleman could not ſhew me any of it; but added, he believed it might be good for dying. I got a ſmall parcel of the *Asbeſtos* from him; and he told me, if he had known its value, he could have preſerv'd ſome Pounds of it. I am ready to think the ſecond kind was Fibrous too, which might make a very beautiful Cloath, being ſtriped with the other. The Quarry is at preſent full of Rubbiſh; but he tells me, he is to build again this enſuing Summer; and you may be aſſur'd, if any ſuch Subſtance be hereafter found, it ſhall be carefully preſerved. In a Word, this whole Quarry may be ſaid to be *Asbeſtos* of different Colours, the blueiſh being of a much courſer, and the white and red of

a

a finer Grain. I have been at the Gentlemans Houſe, of whom I have this Account, and you may look upon it as Authentick.

Coupar of *Angus*, *Tours*,
March 15. 1712. P. BLAIR.

VII. *The Dimenſions of ſome Human Bones, of an extraordinary Size, which were dug up near St.* Albans *in* Hertfordſhire. *Communicated by Mr.* W. Cheſelden, *Surgeon, F.R.S.*

THE Circumference of the Scull, according to its length, is 26 Inches; and according to its breadth, 23 Inches.

The greateſt Diameter of each *Os Innominatum*, is 12 Inches.

The Left *Os Femoris* is 24 Inches long, having only one (and that the great) *Trochanter*. The Right *Os Femoris* is 23 Inches long, having three *Trochanter* Proceſſes.

Each *Tibia* is 21 Inches long.

If all the Parts bore a due proportion, this Man muſt have been eight foot high.

Theſe Bones were found near an Urn, inſcrib'd *Marcus Antoninus*, in the Place of the *Roman* Camp near St. *Albans*.

LONDON: Printed for *H. Clements* at the *Half-Moon*, and *W. Innys* at the *Princes-Armes*, in St *Pauls Church-yard*; and *D. Brown* without *Temple-Bar*.


BRITISH MUSEUM
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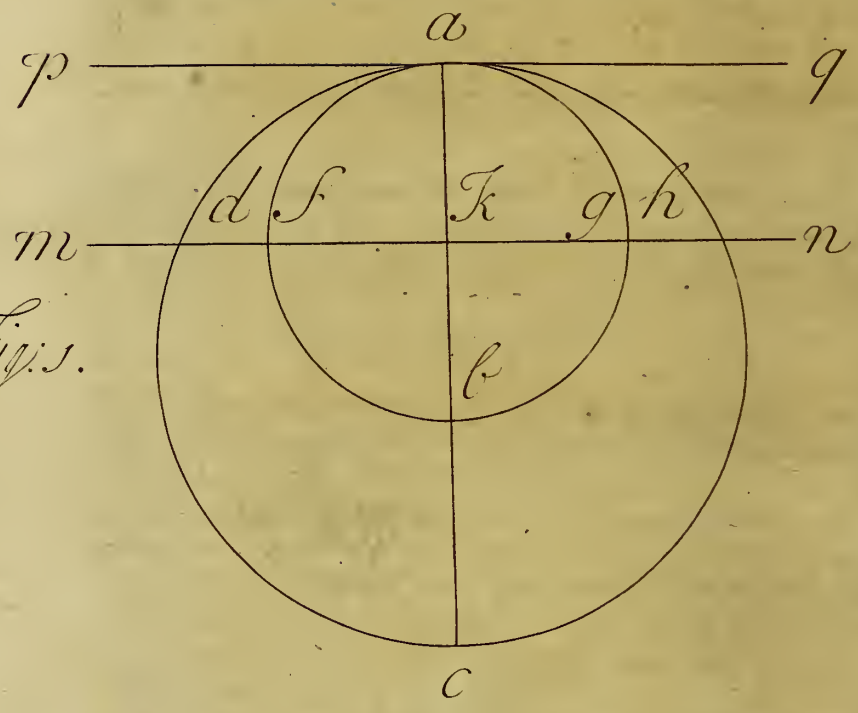

Fig. 1.

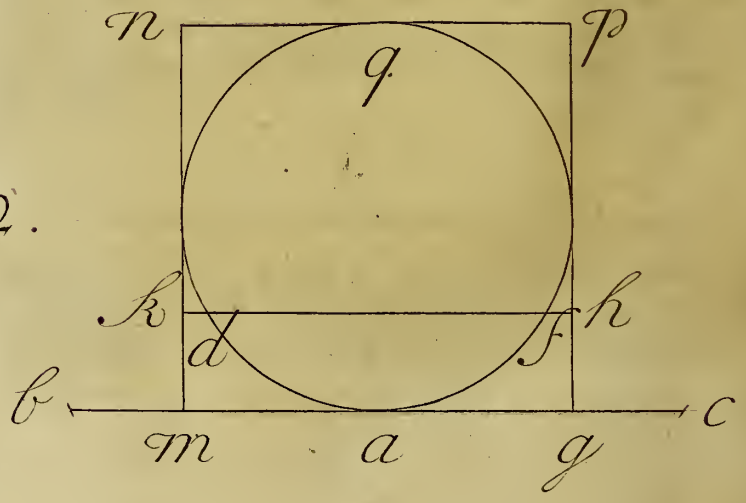

Fig. 2.

(Numb. 334.)

PHILOSOPHICAL TRANSACTIONS.

For the Months of April, May, *and* June, 1712.

The CONTENTS.

I. *A Letter from Mr* Anthony van Leeuwenhoek, *F.R.S. Containing his Obſervations upon the Seminal Veſſels, Muſcular Fibres, and Blood of Whales.*

Delft in *Holland*, March 1. 1712.

I Have formerly affirm'd, that the *Animalcula in Semine Maſculino* of a Horſe, and thoſe of a Dog, are of one and the ſame bigneſs; at leaſt, that they appear'd ſo to me thro' the Microſcope.

Since which time I have been very deſirous to obſerve the *Semen Maſculinum* of a Whale, in order to diſcover, if it were poſſible, whether the *Animalcula* in thoſe great Creatures did not proportionably exceed ſuch as I have diſcover'd in ſmaller Creatures.

Having therefore made an Acquaintance with one *Iſaac van Krimpen*, who had for many Years been concern'd in the Whale Fiſhery, as Commander of a *Greenland* Ship; and he being an obſerving Man, I intreated him that he would give me a piece of the *Penis* of a Whale, *viz.* of the thickeſt part of it, where it was joyn'd to the Body, in hopes that I might ſtill diſcover ſome of the *Animalcula* that were in the *Vaſa deferentia*.

The Captain accordingly help'd me to ſuch a piece; but in the hanging it up, and ſtretching and drying it, I believe the *Semen Maſculinum* was run out of it, becauſe he had hung up and dry'd that Member, in order to get Train Oyl out of it. Having open'd the *Vas Seminale* as well as I could, for it was very much dry'd up, and ſcraped off a little of the Matter that was in it with

with a ſmall Knife, I mix'd it with a little Rain Water, in order to ſeparate the Parts from one another: Whereupon I obſerv'd in the ſaid Matter a great number of long four-ſided Particles, moſt of them having 4 Right Angles, but of different ſizes, and many of 'em were three times as long as they were broad; but I ſaw none of 'em ſo broad as the Diameter of the Hair of a Man's Head, and the ſmalleſt was a hundred times leſs, in ſome few of which I could perceive no thickneſs.

All the ſaid Particles, or little Figures, were as clear as Cryſtal, ſo that I concluded that they were fix'd Salts; and the rather, becauſe they were ſo hard, that they were not diſſolv'd in the Water. And when this Matter, which I had ſcrap'd out of the Veſſels of the Whales *Penis*, had lain a little longer in the Water, I diſcover'd Salt Particles; the two longeſt ſides of which run parallel to each other, but the two ſhorteſt Sides oblique; ſo that one end of 'em had a ſharp, and the other an obtuſe Angle: And tho' the Salt Particles had lain at leaſt a Week in Water that was frozen, and the ſame Water afterwards diſſolv'd, yet I ſaw the Salts floating in it.

As many Obſervations as I made, I could not diſcover the leaſt Particle that bore any reſemblance to the *Animalcula in Semine Maſculino*.

The ſaid Captain having inform'd me, that the Teſticles of a Whale are as big as a Firkin of Butter that weighs about a hundred Weight, I intreated him the next Whale he took, to cut off the *Vaſa Semen deferentia* as near the Teſticles as he could, and to lay them a drying upon a Plank, or to let the Surgeon do it, whom they have always on board, and who is fitteſt for ſuch a work; for by that means I hop'd to diſcover the *Animalcula* therein: But as yet my Requeſt has not been comply'd with.

The

The ſame Perſon told me, that he had never found but one young Whale in the Belly of the Mother, and that was in a Whale which he had taken; the Body of which burſting open ſome Days afterwards, there came out a young Whale that was Fifteen Foot long; but he could not tell, whether they were Feet conſiſting of Eleven, or of Twelve Inches.

About two Years ago there came a Stranger to me, who had two *Penis's* of the Whale Fiſh; and I took the liberty to ask him of what uſe thoſe Members were; but he made me no other Anſwer, than that they were uſed in Phyſick. Soon after came the aforeſaid Captain to me, and preſented me with ſome Slices of a Whale's *Penis*; adding, that a little of it grated, or cut into ſmall Pieces, and boil'd in Milk or Beer, was very good againſt the *Bloody Flux*, and that a Neighbour of his, who had been ill of that Diſtemper a whole Year, was cur'd by the ſame Medicine.

The ſaid Captain told me alſo, that the Female of a Whale (on the ſide of the *Uterus*, but a little nearer its Tail) has two Nipples, or Teats, which yield Milk, and that he had drank thereof; and he ſhow'd me the Teats, the Diameter of one of which was no more than an Inch and a half, and it was two Inches long, but it was dry'd hard.

I intreated the Captain when he return'd again to the Whale-fiſhing, to bring me ſome of the Fleſh of a Whale that had been dry'd in the Air; becauſe that which had been provided for me before, ſtunk very much, and was almoſt rotted, and ſo was not fit for my purpoſe.

He brought me two pieces of hard-dry'd Fleſh, of the length of a Span, and of the thickneſs of ones largeſt Finger. They were as black as Pitch; but, as he ſays, when the Fleſh was cut off, it was red. From the blackneſs of it I concluded, that the Blood was of a deep or dark Red; which the Captain alſo confirm'd; adding, that where the Blood fell, it left a Stain.

I cut through the Fleſh both croſs and length-ways, in order to diſcover the thickneſs of its Particles; and after I had cut thin Scales a-croſs, they appear'd of a bright red Colour; but when I cut them thicker, they were of a dark Red; and when very thick, they were blackiſh. In this Operation I obſerv'd, that the ſmall Fleſhy Muſcles were ſurrounded with very thin Fibrous Particles, that look'd like little Membranes torn to pieces: And upon ſeveral Parts of theſe little Membranes, there lay Fat, which, when there is a quantity of it together, they call the Train; and theſe Train Particles lay preſſed together in the ſame manner as I have formerly deſcribed thoſe of an Oxe; nor were they bigger than the Particles of the Fat of an Oxe; and many of theſe Particles were like melted Fat; inſomuch, that when I ſqueez'd the Fleſh, the Fat came out at the end of it.

I laid a ſmall part of this Fleſh, after that I had cut it into little pieces, in Water; and I obſerv'd that the Fleſh was thinner when it was dry, than when it was ſoak'd through: and in comparing the Fleſh of a Whale with the Fleſh of an Oxe, I judged that the Particles of the former were finer than thoſe of the latter.

Now, in order to demonſtrate the fineneſs or ſlenderneſs of the Parts of the Fleſh, length-ways, of ſo great a Creature as the Whale is (for this was above 50 Foot long) I placed one of the Hairs of my Beard by one of the Fleſh Particles of the Whale, and I judg'd that the ſaid Hair was at leaſt Nine times thicker than one of thoſe which I may call a little Fleſh Muſcle, it being again compoſed of other long Particles or Fibres.

I could not aſcribe either a round or Sexangular Figure to theſe little Fleſh Muſcles of the Whale, becauſe they lay ſo compreſs'd in one another, that they appear'd in ſeveral Shapes, but moſt of 'em were incli-

ning to a Sexangular: And when I view'd them more curiouſly at their ends, I obſerv'd for the moſt part that one Fleſh Particle was wrapt up in ſix others, but not regularly, for one took up more place than another; inſomuch, that ſometimes the outward Fleſh Particle did not touch the inward but in one point.

When I cut the afore-mention'd long ſlender Fleſh Particles, either acroſs or obliquely with a ſharp Knife, I could ſee therein a vaſt number of exceeding ſmall Particles, of which one of thoſe Fleſh Particles did conſiſt, and they were alſo cut a-croſs: And through the Microſcope it appear'd to me juſt as if one ſhould ſee with the naked Eye ſmall Grains of Sand lying upon them; and I alſo could diſcover the ends of them. In theſe my Obſervations there appear'd to me a great many Fleſh Particles, ſurrounded with little Figures like Rings, and very cloſe to one another, juſt as if you ſhould take a common Iron Wire, and twiſt it about with another very fine one: And ſuch circular Fleſh Particles have I formerly obſerv'd in the Muſcular part of the Paw or Foot of an Gnat; but the Rings were cloſer to one another in the Fleſh Particles of a Whale, than in thoſe of a Gnat; and if I remember right, the Fleſh Particles (or Fibres) of a Gnat, were as thick as thoſe of a Whale. How wonderful are ſuch Contextures!

From the ſaid Obſervations one may more firmly conclude, that when the Muſcles are ſtretch'd out, the Fleſh Particles have no Wrinkles; and that when they lye in their natural Poſition, then the Fleſh Particles have Wrinkles

I was above meaſure aſtoniſh'd at theſe my Obſervations, having always imagin'd, that the Fleſh Particles of very great Creatures, ſuch as the Whale is, ſhould have been compoſed of greater Parts, in proportion, than others.

In

In theſe Diſcoveries it was very remarkable, that each of the before-mention'd long Fleſh Particles appear'd to me as if they were wrapt about with a little thin Membrane, which I obſerv'd in a thouſand ſeveral Places; and the more eaſily, becauſe as the Fleſh Particles grew dryer, theſe fine Skins or Membranes were ſeparated from them.

The afore-mention'd Captain acquainted me, that the Whale has three diſtinct Skins; the uppermoſt of which is very thin, and the next to that is as ſoft as Velvet; but the third and undermoſt is a thick Skin, which we call the *Sward*, and is like the Skin of a Hog. Soon after he gave me a little piece of the firſt Skin, which he ſaid was eaſily ſeparated from the ſecond; it was no thicker than a Leaf of Writing Paper. Having view'd that Skin thro' a Microſcope, I judg'd it to be compoſed of ſuch flattiſh Particles as I can call by no other Name than little Scales, and which were no bigger than the little Scales of which our own outmoſt Skin is compos'd: But whereas the Scales of our Skin are very eaſily ſeparated, and eſpecially the uppermoſt Scales, which are ſhed or caſt often, the little Scales of the Skin of the Whale are firmly united together.

When I came to conſider the aforeſaid Skin, with regard to its thickneſs, I judg'd it to be compoſed of not fewer than four Skins, lying upon each other: But when I view'd the ſame more nicely, I diſcover'd, that there were at leaſt twenty Skins upon one another; all which were compoſed of little Scales, and of exceeding ſmall Particles that lay ſcatter'd under thoſe Scales; but as carefully as I examin'd the ſaid Skin, I could not diſcover in it the leaſt Fibres or Veſſels.

From theſe Obſervations I concluded, that the aforeſaid uppermoſt Skin was ſeparated of itſelf from the reſt; which the Captain alſo confirm'd; adding moreover, that he gave but one cut or ſlit in the uppermoſt

Skin, and then twiſting it about a round Stick of Wood, it came very eaſily off from the ſecond Skin.

In ſeveral of my Obſervations I did diſcover, that there were a great many Salt Particles, moſt of them of the Colour of Aſhes, ſhut up in the outmoſt Skin; but I ſeparated them from it by Rain Water. Theſe Salt Particles were twice as long as they were thick, having each of them four Right Angles; they lay coagulated in a very clear thin Liquor, which did not evaporate or melt away in rainy Weather: From whence I concluded, that they were nothing but common Sea Salt.

Moreover, I obſerv'd a great number of very ſmall Salt Particles, that were about as long as the former, but exceeding ſlender.

I got alſo a piece of the ſecond Skin of a Whale, about as broad as my Hand, which was as black as Pitch, and had four or five Protuberances or Bumps on it, that were about as big as the third part of a Pea; and which, I was told, were occaſion'd by the biting of the Lice, of which there were great Numbers upon the Whales Body.

This Skin was dry'd hard, and was almoſt half an Inch thick; but it was not ſtrong, becauſe there were no Veſſels or Sinewy Fibres running through each other, as in the Skins of Beaſts and our common Fiſh; only there were ſome ſmall Fibres that joyn'd it a little to the Skin that lay under, and which paſs'd, as it were, in a Right Line to the uppermoſt Superficies of the Skin. Theſe Strings, or Fibres, were ſo cloſe to one another, that there was not above the breadth of two or three Hairs between them; they were tranſparent or whitiſh, and in one of them I could diſcover a Blood Veſſel.

The undermoſt, or third Skin, was whitiſh, and ſo ſtrong withal, that I concluded, that in caſe the Harping Iron was ſtruck ſo deep into the Whale, that the Beard or Hooks thereof did penetrate into the afore-

ſaid

ſaid white or third Skin, it would keep its hold; but if it went no farther than into the black Skin, it would eaſily be torn out.

I have done my utmoſt Endeavour to diſcover the Parts of the aforeſaid black Skin, but could not do it to my Satisfaction; for when I cut it very thin, I judg'd it to be full of a great many ſmall Pores or Openings, and that upon this account it was not ſo heavy as I ſuppoſed a cloſe ſolid Body ought to be; and I ſaw in it little black ſpots ſtanding ſo near one another, that you could hardly thruſt a Hair between; and theſe Spots were the cauſe of its being lighter. So have I obſerv'd in the Skins of Beaſts, in many places, between the Parts of which the Skin is compoſed, a great number of little Globules, which I found to be Fat; but in the aforeſaid Skin I could diſcover no Fat; which appear'd very ſtrange to me, becauſe it is well known, that Whales have 10, 14, 15, or more Inches thickneſs of Fat (which they call Bacon) under the third Skin.

Moreover I obſerv'd, that the black Skin was clammy, or Glutinous, when it was wet; from whence I concluded, that People might draw a very good Glue from it.

From the black Skin and black Blood of a Whale, I turn'd my Thoughts to the black Blood of a Salmon; and ſuppoſed, that the redneſs of the Fleſh of that Creature, was alone occaſion'd by the blackneſs of its Blood; and that in like manner the blackneſs of the Fleſh of Whales proceeded from the ſame Cauſe.

From hence I was conſidering, whether the blackneſs of the Men upon the Coaſt of *Guinea*, might not alſo proceed from their black Blood; and whether alſo their Fleſh might not be blacker than that of white Men, and that the blackneſs of their Skin alone depended upon

To ſhew that the Colours in this *Spectrum* were ſimple and homogeneal Lights, I made the following Experiments.

EXPERIMENT IX.

Having made an Hole *h* in the Paper which receiv'd the colour'd *Spectrum*, I ſuffer'd the red Light to paſs; which being refracted by a ſecond Priſm, fell upon another Paper at *T*, where it appear'd ſtill Red whether ſeen with the naked Eye or Priſms of different refracting Angles. To the Eye which ſaw it thro' the Priſm *V*, it appear'd indeed lower as at *t*, but red, round and unchang'd. I made the Experiment upon all the Colours, which by this means appear'd to be ſimple and homogeneal. See *Fig.* 22. Where the ſame Letters denote the Lens, Priſm and firſt Paper.

Thro' the ſame Lens and Priſm the *Spectrum* was made to fall on a Book; then thro' the Priſm *F* it appear'd unchang'd; and the Letters in the Book which croſs'd the *Spectrum*, were as diſtinct as when ſeen with the naked Eye. See *Fig.* 23.

N. B. The Axis of the Priſm *F* ought to be perpendicular to the long Axis of the *Spectrum s m* thrown on the Book, which will appear as at $\sigma\mu$; and the Priſm in the Poſition repreſented at *F*, with its flat Side towards the Noſe: for that is the moſt convenient Poſition for looking at the *Spectrum* in theſe Experiments.

I ſuffer'd the purple Ray only to paſs thro' the Hole *h* and fall upon a Book at *P*, the Letters of which appear'd at π, and were as diſtinct thro' the Priſm *Q* as when ſeen with the naked Eye: and I had the ſame Succeſs with all the other Rays. See *Fig* 24.

But if a Sun-Beam as *r* comes thro' the Hole *H* directly upon the Book at *W*, an Eye looking at it thro' a Priſm

at

at *X* will ſee this Beam at *T* oblong and colour'd, and the Letters on which it falls, confus'd. See *Fig.* 24.

N. B. The Lens ought to be very good, without Veins or Blebs, and ground to no leſs a Radius than I mention'd in the Experiment; tho' a Radius of a Foot or two longer is not amiſs. The Priſm ought to be of the ſame Glaſs as the Object-Glaſſes of Teleſcopes, the white Glaſs, of which Priſms are uſually made, being commonly full of Veins. And the Room in theſe laſt Experiments ought to be very dark.

A few Days after, having got very good Priſms made for the purpoſe of the above mention'd Glaſs, I made all the Experiments over again before ſeveral Members of the *Royal Society* with better Succeſs; and had the *Spectrum* very regularly terminated, without any pale Light darting from the Ends of it.

For a further Account of Experiments to this purpoſe, ſee Sir Iſaac Newton's Opticks. B. 1. Part. 1. to which I might have referr'd the Reader altogether; but that I was willing to be particular in mentioning ſuch things as ought to be avoided in making the Experiments above-mention'd; ſome Gentlemen abroad having complained that they had not found the Experiments anſwer, for want of ſufficient Directions in Sir *Iſaac Newton*'s *Opticks*; tho' I had no other Directions than what I found there.

III.

Quantum itaq; in me eſt reſumo calamum, indicaturus Tibi, Vir Celeberrime, quænam ſub manibus habeam in jucundiſſimo utiliſſimoq; Hiſt. Naturalis Studio publicanda; quæ ſi approbatione Tuâ digna fuerint, mihi ſummopere gratulabor. Ut enim nihil jam dicam de Boruſſiæ vel potius Pomerelliæ Viridario, quod in tempus magis commodum, ſi Deo placuerit vitam, ſanitatem, quæ mihi ſatis fragilis, & pacem largiri, differo; nunc occupor Opere ad prælum parando, cui ſequens erit Rubrica:

Icones Breynianæ
Rariorum & Exoticarum Plantarum,
partim in Centuria & Prodromis
Jacobi Breynii Gedanenſis
contentæ;
partim verò novæ nunc editæ
à
Joh. Philippo Breynio, Jac. Fil. M. D.
adjunctis
Contractis earundem Plantarum Deſcriptionibus,
Illuſtrationibus Notuliſq; perutilibus.

Continebit ſcilicet ultra Icones Paternas Centuriæ & Prodromorum, plus quam viginti Tabulas, partim novas Plantas, imprimis Officinales, partim etiam deſcriptarum partes eſſentiales, flores & fructus puta, omiſſas & ignotas hactenus complectentes. Cauſa hujus Propoſiti fuerunt multi ex clariſſimis Botanicis, qui in peregrinationibus meis partim Ore tenus ſuaſerunt, partim Literis compellarunt, ut Novam Paternorum Operum Editionem adornarem cum meis additamentis, quorum ego petitioni deeſſe nolui, nec debui.

Præterea penes me eſt Additamentum ad Floram Pruſſicam ante annos aliquot à D. D. Gottſched editam, à Reverendo admodum D°. M. Helwing Angersburgenſium Eccleſiæ

Ecclesiæ Pastore adornatum Nomine *Floræ Quasimodogenitæ*, trecentas circiter continens Plantas indigenas, quarum nulla in supra laudata Flora fit mentio; quod etiam cum Auctoris venia correctum cum mea præfatione brevi publici Juris faciam. Cæterùm in Historia Nat. nihil in nostris regionibus prodiit notatu dignum; quid in Britannia Vestra verò bonarum Literarum & Artium Asylo circa hanc Materiam agatur, discere aveo.

Nunc restat adhuc ut rariorem Literis hisce addam aliquam Observationem; cùm verò portiunculam Itineris mei Anni 1703. Vobiscum jam communicaverim, quam Transactionibus Vestris de Anno 1705. Mens. Jul. inserere libuit, telam jam exorsam continuare malo, quòd eam Illustri Regiæ Societati non ingratam fuisse ex Literis Tuis acceptissimis intellexerim. Nec me ab hoc proposito dererret Excellentissimi Viri D. Christiani Henrici Erndh, Med. Doct. & Medici Aulici h. t. Sereniss. Polon. Regis Dignissimi Exemplum. Hic enim anno elapso edidit Relationem quandam succinctam de Itinere suo Anglicano & Batavo Annis 1706. & 1707. facto, in qua variæ Observationes Rem Medicam præsertim spectantes, & Celeberrimi Nominis Tui & aliorum mentio honorifica inveniuntur. Huic se publico Scripto quadam malignitatis & rancoris macula asperso opposuit quidam ficto Jani Gregorii Betulii Nomine, cujus verum Nomen detegitur *dans les Nouvelles dela Republique des Lettres* Anno 1710. Mens. Novembr. Hic certò admodum indignè Optimum Virum meliùs de Republ. Literaria meritum tractavit; sed apparebit brevi nova & emendata hujus Relationis Editio in Belgio, cum Præfatione, in qua malignas Adversarii sui Animadversiones refutaturus est Auctor. Non me inquam à Proposito memoratum deterret exemplum; non enim Malevolorum obtrectatiunculas moror, si ad palatum vestrum fuerint,

quas traditurus sum, Observationes præsertim circa Rem Medicam & Naturalem minùs obviæ in Itineribus meis factæ.

Faciam initium à Portu Liburno, in quo post longam, præ Æolo minùs cursui nostro favente, navigationem Maris pertæsus, Sanus tamen Dei gr. tandem ipsis Octobris Calendis Anni 1703 appuli; ubi Neptuno valedicens mox me in littus contuli, quod mihi inter alias rariores Plantas contemplandas mox offerebat

Crithmum maritimum, fl. Asteris Attici, C. B. Pin.
Kali geniculatum majus, C. B. Pin.
Kali minus album semine splendente, C. B. Pin.
Gramen dactylum Ægyptiacum, C. B. Pin. Gramen Crucis, s. Neiemelmsalib, J. B.

Urbs in planitie sita ad maris littora, montibus utrinq; elatis, ut ut non admodum ampla, Emporium tamen elegans & probè munitum. Aer non admodum salubris, & Tertiana duplex, quæ hîc difficilioris curationis, frequens mihi narrabatur. Itaq; quia Palladem hic Mercurio cedere intellexeram, post octiduanam quietem, Pisam aliquot milliaribus Liburno distantem, cum quodam ex conterraneis meis Itineris Socio profectus sum. Iter erat amœnissimum, per planam fertilemq; terram, interpositis sæpius Nemoribus Quercu, Ilice, & Subere, ut & Myrto frequentibus.

Pisa quondam Resp. & elegans Civitas, nunc M. Hetruriæ Duci subjecta ordine secunda, multum de pristino splendore ac hominum copia, quod vulgo notum est, amisit. Plurima hic sunt, quæ inspectionem merentur, quæ, cùm in aliis Itinerariis & Topographis exstent, sicco pede transeo. Literas Systaticas habebam ad Clariss. Mich. Angelum Tilli, Doct. & Professorem Med. & Botanices in Universitate Pisana, cujus, cùm ob ferias tunc

Flo-

Florentiæ degeret, vices mihi ſupplebat ipſius Frater, J. U. D. & Subcancellarius, Vir, ut ſolent Itali, erga exteros humaniſſimus. Univerſitas fuit quondam hîc celebrior, quàm quidem hoc tempore. Quatuor habet Collegia Oxonienſibus nequaquam æquiparanda: quorum primum dicitur Collegium Sapientiæ; ſecundum eſt Collegium Ferdinandi, à Ferdinando I. M. H. D. Anno 1595. extructum in loco, ubi erant Ædes Bartholi famoſiſſimi J. C. ut docet Inſcriptio; tertium Puteanum, à Puteo Epiſcopo Nomen gerens, Anno 1605. erectum. Sed præſentibus feriis omnes Scholæ clauſæ erant, ipſis Novembris Calendis recludendæ. Hortus Botanicus Piſanus Rei Herbariæ Profeſſoribus ſatis notus à Coſmo I. M. Hetr. Duce Anno 1547. ſeptennio ſc. poſt Patavinum, qui primus fuit, inſtitutus eſt, eiq; præfectus Lucas Ghinus (teſte Caſtello in Opt. Med.) cui ſucceſſit Botanicorum ſui ævi Princeps nunquam ſatis laudandus Andreas Cæſalpinus. Citatus Lucas Ghinus, à Jo. Antonio Bumaldo (quo ficto Nomine Ovidius Montalbanus anagrammaticè latet) in ſua Bibliotheca Botanica primus Hortorum publicorum Academicorum Fundator dicitur. Ædes autem Horto adjacentes, in quibus plurima rariora Naturalia & Artificialia ſervantur, Ferdinandum I. Fundatorem agnoſcunt Anno 1595. ut Inſcriptio in portæ limine teſtatur. Antequam ad Hortum itur in atrio multa Balænæ oſſa repoſita videntur; in parte ſuperiore verò Gazophylacium rerum Naturalium & Artificialium bono ordine digeſtarum: Per aream ubi pergimus ad alteram Ædificii partem ad Horti Introitum ſitam accedimus, in cujus porticu variæ Effigies, ut Cæſalpini, Cluſii, Caſauboni, Matthioli, Ponæ, &c. in perpetuam Clariſſimorum Botanicorum Medicorumq; memoriam ſuſpenſæ ex parietibus ſpectantur. In ſuperioribus conclavibus Antlia habetur pneumatica major cum aliis quibuſdem Inſtrumentis Phyſicis, ut & Furni cum ſuis Chemicis Inſtrumentis. Hortus ipſe ſatis ſpatioſus eſt, non tamen exquiſitè cultus, quem Hortulanus

tulanus ſenex 1500 Plantarum, ſed nullo fere ordine diſpoſitarum, ſpecies alere mihi affirmabat. Interim rariores quaſdam videbam alibi non obſervatas; imprimis oculum & animum meum delectabant

Palma Dactylifera trium ferme virorum altitudine, fructibus onuſta, qui rarò hic plenam maturitatem aſſequuntur.

Myrtus latifolia Bœtica ſecunda, vel foliis laurinis confertim naſcentibus, C. B. Pin. Arbor hæc in nullis aliis Hortis à me viſa, ſi arbor dicenda eſt, quæ multis ſtipitibus ex ſolo exſurgit ad duorum virorum altitudinem; Folia habet Aurantio Sinenſi, Ferrarii, ſimillima; Fructibus referta erat majoribus ex nigro cæſiis. Hortulanus Africanam eſſe aiebat.

Styrax folio Mali Cotonei, C. B. Pin. procera arbor fructibus maturis ornata.

Ilex aculeata cocciglandifera, C. B. Pin. magnitudine ſpectabilis.

Hujus Horti Catalogum quondam edidit Thomas Belluccius ejuſdem Horti Præfectus & Botanices Prof. Ord. Impreſſus eſt Florentiæ 1662. in 12mo.

Aquæductus Piſanus, qui limpidiſſimam aquam per 5 Milliaria Italica ad urbem ducit, viſu dignus eſt, antiquus & temporis injurias ferens.

De famoſa illa Turri inclinata hic ſaltem monendum duxi, ejus fundamentum in illo latere in quo inclinatur, mox in vel poſt erectionem ſubſediſſe, hincq; ſitum illum inclinatum, adeo decantatum, turrim, præter Architecti intentionem, acquiſiviſſe, quod facile examinanti patet.

Elapſis aliquot diebus relicta Piſa, Lucam iter aggreſſus, primò tranſivi planitiem ſatis fertilem, & ob agros Moro, Lauro, Populo, Ficu, &c. cum annexa Vite circumdatos viſu jucundam. Poſtea tranſcendendus erat Mons Sti. Juliani, ob Thymbram Montis Sti. Juliani dictam non ignotus, altus & petroſus, rarioribus nihilominus plantis ornatus; in tranſitu præter dictam Thymbram

varias

varias obſervabam Ciſti tam Ledi, quàm Mariſ, & Myrti ſpecies, Lentiſcum, nec non Ericæ & Sedi ſpecies aliquot. Ad montis pedem Lucenſium incipit Juriſdictio, in qua mox ſeſe Oculis noſtris offerebant Oleæ olivis, quæ inter optimas numerantur, Caſtaneæ etiam, Arbutus & Terebinthus fructibus onuſtæ maturis. Tandem nova & fertilis planities vineis abundans ad Lucam uſq; Caput Reipubl. ſatis notæ. In hac parum quod Medicinam vel Hiſt. Nat. concernit vidi ſingulare. Hoc ſaltem obſervandum, me in hac Ditione, ut & in Hetruria, quamplurimos notaſſe agros Lupino vulgari ſemine albo, quo cocto homines veſcuntur, conſitos. Cæterùm ibidem & Cicores, Milium, Sorgum, & Panicum in agris partim pro hominum, partim verò pro columbarum aliarumq; avium uſu coluntur.

Hinc per Piſtoriam ad Hetruriæ Metropolin Florentiam iter meum direxi, ubi 17. Octobr. appuli. Innumera habet ampla hæc & elegans Civitas viſu digniſſima, ab aliis, imprimis in Libello, cui titulus, *Riſtretto delle Coſe più Notabili della Città di Firenze*, recenſita, inter quæ Gazophylacium M. Ducis, quod *Galeria* appellatur, prætioſiſſimarum rerum arte factarum magno apparatu refertum, & ſplendidiſſimum Sti. Laurentii Sacellum M. Hetr. Ducum Sepulturæ dicatum, nec dum perfectum, quibus cultiſſimos M. Ducis Hortos addas, facile primas tenent.

Maxima tunc temporis Florentiæ ornamenta erant Celeberrimi per totam Europam Viri Laurentius Bellini & Antonius Magliabechi. Ille M. Ducis Archiater, in Medicina, imprimis Theoretica ejus parte, quod variæ ejus teſtantur Lucubrationes editæ affatim, verſatiſſimus, & verè magnus Vir, in Praxi tamen (quod ſæpius etiam in aliis obſervatum eſt) non adeo felix, me ultra morem, cùm ſe aliis difficiliorem habeat, accepit quam humaniſſime. Vir eſt parvæ ſtaturæ, ſexagenarius, variis morbis fractus, ſiniſtri oculi à quinq; jam annis Catarrhactâ laborans.

Cum

Cum hoc de variis rebus Medicis mihi erat Sermo. Nihil ſtatuebat eſſe in Medicina, quod ingenio & ſtudio non poſſit expiſcari, cùm omnia ſecundùm leges Mechanicas fiant, præter minimarum particularum & Elementorum figuras, hancq; eſſe rationem, cur Medicina nunquam ad perfectionis culmen perventura ſit. Aquæ Tetuzzianæ in Dyſenteriæ curatione adeo decantatæ ſcaturiginem prope Piſtoriam eſſe, me docebat, eamq; continere Salem marinum ſive commune, & purgandi vi præditam eſſe; hinc pauperibus aliquando Salem marinum in Aqua fontana ſolutum propinari ſimili, licet non ſemper æquè felici cum ſucceſſu. Multa ſe chartis commiſiſſe affirmabat, lucem publicam fortè nunquam viſura. Ab annis jam aliquot ſæpius vacavit Muſicæ & Poeſi, quas perditè ſe amare aiebat, continuis Meditationibus diſtractus. De hujus Viri morbo & morte in ſequentibus dicam.

Alter Antonius Magliabechi, M. Ducis ejuſq Fratris t. t. Cardinalis Bibliothecarius, in Librorum cujuſcunq; generis cognitione ad ſtuporem verſatus, unde eum non immeritò Vivam à Sereniſſimo Duce Bibliothecam ſalutari tradunt. Vir hic erga exteros humaniſſimus eſt, quod ipſe ſatis ſuperq; expertus ſum, cùm prima ſaltem vice ipſum in inſtructiſſima Bibliotheca Cardinalis, quæ in ſupremi Principis Palatio ſervatur, ſalutarem, ubi de variis libris me inſtruxit quàm lubentiſſimè. Inter Libros Medicos, ut & Hiſt. Nat. Scriptores, quorum magnus adeſt numerus, eminebat ſpiſſum Volumen in regali forma, vivas Plantarum Icones artificioſe ſuis coloribus expreſſas, additis Nominibus manuſcriptis, continens, cui Titulus: *Viridarium Botanicum, in quo Arborum, Fruticum, Suffruticum, Stirpium, & plurimarum Plantarum tam indigenarum, quàm exoticarum Species lætè virentes perennantur; quas è diverſis locis collegit & delineavit, coloribus naturam imitantibus pinxit, & celebrium Botanicorum Nominibus diſtinxit Joſephus Baldius, Medicus, Phyſicus, Civis Florentinus, Academicus Apatiſta* 1650.

Poſt-

Poſtmodum toties miratus ſum, quoties vidi Celeberrimum Virum, præſertim in ædibus propriis, in quibus vix locum invenies, qui Libris repletus non ſit; adeo, ut, qui Libros ejus Elementum vocat, in quo degit, non à vero aberret.

Inter Bibliothecas, quæ pulcherrimam hanc urbem etiam Doctis commendant, non ultima eſt quæ Sti. Laurentii dicitur à Templo adjacente homonymo. Hæc non minus ob elegantem Architecturam, quam famoſiſſimo Michaeli Angelo Bonarotio debet, quàm imprimis ab inſignia in omni Facultate MSS. ex quibus tota ferme conſtat, ferreis catenis uti in Bodleana Oxonienſium alligata, commendabilis. Inter Medica mihi maximè notabile videbatur vetus aliquot MS. in Folio in membrana exaratum, cum figuris vivis coloribus expreſſis ad luxationes præſertim pertinentibus, ſequenti titulo: *Chirurgia Hippocratis, Galeni, Oribaſii, Heliodori, Aſclepiadis Bithynii, Archigenis, Dioclis, Amyntæ, Apollonii Ther. Nymphodori, Ruffi Epheſii, Apollonii Citienſis, Sorani, Pauli Æginetæ, Palladii.* Hoc MS. ut me D. Magliabechi certiorem fecit, tranſcripſit Jacobus Tollius, poſt cujus mortem eo jam potitur Hainius Profeſſor Dusburgenſis illud propediem publicaturus. Hîc & Dioſcoridis codex MS. aſſervatur, in charta ſcriptus, qui tamen non admodum antiquus videtur.

Imprimis grata mihi hic fuit converſatio cum admodum Rev. Patre Brunone Tozzi, Monacho Valombroſano, cui ab Illuſtri Viro, D. Wilhelmo Sherard, J. U. D. Nationis Anglicanæ Smirnæ Conſuli meritiſſimo, Botanicorum Principe, quem ſe brevi ut ſpero operoſiſſimo Opere, Caſpari Bauhini ſcilicet Pinace correcto & ad hæc uſq; tempora continuato, ad quod ſolus Sherardus ſufficit, integro Orbi ulteriùs demonſtrabit, uti omnibus ferme Italiæ Botanicis, commendatus eram. Sanè vix me temperare poſſum, ubi Clariſſimi hujus Viri optimè de me meriti mentionem injicio, quin in effuſiſſimas ejus

effundar

effundor Laudes, nisi nota mihi esset ipsius, quam habet, Fama cum Modestia conjuncta. Sed ut ad D. Brunonem Tozzi redeam, ejus sanè humanitatem & in Botanicis peritiam satis deprædicare nequeo. Incredibilis est ejus in inquirendis Plantis diligentia, quam ob rem singulis annis Hetruscas Alpes perreptat, Plantasq; collectas propria manu vivis coloribus quàm accuratè depingit. Promisit Catalogum Plantarum in Hetruria nascentium, cum non descriptarum Iconibus, quarum nonnullæ jam erant sculptæ. Ducebat me laudatus Vir ad Nosocomium Stæ. Mariæ, quod Italiæ, si non totius Europæ, amplissimum dicitur, in quo ingens Ægrotantium numerus egregiè curatur. Vidi cum eodem etiam Laboratorium Chemicum M. Ducis, quod *Fonderia del Grand Duca* appellatur Italis, in quo quamplurima Præparata Chemica cum Furnis & Instrumentis servantur. Hic observabam modum conficiendi varias Essentias odoriferas per integram Europam ferè decantatas, quæ Essentia de Bergamotte, Cedro, &c. vulgo nominantur. Præparantur scilicet per distillationem (secus ac Romanæ Essentiæ, quæ per expressionem saltem fiunt) ex corticibus per Vesicam & Serpentinam, sola addita aqua communi, à qua post distillationem Oleum supernatans Essentia dictum separatur. Aquæ autem odoriferæ ex Floribus, hic absq; ullius aquæ additione distillari solent, & sunt excellentissimæ. Præter hoc Laboratorium Florentiæ quoq; habetur M. Ducis Pharmacopœia, in qua inter rariora Monstrosi aliquot fœtus in Sp. Vini servati, ut Lepus octipes, Caniculus biceps, Caniculus monophthalmos in fronte, & alii mihi demonstrabantur. Idem D. Tozzi mihi viam aperuit ad summe Rev. Abbatem Monasterii Ripolitani Valombrosæ Virgilium Falusium, multa ætate provectum, sed humanitate, & in Botanicum Studium amore, quod ejus Prosopopœia Botanica testatur, nemini secundum.

Botanicis

Botanicis Hetruſcis quoq; annumerandus eſt D. Petrus Antonius Michaeli junior Bibliopola, ſupra nominati D. Tozzi amicus. Hic Rei Herbariæ ſtudioſiſſimus, imprimis Methodi Tournefortianæ gnarus, qua adeo & non abſq; ratione delectatur, ut integras Tournefortii Inſtitutiones Botanicas ipſe ad ſeptem circiter plagas in forma duodecima contraxerit, quibus tamen omnes figuras Tournefortianas genericas cum Nominibus & claſſium Inſcriptionibus complectitur; opus certè editione digniſſimum, de qua tamen hactenus nihil comperi

Antequam Florentiam relinquam, non poſſum planè ſilentio præterire elegantiſſimæ hujus Urbis dedecus, feneſtras videlicet chartaceas plurimarum ædium, ut & Palatiorum nonnullorum, quas frequentiores adhuc Piſæ & Lucæ annotaveram. Miror ſanè Incolas aliàs in Ædificiis ſatis ſplendidos hac in re adeo eſſe negligentes; cùm tamen Vitra ibidem non majoribus, quàm alibi ſumptibus parari poſſe perſuaſus ſum.

D. 30. Octobris me Romam contuli; tranſibam Senam linguæ Toſcanæ puritate celebrem, poſtea & Montem Radicofani præaltum, ad cujus radices deſcendendo incipit Juriſdictio Papæ.

Bolſena Oppidum eſt ad lacum ejuſden Nominis ſitum, ad cujus ſiniſtrum latus via regia eſt Sylvæ quernæ adſita. Quercus hic ſolent eſſe humiliores, gallis majoribus refertæ, ut & excrementis illis, quæ Pilulæ capillatæ, C. B. Pin. Lobelio verò rectiùs Bedeguaris effigie excrementum ſpongioſum & muſcoſum. Frequens quoq; Quercus calyce echinato, glande majore, C. B. Pin. à me obſervabatur. Montes erant ſaxei, multis in locis ex Baſalte compoſiti, multis cavernis & ſpecubus olim arte ut ſuſpicor excavati.

Monte-Viaſconi dictum Oppidulum à Vino muſcato optimæ notæ *Eſt, Eſt, Eſt.* adeo notum; de quo præ cæteris legendus eſt D. Miſſon *dans ſon Voyage d' Italie*; ubi tamen notandum, ipſum etiamſi alios hanc ob ratio-

nem carpat, inſcriptionem Sepulchri non rectè notaſſe, quam ſequentem deprehendi:

EST. EST. EST. PPR. NIUM.
EST. HIC. IO. DEUC. D.
MEUS. MORTUS. EST.

Viterbium Civitas eſt poſt Senam in hoc Itinere maximè notabilis & ſatis ampla Pontifici ſubjecta; ad cujus dextrum latus, cùm Thermas reperiri Naturales, *Bulicanti*, i. e. bullientium nomine ibidem cognitas, unum milliare Italicum diſtantes audiviſſem, eo mox mè mea duxit curioſitas. Inveni autem eas decliviori loco, in ſolo albicante arido & quaſi calcario, odore ſulphureo & fumo mox adeuntibus ſeſe prodentes. Sapor quoq; ad ſulphureum admixta aliquali ſalſedine accedebat. Primariæ in loco aliquantulum elatiori ſitæ, multis ſcaturiginibus ex terra propullulantibus compoſitæ, muro lapideo humili heptagonæ figuræ cingebantur. Balneum Regis Bathonienſe magnitudine ferme adæquantes. In uno muri latere ſequens ſaxo inſculpta legitur inſcriptio:

D. O. M.
Ars Ortulanorum
fecit. A. D. MDC.

Aqua eſt calidiſſima, ita ut manum, ſi paulo diutius in ea detineatur, comburat, & Ova brevi induret. Ex his 4 rivuli veloci curſu prodeuntes adjacentibus Thermis ſecundariis aquam largiuntur, ſed caloris longè remiſſioris. Rivulorum fundus ſaxeus eſt, albus ex ſedimento aquæ calcario ortus, quo refertam eſſe ſtipites quoq; Cannabini ſimili cruſta lapidea & calcaria undiquaq; obducti, quos ibidem colligebam, teſtantur. Multis in locis concretum hoc ſedimentum coloris eſt virideſcentis, quod aquæ quoq; dictum colorem conciliat. Fere neglectæ

mihi

mihi hæ Thermæ videbantur, quod tamen ſummopere mirabar, etiamſi internum earundem uſum ob copioſe admixtas particulas calcarias nemini ſuaderem. Cæterùm in Thermis hiſce ſecundariis Cannabim macerare ſolent accolæ.

Relicto Viterbio loca quædam alia vidimus minùs notatu digna, donec tandem d. 4. Novembris totius terrarum Orbis quondam Dominam Romam ſc. intravimus. Quid in ampliſſima hac civitate circa ſtudia noſtra obſervaverim ex ſequentibus cognoſces literis, ubi præſentes Tibi non ingratas fuiſſe ex benevola reſponſione cognovero. Vale, Vir illuſtris, & amare perge inclyti Nominis Tui

Dabam *Gedani* 1711. d. 19. Septembr.

Cultorem humillimum

J. Phil. Breynium, M. D.

III. *Animadverſiones quædam in Codicem MS. membranaceum, ſuperiori Epiſtola memoratum: Excerptæ ex Additamentis* G. Ch. Schelhammeri *ad* Herm. Conringij *Introductionem in Artem Medicam. Cap.* XII. *pag.* 401.

PRæter hos [*ſc.* Hippocratem, Galenum, & C. Celſum] *ex antiquo ævo, qui hanc doctrinam* [*Chirurgicam*] *ſcriptis tradiderit, neminem habemus.* H. Conringius.

Extant quidem plurimi, ſed ἀνέκδοτοι, ſi credimus *Johanni Sponio,* artis & antiquitatis peritia celeberrimo, in Auguſta illa Magni Ducis Hetruriæ Bibliotheca inter Manuſcripta ad Sancti Laurentij Ædem aſſervata; de quibus non pigebit verba ipſamet adſcribere ex *Itinerario,* quo per Italiam, Dalmatiam, Græciam, &

Asiam sibi visa notavit: Sic autem ubi de Florentiæ admirandis Sermonem instituit Idiomate nativo loquitur, quod nos Latine sic reddidimus: *Aliud Manuscriptum commemorabo, quod pertinet ad Artem quam profiteor, & quod omnium per universam Europam Bibliothecarum, quantum quidem novimus, unicum extat. Est vastum volumen Græcum, continens Chirurgiam Antiquorum, Hippocratis, Galeni, Asclepiadis, Bithyni, Apollonij, Archigenis, Nymphodori, Heliodori, Dioclis, Ruffi Ephesij, & Apollodori Cytiensis, in cujus opere figuræ cernuntur chartæ Pergamenæ inscriptæ, ad modum reponendi luxatas partes attinentes. Hujus ultimi, pariter ac Asclepiadis, Apollonij, & Dioclis aliquoties in Plinij operibus fit mentio. Archigenis etiam apud Galenum non infrequens est nomen: verùm integra ipsorum opera nullibi reperiuntur. Bithyni autem, Nymphodori, & Heliodori vix nomina nobis etiam nota sunt.* Sane ista omnia si ita haberent, uti Clarissimus *Sponius* narrat, fraudi foret haud exiguæ rei Chirurgicæ, æternis tenebris tam eximium opus damnari, in quo fieri non posset, quin multa præclara admodum, summæq; utilitatis monita legerentur: multo enim plura fuisse recte observata antiquis illis, cum inter Medicorum filios Chirurgiæ studium floreret, quàm nostris temporibus ab indoctis plerumque operatoribus & rei anatomicæ imperitis fieri potest, rationi conveniens est, & res ipsa loquitur.

Verum enim vero fefelliffe videtur optimum virum cursoria & festinata perlustratio. Cum enim in his inserendis animus esset, opportunè occurrit sagaciſſimi antiquitatum medicarum Indagatoris, Collegæ conjunctiſſimi, *Meibomij* peritia, cui diutius Florentiæ subsistenti Bibliotheca illa Magni Ducis ad invidiam frui concessum fuisse noveram. Is igitur de hoc Codice consultus tale mihi responsum misit:

Liber

Liber ille, quem ex antiquis Chirurgis collegit quidam Medicus, *Nicetas*, neſcio cujus ævi, notiſſimus mihi eſt, illóque, in Magni Ducis Laurentiana Bibliotheca, Scamno LXXIV extante, licuit mihi uti, quamdiu Florentiæ fui, & pluſcula ex illo deſcribere. Non tamen Florentiæ ſolum, ut Sponius credit, ſed etiam in Regis Galliarum Bibliotheca eadem Collectio extat. Nec omnia, quæ in eo Codice habentur, inedita ſunt, nec ejuſdem momenti, multo minus Autores eorum ſunt incogniti. Deprehendi in eo quoſdam Libellos integros; de alijs non niſi tenuia quædam fragmenta. De Hippocratis, Galeni, Oribaſii, P. Æginetæ, Ruffi Epheſii, Palladij, aliunde notis ſcriptis & jam editis nihil moneo. De Bithyno, Nymphodoro, & Heliodoro tantum dicam aliquid, quoniam Sponius illorum nomina pene incognita exiſtimat. De Bithyno fortè non malè dixerit, eum alijs omnibus ne nomine quidem cognitum eſſe, quoniam ex Sponij cerebro nuperrime prodiit. Quæ enim ibi habentur fragmenta, ſunt Aſclepiadis ex Bithynia, ſeu Pruſienſis, cujus toties mentio fit apud Plinium & Galenum, ex quo ille duos facit, alterum Aſclepiadem, Bithynum alterum: quo eodem jure alium Rufum, alium Epheſium facere potuiſſet. Et vero Heliodorus quoque ex Ægineta & Oribaſio, qui ejus Chirurgica laudant: Nymphodorus quoq; ex Celſo & Galeno & eodem Oribaſio, propter Gloſſocomum quoq; potuiſſet eſſe cognitus. Jam tum etiam Heliodorum, cujus de Fracturis Capita xi. in hac Collectione extant, vertit & edidit Vidus Vidius. *G. C. Schelhammerus.*

IV. *A Letter from the late Mr.* Edward Lhwyd, *Keeper of the* Aſhmolean Muſeum *in* Oxford, *to Dr.* Tancred Robinſon, *F. R. S. containing ſeveral Obſervations in Natural Hiſtory, made in his Travels thro'* Wales.

Swanſey, Glamorganſhire, Sept. 14. 1696.

Honoured Sir,

AT *Snowdon* Hills we met with little or nothing additional to what is in Mr. *Ray*'s *Synopſis*; only the *little Bulb* I found plentifully in flower; and in one of the Lakes I gather'd a ſmall Plant, which I ſuſpect to be undeſcrib'd. I have given Orders to watch the *Subularia*; but the Lake where it grows is ſo high, that Men have ſeldom occaſion to come near it, ſo that I have but ſlender hopes of any account of its flowering. I ſent Roots of what rare Plants I met with, to the Duke of *Beaufort*'s, my Lord of *London*'s, and the Phyſick Garden at *Oxford*; and planted many of them at the Biſhop of *Bangor*'s Garden, which is about 7 Miles from theſe Mountains. I have dried ſeveral Paterns of moſt of them; as alſo of ſuch Plants as our Sea Coaſts afford, which are conſiderable for Number; amongſt which I think I have two or three undeſcrib'd.

I ſearched diligently in theſe Mountains for Figured Stones; but met with none at all, except cubical Marchaſites, and Cryſtals, whereof I found one about 9 Inches long, and thicker than my Wriſt, tranſparent as Glaſs for the better half, but opaque towards the Root like white Marble. Some ſmall ones I met with of the colour

colour of a Topaze; and was inform'd of others purely Amethyſtine, found in the Valley of *Nant Phrancon*. I find our Anceſtors (for want of more precious Stones) made themſelves Beads of opaque, or Marble Cryſtal; for I have one given me, cut like a Lottery-ball, and perforated; found not long ſince in *Meirionydhſhire*. I deſire to know whether you are ſatisfy'd, that thoſe tranſparent Stones figured by Dr. *Plot*, and by Dr. *Liſter* [Phil. Tranſact. N°. 201.] by the name of *Ombriæ*, &c. are ſo form'd naturally. One of them was lately given me (ſet in Copper with a little Handle to it) by the name of *Tlŵs Owen Kyveiliog*, i. e. *Owen* of *Kyveiliog*'s Jewel; ſo call'd, becauſe found in an old *Crig* or *Barrow*, near the Place where he lived.

Sir *William Williams* hath ſeveral *Welſh* MSS. (tho' I think no Dictionary) that would be of uſe to me; but his Son tells me, he's reſolv'd never to lend any. They are chiefly Modern Copies out of *Hengwrt* Study in *Meirionydhſhire*, which I am promis'd free Acceſs to; and have this time taken a Catalogue of all the ancient MSS. it contains. There are the Works of *Talieſyn*, *Aneuryn gwawdydh*, *Myrdhyn ab Morvryn*, and *Kygodio Elaeth*, who lived in the 5th and 6th Centuries (but the ſmall MS. containing them all ſeems to have been copied about 500 Years ago) as alſo of ſeveral others valuable in their kind. I muſt intreat you to direct me, if you can, how to procure the uſe of the *Corniſh* MSS. you mention at Mr. *Anſtiſſe's*. I have been told one Mr *Keygwyn*, who died of late Years in *Cornwal*, left a ſort of Dictionary of the Language: Perhaps Mr. *Moyle*, or ſome other of your Acquaintance in that Country, can tell us whether it be true, or a miſtake.

We have neither the *Ibex* nor *Rupicapra* in *Wales*, nor any other Goat but the Common. In our Language the Park Deer is call'd *Geivr Danas*: The former Word ſignifies *Goats*, but whether the latter implies *Daniſh*

(as

(as if Deer had come from *Denmark*) or ſomewhat elſe, we know not.

The Grey Game (tho' I have not heard of the name) ſeems to be the Female of the Black; which we call *Gryg-ieir*, i. e. *Gallinæ ericetorum*. The Red Game we call *ieir y mynydh*, i. e. *Gallinulæ montanæ*; becauſe in our Country they keep to the higheſt Hills, or Alps, [in Welſh *banneu*,] eſpecially if heathy.

There came this laſt *May* into *Cardiganſhire* two ſtrange Birds (as I gueſs by the Deſcription given them) of the Aquatic fiſſiped Tribe. They ſay they were almoſt two Yards tall, and of a whitiſh colour, with the Tips of their Wings dark. I took 'em to be ſome ſort of Exotic Crane; which, whether they portend a Common-Wealth or not, I leave to their Interpretation who regard *Omens*.

This time two Years, there came a Flock of Birds [about a Hundred] to a Hemp-yard, at a place called *Lhan Dhewi Velfrey* in *Pembrokeſhire*; and in one Afternoon deſtroyed all the Hempſeed. They deſcribed the Cocks to be all over red as Scarlet; the Hens greeniſh above, and red underneath; about as big, or little leſs than Blackbirds; with Bills more ſtubbed and bigger than that of a Bull-finch. I ſuſpect theſe to have been *Virginia* Nightingals; otherwiſe, I know not what to make of them.

Our Lakes (tho' they are very numerous) afford no Fiſh that I can hear of, beſides Trout and Eel, and *Torgoch* and *Gwiniad*, i. e. Shelley and Charre. A Fiſherman proteſted to me, that in a Lake called *Lhyn y Cwn* near *Lhan Berys*, he had ſeveral times catch'd Monocular Trouts, the Heads whereof were always ſomewhat diſtorted or contracted awry. They farther aſſured me, that the two higheſt Lakes of *Snowdon* (*Phynnon Vrêch* and *Phynnon lâs*) afford no Fiſh at all; and that the Trouts of the other Lakes differ much in colour: But

theſe

theſe things muſt, and ſhall (God willing) be better inquired into.

Next Summer come Twelvemouth, I intend to try the Barometer and Thermometer on the Top of *Snowdon* and *Cader Idris*, and to take their perpendicular Height, and do any thing elſe that you ſhall adviſe, which may be done conveniently.

There is no Brimſtone or Pumice-ſtones on the Tops of our Mountains, nor any thing elſe that I ſuſpect to have been the Effects of Vulcano's. What ſeemed to me moſt ſtrange, were waſte confus'd Stones, and (to appearance) fragments of Rocks, ſtanding on the Surface of the Earth, not only in wide Plains, but on the Summits alſo of the higheſt Mountains.

I have never ſeen any Lake or Spring on the Summit of a Hill. There are indeed on the tops of ſome Hills, where ſtood anciently Caſtles or Forts, certain Wells called in Welſh *Pydew*; a Word of the ſame Signification as well as Sound with the Latin *Puteus*: But no Water runs out of theſe; and ſeveral of them I found quite dry. I am,

Sir,

Your moſt obliged humble Servant,

E. LHWYD.

V. *An Extract from a Letter of Mr.* Edw. Lhwyd *to Dr.* Tancred Robinson; *giving some farther Account of the Birds mentioned in the foregoing Letter.*

Oxford, Dec. 22. 1696.

THE Person that gave me the Account of the Scarlet Birds, was Mr. *Roberts*; whom you will find mention'd in *Camden*, *Pembrokeshire*. He said they were extraordinary tame; or at least so intent upon their feeding, that being forc'd from their places, they would not remove above 2 or 3 Yards. The Cocks, he says, were of a deep Scarlet Colour, without any distinction in the Feathers of their Wings, that they could discern, excepting that the Tail and the lower part of the Belly were a little paler. The Hen had a lovely Scarlet Breast; her Head and Back grey. He is somewhat Curious in Birds; and says, he never saw any that in the least resembled them as to their Colour.

One of the other two Birds was shot, and its Skin stuffed; which probably I shall meet with this next Summer.

E. LHWYD.

VI. *Some*

VI. *Some farther Obſervations relating to the Natural Hiſtory of* Wales. *In a Letter from Mr.* Edw. Lhwyd *to Dr.* Tancred Robinſon, *F. R. S.*

Uſk in *Monmouthſhire, June* 15. 1697.

SIR,

THE moſt conſiderable Diſcoveries, ſince my laſt, were ſome new *Species* of *Gloſſopetræ* and *Siliquaſtra*, (the firſt *Ichthyodontes*, I ſuppoſe, that ever were obſerv'd in *Wales*) on the top of a high Mountain called *Blorens* near *Aber Gavenni*. The *Siliquaſtra* were ſmaller than the generality of thoſe I had obſerv'd in other Countries. Of the *Gloſſopetræ* we found one pretty large; but the reſt very ſmall; all black, or atrorubent. The ſame place afforded alſo ſome variety of Foſſil Shells, and plenty of *Cuthbert's* Beads, which were very ſmall in compariſon of what are found throughout the North of *England*. We alſo found there a large Teſtaceous Body, not to be compar'd as to its Figure with any ſort of Shell yet deſcrib'd: Together with ſome emboſſed Repreſentations of pieces of the Sceletons of Eels, or ſome leſſer Fiſh. All theſe were in Limeſtone; but

Advancing about 3 Miles further into *Brecknockſhire*, at a place call'd *Lhan Elhi* we ſearched ſome Coal and Iron Mines. Their Coal-works were not Pits ſunk like Draw-wells; but great Inroads made into the ſide of the Hill, ſo that three or four Horſemen might ride in a-breaſt. The Top is ſupported with Pillars left at certain diſtances; and they make their By-lanes (as in other Pits) as the Vein requires. The Slat above this Coal afforded only Stalks of Plants, which we did not

ſave, becauſe it ſeem'd impoſſible to reduce them to their ſeveral proper *Species*. However, cloſe by the Pit we found a valuable Curioſity, *viz.* a Stone for ſubſtance like thoſe they make Lime of; of a compreſs'd Cylinder Form; and as it were cut off even at each End: About 8 Inches long, and 3 in breadth: Its *Superficies* adorn'd with equidiſtant Dimples, like Dr. *Plot's Lepidotes*, *Hiſt. Ox. chap.* 5. *par.* 55. and in each Dimple a ſmall Circle; and in the Center of each Circle a little Stud like a Pins head. This is the only Curioſity of the kind I have ſeen; and is not referable to any thing I can think of, either in the Animal or Vegetable Kingdom. Among the Iron Oars of the ſame Hills we found ſome new Spars, and ſeveral Specimens of Oars ſhot into a conſtant and regular Figure, tho' not reducible to any Animal or Vegetable Bodies.

About 5 Miles thence, at a place called *Pont y Pwl* in this County (where, as alſo at *Lhan Elhi*, there are Furnaces and Forges,) we found more Coal and Iron-Mines; and collected ſome fair Repreſentations of the Leaves of Capillary Plants on the Iron Oar, but found no Branches. One Major *Hanbury* of this *Pont y Pool*, ſhew'd us an excellent Invention of his own, for driving hot Iron (by the help of a Rolling Engin mov'd by Water) into as thin Plates as Tin: But without a Draught of the Machine I cannot give you a Notion of it. They cut their common Iron Bars into Pieces of about two foot long; and heating them glowing hot, place them betwixt theſe Iron Rollers; not acroſs, but their Ends lying the ſame way as the Ends of the Rollers. The Rollers (moved with Water) drive out theſe Bars to ſuch thin Plates, that their Breadth, which was about 4 Inches, becomes their Length, being extended to about 4 Foot; and what was before the Length of the Bars is now the Breadth of the Plates. With theſe Plates he makes Furnaces, Pots, Kettles, Sauce-Pans, *&c.*

Theſe

Theſe he can afford at a very cheap rate (about the third part of what is uſual) and yet dares warrant them not leſs ſerviceable: So that it is not to be doubted, but that he will meet with the Encouragement due to ſo Ingenious and uſeful an Invention. He ſends moſt of his Plates to *London* (where he has Workmen) making at home only what he finds the Country will take off. I am,

Sir,

Your moſt obliged Servant,

E. LHWYD.

P. S. We had at *Pont y Pool*, on the 6th inſtant, an extraordinary Shower of Hail; which extended about a Mile, and laſted near half an Hour. It broke down the Stalks of all the Beans and Wheat within that Circumference; and ruined as much Glaſs at Major *Hanbury*'s Houſe, as coſt 4 *l.* the repairing. Some of the Hail were 8 Inches about; as to their Figure, very irregular and unconſtant; ſeveral of the Hail-ſtones being compounded, as the Major judg'd, who ſaw them.

VII. *Con-*

VII. *Concerning the Proportion of* Mathematical Points *to each other. By the Honourable* Francis Robartes *Esq; Vice-President of the* Royal Society.

IT has heretofore pass'd for a current Maxime, That all Infinites are equal.

Divines and Metaphysicians have not scrupled to ground many of their Arguments on that Foundation.

The Position nevertheless is certainly erroneous, as Dr. *Halley* abundantly has shown in the *Philosophical Transaction* for *October* 1696. He there gives divers Instances of infinite quantities which are in a determinate finite proportion one to another, and some infinitely greater one than another.

The like may be observ'd of infinitely small quantities (*viz.*) Mathematical Points,) as the following Propositions will make appear.

PROP. I. *Fig.* 1.

The Points of contact between Circles and their Tangents are in Subduplicate proportion to the Diameters of the Circles.

Let two Circles *a d c b*, *a f b g*, touch one another from within at the point *a*. Draw the Tangent *p a q*, and parallel to it the line *m n*. From the point *a* draw the Diameter *a c*.

Let

Let $a\,c$ the Diameter of the greater Circle be equal to R, and $a\,b$ the Diameter of the leſſer Circle be equal to S.

Let $d\,h$ the Chord of the Arch $d\,a\,h$ be equal to z, and $f\,g$ the Chord of the Arch $f\,a\,g$ be equal to y, and let the Abſciſs $a\,k$ be equal to x.

If the Line $m\,n$ be ſuppoſed to move till it becomes coincident with the Tangent $p\,a\,q$, the nature of a Circle will always give the following Æquations.

$$zz = 4Rx - 4xx.$$
$$yy = 4Sx - 4xx.$$

When the Line is arrived at the Tangent, z and y will become the two Points of Contact, and then $zz = 4Rx$ and $yy = 4Sx$. ($4xx$ being laid aſide as Heterogeneous to the reſt of the Æquation, by reaſon of x being become infinitely little.) Therefore

$$zz \,.\, yy :: 4\,Rx \,.\, 4\,Sx :: R.S.$$
Therefore $z \,.\, y :: \sqrt{R} \,.\, \sqrt{S}$. *Q. E. D.*

PROP. II. *Fig.* 2.

The Point of Contact between a Sphere and a Plane is infinitely greater than that between a Circle and a Tangent.

Let a be the Point of Contact between the Sphere $a\,d\,q\,f$ and the Plane $b\,c$. About the Sphere deſcribe the Cylinder $n\,p\,g\,m$.

Draw $k\,h$ to repreſent a Circle parallel to the Plane. Let the Circle be ſuppos'd to move, till it becomes coincident with the Plane. The Cylindrical Surface $k\,h\,g\,m$ will always be equal (according to *Archimedes*) to the Spherical Surface $d\,a\,f$.

Now

Now when these Surfaces become infinitely small, one terminates in the Point of Contact, and the other in the Periphery of the Base of the Cylinder. Therefore the Point of Contact is equal to the Periphery of the Base of the Cylinder (equal to a Periphery which has the same Diameter as the Sphere) and by consequence is infinitely greater than any point of Contact between a Circle and a Tangent. *Q. E. D.*

PROP. III.

The Points of Contact by Spheres of different Magnitude are to one another as the Diameters of the Spheres.

For by the second Proposition the Points of Contact are equal to the Peripheries of such Diameters, whose proportion is the same as the Diameters.

Q. E. D.

VIII. *An*

VIII. *An Account of an Experiment, concerning the Angle requir'd to ſuſpend a Drop of Oyl of Oranges, at certain Stations, between two Glaſs Planes, placed in the form of a Wedge. By* Mr. Fr. Hauskbee, *F. R. S.*

I Procured two Glaſs Planes that meaſur'd a *Radius* of twenty Inches each; their breadth was about 3 Inches: That which I uſed for the lower Plane, was plac'd with its Surface parallel with the Center of its *Axis*, and parallel with the Horizon. Thus (the Planes being very clean) they were rubb'd with a clean Linnen Cloth dipt in Oyl of Oranges: Then a drop or two of the ſame Oyl being let fall on the lower Plane near the *Axis*, the other Plane was laid on it; which ſo ſoon as it touch'd the Oyl, the Oyl ſpread itſelf conſiderably between both their Surfaces. Then the upper Plane being raiſed a little at the ſame end by a Screw, the Oyl immediately attracted itſelf into a Body, forming a Globule contiguous to both Surfaces, and began to move forwards toward the touching ends. When it had arriv'd two Inches from the *Axis*, an Elevation of 15 Minutes at the touching ends ſtopt its progreſs, and it remain'd there without Motion any way. The Planes being let fall again, the drop mov'd forward till it came to four Inches from the Center; then an Elevation of 25 Minutes was requir'd to give it a fixt Station. At 6 Inches it requir'd an Angle of 35 Minutes; at 8, of 45 Minutes; at 10, a Degree. At 12 Inches from the *Axis*, the Elevation was 1 Degree 45 Minutes; and ſo on, at the ſeveral Stations, as they ſtand in the following Table. This, after

abundance of tryals, I take to be the moſt correct, tho' the others ſucceeded very little different from the ſame. It is to be obſerv'd, that when the Globule, or Drop, had arriv'd to near 17 Inches on the Planes from their *Axis*, it would become of an Oval form; and as it aſcended higher, ſo would its Figure become more and more oblong; and unleſs the Drop was ſmall, upon ſuch an Elevation of the Planes as was requir'd at ſuch a progreſs of the Drop, it would be parted, ſome of it deſcending, and the reſt of it running up to the top at once: But upon a Drop that ſeparated thereabouts, I found the remaining part of it at 18 Inches, would bear an Angle of Elevation equal to 22 Degrees to ballance the weight of it. Higher than that I could not obſerve. The Planes were ſeparated at their *Axis* about $\frac{1}{16}$ of an Inch. I found but little difference between ſmall and larger Drops of the Oyl, in relation to the Experiment. The Angles were meaſured by a Quadrant mark'd on Paper of near 20 Inches *Radius*, divided into Degrees and Quarters.

Diſtance in Inches from the *Axis*.	Angle of Elevation. *D.*	*M.*
2	0	15
4	0	25
6	0	35
8	0	45
10	1	00
12	1	45
14	2	45
15	4	00
16	6	00
17	10	00
18	22	00

IX. *A Letter from Mr.* Richard Hopton *to Mr.* John Batchelor; *Giving an Account of the Eruption of a Burning Spring at* Broſeley *in* Shropſhire. *Communicated by Dr.* William Gibbons, *Fellow of the College of Phyſicians.*

September 18. 1711.

SIR,

I Have according to promiſe here ſent an Account of the famous boyling Well at *Broſeley* near *Wenlock* in the County of *Salop*, diſcovered about *June*, 1711.

It was firſt found out by a terrible uncommon Noiſe in the Night (about two Nights after a remarkable Day of Thunder:) The Noiſe was ſo very great, that it awaked ſeveral People in their Beds, that liv'd hard by; who being willing to be ſatisfy'd what it was, roſe up from their Beds; and coming to a boggy Place under a little Hill about 200 Yards off the River *Severn*, perceiv'd a mighty rumbling and ſhaking in the Earth, and a little Boyling up of Water through the Graſs. They took a Spade, and digging up ſome part of the Earth, immediately the Water flew up a great Height, and a Candle that was in their Hand ſet it on Fire.

To prevent the Spring being deſtroyed, there's an Iron Ciſtern plac'd about it, with a Cover upon it to be lock'd, and a Hole in the middle thereof, that any who come may ſee the Water through. If you put a lighted Candle or any thing of Fire to this Hole, the Water immediately takes Fire and burns like Spirit of Wine, or Brandy, and continues ſo as long as you keep the Air from

from it; but by taking up the Cover of the Ciſtern, it quickly goes out. The heat of this Fire much exceeds the heat of any Fire I ever ſaw, and ſeems to have more than ordinary fierceneſs with it.

Some People out of Curioſity, after they have ſet the Water on Fire, have put a Kettle of Water over the Ciſtern, and in it Green Peas, or a Joint of Meat, and boyled it much ſooner than over any artificial Fire that can be made. If you put Green Boughs, or any thing elſe that will burn upon it, it preſently conſumes them to Aſhes. The Water of itſelf is as cold as any Water I ever felt; And what is remarkable, as ſoon as ever the Fire is out, if you put your Hands into it, it feels as cold as if there had been no ſuch thing as Fire near it. It ſtill continues boyling up with a conſiderable Noiſe; and is viſited by almoſt all that hear of it; and is look'd upon to be as great a rarity as the World affords.

R. HOPTON.

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BRITISH MUSEUM
NATURAL H[illegible]ORY.

Fig: 1.

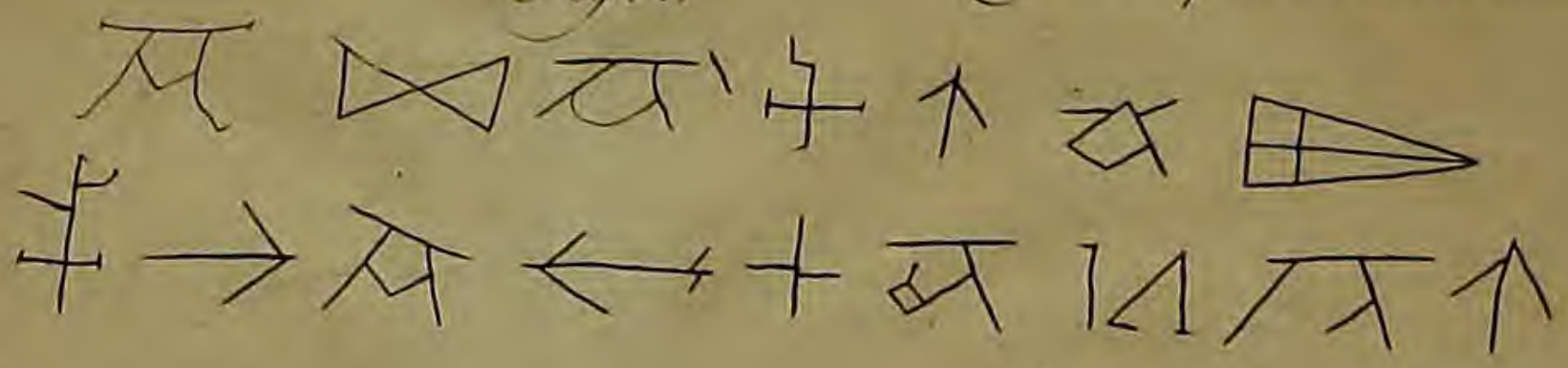

Fig: 2.

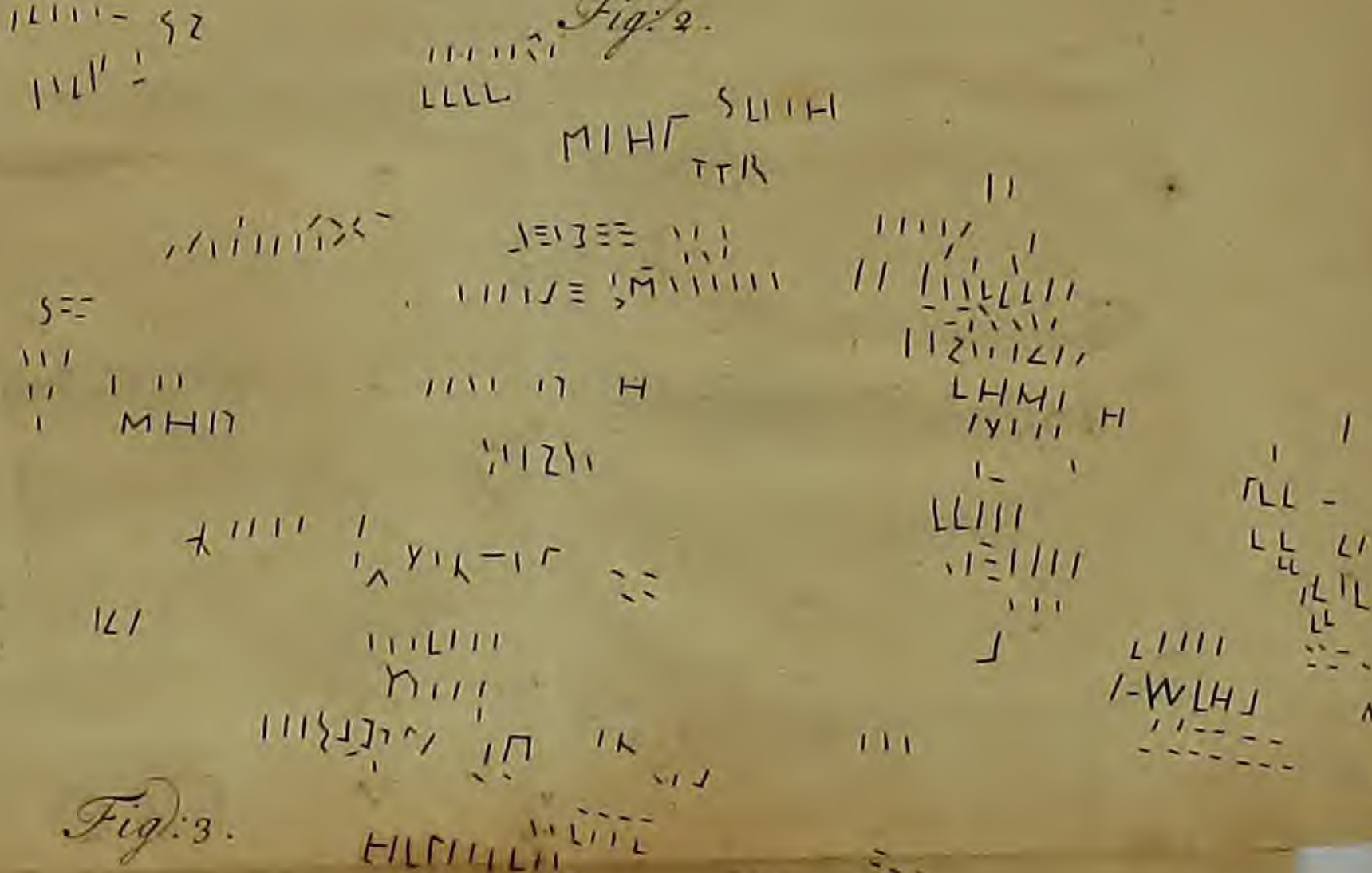

Fig: 3.

Fig: 4.

(Numb. 335.)

PHILOSOPHICAL TRANSACTIONS.

For the Months of July, August, *and* September, 1712.

The CONTENTS.

I. *Observations*

II. *Observations concerning the* Subterraneous Trees *in* Dagenham, *and other Marshes bordering upon the River of* Thames, *in the County of* Essex. *By the Revd. Mr.* W. Derham, *Rector of* Upminster *in the same County, and F. R. S.*

THE *Royal Society* having some time since laid their commands upon me, to give them an account of the *Subterraneous Trees*, uncovered by an Inundation of the River of *Thames* in *Dagenham* and *Havering* Marshes, not far from me; and having lately received a renewal of the same commands, my Duty and great Respects to that most Illustrious Body, oblige me to give the best Relation I can of the Observations I have had some good Opportunities of making about that Matter. And I hope such an Account may be the more acceptable, by reason it hath relation to a different sort of Subterraneous Trees, and a way of interment of them, varying from what is remark'd by two very Ingenious Members of the *Royal Society*, the Right Honourable the Earl of *Cromertie*, and Dr. *Sloane*.

The Inundation happened between Four and Five Years ago, by a Breach in the *Thames* Wall, at an extraordinary high Tide: And by means of the great violence of the Water, a large Channel was torn up, or Passage for the Water of 100 Yards wide, and 20 Foot deep in some Places; and in some more, some less. By which means a great number of Trees were laid bare, that had been there interred many Ages before.

The

The Trees were all, as far I could perceive, of one ſort, except only one, which was manifeſtly a large Oak, with the greateſt part of its Bark on, and ſome of its Head and Roots. The reſt of the Trees the Country People (Carpenters and others) take to be *Yew*: And ſo did I myſelf imagine them to be, from the hardneſs, toughneſs, and weight of the Wood, notwithſtanding we have no *Yew* growing any where thereabouts, and it ſeem'd ſtrange to me, that *Yew* ſhould grow, in ſuch vaſt quantities, in ſuch a Soil, and ſo near the brackiſh Waters. But a very Ingenious Neighbour of mine, and a Member of the *Royal Society*, *D' Acre Barret* Eſq; convinced me they might more probably be ſome other Wood, as *Alder*; which grows plentifully by our freſh Water Brooks. And lately he told me, he had the Opinion of an ingenious and good Judge of Wood, who takes it to be *Horn-beam*, which grows plentifully alſo with us in the higher Lands (but I do not remember to have ſeen it in watery Places near us) but I rather incline to the Opinion of its being *Alder*; the Grain of the Wood, and manner in which the Boughs grow, *&c.* much reſembling that of *Alder*, more than *Horn-beam*; as the Specimens herewith ſent will manifeſt.

By lying ſo long under ground, the Trees are become black and hard, and their Fibres are ſo tough, that one may as eaſily break a Wire of the ſame ſize, as any of thoſe Fibres. This toughneſs they maintain, if the Wood be kept dry, as I find by two of the Trees I have now by me. But by drying, thoſe Trees are become cracked, and very flawy within, but look ſound outwardly, and with difficulty yield to Wedges. But for the Trees lying in the Marſhes, which are covered by every Floud, and laid bare by every Ebb, in a ſhort time they became very rotten.

There is no doubt but thoſe Trees grew in the Place where they now lye; and that in vaſt multitudes, they lying

lying ſo thick upon, or near one another, that in many places I could ſtep from one to another. And there is great reaſon to think, that not only the Marſhes, which are now over-flown (which are about 1000 Acres) are covered underneath with thoſe Subterraneous Trees, but alſo all the Marſhes along by the River ſide, for ſeveral Miles: For we diſcover theſe Trees all along the *Thames* ſide over againſt *Rainham*, *Wennington*, *Purfleet*, and other places: And in the Breach that happened at *Weſt-Thorrock* about 21 Years ago, they were waſhed out in as great Numbers (as I have been inform'd) and of the ſame kind of Wood, as thoſe found lately in *Dagenham* and *Havering* Levels.

Theſe laſt mentioned Trees are of different ſizes; ſome above a Foot Diameter, ſome leſs. As I was rowed in a Boat along the Channel, I met with two of the leſſer ſort, ſtanding upright, in the ſame poſture in which they grew; their Tops juſt above Low-Water, and their Bottoms (at leaſt the bottom of the Channel) at 16 Feet depth. We endeavoured to draw them out, but could not do it with all our Strength. They ſeemed to be about 2 Inches Diameter in their Trunk, had ſome of their Boughs on, were dead, and in all likelyhood, being young and light, eſcaped the force of what threw the other more large, and unweildy ones down.

Moſt of the Trees, that I met with, had their *Roots* on, and many of them their *Boughs*, and ſome a part of their *Bark*. There was only one that I perceived had any ſigns of the *Ax*, and its Head had been lopped off.

As I paſſed the Channel which the Water had torn up, I could ſee all along the Shores vaſt Numbers of the *Stumps* of thoſe Subterraneous Trees, remaining in the very ſame poſture in which they grew, with their Roots running ſome down, ſome branching and ſpreading about in the Earth, as Trees growing in the Earth com-

commonly are ſeen to do. Some of thoſe Stumps I thought had ſigns of the Axe, and moſt of them were flat at top, as if cut off at the Surface of the Earth: But being rotten, and batter'd, I could not fully ſatisfy my ſelf, whether the Trees had been cut, or broken off.

The *Soil*, in which all thoſe Trees grew, was a black, ouzy Earth, full of the Roots of Reed; on the Surface of which ouzy Earth the Trees lay proſtrate, and over them a Covering of grey Mould, of the ſelf ſame colour and conſiſtence with the dry Sediment, or Mud, which the Water leaveth behind it at this Day. This Covering of grey Earth is about 7 or 8 Feet thick, in ſome places 12 Feet or more, in ſome leſs; at which depths the Trees generally lye.

Another thing I took notice of, was the *Poſture* in which the Trees lay, which was indeed in no kind of order, but ſome this way, ſome that, and many of them acroſs: Only in one or two places I obſerv'd they lay more orderly, with their Heads for the moſt part towards the North, as if they had been blown down by a Southerly Wind, which exerts a pretty ſtrong force upon that Shore.

As to the *Age* in which thoſe Trees were interred, it is hard to determine. Many think they have lain in that Subterrane State ever ſince *Noah*'s *Flood*. But altho' I have not the leaſt doubt but that at this Day we have many Remains of the Spoils of that Deluge, even in the higheſt Mountains, yet I rather think theſe Trees to be the Ruins of ſome later Age, occaſioned by ſome extraordinary Inundations of the River of *Thames*, or by ſome Storms, which (as I ſaid) blow ſharply upon this Shore: Either of which acts of violence might be able to root up, and tumble down Trees growing in ſo lax a Soil, as theſe manifeſtly grew in at that time. And as for extraordinary *Inundations* of the *Thames*,

there is at this Day a Mark, which, if occasioned by an Inundation, was the Mark of an Inundation very prodigious, beyond all ever known to have been in that River; and that it is a *Bed of a Shells*, if not of a kind of Marble too, lying cross the High-way on the Descent near *Stifford-bridge*, going from *S. Okendon*: Of which I shall give a distinct Account at some time of leisure, by reason it would be too great a Digression here to expatiate upon it, as it deserves.

Below this Bed of Shells, at above 50 or 60 Yards distance, in the bottom of the Valley, runneth a Brook, that empties itself into the *Thames* at *Purfleet*, about 3 Miles from thence; which Brook ebbeth and floweth as the *Thames* doth, but not at any certain height, by reason of Mills standing thereon; but above a pretty High-water in the Brook, the Surface of the Bed of Shells I find to lye above 20 Foot perpendicular. Consequently if this Bed of Shells was reposited in that place by an Inundation of the *Thames*, that Inundation must be such as would have drowned a vast deal of the adjacent Country, and have over-topped the Trees by the River, in *West-Thorrock*, *Dagenham*, and the other Marshes, and probably by that means over-turn them.

This I say seems to me the most rational way of accounting for our Subterraneous Trees, and not by the *Universal Deluge*: For had they been left there by that Deluge, we should not find the Bed of Earth, in which they grew, so entire and undisturb'd, as it manifestly is at this Day, a spongy, light, ouzey Soil, full of Reed-roots, as I said; and I assure my self (altho' I never try'd it) of much less Specifick Gravity than the *Stratum* above it is. Whereas I can assure this Curious and most Learned Society (having lately tryed the Experiment my self with competent care and exactness, because I never could be satisfy'd, upon the strictest enquiry, that any body else had done it: I can, I say, assure this Society)

that

that in three Places where I have try'd it, the *Strata* are in a ſurprizing manner, gradually ſpecifically heavier and heavier, the lower and lower they lye. Concerning which Matter, if God granteth me Life and leiſure, I intend to give this moſt Illuſtrious Society a farther Account, when I have made Experiments enough to fully ſatify my ſelf, and render my Obſervations fit for the cognizance of ſo curious and accurate a Body of Naturaliſts.

Having given this Account of their *Proſtration*, let us laſtly enquire into the *Manner how theſe Trees came to be interred*, which is a difficulty more eaſy to be reſolved than the laſt. And this I take to be from the gradual increaſe of the Mud, or Sediment, which every Tide of the *Thames* left behind it. I preſume thoſe Trees might be thrown down before the Walls or Banks were made, that keep the *Thames* out of the Marſhes; and then thoſe Trees were over-flown every Tide. And by reaſon they lay thick, and near one another on the ground, they would ſoon gather a great deal of the Sediment, and be ſoon covered therewith. And after the *Thames*-Walls were made, every Breach in them, and Inundation would leave great quantities of Sediment behind it; as I by a troubleſome Experiment found, in going over ſome of the Marſhes, ſoon after the late Breach, where I found the Mud, generally above my Shoes, and in many places above my Knees. And it is a practice among us (of which we have divers Inſtances) that where a Breach would coſt more to ſtop, than the Lands over-flown will countervail, there to leave the Lands to the mercy of the *Thames*; which by gradually growing higher and higher, by the Additions of Sediment, will in time ſhut out the Water of the River, all except the higheſt Tides. And theſe Lands they call *Saltings*, when covered with Graſs; or elſe they become *Reed-ground*, &c.

That it was the Sediment of the *Thames*, that burried thoſe Trees, is farther manifeſt from what I ſaid before, of the likeneſs of the Earth above them, in all reſpects, to the Sediment the River now lets fall, when dry; a Sample of which accompanieth this Paper: Which may be obſerv'd to conſiſt of many diſtinct Layers; ſome $\frac{1}{10}$ of an Inch thick, ſome leſs, and ſome ſcarce $\frac{1}{30}$ of an Inch. All which ſeveral Layers are, no doubt, the ſeveral quantities which every Tide left behind it. This Sediment, when dry'd by the Sun and Wind, becomes tough and hard, and looketh like a grey *Lapis-Sciſſilis*, or *Slate*, diviſible into many Plates or Layers. And what if we ſhould aſcribe the Conformation of *Slate*, *Muſcovia-glaſs*, and other the like laminated Concretions, to a like work of Nature, by adding new Layers of ſuch Petrifactions, and Particles, as the Foſſile is made of?

P. S. I preſume there will be no doubt, but that the Subterraneous Wood receives its blackneſs from Vitriolick Juices in the Earth. If any doubt ſhould be, I have try'd the Experiment, and find that *Alder-Wood*, whether green or old, becomes blackiſh, much of the ſame colour as the Wood before-mentioned in this Paper, in a Solution of Copperas. Which is not only an Argument, that the blackneſs of the Wood is owing to Vitriol, but alſo that the Wood is *Alder*, or ſome ſuch like Wood, that will become black with Vitriol: For I am inform'd that all Subterraneous Wood is not black, particularly *Firr*. I have alſo try'd *Hornbeam* ſince, after the ſame manner, and find that alſo becomes black, as the *Alder* doth.

II. *Experiments*

II. *Experiments and Observations of the Effects of several sorts of Poisons upon Animals, &c. Made at* Montpellier *in the Years* 1678 *and* 1679, *by the late* William Courten *Esq; Communicated by Dr.* Hans Sloane, *R. S. Secr. Translated from the* Latin *MS.*

IN the Month of *July*, *Anno* 1678. we gave a Dog a piece of Bread steep'd in two Ounces of the Juice of *Dutch Night-shade* [*Solanum Batavicum*] expres'd from the green Plant, and mixt with Cheese. As far as we could perceive, he did not seem to receive any manifest Damage from it.

The same Dose of the Juice of the Leaves of *Hemlock* [*Cicuta*] had no more effect. We gave also the same Dog a pretty large Root of *Wolfs-Bane* [*Aconitum Pardalianches*] together with the Leaves and Flowers of the same Plant bruised and mixt with Flesh; which did him no hurt.

Two Drachms of *White Hellebore* [*Helleborus albus*] very much disorder'd him, and caused Reachings, Suffocations, Vomiting, and Voiding of Excrements. This Dog (as afterwards we often observed in others that had taken the like Corrosive Medicines) whether because he was not able to endure the Pain, or by reason of any other Uneasiness, often scratched the Ground with his Feet: However he recover'd, and was well again.

He swallowed also five Roots of *Meadow-Saffron* [*Colchicum Ephemerum*] dug fresh out of the Earth: With which he was violently tormented, but did not dye.

At

At last he took two Drachms of *Opium*, which cast him into a deep sleep; but after Vomiting and voiding fetid Excrements, he recover'd by degrees his former briskness. So many, and those so notorious Poisons, could not kill this Dog.

Some Weeks after, when the same Dog had recover'd his former Vigour, we try'd on him the force of a much stronger Poison. We caused him to be bit 3 or 4 times on the Belly, a little below the Navel, by an inraged Viper. There arose immediately little black Bladders, containing a liquid blackish sort of Corruption; they were flaccid and tremulous, like the Gall Bladder when it is about half full; and a livid colour by degrees spread over all the neighbouring Parts. The Venome propagated itself with wonderful quickness, and weakened all, but more especially the Animal Functions: For notwithstanding the Diaphragme did still perform its Office pretty strongly, tho' with some disorder, and the Heart continued beating, tho' faintly and irregular; yet they seemed to fare much better than the Brain, whose Strength was so weakened, that it could not perform the Functions of Sense and Motion but very faintly; insomuch, that the Dog lay without any Strength or Sensation, as if he had been seized with a Lethargy or Apoplexy: Which kind of Stupidity we also observ'd, sometimes in a greater, and sometimes in a less Degree, in all other Dogs bit by a Viper. Being willing to save this Dog (tho' we had found by many Experiments, that much slighter Wounds made by a Viper had occasioned Death) we thought fit to have recourse to several Remedies; and therefore cupped and scarified the part that was wounded, and applied Treacle [*Theriaca*.] After this we let him alone for about two Hours: But his Sleepiness encreasing more and more, and his Vital and Animal Functions sinking, we were forced to have recourse to another Method of Cure. Wherefore to dis-

pel

pel his Sleepineſs, we forced into his Throat half a Drachm of Volatile Salt of Hartſhorn mixt in Broth; which we eaſily did, by reaſon of his weakneſs. In a little time after, his Eyes, which before looked dead, began to revive, and he was able to ſtand on his Feet and walk. Whereupon we repeated the ſame Doſe of the Volatile Salt, by which he was freed from his Sleepineſs, and the Strength of his Heart recover'd; and notwithſtanding he remained weak for three Days, yet he ſenſibly recover'd Strength, tho' he would eat nothing all that time: But he drank Water very plentifully and greedily; and on the ſecond Day did not refuſe cold Broth. After the third Day he began to eat ſolid Meats, and ſeemed now out of Danger; only ſome large foul Ulcers remain'd on that part of his Belly that was bit, of which he would ſcarce have died, had he not been killed by another Dog; which prevented us from ſeeing the Event of this Experiment.

But to try more fully the force of the above-mentioned Poiſon, it is neceſſary to make ſeveral Experiments of it: For tho' the Bite of a Viper, if it be but ſlight, may kill ſome Dogs; yet in the Month following, a large ſtrong Dog, that was bit in the Tongue, which is a very dangerous part, recover'd without any Medicines. His Tongue indeed turned black, and ſwelled ſo much, that it could ſcarce be contained in his Mouth: He was ſtupid, as is uſual from the Venome of a Viper, but not ſo much but that he could ſtand on his Feet. A few Hours after, his Sleepineſs decreaſed; and the next Day he endeavour'd to lap Water, but the bigneſs of his Tongue prevented him. On the third Day he threatned to bite any body that diſturb'd him, and had recover'd ſo much Strength, as to be able to eſcape out of the place where he was kept: And two after, was ſeen in the Streets; but what became of him afterwards we could not learn.

On

On the 17th of *October* we gave a Dog 15 Grains of the dryed Root of *Monks-Hood* [*Napellus*] powder'd, and mixt with Fleſh and Broth. He had no ſooner taken it, but he was ſeized with a difficulty of ſwallowing, or rather ſeemed as if he was like to be ſtrangled. He immediately grew faint and reſtleſs, and dug the Ground with his Feet; but ſoon deſiſted, by reaſon of a fainting-Fit, as we imagined from the dull colour of his Eyes, and a weakneſs of all his Body. This Fainting was preſently ſucceeded by a violent Vomiting, in which he threw up the Fleſh that he had Eaten, which was very little alter'd. His Fainting ſoon returning again, he laid himſelf on the Ground; but being ſeized with terrible Convulſions of the *Abdomen*, Diaphragme, and of almoſt the whole Body, he run from place to place, and vomited ſo great a quantity of frothy Matter, that he was like to have been ſtrangled. His Vomiting increaſed, with a kind of crying and ſobbing, like broken Sighs, as if he had endeavour'd to bark at thoſe that ſtood by. In this manner he was miſerably tormented for the ſpace of an Hour; at which time all his Symptoms remitted, and by degrees he recover'd.

In the Summer before, we gave a little Dog a Drachm of the Root of *Monks-Hood* [*Napellus:*] He was ſoon after ſeized with the ſame Symptoms, but they were longer and more violent; and he in like manner recover'd.

In both theſe Dogs we particularly took notice of theſe broken and interrupted Sighs, or kind of ſobbing; becauſe we did not obſerve the like to be occaſioned by any other Poiſon that we had made Trial of.

An Ounce of the Leaves, Flowers, and Seed of the *Napellus* when green, being bruiſed and given to a Dog, ſcarce diſorder'd him any more than if he had eaten ſo much Graſs.

About

About the ſame time we made tryal of the *Nux Vomica* on another Dog; not that we doubted of its being a Poiſon, but that we might ſee the effect of it on his body when dead. The Dog accordingly dying in a ſhort time, we found his Stomach and ſmall Guts very red; and judged this Redneſs and Inflammation to be cauſed by the Corroſiveneſs of the Medicine.

On the 20th of *October*, we injected warm into the Jugular Vein of a ſtrong luſty Dog an Ounce of Emetic Wine [*Vinum Emeticum:*] For a quarter of an Hour, after the Operation was over and he was let looſe, he continued pretty well, unleſs that he ſeemed ſomewhat dejected; but afterwards he began to grow ill, and an unuſual Agitation was manifeſt about the Diaphragme; this was followed by a continual Vomiting, and a little after by an Evacuation of ſome hard Excrements. By theſe Evacuations he ſeemed to be ſomewhat relieved, but ſoon grew uneaſy, moved from place to place, and vomited again. After this he laid himſelf down on the Ground pretty quietly; but his Vomiting returning again, diſturbed his Reſt, and abated his Strength, which grew weaker and weaker; for in the ſpace of an Hour he vomited 12 times or more, and ſometimes voided ſome liquid Excrements, but in ſmall quantity; having frequent Inclinations to go to Stool, but in vain, as in a *Teneſmus*. An Hour and half after the Oparation, he being ſo weak that he could not ſtand, his Eyes dull, and looking as if he were half dead, we gave him ſome warm Broth thro' a Funnel. With this he was wonderfully refreſh'd immediately, and ſoon after could look about, ſtand on his Legs and walk; but by reaſon of his weakneſs, reel'd as if he had been drunk. We left him by himſelf in a warm Room, where he remained cold, and lay as if he had been dying; and in an Hour after, we forced him to take ſome more Broth, which revived him again: But in a little time, after ſome agitation of

his Body, he vomited, made Urine very plentifully, howled miserably, and dyed convulsed. Next Day in viewing his *Viscera*, we found two things very observable (but neither of them occasioned by the Liquor that was injected;) one of them was in the Heart, the other in the *Œsophagus*. In the Heart there were two *Polypus*'s: That which possess'd the right Ventricle, stretched itself into the *Vena cava* and Pulmonary Artery; and that which was in the left Ventricle, sent Branches into the adjoyning Vessels, and was less than that in the Right Ventricle. The Substance of the *Polypus* was pretty firm, of a Flesh colour, somewhat pellucid, and being cut thro' the middle was altogether of the same colour and consistence as on the Surface. To the *Œsophagus* there grew a remarkable Gland, which was hard, callous and foul, and opened with a small, round, fleshy Orifice into the Inside of the Stomach, where, upon pressing it, a little Corruption came forth. Upon opening this Gland or Tubercle, we found in it a great many little Worms, wrapt and entangled together, and moisten'd with a corrupted Matter. Some of these Worms were above 4 Inches long, others less. Afterwards we found the like Glands, full of Worms, in other Dogs, and in most we opened, but not so much corrupted as in this. We observ'd also the like foul Glands in the *Aorta descendens*, but in one only found a Worm like these, which was almost got out of it, thro' an Orifice, into the Cavity of the *Thorax*. After this we likewise observ'd more *Polypus*'s in Dogs.

On the 27th of *October* we injected warm into the Jugular Vein of a Dog a Drachm and half of *Sal Armoniac* dissolved in an Ounce and half of Water. The Liquor had scarce arrived at the Heart, but the Dog presently fell into deadly Convulsions over his whole Body: Wherefore we let him loose, but he dy'd immediately.

On

On the 18th of *November*, we cauſed a Whelp to be bit in the lower Lip by a *Blind-Worm* [*Cæcilia*] ſo that the Blood appear'd in the Wound. The Whelp dy'd indeed the ſame Day; but becauſe we had committed him to the care of another Perſon, we could not be certain whether he dy'd of the Wound or not; and what increaſed our Suſpicion, was, that there did not appear on the part that was bit any livid Colour.

On the 12th of *December* we injected into the Jugular Vein of a Dog a Drachm of *Salt of Tartar* diſſolved in an Ounce of warm Water: He dy'd crying, and in Convulſions, almoſt immediately.

On the 15th of *December* we found a *Polypus* in both the Ventricles of the Heart of a Dog, each *Polypus* ſtretching itſelf with a double Root into the Veſſels of the Ventricle it poſſeſſed. Afterwards we often obſerved the like *Polypus's* in other Dogs.

On the 20th of *December* we injected warm into the Jugular Vein of a Dog an Ounce of *Urine* made by a Man faſting. The Dog was uneaſy during the Injection, and while the Liquor paſſed to the Heart; but was not ſeized with any Convulſions or other ill Symptoms; and being let looſe, eat Breed very greedily.

The ſame Day we made a gentle Decoction of two Drachms of *White Hellebore*, well powder'd, in Spring Water, and evaporated it away to Nine Drachms and a half; and the next Day injected all the Decoction, ſtrongly preſſed out and turbid, into the Jugular Vein of a Dog. At firſt ſome few Drops only paſſed to the Heart, ſome concreted Blood obſtructing the Paſſage; but thoſe Drops very much affected the Dog, for he was ſeized immediately with convulſive Motions: But ſoon after, when the Liquor had removed what lay in its way, and had enter'd the Heart, it killed the Dog as ſuddenly as if he had been ſhot thro' the Heart with a Bullet; for having loſen'd him preſently, to ſee if any Life

remain'd, he was quite dead and flaccid, and hung like a Fleece in the hand of the Perſon that held him.

On the 2d of *January* 1679. *Vinegar* was injected warm into the Jugular Vein of a Dog, without doing him any manifeſt harm.

The ſame Day we cauſed a *Whelp* to be ſtung in the Tongue by ſeveral *Scorpions*; but the Wounds made by the Scorpions, by reaſon of their weakneſs, being but ſlight, and not penetrating deep, we made a ſmall Inciſion on the *Abdomen*, and drawing aſide the Skin, let the Scorpions make ſeveral Wounds on it; but without any effect, tho' we often forced the Sting into the Wounds, and preſſed the Bladder that is ſuppoſed to contain the Venome.

In like manner a *Pidgeon*, being ſeveral times ſtung by a *Scorpion*, remained unhurt.

January the 3d, two Drachms of *Sugar* diſſolved in an Ounce of Water, was injected into the Jugular Vein of a Dog: He received no harm from the Injection, but continued well for the three Days after, that we kept him.

On the 4th of *January*, a Drachm and half of *Spirit of Salt*, diluted in an Ounce and half of Water, and injected into the Jugular Vein of a Dog, killed him immediately. In the Right Ventricle of his Heart, we found the Blood partly grumous and concreted into harder Clots than ordinary, and partly frothy. In the ſame Dog that Gland that contains Worms, and is frequently found in the *Æſophagus*, opened with two Orifices into the Cavity of that Part, and in the *Sinus's* of it there lay ſeveral ſmall Worms.

January the 5th, we gave a Dog 12 ſmall Caterpillars of the Pine-tree [*Pityocampæ, vel Erucæ Pini*] weighing ½ a Drachm, which we bruiſed alive, and mixed with Fleſh. The Dog, tho' he was but young, received no other hurt, than that now and then he ſeemed as if he endea-

endeavour'd to ſwallow ſomething, or was troubled with an Inclination to Vomit; from whence we judged the Stomach and *Æſophagus* to be only lightly affected: But theſe Symptoms vaniſhed in a few Hours, and the Dog continued Brisk, and greedy of Meat, all the reſt of the Day.

The ſame Day we included a Rat in a large Glaſs with a *Scorpion*; but the Scorpion, being dull and benumn'd with the extream coldneſs of the Weather, was able to wound the Rat but very weakly; with which however the Rat being provok'd, ſet upon the Scorpion, and knawed off and devour'd part of him, keeping his Eyes ſhut all the while, that he might not be hurt by his Claws or Sting. The ſame Fate happened to another Scorpion, which we added to the former; but the Rat notwithſtanding remained unhurt.

January the 6th, we killed a Dog almoſt in a Moment, by injecting into his Jugular Vein an Ounce of *Spirit of Wine*, in which there was diſſolved a Drachm of *Camphire*.

The ſame Day we injected warm into the Crural Vein of a Cat, 50 Grains of *Opium*, diſſolved in an Ounce of Water. The Cat preſently after the Injection ſeemed very much dejected, but did not cry; only made a low, interrupted, complaining Noiſe. After this followed Tremblings of her Limbs, Convulſive Motions of her Eyes, Ears, Lips, and almoſt of all parts of her Body, with violent Convulſions of her Breaſt: Sometimes ſhe would raiſe up her Head, and ſeem to look about her, but her Eyes were very dull and deadiſh; and tho' ſhe was let looſe, and had nothing tied about her Head or Neck, yet her Mouth was ſo filled with Foam or Froth, that ſhe was like to be ſtrangled. At laſt, her Convulſive Motions continuing, and being ſeized with a ſtretching of her Limbs, ſhe dy'd within a quarter of an Hour.

Upon

Upon opening her Body, we did not find the Blood much altered from its Natural State.

February the 7th, we injected into the Crural Vein of a lusty strong Dog a Drachm and half of *Opium*, dissolved in an Ounce and half of Water. The Dog immediately shewed the great Pain he endured, by a violent strugling of his whole Body, a loud Noise that he made, notwithstanding his Jaws were tied, a great difficulty of Breathing and Palpitation of the Heart, with Convulsive Motions of almost all Parts of his Body: In a little time all these remitted, and he was seized with a profound Sleep, as if he had been in a Lethargy or Apoplexy. Having let him loose, he lay upon the Ground without moving or making any Noise, in so deep a Sleep, that he would not move with beating. About half an Hour after, if we beat him, he would move a little, but presently lay down again. After an Hour, if we beat him, he would move a little more; and by degrees his Sleepiness a little decreasing, in an Hour and half or two Hours time, when he was beat he would make a Noise and walk a little, but seemed very heavy and stupified, and reeled as he went; but as soon as we left off beating him, as if he had forgot every thing that had past, he presently laid himself down again and fell asleep. Next Day when we viewed the Place where he lay, we found a great quantity of fetid Excrements, like corrupted Blood, or the diluted *Opium* that he had taken: But still his Drowsiness continued, and tho' we beat him with Whips, that he ran crying about the Room, yet he presently forgot it, and immediately fell asleep again. In this sleepy Condition he continued 3 Days, refusing whatsoever was offer'd him to eat, or rather not minding that or any thing else: On the 4th Day we found him dead: But perhaps he would not have dy'd of the stupifying Quality of the *Opium*, if (considering the extream coldness of the Weather)

ther) we had put him in a warmer place, and had forced him to have taken some Broth.

February the 8th, we found in the Bladder of a *Tortoise*, adhering to its Coat, a flat porous *Stone*, about twice as big as a Lentil.

February the 9th, a Drachm and half of *Common Salt*, dissolved in an Ounce and half of Water, was injected into the Jugular Vein of a Dog. After the Injection, he was thirsty, and drank Water greedily; but in other Respects he seemed to be pretty well, and the next Day was quite recover'd.

February the 20th 1679, we injected into the Crural Vein of a little Dog, half an Ounce of warm *Oil of Olives*, which we did with a great deal of difficulty, and very slowly, by reason of the smallness of the Vein and thickness of the Liquor. For half a quarter of an Hour that we were injecting the Liquor, the Dog did not seem to be uneasy or out of order; but after that, he barked, cryed, looked dejected, and fell presently into a deep Apoplexy; so that his Limbs were depriv'd of Sense and Motion, and were flexible any way at pleasure; his Respiration still continuing very strong, with a snorting and wheezing, and a thick watery Humour flowing in great quantity out of his Mouth, which was sometimes mixt with Blood. He lost all External Sense: His Eyes, tho' they continued open, were not sensible of any Objects that were put to them; and we touched and rubbed the *Cornea* (as sensible a part as it is) without any more sign of his being sensible of it than if he had been dead. His Eye-lids notwithstanding had a Convulsive Motion: His Hearing was quite lost; and his Feeling, tho' at first he seem'd to have some small Sense of it when we touched his Wound, yet afterwards it was so dull, that we pinced his Claws and Flesh with Pincers, and bored Holes thro' his Ears, without his moving or seeming to be the least sensible of it. It is worth obser-

obſerving, that in the midſt of his Sleep, being ſometimes ſeized with a Convulſive Motion of his Diaphragme and other Muſcles that help Reſpiration, he would bark ſtrongly as if he were awake, and in a little time would be quiet again: So that in leſs than a quarter of an Hour his Reſt would be diſturbed 3 or 4 times with this violent Barking. But conſidering this more attentively, we found that at the very time he barked, he was as void of Senſe as before; for we could neither make him Bark, nor leave off Barking, by either beating or pricking him; but in a little time he would leave off of himſelf, and return to it again ſome time after. Thus in three Hours after the Injection, ſpent in Sleeping and Barking, he dyed; and having opened his Body after he was dead, we found the *Bronchia* of the Lungs filled with a thick Froth.

A few Days after we injected a larger quantity, *viz.* an Ounce of *Oil of Olives* into the Jugular Vein of a Dog, which ſuffocated him the ſame Moment.

Afterwards the ſame quantity of *Oil of Olives*, being injected into the Jugular Vein of a Dog, killed him in an Hours time. He was ſeized with a great Sleepineſs, Snorting and Wheezing, and a bloody Water run plentifully out of his Mouth. In this Dog, tho' he did not dye immediately, we did not obſerve the Barking as in the former: But in all that were ſuffocated by Oil, we found their Lungs filled with a very thick Froth.

February the 27th, we injected 10 Drachms of highly rectified *Spirit of Wine* into the Crural Vein of a Dog. The Dog died in a very little time, very quietly, and as it were with pleaſure, licking his Jaws with his Tongue, and breathing quick, but eaſily, without barking, crying, or any Convulſive Motion. In the *Vena cava* and right Ventricle of the Heart, the Blood was concreted into a great many little hard Clots; which appeared yet more conſpicuous and harder in ſome Blood that flowed back from

from the Vein into the Syringe. In this Dog we found the Emulgent Artery of the Left Side to be double.

March the 2d, we injected three Drachms of rectified *Spirit of Wine* into the Crural Vein of a small Dog; which made him Apoplectick, and as he were half dead. In a little time he recover'd from his Apoplexy, but grew giddy; and when he endeavour'd to go, reeled and fell down. Tho' his Strength increased by degrees, yet his Drunkenness still continued: His Eyes were red and fiery, and his Sight so dull, that he did not seem to take notice of any thing, and when he was beat would scarce move. However, in four Hours time he grew better, and would eat Bread when we gave it him. The next Day he was brisker, and seemed past all Danger.

In dissecting the same Dog some time after, we found in the small Guts two *Flat-Worms*; one of them about 6 Spans long, and the other about 5. They had perforated the Gut; and one of them was got half out of it into the Cavity of the *Abdomen*.

About the same time we found in two Dogs a *Worm*, of near a Foot in length, out of the Intestines, in the Cavity of the *Abdomen*, the Intestines being no ways perforated, but remaining sound and whole. That we might be more certain of this, we separated them from the Mesentery, and viewed them very carefully. But in both these Dogs the *Omentum* was of an ill colour and putrified; from whence we conjectured, that these Worms were bred from the Putrifaction of the *Omentum*.

We injected into the Crural Vein of a Dog 5 Ounces of a strong *White Wine*; which made him very drunk, and little different from what a less quantity of *Spirit of Wine* would have done: But in a few Hours his Drunkenness abated, and he recovered.

In the ſame Month of *March* we injected into the Crural Vein of a Dog, an Ounce of a ſtrong Decoction of *Tobacco*. He was ſeized immediately with ſtrange Convulſions of his whole Body. At firſt his Eyes looked wild and diſtorted, his Jaws trembled; and in a little time he died terribly convulſed. This Experiment we repeated ſeveral times after, and always with the ſame ſucceſs.

Ten Drops of diſtilled *Oil of Sage*, mixt with half a Drachm of Sugar, and diſſolved in an Ounce of Water, being injected into the Crural Vein of a Dog, did him no harm.

In a Caſtrated Dog we obſerved the Proceſſes of the *Peritoneum* and Spermatic Veſſels to be cover'd with Fat, and ſcarce to be ſeen; and that he did not ſmell ſo rank and ſtrong, as other Dogs that had not been Caſtrated.

A yellow-ſtreak'd *Lizard* [*Lacerta Chalcidica*] which had been kept all the Winter in a Glaſs with Bran, being expoſed to the Sun to refreſh it, on the contrary died in a few Hours. We have alſo often found, that *Scorpions* expoſed to the hot Sun, eſpecially in the Summer, died in a ſhort time.

A Drachm of purified *White Vitriol*, injected into the Crural Vein of a Dog, killed him immediately.

Fifteen Grains of *Salt of Urine*, diſſolved in an Ounce of Water, and injected into the Crural Vein of a Dog, caſt him into ſuch violent Convulſions, that we were afraid he would dye under them. When he had recovered himſelf a little, we repeated the Injection with the ſame quantity; but the Dog got the better of it, tho' with a great deal of difficulty, and perfectly recovered.

April the 27th, we made a Decoction of 2 Drachms of *Sena* in Water, and injected warm three Ounces of it into the Crural Vein of a very fat, large, and ſtrong Dog.

Dog. He continued pretty quiet, without any ſign of pain or uneaſineſs, during the Operation; and when it was over we let him looſe, expecting the Event of it. He was melancholy and dejected, but eaſy and without any ſenſible commotion, for the ſpace of an Hour. After that, his Reſpiration grew quicker, he had a murmuring Noiſe in his Belly, with violent Commotions of the Muſcles of his *Abdomen*, Diaphragme, Stomach and Inteſtines, and vomited plentifully a Bilioſe Matter. After his Vomiting he grew faint, and in a little time his Vomiting returned again; ſo that in an Hour and half he vomited four times. His Strength and Appetite were very weak, and he would eat nothing for three Days. But on the third Day his Appetite, Strength, and former Briskneſs returned, and he recover'd.

Two Dogs, which had their *Recurrent Nerves* cut, loſt their Barking and Voice. But doubting whether the Wound or Scar might not affect and hurt the Motion of the Muſcles, we performed the ſame Operation on another Dog, but without cutting the Nerves; and when the Wound was healed, he barked as freely as before.

A Dog that had the Nerves of the *Par vagum* cut aſunder, preſently grew dejected and faint. He breathed very ſlowly and with Sighs; for when he had drawn in his Breath leiſurely and inſenſibly, it came forth again immediately very forcibly and with a Sigh, as if it had been retained a long time in the Lungs. The Muſcles of the *Abdomen* and the Diaphragme laboured hard, as if they were to ſupply the Defect of the Lungs, which were grown almoſt uſeleſs by being denied an Influx of Spirits by the Pneumonic Nerves. The Dog refuſed all kind of Meat; ſometimes he vomited, or had an Inclination to Vomit; and at laſt, in two Days time, he dyed.

An other Dog, that had the Nerves of the *Par vagum* only tyed, lived 10 Days. He vomited frequently, and would not eat unleſs clandeſtinely: He breathed with Sighs, and was very faint.

A Dog, that had the Trunk of the *Aorta deſcendens* tyed hard a little above the Diaphragme, immediately loſt the uſe of his hind Legs; for when he ſtood on his fore Legs, he would draw after him his hinder Legs, as if they had been dead: He grew weaker by degrees, and dyed in five Hours.

July the 12th, a *Mole* being ſtung in the Side by a *Scorpion*, dyed immediately convulſed. In this we obſerved, that the *Inteſtinum cæcum* is wanting in Moles.

III. *A Letter from the late Mr.* Edward Lhwyd, *Keeper of the* Aſhmolean Muſeum *in* Oxford, *to Dr.* Tancred Robinſon, *F. R. S. Giving a farther Account of what he met with remarkable in* Natural Hiſtory *and* Antiquities, *in his Travels thro'* Wales.

Lhan Dyvodog, Glamorganſhire, Sept. 22. 1697.

SIR,

I Had no ſooner received your laſt, but was forced to retire in a hurry to the Mountainous Parts of this County, in order to copy out a large *Welſh* MS. which the Owner was not willing to ſpare above two or three Days, and that in his Neighbourhood. It was writ on Vellom, about 300 Years ſince; and contained a Collection of moſt of the oldeſt Writers mentioned by Dr. *Davies*,

Davies at the end of the *Welsh* Dictionary: So I thought it better trespassing on the Gentleman's patience that lent it, than lose such an Opportunity as perhaps will not occur again in my Travels. This is the occasion of my long Silence —— the transcribing of that Book taking up two Months of our time.

I sent Mr. *Ray* an Account of some Plants we met with, with three or four Figures, which perhaps you have seen. We have since found two or three others, which I had never met with before; *viz.* 1. *Lysimachia Chamænerion dicta Alpina C. B. Prodr.* 2. *Bifolium minimum.* 3. *Solanifolia Circæa Alpina C. B.* 4. Mr. *Ray's Alsine spuria pusilla repens foliis Saxifragæ aureæ.* We found indeed the First also last Year at *Hyswal*, one of the Hills of *Snowdon*; and I had formerly sent Mr. *Ray* a dried Leaf. Dr. *Richardson* brought it home with him last Year; and it flowring since in his Garden, he is fully satisfy'd it is distinct from the Common *French* Willow-Herb.

In a steep Rock called *Craig y park*, and others in the Parish of *Ystrad Dyvodog*, we observed divers Veins of Coal, exposed to sight as naked as the Rock; and found a Flint Axe, somewhat like those used by the *Americans*.

At *Goldcliff* in *Monmouthshire* we had some variety of form'd Stones: But what pleased me most was an *Asteria*, or Column Star-Stone, beset with Sprigs the whole length of it, issuing from the Commissures of the Plates.

This County abounds with *Entrochi*; one whereof I saw in a Rock at the Isle of *Barry*, above 15 Inches in length; and an other about 10 Inches long, but as thick as a Cane. We took their Figures and Dimensions, but could not get off the Stones without breaking.

At *Kaer phily* Castle the People shewed us an Inscription (as they supposed) on one of the Steps of the Tower;

Tower; a Copy whereof I here ſend you. I muſt confeſs I am not fully ſatisfied whether it were ever deſigned for reading, or for ſome kind of Antique Ornament; but rather incline to the latter. The Stone was not deſigned for a Step, there being none of the ſame kind in the whole Stair-Caſe. The Marks were moſtly worn out by treading; and it is poſſible they might be once more uniform; and ſome few Miſtakes may have happened in the copying it as it is. I have ſent the Stone to the *Muſeum* at *Oxford*; where the Curious may be ſatisfied. Were it the old *Celtic* Character, which *Cæſar* ſays was like the *Greek*, 'twere a noble Diſcovery: But I fear our Anceſtors (if ever they had any Writing) have left us none upon Stones.

I alſo copied the Maſons Marks on ſome Stones there; whereby perhaps ſome Perſons curious in Architecture may judge whether it has been a *Roman* or later *Britiſh* Building: I ſay *Roman* or *Britiſh*, becauſe the *Saxons* and *Danes* never ſettled here; and it is older than the *Norman* Conqueſt.

We have collected what Inſects occur'd this Summer, eſpecially the Butterflies; but we are ignorant of the means of preſerving them well in our Travels. I ſhall take all the Care I can of the Zoophytes this Winter in *Pembrokeſhire* and *Cardiganſhire*; but as yet we have met with very few of them. I am,

Honoured Sir,

Your moſt humble and

affectionate Servant,

E. LHWYD.

Fig. 1.

Fig. 1. The Masons Marks on the Stones that supported the Arches at *Kaerphily* Castle, *Glamorganshire.*

Fig. 2. A Sculpture on one of the Steps in a round Tower at *Kaer Phily* Castle.

Fig. 3. Certain Plates which frequently occur amongst the *Entrochi* of this County.

IV. *Several Observations relating to the* Antiquities *and* Natural History *of* Ireland, *made by Mr.* Edw. Lhwyd, *in his Travels thro' that Kingdom. In a Letter to Dr.* Tancred Robinson, *Fellow of the College of Physicians and Royal Society.*

Bathgate near *Linlithgow, Scotland*, Dec. 15. 1699.

SIR,

YOUR last, dated some time in *July*, overtook me about a Month after in *Ireland*; whence I had returned my Thanks, but that I was desirous to see somewhat more of the Country, in order to some Materials for a Letter. But having no conveniency of dispatching Letters from the *Highlands* of this Kingdom, I find I have now so long defer'd it, that I have by me Materials for several Letters; which must serve hereafter, when we traverse Places affording fewer Curiosities.

We continued not above three Days at *Dublin*, when we steer'd our Course towards the *Giants Causway*. The most remarkable Curiosity we saw by the way, was a stately Mount at a Place called *New Grange* near *Drogheda*; having a number of huge Stones pitch'd on end round about it, and a single one on the Top. The Gen-

tleman

tleman of the Village (one Mr *Charles Campbel*) obſerving that under the green Turf this Mount was wholly compoſed of Stones, and having occaſion for ſome, employ'd his Servants to carry off a conſiderable Parcel of them; till they came at laſt to a very broad flat Stone, rudely Carved, and placed edgewiſe at the Bottom of the Mount. This they diſcover'd to be the Door of a Cave, which had a long Entry leading into it. At the firſt entering we were forced to creep; but ſtill as we went on, the Pillars on each ſide of us were higher and higher; and coming into the Cave, we found it about 20 Foot high. In this Cave, on each hand of us was a Cell or Apartment, and an other went on ſtreight forward oppoſite to the Entry. In thoſe on each hand was a very broad ſhallow Baſon of Stone, ſituated at the Edge. The Baſon in the Right Hand Apartment ſtood in another; That on the Left hand was ſingle; and in the Apartment ſtraight forward there was none at all. We obſerved that Water dropt into the right hand Baſon, tho' it had rained but little in many Days; and ſuſpected that the lower Baſon was intended to preſerve the ſuperfluous Liquor of the upper, (whether this Water were Sacred, or whether it was for Blood in Sacrifice) that none might come to the Ground. The great Pillars round this Cave, ſupporting the Mount, were not at all hewn or wrought; but were ſuch rude Stones as thoſe of *Abury* in *Wiltſhire*, and rather more rude than thoſe of *Stonehenge*: But thoſe about the Baſons, and ſome elſewhere, had ſuch Barbarous Sculpture (*viz.* Spiral like a Snake, but without diſtinction of Head and Tail) as the fore-mentioned Stone at the Entry of the Cave. There was no Flagging nor Floor to this Entry nor Cave; but any ſort of looſe Stones every where under Feet. They found ſeveral Bones in the Cave, and part of a Stags (or elſe Elks) Head, and ſome other things, which I omit, becauſe the Labourers differ'd in their

Account

Account of them. A Gold Coin of the Emperor *Valentinian*, being found near the Top of this Mount, might beſpeak it *Roman*; but that the rude Carving at the Entry and in the Cave ſeems to denote it a Barbarous Monument. So, the Coin proving it ancienter than any Invaſion of the *Oſtmans* or *Danes*; and the Carving and rude Sculpture, Barbarous; it ſhould follow, that it was ſome Place of Sacrifice or Burial of the Ancient *Iriſh*.

The *Giants Cauſway* is ſo well deſcribed in the *Phil. Tranſact.* [N° 212 & 241.] that nothing can be added to that Account of it. We have the ſame Stone on the Top of *Cader Idris*, one of the higheſt Mountains of North *Wales*; but ours is leſs elegant, and does not at all break off in Joints; nor could I ſatisfy my ſelf that there are ſet Joynts (as in the *Entrochus* and *Aſteria*) in the *Baſaltes* of *Ireland*; but that it is the Nature of the Stone to break off in ſuch a convex Form. However, we could perceive no Seams in theſe Pillars, excepting on thoſe Sides that were expoſed to the Weather.

An other remarkable Curioſity we met with, was a Copper Trumpet like a Sow-Gelders Horn; having the Hole for ſounding near the midſt, and two Rings at the ſmaller End; above two foot long. Three of theſe were found in an old *Karn* (*i. e.* a great Heap of Stones) at *Balle Niwr* near *Carreg Fergus*.

We could make nothing of the Petrifying Quality of *Loch Neach*; but that they ſometimes find Stones there, having the Grain of Wood.

We met with ſome *Iriſh* Inſcriptions there, and others here; which none of the Critics in that Language we converſed with could interpret.

Near *Larne* in *Antrim* we met with one *Eoin Agniw*, whoſe Anceſtors had been Hereditary Poets, for many Generations, to the Family of the *O Neals*; but the Lands they held thereby being taken away from his Father, he had forſaken the Muſes and betaken himſelf to

the Plow: So we made an eaſy Purchaſe of about a dozen ancient Manuſcripts on Parchment.

As to your Queries: The *Mackinboy* is the *Tithymalus Hibernicus* (or *latifolius ſylvaticus*) *Cat. Hort. Oxon.* Their *Shamrug* is the common Clover. The *Potato* is not indigenous of *Ireland.* The *Arbutus* is, for what I can yet underſtand, the ſame with the Common: And for the *Sabina*, I doubt my Friend I ſent to *Kerri* (whom I have not yet ſeen) will bring me no News of it.

I have the Account of the living Foſſil Muſcles atteſted and ſigned by the four Perſons preſent at the finding them; ſo that nothing but its being a ſingular Inſtance makes me ſcruple the Relation: But the Labourers have ſuch a Character for Veracity, that I rather incline to believe it, than to doubt. I am,

Honoured Sir,

Your moſt obliged Servant,

E. LHWYD.

V. *An Account of Experiments concerning the Proportion of the Power of the Load-ſtone at different Diſtances. By Mr.* Fr. Hauksbee, *F. R. S.*

WIthout mentioning the many Difficulties that attend the making of Experiments of this Nature, I ſhall immediately give an Account of their Succeſs, and the manner of proceeding; which was as follows. I took a Quadrant of 4 Feet *Radius*; and having fix'd it to the Floor, in the Poſition of the Needle, whoſe South

South Point directed itself to no Degrees, I then fix'd a Board (likewise on the Floor) in a direct Angle from from the same, the Graduations on which Board were 3 Inches distant from each other. The Needle was suspended on a Point arising from the Center of the Quadrant, from whence were measured the several Stations of the Magnet. The Magnet was laid on a thin piece of Board; under which to one side was nail'd a narrow slip of Wood, to slide it along the side of the fore-mention'd graduated Board, whereby the Stone might be always kept in the same Direction to the Needle. The Stone that I used weighed about six Pounds; was rough, and of an irregular Figure; yet I could discover no Inconveniency in the Experiment arising from the same, it being, and acting at all Distances in the same Position as it is first plac'd on the Board: And I see no reason to doubt, but the Proportions of its Power will be regular, and agreeable to the several Distances; as more than once I have observ'd. For when the Stone hath been differently posited on the fore-mentioned thin board, different Angles of the Needle would ensue at the same Stations; yet their Proportions one to another would be nearly the same. My meaning is this: Suppose the Stone was so plac'd, as at 3 Inches from the Needle it would give the Needle an Angle of 90 Degrees, the Stone being continued in the same Direction at the several Stations, the Proportions of its Power one to another would be much the same, as if the Angle of the Needle at the first beginning made but 87, or even but 80 Degrees on the Quadrant; for upon a small alteration of the Poles of the Stone, such diversity of Angles will arise.

In these Experiments I made use of two Needles; one of a *Radius* of 6 Inches, the other but of one Inch: Which last, after abundance of tryals, I found to be most accurate; besides the Advantage it gave in begin-

ning the Experiment 6 Inches nearer the Stone than the other: And from two Feet diſtance from the ſame, it became nearly agreeable to the Angles made by the long Needle to all the farther Diſtances; as you will find by the following Tables, which were made with the ſeveral Needles in the ſame direction of the Stone. I meaſured the Angles by a Silk thread ſtrained directly over the Needle to that part of the Quadrant to which it was directed; which was the beſt way I could contrive to come neareſt the truth.

It may be obſerv'd from the following Tables, that the long Needle at 9 Inches from the Stone, made ſomewhat a larger Angle than the ſhort Needle at 3 Inches diſtance from the ſame; that the ſhort Needle at the diſtance of 9 Inches, made an Angle of 9 Degrees leſs than the long one at the ſame place. But this odds will eaſily be accounted for, if we conſider the diſproportions of the Needles lengths; for the Point of the long Needle at 9 Inches, was brought within an Inch as near the Stone, as the Point of the ſhort Needle was, when but 3 Inches diſtant from the ſame: The Point of the ſhort Needle at 9 Inches from the Stone, was 5 Inches farther from it, than the long one at the ſame Station. Theſe diſproportions being conſider'd, it is no wonder ſuch difference of Angles ſhould enſue upon the Uſe of the ſeveral Needles near the Stone; for at two Feet, and the farther diſtances, they become nearly agreeable, as I ſaid before. When I ſpeak of Diſtances from the Needle, I always mean from the Center of it.

Farther it is obſervable, that the Stone at 5 Feet diſtance from the Needle made an Angle of 2 Degrees with one, and with the other of two and a half; yet upon the abſence of the Stone they would return to no Degrees, as at firſt: Which plainly ſhews, that the Influence of the Stone extended farther; Altho' Obſervations, at remoter Stations, could not eaſily be determined.

Ex-

Experiments by the ſhort Needle.

Diſtances of the Loadſtone from the Needle in Inches.	The ſeveral Angles of the Needle at the ſeveral Diſtances. *D.* /	The differences compared one with another, at the ſeveral Obſervations, in Minutes.
3	87—00	180
6	84—00	330
9	78—30	570
12	69—00	735
15	56—45	795
18	43—30	630
21	33—00	540
24	24—00	360
27	18—00	270
30	13—30	150
33	11—00	135
36	8—45	105
39	7—00	90
42	5—30	60
45	4—30	40
48	3—50	30
51	3—20	20
54	3—00	15
57	2—45	15
60	2—30	00

Exa

Experiments by the long Needle.

Distances of the Loadstone from the Needle in Inches.	The several Angles of the Needle at the several Distances. *D.* *I*	The differences compared one with another, at the several Observations, in Minutes.
09	87—30	345
12	81—45	570
15	72—15	1135
18	53—20	1100
21	35—00	660
24	24—10	380
27	17—50	280
30	13—10	180
33	10—10	130
36	8—00	90
39	6—30	75
42	5—15	65
45	4—10	40
48	3—30	30
51	3—00	25
54	2—35	20
57	2—15	15
60	2—00	00

At greater Distances, and even the more remote in these Tables, the Power of the Stone is so weak, and the measuring the Angles at all times exactly so difficult, that 'tis well if we come sometimes within 10 or 20 Minutes of Truth: The Correction of which I shall wholly leave to the Determination of such Gentlemen, whose Province such an Experiment as this most peculiarly belongs to.

A Deſcription of the Loadſtone made uſe of in the foregoing Experiments.

This Stone weighed exactly 6 Pound, one Ounce and $\frac{1}{4}$ Averdupois Weight. Its Form reſembled *Figure* 4. Its breadth at the North Pole was 4 Inches; at the South Pole 5 Inches; the Poles running thro' the Stone in the direction of the prick'd Line. The length of the ſhorteſt ſide was 6 Inches $\frac{1}{2}$, of the longeſt ſide 7 Inches $\frac{1}{2}$. Its thickneſs at the North Pole was one Inch and a half, and at the South Pole one Inch.

VI. *The Specifick Gravities of ſeveral Metalline Cubes, in compariſon with their like Bulks of Water. By Mr.* Fr. Hauskbee, *F. R. S.*

THeſe Cubes were deliver'd to me by Dr. *Sloane*, and ſuppoſed to be extraordinary in their ſeveral kinds, except the Gold. Their workmanſhip was very accurate; and they were exactly of a ſize, altho' they differ'd a little from our Meaſure. Six of them being laid on a Rule, Side by Side, meaſured about a tenth more than 6 Inches; and if their Sides were chang'd, they ſtill made the ſame meaſure. And it farther appeared that they were exact, by their agreeableneſs in the Weight of their reſpective Bulks of Water, as may be obſerved by comparing them in the following Table.

Troy

Troy Weight.

	Weight of the ſeveral Cubes in Air.	Weight of the ſeveral Cubes in Water.	In proportion to their like bulk of Water.
	O. DW. G.	*O. DW. G.*	
Gold	9—11—8	9—00—6½	17.3
Silver	5—14—10	5—03—10½	10.421
Copper	4—16—8	4—05—10½	8.841
Braſs	4—05—7	3—14—9	7.81
Lead	6—02—12	5—11—17	11.35
Iron	4—04—17	3—13—20	7.777

as to Unity.

VII. *An Account of what appeared on the Diſſection of the Body of Mr.* —— Dove. *By the late Mr.* William Cowper, *Surgeon, F. R. S. In a Letter communicated by Dr.* Hans Sloane, *R. S. Secr.*

Honoured Sir.

HAD any opportunity offer'd, you ſhould have received the following Account of what appeared on the Diſſection of Mr. *Dove* before now.

The Body in divers Parts appeared of a Black, Blue, Livid, and various Colours, before I made any Inciſion into it; particularly the Back (where the Blood was ſettled) had a Cadaverous Blackneſs; where the *Cuticula* was

was here and there veſicated, or diſtended with *Serum*. Of this there was no Appearance before Death.

The Muſcles of the *Abdomen* had a Mortified Appearance, being a blackiſh green Colour. The Liver was intirely ſphacelated. The Spleen had large mortified Spots on its Surface: Both theſe Parts were ſpecifically lighter than in the Natural State; inſomuch, that Portions of each of them ſwam on the Surface of Water, and ſeemed to have more Air in them than we commonly find in the Lungs in their Natural State. The reſt of the *Viſcera* in this lower Cavity were not in ſo ill a State; tho' the Guts had here and there blackiſh Spots on them.

The Pectoral Muſcles were in little better State than thoſe of the *Abdomen*; nor were the Intercoſtal Muſcles like thoſe of the Limbs. I am apt to think all the Muſcles imployed in Reſpiration, had more or leſs of this Blackiſh Appearance. The Right Lobes of the Lungs were diſeaſed; and the ſame ſide of the *Thorax* had a ſmall quantity of *Serum* in it. The Lungs on the other ſide were in no ill Condition. The Heart was very flaccid and large: The Right Ventricle and *Vena Cava* had no ſmall *Polypus* in them. The *Vena Pulmonaris* was exceedingly dilated next the *Baſis* of the Heart. The Left Ventricle of the Heart was furniſhed with a ſmall *Polypus*, and a great quantity of Grumous Blood. The Great Artery was very thin, and appeared not a little extended, and had ſome Cartilaginous Bodies interſperſed in its Membranes.

In the Head; the *Dura Mater* was found inſeparable from the *Cranium* in its upper part. A *Polypus* was drawn out of the upper great Vein of the Brain, called *Sinus Falcis ſuperior*.

The Carotide Arteries were very thin, and much larger than they ought to be, before they entered the Subſtance of the Brain. In ſhort, all the Blood-Veſſels

which I examined were very much dilated, and seemed to be charged with as much Wind as Blood.

If there is any thing I have omitted, or have been too tedious in, I hope you will be pleased to excuse me, being in some confinement for want of time; which I will endeavour to mend at leisure. I am

Your obliged

Humble Servant,

W. COWPER.

VIII. *A Letter from Mr.* Ralph Thoresby, *F. R. S. to Dr.* Hans Sloane, *R. S. Secr. Giving an Account of the Damage done by a Storm of Hail, which happen'd near* Rotherham *in* Yorkshire, *on* June *7.* 1711.

Leedes, Nov. 3, 1711.

Honoured Sir,

BEing not long ago at *Wentworth-Woodhouse*, and other Places near *Rotherham*, where very considerable Damage was done by a Storm, I enquired after the most remarkable Particulars; which having receiv'd from so sure Hands as the Parties immediately concern'd, will not, I presume, be unacceptable to you.

The Storm of Hail, accompanied with very terrible Thunder and Lightning, happened upon the 7th of *June* last: It begun about *Rotherham*, (a little beyond which was somewhat of a Hurricane) where it burnt a noted

Tree. About one of the Clock it reached *Wentworth-Woodhouſe*. The Hail-Stones were from 3 to 5 Inches in Circumference, and ſome ſay larger, which killed ſeveral Pidgeons; but the chief Damage done here was in the Glaſs Windows, which coſt Forty Pounds in repairing. In *Waſh* Field, about two Miles from thence, it did vaſt Damage. This Field is generally computed to be worth a Thouſand Pounds when in White Corn (to uſe the Countryman's expreſſion:) Some part of it eſcaped, and the *Barley* received no Damage; but the generality of the *Wheat* was cut off, about half a Yard from the Ground, and the *Rye* about two Foot. The Stubble, tho' green at firſt, turn'd white, that it look'd like a Field newly Shorn. The *Rye* was afterwards Mown inſtead of Shearing, and yielded not above a Buſhel of Corn in a Wain-load. Some of the *Wheat* took Root, and grew up; but the Husbandmen generally thought, that if it ſhould come to Perfection, it would ſcarce yield as much as would be Seed for another Year. The breadth of this Storm was about half a Mile, as appeared by the Effects. In Places adjoyning there was no Hail, but large drops of Rain. A Joiner working with the Miniſter, from whom I receiv'd part of this Relation, meaſured one of the Hail-Stones with his Compaſſes, and it was an Inch and half in length; But theſe were not globular, but moſtly oblong. The generality of them there (which was at *Bolton ſuper Dearne*) were of the bigneſs of ordinary Cherries; tho' the aforeſaid Miniſter's Son took up one that was an Inch and half in Diameter and round, not long, and ſomewhat flat, as the others were; but the Youth durſt not ſtay long out, the Hail fell with ſuch violence. Ten of his Pidgeons were brought in ſore wounded, tho' not quite dead. Great quantities of Twigs and ſmall Boughs were beaten off the Trees, which being of leſs

Momen-

Moment are omitted; but the Damage in the Corn was ſevere upon the poorer ſort of Inhabitants. I ſhall conclude this, as the good old Miniſter (who was a Sufferer by this Calamity) does his Letter: *When thy Judgments, O Lord, are in the Earth, the Inhabitants of the World ſhould learn Righteouſneſs.* Iſai. 26. 9. I am,

Sir,

Your Obliged

Humble Servant,

RALPH THORESBY.

LONDON: Printed for *H. Clements* at the *Half-Moon*, and *W. Lynys* at the *Princes-Armes*, in St *Pauls Church-yard*; and *D. Brown* without *Temple-Bar.*

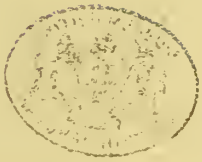

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

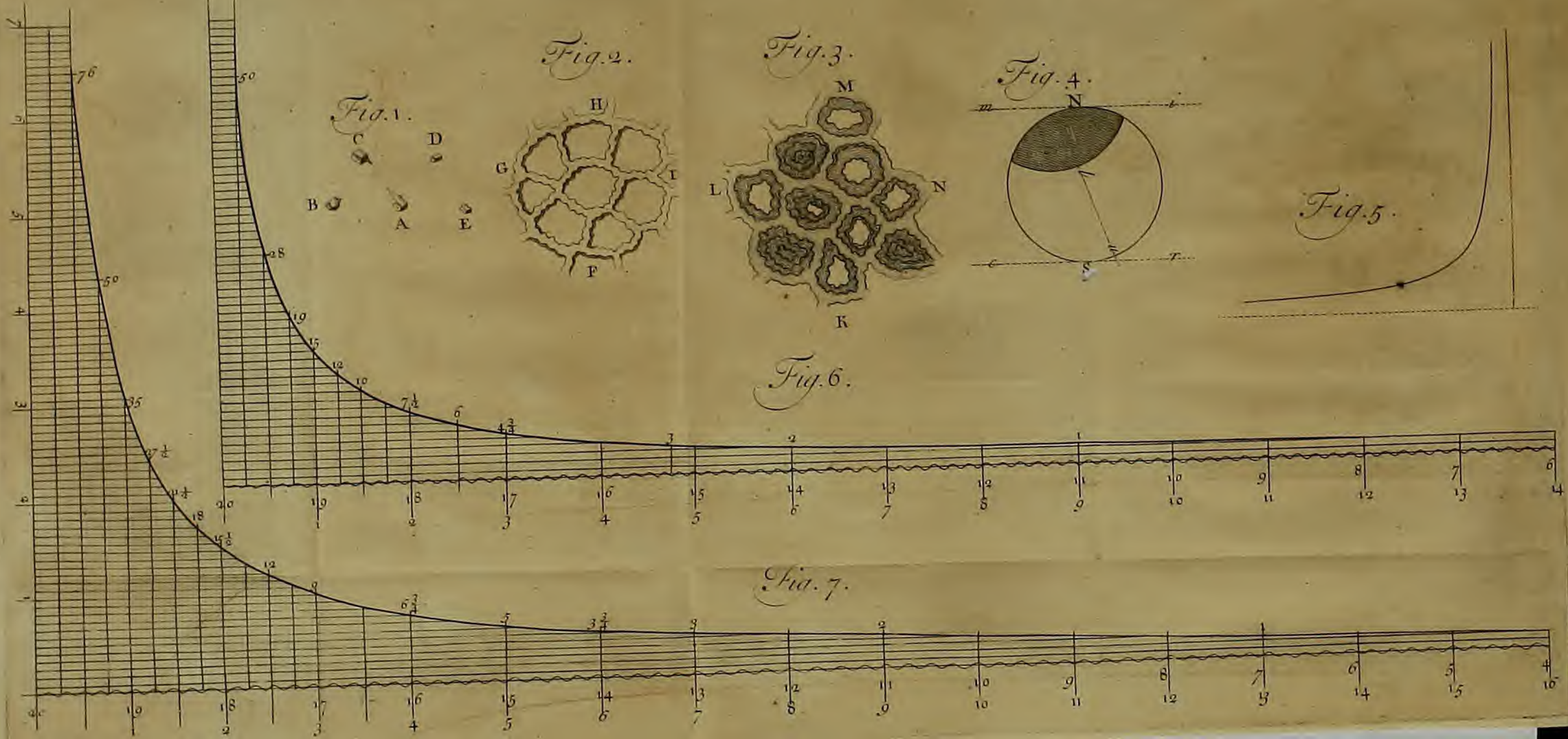

Fig. 7.

(Numb. 336.)

PHILOSOPHICAL TRANSACTIONS.

For the Months of October, November, *and* December, 1712.

The CONTENTS.

I. *Some*

I. *Some Remarks upon the Diſpoſition of the Parts, and Microſcopical Obſervations upon the Contexture of the Skin of Elephants. In a Letter from Mr.* Anthony van Leeuwenhoek, *F. R. S.*

Delft in *Holland*, *April* 12. 1712.

IT is ſome Years ago, that there was an Elephant ſhewn about for Money at the *Hague*, the biggeſt that ever I ſaw. Caſting my Eyes upon the hinder part of her, in order to obſerve the *Matrix*, I could not diſcover the leaſt appearance thereof; which ſeem'd to me very ſtrange. But it happen'd, whilſt I was curiouſly viewing this great unweildy Creature, that ſhe made Water; but not like our four-footed Creatures, from whom the Water iſſues, as it were, in a Stream; for from this Creature it burſt out all at once, juſt as if any Liquor were poured out of a Can, top and bottom all together: And I obſerved, that the Skin, out of which the Water flowed, was extended, or thruſt outwards about the ſpace of three Fingers breadth; and the Orifice, or opening of the Skin in that place, ſeem'd to be ſo large, that one might thruſt ones Fiſt into it: And that part, from whence the Water was diſcharg'd, was not ſituated, as it uſually is in our four-footed Beaſts, under the Tail, but in the Belly, and very near that part where the Navel grows in our Creatures.

This appear'd to me to be a very particular Diſcovery; the more, becauſe I remember'd I had often read, that when the time came for the Copulation of Elephants,

phants, the Female Elephant uſed to prepare herſelf a Bed with the Boughs of Trees, and then caſt herſelf upon her Back on them; but none of the Authors that I had read, gave their Reaſons for her doing ſo.

Caſting my Eyes upon the fore Legs of the Elephant, I obſerv'd growing upon the upper part of the Body, or about the Breaſt, two Nipples, which in Cows we call Dugs, quite contrary to thoſe of Mares, Cows, *&c.* whoſe Dugs are plac'd near the hinder Legs. But when we conſider farther of the Matter we muſt conclude, that Nature has ſo order'd it, in relation to the Elephant, for the Benefit of her youug ones, whom ſhe could not ſuckle, if her Dugs had been plac'd between her hinder Legs; for by reaſon of the Poſition of the Mouth under the Trunk the young Elephant can't ſuck its Dam; but the old one ſucks at her own Breaſt, and by the help of her Trunk conveys the Milk into the Mouth of the young one.

After theſe Obſervations, I viewed the Skin of the Elephant, which was very rough; upon which, diſcourſing with the Keeper, I was told that that Roughneſs fell off every year.

I therefore intreated the Keeper that he would with a Knife ſcrape off a little of that annually falling Roughneſs: But he at firſt refus'd my Requeſt; yet after I had aſſured him, that I would Reward him well for his Pains, he readily conſented to my Requeſt, and ſcrap'd off a little of the ſaid Skin upon a Paper.

Since that time I have view'd the ſcrap'd off Particles of the Skin, and always imagined that the moſt part of of it was a protruded Matter, which had not nonriſhment enough to turn it all into Hair; and that what became Hair was very ſhort and thin, in proportion to the bigneſs of ſo great a Body; and the Hair which is upon the Tail of the Elephant, is much thicker than that

which

which is upon the other Parts of the Body. But as I more nicely view'd the ſcrap'd off Particles of the Skin, I diſcover'd in ſome of the Particles ſhort ſmall Hairs, the Roots of which were ſticking outwards in that part which is joined to the Skin.

The Particles that were ſcrap'd off from the Skin of the Elephant, were crumbled into as ſmall pieces as are deſcrib'd by Figure 1. A. B. C. D. E. A. was a Particle on which there had been two Hairs, but by the Microſcope one might diſcover four.

When theſe Particles were ſcrap'd off from the Skin, ſome of 'em were thick, and as it were united to each other; but they were eaſily divided into ſuch Particles as are deſcrib'd by the aforeſaid Fig. 1.

This yearly ſhedding of the Matter that is upon the Skin may be thus accounted for: When the time comes that there is no Increaſe of the Hair, but that it is, as it were, at a ſtand, as we ſee in other Creatures that ſhed their Hair, the ſame thing happens to the Elephant; the Hair of which, as thin and as ſhort as it is, for the moſt part falls off, and the encruſtated Particles which ſtick to the Skin muſt alſo fall: And thoſe Particles lay as cloſe to one another as if they were united, being ſurrounded with flattiſh Sides in the manner they are ſhewn by Figure C. upon which there was remaining a ſmall Particle of Hair or Wooll.

Having nicely view'd one of thoſe Particles that are deſcrib'd by Figure 1. I diſcover'd on that ſide which was next the Skin ſeveral little Holes, in ſome of 'em 8, 10, 15, or more, according to the bigneſs of the Particle; but when I view'd the ſame on that ſide which was fartheſt from the Body, the ſaid Holes were cloſed: And I obſerv'd in ſome few of thoſe Particles ſmall Hairs ſtanding out, which run into an exceeding ſlender Point, agreeing with the Hairs of other Creatures, which are rubbed or cut off.

That I might the better discover the Figures of the said Matter, I endeavour'd to slit some of the Particles with a sharp Knife: But I found 'em so hard, that a thin and sharp Penknife got notches in it, and its edge turn'd in the Attempt: So that I was forc'd to whet it again, till at last I had slit some to my mind; which I did more easily after I had steep'd them a little while in boiling Water.

My design in separating or dividing these Particles, was to see if I could discover in them any thing that was worth Notice: But I could not; save only, that in the dissecting of such a Particle, I met with 25 small Sands; and then I did no longer wonder that it was so hard in cutting, and made notches in my Knife.

I took a slice of one of the Particles describ'd by Figure 1. and which, as I said before, had a great many Cavities or Holes in it; and placing the same before a Microscope, caused it to be drawn, as you may see in Figure 2. F. G. H. I. and so it appear'd to the Painter, tho' in my Eye it was larger: But I will not determine whether these little Holes were filled with Hairs when they were united to the Body, nor whether those Hairs stuck so fast in the Skin, as to remain there upon the Separation of the aforesaid Particles.

I cut off a Slice from another Particle, and caused that to be drawn also, as you may see in Figure 3. K. L. M. N. And this Particle appear'd very wonderful to me, consisting of 10 Circles; each of which I fancied was produced at a different time, and perhaps in a Month, according as the Matter was protruded from the Skin. When I cut a Slice out of the middle of one of those Particles describ'd by Figure 1. I could see no Holes in it; no more could I, when I cut off any of the upper part, discover the least appearances that are describ'd in Fig. 3. which was occasion'd perhaps by the Elephants rubbing or lying upon those Parts.

This is what I have thought proper to communicate of my aboveſaid Obſervations; and with great Reſpect I remain,

Your moſt humble Servant,

Anthony van Leeuwenhoek.

II. *Obſervations of the Eclipſe of the Moon, on* Jan. 12. 1711-12. *By the Revd. Mr* Wm. Derham, *F. R. S. In a Letter to* Rich. Waller *Eſq; R. S. Secr.*

Upminſter, Jan. 14. 171½.

SIR,

Saturday Evening being clear, gave me a good opportunity of obſerving the Lunar Eclipſe. The Times are very nice, and the Obſervations made with an excellent Six-foot Teleſcope, as followeth.

h. ′

6. 15 A duskiſhneſs upon the N. Eaſt ſide of the Moon.
6. 36 A thick *Penumbra* on the Moon.
6. 37 The *Penumbra* ſo denſe, that it may be taken for the Beginning of the Eclipſe.
6. 39 The Eclipſe undoubtedly is begun.
6. 41 The Shadow ſo dark, that it nearly hid the Moons N. Eaſternly Limb.
7. 21 Moons Diameter by the Micrometer 1612 equal parts, equal to 31′ 25″.

The

7. 25′ The distance of the Shadow from the opposite luminous Limb of the Moon, represented by the Line *l. u.* was 1025 Parts of the Micrometer, equal to 20 Minutes.
8. 31 End of the Eclipse is very near.
8. 32 End of the Eclipse.
8. 32 45″ Eclipse is undoubtedly ended.
8. 36 A *Penumbra* is left.

It unluckily fell out, that I disordered my Micrometer at the Beginning of the Eclipse; so that I could not take with any exactness the Inclination of the Cusps, and some other Matters I had a mind to have observed; to supply which defect in some measure, I have sent you a Type of the Eclipse as well as I could by guess. And from the same defect I cannot warrant the Micrometrical Measures of the Moon's Diameter, and her eclipsed Parts to be otherwise, than somewhat near the truth; perhaps not exactly true.

Fig. 4. A Type of the Lunar Eclipse *Jan.* 12. 1711-12.

m. i. c. r. represents the two Claspers of the Micrometer, parallel to the Equator.

N. The Northern, *S.* the Southern part of the Moons Disk, running between the Claspers of the Micrometer.

l. u. The enlightned part of the Moon, being 1025 Micrometrical Parts, or 20′

I am sorry I had not *Hevelius*'s Map of the Moon, to have noted the Spots the Shadow passed over; but I hope to mend that defect, if I live to observe another Lunar Eclipse. With great Respect I am

Your most humble Servant,

W. DERHAM.

III. *Some farther Observations relating to the Antiquities and Natural History of* Ireland. *In a Letter from the late Mr.* Edw. Lhwyd, *Keeper of the* Ashmolean Museum *in* Oxford, *to Dr.* Tancred Robinson, *F. R. S.*

Pensans, in *Cornwall*, Aug. 25. 1700.

Honoured Sir,

FOR Antiquities, *Ireland* affords no great variety; at least it was not our fortune to be much diverted that way. I have in divers Parts of the Kingdom picked up about 20 or 30 *Irish* Manuscripts on Parchment: But the Ignorance of their Criticks is such, that tho' I consulted the chiefest of them, as *O Flaherty* (Author of the *Ogygia*) and several others, they could scarce interpret one Page of all my Manuscripts; and this is occasioned by the want of a Dictionary, which it seems none of their Nation ever took the trouble to compose. I was informed (but how truly I know not) they have lately printed one at the *Irish* College in *Lovain*; which if I could procure, I should not despair of being in a short time able myself to understand these Manuscripts; tho' many of them being but insignificant Romances, it would scarce quit the Pains. What I most value amongst them are their old Laws, which might give some Light to the Curious as to many of their National Customs; and some of their old Poems: But all are of use to any that would compose a Dictionary of their Language; which was anciently (considering the narrowness of their Knowledge as to Arts and Sciences) doubtless very copious.

I saw no Coins found there, but the *Roman* Gold Coin of *Valentinian jun.* formerly mentioned; several of our old *English* since the Conquest; and one cast Brass Piece inscribed with *Runic* Letters, which I take to have been a *Danish* Amulet.

Several of our old *British* Monuments, called *Kaer*, *Karn*, *Cromlech*, &c. we met with; and found that they distinguished them by the same Names.

What were peculiar to themselves, were their high round Towers for Belfreys; their round Entrenchments, commonly called *Danes* Rathes; and the Elf-Arrow Heads of Flint.

About *Slego* and *Bali Shany* we had good success as to Figur'd Stones; where we met with variety of *Astropodia* and *Astrorrhizæ*, or *Modioli*, not yet figured or described, together with other Curiosities in that kind; all which (together with the Manuscripts) I have long since sent to *Oxford*.

In the same Neighbourhood, on the Mountains of *Ben Bulben* and *Ben Buishgen*, we met with a Number of the rare Mountain Plants of *England* and *Wales*, and three or four not yet discover'd in *Britain*. Mr. *Heaton*'s *Chamædrys Alpina* is a common Plant on those Hills, as also on divers other Mountains and Heathy Grounds in *Connacht* and *Munster*.

In the Isle of *Aran* (near *Galloway*) we found great plenty of the *Adianthum verum*, and a sort of matted Campion with a white Flower, which I bewail the Loss of; for an imperfect Sprig of it was only brought me; and I waited afterwards in Rain almost a whole Week for fair Weather, to have gone in quest of it.

In most of the Mountains of *Galloway* and *Mayo* grows an elegant sort of Heath, bearing large Thyme-leaves, a Spike of fair purple Flowers like some *Campanula*, and viscous Stalks. I know not whether it be any thing related to the *Cisti Ladanifera*.

In

In the ſame Places *Pinguicula flore carneo minore* is a common Plant, and a ſort of *Ros Solis*, which I take to be undeſcribed.

Sedum ſerratum foliis pediculis oblongis inſidentibus is exceeding common on all the Mountainous Tracts of *Mayo*, *Galloway*, and *Keri*.

On the Mountains of *Keri*, *Sanicula guttata* grows in abundance; together with ſome other rare Plants, as the *Arbutus*. *Cotyledon hirſuta*. *Cirſium humile montanum Cynogloſſi folio polyanthemum R. Syn.* *Alchimillæ Alpina pentaphyllos*. *Sanicula aizoides inter guttatam & Sedum ſerratum ambigens*. *Veronica procumbens maxima, an N. D? &c.* But the Tories fruſtrated our Curioſity here, tho' no where elſe in the Kingdom.

Pentaphylloides fruticoſa we found plentifully amongſt Lime-Stone Rocks on the Banks of *Loch Crib* in the County of *Galloway*; and Dr. *Merret's Vaccinia rubra foliis Myrtinis criſpis* (a very beautiful Plant) we found to be no rarity in this Kingdom.

We have preſerved of all theſe, and ſome more I have not time to mention; as alſo of ſuch Marine Plants as had not occur'd in *Wales*.

We met with ſome Marine Animals of the Exanguious kind, that were Strangers to us; and have preſerved by Figures and dried Paterns what we could.—— I am,

Honoured Sir,

Your Obedient humble Servant,

E. LHWYD.

IV. *An*

IV. *An Extract of a Letter from the late Mr.* Edw. Lhwyd *to Dr.* Tancred Robinſon; *giving an Account of ſome uncommon Plants growing about* Penſans *and* St. Ives *in* Cornwall.

Penſans, Sept. 22. 1700.

SIR;

I Have met with no Birds or Fiſh, ſince our coming hither, that I ſuſpect for undeſcribed: Only two or three *Stellæ*, and ſome other *Exanguia marina* have occur'd, which I have not ſeen before on our *Britiſh* Coaſts.

We have alſo met with the *Capillus Veneris verus* in abundance on the Sea Clifts about St. *Ives*. 2. Dr. *Sherard*'s *Scrophularia Scorodoniæ folio*. 3. *Blattaria lutea*; *an lutea minor Park*? But the Leaves of ours are not jagged: Alſo all the Plants mentioned by Mr *Ray* to grow here; excepting the *Gnaphalium marinum*, which ſhould grow by this Town; and two or three more, which being at ſome diſtance, we have not looked for.

We have alſo found ſome *Fuci*, which perhaps may be new: And I am told the Fiſhermen ſometimes take up the *Corallina marina reticulata* by their Hooks; but I have not yet ſeen one of them.

E. LHWYD.

V. *A Relation of the Effects of a Storm of Thunder and Lightning at* Sampford-Courtney *in* Devonshire, *on* October *the 7th* 1711. *Communicated by* John Chamberlayne *Esq; F. R. S.*

IN the Parish of *Sampford-Courtney* near *Oakhampton* in *Devon*, on the 7th of *October*, about 3 or 4 a Clock in the Afternoon, there was a great darkness as the Minister was Catechising the Children; that he could hardly see with Spectacles: And as soon as Prayers were over, some young Men went to ringing, as commonly they used to do; and there were several People in the Church Porch talking; and of a sudden, a great Fire-Ball fell in between them, and threw some one way, some another; but no one was hurted. The Ringers said, they never knew the Bells go so heavy in all their lives, and were forced to leave off: And being very weary, and looking out of the Belfrey into the Church, saw 4 Fire-Balls more, a little bigger than a Man's Fist, which of a sudden broke to pieces; so that the Church was full of Fire and Smoak.

John Goodman's Man received a full Blow in the Neck, which caused him to bleed both at Nose and Mouth; but is very well now. He says, that the Fire and Smoak went up into the Tower, which broke a great Beam which one of the Bells hung on, and the Gudging breaking, the Bell fell on the Floor. It likewise carried away one of the Pinacles of the Tower next the Town, and threw some of the Stones near a Barn Door at a pretty distance from the Church, and hath done some Damage to the Barn at one end. The Chimney of the House

was

was removed in such a manner by the Thunder and Lightning, that all People did admire it stood, and not fall upon the House. And tho' the People ran up and down in a great Consternation at the dreadful Thunder and Lightning, yet no body was hurt.

This Relation comes from the Minister who then officiated.

VI. *Some Microscopical Observations upon Muscles, and the manner of their Production. In a Letter from Mr.* Anthony van Leeuwenhoek, *F.R.S.*

Delft, June *the* 10*th* 1712. *N. S.*

I Have observ'd a great many Years ago, that the Shell Fish call'd Muscles, lay their Eggs upon the outside of their Shells; and that so regularly one by an other, that they may be compared to a String or Band. These Eggs, or imperfect Muscles lying upon the Shells, do continually increase in Strength, till at last they come to be perfect Muscles; but then you may see remaining upon the Shells a part of the Egg-shell, which sticks fast to the said Shell, till the Skin or Membrane, wherewith the Muscles are encompassed, is changed.

In the Month of *August* 1710. I procured some Muscles, and dissected them according to the best of my Power; and found within the Shells on both sides of the Muscle, against the Parts of the Fish, very thin and weak Membranes; which I have taken often out of the Muscles, and placing them before a Microscope I have seen such a vast Number of Motions in the said Membranes, that it is not to be described either by Pen or Words; and I show'd the same likewise to other Persons: And

I obſerved thoſe Appearances, not only in one, but all the Muſcles I diſſected, eſpecially in ſuch as had not been long out of the Water.

Theſe Muſcles don't lye ſingle, but are at leaſt three double on one another, and are compoſed of longiſh Fibres; and each Fibre has on both ſides an unconceivable number of moving Particles. Theſe Fibres are not extended length-ways, but in breadth, and each of them is provided with a great many Joints; inſomuch, that I have been able to count 25 Joints in one of them, in the broadeſt part of the Membrane; and they lay as regularly and joyned one with another, as you may have obſerv'd in the little Bones that ſhoot out on both ſides of the Back Bone of a Fiſh.

I placed a ſmall Particle of the afore-mentioned Membrane before a Microſcope: And tho' that Particle was not the hundredth part ſo big as a common Grain of Sand, yet I diſcover'd ſuch a vaſt number of Motions in the ſaid ſmall Particle that was broken off from the Membrane, that it is incredible to any body but thoſe that have ſeen it: And thoſe Motions were not only Circular, but I could diſcover at leaſt 50 ſlender Particles in the length; which appear'd through the Microſcope of equal ſize to 6 Hairs breadth, and the thickneſs of one Hair, as they appear to the naked Eye: And theſe Motions continued ſo long, till our Eyes were weary of viewing them; but as ſoon as the moiſture of the Muſcle, in which the ſaid Particle lay, was evaporated, the Motions were ended. The exceeding ſmall Particles that lay round about, were put into ſuch a Motion, that one would have taken them for little living Creatures.

I have endeavoured for ſeveral Years to diſcover the *Ovarium*, or Egg-Neſt, in the Muſcles; and now lately, upon the 18th of *November*, there was a Preſent made me of exceeding fine and well taſted Muſcles; ſome of which

which had placed their Eggs in part upon their Shells, and others had no Eggs upon their Shells. This occasioned me to diſſect ſeveral Muſcles again; whereupon at laſt I diſcovered the *Ovarium* of the Muſcle, and in a great many of them could ſee the unborn Muſcles as perfect, as we could ſee them with our naked Eyes; lying with their ſharp end faſtned to the String, or Veſſels, by which they receive their Nouriſhment.

A few Days after my fore-mentioned Diſcovery, ſome Muſcles were brought me to buy, which were very lean, like ſome of the firſt Muſcles; and among 'em I obſerv'd about 25 that had not yet placed their Eggs upon their Shells, but moſt of them were ſtill ſhut up in the *Ovarium*, from which I took a great Number of Eggs; which even through the Microſcope appear'd ſo ſmall, that I could but juſt diſcover the Figure of them. In ſome other Muſcles the Eggs were bigger: And whereas the firſt unborn Muſcles, which I judged to be ſo perfect, as to be ready to be placed upon the Shell, were of a browniſh Colour mixt with little ſpecks; ſo the very ſmall Eggs were clear and tranſparent; but in the larger, one might diſcover ſome of the Parts of the little Fiſh within.

Moreover I took out of the *Ovarium* of one of the Muſcles ſome Particles, that were as big as an unborn Muſcle, and which were ſomewhat longer than broad; being very white, and ſome of them of a Particular Figure: So that I ſtood amazed, and began to conſider with myſelf, whether theſe might not be ſome of thoſe Creatures, which are ſo prejudicial to ſuch as eat Muſcles; as we had an Inſtance ſome Years ago of a Perſon, whoſe Body was ſo ſwelled with eating Muſcles, that it was thought he would have dyed of it.

I turned my Thoughts afterwards upon the Conſideration of the Excrements, or Food of the Muſcle, as it lay in the Guts: And I obſerv'd a Gut, which had its

beginning, or rather its ending, in the thinneſt part of the Fiſh (where the Shell opens when the Muſcle is in the Water;) and which Gut was very near the extream part of the Fiſh, and run into that part where the Stomach is. I have often ſeparated this Gut from the Fiſh; and ſqueezing the Matter out of it, I always obſerv'd that the Earthy Matter, which was in the Gut, was mingled with a great Number of Grains of Sands of different Magnitudes; inſomuch, that I judged that there was above a Thouſand Grains of Sand in one Gut; ſome of which were as large as the Sand upon the Sea Shore; but others again ſo ſmall, that a Thouſand of them were not equal to one of the afore-mentioned great Grains of Sands.

I took a ſecond Gut out of the Muſcle, which lay deeper in it; and therein I alſo diſcovered as great a quantity of Sand.

I have likewiſe ſqueezed the Matter out of the Guts of ſome Muſcles, in which I fonnd but few Grains of Sands.

Having examined the two fore-mentioned Guts, I imagined to myſelf, that one of them might be that which carried the Food to the Stomach, and the other that which carried it off after that it was turned into Chyle.

I purſued my enquiry into the Gut, which was the outermoſt, till I had brought it to the Part which I took for the Stomach; and there alſo I diſcovered as many Sands in the Matter that lay within it, as I had done before in the Guts; and one might make greater Diſcoveries in Muſcles, were not the Parts of them ſo ſoft and weak.

Since my laſt Account, I have made ſeveral Obſervations upon theſe Matters; and now lately upon the 20th of *January* laſt, having diſſected ſome Muſcles, I diſcovered not only a great many Sands in their Stomach, but

I alſo obſerv'd many long and very clear Particles; the longeſt of which, as far as I could judge, was about the Diameter of a Hair of ones Head; others were not a fourth part ſo long; and by the gueſs of my Eye, their thickneſs was not the eighth part of their length; and they were as clear as Cryſtal: ſo that I imagined them to be Salt Particles.

I alſo obſerv'd ſeveral little Particles in the Matter I took out of the Stomach, which I concluded to be Graſs, or ſomething like it. They were compos'd of very ſmall Tubes or Pipes, which I ſuppoſe to be the ſmall Parts of Graſs; for the Pipes were much too ſmall for any Straw.

In that Matter that I took out of the Stomach, I likewiſe obſerv'd ſeveral very ſmall *Animalcula* ſwiming; and had not till now perceiv'd the Stomach ſo full of Food, nor of ſo thin a Subſtance as this was.

I have moreover obſerv'd, that in all the great Number of Muſcles I have open'd, there were *Ovaria* or Egg-Neſts in them; and I have taken the Eggs out of them: And in thoſe that I open'd lateſt, I obſerved that the Eggs were bigger than I had ſeen any before. So that I concluded that all Muſcles brought forth young ones; and that the Eggs that were found on the outſide of the Shell were not all laid by the Muſcle itſelf; but that other Muſcles did alſo lay their Eggs upon each others Shells; and accordingly I have obſerved ſome Shells that were covered all over with Eggs.

During the motion of thoſe Parts that have been mentioned above, which I ſhall here call the Beard of the Muſcle, I have obſerv'd ſeveral times two or three *Animalcula* ſwimming; and the ſmall Parts that lay round about were put into ſuch a Motion, that one would be apt alſo to take them for *Animalcula*. And according to my Judgment, after ſeveral Obſervations, if not all, yet at leaſt moſt of the Shell Fiſh, bring forth young with-

out

out the help of Males: So likewiſe I believe it is in Oyſters; and I am alſo of Opinion, that that exceeding Number of ſmall Particles, which I diſcovered in them, and which I took for *Animalcula*, are nothing elſe but the Parts put into a violent Motion: But theſe are not Obſervations, but gueſſes in relation to the Oyſters. But if one dwelt upon the Sea Shore, and could daily view the Shell Fiſh, one might ſpeak with greater certainty and ſatisfaction concerning them.

I never made ſo many Obſervations, nor with ſo much Pains, as I have done in the Buſineſs of Muſcles: But not being able to do it with Satisfaction, my wiſhes are, That the Diſcoveries about the Production of Shell Fiſh, may be enter'd upon by ſome body elſe; for as for my own Part I give it up; and with great Reſpect I remain.

Your moſt humble Servant,

Anthony van Leeuwenhoek.

VII. *An Account of what appeared on opening the Body of* —— St. Johns *Eſq; who dyed of an* Aſthma, July *the* 2*d* 1705. *Aged* 72 *Years. By the late Mr.* William Cowper, *Surgeon, F. R. S. Communicated by Dr.* Hans Sloane, *Reg. Soc. Secr.*

IT was remarkable, before the Body was removed from the Bed, whereon it lay .... Hours after Death, that the Bliſter in the Neck had diſcharged not leſs than a Quart or three Pints of *Serum* before I began the Diſſection.

In

In the *Abdomen* was a ſmall quantity of Water; ſuch as is uſual in thoſe who dye of Chronical Diſeaſes. The Parts in this Lower *Venter* were in a Natural State; except

The Kidneys, of which the Right was very much contracted, even to a third part of its Natural ſize, and had two large *Hydatides*, or Bladders of clear Water, on its Surface.

The Left Kidney was alſo leſſened, but not ſo much as the Right: Its Surface like that was unequal, but had no *Hydatides* on it.

The *Ureter* of this Left Kidney was very much contorted, at its riſe from the *Pelvis*, where its Sides were Petrified; inſomuch that its Canal was almoſt render'd impervious for the Paſſage of the Urine.

Nothing was found in the Bladder of Urine, but divers Stones of unuſual Figures, as if they had been pieces of a large Stone broken to bits, in whoſe Center a *Nucleus* had been lodged.

The Gall-Bladder was filled with Gall-Stones.

Nor was the Stomach, which he complained of (*i. e.* in want of Appetite) any other ways diſordered; but a little redder, having more Blood in its Veſſels than is uſual; its Muſcular Fibres being ſtronger than we generally find them in the Stomachs of healthful Perſons.

The Cavity of the *Thorax*, or Cheſt, was filled with Water on both ſides; inſomuch, that the Lungs were not above a third part of their Natural Magnitude.

The *Pleura*, or Membrane that lines the two Cavities of the *Thorax*, was very much thick'ned by the *Serum* or Water; from whence it deſcended by the Muſcles of the Back into his Legs.

The Valves of the Left Ventricle of the Heart were Petrified in ſeveral Places, eſpecially thoſe call'd *Mitrales*.

There were ſome Stony Bodies found on the *Bronchia*, at and near their Riſe from the Lungs.

VIII. *A Letter from Mr* Ralph Thoresby, *F.R.S. to Dr.* Hans Sloane, *R. S. Secr. Concerning large Stones voided* per Urethram.

Leedes, Nov. 26. 1711.

Honoured Sir,

SOmething extraordinary happening in the Case of a young Man who dyed yesterday, please to accept of the Relation of it, as follows. *Joshua* the Son of *Thomas Spurrit*, a poor Clothier upon the *Quarry-Hill* near this Town, having been for a long time sadly afflicted with the Stone, was the last Year in an extraordinary manner tormented. I have 3 Stones that he voided, which are of a great bigness to pass the *Penis*, and five more that he could not get rid of without the kind assistance of Mr. *S. Pollard*, an Ingenious Surgeon of this Town; who by an Incision made way for them, as they came severally near the *Glans:* When ever one of these great Stones broke out, there was a Crack within his Body, as if the Sphincter Muscle, or Bladder itself, was rent. Till this Instance I thought it (I confess) impossible, that the Ureters (which are naturally no thicker than a Barley Straw) or the Urinary Passage was capable of receiving Stones of this Dimension. I have sent you one of the 5 (neither the biggest or least of them) to know whether it be really so extraordinary as I apprehend: This Day the Youth being dissected, there were found in the top of his Bladder (which was contracted like a Purse) two prodigious large Stones; one especially which I measured, and it was rather more than 5 Inches

ches and a half one way, and 4 the other; it weighed two Ounces, wanting 3 Drams: The other seems lighter, and weighs but one Dram above an Ounce. There were two very odd Stones taken out of the Right Kidney; the Left was wholly degenerated into a kind of Mucilage: And betwixt the Neck of the Bladder and the end of the *Penis* (which was mortified thereby) were lodged no less than half a dozen such Stones as this herewith sent you; which if it be as rare, as we are ready to apprehend here, you will not grudge, tho' it put you to the Charge of double Postage, from

Sir,

Your most obliged

and most humble Servant,

RALPH THORESBY.

P. S. There was little Moisture left in the Bladder; the Ureters being broke off, and almost wholly consumed.

IX. *Part of a Letter from Mr.* Brook Taylor, *F. R. S. to Dr.* Hans Sloane *R. S. Secr. Concerning the Aſcent of Water between two Glaſs Planes.*

THE following Experiment ſeeming to be of uſe, in diſcovering the Proportions of the Attractions of Fluids, I ſhall not forbear giving an Account of it; tho' I have not here Conveniencies to make it in ſo ſucceſsful a manner, as I could wiſh.

I faſten'd two pieces of Glaſs together, as flat as I could get; ſo that they were inclined in an Angle of about 2 Degrees and a half. Then I ſet them in Water, with the contiguous Edges perpendicular. The upper part of the Water, by riſing between them, made this *Hyperbola*; [See *Fig.* 5.] which is as I copied it from the Glaſs.

I have examined it as well as I can, and it ſeems to approach very near to the common *Hyperbola*. But my *Apparatus* was not nice enough to diſcover this exactly.

The Perpendicular *Aſſymptote* was exactly determined by the Edge of the Glaſs; but the Horizontal one I could not ſo well diſcover. I am,

Sir,

Bifrons near *Canterbury*, June 25. 1712.

Your moſt humble Servant,

BROOK TAYLOR.

X. *An*

X. *An Account of an Experiment touching the Aſcent of Water between two Glaſs Planes, in an Hyperbolick Figure. By Mr.* Francis Hauksbee, *F. R. S.*

I Took two Glaſs Planes, each ſomewhat more than 20 Inches long, of the trueſt Surfaces I could procure. Theſe being held cloſe together at one of their Ends, the other Ends were opened exactly to an Angle of 20 Minutes. In this Form they were edgeways put into a Trough of ting'd Water, which immediately aroſe between them in the Figure of the annext Scheme. *See* Fig. 7. At another time the Planes were opened to an Angle of 40 Minutes; then the Water appear'd between them, as in the Scheme with that Title. By theſe Schemes *See* Fig. 6. the Proportions of the Power of Attraction are in ſome meaſure evident to the Eye; for there may be ſeen at the ſeveral Diſtances, how many Lines (which are 12ths of Inches) the Water is elevated, and the prodigious Increaſe of them near the touching Ends. I hope the Tables are pretty accurate; for after many tryals, I find the Succeſſes to be much the ſame, according to the different Angles. This Experiment was firſt made by Mr. *Brook Taylor*, as appears by his Letter to Dr. *Hans Sloane*, R. S. Secr. but he confeſſes his *Apparatus* not nice enough to diſcover exactly the Figure which the Water made between the Planes.

A Table according to the Scheme of the Planes opened to an Angle of 40 *Minutes, in* Fig. 6.

Distances in Inches and Parts of Inches from the touching Ends.	Number of Lines elevated at the several Distances.
9.	1.
6.	2.
$4\frac{3}{4}$.	3.
3.	$4\frac{3}{4}$.
$2\frac{1}{2}$.	6.
2.	$7\frac{1}{2}$.
$1\frac{1}{2}$.	10.
$1\frac{1}{4}$.	12.
1.	15.
$0\frac{3}{4}$.	19.
$0\frac{1}{2}$.	28.
$0\frac{1}{4}$.	50.

A Table according to the Scheme of the Planes opened to an Angle of 20 *Minutes, in* Fig. 7.

Distances in Inches and Parts of Inches from the touching Ends.	Number of Lines elevated at the several Distances.
13.	1.
9.	2.
7.	3.
6.	$3\frac{3}{4}$.
5.	5.
4.	$6\frac{3}{4}$.
3.	9.
$2\frac{1}{2}$.	12.
2.	$15\frac{1}{2}$.
$1\frac{3}{4}$.	18.
$1\frac{1}{2}$.	$21\frac{1}{2}$.
$1\frac{1}{4}$.	$27\frac{1}{2}$.
1.	35.
$0\frac{3}{4}$.	50.
$0\frac{1}{2}$.	76.

XI. *A Deſcription of the ſeveral* Strata *of Earth, Stone, Coal, &c. found in a Coal-Pit at the Weſt End of* Dudley *in* Staffordſhire: *By Mr.* Fettiplace Bellers, *F. R. S. To which is added, a Table of the Specifick Gravity of each* Stratum: *By Mr* Fr. Hauksbee, *F. R. S. Communicated by Dr.* Hans Sloane, *R. S. Secr.*

I. A Yellowiſh Clay, which lyes immediately under the Turf.

II. A Blewiſh Clay.

III. A Blewiſh hard Clay; the Miners call it *Clunch.* This is one of the certain Signs of Coal. It has in it Mineral Plants.

IV. A Blewiſh ſoft Clay.

V. A fine-grained Gray Stone: It lyes next the former, and is found in ſome Pits only.

VI. A Clay almoſt like the Firſt, only whiter.

VII. A hard Gray Rock; with ſomething like the Impreſſions of Vegetables, but none diſtinct.

VIII. A Blew *Clunch*, like Numb. 3. with Mineral Plants in it.

VIII. +. This *Stratum* (which is the ſame with Numb. 13.) was not taken.

IX. Coal, called *Bench-Coal.*

X. Coal, leſs black and ſhining than the former, called *Slipper-Coal.*

XI. Coal, more black and ſhining, called *Spin-Coal.*

XII. A Coal like *Cannal-Coal*, by the Miners called *Stone-Coal.* Theſe *Strata* of Coal have between each

of them a *Bat*, of about the thickneſs of a Crown Piece.

XIII. A black Subſtance, called the *Dun-Row-Bat.*

XIV. A hard grey Iron Oar, called the *Dun-Row Iron-Stone.*

XV. A blewiſh *Bat*, in which the following *Iron-Stone* lyes, called the *White-Row.*

XVI. A hard blackiſh Iron Oar, lying in ſmall Nodules, having between them a white Subſtance; and from thence by the Miners called the *White-Row-Grains*, or *Iron-Stone.*

XVII. A hard grey Iron Oar, with ſome white ſpots in it, called the *Mid-row Grains.*

XVIII. A black fiſſile Subſtance, called the *Gublin-Bat.*

XIX. A hard blackiſh Iron Oar, with white ſpots in it, called the *Gublin Iron-Stone.*

XX. A *Bat*, in Subſtance much like that of Numb. XVIII.

XXI. A hard grey Iron Oar, called the *Cannoc*, or *Cannot-Iron-Stone.*

XXII. A *Bat*, ſomewhat harder than Numb. XX.

XXIII. A dark, gray, hard Iron Oar, called the *Rubble Iron-Stone.*

XXIV. The *Table-Bat*, next under the *Rubble Iron-Stone.*

XXV. A coarſe ſort of Coal, called the *Foot-Coal.*

XXVI. A black, brittle, ſhining *Bat.*

XXVII. *The Heathen-Coal.*

XXVIII. A Subſtance like a coarſe Coal, but by the Miners called a *Bat*; perhaps becauſe it does not burn well.

XXIX. The *Bench-Coal.*

XXX.

XXX. A *Bat* under the laſt, and is as low (*viz.* 188½ Feet) as they generally dig, tho' there is a coarſe Coal under this.

N. B. Thoſe Subſtances, which divide the *Strata* of Coals and Iron Oars from each other, are called *Bats* by the Miners: They are generally black, conſiſting of a Matter peculiar to themſelves, and are of a Texture neareſt like *Marle*; tho' ſome of them are fiſſile, and others have a Subſtance not unlike Coal mixt with them.

A Table of the Thickneſs of each Stratum, *and its Proportion to Water, or Specifick Gravity.*

Number of the *Strata*.	Thickneſs of each *Stratum*. Feet.	Inches.	Proportion to Water,		Or Specifick Gravity.
I.	4	0	as 385	to 192	as 200 to 100
II.	5	0	296	168	176
III.	24	0	23	9	256
IV.	9	0	209	106	197
V.	4	0	583	237	246
VI.	21	0	401	192	209
VII.	75	0	683	259	243
VIII.	5	0	223	88	253
VIII+.	1	0	—	—	—
IX.	3	0	7	5	140
X.	3	0	106	72	147
XI.	4	0	147	114	129
XII.	4	0	185	143	130
XIII.	1	0	408	198	206
XIV.	0	1	204	67	303
XV.	0	3	183	72	254
XVI.	1	3	325	232	334
XVII.	0	2	781	244	320

Number

Number of the *Strata*.	Thickneſs of each *Stratum*. Feet.	Inches.	Proportion to Water,		Or Specifick Gravity.
XVIII.	2	0	as 305 to	129	as 236 to 100
XIX.	0	9	920	266	346
XX.	1	6	192	76	253
XXI.	0	6	675	216½	313
XXII.	1	0	428	165	290
XXIII.	0	6	828	231	358
XXIV.	2	0	333	153	218
XXV.	1	0	198	154	128
XXVI.	6	0	238	141	169
XXVII.	6	0	298	236½	126
XXVIII.	0	1	267	186	144
XXIX.	2	0	314	240	131
XXX.	0	6	244	133	183

By which it is evident, that the Gravities of the ſeveral *Strata* are in no manner of Order; but purely caſual, as if mixt by chance.

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