Literary memoirs of Germany and the North : being a choice collection of essays on the following interesting subjects ... / Done from the Latin and High-Dutch, by a society of gentlemen.

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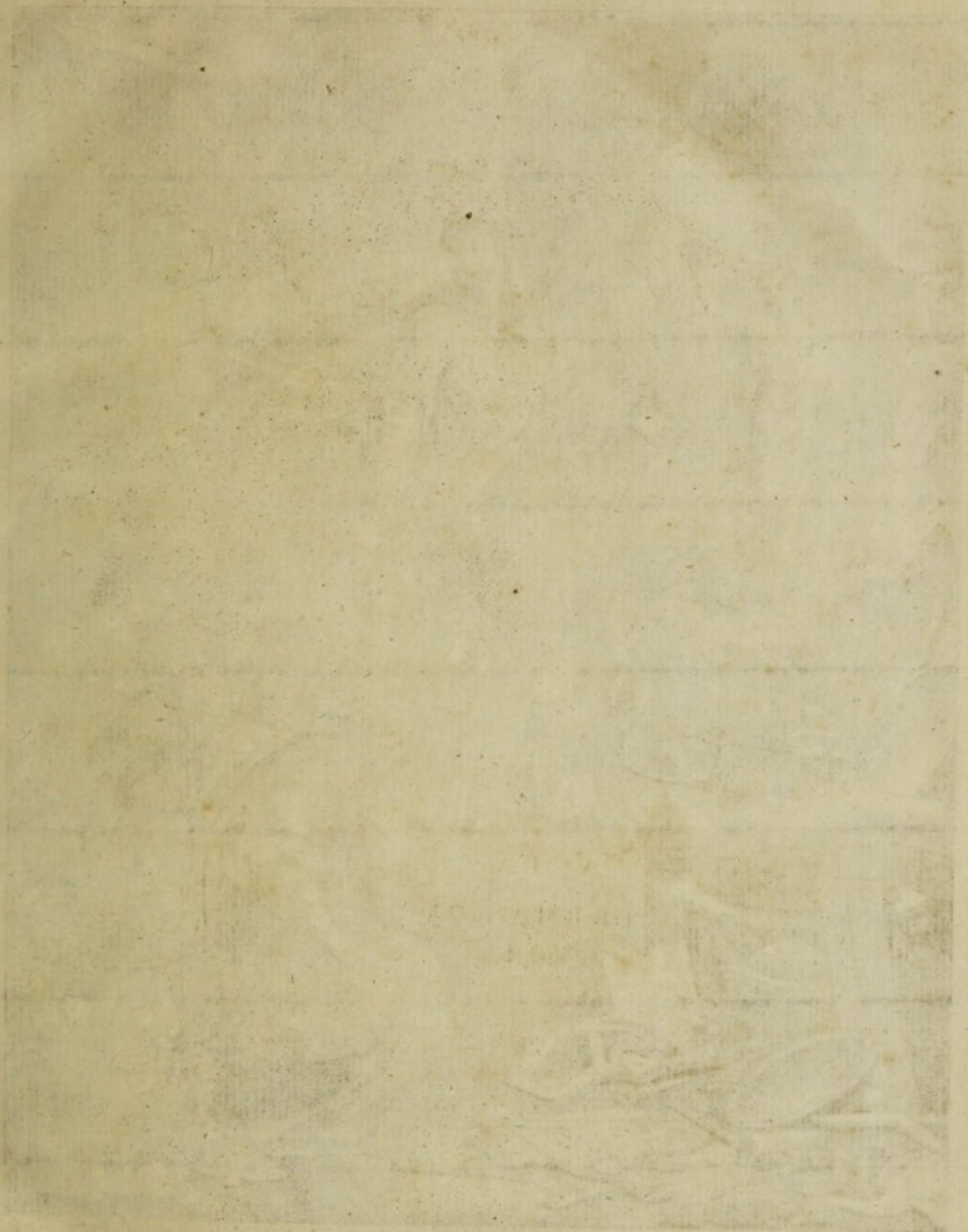

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I. Goeree invt et delin.

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LITERARY MEMOIRS

OF

GERMANY and the *NORTH*,

Being a Choice Collection of

ESSAYS

ON THE FOLLOWING

INTERESTING SUBJECTS,

VIZ.

Alchemy,	Geography,	Medicine,
Algebra & Analysis,	Hydraulics,	Metallurgy,
Anatomy,	Hydrology,	Meterology,
Animal Oeconomy,	Levelling,	Mineralogy,
Architecture,	Literary History,	Natural History,
Astronomy,	Logic,	Optics,
Chemistry,	Manufactures,	Surgery,
Chronology,	Mechanics,	Agriculture, *&c. &c.*

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By a SOCIETY of GENTLEMEN.

IN TWO VOLUMES.

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THE

LITERARY MEMOIRS

OF

GERMANY and the *NORTH*,

CONTAINING many curious and uſeful Pieces, which, unleſs tranſlated, in ſome ſuch Collection, muſt continue unknown to the learned here in *England*, who are rarely acquainted with the *German* and *Northern* languages: We think the publiſhing this Work may be both agreeable and ſerviceable to the Publick. But as the ſame muſt be attended with a conſiderable Expence to the Publiſher; we hereby recommend the Encouragement of it to ſuch Gentlemen, as ſhall be deſirous or willing to have the ſame carried on, without Prejudice to the Undertaker.

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TO

MARTIN FOLKES, Esq;

PRESIDENT,

AND TO THE

COUNCIL and FELLOWS

OF THE

ROYAL SOCIETY

OF

LONDON,

FOR

Improving NATURAL KNOWLEDGE,

This FIRST VOLUME *of the*

Acta Germanica

Is humbly dedicated by

Their most devoted and

most obedient humble Servant,

The EDITOR.

TO

MARTIN FOLKES, Esq;

PRESIDENT,

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THE

PREFACE.

THE Deſign of this Undertaking (of which now the firſt Volume is finiſh'd) is to preſent the Reader with a Tranſlation of what is deem'd moſt valuable and curious in the ſeveral Literary Memoirs, publiſh'd in different Parts of *Germany* and the *North*.

The Variety of curious and really uſeful Matters in the different Branches of Science which theſe ſeveral Memoirs contain, the Reputation they are in among the Learned, and thoſe publiſh'd in the *German* Language being inacceſſible to moſt Readers, ſeem Reaſons ſufficient to juſtify the preſent Undertaking.

But this Work is not confined to ſuch Memoirs alone, as are publiſh'd in Sets of Volumes; it alſo takes in ſeveral curious and uſeful Academical Diſſertations, publiſh'd in looſe Sheets, which might otherwiſe be loſt even to the Generality of learned Readers: And here it would be doing the Editor a particular Pleaſure to mention ſome Gentlemen, who have not only encourag'd this Work, but have ſupplied the Originals of perhaps ſome of the moſt valuable Materials contain'd therein; as particularly, the Diſſertation on the *Philoſopher's Stone*, on *Camphire*, *Amber*, *Metallic Salts*, &c.

In the Execution of this Work Care has been taken to retrench no one Circumſtance, that ſeemed material to the Subject in Hand: Pompous Preambles, perſonal Addreſſes, Matters of mere Form, *&c.* have indeed been cut off, as what probably, the Original Authors themſelves, were they in this Manner to publiſh their ſeveral Performances, would without Reſerve have ſtruck out.

The diſpoſing the ſeveral Materials under general Heads might poſſibly be the more preferable Method; yet on ſeveral Accounts (which would be needleſs to mention) this could not be gone in to: However, to obviate in ſome Meaſure any ſuch Objection, a par-

ticular Index is prefix'd to the Book, wherein the different Subjects are brought under general Heads, alphabetically ranged: Tho' possibly the other Method, that has been taken, may not be without its agreeableness with some Readers, as they may be pleas'd with an artless Variety.

As to the Names of Authors; they are cited in the Manner they generally occur in *English* Writers: But as to such as are rarely or never to be met with in these, the most eligible Way, one would think, was to call them by their *Latin* Names; as by these, it is presumed, they are best known among the Learned.

And now the Whole is submitted to the candid Judgment of the Reader: In a Work of such Variety and Compass, some Mistakes must be unavoidable; the Language may sometimes happen to be rough and unequal, owing to the Difference of Stile of the various Persons employed in the Translation, so that perhaps it was not always a very easy Matter to avoid these Blemishes: The over-critical and squeamish, indeed, may not only magnify such Escapes, but also imagine they discover Mistakes, where really there may be none: But the Candid and Judicious will be ready to extenuate and overlook such Miscarriages, if there is any Thing in the whole Performance that may attone for them.

It only remains to acquaint the Reader that the succeeding Volumes will with all convenient Speed follow this first, if the Publick by their generous Encouragement shall enable the Editor chearfully to go thro' so expensive an Undertaking.

AN

AN

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ACTA GERMANICA:

OR, THE

LITERARY MEMOIRS

OF

GERMANY, &c.

An Account of Storms of Hail and Thunder in different Parts of Europe; *together with ſome hiſtorical Reflexions on Lightning. From the* Breſlaw Collection, *An.* 1717. Claſs IV. Article I. p. 62.

Tranſlated from the High Dutch.

IN the month of *July*, in particular, *Anno* 1717, as there happen'd dreadful ſtorms of hail and thunder in different parts of *Europe*, ſo it may ſeem no fruitleſs attempt to be ſomewhat the fuller in our accounts of them.

Storms of hail and thunder at *Hamburg*.

On the firſt of *July*, at *Hamburg* and the adjoining parts, the ſtorm was uſhered in about noon with a hurricane, which was accompanied with a peal of rain, dreadful thunder and lightnings, and with hail-ſtones of a prodigious ſize: The flaſh ſtruck upon St. *Peter*'s ſteeple, ſhatter'd the hand of the dial-plate in two different places, and ſplit two beams on which the bells hung. A young lad,

of about 14 or 15 years of age, who ſat ſleeping in a chair, was ſo ſtunn'd by the thunder-clap, as to become quite ſenſeleſs, and it was ſome time before he came to himſelf again, and that with difficulty, and by the uſe of proper medicines.

The fruits of the earth, in theſe parts, were entirely deſtroy'd and beat
In Juliers. down by the hail. In *Juliers*, about the ſame time, there alſo fell hail-ſtones of the bigneſs of hen-eggs.

In Bohemia. At *Seidenberg*, on the borders of *Bohemia* and *Lauſſnitz*, not far from *Zittau*, on the ſecond of *July*, about three in the afternoon, the thunder beat into the church in time of divine ſervice, greatly ſhatter'd the gabel-end timbers, and beat down about 30 boards in both the corners, kill'd ſeven perſons near the organ-loft, and hurt about 50 more.

In France. *July* 2, not far from *Eſtampes*, near *Paris*, the hail did not only do a deal of damage, but the lightning kill'd a man and two horſes; as the father and the ſon ſought to ſhelter themſelves from the hail under a waggon laden with wine, the lightning beat upon it, ſtruck the father dead, and conſum'd ſome of the butts. About the ſame time the hurricane did a great deal of damage on the ſea-coaſts of *France*, and in *Avignon*.

In Italy. In the kingdom of *Naples* the rain, the thunder, and large hail-ſtones did conſiderable damage, eſpecially to the grapes; and to avert theſe calamities public prayers were put up. At the ſame time this ſtorm raged moſt violently near *Reggio* in *Calabria*, where the large hail-ſtones deſtroy'd all the country along the ſea-coaſt for 20 miles together, kill'd upwards of 300 perſons, and wounded a great many more.

In Poland. On the 7th and 8th of *July* the hail greatly damaged the fields and gardens about *Warſaw*, near *Praſnick* and *Obory*. The hurricane beat down an alehouſe in *Jezier*, by which accident ſeveral people were kill'd.
In Moldavia. On the 10th, the lightning beat 60 times into *Choczim* in *Moldavia*, and
In Auſtria. laid ſeveral houſes in aſhes. On the 11th and 12th, by a dreadful ſtorm of thunder and hail, the fruits of the earth and the vines ſuffer'd conſiderably in *Auſtria*, particularly about *Peters-Dorff*, *Melling*, &c. About
In Servia. *Belgrad* on the 13th, between five and ſix in the evening, there was for two hours as dreadful a ſtorm of wind, hail and thunder, as ever happen'd in the memory of man; it forced two ſhips from their faſtenings to a bridge on the *Danube*, kill'd four horſes, overturn'd into the river ſome baggage-waggons with their horſes and oxen, ſunk two barks laden with warlike ſtores and proviſions, and drove from her moorings a *Turkiſh* galley of 18 guns.

At Leipzig. On the 15th, near *Leipzig* there came from the weſt a terrible ſtorm of thunder and hail, which laſted about half an hour, and chiefly raged for a mile and a half to the weſt of the town, and a mile to the eaſt; the hail-ſtones were bigger than pidgeon-eggs, nay, many of them as big as hen-eggs, and beſet with ſeveral points and angles; ſo that the windows to

the

the weſtward were all broke to pieces, and their bars ſtruck out, and the damage computed at about 1000 rixdollars: But the fruits of the earth ſuffer'd more conſiderably by this ſtorm, being all irrecoverably beat down to the ground: It is here obſervable that the tract of this ſtorm of hail did not extend above four foot in breadth. Eight days after, the like hail-ſtones fell at *Sckeuditz*, two miles from *Leipzig*.

A Storm of Thunder at *Epperies*.

As on the 16th of *July*, the weather was very cloſe and ſultry (by which is not meant any remarkable degree of heat by the thermometer, but barely an uneaſy ſenſation of it among animals, *&c.*) ſo after midnight there aroſe a violent ſtorm of thunder, with a peal of rain, that continued at the ſame pitch for a whole hour: After this it abated a little; but about ſix in the morning it came on again ſtill heavier, and then, which is obſervable, there was little or no wind ſtirring; the clouds were very thick and lowring, moving from weſt to eaſt, and every moment threaten'd ſome terrible diſaſter: At times it rain'd a little; but all of a ſudden there aroſe a dreadful ſtorm of thunder and lightning, that beat upon the ſteeple of *Epperies* with a prodigious craſh: At this time the *Author* was in his ſtudy, and he obſerv'd the flaſh come from the eaſt in form of a fiery ball; and in this form it ſcarce continued a ſecond of time, but ſprung into a thouſand pieces, and with a dreadful exploſion fell upon the ſteeple, as above. This ſteeple is built four ſquare and pretty high, and ſtands at the weſt end of the Church; after that the lightning had ſplit one of the roof-timbers towards the eaſt, and tumbled down ſome rows of tiles, and at the ſame time demoliſh'd the weſt ſide, and rent downwards the north wall, without endamaging the ſouth ſide, it paſſed along an iron wire faſtened to the hammer of a bell, and after breaking an iron wheel in the clock-work, it flew into the open air thorough the ſouth dial-plate, and bent the hand outwards: Here again it ran down along another iron wire which came from the top of the ſteeple, and reached below to a little bell, and only left on the outſide of the ſteeple a black ſpot, without burning a ſmall cord faſtened to the end of the wire; and after that, it paſſed over to the oppoſite wall, tore out a corner-ſtone, and made its way again thro' a ſmall crevice into the concavity of the ſteeple; from whence it eſcaped thro' a lower window into the open air, and only left a brand behind it; but there was perceivable a ſtrong ſulphurous ſmell, and the iron wires were obſerved to be broken in pieces, and almoſt glowing hot. In the middle ſtory of this ſteeple are hung thoſe bells, which, according to the cuſtom of this country, are uſually rung in times of great ſtorms: At a ſouth window of this ſtory, on which ſide the laſt mention'd wire goes down, and along which the lightning ran, ſtood a man, who was obſerv'd to drop down all of a ſudden, and was ſuppos'd to be thunder-ſtruck, but really was not; for, upon opening a vein he recover'd, without any perceivable hurt.

It is to be obſerved, that the end of the wire, to which the cord was faſtened, reſted upon the above-mention'd corner-ſtone, ſo that the lightning, after paſſing along the wire, muſt neceſſarily light on the ſtone: Now whether this was the reaſon of its entering the wall, or rather, by the end of the iron-wire, on account of a peculiar ſympathy between iron and lightning, muſt be left to others to determine; tho' the latter ſeems more probable: For, in a ſtorm of thunder, in 1673, the lightning ran down quite along the ſame wire, which then happen'd to be of a greater length, without the ſaid corner-ſtone being oppoſite to it.

The Notion of a Thunder-bolt diſprov'd.

From what has been ſaid, it ſeems to be very evident, that what is commonly call'd a *Thunder-bolt*, is a mere empty conceit without any foundation in nature; ſince all the *phænomena* of lightning may eaſily be accounted for from the ſole accenſion of a compacter ſulphureo-nitrous matter: And he, who conſiders at the ſame time the power of the *phlogiſtic* matter in the fuſion of metals, (of which Dr. *Stahl* has treated very learnedly) and the force of the ſun-beams collected in the *focus* of a burning-glaſs, whereby gold itſelf is calcined; and how gold-ſmiths can in a moment, by directing the flame by the blaſt of a blow-pipe, melt down their metal; and in fine, how *Aurum fulminans* breaks in pieces, and that with a prodigious exploſion, every thing that oppoſes it, may eaſily perceive, that we need not have any recourſe to the notion of a thunder-bolt. So far this account.

Reflections on Lightning.

As it is none of the leaſt difficulties in nature to give a rational account of lightning, which is only to be deduced from the *phænomena*; and as theſe again, on account of many obſtacles, are not ſo eaſily and evidently to be obſerv'd, ſo it will be the more neceſſary, carefully to ſet down all the hiſtorical *data*, that can poſſibly be collected, in order to a clear conception in this matter. It may, therefore, be no fruitleſs attempt to give a ſhort abſtract of the above-mention'd effects and *phænomena* of lightning, and ſubjoin it to theſe obſervations.

Nature of Lightning.

From the above relations it appears. 1. That lightning is a real, manifeſt, fiery ſubſtance. 2. That its matter is of the ſulphureous kind. 3. That generally, and perhaps at all times, a greater quantity of igneous matter is ſet on fire than actually ſtrikes, and that of this burning maſs the moſt concentred part only comes down to the earth. 4. That from this we may probably infer, that not all ſuch accended matter produces an actual lightning, but often times only a bare flaſh. 5. That lightning is an incomparably ſubtile and highly penetrating, active fire. 6. That one and the ſame particular lightning both rends and melts down bodies, and alſo burns them, as ſufficiently appears by the brand. 7. That the power of lightning is greater in rending and diſſolving hard and compact bodies, than ſetting them on fire, unleſs the ſubjects be very apt to take fire, as gun-powder, ſtraw, hay, reſinous wood, *&c.* to which effect probably the burning,

burning, groſs, fiery matter itſelf, that falls down, may contribute ſomething. 8. When the matter of lightning is kindled at a greater height, it does not come down perpendicularly but goes off tranſverſely, and ſpends itſelf aloft in the air; tho' it is not to be denied, but that the different poſitions of the clouds may contribute ſomething to this diverſity; as has been often obſerved, that when the ſtorm has for ſome time continued to come directly downwards, at laſt its direction becomes oblique and tranſverſe, and gradually the whole evaniſhes. 9. That the principal efficacy of lightning is owing to its motion, as in its velocity it exceeds all other things except light. 10. That lightning exerts its rending, penetrating, melting, and burning force according to its ſtroke on this or the other body; ſeeing, when it comes down unreſiſted on bodies, it does them no great harm, whereas things that ſtand in its way, and the place, where it firſt falls, ſuffer moſt. 11. That lightning, on account of its angular motion ſtrikes with greateſt force not only on high places, ſteeples, houſes, and trees, but likewiſe readily both on compacter and rarer bodies. 12. That when it thus comes down on any thing, it often faſtens on its whole extent, and even continues its courſe thro' narrow apertures, and this evidently refutes the notion of a thunder-bolt, and the above inſtance of the wire evinces it ſtill further. And here we may alledge another remarkable and exactly ſimilar inſtance, which happened at *Breſlaw* in 1714, on *June* 21, about nine in the evening; at which time the lightning beat into St. *Elizabeth*'s ſteeple, ſplit ſome beams, paſſed thro' the falſe ceiling, and eſcaped out at the window; and it alſo faſten'd on the long wires, reaching from the place where watch is kept, and with which they uſually ring for a ſignal a ſmall bell that hangs in the ſexton's houſe below; it actually broke in pieces one iron-wire, but paſs'd along the other, without quite reaching the earth, into the open air in a right angle thro' a very ſmall crevice; it paſſed directly over to about the diſtance of 40 foot into the ſexton's houſe, where it ſplit the wooden mantle-piece; and at laſt it got out into the open ſtreet thro' the oppoſite window. 13. That by means of this ſwift motion, and the concomitant expanſive igneous force of lightning, the air is very violently divided and put into a great commotion; conſequently, its *gyri* and rotations on the great number of thick clouds that paſs along muſt neceſſarily cauſe a ſtrong and continued ſound, which, the more and the oftner it is reflected, the more violent is the thunder; as for inſtance, among ridges of mountains, in towns and even in houſes. 14. That the receptacle of this matter of lightning is commonly thick clouds pregnant with rain, which, when they have diſcharged their ſtores, deprive the lightning partly of its *matrix* and partly of its fuel.

Some

Some anatomical *Obſervations on the Structure of the* Biliary Veſſels *and Motion of the* Bile. *From the* Acta Erud. An. 1682. p. 20.

Tranſlated from the Latin.

The Gall-bladder communicating with the Hepatic Duct.

THAT the neck of the gall-bladder ſends forth conſiderable branches, beſides that mention'd by *Gliſſon*, the *Collegium Amſtelodamenſe*, and *Blaſius*, into the ſubſtance of the liver, or rather receives them from thence; nay, that ſome of theſe communicate with the hepatic duct appears by the following experiments.

Experiment I. In an Ox.

In a bullock's liver it was ſeveral times obſerv'd, that upon blowing thro' the cyſtic duct till the gall-bladder was quite inflated, the wind paſſing thro' different parts of the concave ſide of the liver, return'd thro' the *ductus hepaticus*. It is true, this experiment fail'd two or three times in ſubjects, whoſe livers were ſtuffed with a calculous and tartarous matter; but in other ſounder livers the event was more ſucceſsful.

Experiment II. In a Calf.

Upon ſqueezing all the bile out of the gall-bladder of a calf, and making a ligature on its duct, at its inoſculation with the *ductus hepaticus*, to prevent the paſſing of any gall into the bladder, and then injecting warm water into the hepatic duct; part of this water paſſed into the bladder, remarkably diſtended it, and guſh'd out at a wound made in it.

Experiment III. In a Man, a Dog and an Ox.

Upon opening the cyſtic duct in a man, a dog, and an ox, at its continuation with the liver, I obſerv'd ſeveral orifices, which *Blaſius* and thoſe of *Amſterdam* obſerv'd only in an ox, as the mouths of ſo many biliary veſſels; yet their number differ, as ſometimes three in a dog, five in a man; and in an ox, ſometimes a greater number, as twelve, and ſometimes a leſſer, as eight, and very lately five only; their courſe is ſometimes longer, and ſometimes ſhorter, and they generally penetrate pretty obliquely into the coats of the *meatus cyſticus*; in a dog and a man, it is true, they are capable of admitting a probe: And hence they ſeem to be either the origin or inſertion of peculiar veſſels, whoſe progreſs could not be further traced by reaſon of their exceeding ſmallneſs: But in an ox, a ſubject, on account of its bulk, more proper for this purpoſe, beſides the other *meatus*'s of the cyſtic duct that run into the ſubſtance of the liver, two veſſels of larger orifices ariſing from its oppoſite ſides, and but ſlightly dipping into the ſubſtance of the liver, proceeded to the *ſinus* of the *ductus hepaticus* in ſuch manner, as to give the freeſt admiſſion both to the probe and blow-pipe, from the neck of the bladder as far as the *ductus hepaticus*. In another liver, which was likewiſe that of an ox, there appear'd only one of theſe ducts, into whoſe orifice I injected melted wax, which, returning by the *ſinus* of the *ductus hepaticus*, plainly ſhew'd the inſertion of an intermediate duct, common to the cyſtic and hepatic ducts: And but ſlightly cutting into the ſubſtance of the liver, its branching

Plate I. Fig. 1.

Fig. 1.

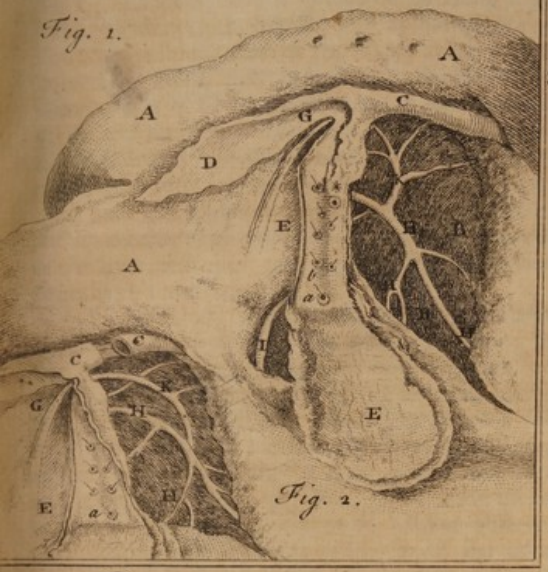
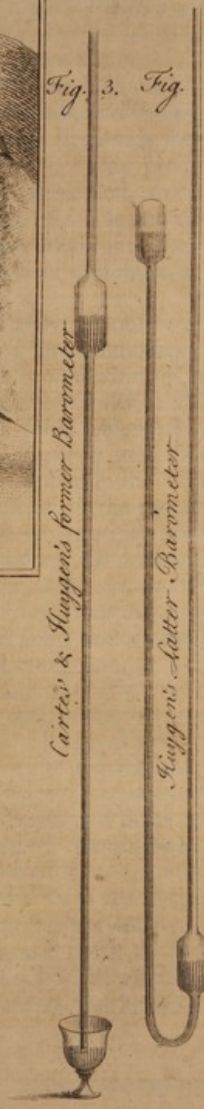


Fig. 2.

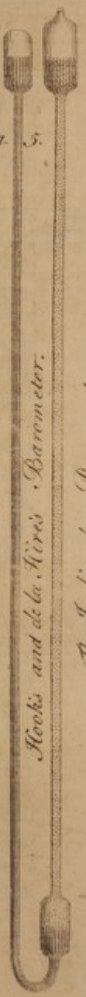
Fig. 3. Fig. 4.



Cartes' & Huygens former Barometer

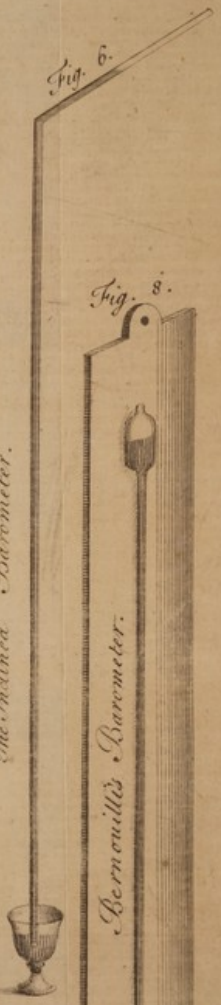
Huygens Latter Barometer

Fig. 5.



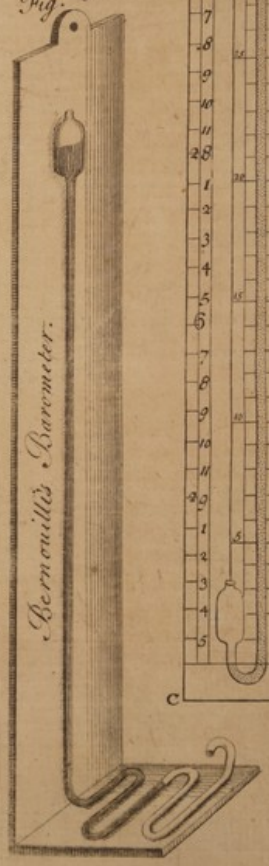
Hooks and de la Hire's Barometer.

Fig. 6.



The Inclined Barometer.

Fig. 8.



Bernouilli's Barometer.

Fig. 12.

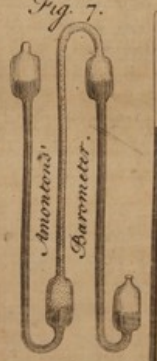
The Authors New Barometer.

Fig. 9.

Fig. 11.

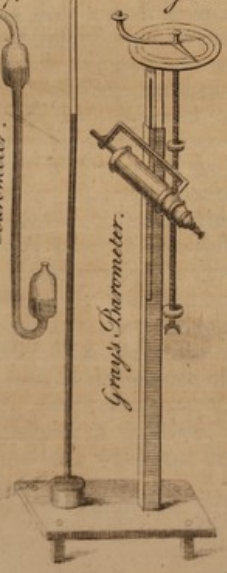
Hooks' old Barometer.

Fig. 7.



Amontons' Barometer.

Fig. 10.



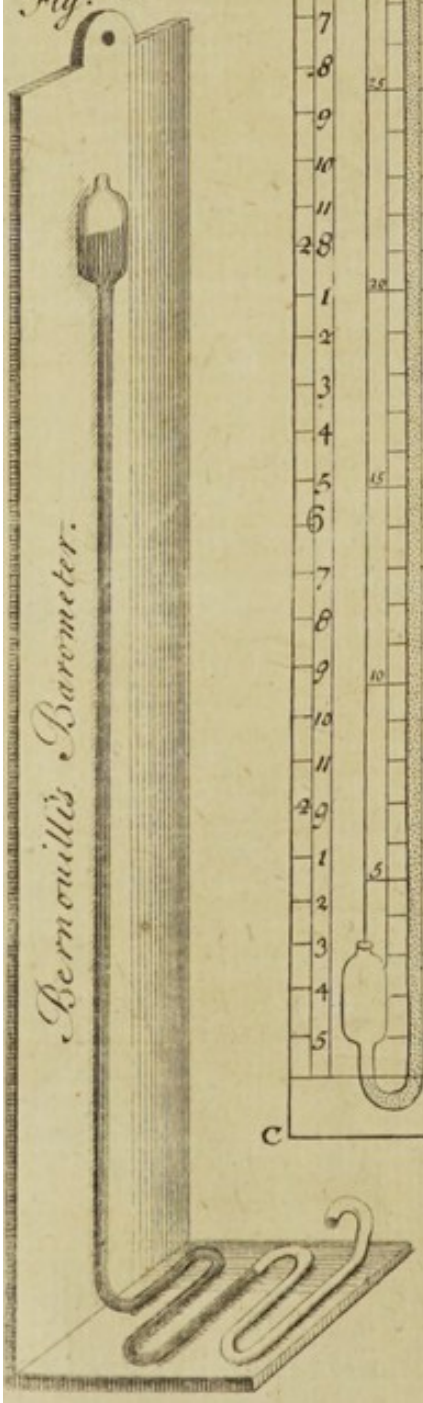
Grays Barometer.

G. Smith delin.

Hulett Sculp.

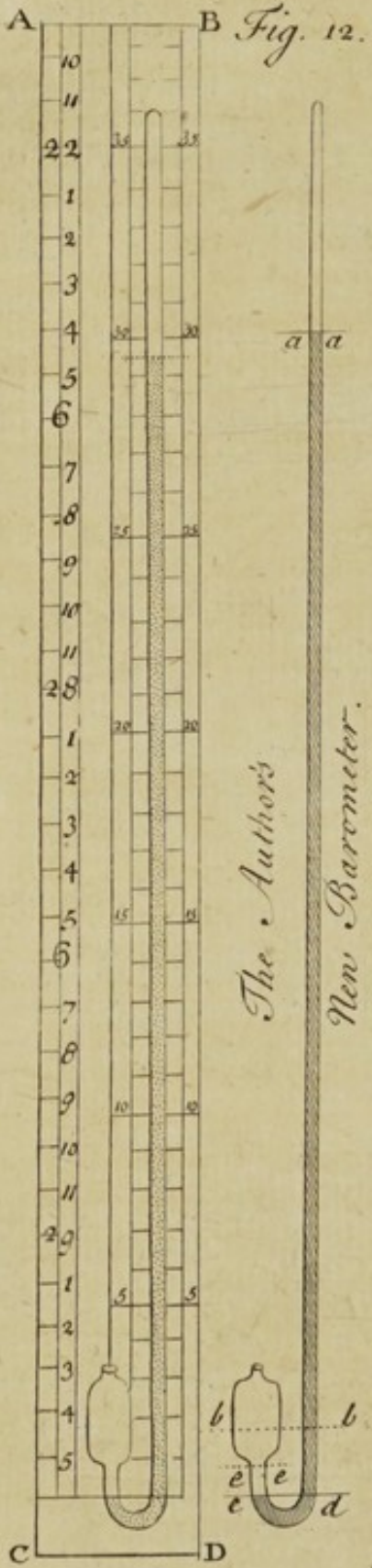
6.

Fig. 8.



Bernoulli's Barometer.

Fig. 12.



The Author's New Barometer.

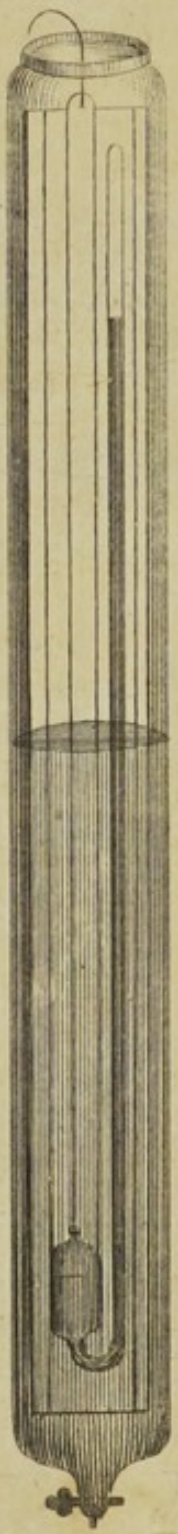
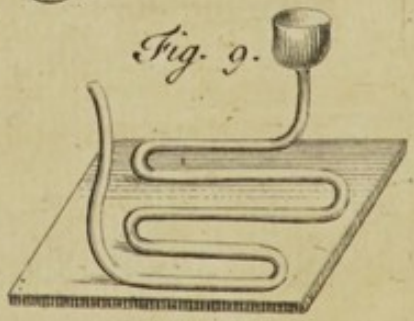


Fig. 9.



ing and its entire courſe preſented to view, together with a remarkable branch tending to the hepatic duct, as likewiſe appears by the Figures. Whether this communication of the biliary canals be what is common and what univerſally holds, may indeed ſeem doubtful on the following accounts; namely, that as I complain'd above, I ſometimes found no communication at all, and once only obſerv'd it double, but more frequently ſingle: But as ſomething of it is always obſerv'd in ſound livers, I may probably conclude, that ſuch a communication is no ways preternatural, tho' I frankly own, that it is ſometimes greater and ſometimes leſſer; at one time ſingle and at another time manifold; that now it enters deeper into the ſubſtance of the liver, and again only ſuperficially; ſometimes with more, and ſometimes with fewer branches. Fig. 1. and 2.

In *Gliſſon*'s duct, at the neck of the gall-bladder, I obſerv'd that its ſtructure and inſertion are not always the ſame: Since ſometimes I found two ſimilar ducts adjoining to its orifice, which would admit of a probe, more rarely at the extremity of the bottom, and generally at the beginning of the *ductus cyſticus*; nay, ſeveral times I could obſerve no trace of it, which I aſcribe to the dimneſs of my ſight; for, very lately in an ox it appear'd, that ſometimes a *luſus naturæ* may happen in the ramification and inſertion of this duct: For, tho' I made uſe of all the proper contrivances in tracing it, yet I could neither obſerve its orifice in the more uſual places, nor its roots ariſing from the liver; till at length there appear'd a very manifeſt *hiatus* in the ſide of the *ductus cyſticus* itſelf, thorough which injecting ſome wax, and ſlightly cutting away the fleſhy parts, there preſented to view a duct almoſt an inch long, and as thick as an ordinary writing pen, and furniſh'd with ſeveral ramifications; which duct I may very reaſonably ſuppoſe to ſupply the room of *Gliſſon*'s duct. Structure of *Gliſſon*'s Duct not always the ſame.

What theſe things may contribute towards determining the motion of the bile, and the place where it is elaborated, which are otherwiſe pretty uncertain, I leave others, who perhaps have made a greater number of experiments, to determine: Yet that all the bile is not deliver'd from the liver into the gall-bladder, thro' the above-mention'd ducts only, but likewiſe thro' the *ductus hepaticus*, is confirm'd by the following obſervation, made on a live dog; I tore up the gall-bladder as far as the neck, to try whether any of the bile would run down thro' the neck towards the lacerated bottom: The event anſwer'd expectation; for not only did the bile, as in a flood, burſt out from the narrower cyſtic duct thro' the wider neck of the bladder; but the cyſtic duct itſelf, after making a ligature on it, ſwell'd in ſuch a remarkable manner, that little or no bile was afterwards deliver'd by the neck. Experiment on a live Dog, with Regard to the Bile.

A A. Repreſents the ſubſtance of the liver.
B B B. A portion of the liver where the fleſhy parts are cut away.
C C. The *ductus hepaticus*. Explication of the Fig. 1. and 2. Plate I.

D. The

D. The *ductus choledochus communis* laid open.

E E. The *ductus cysticus* laid open, as also the gall-bladder.

* The orifice of the *ductus cysticus* and intermediate hepatic ducts.

G. The communication of the said duct with the *ductus hepaticus.*

H H. The intermediate duct with its branches, dispersed thro' the substance of the liver.

K. A branch of this intermediate duct communicating with the hepatic duct.

a. The insertion of *Glisson*'s duct.

I. A canal resembling *Glisson*'s duct.

b. Its orifice.

Of the different Sorts of more sensible Barometers, *and of a new Kind of them and their Uses. By* M. G. B. Bülffinger. *From the* Commentarii Academiæ Scientiarum Imperialis Petropolitanæ, Tom. I. An. 1726. p. 317.

Translated from the Latin.

An Account of different Barometers.

1. *D'Alencéus* has in a particular treatise given an account of the origin and divers kinds of barometers: Few new ones have been added since that time; and yet there are some, and those worthy of the attention of the Learned. The principal care of the Inventors was to make the variations of the heights more sensible; for, to this, *Des Cartes*, *Hook*, *Huygens*, *Amontons*, *De la Hire*, and *Jo. Bernouilli*, have applied themselves: What *Amontons* chiefly regarded beyond the others was to distinguish by the effects of gravity what things are owing to heat, and to the expansion of the liquors. These great men were not disappointed in their attempts; for, we have many contrivances of theirs, yet some preferable to others: I myself have something on this head, which I shall submit to the judgment of the intelligent.

Two Classes of Barometers.

2. I shall first treat of the barometers of others; and those, as far as they are come to my knowledge, I reduce chiefly to two classes. Some have attempted to render the variations more sensible, by the form or figure of the machine only; and others by using liquors of different specific gravities.

Water Barometers.

3. If we should use water instead of mercury, and tubes of 33 feet, such as *Sturmius* mentions in his *Collegium curiosum* [a]; the variations would in that case, it is true, be more sensible than they usually are in simple mercurial barometers: But who with patience could bear so unwieldy a height? Or who can purge the water of its air, so as that none of it may rise

[a] *P. II. Tent. V. p. 76. Seqq.*

riſe up to the top? And who can reduce to rules the expanſions of the water that are owing to heat? Yet its freezing may ſometimes be prevented.

Des Cartes's Barometer.

4. Such as with *Des Cartes* make the tube larger in that part, wherein the mercury plays in its riſing and falling, and would pour water or oil upon it to indicate the variations in a narrower tube, cannot eaſily avoid the inconveniencies of the air that poſſeſſes its upper part; and both that air and the liquor itſelf are ſubject to variations ariſing from heat, which ſhall diſturb the obſervation of gravity. *Poleni* [a], in this caſe, ſhews, that, by repeated inverſions of the tube, the greateſt part of the air may be expell'd as it riſes out of the water; but whether the whole quantity of air may be thus exhauſted, I ſhall neither poſitively affirm nor deny. It is certain, that this expedient is of great uſe, when we employ *Des Cartes*'s barometer; for, upon uſing it I ſcarcely think there remain any other ſenſible difficulties beſides the influence of heat. We may eaſily reduce to rule the irregularities depending on the different heights of the fluid above the mercury; and at the ſame time note them in the ſcale of degrees: So that that correction of *Poleni* is entirely praiſe-worthy.

Plate I. Fig. 3.

Barometers with double tubes by *Huygens* and *De la Hire*.

5. M. *Huygens* [b] has avoided ſome of the inconveniencies of the former barometers by employing a double tube; but *De la Hire* [c] has hinted at ſome imperfections that ſtill remain in *Huygens*'s conſtruction: *De la Hire* himſelf, by the ſame contrivance of a double tube, inflexed in the manner which *Hook* [d] had uſed, has avoided or leſſened moſt of the inconveniencies of the former barometers; and that by ingenious contrivances, tho' not entirely without their imperfections [e].

Fig. 4, 5.

Barometers by *Amontons*.

6. *Amontons*, it is true, with another deſign, uſed a double tube; but by that very method he likewiſe render'd the variations more ſenſible, and entirely avoided ſome of the inconveniencies of former barometers. We read in the *Journal des Scavans* [f] a contrivance of conſtructing a barometer of 14 or 7 inches only; and upon filling the intermediate tube with any two liquors, we may render the variations much more ſenſible than in the ſimple barometer: I caus'd ſome to be made by the ingenious artiſt *Lucas de Coſſa*, nor was I diſappointed in the ſucceſs; but it muſt be owned, that in the very ſtructure of this barometer I met with difficulties, which every one cannot eaſily get over: So that it is not to be wonder'd at, that tho' the ſame be curious and elegant, and greatly commended in a particular treatiſe by an anonymous *French* Author [g], yet it is not commonly known nor deſcribed in the common *compendium*'s.

Fig. 7.

7. This

a *Giornale dei Liter. d'Italia* T. 5. p. 300.
b *Journ. des Sçavans* An. 1672. d. 12. Dec. p. 173. Ed. Bat.
c *Mem. de l'Acad. des Sciences* An. 1708. p. 207, 208. Ed. Bat.
d *Phil. Tranſ.* N° 185. p. 241.
e *Herman. Phoronom.* § 324. & *infra* § 12.
f An. 1688. d. 10. Maii.
g *Act. Erud.* An. 1711. p. 319, 320.

The ſecond Claſs of Barometers.

7. This is one claſs of barometers: Others have ſought to mend the matter by the figure of the barometers only, and that in a twofold manner: Some have applied themſelves to cauſe greater variations in the mercury; others again to obſerve at leaſt more accurately the ordinary variations. The former was effected by thoſe who inclined the upper part of the tube from the perpendicular to the horizon: This is an ancient contrivance, whoſe firſt author I know not; but it is found to be propoſed by an anonymous author in the *Philoſophical Tranſactions*[a], and is generally deſcribed by others: As it may be eaſily conſtructed, and as by increaſing the inclination, it may be render'd ſomewhat more ſenſible, it, therefore, deſerves commendation; yet it does not attain to the higheſt degree of exactneſs, and that on ſeveral accounts; as the increaſed frictions of the glaſs, the coheſion of the mercury, which hinders its running in narrower tubes, and makes it irregular in wider ones; the inconveniencies from heat become more ſenſible by the inclination, *&c.*

Plate I. Fig. 6.

Jo. Bernouilli's Barometer.

8. The beſt in this kind is undoubtedly that which we owe to *John Bernouilli*, and is explain'd in *Hermann's Phoronomia*[b]; its upper part, where the variations of altitude are made, conſiſts of a bubble of any degree of bigneſs; the tube at its lower part is incurvated, that it may run out parallel to the horizon; or which is more commodious in practice, it is reflected at pleaſure upon a horizontal plane: The *Pariſians* have hinted, that *Jo. Dom. Caſſini* attempted ſuch kind of barometers ſeveral years before; but that he afterwards laid aſide this method, becauſe the air inſinuates itſelf into the mercury in a horizontal tube, ſomewhat wider[c].

Fig. 8.

Experiment on *Bernoulli's* Barometer.

9. I made trial of this, and found it ſucceed, when the diameter of the horizontal tube did not exceed a line; I was at firſt apprehenſive of the inconveniencies of friction, that on account of the narrowneſs of the tube it would hinder the minuter variations: But I have learned by experiment, that they are not ſo conſiderable in a barometer accurately conſtructed; for, when, according to *De la Hire's*[d] direction, I ſhook the barometer a little, I obſerv'd that the places, at which the mercury ſtood before and after the ſhake, differ'd little or nothing. The ſcale of the variations, in the one I firſt caus'd make, is ſeven times greater than the common ſcale. I ſhall give in a note[e] my method of conſtructing theſe kinds of barometers, becauſe

The Author's Method of conſtructing theſe Barometers.

[a] N° 236. p. 4.
[b] § 324.
[c] *Phoron.* l. c. p. 180.
[d] *Mem. de l'Acad. des Sciences* An. 1712. p. 4. Ed. Bat.
[e] 'Take a portion of a wider tube, three inches long; at one end let it be hermetically 'ſealed; and at the other, by means of the flame of a lamp, let it be join'd to a ſlenderer 'tube of 28 inches in length: My inſtrument, it is true, on each ſide of the wider cylin-'der, has a ſlender tube; but you may eaſily perceive, that the upper one is not neceſſary: 'Let the tube, thus conſtructed and inverted, be fill'd with mercury to the height of one 'or two inches, with the ſame precautions with reſpect to the air, as are uſually obſerv'd:

After

becauſe greatly different from thoſe, propos'd by others, as that by *Jo. Bernouilli* in *Hermann's Phoronomia* [a], and by *Chriſtian Wolfius* in his experiments [b], both becauſe it is eaſy and accurate.

Barometers by *Hook*, *Hauksbee*, and *Gray*.

10. Dr. *Hook*, Mr. *Hauksbee*, Mr. *Gray*, and perhaps ſome others, have endeavour'd to make exacter obſervations of the variations, tho' not greater in the mercury, or the liquor employ'd: And they made uſe of two weights ſuſpended to a thread about an axis; either of which ſhould reſt on the mercury, and the other hang freely; they faſten'd an index on the axis for deſigning the degrees of a circle, or any leſſer diviſions on a circular plate [c]. But Dr. *Hook* himſelf hinted [d], that the event did not anſwer expectation; becauſe the variations are indicated by fits.

Plate I. Fig. 11.

Gray's accurate Contrivance.

11. Mr. *Gray*'s contrivance is elegant and accurate, if the inſtruments be made by a ſkillful hand [e]. It may even be employ'd, whenever the height of the mercury in any tube is to be accurately obſerv'd; nor is it attended with any other inconveniencies than ſuch as are common in the ſimple barometer; but by that very thing, it is far from that perfect ſenſibility we look for; and if the ſimple barometer doth not obey the minuter variations of the air, as all the Learned are agreed; in that reſpect, ſure, an inſtrument, otherwiſe very ingenious, will diſappoint the obſervers.

Fig. 10.

Circumſtances in which the ſeveral Contrivances agree.

12. After having rehearſed the ſeveral contrivances, hitherto propos'd by the Learned, we ſhall hint at thoſe circumſtances, in which they all gene-

' After this take a new tube of ſuch length, as ſomething to exceed the ſpace, which, in ' reſpect of its diameter and of that of the ſuperior bubble, the mercury ſhall run over in its ' variation: Let the internal diameter of this tube be about a line, and let it be joined at ' the lamp to the former tube in the place where it is void of mercury: From the middle ' of the wider tube meaſure the mean height of the mercury, for inſtance 27 inches; and ' at this diſtance let the tube be ſo inflected at the lamp, that the one part may be perpen- ' dicular to the other: This inflected part, which is to be horizontal when the inſtrument ' is duly erected, (that it may not take up too much room, or eaſily ſwerve either upwards ' or downwards from the horizontal line) may again be variouſly inclined; and theſe incli- ' nations, may, by means of ſome plane, be eaſily examined and rectified by the lamp. ' Upon inverting the inſtrument, the mercury, deſcending from the wider tube, will fill ' not only the remaining ſpace in the vertical tube, but likewiſe a part of the horizontal ' tube, wherein it will afterwards vibrate: In joining and inflecting the ſmaller tubes, you ' are carefully to avoid the nodes and acuter angles, leſt the impediments from friction be ' increas'd, as I remember happen'd in a like caſe: Moreover, from the given diameters ' of the wider tube and ſlenderer tubes, it is eaſy to determine the point of inflexion of the ' tubes, and the length of the horizontal tube: So that there may be no apprehenſion of ' the mercury being forced upwards from a heavier ſtate of the air, or of its running out of ' the horizontal tube from a lighter ſtate of the ſame; yet, by way of precaution, I bent ' upwards about an inch of the extremity of the horizontal tube; and to prevent any duſt ' getting in, I again bent it downwards.'

[a] l. c.
[b] Tom. II. § 33. p. 63.
[c] *Hauksbee's Exper.* Tab. I. pneumat.
[d] *Phil. Tranſ.* N° 185. p. 241.
[e] *Ibid.* N° 240. p. 176.

generally agree. 1. They all have this in common, that the top of the mercury may vary; and therefore unleſs the tube be perfectly equable (a thing not well to be expected) there are irregularities that ariſe from friction; and unleſs it be perfectly of the ſame width, there are others that are owing to a capillary tube: For, it is well known, that mercury does not riſe to a level in ſomewhat narrower tubes; and that in the ratio of their diameters. Dr. *Jurin* [a] juſtly complains of this inconveniency. 2. All of them are ſubject to diſadvantages, from the diverſity of the riſe and fall of the mercury; which in the former caſe puts on a convex, and in the latter, a concave ſurface: And therefore, tho' at the ſides of the glaſs it reaches to the ſame height; yet it does not indicate the ſame gravity of the atmoſphere: And I am ſurpriſed, that this has never been objected to compound barometers. 3. The variations of all are diſturbed by heat and cold, on account of the different and irregular expanſions and condenſations of the liquors. 4. All compound barometers are attended with the difficulty of knowing the diameters of the tubes, and that thro'out the whole length of the variation. 5. The neceſſary ſhake, mention'd above [b], begets oſcillations no leſs incommodious in compound barometers than in ſimple ones. 6. And laſtly; the difficulties of conſtructing are inſeparable from almoſt all theſe barometers.

A new Barometer by the Author. Plate I. Fig. 12.

13. I here give the world the deſign and ſtructure of a new kind of barometer, which I lately hit upon, that I may be inform'd how near, or how far I am from the truth.

Its ſeveral Advantages.

14. I propoſe to myſelf a barometer, that ſhall indicate even the minuter variations of gravity; that ſhall be ſubject to no inconveniencies from the inequality of the tube, or from the diverſity of the riſe and fall of the mercury; that ſhall diſtinguiſh the expanſions and condenſations by heat and cold from the effect of gravity; that ſhall not require meaſuring the diameters of the tubes, and wherein the oſcillations ſhall cauſe the leaſt poſſible impediment; that ſhall not be affected by evaporating, foulneſs, freezing, *&c.* that ſhall be eaſily conſtructed; and in fine, that ſhall carry along with it the teſt of its own exactneſs.

Manner of its Conſtruction.

15. For this purpoſe, take the common ſimple recurve barometer; mark upon it the place of the greateſt height; and that either by obſervation, if ſuch has been already made for ſome years paſt; or by the actual menſuration of the height of the tube: But take care that there be no more mercury in the tube and bubble than ſhall reach in the recurve part to the place *d*, at leaſt three lines lower than the bubble *b*, when it riſes to the greateſt poſſible height *a:* But inſtead of the height *a*, you may take any other, ſomething greater than that to which the mercury ever riſes: So that the height *da* may be a ſmall matter greater than any hitherto obſerv'd.

Fig. 12.

16. Let

[a] *Phil. Tranſ.* N° 363.
[b] § 9.

16. Let this tube be fixed to a braſs plate ABCD, of a breadth not much exceeding the tube itſelf; divide the plate, beginning from the horizontal line *cd*, into degrees and inches, by parallel lines to *cd*; make a groove in the plate for receiving half the depth of the tube; ſo that it may every where touch the diviſions in the plate on each ſide of it.

17. Immerge the plate along with the tube in water, till the mercury touch the place *a*; and note to what depth the tube is immerged under the water: I ſay if this be done, as the gravity of mercury to that of water, ſo is the height of the water above the line *cd*, to the depth of the mercury under the line *a*; and this fourth proportional, ſubſtracted from the whole height *ac*, leaves the true height of the mercury, at which in a given time it ſtands by the weight of the atmoſphere.

18. The demonſtration is eaſy: For, the mercury riſes by the weight of the atmoſphere and the incumbent water; deducting, therefore, the height ariſing from the preſſure of the water, the remainder is equal to the preſſure of the air. To avoid the trouble of calculation, I ſhall give an eaſy expedient in § 39. *infra*.

Its Senſibility.

19. It appears, that this barometer is ſo much the more ſenſible than the ſimple one, by how much the liquor into which the tube is immerg'd is ſpecifically lighter than mercury: And therefore, tho' its ſenſibility cannot be increaſed *in infinitum*, yet it may be increaſed to ſuch a degree, as to anſwer the purpoſes of obſervations.

Specific Gravity of the Liquor to Mercury inveſtigated.

20. The ſpecific gravity of the liquor to mercury may be independently inveſtigated; for, if you conſider what depth is requiſite to make the mercury riſe to the height of one inch, the ratio of the ſpecific gravities will be the inverſe of the ſaid heights.

How it may be accurately obſerv'd.

21. And that this may be accurately obſerv'd, you may employ a convex glaſs, ſimple or double, with or without threads, fixt to a plate in ſuch manner, as to move upwards and downwards parallel to itſelf; for, by this means you may more exactly obſerve the limits of the mercury in the tube, and its agreement with the line of the plate, by which it is examined; and here Mr. *Gray*'s contrivance, mention'd above [a], may be of ſervice: Yet the uſe of a convex lens is eaſier.

Expedients to prevent the Oſcillations of the Mercury and Liquor.

22. It is a difficult matter, when the plate is immerg'd in the liquor, entirely to prevent the oſcillations both of the mercury and liquor; yet two things may be of ſervice in this caſe. 1. I could wiſh that the plate were ſuſpended in a glaſs tube, ſufficiently long and ſomewhat wide, that afterwards by means of a thread, paſs'd round an axis, which is plac'd at the top of the tube, the tube might by means of a handle that turns quite round, and an endleſs ſcrew, be gently, and without any violent ſhake, ſucceſſively immerg'd into, or taken out of the water: For, in this manner the oſcillations would be ſhorter. 2. If there is no hazard in delaying, you

[a] § 11.

you may wait till the vibrations are over; but they will be ſooner ſo than in the common ſimple barometers, from the reſiſtence of the liquor in the other leg: If there is any inconveniency in waiting, note two or more ſucceſſive oſcillations; and for the true height, take the mean of the vibrations; and thus there will be little or no miſtake, eſpecially in eſtimating and transferring the height of the liquor; for inſtance, water, to the mercury: For, ſuppoſe you err in eſtimating the height of the water a whole line, after reduction it will not amount to the twelfth part of a line in eſtimating the height of the mercury.

Contrivances for immerging the mercurial tube.

23. If any one is at a loſs for glaſs-tubes of a ſufficient length and width, he may of any materials make an oblong veſſel, and cover its fore-part with glaſs-plates, whereby to obſerve the immerſions of the mercurial tube. The bubble, or wider part of the tube, may be furniſh'd above with a funnel, and below with a ſtop-cock, in order to ſhift the liquor at pleaſure; but that part of the liquor in the ſmall tube *db* may by means of a ſiphon be drawn off, whenever you have a mind to ſhift the liquors: For, there are ſome ſiphons, and thoſe running ſpontaneouſly, into which the mercury does not enter, and by which all the water may be drawn off. And if you are alſo at a loſs for ſuch a veſſel, the barometer may be immerg'd in any veſſel full of water, and the depth to which it is plunged be noted: But in this caſe it is to be obſerv'd, that the top *a* is to be taken ſo as that in the experiment it be not plunged deeper under the water.

Plate I. Fig. 12.

Advantages of theſe Contrivances.

24. From what has been ſaid it appears, that in this caſe there ariſes no inconveniency from the inequality of the tube; for, the mercury is always elevated preciſely to the ſame height; nor from the diverſity of the concavity and convexity of the upper ſurface of the mercury in its riſing and falling; for, in riſing it always acquires a convex ſurface; nor from the evaporating of the liquor; for, there is always a ſufficient quantity of it; nor from the foulneſs of the liquor; for, the old may be ſhifted for freſh; nor from freezing; for, any liquor may be taken, and its ſpecific gravity to mercury found out; nor from the menſuration of the diameters, which cauſes a great deal of difficulty in compound barometers, and that not only as to the abſtract calculations, but likewiſe as to the execution in practice.

Farther Advantages; together with ſome Diſadvantages.

25. I own indeed, that the actual meaſures cannot be taken with ſufficient exactneſs by a pair of compaſſes; if they be taken for the liquors themſelves, ſo as to obſerve how much ſpace ſhall be run over in the ſlenderer tube, by the riſe and fall of the mercury for one inch in the wider tube; for that whole ſpace you ſhall have that degree of exactneſs, mention'd above [a], in examining the gravity of the liquors: But you have by no means the ſame ſpace for each part of the tubes, unleſs you ſuppoſe the tubes to be exactly equable throughout that ſpace: But if you would examine by each line of the heights of the mercury the places of the liquor in

[a] § 20.

in the ſlenderer tube, it will be a tedious and endleſs work, and not always in your power: For, we cannot at pleaſure have all the heights, except the greater ones, by the inclination of the tube; but this in a bubble is ſubject to many difficulties.

26. There is one difficulty, and that the greateſt of all, which is, how the effects of heat are diſtinguiſh'd from thoſe of the gravity of the atmoſphere? Some authors generouſly overlook this difficulty, and take no notice of the diſadvantages, and others palliate the matter; but *Amontons* is the only one I know of, who profeſſedly treats of the affair. One great Diſadvantage.

27. Such as allow of *Amontons* correction of the ſimple barometers [a], may eaſily apply it to my barometer, obſerving to make the line *c d* fall upon the middle of the bubble, fixt to the recurve part of the tube; and then they will have the common ſimple barometer, agreeing in every reſpect with the common barometers; nor will the expanſion of the water, or any other liquor employ'd, be any hindrance to the ſucceſs: For, by § 20 we may at all times diſcover its relation to the preſent ſtate of the mercury; conſequently, its preſent true height may be found in the ſame manner; nay, better and more exactly than if it was diſcover'd by the ſimple barometer. But having had the height of the mercury at that time, you may afterwards reduce it by *Amontons* table to the height of a hotter or colder mercury, employ'd at the time of conſtruction. *Amontons* Correction eaſily applied to the Author's Barometer. Plate I. Fig. 12.

28. I ſometimes thought, that the whole matter might be more eaſily and ſhortly thus diſcover'd: Suppoſe from *Amontons* definition [b], that the mercury in paſſing from the higheſt degree of cold to the higheſt degree of heat, is increaſed $\frac{1}{115}$ of its bulk; it is evident, if in its higheſt degree of cold it poſſeſſes the ſpace *a c d*, that in its higheſt degree of heat it muſt take up a greater ſpace: But ſuppoſe its top at *a*, it would riſe at leaſt three lines above *d*; its expanſion by heat, therefore, may be known by the height *e d* above *d*, and the ſame be compar'd to the whole ſpace *a c d e*; and that either ſimply according to the length of theſe ſpaces *e d* and *a c d e*, if you ſuppoſe the tube ſenſibly, and in thoſe reſpects, equable; or, if you would even take in the conſideration of theſe niceties, by a more operoſe examination. Thus, therefore, the *ratio* of the denſity of mercury would be diſcover'd from one time to another; and conſequently, the preciſe meaſure of the gravity of the atmoſphere would at all times be determin'd: For, we ſhould have the heights and denſities of the mercury for any time. Denſity of the Mercury not diſcover'd. Fig. 12.

29. *Amontons* opinion favours this method, when he hints [c] that he learned by experiment, that the common tubes of barometers ſuffer no ſenſible conſtriction by cold, nor ſenſible dilatation by heat; and adding this conſideration Tubes of Barometers, whether affected by Heat and Cold.

to

[a] *Mem. de l'Acad. des Sciences An.* 1704. *p.* 230. *Ed. Bat.*
[b] *Mem. de l'Acad. des Sciences An.* 1704. *p.* 225.
[c] *Mem. de l'Acad. des Sciences An.* 1704. *p.* 373.

to what has been already ſaid, I ſee that nothing more can be wanting to reach our end: For, this can be the only difficulty remaining, namely, whether glaſs may be both contracted by cold and dilated by heat; and whether therefore, the increaſe of the bulk of the mercury is always greater in heat than the concavity of the little tube *e d*; it were, therefore, to be wiſh'd, that this other notion of *Amontons*, and his meaſure of the expanſion, mention'd above [a], were aſcertain'd.

Plate I. Fig. 12.

Amontons Experiment not ſatisfactory.

30. But I am oblig'd to own, that all my ſcruples have not been removv'd by his experiments: And I am perſuaded by experiments on the thermometer [b], that the cavity of the tube may be enlarg'd by heat, as that is commonly inferr'd from the ſudden falling of the liquor, when the thermometer is plunged into hot water: It will, therefore, be a thing made out, that the ſmall ſpace in *Amontons* experiment [c], thro' which the mercury ſubſides, does not amount to the whole of the contraction of the mercury; for, even the tube was conſtricted by cold: The expanſion and contraction of the mercury and ſpirits of wine are, therefore, greater than is determin'd by that place. You may, therefore, in like manner be apprehenſive, leſt in the other experiment, in which the increaſed capacity of the glaſs veſſel was ſought, the expanſion of the contain'd liquor, made at the ſame time, ſhall exhibit the ſame leſs than the truth: But I would not obſtinately inſiſt on this; becauſe the whole of that experiment is not deſcrib'd.

31. You may eaſily judge; ſince this opinion of *Amontons* was ſo much to my purpoſe, that I left nothing untried, but rather wiſh'd to eſtabliſh the ſame if poſſible; nor was I entirely diſappointed. The tubes uſed for thermometers differ very much from the tubes of barometers in the ſolidity of their ſides, and in their internal capacity: I did not, therefore, think it impoſſible to reconcile *Amontons*'s experiment with thoſe made on thermometers.

Fig. 9, 12. *Amontons* Experiment reconciled with thoſe made on Thermometers.

32. For this purpoſe I took ſome ſlenderer tubes, but of a greater length, and I inflected them as in the Figure, with this view at leaſt, that the longer tube might take up a ſhorter ſpace. I furniſh'd one end with the funnel *a b*, and directed the other into the capillary tube *c d*; and at the ſame time I pour'd a ſufficient quantity of mercury into the funnel, that when once it ſhould begin to run, no air might inſinuate; becauſe the air could eſcape thro' the orifice of the capillary tube, the tube was in a moment fill'd, and the mercury ran out of the capillary tube; till in the higher leg *b e* it was in a level: Then the capillary tube was hermetically ſeal'd

[a] § 28. [b] *Mem. de l'Acad. An.* 1700. *p.* 153. *and An.* 1705. *p.* 101. *An.* 1710. *p.* 563.

[c] In the *French* Memoirs for the year 1710, we have the converſe of the former experiment. I repeated both experiments, on occaſion of a doubt ariſing about the true cauſe of the phenomenon, and in the preſence of our Society, putting the *Florentine* thermometer alternately into hot and cold water, I found it anſwer as mention'd.'

[c] *Mem. de l'Acad. An.* 1704. *p.* 225.

ſeal'd at the lamp; ſo that no more air remain'd, than what the quickeſt eye could ſcarcely diſtinguiſh: The inſtrument thus prepar'd, I plung'd it alternately into hot and cold water; but I could not diſtinguiſh any ſudden riſing of the mercury in the cold, nor falling in the hot water. I examin'd the tube, whether any bubble of air, or the leaſt particle of it, lay conceal'd in the hot water, but to no purpoſe. If any one cannot conveniently procure, or make a tube with a funnel, or hermetically ſeal a capillary tube, he may exactly enough cloſe it up with cement, after he has fill'd it by ſuction; which is always eaſily done, and in wider tubes is almoſt neceſſary.

Another Method of diſcovering the Denſity.

33. It therefore appears, that the method deſcrib'd above[a], may be uſefully employ'd: Yet this is not the only one; for, there is another, which I ſhall deſcribe, in order to compare them both together, and which is the beſt, practice itſelf may determine: But there are two things neceſſary. Firſt, at any given time to determine the height of the mercury above the level, which, by means of the liquor, may be thus exactly done.

Plate I. Fig. 12. How to determine the Height of the Mercury above the Level.

34. Plunge the barometer till the mercury reach the line *a*; and in the annex'd ſcale of diviſions note the height of the liquor above the line *c d*[b]: If in this caſe the mercury be rais'd above the line *c d*, plunge it farther; if depreſs'd below *c d*, draw out the tube till the mercury exactly anſwer to the line *c d*; examine what each of theſe heights, according to the ſpecific gravity of the liquor, defined above[c], does make, when reduc'd to the heights of the mercury: Then to obtain the true height of the mercury for that time above the level in the other tube; in the former caſe ſubſtract, and in the latter add the laſt height to the firſt: I here neglect the height of the liquor *e d*, as being inconſiderable; but if you would not, it is eaſy to take it into the account too: For, it is ſufficient to take it barely by the eye.

To know the mutual Denſity of the Mercury and Liquor, and how to compare them.

35. Thus we obtain the firſt: The ſecond requires, that you likewiſe know the preſent denſity of the mercury; proceed, therefore, thus: If the water, or any other liquor employ'd, were always of the ſame denſity, the preſent denſity of the mercury to the paſt might be diſcover'd by § 20. But as this does not hold of any liquor; by the method § 20 we only diſcover the mutual denſity of the mercury and liquor, at every time: But for our preſent purpoſe, there is ſtill ſomething more requir'd, to wit, that the denſity of either at different times be mutually compared; for, thus if you can exactly compare the denſity of warm mercury with that of warm water at the ſame time; and the denſity of warm water with that of cold water; and the denſity of cold water with cold mercury at the ſame time, you may likewiſe, with the ſame exactneſs, compare the denſity of the mercury warm at one time, with the denſity of the ſame mercury cold at another time.

36. The

[a] § 28. [b] § 17 *ſupra*. [c] § 20.

To compare the different denſity of water at diffe-rent time.

36. The firſt and third may be done by means of § 20; but the ſecond is ſtill wanting: And thus, at length, the whole difficulty is reduc'd to this, namely, to be able to compare together the different denſity of water at different times. This problem has been long, and that differently reſolv'd by many: I chuſe to pitch on that method, whereby a ſolid body, as metal, for inſtance, is carefully weigh'd in both waters; and from the weight it loſes, the denſity of the liquor is determin'd. To obviate an objection, to wit, that the metal itſelf may be contracted by cold and dilated by heat; you may take it at a mean ſtate, wherein it neither greatly exceeds nor greatly falls ſhort of the ordinary heat of one's hand, for inſtance.

The Author's machine both a baroſcope and a barometer.

37. And thus, at length, I think I have, by three eaſy operations, reduc'd a problem the moſt difficult in itſelf to one of the eaſieſt: And therefore, if naturaliſts allow, that there are ſuch things as areometers, they may alſo grant, that this machine of mine, after ſeparating the effect of heat from gravity, is not only a baroſcope, but a barometer; by which we may not only diſtinguiſh the variations of gravity in the atmoſphere, but likewiſe meaſure them.

In this barometer the error from heat and cold leſs ſenſible than in the ſimple.

38. I add this one thing, that if one does not require the greateſt degree of exactneſs, what has been ſaid § 28 may ſuffice; or even employing, inſtead of the other liquor, oil of tartar *per diliquium*, whoſe rarefaction is ſaid not to be conſiderable [a], the operation § 35 may be omitted: For, the error ariſing from heat, as the calculation eaſily ſhews, premiſing only the operation § 20, will be but little ſenſible; nay, even if the liquor were very ſubject to expand, as for inſtance, ſpirits of wine; then even neglecting the precaution § 20, and employing only the operation § 34, the error ariſing from heat and cold will be leſs than in the ſimple barometers: And therefore, as one aſpires to a greater degree of exactneſs; ſo by a greater number of precautions he may arrive thereto.

How this barometer may be render'd more commodious. Plate I. Fig. 12.

39. But the daily uſe of the barometer may even by this ſmall contrivance be render'd more commodious; if from the one ſide, and that from the horizontal line *c d* be number'd inches and lines, beginning from unity, but number'd from the other ſide in ſuch manner, that the inches of the height of the mercury, ſuſpended by the atmoſphere, be ſet down to thoſe places wherein the water ſhall ſtand above the tube, and the intermediate ſpace be divided into 12 greater parts, each of which may anſwer to the lines of the mercury; and being again ſubdivided into 12 parts, may indicate the duodecimals of the lines. This ſhall ſuffice when it is not neceſſary to attend to the heat; but when it is, you will not begrudge the uſing greater diligence by following the directions, §§. 33, 34, 35.

To make this barometer portable.

40. The only difficulty I have not hitherto conſider'd is, whether this barometer be alſo portable: And it is ſuch if you pleaſe; for, if by a portable barometer we mean ſuch as may on any occaſion be ſafely convey'd from

[a] *Mem. de l'Acad.* An. 1704. p. 369.

from one place to another; ſimple barometers, eſpecially the recurve ones, are reckon'd portable: Take my barometer out of its liquor, and inverting it you ſhall have the ſimple recurve barometer: If you are apprehenſive that the water which ſtagnated in the bubble ſhall enter into the other part of the tube (tho' this may be prevented, if the tube be narrow, and if there be ſuch a quantity of mercury, as that it cannot all enter into the longer leg) you may by § 23 firſt draw off the water by a capillary recurve ſiphon.

Another more commodious Method to make it portable:

41. The following method is more commodious: Leave the mercurial tube with its plate in the other wider tube, if the lower bubble be of ſuch a width, that the mercury vibrating by the ſhaking in the carriage, may not run out in its fall, and the tube from the bubble be at its inflexion of ſuch a length, that ſhould the mercury riſe to the top, yet it may not retire quite to the inflexion of the tube; in this manner may you carry the barometer erect.

How to carry the Barometer inverted or inclin'd.

42. But if you would rather carry the barometer inverted or inclined, and that leſt the top of the tube ſhould be broke by the ſhaking of the mercury in its riſing; let the tube be twice inflected at its lower part, and let the mercury, when it riſes to the top not retire beyond the firſt leg: All which may be eaſily done.

How to ſuſpend the Plate.

43. I take it to be no difficulty, ſhould any one aſk, how the plate ought to be ſuſpended, ſo as that the leg of the barometer may be perpendicular: Let the line of ſuſpenſion paſs through that common center of gravity of the plate and tube, which happens when the plate is half immerged; for, you may ſafely neglect the differences of that centre of gravity, on account of the inequality of the ſides of the tube, which eaſily varies according as it is more or leſs immerged. But if you require the utmoſt exactneſs, fix a plumb-line to the plate; and thus faſten the inſtrument to the wall, that the plumb-line may deſign a line parallel to the axis of the mercurial tube; which line muſt be firſt deſcribed. Let this ſuffice for the ſtructure of my new barometer; to which I ſhall over and above, add this one thing.

How to make this Barometer more perfect than the ſimple one.

44. If you do not require, that the barometer diſtinguiſh heat from gravity, but yet be more ſenſible than the common and ſimple one; and be without ſome of the defects of the ſimple barometer [a], and be eaſily conſtructed; all this may be done in the following manner: Let two plates be join'd together at right angles, yet ſo that the one ſhall remain fix'd, and the other turn round an axis, and in its rotation graze on the other: To the revolving plate fix the ſimple barometer, but much bigger than the common one, and furniſh'd above with a ball, if you ſo incline, but of a narrower tube; in that tube take ſome point, as for inſtance, at the height of four foot from the lower bubble, which is full of mercury; at a greater or leſſer diſtance, as you want your barometer more or leſs ſenſible;

[a] § 12. n. 1. 2.

but then let the moveable plate with its barometer be inclined, till the mercury reach the above-mention'd point, and obſerve the magnitude of the angle, comprehended between the inclination of the tube and the horizon: For, if this angle be greater, the gravity of the atmoſphere is greater, in the ratio of the ſines of the angle of inclination: It will not, therefore, be a difficult matter to conſtruct a ſcale on the immoveable plate, which may exhibit the height of the mercury in common meaſures: And thus we have a new ſtructure of a barometer, which notwithſtanding I think inferior to the former.

Uſes of the more ſenſible Barometers.

45. My opinion on the ſubject of the uſes of barometers, is much to this purpoſe: Tho' barometers do properly indicate only, and not foretel; yet hitherto they have been chiefly employ'd to prognoſticate the weather: But as theſe predictions are often fallacious, the inſtruments came to be blamed; juſt as we uſually blame our ſenſes, when precipitate judgments about the ſenſes deceive us: Corrections therefore, have been ſought, but there are no other than making the changes more ſenſible, and freeing them from the irregularity of heat and cold: So far indeed well; yet it contributes nothing to foretell the weather: We obſerve, that we do not always attain to the ſenſible differences of weather, even at thoſe variations of the mercury, which are eaſily diſtinguiſhable in the ſimple barometer; nor can they, therefore, be probably predicted from ſtill leſſer variations. For this end, therefore, I am of opinion, that theſe more ſenſible barometers cannot be *immediately* applied.

Whether they foretel the Weather.

46. Yet probably, this may ſome time or other be *mediately* done, if one could hit on the method of diſcovering the ſucceſſions of the winds from the variation of gravity; for, on theſe the great variety of the weather depends. But indeed the riſe and effects of winds are more compounded, than that barely from the gravity of the atmoſphere, the knowledge of theſe ſucceſſions can be drawn: And it is even a queſtion, whether from knowing the ſtate of the atmoſphere by ſeveral inſtruments, which indicate the other properties of the air, a probable conjecture may be made on the wind or future ſtate of the atmoſphere.

Greater Heights whether diſcoverable by them.

47. I have, therefore, thought proper to aſſign this uſe, namely, that by means of a more ſenſible barometer, a more accurate ſcale of the variation may be had according to the greater or leſs height of a mountain and depth of a mine; with the view to find, whether perhaps by aſſuming theſe differences, known by obſervation, as the elements of a geometrical *locus*, ſome certain rule may not be got even for greater heights than can be obtain'd by experiments. For this end ſuch obſervations are neceſſary, as have been made in convenient places, as on the tops of mountains and at the bottoms of mines: But care is to be taken, that thoſe heights and depths be obtain'd by actual menſuration, and not by a calculation made from angles alone, and one ſtation actually meaſur'd: As alſo, that we do not here fall into

into a paralogiſm; for, ſince on account of the fallacies of viſion ariſing from the refraction of the rays of light in judging of heights, barometers are ſometimes made uſe of to meaſure the heights of mountains, it is manifeſt, that the heights known in this manner do not at all anſwer our purpoſe.

The Rays of Light whether affected by the different State of the Air.

48. There may likewiſe ariſe a ſcruple, whether or no the rays of light paſſing through the atmoſphere ſuffer a greater or leſs refraction in different ſtates of its gravity? For, the air is heavier, either on account of its increas'd height or denſity, both which vary the quantities of refraction; the one on account of the longer way of the refracted ray, and the other on account of the greater angle of refraction: It is, therefore, a queſtion, whether that variation of refraction, if any, ariſing from the different gravity of the atmoſphere, be ſenſible by obſervations and experiments carefully made? and whether it be of any conſequence in Aſtronomy?

Caſwel's new Baroſcope, and its Uſe.

49. In order to diſcover the ordinary courſe of nature in paſſing from one degree of gravity to another, and to obſerve the varieties of gravity depending on the winds, as alſo on one or more clouds in the horizon or vertex, *Caſwell*'s new baroſcope[a] may be uſed with advantage, being more ſenſible than, and preferable to all others, could we therein either avoid or diſtinguiſh the effects of heat and cold: and therefore could this be done, it would be a thing exceedingly praiſe-worthy.

Uſe of the Author's Correction.

50. As to my correction of the barometer I may ſay in particular, that it may ſerve for finding the ſpecific gravities of different liquors at the ſame time; for verifying *Amontons*'s opinion, mention'd above § 29; for determining the meaſure of the contraction of tubes, if there be any ſuch thing, and what proportion it obſerves, *&c.*

Of the Ignorance of the Human Soul *as to its own Nature, the particular Time of its beginning to exiſt, the Manner of its Union with the Body,* &c. *Being a Diſſertation deliver'd in the Univerſity of* Leyden. Anno 1740. *By* M. Peter Van Muſſchenbroek.

Tranſlated from the LATIN.

The Soul the Cauſe, *&c.* of our Knowledge.

THAT the Soul, infuſed by the Supreme Being into the human body, is the ſource, the cauſe and organ, as it were, of all human knowledge and intelligence, every one will eaſily allow, who with even the leaſt degree of application ſhall attend to himſelf, his meaſure of knowledge, his thoughts, and his operations: For, we find that whatever is merely corporeal, is of itſelf inert and unactive, deſtitute of all knowledge and life, and unfit either to acquire or form any conceptions of itſelf or of external things; but on the ſoul alone are confer'd the moſt excellent powers, and

[a] *Phil. Tranſ.* N° 290.

and the unvaluable endowment of underſtanding the things in this univerſe.

Its great Capacity as to external Objects.

The ſoul, therefore, furniſh'd with its faculties, does not only on all ſides examine the body, with which it is very cloſely united, but expatiating, as it were, beyond itſelf into the remoteſt regions, makes reſearches into the whole ſyſtem of bodies on our globe: Nay, taking a higher flight, it alſo pries into thoſe bodies, which revolve and twinkle in the wide expanſe of heaven; ſeduloufly inveſtigates their properties, motions and periods; forms various judgments about them; reaſons ſubtily and with penetration upon them; and in fine, in various manners enters deep into the knowledge of them. Now if the ſoul acquires no ordinary degree of knowledge about things, remov'd to the greateſt diſtance, will any one venture to infer, that it ſhall not know its very ſelf much better, and with greater clearneſs and penetration? Since by being always intimately preſent to itſelf, it may with the greater eaſe examine itſelf, and viewing itſelf, as it were, with its own eyes, thoroughly pry into its own inmoſt receſſes, contemplate itſelf on every ſide, explore all its own faculties, diſcover all its own operations, and their manner of acting.

Yet ignorant of its own Nature, and why?

At firſt bluſh this might ſeem to be the caſe; but to a more diligent enquirer, alas! what a degree of ignorance and what darkneſs immediately preſent themſelves to view! So that we are rapt into the greateſt admiration, or rather pain, when we find, that this intelligent being, not entirely unacquainted with external things, is notwithſtanding ſo ignorant of its own ſelf. The caſe is this, the ſoul is ſo cloſely confined to a narrow priſon, and that in the thickeſt darkneſs, that it can neither turn, contemplate, nor examine itſelf, neither free itſelf from its confinement: And this ſeems not to have been done in vain by the wiſe Creator, but for many reaſons, founded on the moſt prudent views; among which theſe are not the meaneſt; *viz.* that it might not be fond of the continuance of its earthly impriſonment; and that, as at preſent, it often boaſts beyond meaſure of its knowledge of external things, upon turning its attention upon itſelf, and diſcovering its own dullneſs, ſtupidity and ſelf-ignorance, it might check its proud knowledge, and with ſo much the greater readineſs ſubmit to the divine wiſdom.

Deſign of this Diſſertation.

My deſign in this diſſertation is to prove the great darkneſs that has overſpread the ſoul of man as to the knowledge of itſelf: ſo that tho' the moſt ſagacious philoſophers employ the greateſt degree of diligence and application, ſolicitouſly examine and uſe indefatigable labour; yet they can by no means clearly perceive, nor diſtinctly know the time of its beginning to exiſt, when, and in what manner, and in what part it is united with the body, nor what the nature of its ſubſtance is.

What its Meaſure of Knowledge of itſelf is?

This is a theme that requires no ſmall degree of prudence, in order to avoid the rocks of Scepticiſm, which is deſervedly deteſted: For, tho' I affirm,

affirm, that the ſoul is ignorant of many things relating to itſelf; yet that its knowledge about itſelf is not entirely uncertain or none at all: I only attempt to ſeparate certainties from uncertainties and doubts, that vain ſpeculations may be baniſh'd from philoſophy; and that we may not in the manner of boaſting Quacks talk of every thing, as if we underſtood them; but rather modeſtly confeſs our ignorance about things unknown, that thoſe things that are truly known may appear to the greater advantage, and that upon theſe, as on a ſure foundation, we may raiſe a ſtructure that ſhall remain unſhaken, and ſhall never be overthrown.

Let us firſt enquire into the original and natal day of the ſoul.

Enquiry into the Original of the Soul.

When a man of ripe years and experienc'd judgment contemplates himſelf and the power he exerciſes over his own ſoul, his ideas, and his body, he finds that power ſo weak, and confined to ſuch narrow limits, that he can by no means diſcover in himſelf any power of giving exiſtence either to himſelf, or to other things without him; but that a power is wanting far, nay infinitely, exceeding his own; that operates in another and quite different manner; not like our power, on things exiſting only, but likewiſe on things that do not exiſt, which by his bare word he calls forth to exiſtence: We therefore hold, that the human ſoul is derived from the Divine Being alone, not as a particle taken from his eſſence, according to the *Pythagoreans* and *Stoics*; ſeeing an infinite and ſimple being cannot be divided into finite parts; nor as inherent in the divine eſſence, as the *Manicheans*, *Marcionites* and *Gnoſtics* hold; nor as a mode of God himſelf, as the ſubtile *Averroes* and *Spinoza*, that unhappy genius, do maintain: But that it is a finite being, endued with limited faculties, that it is entirely different from the divine Being, and created in a manner incomprehenſible to mortals, does very evidently appear from the weakneſs of human power. Some of the ancients have, with *Democritus* and *Ariſtotle*, held that the ſoul was *ex traduce*, or propagated by the parents: And this opinion is maintain'd by St. *Auguſtine*, or at leaſt is doubtingly propos'd by him; and to his ſentiment *Hierardus*, *Pomponatius*, *Scaliger*, *Sperling* and *Rudiger*, may be ſaid to give in. But neither their reaſonings nor authority move me: For, who is he that is conſcious to himſelf, that beſides a ſmall corporeal bulk, he has alſo deriv'd his ſoul from his parents? Or who can undoubtedly know it? Or how from the ſoul, a ſimple being, and not conſiſting of parts, could other ſouls be deriv'd as parts thereof? Or with what propriety ſhall we aſcribe to it a power of creating, a thing we do not find in it.

Different Opinions about it.

The Account of the Creation only from Scripture.

But all our knowledge of the creation of the univerſe, and of all the things contain'd therein, we derive from *holy Writ*, and from it, we certainly learn, that all the things, which fill the ſpacious ſeas, the wide regions of the earth, and the boundleſs expanſe of heaven, were in ſix days created out of nothing.

Were,

The Time of the Soul's beginning to exiſt.

Were, therefore, the ſouls of all the men, who were afterwards to become inhabitants of this earth, created by God in the beginning of the world, at leaſt a great while before the bodies, to which they were in time to be united? Or are they ſucceſſively produced, as parents happen to be ſucceeded by their progeny, and directly infuſed into human *fœtus's*, juſt ready to be born?

Various Diſputes about it.

On all theſe heads there is a profound ſilence among the *inſpired Writers:* It is, therefore, not to be wonder'd at, that the luxuriant fancies of philoſophers, ſo very fond of controverſy and diſputation in doubtful matters, have on this head run into various opinions.

Plato's Opinion.

The ſubtile *Plato* had aſſigned places to the ſouls in the viſible heavens about the ſtars: And as they had a hankering after ſublunary things, had condemned them to bodies, as to ſo many priſons; in which being confined, they ſhould forget all their former knowledge, which they were afterwards to recover by long and much exerciſe. But in what manner and by what reaſonings had the philoſopher made this diſcovery? And by what evidence of argument did he prove, that ſouls are depriv'd of the memory of their former knowledge, as ſoon as they are united to bodies? Nay, by none at all. He had only framed to himſelf theſe idle notions, which yet many philoſophers afterwards, (on the Authority of *Plato*) and the ancient Fathers of the Church, tinctur'd with *Platonic* notions, had favour'd and propagated; nay the very ſame notions, if we may credit M. *Tournefort*, are at this day maintain'd by the *Armenians*.

Whether created at the Time of its Union with the Body.

Others on the contrary have held, that the ſouls of men are created by God at the time of their union with their new bodies: And theſe ſeem to defend the much more probable opinion, and to have confirmed it by better arguments: Becauſe otherwiſe the ſouls would remain depriv'd of all knowledge and thought from the beginning of the creation, till their union with the body, and continue in a long ſtate of inactivity, and without anſwering any one uſeful purpoſe; and again, it is not a very eaſy matter to conceive, how they could live without thinking: Yet let no one imagine that theſe reaſonings are genuine demonſtrations, and by their evidence above all exception; for, we are hitherto ignorant what the life of the ſoul properly is; if we ſuppoſe it to conſiſt in thought, we ſhall have ſaid no other thing than that the thinking ſoul is thinking; and if God had a mind to create all the ſouls of men at the beginning of the world, and keep them for a ſtated time under certain laws, his will alone is ſufficient, and his power ſufficiently efficacious.

A Thing not eaſily determin'd.

If we now enter into the inmoſt Receſſes of the ſoul, and enquire, whether it poſſeſſes the immediate knowledge of its own original; and whether it began to exiſt from a great number of years backwards, or but very lately, it is entirely at a loſs, and finds in itſelf no ſigns of its firſt original; ſo that weighing thoroughly the reaſons on each ſide, we muſt own, that the

the natal day of our ſouls is abſolutely unknown; and that philoſophers have in vain attempted to explore or determine it. Now ſuppoſing that the ſoul is created, let us moreover enquire into the time of its union with the body, without giving in to any conjectures. The moſt ſagacious enquirers into nature in our days have evinced, that the *ſemen maſculinum* conſiſts of living *animalcula*, with round heads, and ſlender and oblong tails, which are the firſt rudiments of the future man: One of theſe *animalcula* is convey'd into the membranous *ovum* of the mother, full of a nutritious juice. The *animalculum* being now receiv'd into the *ovum*, is ſubject to various transformations in the manner of caterpillars and many other inſects: The bowels increaſe, the heart, which was a canal but a little before, is formed into a cone; the *thorax* and *abdomen* are cloſed up, and the limbs unfold; till in the ſpace of nine months all the members have arriv'd to their degree of perfection; and then breaking thro' its priſon, a tender infant is born into the world, who by his cries and tears ſhows the great pain it ſuffer'd in the birth, and that therefore, it either then is or has already been informed with a ſoul.

The modern Notion of Generation.

Who ſhall now pretend to diſcover the true time of the union of the ſoul with the body? Or after diſcovery, prove it? Has a ſoul been join'd to every ſpermatic tadpole, or only to that particular one, which enters the *ovum?* Or is the *fœtus* endu'd with it, after its firſt transformation? Or after the heart is entirely compleated? Or after cloſing up the *thorax* and *abdomen*? Or will you rather pitch upon the time in which the *fœtus* evidently moves, and manifeſt ſigns of life begin to be perceiv'd by the pregnant mother? Or rather in fine, when the new-born infant freely enjoys the open air, and now begins to reſpire? Each of theſe opinions may be maintain'd by men of the greateſt ſagacity of genius; may be very warmly diſputed; and many and long chains of reaſoning be formed thereon: Yet they will convince no one, who carefully attends to every circumſtance, and who wants demonſtration and not conjecture: For, here again we are involv'd in palpable darkneſs, out of which we cannot extricate ourſelves. But poſſibly we ſhall attain to a greater degree of inſight, after we ſhall have enquir'd into the ways, thro' which the ſoul has enter'd into the body, till it is firmly united to thoſe parts, to which it afterwards inſeparably adheres, while man acts his part on this ſtage of life: Now whether it enters with the firſt inſpired air into the canals and veſicles of the lungs? and is immediately afterwards convey'd to the heart, and from thence along with the blood to the brain? Or rather by the nerves, that it may be united to their extremities, which it is afterwards to uſe as the inſtruments of all its future knowledge? Or whether it enters by other more patent, or more narrow paſſages? Or whether rather it is created in the brain itſelf, and comes to it from no other part from without? The

The true Time of the Union of Soul and Body impoſſible to be diſcover'd and prov'd.

ſoul is ſo ignorant of all theſe things, that in what manner ſoever it examines itſelf, it is entirely at a loſs.

The Head the Seat of the Soul.

The adorable Creator has aſſign'd the ſoul its ſeat and abode in the head; it is not diffus'd throughout the whole body, by poſſeſſing the arteries, veins, and the whole ſyſtem of nerves, as ſome famous phyſicians in *Germany* would have it: For, they ſeem not to be appriz'd, that the ſoul can neither be extended, nor be of any bulk; for indeed, in that caſe ſurgeons and ſoldiers would exerciſe no ſmall degree of tyranny over it, who by cutting away limbs of the human body, would likewiſe take away and leſſen part of the ſoul: But that perſons, thus maim'd, are not impair'd in their ſagacity, wit and prudence, daily experience teaches.

Whether it lodges between the *Dura* and *Pia Mater*.

But if the ſoul lodge in the head, ſhall we aſſign it its place between the two membranes, that envelope the brain? This place, it is true, may be ſufficiently ſpacious; but theſe membranes afford only coats to the nerves: Beſides, they are ſometimes wounded, pieces of them cut away, and they are ſeparated from each other, without diſlodging the ſoul.

Or in the *Glandula Pinealis*.

But if we would rather chuſe the brain itſelf for the habitation of the ſoul, ſhall we with *Des Cartes*, (who by the acuteneſs of his genius has gain'd himſelf immortal honour) determine for the *glandula pinealis*, ſo much celebrated? But both the putrefaction of this prominent body, and its petrifaction, the life and reaſon of the perſon remaining entire, have diſcover'd the error.

Or in the Extremities of the Nerves or *Senſorium Commune*.

Or ſhall we rather recur to the extremities of the nerves, which are ſubſervient to the organs of ſenſe? or to ſome ſhrine, as it were, which is call'd the *ſenſorium commune*, in whoſe *parietes* the nerves on all ſides terminate? This opinion is, it is true, by far the more probable; ſince it is by means of the nerves that the ſoul perceives all objects, and operates on that body to which it is intimately preſent: But this opinion has not hitherto been confirm'd by ſolid reaſons; for, who has made it appear, that the nerves do terminate, and are not rather recurring canals? Beſides, for I incline not to be obſtinate; ſuppoſe I grant that the nerves have two extremities; I ſhall then deſire, that the moſt ſkillful anatomiſts ſhew the origin or termination of the nerves: It is not ſufficient here to opine, that where the cortical ſubſtance of the brain ends, that from thence the medullary ſubſtance ariſes with produced or continued fibres, which are to terminate in the nerves; for, true and ſolid knowledge requires demonſtration and not probability: Yet in this matter we will entirely depend on the diligence of ſkillful phyſicians, who may poſſibly by ſome contrivance or other harden the nerves, however ſoft and tender of themſelves, and trace them from their origin to their termination; ſo as then to diſcover, whether they terminate in an extended cavity, the abode of the ſoul, or whether in any other manner not hitherto known; unleſs this place, in which

which the unextended ſoul lodges, do, on account of its exceeding ſmallneſs, eſcape all our ſenſes, tho' armed with glaſſes and other helps: We may, however, be allow'd to ſuppoſe, that a true extended place is aſſign'd the ſoul, from which the nerves, which themſelves are really extended bodies, do ariſe; wherefore, the different nerves, ſubſervient to the ſenſes of taſting, ſmelling, feeling and hearing, have different originations. The man, who, applying himſelf to the inveſtigating the ſtructure of the brain, ſhall have found the ſhrine of the ſoul, ſhall deſerve no leſs glory, nor ſhall his fame be leſs permanent than his, who ſhall have found the *perpetuum mobile*, the true quadrature of the circle, or the longitude at ſea.

The reaſon why the ſoul is ignorant of that particular part of the body it poſſeſſes.

But it is no great matter of wonder to me, that the ſoul is ignorant of thoſe parts it poſſeſſes in the brain, or rather to which it adheres: For, after it is condemn'd to its impriſonment in the body, it is tied down to it by the ſtricteſt bonds, ſo that it is not allow'd to expatiate beyond it, nor view the adjoining parts. It is like a captive, who is carried blind-fold from a far country into an unknown priſon, that is ſhut up on all ſides, except five little apertures, thro' which a very ſmall portion of light from external objects does enter: Tho' now in its ſtate of impriſonment it may be endued with the greateſt degree of ſagacity, and its eyes be unvail'd; yet by means of the light that enters, it diſcovers ſo few things, that it cannot divine in what region or part of the world it is: For, in order to know this, it muſt have had the liberty of going out, and viewing both the external and internal parts of its place of confinement: And being denied this, it muſt neceſſarily remain in perpetual ignorance.

The ſoul inſenſible of its union.

But the ſoul obſerves, that it is a captive and united to its priſon; becauſe after all its efforts it cannot get out, without the deſtruction of its place of confinement; and this being greatly hurt, or the nerves affected, the ſoul ſuffers pain, which maugre itſelf it can by no means avoid: In other reſpects it knows not by any immediate ſenſation that it is tied down to its priſon, nor does it learn by experience, or by attending to itſelf, how it is united with it. Hence it might be doubted, whether it was indeed united with the body, did it not conclude, by a careful train of reaſoning, from many and undoubted obſervations, that it was really united in the cloſeſt, but in ſo artful and agreeable a manner, as to have no uneaſineſs nor any ſenſation of it. This exquiſite and agreeable union of the ſoul with the body, and of which we have no ſenſation, was the reaſon that it was denied; and hence aroſe that call'd the *ſyſtem of occaſional cauſes*, and that other call'd the *harmonia præſtabilita:* The former cultivated by F. *Malebranche*; and the other invented by M. *Leibnitz*, men of the profoundeſt erudition, and famous for their inventions of the moſt agreeable hypotheſes and conjectures.

The ſmall apertures of its priſon terminate in very long tubes, call'd the nerves; and by them is convey'd, as it were, to the ſoul all our know-

The knowledge of external objects convey'd by the nerves.

knowledge about bodies; and of this knowledge it remains depriv'd, upon compreſſing, hurting, cutting aſunder and obſtructing, either theſe tubes or apertures. He, therefore, who either wants eye-ſight, or whoſe optic nerve is affected, is forever ignorant of light and colours: A deaf perſon never learns what ſound, muſic and ſpeech are: And he whoſe olfactory nerves are compreſs'd, knows nothing of odours, neither the fragrancy of ſweet flowers, nor the ſtench of putrefied animals: And he whoſe nerves, appointed for the ſenſe of taſting, are wanting, never diſcovers what is ſweet, bitter, tart, ſalt, aromatic, nor any other degree of that ſenſe: In the ſame manner as he whoſe nerves of feeling become paralytic, neither perceives what is hot or cold, ſmooth or rough, heavy or light. In vain have philoſophers attempted to teach thoſe depriv'd of this or the other ſenſe thoſe properties of bodies, which by their means we learn, while we are ſound and in health.

We have properly no idea of thinking, &c.

Let us now examine what the ſoul is, and what it knows about itſelf, or its own faculties. As ſoon as the ſoul perceives the images or ideas of things, that is, when it thinks, we experience that we underſtand and think. This faculty of thinking we apprehend by intimate ſenſation, internal experience or conſciouſneſs; and not by means of any idea, either reflex, or of any other denomination whatever.

As appears by experience.

For, the uſe of ideas is, that the ſoul may know the objects placed without it, and which cannot enter into it; for, ſeeing its faculties are its proper endowments, internally inherent, and preſent to it, we have no occaſion for the ideas of them, in order to know them. I appeal to every unprejudiced perſon, who weighing things impartially, does accurately examine himſelf: Let ſuch a one try, whether he can find or form to himſelf an idea or conception of his faculty of thinking, judging, reaſoning, or willing: Yet he muſt uſe this precaution not to confound the faculties of the ſoul with the preſent ideas, on which it operates. In my opinion ſuch have erred, who have affirm'd, that we underſtand nothing but by means of ideas; and that the ſoul has only one way of underſtanding, and not a two-fold way.

Let us now, moreover, deſcend into ourſelves, and carefully examine what each faculty is, how it is conſtituted, and how it is inherent in the ſoul; but we ſhall find that our utmoſt efforts in this caſe avail nothing; for, we here diſcover nothing clearly, only that we operate on ideas, and that in various manners when we do ſo. Faculties are neceſſarily inherent in ſome ſubſtance or thing, or as it is call'd, ſubject, which properly conſtitutes the ſoul, and is its inmoſt ſubſtance, its nature, and the *ſubſtratum*, as it were, of all its faculties. Who at firſt bluſh would not think that it would be a thing intimately known to the ſoul, as ſoon as it had examin'd itſelf; eſpecially as it can embrace any occaſion or opportunity of unvailing and deſcending into itſelf? But here we find the thickeſt darkneſs and the greateſt

greateſt degree of ignorance! For, the ſoul diſcovers nothing about its own ſubſtance, but is all blindneſs in this reſpect; and tho' it makes the greateſt efforts to penetrate thro' thoſe thick clouds, yet all its ſtruggles are in vain, and this ſubſtance paſſes all its penetration: In whatever manner it attempts to enter into itſelf it can find no admittance, every thing is cloſe ſhut up, and all its efforts prove abortive: We are, therefore, oblig'd to own, that the ſubſtance of the ſoul is unknown, and that no idea, conception or notion can be form'd of it. This is no new doctrine, nor what has not been broach'd by others; but what the moſt diligent among the ancients were alſo appriz'd of, and is excellently well deſcrib'd by *Cicero*, the prince of orators: "The power of the ſoul, *ſays he*, is not ſo great as "to ſee itſelf; but as the eye, ſo in like manner the ſoul, not ſeeing itſelf, "diſcerns other things; and it does not ſee, which is ſtill leſs conſiderable, "its own form."

Wherein the difference of ſoul and body conſiſts.

We need not therefore greatly wonder, that ſome philoſophers, as *Dicæarchus* and *Ariſtoxenus* among the ancients, upon diſcovering this their ignorance of themſelves, thought, that man had no ſoul at all: But if they had obſerv'd, that all bodies are endued with a *vis inertiæ*, by which they can never of themſelves produce any motion or action; and that man has a principle, by means of which he can produce or ſtop motion at pleaſure, tho' unaſſiſted, and without the acceſſion of any thing elſe (ſuppoſing liberty) but the will: Then they would have diſcover'd, that man is not a mere machine, but a thing conſiſting of ſoul and body. Upon ſeriouſly weighing all theſe things thoroughly, it manifeſtly appears, that philoſophers have not hitherto been more ſucceſsful in diſcovering the nature of the ſoul than they have been in diſcovering that of bodies; for, that this latter is a ſecret to human underſtanding and wit, the principal Naturaliſts of our days have evinced.

Different opinions about the nature of the ſoul.

But tho' we are ignorant of the ſubſtance and nature of the ſoul; yet by dint of reaſoning we diſcover many things either unknown to the ancient philoſophers, or perverſely underſtood by them: But becauſe we are always converſant among bodies, and are for the moſt part accuſtomed to think of them only, ſome people, incapable of forming clear and diſtinct ideas of incorporeal things, have held, that the ſoul is corporeal; that it is a breath of wind, or a ſubtile *aura:* Yet many have held, that it is of an igneous nature, which, according to *Cicero*, remaining uncorrupted and ſimilar to itſelf, and flying upwards would penetrate thro' that region of the heavens where the clouds, rains, and winds are collected; and after reaching above that, would arrive to a nature ſimilar to itſelf, conſiſting of a ſubtile *aura* and the temperate heat of the ſun; and that then it would ceaſe to mount higher: For, having attain'd to a heat ſimilar to itſelf, as if it were equally pois'd, it would no longer move to any ſide. There are many philoſophers, who in this agree with *Cicero: Epicurus* and *Lucretius* thought

thought that the ſoul is material; and that thinking is nothing other but the agitation of very minute particles. But omitting heathen philoſophers, in whom ſuch a groſs error is excuſable, we may indeed wonder, that there were ſo many among the ancient Fathers of the Church who thought, that the ſoul is indeed ſpiritual, yet ſome very ſubtile and rare body: For, *Clemens*, *Origen*, and their followers affirm, that indeed the ſoul in itſelf is very ſimple, yet always encompaſs'd with a ſubtile body *Tertullian*, *Arnobius*, and *Methodius* tell us, that the ſoul is nothing but a very ſubtile body; nay, the Learned *Cudworth* and his excellent Commentator *Moſheim* aſcribe the ſame opinion to *Irenæus*; ſeeing, according to *Irenæus*, the ſoul ſeparated from the mortal body, is of a human appearance, and of the ſame form with its own individual body.

Locke's notion of the ſoul.

And has not even the acute Mr. *Locke* almoſt fallen into the ſame error? when he thinks, that the ſoul may be corporeal, and that God by his infinite power could have endued any portion of matter, arranged at his pleaſure, with the faculty of underſtanding and thinking; an opinion, tho' not eaſily to be admitted, yet the celebrated *Buddeus* has not ſcrupled to affirm, that it contains no abſurdity. But had theſe men, who in other reſpects have deſerv'd greatly of philoſophy, conſider'd, that in this manner they deprive matter of its *vis inertiæ*, and endue it with a principle of acting at pleaſure, they would have preſently ſeen, that at this rate body would no longer be body, but be transform'd into ſomething other quite different, whereby it could no longer be properly call'd body.

Cartes's attempt to prove the nature of the ſoul, and confirm'd by other arguments.

But the ſubtile and immortal *Des Cartes* is much more ſucceſsful in this matter; and was almoſt the very firſt, who attempted to demonſtrate that the ſoul is incorporeal, entirely different from matter, and purely ſpiritual. But tho' his arguments are by ſome reckon'd not concluſive; yet this excellent perſon deſerves commendation, as he firſt led the way. But we may now prove this truth in a different manner; becauſe whatever is corporeal has a *vis inertiæ*, whereby it remains in the ſame ſtate, in which it is, unleſs a change be made in it by other external cauſes: But the human ſoul operates alone, at its own will and pleaſure, puts on various ſtates and modes; at one time is employ'd in thinking only, at another time in judging, now forming different chains of reaſoning, and again preferring and willing one thing rather than other, and ſometimes exerciſing its power on the body; ſo that it muſt neceſſarily be a being of a different nature from the body: Beſides, the ſoul ſeems to be a ſimple unextended being: For, were it extended, it would be diviſible into various parts, or it would conſiſt of parts, thro' all which thought would be diffus'd: But we perceive no ſuch thing in the ſoul, whatever degree of attention we uſe. The ſoul, therefore, is not corporeal, but a ſpirit; a denomination that is familiar, but as to the thing itſelf we are all in the dark; ſeeing we can ſcarce form any notion, or conception of it: Wherefore, ſome of the more modern philo-

philoſophers have aſſerted, and that not without reaſon, that when we are about to think of our ſoul, we borrow ſome firſt conception or other from bodies, to exhibit to us obſcurely ſome thing or being, to which we afterwards aſcribe all thoſe faculties, we previouſly by a ſolicitous examination diſcover'd in the ſoul. Hence the acute and learned *Holmann* lays it down from experience; that when we would think of an immaterial ſubſtance, and abſtract from it what we conceive to be proper and peculiar to material things, that we immediately quite loſe any idea of it, and that there remain no longer any object of our thoughts: But let ſuch, as ſeem to experience the contrary, beware, leſt inſtead of the thing itſelf, they think only of the name, which unknowingly they may confound with it. It would, therefore, ſeem that we cannot think of any immaterial ſubſtances without a material idea: Sure, an inſtance of the great and deplorable weakneſs of the human ſoul, and of the great degree of its ſhort-ſightedneſs! ſince in order to form any tolerable conception of itſelf, it muſt conceive of things, obſcure, confuſed, foreign, and diſſonant with truth, on which as foundations, to build our ſmall pittance of knowledge: But if the caſe was otherwiſe, and were men furniſh'd with the cleareſt light and knowledge in this matter, they would not raiſe ſuch warm diſputes about the ſoul and its ſpiritual nature; but after mature and attentive examination would amicably conſpire, and diſcover and demonſtrate the very ſame truths. How great and how many have been the diſputes, not only among the ancient *Greeks*, but alſo among the greateſt Moderns about the different parts of the ſoul; one of which they ſuppoſe to be endued with reaſon, and the other not: By the latter ſome underſtand the animal ſpirits; others, ſome certain principle deriv'd from the *æther*; others, from a ſiderial ſubſtance; and others again from ſome other matter; which principle they ſuppoſe to be the cauſe not only of the vital, but of all other motions ſubject to the will, and of the paſſions too; and that this part of the ſoul dies on the death of the perſon; but that the other part is by no means corporeal, but far more noble, a ſpiritual, intelligent, and immortal being; and they endeavour to ſtrengthen their opinion by teſtimonies from *ſacred Writ:* Whereas others, upon examining this opinion, demonſtrate by better reaſons, and likewiſe eſtabliſh by ſcripture, that the ſoul in man is one ſimple thing, and not conſiſting of parts.

From ſuch hints as theſe, it is, therefore, evident that the ſoul does not ſo clearly know itſelf, as ſome very ſubtile philoſophers have thought; and the thing may be further eaſily made appear: For, I aſk any one converſant in letters, whether upon turning over the writings of the ancient *Greeks* and *Romans*, he muſt not own, that there flouriſh'd among them philoſophers of the greateſt penetration and ſagacity, who took a deal of pains to examine and know themſelves: And yet how few things have they diſcover'd about themſelves and their own faculties? And probably

we might have been for many ages longer in the dark as to theſe faculties, had not Mr. *Locke*, that great ornament of *Britain*, very ſedulouſly applied himſelf to the inveſtigating and clearly deſcribing them; and other very excellent men, incited by his example, have diſcover'd new ones: Nor ſhall poſterity be depriv'd the glory of diſcovering more, if treading in our ſteps, they purſue the true method of philoſophizing, baniſhing *hypotheſes* and laying aſide a pruriency of framing conjectures, they only admit of what is certain and true, and not confound with it things doubtful and uncertain, but lay theſe quite aſide: Beſides, they may not only give a ſcope to their own meditations, but likewiſe make obſervations on other people, remarking how infants, young people, people of maturity and old people, both in a ſtate of health and under different diſtempers, exerciſe their thinking faculty. Solid reaſonings, deduced from ſuch obſervations as theſe, will become true and unſhaken demonſtrations.

A ſhort Sketch of Reflexions on the Originals *of* Nations, *chiefly taken from their* Languages; *by* G. G. L. *From the* Miſcellanea Berolinenſia. Tom. I. p. 1.

Tranſlated from the LATIN.

The original and antiquity of Nations deriv'd from their language.

AS the remote originals of nations riſe higher than our accounts of them from ſtory, their languages ſerve us inſtead of ancient documents: And the moſt ancient traces of languages remain in the names of rivers and woods, which, after changing their inhabitants, do for the moſt part ſtill continue: Next to theſe are the appellations of places built by men: But tho' many villa's and towns are named from their founders, a thing very frequent in *Germany*, which was more lately inhabited; yet other places are denominated from their ſituation, their produce and other qualities; and the etymon of the more ancient names is difficult. The ancient appellations of men, of which no nation in *Germany* have retain'd more than the *Friezlanders*, do even lead us into the inmoſt receſſes, as it were, of the ancient language: For, I lay it down as an axiom, *that all thoſe names, we now call proper, were ſome time or other appellative*; otherwiſe there would be no manner of accounting for them: So often, therefore, as we underſtand not the name of a river, mountain, wood, nation, village, town, *&c.* we ought to take it for granted, that we have ſo far receded from the ancient language. Thus ſo often as the name of a *German*, as for inſtance a *Frank*, *Allemann*, *Saxon*, *Goth*, *Vandal* terminates in *ric*, as in *Theoderic*, *Frederic*, we ſhould poſſibly be at a loſs that it denoted valour and ſtrength, did not *Venantius Fortunatus* thus explain the word *Chilperic:* But for the moſt part, in tract of time, the ancient and native

native ſignifications are either chang'd or obſcur'd; for, languages did not proceed from any inſtitution, nor were they eſtabliſh'd by law, but aroſe from a certain natural inſtinct, whereby men model'd the ſounds to the affections and paſſions of their mind: I except artificial languages, ſuch as was that of Biſhop *Wilkins* (which notwithſtanding ſcarce any one learned beſides himſelf and Mr. *Boyle*, as the latter told me) and ſuch as *Golius*, no deſpicable judge, ſuſpected the *Chineſe* language to be; and ſuch alſo, if there was any ſuch, which God taught mortals: But in languages that aroſe by degrees, words were fram'd occaſionally from the analogy of the word with the affection, which accompanied the ſenſation of the thing; and in this manner, I may ſuppoſe *Adam* gave names to things.

The traces of an univerſal language in the modern languages, and how it came to be corrupted.

But tho' we may hence eaſily conceive, that many peculiar words were framed in proceſs of time by various nations, eſpecially at a time when rude barbariſm, influenc'd by inſtinct rather than reaſon, broke out at random, as occaſion offer'd, from the paſſion into articulate ſounds, which varied according to the temper of the mind and the frame of the organs of ſpeech, the uſe of which is not equally eaſy to all nations; yet it is worthy of remark, that the traces of a certain ancient language, which was very widely ſpread throughout great part of our continent, does ſtill remain in our modern languages; ſince there are many words, which in their uſe extend from the *Britiſh* ocean as far as *Japan*. I forbear to adduce the common inſtance of the word *ſaccus*, as being what I have not ſufficiently examin'd: But I ſhall mention another word, us'd by the ancient *Celtæ*, among whom *ma* denoted a horſe; whence *Pauſanias* informs us, that a triple order of horſe was by them call'd *trimarchia:* The word *mare* or *märe* was well known to the ancient *Teutons* (among whom *Mareſchallus* denoted a perſon who was over the horſe) and it ſtill remains among the *Germans*. The ſame word *mar*, or its cognate, is likewiſe underſtood in the ſame ſenſe by the remoteſt *Tartars*, who conquer'd *China:* Such likewiſe is the word *Kan*, which ſignifies a potentate, a principal perſonage, a king; but *Chagan Can* denotes to the *Sarmatians*, *Huns*, *Perſians*, *Turks*, *Tartars*, and *Chineſe*, a prince; and indeed in pronouncing the initial letter *K*, we perceive no uncommon force employ'd; and the breath breaks out with violence: So often, therefore, as the ſame word, or a little transform'd, is found in common to *Britons*, *Germans*, *Latins*, *Greeks*, *Sarmatians*, *Finns*, *Tartars*, and *Arabs*, (a thing not ſo very unuſual) it affords a trace of the ancient common language: So that we muſt either ſay, that the better part of *Europe* and *Aſia* was ſome time or other under one great empire, where a certain common language prevail'd, (as the *Latin* more lately overſpread *Europe*; the *Greek* and *Arabic*, *Aſia* and *Africa*) or rather (which is more conſonant with *ſacred Writ*) that all other nations were colonies of one nation, or deriv'd from one common ſtock, tho' among the more remote colonies the traces of affinity may be gradually wore out: For, new

languages do eaſily ariſe from the admixture and corruption of the other languages; and I remember to have heard an *Engliſh* lady, who ſpoke *French-Engliſh* and *Engliſh-French*; and ſome hundred ſuch perſons would have eaſily coin'd a new language for poſterity; as the language of the *Griſons* at this day is a corruption of *Italian* or *French*, as theſe are of the *Latin*; and the repeated corruptions of corruptions do at length confound all the lineaments of the original language: I, therefore, wonder not that no affinity can be found between the languages of the inner parts of *Africa*, and the *American* languages and ours.

Two great branches of the ancient language.

We may with propriety enough divide the languages, deriv'd from that ancient diffuſive language, into two kinds, *viz.* the *Japetic*, if I may uſe the expreſſion, and the *Aramæan*; the former fill'd the north, in which I comprehend all *Europe*; the latter, the ſouth: And if you allot the northern parts to *Japhet*; the ſouthern parts will properly fall to the poſterity of *Shem* and *Ham:* The Mythologiſts themſelves have placed *Japhet* and his ſon *Prometheus*, who was the framer of men, near mount *Caucaſus*; the *Aramæans* (or the *Arimi*) were known to *Homer* by the name of *Syrians*.

Extent of the *Arabic* language.

Among the ſouthern languages, the *Arabic* eſpecially is very diffuſive; for, it fills the great *Peninſula* between the *Red* ſea and the *Perſian* Gulph; and the neighbouring languages, as the *Syriac*, *Chaldaic*, and the *Hebrew* itſelf have a very great affinity with it: The *Hebrew* has been made a kind of dialect of a greater language; and it ſufficiently appears that it is preſerv'd but in few monuments; nor is this to be wonder'd at, as it poſſeſs'd but a ſmall part of *Syria:* But it may preſerve its ancient traces better than other languages, as no other nation afford us more ancient records: It is plain that *Carthage* was built by the *Phenicians*; and *Reineſius*, *Bochart*, and others, have excellently well illuſtrated the *Punic* language (a ſcene in which language is extant in *Plautus*) from the *Hebrew* and the cognate languages.

It moreover appears from the conſideration of the *Abyſſinian* language, that colonies of *Arabs*, after croſſing the *Red* ſea, had poſſeſs'd themſelves of the better part of the eaſtern *Ethiopia*; nor is the *Amharic* language different from the common *Ethiopic*, but in dialect. It is ſaid that a great deal of *Arabiſm* is found among the inhabitants of the *Indian* coaſt, where the *Malabaric* language extends as far as the iſlands; on which head *Reland* has things worthy of remark. The *Egyptian* language, which at this day is call'd the *Coptic*, differs much from the *Arabic* and the cognate languages; and it is poſſible that it proceeded from the moſt ancient *Ethiopians*, before the *Arabs* paſs'd over into *Ethiopia*. The *Perſian*, *Armenian*, and *Georgian* languages ſeem to ariſe by a mixture of *Scythians* and *Aramæans*, as bordering on them; but from the moſt ancient *Scythians*, whom their own poſterity at this day would not underſtand. The ancients have handed down to us, that the *Parthians* (who are alſo *Perſians*) came as exiles

exiles from *Scythia*. I could not find ſo much of the *German* language in the *Perſian*, as *Elichmannus* told *Salmaſius*; and excepting almoſt the word *God* alone, the reſt, for the moſt part agreeing with the *German*, are in common to them with the *Greeks* and *Latins*. *Acoluthus*, a man well ſkill'd in the oriental languages, was of opinion that the *Armenian* language had a common foundation with the *Egyptian*; and he explain'd to me at *Berlin* the reaſons of his opinion, but they were little ſatisfactory. The ancients, indeed, have recorded, that a colony of *Egyptians* was left by *Seſoſtres* at *Colchos*; how truly I ſhall not ſay. But our greateſt attention ſhould be applied to thoſe languages that are ſeparated and cut off from all communication with the others; for, there the originals lie deeper.

What is common to the northern languages call'd *Japetic* and *Celto-ſcythic*.

Whatever is common to the northern languages you may call that *Japetic*, and I uſually call it *Celto-ſcythic:* I here, therefore, refer what is common to the *Germans* and *Greeks*, but of an older date; for, what came more lately from the *Greeks* to the *Germans* by the commerce and learning of the *Gauls* and *Romans*, and by their ſtudies and ſacred rites, does not belong to this place: I likewiſe refer hither what the *Germans* have in common with the *Sarmatians*, *Finns*, and *Tartars*; for, if it be true, that the inhabitants of *Europe* came from the eaſt, following, as it were, the courſe of the ſun, it appears that ſwarms of men, coming from *Scythia*, and paſſing the *Tanais* and *Iſter*, penetrated partly into the weſt, that is into *Illyrium*, *Pannonia*, and *Germany*; from whence, at length, their poſterity advanc'd towards *Italy*, *Gaul*, and *Spain*; and partly they directed their courſe to the ſouth, into *Thrace*, *Macedonia* and *Greece*, where more lately colonies arriv'd from *Phenicia* and *Egypt*; whence the letters of the *Greeks* are owing to the *Phenicians*, and their religious rites to the *Egyptians:* But the *Scythians* laid the foundation, as it were, of the *Greeks*, as the *Celtæ* did that of the *Italians*.

Some inſtances of the original of the *Celtic* from the *Scythian* languages.

By *Scythians* I here underſtand the moſt ancient inhabitants of the coaſt of the *Euxine* ſea, of whatever denomination they are; there *Homer* plac'd the *Cimmerians*, and theſe *Herodotus* has diſtinguiſh'd from the *Scythians*. The *Tanais*, *Danaper*, *Danaſter*, and the *Danube*, not to mention the *Duna* and *Dwina*, were names impos'd on theſe four great rivers by one and the ſame nation; and they are pronounc'd by *Jornandes Gothus*, in ſuch a manner that their original becomes manifeſt, but is now in part ſuppreſs'd by the contracted pronounciation of poſterity: For, *Dnieſter* and *Dnieper* ſcarcely retain their ancient radical letter in the beginning; much leſs do *Nieſter* and *Nieper*. What favours the *Scythian* original of the *Celtæ* is, that ſome words of the ancient *Scythians*, preſerv'd to us by *Herodotus*, are excellently well explain'd from the *Celtic*, that is, the *Latin* or *German*; for, *Aeorpata*, an appellation of the *Amazons*, does, according to *Herodotus*, ſignify men-ſlayers; *Aeor* denoting a man, and *pata* to kill: Moreover, *battere*, *battuere* ſignify'd to the ancient *Romans* to beat; and it ſtill re-

mains in thoſe languages, corrupted from the *Latin*; and there are ſome traces of it in the *German:* For, they uſe the term *patſchen*, to denote ſtriking with any broad thing, as with the ſole of the foot, palm of the hand, water or any other yielding matter; and is a word deriv'd from the ſound. It appears that *vir*, *baro*, *herus*, *herr*, *er* are cognate; with which agrees *aeor*, as ον with *vinum*.

Farther inſtances. No leſs happily is the word *arimaſpi* explain'd; for, according to the teſtimony of *Herodotus*, it ſignified one-eyed. By *arima*, ſays he, the *Scythians* denote one; and *ſpu* ſignifies the eye; not as if this nation wanted one of their eyes, but becauſe they chiefly uſed one in aiming: *Arim*, moreover, ſignifies unity, ſolitude, paucity; therefore, *eremus* to the *Greeks* denoted ſolitude, and *arm* to the *Germans*, poor. *Arim* which ſignified one among the *Scythians*, is now call'd by the *Georgians erti:* But *ſpehen*, *ſpecere*, *ſpia*, *épier*, denotes among the *Germans*, *Latins*, *Italians*, *French*, and in a word among the *Celtæ*, to ſee: And hence manifeſtly appears the word *arimaſpus*. In its original ſignification *ſpehen* denotes a ſharp look; as if it would pierce through; for *ſp* is generally uſed by the *Germans* in actions and inſtruments of penetrating. *Herodotus* relates that he convers'd with a *Scythian* prince; and perhaps he went to the borders of *Scythia*, as he was indeed a great traveller; and therefore he generally deſerves the greater credit in his relations: Beſides, it is not to be wonder'd at, that ſome things relating to the ancient *Scythians*, in a language and nation ſo remote, ſhould eſcape our knowledge: But I would not waſte conjectures on the name of *Xamolxis* the *Getan*, of *Anacharſis* the *Scythian*, &c. but I could wiſh that the *Scythian* words were collected by ſome learned perſon, as the *Gallic*, *Phrygian*, *Egyptian*, &c. have been collected from the writings of the ancients. Now *Heſychius* ſupplies us with ſome *Scythian* words.

What languages compriz'd under the *Scythian*. Under the name of *Scythian*, diſtinguiſh'd from the *Celtæ*, I comprehend the *Turcico-Tartaric*, the *Sarmatic* and *Finnic* languages, tho' theſe three differ much from each other. The *Turks* were a people known to the ancients: The name of *Tartars* aroſe, when they broke out to the deſtruction of the world under the command of *Chingis-Cani*. It is ſufficiently apparent from the language of both nations, that the *Turks* came from thoſe countries, which are now inhabited by the *Uſbecks*, that is, from the *Maſſagetæ*, or *Scythians* bordering on *Perſia*, and that the language of the *Crim* has an affinity with the *Turkiſh*; and we are told that the *Calmucks* themſelves (which I take to be a modern name, and given them by the *Ruſſians*) nay, that the *Mogalli* (which is an ancient appellation) come near the *Turks* in their language; nay, the more eaſtern *Tartars* themſelves, who conquer'd *China*, have many words of an affinity with the *Turkiſh*, with ſome of which F. *Bouvet* ſupplied me. I have found by certain indications, that the *Comani* are of *Turkiſh* original; who,

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at the time when the *Tartars* made their firſt incurſions, inhabited between the *Tanais* and *Danube*; and there is ſtill a remnant of them in *Hungary*, whither they had fled from the *Tartars*; but with the loſs of their language, if I miſtake not.

The *Sarmatians* are a nation, that was for a long time backwards, and now is, no leſs widely ſpread over *Aſia* and *Europe*. *Herodotus* took the *Sauromatæ* in a ſtricter acceptation; but *Tacitus* oppoſes the *Sarmatians* to the neareſt *Germans:* It therefore appears, that he meant thoſe nations, which were afterwards call'd *Sclavonic*; under which we comprize the *Ruſſians*, *Poles*, *Bohemians*, *Moravians*, *Bulgarians*, the modern *Dalmatians*, the *Slabini*, and other inhabitants of the *Adriatic* coaſt; as alſo the nations of the *Vinidi* near the *Baltic*, commonly call'd *Wendi* (not to be confounded with the *German Vandals*) and by *Jornandes*, *Antes*; and all thoſe who, after the migrations of the *German* nations, ſucceeded into their deſerted habitations, and poſſeſs'd all that tract of land between the *Mare Barbarum* (ſo the ancients call'd it) and the *Elbe*; nay, even as far as *Salfeld* in *Thuringen*. It is well known, that the *Vinidi* (ſome of which ſtill remain in *Lunenburg*, and more of them in *Luſace* and the *Marckt*) lately ſupplied the place of interpreters to the *Muſcovites*; and *Sparwenfeldius*, the *Swede*, a man ſkill'd in the oriental languages, affirm'd to me by letter, that the language he had learn'd in *Muſcovy* was of ſervice to him in his travels in *Carinthia* and *Carniola*. *Jornandes* places the *Winidæ*, a populous nation, almoſt in thoſe countries, which at preſent comprize *Poland* beyond the *Weiſſel*; and he divides them into *Antes* and *Slabini:* But I ſuppoſe that the *Antes* and *Wendæ*, or *Winidæ*, differ only in pronunciation; the letter *W*, as commonly happens, being ſometimes ſet before, and ſometimes omitted.

The *Sarmatians* ſpread over *Aſia* and *Europe*.

To the *Sarmatians*, or the *Slavi*, I alſo reckon the *Huns* and *Avares*, who poſſeſs'd what now goes under the name of *Hungary*, but formerly *Pannonia*; for, after that the *Goths*, *Lombards*, *Gepidæ*, and other *German* nations paſſing over into *Italy*, *Rhætia*, and among the *Hedui*, &c. either ſpontaneouſly, or driven out by new comers, deſerted all that country, that lies between the *Danube* and the *Alps*; the *Slabini* ſucceeded in their room, a part of whom coming later were call'd *Avares:* Whence likewiſe, at this day, all that tract is inhabited by *Sclavonic* nations; except where the *Hungarians* (a nation of another original) broke in; nay, even it appears from their language, that in *Hungary* itſelf the *Raſcii*, *Servians*, *Croatians*, *Ziculi*, and moſt of the inhabitants of the Upper *Hungary*, are of *Sclavonic* original. Beſides, among the ancients, the *Huns* and *Avares* in *Pannonia* were in *Charlemagn*'s days join'd together, and at one time the *Huns* were comprehended under the *Avares*, and at another time the *Avares* under the *Huns:* But before that time *Jornandes* made mention of certain

The *Huns* and *Avares* likewiſe *Sclavonic*.

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plains on the *Danaper*, call'd *Hunnivar*; and even *Simocatta*, and other *Greek* writers, have made mention of the nation *Hun* and *Var*.

Farther proof thereof.

It likewiſe appears from other indications, that the nation of the *Huns* is *Sclavonic* or *Sarmatian*; tho' by ſome *Greek* writers the *Turks* are call'd a *Hunnic* nation; but then the word is taken in a large ſenſe, ſo as to denote the ſame thing as *Scythian:* For, it ſo happen'd that thoſe remoter *Barbarians* were by the ancients call'd by the general term *Scythæ*, by the writers of the middle age *Huns*, nay *Turks*, and by the more modern writers, *Tartars:* It appears by the embaſſy of *Priſcus*, the rhetorician, that there were only two languages ſpoke in *Attila*'s court, the *Gothic* and *Hunnic*; and it is manifeſt, and even the names of their kings ſufficiently ſhew it, that the *Gothic* is *German*; but the *Hunnic*, were it not *Sarmatian*, ſhould have been the third language us'd there, ſince *Attila* was then in the heart of the *Sclavonic* nations. It moreover appears, that the word *Coni*, or *Chuni*, denotes a horſe to the *Sarmatians*; ſo that by the name of *Huns* nothing other than horſe was meant; and it is manifeſt, from the accounts of the ancients, that they always acted on horſeback, juſt as their ſucceſſors, the *Tartars*, do at this day. *Jornandes*, deſcribing the funeral ſolemnities of *Attila*, makes mention of a great *Strawa*, that is, as he himſelf explains it, a feaſt; and *Eccardus*, profeſſor at *Helmſtad*, has told us, that a great entertainment is alſo at this day call'd *Strawa* by *Sarmatic* nations: I have likewiſe ſome indications, that the *Cazari*, formerly ſeated on the *Euxine* ſea, were *Sclavonic*.

The great extent of the *Finnic* nation.

Another extenſive northern nation are the *Finns*, whom *Tacitus* calls *Fenni*; and he deſcribes their extraordinary wildneſs, ſuch as is at this day that of the wild *Laplanders*, or *Samojedæ:* And indeed *Schefferus* has long ago told us from their language, that the *Laplanders* have a common original with the *Finns*; and thoſe we now call *Laplanders*, are call'd by *Jornandes*, *Scridi-Finni* (from their ſpeed; for, *Schreiten* ſignifies to ſtride, or make ſteps) but they extended farther into the eaſt, as appears by the *Hungarians*, a people of affinity with the *Finns*; who, as appears from *Jornandes*, came from the *Inner Scythia*, or, as we now ſpeak, from the hither tracts of *Siberia*; and *Rubruckius* ſent by St. *Louis* to the *Tartars* learn'd, that *Old Hungary* was then call'd *Paſcatir*, which I take to be the ſame with what, at this day, goes under the name of *Baſkiria*, in the *Czar*'s dominions; beſides, no *European* language comes nearer the *Hungarian* than the *Finnic*, which, as far as I know, was firſt obſerv'd by *Comenius*. But *Fabricius*, who was lately ſent from *Sweden* to *Perſia*, on the account of commerce, accompanied with a young *Finn*, a relation of *Brennerus*, when in his journey, not far from the *Volga*, near the *Caſpian* ſea, he was paying money to the inhabitants for the hire of their beaſts of carriage, he was ſurpris'd to find that their numeral names were almoſt the very ſame with the *Finnic*; and coming to talk with them, he both underſtood a great

great many of their words, and was underſtood by them: I am, therefore, of opinion, that an ancient large and continu'd nation from the northern ocean, as far as the *Caſpian* ſea, was interrupted afterwards by the *Slavi*, or *Sarmatians*; and part of them wore out: And perhaps the *Eſtii*, *Libones*, and other inhabitants of the *Baltic* coaſt, who are of a different original from the *Slavi*, ſhould be reckon'd to the *Finns*; tho' we who are ignorant of theſe languages hardly admit of this; and I ſuſpect the ſame thing of the *Samojedæ*. The *Hungarians* came later from *Aſiatic Scythia* into *Pannonia*, and fill'd the champaign country, at the time that the inhabitants, the *Avares*, weaken'd by *Charlemagn*, could not defend themſelves; and from hence *Pannonia* (except that country which, at this day, from its eaſtern ſituation is call'd *Oeſtereich*, or *Auſtria*, and join'd by *Charlemagn* to *Germany*) took the name of *Hungary* from its new poſſeſſors; and the inhabitants remain'd a mixture of *Avares*, or *Slavi*, and *Hungarians*. The *Hungarians* were by the *Greek* writers of the lower age compriz'd under the name of *Turks*; the *Turks* had the appellation of *Perſians*, and the *Greeks* themſelves had that of *Romans*, to keep up ſome face of the ancient empire.

The extent of the country poſſeſs'd by the *Celtæ*.

So far of the *Scythians*. I come now to the *Celtæ*, who poſſeſs'd almoſt all that part of *Europe*, extending from the *Scythians* to the *Mediterranean*, the ocean and the ſtreights of *Gibraltar*. It appears, that formerly a part of the *German* nations inhabited as far as the *Tanais*, tho' they were interrupted by the *Winidæ*, or *Antes*; and not long ago there were ſome remains of *Germans* in the heart of the *Crim*, and poſſibly they ſtill remain to this day. The *Germans* afterwards, weaken'd by their migrations, ceded to the *Slavi* all the country as far as the *Elbe*; yet, at length, they recover'd moſt of the country as far as the *Baltic* and the *Weiſſel*. The *Baſtarnæ*, beyond the *Carpathian* mountains, were formerly reckon'd to the *Germans*; but I would chuſe to reckon the *Daci* and *Getæ* to the *Sarmatians*. The ancient *Illyrians* and *Pæones* were formerly, in my opinion, *Celtæ*, that is, *Germans* or *Semi-Germans*. But the *Sclavonic* language is with no propriety call'd *Illyric*; tho' at this day the *Slavi* poſſeſs *Illyrium* and all the neighbouring parts: For, their migration was later. *Livy* denominates the *Alpine* nations, *Semi-Germanic*. I reckon to the *Germans* all thoſe *Celtæ* which extended from the *Rhine* to the north and eaſt: But the *Celtæ*, on the other ſide the *Rhine*, belong'd to the *Gauls*; tho' the original of the *Belgæ* was rather counted *German*, and upon a ſurvey of the more remote antiquities, it is credible that the *Gauls* are for the moſt part deſcended from the *Germans*, and the *Germans* from the *Scythians*, as we have already mention'd: Tho' languages may be gradually chang'd by length of time, and by ſucceſſive migrations.

Remains of the old *Gallic* in the *Armoric* and *Welſh*.

The remains of the old *Gallic* language, collected by *Pontanus*, *Cambden*, and others, appear in no other language more than in the *Armoric* and *Welſh*:

Welſh: A vocabulary of this latter *Boxhornius* has inſerted into his *Origines Gallicæ*. And from this it manifeſtly appear'd to me, that the *Welſh* has borrow'd a great deal from the *German*; and if, at this day, we little underſtand moſt words of that language, we muſt aſcribe it to the frequent changes of times, places, and to the migrations of men. The iſlands receiv'd their inhabitants from the neighbouring continent. The ancient *Britons* are deſcended from the *Gauls* and *Germans*. The *Cymræi*, that is, the *Cambri*, or *Welſh*, I take to be from the *Cimbri*, as the *Engliſh* are from the *Saxons*; the ſucceſſors of the *Britons* from thoſe of the *Cimbri*; and becauſe languages are leſs changeable in places inacceſſible, I ſhould think that the *Cymræi* came nearer to the ancient *Cimbri* in language than to the modern *Germans*. I may ſuppoſe the *Iriſh* to have ſprung from *Britain* itſelf: The *Iriſh* language, therefore, repreſents to us the more ancient *Britons*, that is, the ſtill more ancient *Germans* and *Gauls:* The moſt ancient *Celtæ* will, therefore, be again reviv'd in the *Iriſh*.

Italy and *Spain* peopled by the *Celtæ*.

It is credible that *Italy* and *Spain* receiv'd their inhabitants from the *Celtæ*, that is, from the *Germans* and *Gauls* paſſing the *Alps* and *Pyrenees*, long before that arrival of the latter *Gauls* mention'd by *Livy*; I mean the *Aborigines* of *Italy*, that is, its inhabitants, that are more ancient than the *Greeks*, *Lydians*, *Phrygians*, *Phenicians*, and others that came by ſea: For, all the moſt ancient migrations were made by land; and it was later and uncommon for a great multitude to come by ſea, tho' *Tacitus* be of another opinion. Many *Greek* colonies afterwards ſettled on the ſea coaſt of *Italy*; and hence the *Latin* is a mixture of *Celtic* and *Greek*. Afterwards the hither part of *Italy* bore the name of the *Ciſalpine Gaul*, and the further part that of *Magna Græcia*. In the middle the *Latins* and *Tuſcans*, with their neighbours, poſſeſs'd a great deal on each ſide. We underſtand not the ancient *Tuſcan* language, and the remains of it on ſome ſtones we cannot ſo much as read.

Remote antiquities of the *Spaniards* little known.

The remote antiquities of the *Spaniards* are alſo but little aſcertain'd. *Reineſius*, in his treatiſe *de Deo Endewellico*, has thrown ſome light upon them. Some fragments of the ancient *Spaniſh* literature remain on coins, which the Learned *Laſtanoſa* has collected in a treatiſe written in *Spaniſh*, and lately much enlarg'd and illuſtrated by *Baryus*. It is in vain to reckon theſe letters *Runic*; for, the *Runic* characters have no ſuch ſigns of antiquity; and it appears that theſe coins were ſtruck in the time of the *Roman* Republic, long before the coming of the *Goths*. The enquiry into the original of the ancient inhabitants is no leſs perplex'd. The *Celtiberi*, a great part of the *Spaniards*, came from the *Celtæ*, but later I ſuppoſe: For, it is credible that anciently the *Iberi* themſelves were deſcended of the *Celtæ*; yet perhaps we muſt except the *Vaſcones*, and the people of affinity with them: For, the language of the *Vaſcones* differs ſurpriſingly from all the *European* languages; nor is there any other found to which it has an affinity,

affinity. Shall we ſay that *Spain* was inhabited by a colony of *Africans* before the arrival of the *Celtæ*, and that the *Vaſcones* were remains of them? Or rather that ſome ancient nation of a former migration (before the arrival of the nation from which ſprung the *Celtæ*, that is, the *Germans* and *Gauls*) poſſeſs'd not only *Spain*, but *Aquitain*, and all the neighbouring parts; and this is favour'd by the common names of rivers. *Cæſar* has diſtinguiſh'd three *Gauls*, viz. the *Aquitanic*, *Celtic*, and *Belgic*, where it appears, that the name *Celtæ* is taken in the ſtricteſt ſenſe; and I ſhould think, that it properly agreed to the inhabitants of *Celtic Gaul*; and afterwards taken in ſo large a ſenſe by the *Greeks*, that came partly to *Marſeilles* and partly to the *Iſter*, that upon obſerving a certain ſimilitude in their manners and language, it compriz'd all the weſt, which was unknown to the ancients: For, formerly the *Greeks* call'd the weſtern people, whom they knew not, *Celtæ*; the northern, *Scythians*; the eaſtern, *Indians*; the ſouthern, *Ethiopians*; denominating the remoter people from the nearer: And *Herodotus* has ſufficiently ſhewn, (tho' he varies from himſelf) that the *Scythians* were a peculiar and no very extenſive nation, which gave name to the nations of that tract; and was no leſs unknown to the *Greeks* in *Homer*'s time than was that of the *Celtæ*.

Scandinavia peopled by the *Germans*.

As *Germany* ſupplied *Gaul* and *Italy* with its moſt ancient inhabitants; ſo it did *Scandinavia* ſomewhat later: For, I reckon it unqueſtionable, that the *German* nations paſs'd over from the *Cimbrica Cherſoneſus* and the coaſts of the *Baltic*, firſt to thoſe iſlands now call'd *Daniſh*; and afterwards into *Scandia* itſelf; and driving out the *Finno-Lappones*, the ancient inhabitants, to remoter parts, poſſeſs'd the milder tracts along the coaſt: And indeed the *Daniſh*, *Swediſh*, and *Norwegian* languages are plainly referable to the *German*, no leſs than at this day the *Italian*, *French*, and *Spaniſh* are to be reckon'd of *Latin* original; tho' theſe latter receiv'd the *Roman* language, not as deſcended of them, but as being under their empire, which is otherwiſe in the *Germaniſm* of the northern nations: Nor is it to be wonder'd at, that the northern and hither *Germans* do not underſtand each other, ſeeing a Boor of *Auſtria*, or *Bavaria*, does not underſtand one of *Weſtphalia*, or *Holland*. No *German*, at this day, could, without an interpreter, underſtand *Otfridus*, a *German* writer of *Charlemagn*'s time; not to mention *Ulphila*, a much older writer. Thus by intervals of time, as well as places, firſt the dialects and then the languages undergo a change. But when words are ſet down in writing, ſo that one may have an opportunity of reflecting on them, the common original manifeſtly appears in moſt of them: The variation is greater in dialect than in language. Moreover, *Franciſcus Junius* has eſpecially deſerv'd well of the ancient *German* language, and part of his lucubrations is preſerv'd at *Oxford*. Dr. *Hickes*, excited by his example, has given us in a large and uſeful work a treaſury of the northern languages, to wit the *Teutonic*; and lately in *Germany*

Johannes Schilterus, and by my advice *Gerardus Meierus*, have attempted to illuſtrate the ancient *German* language.

The *Goths* deſcended from the *Germans*.

I am aware, that ſome learned men among the northern *Germans* have, at one time, fram'd to themſelves a certain nation of *Goths*, different from the *Germans*; and at another time reckon'd *Germany* itſelf a colony of *Goths*. But no one can deny the *Goths* to be *Germans*, and oppoſe both the teſtimonies of the ancients and the evidence of matters of fact, unleſs he would incline to rival in obſtinacy *Prætorius*, a *Gothic* author, who reckon'd the *Goths* to be *Sarmatians:* But it might be more eaſily credited, that the *Germans* came from *Scandinavia*, if the *German* nations poſſeſs'd its inmoſt parts towards the frozen ocean. But all the country, on both ſides the *Sinus Boddicus*, is poſſeſs'd by the *Finno-Lappones*, a nation entirely different in language from the *Swedes* and *Norwegians:* I, therefore, take the *Finns* to be the true *Aborigines* of that large *Peninſula*, which, from its higheſt and a ſmall part thereof, *Scania* (as it is call'd even at this day) or *Scandia*, or *Scandavia*, the ancients call'd *Scandinavia:* There are in thoſe parts no traces of the *German* language, it being only found on the borders thereof: And, therefore, to derive the *Germans* from thence, would be the ſame abſurdity as making all the *Arabs* and *Syrians* the poſterity of the *Abyſſinians*, or many ages hence making *London* in *England* a colony from *Boſton* in *America*. It appears that *Suedilant* does at this day among the *Swedes* denote land newly broken up and turn'd into plough-land after burning the woods: For *ſueden*, even among the ancient *Germans*, ſignify'd to burn. Whence remains, at this day, *ſieden*, to boil, and *ſud*, the ſouth or warm quarter: But that country was broken up long before the *Roman* writers, ſince *Tacitus* himſelf makes mention of the flouriſhing nation of the *Suiones*, that is, the *Suedones*; and makes the *Suevi*, that is, a part of the *Germans*, to extend that far.

Whether the *Goths* came from *Scandinavia?*

Yet I own that colonies were ſent from the northern to the hither *Germany*, but later: And indeed the *Cimbri*, *Saxons*, *Heruli*, *Vandali*, and other nations came from the *Baltic* coaſt; and *Procopius* tells us, that the anceſtors of the princes of the *Heruli* dwelt in *Scandinavia:* And from thence *Jornandes* deriv'd the *Goths*. On the contrary, *Cluverius*, a principal author in ancient geography, places the *Goths* on the *Weiſſel*, and that from no contemptible arguments: But *Georgius Sternielmius*, a learned *Swede*, (who together with *Benedictus Skyttius* labour'd much on the harmony of languages) wrote a treatiſe with ſome acrimony againſt *Cluverius*; but his reaſonings are not ſo ſolid. I do not entirely deſpiſe the authority of *Jornandes*, tho' I own it is not always to be depended on; eſpecially in the remoter accounts; and I find him ſometimes full of inconſiſtencies. He follow'd *Ablabius*, and the books of *Caſſiodorus* on the *Gothic* affairs, which are now loſt. *Jornandes*, therefore, derives the *Goths* from *Scandinavia*, tho' he confounds them with the *Getæ*, the much more ancient inhabitants of

of the *Euxine* coaſt. I do not only reckon to the *Swedes* the eaſtern and weſtern *Gothland* but *Jutland*, the *Gothones* on the *Weiſſel* (who were known formerly to the *Romans*) and the iſland *Gothland:* It was, therefore, poſſible that the appellation of *Gothones*, or *Guttones*, was ſome time or other common to the inhabitants of both ſides the *Baltic*; and hence the ſea itſelf was call'd *Sinus Codanus*, that is, *Gothicus:* And tho' the firſt, or more ancient *Germans* on the other ſide that ſea, are undoubtedly deſcended from our *Germans*; yet it is not improbable, that afterwards a number of brave young men came again from *Scandinavia*, and ſettled the kingdom of the *Goths* in thoſe parts on this ſide the ſea; and that the original of the princes and leading men was by poſterity and hiſtorians confounded with that of the nation itſelf; as if the whole nation had come from the ſame parts; or as if *Scandinavia*, which in my opinion was never very populous, were the nurſery of theſe nations. This opinion is favour'd by *Jornandes* himſelf [a], who lands the *Goths* among us with their king *Berig*, in three ſhips only: And indeed it is credible, that in the migrations of the *Goths*, as in thoſe of the *Cimbri*, *Franks*, and *Saxons*, thoſe who came from the remote parts were increas'd in number by the acceſſion of others, who either ſpontaneouſly or by force came both into the expedition and name of that people. That the *Goths* gradually proceeded from the *Weiſſel* towards the *Euxine* ſea, *Cluverius* agrees with *Jornandes*; but it appears that the *Baſtarnæ* and other *Germans* were found there long before.

I take the migration of the *Aſiatics* into *Sweden* (mention'd by the more modern mythologiſts of that nation) conſidering the great diſtance, and the difficulty of travelling even at this day, to be fabulous, and invented at the time, when upon the firſt reception of letters, the *Scandinavians* learn'd what *Aſia* was. But it appears, that the *Aſæ*, or *Heroës*, which arriv'd with *Odin*, or *Wodan*, came from the *Saxons*, who ſtill inhabited *Cimbria*, and among whom *Wodan* himſelf reign'd, as far as may be learn'd from the ancient annals of the *Angles*, which are far more ancient than the hiſtories of the northern nations: And therefore, the *Scandinavians* at one time receiv'd kings from them, and they at another time from the *Scandinavians*. The northern people corrupted *Wodan*, as being a foreign word, into *Odin*; for, they generally cut away the *W* from *German* words. *Jornandes* derives the *Danes* (or *Dæni*, as they are call'd by their neighbours,) from the *Cogeni*; and tho' he places them in *Scanzia*, you may therein comprize the outmoſt *Jutæ* as far as the promontory *Scagen*; and they afterwards coming from the river *Dena*, it appears they had the name of *Deni*, and the country that of *Denemarck*; for, that river (at this day call'd *Eidora*, from *Heggidora*, as the ancients relate, or the *gate of the fort*) makes the limits or *marches* of *Jutland*. *Jornandes* relates that the *Heruli*, driven out by the *Danes*, did, together with the *Saxons*, practiſe

The original of the *Danes*.

[a] Cap. 14.

pyracy on the *Romans*; and it is credible, that they were often conceal'd under their name.

Of the Original of the *Franks*.

I need not much enlarge on the migrations of the *German* nations into the provinces of the *Roman* empire, ſince they are well known from hiſtory, and ſtand not in need of the ſupport of languages; and yet there are ſome things on this head worthy of remark. It is manifeſt that thoſe few *Suevi*, who have retained their ancient name, were mixt with the *Allemanni*. I ſhould think that the *Boii* came into *Bavaria* from *Bohemia* and the *Marcomanni*, at the time the nations of the *Vinidæ* prevailed. We muſt treat ſomewhat more fully of the *Franks* and *Saxons:* Some Authors, and thoſe of no modern date, derive the *Franks* from *Troy*, and again from the *Euxine* ſea, and aſcribe to them ſome certain town called *Sicambria*, as if they had ſome time or other inhabited *Pannonia:* But it is a prevailing cuſtom among people, upon their firſt reception of letters, for their half-learn'd writers to deviſe ſtrange ſtories; partly imitating the fictitious and idle relations of other people, and partly applying ſome of their own popular traditions to what they read in books: And hence aroſe among the *French*, *Britons*, *Scots* and *Scandinavians*, thoſe prodigies of ſtories, which the northern people called by a *German* term, *Sagas*, that is, idle tales. Some learned *Frenchmen*, ſuppoſing that an ancient colony of *Gauls* was carried into *Germany*, do from thence derive the *Franks*; but how does it appear that the *Franks* came from that part of *Germany*, which the ancient *Gauls* are ſaid to poſſeſs. I find that the original of the *Franks*, as well as that of the *Vandals*, *Goths* and *Saxons*, is to be deriv'd from the *Baltic* coaſt; not that they came from thence as a great nation, but that a number of brave men, ſallying out, did in their progreſs grow into a mighty people: For, it appears, that upon occaſion of the *Marcomannic* war, when under *Marcus Antoninus*, *Italy* itſelf was in danger, the *Barbarians* were encouraged by the hopes of plunder, and rouſed from their habitations; and from that time the fury of migrations continu'd, till the farther countries of the *Germans*, being exhauſted, gave way to the *Vinidi*; and the hither countries, coaleſcing into larger kingdoms, were more quietly inhabited: Beſides, the *Franks* did ſoon after ſettle among the *Hermunduri* and *Cheruſci*; from whence they proceeded to the *Rhine*, into the country of the *Sigambri* and the neighbouring parts; and gave name to that whole tract between the river *Maine* and the *Batavi*; and infeſted the *Gallic* coaſt, till at length they paſſed over into *Gaul*, when a later and ſtill fiercer nation of *Saxons* ſucceeded them.

And *Saxons*.

Ptolomy was the firſt who mention'd the *Saxons* in the mouth of the *Cimbrica Cherſoneſus*, and not far from theſe *Tacitus* places the *Angles*, in which Author's time either the name of *Saxons* was not known, or it was confined to very narrow limits; but as they afterwards increaſed, and had joined with them the *Chauci* and *Friſii*, they became noted pyrates, and made

made deſcents into *Gaul* and *Britain*, with a view to plunder; and hence both coaſts are in the *Notitia Imperii*, called *Saxonicum*. It appears, that about that time the *Franks* were driven out of *Batavia* by them, and that before the *Saxons* ſettled in *Britain:* The ſame people ſucceeded the *Franks* in *Weſtphalia*; and afterwards the kingdoms of the *Werini* and *Thuringi*, (whoſe ancient names were *Cheruſci* and *Hermunduri*) were partly overthrown by the *Franks*, and partly by the *Saxons*. The country of the *Werini* (if you except *Friſia*) ceded to the *Saxons*, and they alſo obtain'd part of *Thuringia* (which in *diploma's* was for a long time call'd *Northuringia*) between the *Elbe* and the mountains of *Hartz*. Part of the *Saxons* alſo, together with their former neighbours, the *Lombards*, paſſed into *Italy*. At laſt under the *German* Emperors moſt of the country of the *Wenidi*, between the *Elbe* and the *Warta*, and even farther (partly the colonies of the *Germans*, and partly the natives aſſuming our manners and language) fell to the *Saxons*, and conſtitute the principal part of the upper Circle of *Saxony*.

Of the reputed Sileſian Cotton. *From the* Breſlaw Collection, July 1717, Claſs IV. Art. VI. p. 76.

Tranſlated from the HIGH-DUTCH.

ABOUT *Hirſchberg*, *Kühnaſt*, and more eſpecially about *Grieffenberg*, is found a new ſort of cotton, of which we have not only had an account in writing, but likewiſe a large ſample of it ſent us: But we muſt in the firſt place obſerve, that it does not at all deſerve the name of true cotton, 1. As it is entirely different either from the true *goſſypium herbaceum*, or *arboreum*, as ſuch is plentifully produced and found in *Aſia*, *Africa*, *America*, and alſo in *Europe*, and particularly in *Syria*, *Egypt*, *Armenia*, *Perſia*, *Bengal*, *Coromandel*, *China*, *Brazil*, and the *Antilles*, as alſo in *Spain*, *Calabria*, *Cyprus*, and particularly in the iſland of *Malta*; where eſpecially the *goſſypium herbaceum*, as the common cotton tree, does in its leaves and branches reſemble the vine; yet it is much lower, and uſually grows to the height of about two foot, and muſt every year be ſown in the month of *June*, in fields properly prepar'd for it, and in ſuch manner that the ſeed be previouſly ſprinkled with aſhes and water, to prevent its being eaten by the worms: Whereas on the contrary, the *goſſypium arboreum*, or *gotne mſegiar* is a true tree, and laſts for many years; but in *Egypt* it is rear'd only in gardens, and cannot be brought to ſuch profit as the *herbaceum*, a figure of which we find in *Proſper Alpinus*[a], 2. As our cotton does not grow in any nuts or heads, like the true cotton,

Difference between the *Sileſian* and true cotton.

[a] *De plant. Ægypti*, fol. 29.

cotton, which is incloſed in a ſort of nuts almoſt as big as walnuts, and found on the top of the ſtalk, which, when ripe, burſt on four or ſix ſides, and through the rent diſcover the incloſed cotton. In *Syria* and other parts it is cleanſed by means of a round ſtick, which is faſten'd to a round iron bar, and then turned round; ſo that the ſhells or the ſeeds muſt remain behind: And this in the *Antilles* is perform'd by a ſmall machine, which turns round by means of a wheel, and the cotton is in this manner clear'd from the ſhells and ſeeds, which laſt are as large as ſmall beans, and hang on the cotton, in whoſe middle they grow; ſo that thus the cotton falls on one ſide, and the ſeed on the other. 3. Not to mention that the true cotton, as was ſaid, contains in itſelf its ſeed, from which it is propagated. 4. The wool alſo itſelf is entirely different from ours, being as long as hair, and as ſtrong as a thread.[a]

The Deſcription and Uſe of the *Sileſian* Cotton.

Our cotton on the contrary is nothing other than the produce of a real ſhrub, whoſe heads grow on a long ſtalk, and bear the cotton; theſe heads are a ſmall finger in length, round and beſet with two ſharp-pointed follicles, almoſt like an ear of corn, only that the upper ſpike of this *calix* ſtands almoſt bolt-upright, but the lower is bent outwards and downwards; and from their middle the flocks or downy threads, which yet are very ſhort, ſtand out on a very ſmall grain, ſmaller than the ſmalleſt poppy-ſeed, and beſet the whole head ſo thick, that one can in no wiſe obſerve the *ſtamina* and *calices*; but in this their collected appearance they exhibit the bigneſs of a white mouſe: Now this cotton is prodigiouſly ſoft and fine and feels like ſilk; white as ſnow, yet very ſhort, and at the ſame time very tufty, and cannot be eaſily compreſs'd. In this form, it is true, it is on account of its ſhortneſs, not fit to ſpin, unleſs we could by art improve it, and draw it into long threads; but it appears to be very fit for lining of cloaths, as being much lighter and ſofter than cotton, yea even than ſilk itſelf; eſpecially when it is open'd out, beaten and well clean'd, and as it may alſo be had in great plenty; ſeeing not only each head is ſtuff'd therewith, but even the trees themſelves are full of it: So that as we are well aſſur'd, a whole baſket may be fill'd with it from one tree only: Beſides, this tree does not require the leaſt culture, and is found pretty plentiful in other places beſides the abovemention'd, particularly in marſhy grounds, yet with this circumſtance, that in five or ſix years growth at moſt, it turns rank, and yet it muſt not be grubb'd up: And to this we farther add, that this cotton is in no wiſe ſpoil'd by water, but after drying, retains its colour pretty well, only that it turns a little yellowiſh; but

a Vid. *Dapper Africa*, p. 166. It. *Aſia ſ. Perſia*, p. 66. P. a S. T. Oriental Reiſebeſchr. l. 7. c. 10. p. 427. Monconis *Voyage de Syrie*, p. 327. Walther Mulze Reiſebeſchr. l. 3. p. 202. Proſp. Alpin. *de plant. Egypt.* c. 18. fol. 29. Rechi *hiſtor. nat. Braſil.* p. 308. Rochefort *Deſcript. des Antilles*, l. 2. c. 5. p. 102. Megiſeri *Deſcript. Malt.* p. 249, 250, *and many others.*

but in ſubſtance it ſeems, indeed, to be improved; becauſe then it is obſervable to be really firmer and cloſer, yet at the ſame time very ſoft, and perfectly fit for lining of cloaths; yet poſſibly by art it may be brought to a greater degree of perfection: It might alſo be worth enquiry, whether this cotton might not be employ'd for making of hats; and upon conſulting ſome hatters on this head, we were told it was no impracticable thing: And for the future we ſhall embrace all opportunities of making more oeconomical and phyſical experiments upon this vegetable. But whether it was formerly taken for cotton, and whether the words of *Tannerus*[a] have poſſibly any relation to it; 'cotton, that rarity of nature, 'is alſo found in *Bohemia*[b]', is what we cannot aſſert for truth: At the leaſt, as this wool very eaſily falls from its trees, ſo that when one goes under one of them, he is ſoon by the ſmalleſt breath of wind all over cover'd with it; and as on account of its lightneſs, it is uſually carried by the wind far and near, it is very credible that the cotton-rain, that fell in *Poland*, *Anno* 1571, mention'd by *Paulinus*[c] from *Spangenbergius*, might be owing to this or the like wool; as it is alſo well known, that the *gramen tomentoſum*, which was once driven in plenty upon a meadow not far from *Hall*, is wont to produce plentifully a like wool, but of a greater length; not to mention the like ſort of woolly ſtuff which is to be found on poplars and on other trees or ſhrubs: In fine, how far the *eſula rara Indica*, which is productive of white ſilk, and which grows in *Moravia*, according to the teſtimony of M. *Hertodts*[d], is to be refer'd hither, we leave others to determine.

[a] *Veſtig. Bohem. piæ, notis ad* c. 10.
[b] Vide Bohuſl. Balbinus *Miſcel. Bohem. dec.* I. *lib.* 1. *c.* 49. *p.* 115. b.
[c] Zeitkürtzl. Luſt. part III. p. 902.
[d] Tartoromaſt. P. I. c. 17. p. 129.

Of the Invention of the Microſcope; *together with ſome microſcopical Obſervations. By Dr.* Phil. Jac. Sachs à Lewenheimb. *From the* Miſcellanea Naturæ Curioſorum, Ann. I. Dec. I. Obſ. XIII. p. 40.

Tranſlated from the LATIN.

Inventor of the Microſcope.

AMONG the curious inventions of this age, the microſcope is none of the leaſt; as by it the ſmalleſt atoms and inſects are magnified to a great degree: The *Italians* claim to themſelves the honour of the invention, and mention *Franciſcus Fontana*, a *Neapolitan*, for its inventor; and *Fontana* himſelf teſtifies that he firſt made the diſcovery at *Naples*, about the year 1618[a]; and ſome years after, *Scheinerus* makes mention of him.[b]. *Borell* in the dedication to his microſcopical obſervations,

[a] *Tract. 8. de nov. cæleſt. & terreſtr. rerum Obſ.* c. 1. p. 145. *Roſa Urſinal.* 1. c. 30.

tions, is of another opinion, who therein tells us that it was invented in *Holland*; and in another treatiſe [a], he mentions *Zachary Janſen* of *Middleburg*, as the inventor (confirming it by many teſtimonies) who about the year 1590 had diſcover'd both the teleſcope and microſcope; and in *cap.* 14. p. 34. he adduces the teſtimony of *William Borelius*, Ambaſſador of the *United Provinces* to *France*; to wit, that a certain citizen of *Middleburg*, named *Hans*, and commonly call'd the microſcope-maker, had together with his ſon *Zachary* found out thoſe glaſſes; and had preſented the firſt of them to prince *Maurice* of *Naſſau*, and another to archduke *Albert*, which this latter had made a preſent of to *Cornelius Drebbel* in the year 1619: As many learned men were afterwards appriz'd of the great uſefulneſs of this inſtrument they ſeriouſly applied themſelves to bring it to greater perfection; and in making of them *Franciſcus Fontana* and *Torricelli* were famous in *Italy*: And at this day *Manfredus Settala* of *Milan* is no leſs famous for his optical inſtruments. *Euſtachius de Divinis* has compleated a microſcope in a new manner, 10 inches and ½ in length; and it may be drawn out to four lengths; the firſt and leaſt ſhows lines 40 times greater than they appear without a microſcope; the ſecond, 90 times; the third, 111; and the fourth, 143; and it has this peculiar to it, that it repreſents objects plain and not curve; and tho' a great part of the microſcope be cover'd, yet it is ſurpriſing how much it magnifies [b].

In France. Among the *French*, *Ferrerius Arvennas Choureus* and *Guil. Menardus* at *Paris*, and *Stephan. Breſſyeus* at *Grenoble*, have been famous for microſcopes, as alſo M. *Challomon* at *Aix*, and M. *de Servié*, at *Lyons*.

In England. In *England* the beſt and moſt perfect were made by Mr. *Reeves* at *London* [c], and by Dr. *Hook*, who at great expence and after a great number of experiments, publiſh'd at *London* in 1665 his Micrography or deſcription of minute bodies, together with the deſcription of this inſtrument, which is the beſt in its kind.

In Holland. In *Holland*, next to the firſt inventors of *Middleburg*, were *Hans*, the ſon of *Janſen*, a *Zealander*, and *Hans Lapperhey* of *Middleburg*, and *Cornelius Drebbel* of *Alcmaer*. *Iſaac Voſſius*'s microſcope is mention'd by M. *Monconys* [d], conſiſting only of one hemiſpherule, which is put into a ſmall piece of wood that draws out, behind a ſmall black plate, excavated in form of an eye, and perforated in the middle with a ſmall hole to look through. M. *De Hudd* at *Amſterdam* ſhow'd M. *Monconys* two different microſcopes; one with one ſpherule only; another to which he applies a thicker ſpherule, at the part where the object is admitted, in ſuch manner that the rays of light entering the ſpherule may illuminate the object. He likewiſe ſhow'd M. *Monconys* the method of preparing theſe ſpherules [e], for,

[a] *De Invent. teleſc.* c. 12. p. 26.
[b] Journal des Scavans, tom. IV. p. 134. Phil. Tranſ. N. 42. p. 842.
[c] Moncon. *Voyage* tom. II. p. 11. [d] Ibid. p. 153. [e] Ibid. p. 161.

for, he melted the metal for the ſpherule at the lamp, at which cryſtal glaſs is uſually purified, by extracting the ſalt from it; while this maſs is glowing hot it diſcharges the ſalt to the ſurface, which is afterwards eaſily remov'd; from the maſs of glaſs thus depurated, he takes up a ſmall portion on the end of his red hot iron rod, which he melts, and afterwards turning it round in the flame of the lamp, it becomes exactly globular.

In *Germany.*

Among the *Germans*, I reckon *Kircher*, who, in his treatiſe *de peſte*[a], ſays that his microſcope is prepar'd with no leſs application than ſkill, that it magnifies a thouſand times. At *Breſlaw* for ſome years liv'd *Theodorus Moretus*, a *Jeſuit* and profeſſor of mathematics, who ſtrenuouſly applied himſelf not only in divers mathematical inſtruments and different glaſſes, but likewiſe in microſcopes. M. *Baſilius Titelius* is no leſs famous for his microſcopes, than for his military ſkill and knowledge in mathematics and phyſics. *Chriſtopher Weickman* at *Ulm* is noted for his preparing of microſcopes[b]; as alſo *Wieſelius* and *Daniel de Pierr*[c], his ſon in law, at *Augſburg:* And at *Vienna*, *Mattmiillerus.*

Different methods of preparing microſcopes.

Microſcopes are prepar'd in different manners; ſome uſe two convex lens's; others large glaſs-ſpheres fill'd with water; others again the ſmalleſt ſpherule, whoſe diameter does not exceed that of the ſmalleſt pearl, and which they incloſe in a tube, and look on its ſurface placed between the eye and the light; ſuch as was that of the Cardinal *de Medicis*, which *Kircher* does not diſapprove of[d]; yet he prefers to all others an hyperbolical lens. More may be ſeen about the conſtructing of microſcopes in *Fontana*[e]. *Des Cartes* in his Dioptrics, *Hevelius* in his *Selenographia* publiſh'd at *Dantzick* in 1647, *Athanaſius Kircher*[f], *Petrus Borellus* in his treatiſe of preparing microſcopes, publiſh'd at the *Hague* in 1656, where he mentions from different Authors, conſtructions of it, and which he adds to his own method, *Jo. Chriſtopher Kolhans*, in his optical treatiſe, and *Monconnys* in his travels[g].

Microſcopical obſervations.

To this account of microſcopes we ſhall add ſome microſcopical obſervations; and theſe relate either to works of art or nature.

On works of art.

As to works of art; 1. The fineſt and ſmootheſt paper appears rough in a microſcope: For, in it are ſeen fibres, hairs, cavities, and innumerable inequalities. 2. The ſmootheſt ſurface of glaſs appears very rough and full of cracks, fiſſures and inequalities. 3. The fineſt point of a needle, tho' it may ſeem to be imperceptible, appears by the microſcope as broad as a quarter of an inch. The extremity of its point does not end in a cone, nor is it entirely round or flat, but blunt, unequal, irregular, reſembling a bro-

[a] ſ. 1. c. 7. §. 2. p. 70. [b] Ibid p. 320. [c] Ibid p. 328.
[d] Ars Magna de Luc. & Umbr. L. x. p. 2. c. 8. § 5.
[e] Tract. 8. de nov. cæleſt. & terr. Obſerv. c. 2.
[f] l. c. [g] Tom. 1. p. 117. —— 128.

a broken nail [a]. 4. The edge of a very ſharp razor appears in ſome meaſure like the back of a dog, with ſeveral teeth [b]. 5. The ſmalleſt points, uſed in printing for diſtinguiſhing the periods, appear like ſo many cheſnuts [c]. 6. The threads of the fineſt webs appear like coarſe cords, and the holes between the threads, which render the web tranſparent, nearly reſemble the lettice of a window [d]. 7. The waves in tabbies do hence appear, becauſe ſome parts thereof are more elevated, and others more depreſs'd, whence ariſe the different reflections of the light.[e] 8. The ſalt of *May* dew, prepared in a peculiar manner by Mr. *Henſhaw*, and view'd with a microſcope, did, in the number and figure of its angles, reſemble nitre.[f] 9. The variety and true mixture of colours may be eaſily collected by the microſcope; and of the colours diſcover'd by it Dr. *Hook* has treated in his micrography.[g] Some years ago M. *Chriſtian Langius*, an excellent chemiſt, and profeſſor of philoſophy at *Leipzig*, at ſeveral times ſhow'd to his pupils, that a green colour by the microſcope was nothing other than a mixture of white and blue. *Ludovicus Savotus* in his accurate treatiſe on colours, publiſh'd at *Paris* in 1613, ſhews, that a variety of colours ariſes from their different mixtures; from a yellow or a white, and a light red and a blue, a green is produc'd; from a ſmall portion of a yellow and blue, ariſes a lively green; from a larger portion of blue and yellow, a dingy green and a dark green; if the blue prevail in the mixture, there is produc'd a ſea-green; but if the yellow prevail, a yellow-green; and if ſome black be added, a *fueille-morte:* Thus when dyers and painters mix a red of groſſer parts in ſmall quantity to a yellow, they produce orange; but in a larger quantity, *zinzolin*; from a ſtraw-colour and the leaſt portion of a red of groſſer parts is produc'd the *iſabella*-colour. If to the *zinzolin* you add a little black, you have the *couleur de Roy*; but if more black, the *couleur de Minimes*; but a yellow is produc'd from a light red, and a pellucid white; a blue colour with white ſtrikes a turcois blue, a ſky blue, and a white blue[h]; a bright white mixt with a black makes a grey; and according to the proportion of both, and as the one or the other is predominant, a blue grey, ſilver grey, dingy grey, dark grey[i]; a red of groſs parts mixt with a white, if the red prevail moſt, makes a dingy red; but if the white prevail moſt, a lively red, which in wool produces the ſcarlet; in ſilks, the crimſon; and in fine, the carnation and the fleſh-colour[k]: And it is credible, that the origins and mixtures of ſo many colours may be diſcover'd by the microſcope; and from thence more new *phenomena* of colours be found out.

On the works of nature, and firſt in the mineral kingdom.

1. In the *aſtroites*, the ſeeming ſtars or roſes are nothing other than fiſſures[l]: Whence this ſtone is made to move by pouring vinegar upon it; and

[a] *Jour. des Sçav.* Tom. II. p. 479. [b] *Ibid.* p. 480. [c] *l. c.* [d] *Ibid.* p. 461. [e] *Ibid.* p. 481. [f] *Phil. Tranſ.* N° 3. p. 33.
[g] *Jour. des Sçav.* Tom. II. p. 488. [h] *Savot.* c. 7. [i] *Id.* c. 6. [k] *Id.* c. 8.
[l] *Borel. Obſ. Microſ.* 6.

and if it was ſhap'd into the form of a tortoiſe, it would yield a ſurpriſing *automaton*, as *Kircher* obſerves[m]; becauſe the vinegar, inſinuating with its ſpirit into the fiſſures, acts upon the ſalt of the ſtone, where in that mutual ſtruggle and ebullition that more violent motion is excited, as I have alſo accounted for the local motion of crabs-eyes in my *Gammarologia Curioſa*[n]. Upon viewing each corpuſcle of powder'd cryſtal apart, according to *Kircher*, it appears ſomewhat radiant [o].

In the vegetable kingdom in general.

1. Rotten wood, view'd with the armed eye, exhibits a vaſt number of little worms; ſome of which have horns; ſome wings; and they have eyes like black points and a *proboſcis:* So that the wiſdom of the Creator is very much to be admir'd, as having furniſh'd theſe *animalcula*, which are imperceptible to the quickeſt eye, with theſe members, without which they could neither move nor exerciſe any vital action[p]. 2. In general, we obſerve in plants, herbs, and the leaves of trees, veins drawn with the greateſt art, and in theſe a juice, with which are fed the veins of the roots; and we alſo obſerve, how that juice congeals and runs again: In flowers is ſeen a juice and a florid *ambroſia* running in their ſmall veins[q]. 3. In all herbs are ſeen very minute worms, which are produc'd according to the nature of the herb and plant, and which now degenerate into butterflies, and again into ſome other volatile inſect[r]. 4. In ſome leaves of plants are obſerv'd many little ſtars and collections of long atoms, and many ſpines ſtick out on them on all ſides[s]. 5. In capillary herbs, as the *lonchites*, polypody, *lingua cervina*, and other plants without ſeed, as is commonly thought, the ſeeds are diſcover'd by the microſcope: For, they are tergiferous[t]. 6. In moſt plants there are holes obſerv'd, as in the *hypericum*, dandelion, and ſpinage; yet theſe holes do not penetrate the plant, but are furniſh'd with a ſmall lucid membrane like a lettice[u].

In particular.

1. The entire external ſurface of a ſage-leaf is rough, but by the microſcope it appears as if cover'd with a cobweb, within which very minute *animalcula's* appear, together with ſome little balls like eggs, ſpread over the ſurface: Which virulent brood, if rubb'd on the gums of a perſon without waſhing, proves noxious; but wiping the leaf with the finger, or waſhing it in water, they preſently diſappear[w]. 2. Both the leaves and bark of the mulberry, if their texture be obſerv'd by the microſcope, you will find that in their fibres they very nearly reſemble yellow ſilk; *Borellus* has ſhown in the leaves of the mulberry a wonderful *plexus* or net-work[x]. 3. The leaves of hoar-hound have tubercles and round rugoſities reſembling

m *Ars Magnet.* l. 3. p. 3. c. 2. p. 562. n l. 1. c. 14. p. 318.
o *Mund. ſubter.* l. 8. ſ. 1. c. 8. f. 24.
p *Kircher Scrutin. peſt.* ſ. 1. c. 7. §. 2. Exper. 4. p. 74.
q *Fontan. Obſ.* 10.
r *Kircher Scrutin. peſt.* l. c. Exp. 3.
s *Borel. Obſ. Micr.* 6. t Id. *Micr.* 8. u Id. *Obſ.* 5.
w *Kircher de peſt.* ſ. 1. c. 7. §. 2. & *Mund. ſubter.* L. XII. ſ. 2. c. 6. f. 369. x *Obſ. Micr.* 63.

drops of oil[z]. 4. The leaf of the *Sigillum Solomonis*, which to the naked eye diſcovers only 9 ribs, does by the microſcope ſhow 74[a]. 5. In the nettle we preſently diſcover by the microſcope whence it cauſes ſuch a troubleſome itching, and to what its power of raiſing puſtules is owing: Over the whole herb, eſpecially in its leaves, are obſerv'd prickles in the form of needles, nay with three points, with which the whole ſurface of the nettle is plentifully beſet, whereby it evidently pricks; and from this painful compunction there afterwards ariſes a heat in the wounded ſkin, as many of the prickles are left behind in it; whereby the blood flows more copiouſly to thoſe parts [b]. *Hook* in his *Micrography* has alſo obſerv'd in the nettle, that its leaves are all over cover'd with very ſharp prickles, whoſe baſe conſiſts of a bag of a flexible ſubſtance, in form of a wild cucumber, with a ſharp poiſonous liquor, contain'd therein, which may be ſeen to riſe and fall, if the extremity of the prickles be preſs'd with the finger againſt the baſe: Hence ſeeing the point, conſiſting of a very hard and ſtrong ſubſtance, has a hole in the middle, from which that poiſonous liquor may be diſcharged into the part that touches it, a ſenſe of pain is thereby excited[c]. In a *lixivium* of nettle-aſhes *Kircher* affirms [d] that it contracts a ſcurf of ice in the night, and that the whole nettle is repreſented on the ice itſelf: But by the microſcope the entire appearance of the nettle ſeems to have been concreted from an infinite number of very ſmall *ſtellulæ*. 6. In a freſh ſmall fig-leaf are ſeen on its back ſurpriſing rugoſities, reſembling obtuſe cones: In the *Indian* fig a vaſt number of large prickles are obſerv'd; whence upon handling, it cauſes pain[e]. 7. The leaves of ſorrel exhibit oblong, rough and ſtreight atoms in form of needles, by which it is probable that the tongue is twinged[f]. 8. The leaves of the maſtic-tree and the *liburnus* are full of worms[g]. 9. In the leaves of the *palma Chriſti* is an innumerable collection of ſtars[h]. 10. On borage are very rough prickles, and thoſe jointed[i]. 11. Common graſs has ſtriated leaves like the *Chineſe* fillets, or rather like the leaves of ſtriated graſs, in which nature has more manifeſtly expreſs'd it[k]. 12. The leaves of the celandine are perforated[l]. 13. The holes of *St. John's wort* are ſo magnified in the microſcope, as to cauſe the greateſt admiration[m]. 14. The veins in the leaves of the honey-ſuckle appear ruddy, in the laurel, greeniſh[n]. 15. The leaves of wood-ſorrel are very much perforated, and moiſt, as it were, with a perpetual dew[o]. 16. Fever-feu appears all over ſpotted

z Id. *Obſ.* 87. a Id. *Obſ.* 71.
b *Chriſt. Lange de Morbillis Diſput. Lipſ.* 1660. *habita* §. 61. —— 67.
c *Jour. des Sçav.* Tom. II. p. 484.
d *De Luc. & umbr.* part. I. c. 12. f. 156.
e *Borel. Obſ. Micr.* 86. f Id. *Obſ.* 4.
g Id. *Obſ.* 15. *Kircher Ars magna* L. X. p. 2. c. 8. §. 2. f. 834.
h *Kircher* l. c. *Borel. Obſ.* 25. i *Borel. Obſ.* 46.
k Id. *ibid.* l Id. *Obſ.* 63. m Id. *Obſ.* 5. n Id. *Obſ.* 63. o Id. *Obſ.* 52.

ſpotted[p]. 17. If the ſeed of a *French* bean or almond be ſteept in hot water and open'd, and its bud be cut away with a fine needle, you will find in it the appearance of the plant, in the ſame manner as in the buds of trees and in the eyes of ſeeds the rudiments of plants are ſeen[q]. 18. In examining the filaments of the leaves of the *orchis*, the flowers appear all over interwoven with very ſmall images of a human form[r]. 19. Vinegar, made from wine, in the microſcope exhibits eels, which wriggle and move pretty faſt therein[s]: And they are ſometimes ſeen, even by a quick eye, when view'd in the ſun without a microſcope; which was obſerv'd in the laſt century by *Andreas Baccius*[t]; or if vinegar be mixt with clear water, ſomewhat long worms are obſerv'd to float in the glaſs, and they are manifeſtly ſeen, according to *Eraſmus Bartholin*[u]. Thus *Franciſcus Pona*[w] ſaw worms of a ſilver colour ſwimming like ſo many ſmall fiſhes in vinegar, which upon withdrawing the vinegar, would ſtick to the ſides of the glaſs. *Joh. Nardius*[x] relates, that in ſome ſorts of vinegar he only obſerv'd worms by the microſcope, namely, in ſuch vinegar as is made from palled and weak wines, but not in that made from generous wines: Yet *Borellus*[y] does not exclude even the ſtrongeſt vinegar; and *Panarollus*[z] affirms, that they are found in all ſorts of vinegars, and that the ſtronger theſe are, the more numerous are the worms; which are of an oblong figure, ſlender, with a ſmall head; and that they are kill'd by adding treacle to the vinegar.

In the animal kingdom, and firſt on inſects.

1. The *acari* or *ſirones*, which are ſmall worms lodging in puſtules on the human ſkin, being taken out, are very ſmall inſects reſembling a white point, but view'd in the microſcope, they appear to be hairy animals, entirely like a bear[a]. *Borellus* makes them reſemble a hedge-hog[b]; and thinks it ſurpriſing, that in ſo ſmall an animal and almoſt no bigger than a point, all the organs, as the feet, nerves, eyes and other parts of an animal, may be ſeen. *Auguſtus Hauptman* in a letter to *Kircher*, inſerted in a treatiſe of his *de thermis Wolckenſteinenſibus*, p. 200, gives them a monſtrous figure, with many oblong tails behind, and repreſents them like the mites of cheeſe. 2. The commiſſures and articulations of the little bones of a bee, its ſmall claws, the variegated colours of its wings, its diſtinct rows of teeth, with which it ſips the flowers, are ſeen in the microſcope[c]. By this inſtrument we obſerve, that the bee carries the wax externally on his thighs, and the honey in his ſtomach, which he afterwards diſcharges, a little alter'd and like a chyle, as young pigeons

[p] Id. *Obſ.* 63. [q] Id. *Obſ.* 17.
[r] *Kircher Mund. ſubter.* L. XII. ſ. 1. c. 9. f. 349.
[s] *Borel. Obſ.* 1. *Joh. de Mey* in cap. 4. *Goedart. de inſect.* p. 52. *Dominic. Panarol. pent.* 4. *Obſ.* 36.
[t] *Natur. Vinor. hiſtor.* l. 1. c. 23. & *Thermæ* l. 4. c. 21.
[u] *Thom. Bartholin.* Cent. IV. *Obſ. Hiſt.* 13. [w] 8 *prol. Saturn.* [x] *Noctes geneal.* noct. 1. p. 75. [y] *Obſ.* 1. [z] l. c.
[a] *Kircher ſcrutin. peſt.* ſ. 1. c. 7. exp. 4. [b] *Obſ.* 21. [c] *Fontan. Obſ.* 10.

pigeons do: For, if a bee be cut into two, you immediately obſerve a veſicle of honey like a grain, which if ſuck'd is found ſweet [d]. *Kircher* alſo obſerves•, that if the excrements of a bee be examin'd with a microſcope, that at firſt they appear like a number of ſmall bags, and immediately upon breaking them, a number of ſmall worms, ſome of which reſemble catterpillars and others, perfect bees with their wings. 3. Silk-worms ſeem to diſcharge the ſilk not from their mouths, but from nipples with which their back is all over cover'd [f]. 4. In catter-pillars the hairs and colours appear finer than in ſables and velvets [g]: And on the back towards the tail they have three red navels; and ſome only two, from which they diſcharge ſome red matter [h]. 5. An ant in a microſcope appears as big as a crab, its mouth is pointed and ſharp, like a pair of pincers, in whoſe internal parts its teeth appear white, and diſpoſed in a long row; from the top of its head are projected two oars, as it were, all over ſhaggy; its eyes are black like ſloes; it has ſix feet, ſupplied with joints; its head conſiſts of various and diſtinct parts; its body reſembles an egg, and roll'd round, as it were, with ſeveral ſwaths [i]: Yet its eyes are with difficulty diſtinguiſh'd on account of their blackneſs; but they are better ſeen in white ants, whoſe eyes are very black [k]. 6. If butterflies be included in a glaſs along with proper plants, by a natural inſtinct they fly to each other, and they together diſcharge an excrement like the eggs of fleas, which if examined by a microſcope, in a little time they are animated into new worms or *erucæ*, and theſe into *aurelia's*, and at length into young butterflies [l]. 7. A gnat, ſays *Hieronymus Sirſalis*, appears like an elephant; its ſharp ſtings like a dart; and its flexible trunk, and its ſmall legs are magnified to a great degree. 8. The hook'd claws of a fly are ſharp, and very like thoſe of a cat; its wings are beautifully colour'd and variegated with ſmall ſpots; the arteries, the articulation of the bones, the veins and the blood moving therein, and the nerves in this very minute animal are clearly ſeen [m]. The eye of a fly conſiſts of 3000 lettices [n]. The ſtructure of its ſting and its foot are excellently well deſcrib'd by Dr. *Hook* [o]. The dead bodies of flies or their excrements, macerated in mead, and warmed a little before a gentle fire upon a plate, appear at firſt by the microſcope to be imperceptible worms; and then getting wings, they become little flies, and at length they ſenſibly grow into perfect ones [p]. 9. A ſpider is armed with briſtles like a boar; its eyes are diſpoſed in an ineffable manner; four on

[d] *Borel. Obſ. medico-phyſic Cent.* I. *Obſ.* 10.
[e] *Mund. ſubter.* L. XII. ſ. 2. c. 2. exp. 1.
[f] *Mey in Goedart de Inſect.* not. in c. 4 p. 54.
[g] *Borel. Obſ. Micr.* 55. [h] Id. *Obſ.* 62. [i] *Fontan. Obſ.* 3. p. 149. *Borel. Obſ. Micr.* 48.
[k] *Borel. Obſ.* 34. [l] *Kircher* L. XII. *Mund. ſubter.* ſ. 2. c. 3. ſ. 360.
[m] *Fontan. Obſ.* 4. —— *Borel. Obſ.* 49. [n] *Borel. Obſ.* 33.
[o] *Journ. des Sçav.* T. II. p. 484. *Ibid.* p. 481.
[p] *Kircher Mund. ſubter.* L. XII. ſ. 2. c. 4. f. 361.

on its forehead, two on the crown of the head; one to the left, the other to the right, and afford light to the whole body; its teeth are very like thick hairs, the little bones of the feet have different articulations: And what is ſurpriſing, it has very black claws, not unlike an eagle's[q]. *Borellus* obſerv'd eight eyes in ſome ſpiders (but not in all of them) diſpos'd on the forehead in form of a half moon; ſix in the firſt row, and two in the ſecond; and theſe eyes are furniſh'd with their cryſtalline humours: Whence, on account of their ſharp-ſightedneſs, it is that they ſo nimbly hunt down flies. All its body is covered over with hair; it ſpins its web out of its mouth; its tail, or the eminencies thereon are moveable. *Borellus* obſerv'd[r] by a ſmall microſcope at a candle, 40 eggs in a ſmall purſe of its web, hanging like ſo many pearls; and in theſe a black point, the beginning of the heart. 10. A flea is a ſurpriſing ſight; its inteſtines are diſtinguiſh'd and arranged in a wonderful manner. *Fontana*[s] has obſerv'd more than once, that upon pricking a flea with a fine needle, eggs would burſt out of the wound, and from theſe eggs were diſcharg'd half-form'd young ones. A flea, ſays *Kircher*[t], is no other than a locuſt without wings; for, in the ſmalleſt animals, nature has exhibited to us lyons, bulls, horſes, dogs, cats, aſſes, eagles and geeſe. *Borellus* is of opinion, that a flea is like a ſhrimp or craw-fiſh[u]; and wounds with its many and uniform ſtrong ſtings; eſpecially thoſe in its thighs and legs, and with its ſcaly tail: As to the legs of a flea, (of which it has ſix) and their ſhape, *vide* Dr. *Hook*'s account in the *Journal des Sçavans*[w]: In fine, from its eggs is obſerv'd to proceed a great number of fleas, which at firſt are white; but afterwards are covered with a black caſe[x]. 11. No one has better deſcrib'd and delineated the louſe, than Dr. *Hook*, who in the *Journal des Sçavans* has given a draught of its eyes, breaſt, ſnout, feet, *&c.*[y]. And *Borellus*[z] has obſerv'd a wonderful tranſparency in it, by means of which the circulation of the blood in its heart, may be ſeen with admiration; and if it be engag'd with a flea, the fight appears like that of two wild beaſts on the amphitheatre: So that the motion and ebullition of the blood, caus'd by their rage, may be plainly ſeen. 12. *Nicolaus Tulpius*[a] caus'd thus delineate, as magnified in the microſcope, a worm diſcharged by urine, that was as big as a barley-corn; in its head and pair of horns it reſembled a beetle, only that its ſnout was ſharp and ſmooth; its belly conſiſted of 10 articulations, as if it was jointed; from each of which on both ſides proceeded a hairy and rough leg, like that of a beetle: Its tail conſiſted of three articulations, of which the laſt but one about its extremity ſends forth from a ſmall hole on each ſide, two hairs; but the laſt articulation ſends out three, from whoſe middle an incurvated tail does project like a beetle's. 13. The ſame Author delineates another worm diſcharged by

[q] *Fontan. obſ.* 6. [r] *Obſ.* 20. [s] *Obſ.* 2. [t] *Ars magn.* f. 156.
[u] *Obſ.* 12. [w] T. II p 487. §. 8. [x] *Kirch. Mund. Subter.* L. XII. f. 2. c. 7. f. 371.
[y] T. II. p. 487 §. 8. T. II. p. 482. *ſeq.* [z] *Obſ.* 11. [a] L. II. *obſ.* 42. p. 171.

by urine, of the thickneſs of an ordinary thread, and in length ſcarce the breadth of the little finger: This inſect, magnified in the microſcope, exactly exhibits a caterpillar, jointed like a coat of mail, with a very ſmall ſharp head; and forwards with only four feet on each ſide.

2. On Fiſhes. The ſcales of fiſhes appear diſtinguiſh'd by ſeveral circular lines; and in that part where they adhere to the ſkin, divided up and down by ſeveral lines and points.

3. On Birds. 1. In the treadle of an egg we obſerve in a few days after incubation an entire chick formed, as alſo the motion of the heart [b]. *Kircher* in his treatiſe *de luce* [c], explains this more at large. Take, *ſays he*, an egg and open it carefully on the third day after incubation; and upon viewing the yolk with a microſcope, the form of the heart will appear manifeſtly in it, alive like a concreted drop of blood, and moving in a ſurpriſing manner, with ramifications full of blood proceeding from it on all ſides, as rays from the ſun, or ſtreams from a fountain: None other of the members appear till after four days more; when the rudiments, as it were, and cloudy ſubſtance of the ſpine, reaching from the brain, appears; and then ſucceſſively the reſt of the members. 2. That force in ducks and hens, whereby digeſtion is performed in them, is ſurpriſing: Upon opening their ſtomachs a few hours after feeding them with ſolid cryſtal-balls, they were ſeen encompaſs'd with a coat, which, view'd by the microſcope, ſhow'd nothing other than a ſmall quantity of a very ſubtile and impalpable duſt of glaſs [d].

4. On terreſtrial animals, and their parts. 1. Snails are not only furniſh'd with very ſharp teeth; but alſo with eyes in their horns, which draw out; we obſerve the black of them aſcend from the lower part of the horns, or from the brain to the upper parts, when they have a mind to move and direct their ſteps, whither their horns are turned; they have only one ear, and in their bodies we find a liver, veins, arteries, *&c.* 2. Fleſh expoſed over night to the rays of the moon, upon applying a microſcope to that part where the lunar rays fall, it is found to ſwarm with maggots of different ſizes [e]. 3. In ſtale hog's lard we find not only hairy maggots with eyes, but numberleſs other *animalcula* of a different figure [f]. 4. Milk, eſpecially if ſour, is full of worms [g]; and this *Kircher* likewiſe teſtifies [h]: And hence he accounts for worms in children; becauſe they feed for the moſt part on milk [i]. 5. The duſt, which grows on cheeſe, exhibits a prodigious animal, whoſe brows are gently drawn, and as it were, with a pencil; the large balls of its eyes are plainly blackiſh, and give a large light; it is armed with nails and claws;

b *Borel. obſ.* 18. c L. 2. p. 1. c. 10. f. 151.
d *Acad. del Cimento Nat. exper.* f. 268.
e *Kirch. de peſte* ſ. 1. c. 7. § 2. exper. 1. p. 70.
f *Borel. obſ.* 14. g Id. *obſ.* 2.
h *Mund. ſubter.* L. XII. ſ. 1. c. 10. f. 352. & ſect. 2. c. 1. f. 357.
i *Id. ibid.* c 7. f. 370.

claws; its body is all over finely colour'd; it creeps, eats and moves, and is as big as a man's nail; its back is entirely rough and ſcaly, variegated with a great many ſtars, and it is armed with thick and ſtrong briſtles[i]; its motion and eating is obſerv'd; nay, even the diſcharge of its excrements; it reſembles a hedge-hog, with little horns, and three remarkable ſtings in its tail[k].

5. On man, and firſt on the parts of his body.

1. In the human *epidermis* appear pieces of net-work[l]. 2. The ſmootheſt ſkin of a woman appears rough and ſcaly, as it were[m]; and almoſt every where in the pores there are hairs ſeen[n]. 3. Human hair, expos'd to the microſcope, exhibits a rounded and channel'd girdle; nay, upon pulling out a hair, we obſerve the pores of the ſkin, thro' which the ſweat and hair come out, and even a thick and earthy humour, and the viſcous root of the hair[o]. The hairs are concave like ſo many tubes; ſo as to reſemble the quills of birds; and in them are ſeen various colours like a rainbow[p]. In the *Journal des Sçavans* Dr. *Hook* affirms[q], that they are round and thicker towards the end, than at the root, and that from the one end to the other, they are hollow like a horn. 4. The nits of the head appear like ſo many round eggs, full of juice and tranſparent[r]. 5. In the pores of the noſe of ſeveral men, by the microſcope we find worms of a black head, like ſo many ſpiders in their holes[s]: Whence we may account for that remarkable itching in the noſes of children, that have the worms. 6. The lines in the fingers, which are almoſt inviſible to the naked eye, are found by the microſcope to be like the furrows of a field full of dirt[t]: And by this inſtrument the latent lines in the palm of the hand are diſcover'd[v]. 7. The nails appear gaping in ſuch manner, as not ill to repreſent the wideſt open mouth of a wild beaſt[w]. 8. In the *parenchyma's*, as the heart, the lungs, the liver and kidneys, is ſeen a *plexus* of little organs and fibres like ſo many ſieves, by which different liquors are ſecreted by nature according to the figure of their pores[x]. 9. In a microſcope the human blood appears verminous, of which more in a particular obſervation. 10. *Bellini*[y] aſſerts, that in the kidneys throughout their whole mammilary ſubſtance the *ſerum* is pour'd from numberleſs ſmall orifices and pores into the *pelvis*; if theſe filaments be compreſs'd from the extremity that regards the *pelvis*, and then view'd, they exhibit a water plentifully ouzing out: This is much more eaſily diſcover'd by the microſcope; for, then compreſſing the *tubuli*, the urine is very plainly ſeen guſhing out, as from ſo many little ſiphons[z]. 11. The mouths of thoſe very minute veſſelswhich pour the blood from the deſcending artery into the emul-

i *Fontan. obſ.* 1. k *Borel. obſ.* 27. l *Borel. obſ.* 88. m *Id. obſ.* 97. n *Id. obſ.* 13. o *Fontan. obſ.* 8. p *Borel. obſ.* 23.——*Panarol. Pentit.* IV. *obſ.* 34.——*Th. Bartholin Anat. reg.* L. IV. c. 1. q T. II. p. 485. r *Borel. obſ.* 10. s *Id. obſ.* 30. t *Id. obſ.* 13. v *Id. obſ.* 94. w *Id. obſ.* 40. x *Id. obſ.* 76. y *De ſtruct. renum*, p. 68. z *Ibid.* p. 70.

emulgent and convey it to the ſurface of the kidneys, are not perceptible to the naked eye; yet both reaſon perſuades us, and the microſcope confirms that there are ſuch[a]. 12. On the eminencies of the tongue, whoſe roots are furniſh'd with nerves, *Bellini* in his treatiſe *de guſtus organo* diſcover'd by the microſcope a number of flat holes[b]. 13. Dr. *Willis*[c] diſcover'd by the microſcope, that the nerves are compact and firm bodies; his words are to the following purpoſe; "the nerves are not perforated "like the arteries and veins: For, their ſubſtance is not only impervious "to any probe, but by the microſcope we diſcover no cavity in them". And tho' in the ſame place, and afterwards in *Page* 206 he reckons both the olfactory and optic nerves to be *tubuli*; yet he aſſerts that theſe cavities do not properly belong to them as they are nerves, but on another account, to wit, for the influx of the animal ſpirits.

2. On the diſeaſes of men.

1. *Borellus*[d] ſhows from *Alſtedius*, that in time of a peſtilence the air is full of little worms, which are ſwallowed down in reſpiration, and which are produced from the corruption of the air. In the ſame manner *Kircher*[e] holds, that worms propagate a peſtilence, tho' they are ſo very ſmall that they cannot be ſeen but by the moſt exquiſite microſcope, and are rather to be call'd atoms; and when expell'd out of the body by ſudorifics they fly away by the leaſt breath of air; whatever body they meet with, hey firmly adhere to it and inſinuate into its inmoſt pores. M. *De Monconnys*[f] aſſerts, that in peſtilential puſtules there was found a great number of little inſects, which after they had got wings flew away and ſpread every where that contagious diſeaſe. 2. In ſpotted fevers little worms are obſerved to eat through the capillary veſſels and thus together with the extravaſation of the blood they cauſe ſpots and *petechiæ*[g]. 3. Dr. *Chriſtian Lange*[h] aſſerts, that the puſtules in the ſmall pox are nothing other than the receptacles and lodgements of verminous *effluvia*; and theſe worms have a common figure with the acari[i]; they are many-footed and have ſharp ſnouts, with which they bite through the ſkin, and by the painful itching, cauſe an afflux of humours[k]. *Borellus* likewiſe holds, that there are worms in the ſmall pox[l]. 4. In the itch likewiſe worms are ſeen[m]. 5. In veneral blotches *Kircher* has ſeen worms like ſnails; and ſo broody, that in half an hour they brought forth 50 at a birth[n]. 6. In thoſe troubled with the gravel, the little white ſands appear opaque in the microſcope, and not tranſparent; very rough and pricking, ſeeing their extremities are pointed; but the red or the yellow repreſent precious ſtones like the *ſardonyx*; and ſmooth, either of an oval or round figure, and friable[o]. 7. In the glans of a venereal patient, *Borellus* found a little inſect like a ſnail[p].

The

[a] *Ibid.* p. 74, 75. [b] *Journ. des Sçav.* Tom. II. p. 460. [c] *Deſcript. nervor.* c. 19. p. 179. edit. Amſtel. [d] *Obſ.* 79. [e] *De peſte* ſ. 2. c. 4. p. 293. [f] *In voyag.* Tom. II. p. 178. [g] *Hauptman epiſt. ad Kircher. de vivâ mort. imag.* p. 200. [h] *Diſp. de morbil.* § 59. [i] *Id. ibid.* § 68. [k] *Id. ibid* § 69. [l] *Obſ.* 31. [m] *Id. Obſ.* 32. [n] *Mund. ſubter.* L. XII. ſ. 1. c. 16. f. 352. [o] *Panarol.* Pent. IV. Obſ. 35. [p] *Obſ.* 53.

Fig. 2.

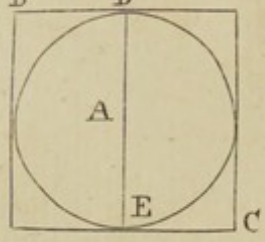
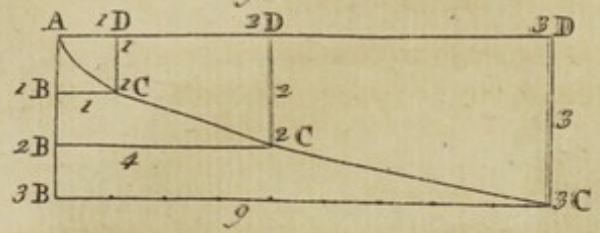


Fig. 1.



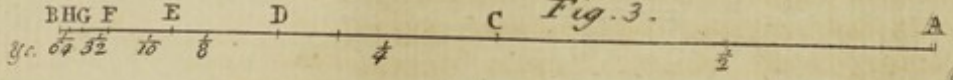
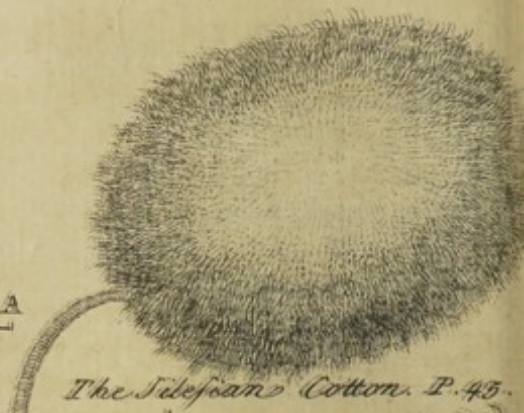


Fig. 3.



The Sileſian Cotton. P. 45.

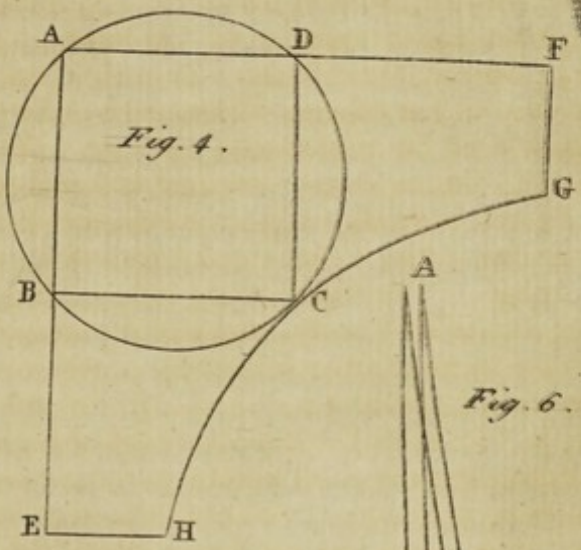


Fig. 4.

Fig. 6.

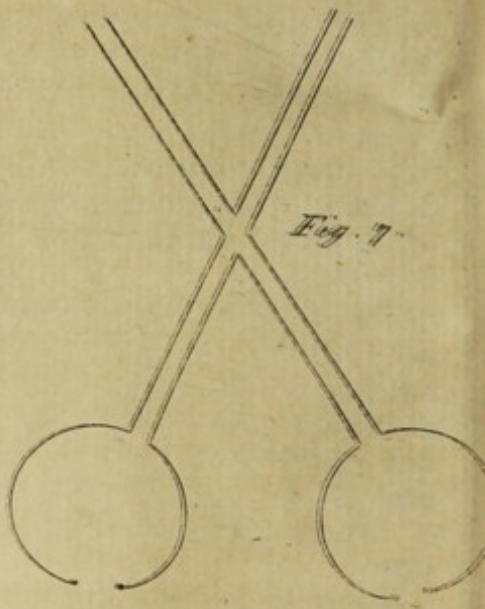


Fig. 7.

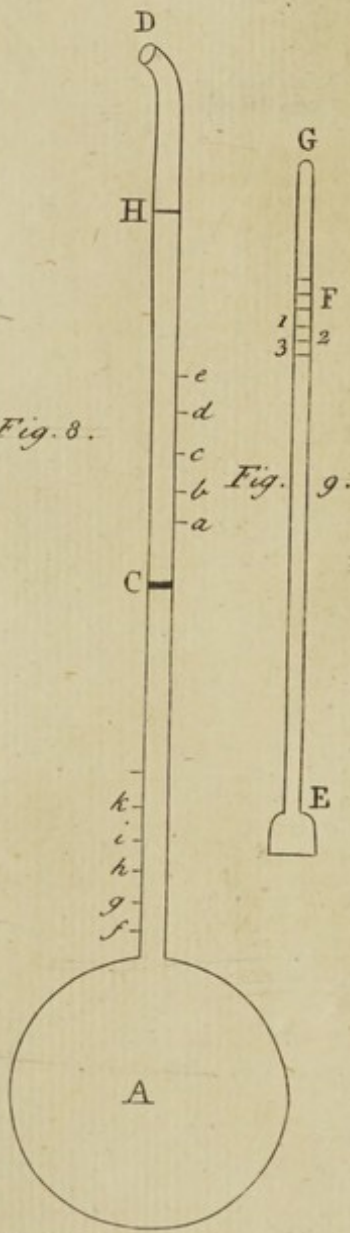


Fig. 8.

Fig. 9.

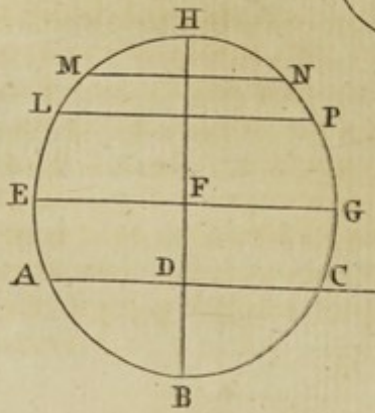


Fig. 5.

G. Smith del.

Rudett

The true proportion of the circle to the circumſcrib'd ſquare, in rational numbers. By G. G. Leibnitz. *From the* Acta Eruditorum, An. 1682. p. 41.

Tranſlated from the LATIN.

GEometricians have at all times attempted to inveſtigate the proportions of curves to right lines; and yet this is ſtill far from being in our power, even by algebra, according to the methods hitherto known; nor can theſe problems be reduced to algebraical equations; and yet they are excellently uſeful, eſpecially in reducing mechanics to pure geometry, as is well known to thoſe few Mathematicians, who have enter'd deeper into theſe matters. *Archimedes* was the firſt, as far as we know, who found out the ratio between a cone, a ſphere, and a cylinder of the ſame baſe and height, to wit, that of 1, 2, 3: So that the cylinder is in a triple ratio of the cone, and in a ſeſquialteral ratio of the ſphere: Whence he order'd the ſphere and cylinder to be engrav'd on his monument: He alſo diſcover'd the quadrature of the parabola. In our days a method is found of meaſuring numberleſs curvilinear figures, eſpecially when the ordinates BC are in any multiplicate or ſubmultiplicate ratio, either direct or inverſe, of the abſciſſa's AB or CD: For the figure ABCA will be to the circumſcrib'd rectangle ABCD, as 1 to a number increas'd by unity, and which expreſſes the multiplication of the ratio; as for inſtance, becauſe in the parabola, the abſciſſa's AB or DC being as the natural numbers 1, 2, 3, *&c.* the ordinates BC are as their ſquares 1, 4, 9, *&c.* or in the duplicate ratio of theſe numbers; and then the number expreſſing the multiplication of the ratio will be 2: The figure ABCA will, therefore, be to the circumſcrib'd rectangle ABCD, as 1 to 2 + 1, or as 1 to 3; or the figure will be $\frac{1}{3}$ of the rectangle. If AB or CD remain natural numbers, and BC be cubes, 1, 8, 27, *&c.* (as in the cubical paraboloid) the ratio of the ordinates would be triplicate of the ratio of the abſciſſa's; the figure, therefore will be to the rectangle as 1 to 3 + 1, or 4, or $\frac{1}{4}$. But if DC are ſquares, BC cubes, or the ratio of BC be triplicate-ſubduplicate of the ratio of DC, the figure ABCA (the cubico-ſubquadratic paraboloid) will be to the rectangle ABCD, as 1 to $\frac{3}{2}$ + 1, or make $\frac{2}{5}$ of the rectangle. In the reciprocal, the ſign — is prefixt to the number expreſſing the multiplication of the ratio.

The ratio of curves to right lines not diſcoverable by common algebra.

A method of meaſuring numberleſs curves. Plate II. Fig. 1.

But the circle could not hitherto be reduced to theſe laws, tho' attempted by geometricians of all ages; for, hitherto a number could not be found, that would expreſs the ratio of the circle A to the circumſcrib'd ſquare BC, which is the ſquare of the diameter DE; nor could the ratio of the circumference to the diameter be found, which is quadruple of the ratio of the circle to the ſquare. *Archimedes*, indeed, ſhows a method by inſcribing and circumſcribing polygons about a circle (becauſe it is greater than the inſcrib'd and leſs than the circumſcrib'd) of exhibiting the limits,

The ratio of the circumference of a circle to its diameter by approximation. Fig. 2.

between which the circle falls, or of giving approximations; to wit, that the ratio of the circumference to the diameter is greater than 3 to 1, or than 21 to 7, and less than 22 to 7. Others, as *Ptolemy*, *Vieta* and *Metius* have prosecuted this method; but above all *Ludolphus Van Ceulen*, who has shewn that the circumference is to the diameter as 3.14 159 265 358 979 323 846, *&c.* to 1.00000000000000000000.

Approximations not entirely satisfactory.

But such approximations, tho' of use in practical geometry, afford nothing that can satisfy a mind eager on truth; unless the progression of such numbers to be continu'd *in infinitum* can be discover'd. Many, it is true, have pretended to a perfect quadrature of the circle, as Cardinal *Cusan*, *Orontius Finæus*, *Joseph Scaliger*, *Thomas Gephyrander*, and *Thomas Hobbes*; but all of them falsely.

The quadrature of the circle discoverable in a four fold manner.

But because I find, that many are not sufficiently aware of what is requir'd to be done; we are to observe, that the quadrature, or the conversion of a circle into an equal square, or any other rectilinear figure (which depends on the ratio of the circle to the square of the diameter, or of the circumference to the diameter) may be understood to be fourfold; to wit, either by calculation, or by linear construction, and both, either accurate or nearly so: The quadrature, by accurate calculation, I call the analytical; but that by accurate construction, the geometrical; by calculation nearly true, we have the approximation; by construction nearly true, the mechanism. *Van Ceulen* has fartheſt of all carried the approximation. *Vieta*, *Huygens*, and others, have given us excellent mechanisms.

The quadrature of the circle in rational numbers.

The accurate geometrical construction may be had, by which not only the entire circle may be measur'd, but any sector or arch thereof by an exact and ordinate motion, but such as may agree to transcendental curves, which are otherwise erroneously call'd mechanical; since they are equally geometrical as those commonly so esteem'd, tho' they are not algebraical, nor reducible to equations algebraical, or of a determinate degree: For, they have their peculiar degrees, tho' not algebraical, yet analytical. The analytical quadrature, or that by accurate calculation, may again be divided into three kinds; to wit, the analytical transcendent, the algebraical and the arithmetical. The analytical transcendent is obtain'd among others by equations of an indefinite degree, hitherto consider'd by no one; as if $X^x + X$ be $= 30$, and X be sought, it will be found to be 3; because $3^3 + 3$ is $27 + 3$, or 30. The algebraical expression is by vulgar tho' irrational numbers, or by the roots of common equations, which is indeed impossible for the general quadrature of the circle and its sector. There now remains the arithmetical quadrature, which is perform'd by series's exhibiting the exact value of the circle in a progression of terms, first rational, such as I shall here propose: I, therefore, found (supposing the square of the diameter to be 1,) that the area of the circle would be $\frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \frac{1}{11} + \frac{1}{13} - \frac{1}{15} + \frac{1}{17} - \frac{1}{19}$, *&c.* to wit, the entire square of

of the diameter diminiſh'd (leſt the value ſhould be too much) by $\frac{1}{3}$; and again encreaſed (becauſe too much was taken away) by $\frac{1}{5}$; and again leſſen'd (becauſe we added too much) by $\frac{1}{7}$, *&c.* The firſt quantity will, therefore, be too great, yet the error leſs than $\frac{1}{3}$; the ſecond, $\frac{1}{1} - \frac{1}{3}$, too little, but the error leſs than $\frac{1}{5}$; the third, $\frac{1}{1} - \frac{1}{3} + \frac{1}{5}$, too much, but the error leſs than $\frac{1}{7}$; the fourth, $\frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7}$ too little, but the error leſs than $\frac{1}{9}$, *&c.* The whole ſeries, therefore, contains all the approximations together, or the values both greater or leſs than the truth: And continuing the ſeries, the error will be leſs than a given fraction, and conſequently leſs than any aſſignable quantity; wherefore the entire ſeries expreſſes the exact value: And tho' the ſum of the ſeries cannot be expreſs'd by one number, and the ſeries be continu'd *in infinitum*; yet as it conſiſts of one law of progreſſion, the whole is ſufficiently perceiv'd by the mind; for, ſeeing a circle is not commenſurable to a ſquare, it cannot be expreſs'd by one number, but in rationals it ought neceſſarily to be exhibited by a ſeries: And indeed, if *Van Ceulen* could have given us a rule whereby the numbers 314 159, *&c.* could have been continu'd *in infinitum*, he would have given us in integers the exact arithmetical quadrature, which I here give in fractions.

The ſum of an infinite ſeries finite.

But leſt any one but little converſant in theſe matters ſhould think that a ſeries, conſiſting of an infinite number of terms, cannot be equal to a circle, which is itſelf a finite quantity; we are to obſerve, that many ſeries's, which are infinite in the number of the terms are in their ſum finite quantities: As an eaſy example, take a ſeries decreaſing from unity in this duple geometrical progreſſion $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \frac{1}{32} + \frac{1}{64}$, *&c. in infinitum*, and the whole makes no more than 1: For, in the right line AB, which ſuppoſe to be 1, AC will be $\frac{1}{2}$, and biſſecting the remainder CB in D, you will have CD, $\frac{1}{4}$; and biſſecting the remainder DB in E, you will have DE, $\frac{1}{8}$; and biſſecting the remainder EB in F, you will have EF, $\frac{1}{16}$; and thus you may proceed *in infinitum*. Plate II. Fig. 3.

The terms of M. *Leibnitz*'s ſeries in harmonical progreſſion.

Many remarks might be made on this quadrature, but I muſt not omit one, *viz.* that the terms of my ſeries $\frac{1}{1}\ \frac{1}{3}\ \frac{1}{5}\ \frac{1}{7}\ \frac{1}{9}$, *&c.* are thoſe of an harmonical progreſſion, or in a continu'd harmonical proportion, as will appear upon trial. And even a ſeries made by ſkipping, as $\frac{1}{1}\ \frac{1}{5}\ \frac{1}{9}\ \frac{1}{13}\ \frac{1}{17}$, *&c.* is likewiſe in harmonical progreſſion; and $\frac{1}{3}\ \frac{1}{7}\ \frac{1}{11}\ \frac{1}{15}\ \frac{1}{19}$, *&c.* is likewiſe a ſeries of harmonical proportionals. Since, therefore, the circle is $\frac{1}{1} + \frac{1}{5} + \frac{1}{9} + \frac{1}{13} + \frac{1}{17}$, *&c.* $- \frac{1}{3} - \frac{1}{7} - \frac{1}{11} - \frac{1}{15} - \frac{1}{19}$, *&c.* by ſubſtracting the latter partial ſeries from the former, the circle will be the difference of two ſeries's in harmonical progreſſion: And becauſe the ſum of any number of terms in harmonical progreſſion, how many ſoever, may by ſome compendium be obtain'd, you may hence deduce (if after *Van Ceulen*'s there were occaſion for any) compendious approximations.

If

A new ſeries for the circle.

If any one would take out the terms affected with the ſign — in my ſeries, by adding together the two next terms, as $+\frac{1}{1}-\frac{1}{3}$, alſo $+\frac{1}{5}-\frac{1}{7}$, and likewiſe $+\frac{1}{9}-\frac{1}{11}$ and $+\frac{1}{13}-\frac{1}{15}$ and $+\frac{1}{17}-\frac{1}{19}$, *&c.* he will have a new ſeries for the magnitude of the circle; to wit, $\frac{2}{3}$ (*i. e.* $\frac{1}{1}-\frac{1}{3}$) $+\frac{2}{35}$ (*i. e.* $\frac{1}{5}-\frac{1}{7}$) $+\frac{2}{99}$ (*i. e.* $\frac{1}{9}-\frac{1}{11}$): The inſcrib'd ſquare, therefore, being $\frac{1}{4}$, the area of the circle will be $\frac{1}{3}+\frac{1}{35}+\frac{1}{99}+\frac{1}{195}+\frac{1}{323}$, *&c.* but the numbers 3, 35, 99, 195, 323, *&c.* by ſkipping are taken out of the ſeries of ſquare numbers 4, 9, 16, 25, *&c.* leſs by unity: Whence the ſeries becomes 3, 8, 15, 24, 35, 48, 63, 80, 99, 120, 143, 168, 195, 224, 255, 288, 323, 360, 399, *&c.* out of the members of which ſeries every fourth after the firſt is a number of my ſeries: But I have found (which is remarkable) the ſum of this infinite ſeries $\frac{1}{3}+\frac{1}{8}+\frac{1}{15}+\frac{1}{24}+\frac{1}{35}+\frac{1}{48}+\frac{1}{63}+\frac{1}{80}+\frac{1}{99}$ to be $\frac{3}{4}$; nay, and by taking them by ſingle ſkipping, to wit, $\frac{1}{3}+\frac{1}{15}+\frac{1}{35}+\frac{1}{63}+\frac{1}{99}$, *&c.* the ſum of that ſeries makes $\frac{2}{4}$ or $\frac{1}{2}$: But if again from this we take out the terms by ſingle ſkipping, to wit, $\frac{1}{3}+\frac{1}{35}+\frac{1}{99}$, *&c.* the ſum of that ſeries will be the ſemicircle, ſuppoſing the ſquare of the diameter to be 1. But becauſe by the ſame means the arithmetical quadrature of the hyperbola is obtain'd, I ſhall here give the reader the whole harmony.

The quadrature of the hyperbola and circle in one view.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
1	4	9	16	25	36	49	64	81	100	121	144	169	196	225	256	289	324	361	400	
0	3	8	15	24	35	48	63	80	99	120	143	168	195	224	255	288	323	360	399	*&c.*
$\frac{1}{3}$	$\frac{1}{8}$	$\frac{1}{15}$	$\frac{1}{24}$	$\frac{1}{35}$	$\frac{1}{48}$	$\frac{1}{63}$	$\frac{1}{80}$	$\frac{1}{99}$	$\frac{1}{120}$	$\frac{1}{143}$	$\frac{1}{168}$	$\frac{1}{195}$	$\frac{1}{224}$	$\frac{1}{255}$	$\frac{1}{288}$	$\frac{1}{323}$	$\frac{1}{360}$	$\frac{1}{399}$,	*&c.* = $\frac{3}{4}$.	
$\frac{1}{3}$	.	$\frac{1}{15}$	.	$\frac{1}{35}$	.	$\frac{1}{63}$	.	$\frac{1}{99}$	.	$\frac{1}{143}$	.	$\frac{1}{195}$	.	$\frac{1}{255}$	.	$\frac{1}{323}$	.	$\frac{1}{399}$,	*&c.* = $\frac{2}{4}$.	
.	$\frac{1}{8}$	.	$\frac{1}{24}$	.	$\frac{1}{48}$	.	$\frac{1}{80}$	.	$\frac{1}{120}$	.	$\frac{1}{168}$	.	$\frac{1}{224}$	.	$\frac{1}{288}$	.	$\frac{1}{360}$	.	*&c.* = $\frac{1}{4}$:	
$\frac{1}{3}$	.	.	.	$\frac{1}{35}$	.	.	.	$\frac{1}{99}$	.	.	.	$\frac{1}{195}$	.	.	.	$\frac{1}{323}$	.	.	*&c.* = to	
	$\frac{1}{8}$	.	.	.	$\frac{1}{48}$	.	.	.	$\frac{1}{120}$	.	.	.	$\frac{1}{224}$	.	.	.	$\frac{1}{360}$	.	*&c.* = to	

the circle ABCD
whoſe inſcrib'd ſquare
the hyperbola CBEHC
whoſe power ABCD
} is $\frac{1}{4}$.

Plate II. Fig. 4.

To the aſymptotes AF and AE at right angles to each other, deſcribe the hyperbola GCH, whoſe vertex is C, but ABCD its inſcrib'd power or ſquare, which is always equal to the rectangle made of any ordinate EH and its abſciſſa AE; about this ſquare deſcribe a circle, and ſuppoſe the hyperbola be continued in ſuch manner from C to H, that AE be double of AB; then ſuppoſing AE to be 1, AB will be $\frac{1}{2}$, and its ſquare ABCD $\frac{1}{4}$; and the circle, whoſe inſcrib'd power is ABCD, will be $\frac{1}{3}+\frac{1}{35}+\frac{1}{99}$, *&c.* But the portion of the hyperbola (whoſe inſcrib'd power is the ſame ſquare $\frac{1}{4}$) CBEHC, which repreſents the logarithm of the ratio of AE to AB, (or of 2 to 1) will be $\frac{1}{4}+\frac{1}{48}+\frac{1}{120}$, *&c.*

An

An Experiment concerning the Optic Nerve, by Dr. Dan. Bernouilli. *From the* Comm. Acad. Imp. Petrop. Tom. I. p. 314.

Tranſlated from the LATIN.

M. *Mariotte* on occaſion of a controverſy between him and M. *Pecquet*, about the immediate organ of viſion, contriv'd an experiment to prove that a certain ſpace in the middle of the *choroïdes* or the *retina*, as ſome would have it, is quite unfit to receive the image of objects. Upon which another diſpute enſued: Whether this inſenſibility was owing to the perforation of the *choroïdes* by the optic nerve, or to a diſtinguiſhable *plexus* of blood-veſſels in the *retina*. It was my opinion, that the beſt way of making a judgment hereon, wou'd be from the form, poſition and ſize of the ſpace thus unaffected by the action of the rays of light; all which may be accurately determin'd thus.

To what the inſenſibility of a part of the *retina* is owing.

On an even floor, cover'd, for diſtinction ſake, with black cloth, lay a piece of ſilver coin, as at O, and draw a ſtrait line, as OA; then take a plumb-line, and holding one end thereof cloſe to the right eye, let the other end down as near as may be to the floor, without touching it. Laſtly, ſhutting the left eye, look ſteadfaſtly with the right, at the bottom of the plumb-line, and whilſt you do thus, gradually advance your whole body to the left hand, in ſuch ſort, that the bottom of the plumb-line may be kept continually over the line OA: Thus proceeding, note accurately the place where you begin to loſe ſight of the object, ſuppoſe at C; then moving on again; note likewiſe carefully the point A, where you perceive the object again. Biſſect the line AC in D, and having drawn the perpendicular BH, go over BH, as you did over OA, that is, obſerve diligently the points B and H, the limits, between which the plumb-line hanging, the object O diſappears. Again, let BH be biſſected in F by the perpendicular line GE, and in this alſo after the like manner find the points E and G; do the like in other lines LP, MN, *&c.* and thro' all theſe points draw the curve line HEBGH, which will be of ſuch a nature, that as long as the eye looks at any point within the curve, the object at O will be quite inviſible, but if the axis of viſion be directed any where without the curve, it will that inſtant be ſeen. I made ſuch an experiment myſelf, and having reduced my ſeveral quantities obſerved, to the length of my plumb-line, which I chooſe to call 100, I found OC = 23, AC = 10, BD = 3, DH = 13, and EG = 14: From whence it appears that the curve is nearly an ellipſe, whoſe centre is in F, and the greater to the leſſer axis, as 8 to 7.

An expetiment to determine it. Plate II. Fig. 5.

I am now to ſhew how, from theſe obſervations, the poſition, form, and ſize of this inſenſible ſpace may be determined, and this may eaſily be done; for ſince the lines AC, EG, LP, MN, HB, *&c.* are known, the

The poſition and ſize of that inſenſible ſpace how determined.

the lines analogous to them in the eye are determined. And though BH be greater than EG, yet will the lines analogous to them in the eye be equal; ſo that the elliptic figure will degenerate into a circular one; and the diameter of ſuch little circles will be equal to a ſeventh part of the diameter of the whole bulb. Its centre will be diſtant ſeven twenty fifth parts of the bulb, from the point oppoſite to the pupil, and it will be alſo elevated a ſmall matter above the middle of the eye; all which particulars anſwer ſo accurately to the optic nerve in the human eye; that M. *Mariotte*'s opinion as to this point is confirmed beyond all doubt.

The inſertion of the optic nerve lateral.

Now if the inſertion of the optic nerve be the cauſe of M. *Mariotte*'s phænomenon, 'tis evident why it was not inſerted into the bulb directly againſt the pupil: For, then all objects would appear perforated in the middle, and ſo we ſhould not ſee, what, in the preſent conformation of the eye, we look directly at* : But as this nerve is inſerted laterally into the bulb, it thence follows, that we looſe only ſuch objects, as are placed ſideways under a certain angle: Nor can one and the ſame object be ever inviſible to both eyes at the ſame time, when the optic nerves are laterally implanted, which would always be the caſe if they were ſet in oppoſite to the pupil.

And perpendicular.

Another corollary, which I deduce from the ſame experiment, is this, that the optic nerve could not be otherwiſe inſerted into the eye, than perpendicularly: For, the place of its inſertion being of no uſe in viſion, nature muſt have ſo provided that it ſhould be the ſmalleſt poſſible; and it can be ſo no otherwiſe but by the nerves entering the bulb in a perpendicular direction.

If the nerves had been directed to the eyes in a right line from their origins; that is, from the branches of the *medulla oblongata*, this muſt neceſſarily have interfered with one or other of the foregoing *lemmata*: For, the origin of the optic nerve being in a manner oppoſite againſt the eye, as at A. 'Tis plain that the nerve itſelf (which I ſuppoſe perpendicular to the bulb or ſphere of the eye) muſt be oppoſite to the pupil; but if the nerve had been inſerted into the eye laterally at C, it had for that reaſon been oblique.

* Plate II. Fig. 6.

The nerves, as they are not directed to the eye in a right line, but are firſt united, do thereby conform to both the *poſtulata*, as will appear upon a bare inſpection of fig. 7.

Fig. 7.

If any one is for aſſigning this for the reaſon of the union of the optic nerves, I ſhall not ſcruple to be of his opinion.

A new

* This remark was made long ſince by Dr. *James Keill*, in his anatomy.

A new method of making Sea-water freſh. From the Breſlaw Collection, July, An. 1717. Claſs V. Art. 2. p. 94.

Tranſlated from the HIGH-DUTCH.

IT is, in general certain, that this proceſs is not ſo much to be attempted by the way of correction, as was done in the year 1713, by the brackiſh water at *Tonningen*, by the admixture of cinnamon, ſugar, *&c.* as principally, by the way of ſeparation. In what manner the making ſea-water ſweet has been attempted at different times and lately in *England* by *Hauton*, and Dr. *Liſter*, may be ſeen in the *Philoſophical Tranſactions*[a] and the *Acta Eruditorum*[b]; which was partly by diſtillation and partly by filtration, yet always without the deſired ſucceſs; in regard theſe methods are together either too expenſive, or at moſt too tedious; on which head Mr. *Boyle* is very full in his letter on the manner of making ſea-water freſh. The different methods of making ſea-water freſh.

We may juſtly reckon among the new methods, that which M. *Reyher*, profeſſor of law at *Kiel* attempted to render practicable by the way of congelation: On *February* 6, 1697, he cauſed make a hole in the ice that was a foot thick in the harbour of *Kiel*; and he found the ice there entirely freſh, and the water next below the ice without any brackiſh taſte; but that water which he cauſed draw by means of a pipe, at a foot and a half beneath the ice, was a little brackiſh, and that taken up at the depth of five foot below the ice held ſo much ſalt, that four pounds apothecary weight yielded after boiling, an ounce and 3 ½ ſcruples of a ſharp ſalt. M. *Reyher's* method.

Tho' this method, ſays M. *Reyher*, can be of no ſervice in warmer climates, yet a method may be hit on of producing an artificial cold, by means of which ſea-water may be render'd fit to drink[c]: And in the *Philoſophical Tranſactions*[d] we have the manner of making this artificial ice. That method, probably, if it could be aſcertained, is the eaſieſt and moſt ſpeedy, which *Walckort* has attempted by means of a certain pump; by which, when put into ſea-water and pumped, ſweet water may be immediately drawn out of it: And probably this contrivance is founded on the experiment alledged by Mr. *Oldenburgh* in the *Philoſophical Tranſactions*, where a hollow and very cloſe veſſel of wax is let down into the ſea, and into its cavity pure freſh water, ſeparated from its ſalt, is made to ſoak: What an anonymous author mentions about the way of precipitation is curious; by it the ſalt, in form of a ſlimy ſubſtance, ſettles to the bottom, and the freſh water ſtands a-top; but he adds that this method is too expenſive. M. *Walckort's* method.

[a] N° 67. p. 2048, 2050 and N° 156. p. 493. [b] Supplem. T. IV. Sect. 8. p. 364.
[c] Vid. The Hamburg Remarks, Jan. An. 1699.——Paſchii Invent. nov-antiq. c. 2. p. 661, 662. [d] N° 15. p. 255——Act. Erud. Suppl. T. IV. §. 8. p. 363.

Some Indications of the Deluge in Sweden. *By M.* Emanuel Suedenborg. *From the* Acta Literaria Sueciæ, Trimeſtre tertium, An. 1721, p. 192.

Tranſlated from the LATIN.

Indications of a deluge from figur'd ſtones, &c.

THAT the earth we now inhabit was formerly cover'd by the ſea, appears very clearly both from figur'd ſtones and various petrified bodies, as alſo from other indications.

Not far from the town of *Uddevalla*, on a high mountain, is to be ſeen an entire tract, conſiſting of ſhells of different kinds: The ſame is alſo to be ſeen near *Stromſtad* on a ſtill higher mountain, and which is elevated 70 yards above the ſurface of the ſea; as alſo in the iſlands *Cornia* and *Crouſthia*, from which the inhabitants burn an excellent kind of lime, with which they ſupply the whole country.

From different *ſtrata* in *Sweden*.

In *Sweden* likewiſe are obſervable *ſtrata* of very different kinds, as up and down in mines, and in one of *Scania*, not far from *Landſcron*; and every where in the ruins of certain mountains, and alſo in the ſloping ſides of very high hills, as *Kinnekuelle*, *Billingen*, &c.

From the face of the northern parts.

That the ocean ſtood high above our earth ſeems to be more evidently concluded from the face of the northern parts, than from that of countries more ſoutherly. Here we find entire tracts, fill'd, and as it were, pav'd with ſtones of a huge bulk and weight: And the higher the country lies from the ſea, theſe ſtones are larger and more numerous. That ſtones of a great weight may be rolled and carried to a great diſtance, appears from the following hydroſtatical conſiderations. 1. The weight of ſtone to water, bulk for bulk, is no more than 2 and ½ to 1, and to ſalt-water ſtill leſs. 2. Beſides, it almoſt loſes half its weight in water; and there remains but 1 and ½. 3. Whence the weight of ſtone is not ſo ſenſible in the ſea as in the air, ſeeing water is ſo heavy as almoſt to equal part of the remaining weight, that is, ſince the weight of ſtone in water is to water as 1 and ½ to 1, in air it will be as 2000 to 1, if not more. 4. If, therefore, the waves agitate the ſea at its bottom, as tempeſts do the atmoſphere in its lower parts where we live; and if a column of ſea-water be ſome hundred yards high, the motion and force of the fluctuating water at the bottom will be increas'd in the ratio of the height and of the baſes: So that a wave of the ſea, continu'd towards the bottom, has a greater force from its height than the ſame wave on the ſurface. 5. And conſequently, the primæval ſea could have carried along with it ſtones of a huge bulk, looſen'd ſpontaneouſly from mountains, and ſtrew the earth up and down with them, and even move its whole bottom. 6. In the ſame manner as the atmoſphere at its bottom uſually drives along, barks, leaves, feathers, &c. which are a thouſand times lighter, provided the air be

How large ſtones may be roll'd a great way, accounted for hydroſtatically.

agi-

agitated by a tempeſt; and theſe are carried away and rais'd aloft, as they are lighter: And this force is partly owing to the height of the atmoſphere, which being agitated imparts by the weight of its column the ſame force to a tempeſt, which another force would to a greater body in motion. 7. We may have many inſtances of this from thoſe bulwarks or dykes, which are built of a double frame of boards and heaps of ſtones: ſo often as the water riſes to 3 or 4 yards, which is uſual in winter, we ſee the water have ſo much force, as often to overturn theſe dykes, and carry the ſtones along with it, and convey them ſometimes to the diſtance of 100 yards, which is alſo owing to the height of the water. 8. Hence in thoſe parts of *Sweden* that are higheſt, from the ſea, as in *Orebro*, which lies between two ſeas, larger and more numerous broken fragments are obſerv'd than any where elſe; becauſe ſo far the waves could drive and follow, not higher, becauſe nearer to the ſurface.

To what the preſent face of the earth owes its inequality.

From theſe things we may deduce, that the face of the preſent earth owes its inequality to the ocean; and all thoſe parts which conſiſt of ſlime, ſhells, ſand and ſtones, and which are unequal, to the fluctuation of the ſea at the bottom: Whence ariſe 1. So many kinds and figures of hills; 2. So many *Strata* in theſe; 3. So many ridges of mountains, conſiſting partly of ſands, partly of ſmaller and partly of larger ſtones, and extending for 8 or 10 miles; 4. The roundneſs of thoſe ſmall ſtones, of which large ridges of mountains conſiſt: For, they ſeem as if they were turn'd in a lathe, which is an indication of their agitation and mutual attrition by their continual rolling motion at the bottom. 5. And what very much confirms this opinion is, that the above ridges in *Sweden* do for the moſt part run north and ſouth; which ſeems to have ariſen from the continual eaſterly and weſterly winds, ſuch as are at this day in the great ocean: For, ſuch muſt neceſſarily have been in the diluvian and northern ocean, when it wanted a ſhore *&c.*

All theſe things might have happen'd in a deluge; but whether all of them in that of *Noah*, may poſſibly be queſtion'd; the reaſon is becauſe in very many places the ribs and other different parts of ſhips are ſtill found and theſe rais'd above the ſurface of the ſea at this day to 40 and 50 yards nearly; and even in mountains themſelves we find anchors and cables and many other things which indicate, that the ancient inhabitants had a harbour there: And it is certain that the ſurface of the *Baltic* does ſtill gradually ſubſide towards the north; and in 70 years we find to 4 and 5 yards perpendicular height: Whence in many places they now plow and ſow, where 100 years ago they ſail'd and catch'd fiſh. In *Weſtro-Bothnia*, within the ſpace of one century, ſome towns are removed, as it were, ſpontaneouſly from the ſhore and are become diſtant ſome hundred miles from the ancient harbour: And we are likewiſe told the ſame of *Upſal* and other places; which may be indications that all theſe changes did not happen in the

univerſal deluge; but that the northern countries eſpecially, lay long under water after the deluge and gradually appear'd or became habitable, as the ſea ſubſided towards the north. Which if it can be further confirm'd by experiments about *Lubeck*, it will ſupply a handle of ſurmiſing 1. That the horizontal preſſure of our part of the earth is ſubject to change; which follows, if the ſeas towards the poles be depreſs'd and elevated, as is affirm'd towards the equator. 2. And conſequently, that the diſtances in latitude vary. 3. That ſome continents might formerly have been iſlands, and in tract of time be joined upon the ſubſiding of the ſea.

A new method of improving barren, ſtony and ſandy Lands. *From the* Breſlaw Collection, July, An. 1717. Claſs V. Art. 7 p. 106.

Tranſlated from the HIGH-DUTCH.

The improvement of barren lands by ſowing ſainfoin.

FIELDS, entirely barren, moſſy, ſandy and ſtony, and that bear neither graſs nor any other thing for the uſe of man or beaſt, are improv'd by ſowing ſainfoin in them; and they not only yield a fine, rich and wholeſome food for cattle, but alſo the ground is improv'd in ſuch manner as to be fit for corn. This method has ever ſince the year 1676 and 1677 been known eſpecially in *Neufchattel*; after that a certain nobleman had ſown no more than two pounds of ſainfoin in a ſmall farm, with which at firſt, indeed, he could maintain no more than one ſingle head of cattle; but afterwards by farther culture above twenty, and alſo make conſiderable profit of it. From that time this method of improving land was more and more known in the canton of *Switz*; and us'd with good ſucceſs and no ſmall advantage on barren lands in *Neufchattel*, *Solothurn*, *Bern*, the *Pais de Vaude* and other places, as alſo in *Burgundy* and the adjacent countries; at laſt alſo in *Germany*, as in *Auſtria*, *Suabia*, *Franconia*, *Bavaria*, *Pomerania*, in the *Marckt* and other parts.

The manner of managing the ſainfoin.

At *Ratiſbon* was publiſh'd a treatiſe on the ſubject of this improvment to the following purpoſe: This ſeed, mixt with ſome oats, is ſown in the ſame manner as hemp-ſeed, eſpecially in the months of *March* and *April*, on fields ſomewhat ſloping, hollow, ſandy, nay even ſtony and cover'd with moſs; but by no means on wet or clayey meadow grounds, gardens, and fields, where no good graſs will grow: And upon this a fine and plentiful clover, with a great deal of graſs growing among it, ſprings up; and from month to month, and year to year, without any farther culture it propagates and increaſes of itſelf in ſuch manner, that in 15 or 20 years there is no occaſion for breaking up the ground anew or ſowing it. The reaſon of mixing the oats with it is, that the clover-ſeed may not fall too thick, nor grow up too rank. For the firſt year you muſt only cut down the oats, but the following, the clover, and that after the ſeed is ripe; and

and it grows ſo rank that you may afterwards mow it three or four times a year. It yields the ſofteſt graſs when cut down in the bloom; but if you would preſerve the ſeed, it is better to wait till it is ripe, when, indeed, the clover is ſomewhat ſtronger, but very ſerviceable for foddering cattle, and then you may threſh out the ſeed. When the clover will no longer grow upon that field, corn thrives very well in it, as it acquires from the many and long roots of the ſainfoin a ſtrong manure. Now this clover affords an excellent food, eſpecially for cows, who thereby yield a great deal of milk. As to horſes, if the ſainfoin were given them in plenty, and alone without any other fodder, there would be a hazard of their growing too fat by it, and becoming regardleſs of common hay.

From the above treatiſe we may ſee, that this is not bare ſpeculation, but what is actually performed with great advantage in the canton of *Switz*, and particularly in *Bern:* And we farther add, that *Joſeph von Feldic*, in his *Bohemian* and *Auſtrian Oeconomiſt*[a], teſtifies from his own obſervation, that he has ſeen the trial of it both in the *Marckt* and other parts, and found it hold good.

An aerometrical Eſſay towards the improvement of the Thermometer. By *S.* Klingenſtierna. *From the* Acta Literaria Sueciæ. Trimeſtre tertium Anni 1723, p. 436.

Tranſlated from the LATIN.

Suppoſitions deduced from experiments.

1. THE given denſity of the air correſponds to the given gravity of the atmoſphere, and to the given degree of heat 2, The ratio of the denſities of the air, ariſing from two given degrees of heat, in any degree of the gravity of the atmoſphere is conſtant. 3. The denſity of the air, *cæteris paribus*, is proportional to the gravity of the atmoſphere.

Definition.

I diſtinguiſh the changes of heat into degrees, according to the degrees or quantities of the changes, which the heat produces in the denſity of the air; and conſequently one degree of heat will be reckon'd to be to another reciprocally as the denſity of the air, correſponding to that degree of heat, to the denſity of the air, correſponding to this degree of heat; ſo far as the change of theſe denſities does not proceed from the altered gravity of the atmoſphere, but only from the decrement, or increment of heat.

Corollary.

Equal increments are reckon'd to be added to unequal degrees of heat, when the decrements of the denſities, or the increments of the volumes of the air are in the direct ratio of the firſt volumes, and inverſe ratio of the firſt heats.

Let

[a] p. 154.

Theorem I. Let the glaſs tube AD be open at D, and terminate in a larger ball A,
Plate II. Fig. 8. and in any part of this tube let there be a drop of mercury C filling its cavity; I ſay, that the air, included in this inſtrument, is of the ſame denſity with the ambient air.

Demonſtration. For; the mutations of heat are eaſily communicated by the inſtrument to the included air, as appears by experience: Whence the elaſticity of the internal air becomes of a ſudden to that of the external, as the denſity of the former to that of the latter: Wherefore, if theſe denſities be ſuppos'd unequal, the elaſticity of the denſer will prevail, and by protruding the drop of mercury C, reduce it to equality. Q. E. D.

Corollary 1. The denſity of the included air, *cæteris paribus*, is proportional to the gravity of the atmoſphere by *Suppoſition* 3. The volume, therefore, or ſpace which the included air occupies, is reciprocally proportional to the gravity of the atmoſphere.

Corollary 2. The ſame degree of heat remaining, the drop C is protruded towards A, if the gravity of the atmoſphere be increas'd, but towards D, if the ſame be diminiſh'd.

Corollary 3. The gravity of the atmoſphere remaining, the drop C is protruded towards A, if the heat be diminiſh'd, but towards D, if it be increas'd.

Theorem II. Fig. 9. Laying down theſe things; let EG be a barometer, in which the height of the mercury is EF; and if the ſame degree of heat remaining, the mercury ſubſide ſucceſſively thro' equal degrees, 1, 2, 3, 4, 5, &c. by the diminiſh'd gravity of the atmoſphere; I ſay, that the drop of mercury C will at the ſame time be protruded through the degrees *a*, *b*, *c*, *d*, *e*, &c. So that the volumes of the included air, or the capacities AC, Aa, Ab, Ac, Ad, &c. be in harmonical progreſſion.

Demonſtration. Seeing the denſity of the included air in a given degree of heat is proportional to the gravity of the atmoſphere (*Cor.* 1. *Theor.* 1.) and the gravity of the atmoſphere is proportional to the height of the mercury in the barometer, the denſity of the included air will alſo be proportional to the height of the barometer: Wherefore, ſeeing the mercury ſubſiding thro' equal degrees, 1, 2, 3, 4, 5, &c. ſucceſſively, the heights of the barometer, and conſequently the gravities of the atmoſphere, correſponding to theſe heights, are in arithmetical progreſſion; the denſities of the included air will in like manner be in arithmetical progreſſion; and therefore its ſucceſſive volumes, or the ſpaces AC, Aa, Ab, Ac, Ad, &c. which that included air ſucceſſively occupies, will be in an inverſe arithmetical progreſſion, *i. e.* in an harmonical progreſſion. Q. E. D.

Theorem III. The quantity or degree of heat is as the weight of the atmoſphere, and the volume of the included air conjointly.

Demonſtration. The degree of heat being given, the denſity of the included air is as the weight of the atmoſphere (*Cor.* 1. *Theor.* 1.) and the weight of the atmoſphere being given, the denſity of the ſame air is reciprocally as the heat

by

by the *definition:* Wherefore, neither being given, the denſity is directly as the weight of the atmoſphere, add inverſely as the heat; and therefore the heat directly as the weight of the atmoſphere and inverſely as the denſity: But the denſity of the air is reciprocally proportional to its volume: The heat, therefore, is as the weight of the atmoſphere and the volume of the included air conjointly. Q. E. D.

Corollary. The heat is as the height of the barometer and the volume of the included air conjointly.

Theorem IV. Fig. 2. In our inſtrument let the drop of mercury ſtand at any time in C, the height of the mercury in the barometer being E F; let the drop alſo at another time ſtand in H, the height of the barometer being E3; and let the capacity A C to the capacity A c be taken reciprocally as the height E F to the height E3; I ſay that the heat in the firſt caſe is to the heat in the ſecond caſe, as the capacity A c to the capacity A H.

Demonſtration. The heat in the firſt caſe is to that in the ſecond, as the height of the borometer E F and the capacity A C conjointly to the height of the barometer E3 and the capacity A H conjointly (*Cor. Theor.* III.) and therefore by diviſion of ratio, as the height E F and the capacity A C directly, and the height E3 inverſely to the capacity A H: But the capacity A c is likewiſe as the height E F and the capacity A C directly and the height E3 inverſely (by the *conſtruction*) wherefore the heat in the firſt caſe is to that in the ſecond, as the capacity A C to the capacity A H. Q. E. D.

Corollary. Our inſtrument A D, therefore, compar'd with the barometer in the manner above deſcrib'd ſerves to diſtinguiſh and meaſure the degrees and alterations of heat.

Theorem V. Equal changes in the degree of heat produce changes in the volume of the included air reciprocally proportional to the height of the barometer.

Demonſtration. For, in this caſe, the increments or decrements of the volumes are in the direct ratio of the firſt volumes, and in the reciprocal ratio of the firſt heats (by *Corol.* of *definition*) but the heat is as the height of the barometer and the volume of included air conjointly (*Cor. Theor.* III.) wherefore, the mutations of the volumes are in the direct ratio of the firſt volumes and the inverſe ratio of the ſame volumes and of the heights of the barometer, *i. e.* (the direct and inverſe ratio's of the volumes deſtroying each other) in the inverſe ratio of the height of the barometer. Q. E. D.

Corollary. And the height of the barometer being given, equal changes of heat produce equal decrements or increments of the volumes of the included air.

Scholium 1. If any one would compare this theory with experience, the inſtrument ſeems to be very commodiouſly conſtructed in the following manner: Having prepar'd the glaſs-inſtrument A D, whoſe tube let be as long as poſſible, let the capacities of the ball A and of the tube A D and each of its parts be very carefully inveſtigated: Wherefore, it is to be obſerv'd, that the capacity of the tube ought to be to that of the ball at leaſt as 1

to

to 6; for, the leaſt denſity of the air, when the leaſt gravity of the atmoſphere has the greateſt degree of heat, is to its greateſt denſity, produced by the concurrence of the greateſt degree of cold with the greateſt gravity of the atmoſphere, nearly as 6 to 7. In the next place let the poſition of the drop of mercury be choſe about the middle of the tube, as for inſtance, in C, the mercury in the barometer being in like manner at a mean height in F; and let the diviſions of the ſcale of the barometer on each ſide the point F be 1, 2, 3, 4, *&c.* Then if the tube be divided on each ſide the point C into the parts C*a*, *ab*, *bc*, *cd*, *&c.* ſo that the capacities AC, *Aa*, *Ab*, *Ac*, *&c.* be reciprocally proportional to the heights of the barometer EF, E1, E2, E3, *&c.* which is done by taking Ca, Cb, Cc, Cd, *&c.* to AC, Aa, Ab, Ac, *&c.* reſpectively, as F1, F2, F3, F4, *&c.* to E1, E2, E3, E4, *&c.* reſpectively, as may be eaſily demonſtrated. In fine, let the tube be divided from its upper part into equal degrees f, g, h, i, k, *&c.* ſo that the capacity of a ſmall portion of the tube, correſponding to any degree be to the capacity of the ball A, as 1 to 600; and the inſtrument will be perfect: For, the ratio of one degree of heat to another here is found by *Theor.* IV. and the ratio of the increments by *Theor.* V.

Scholium 2. The *Florentine* thermometers are reckon'd the beſt; but it has been long ſince diſcover'd, that they have many, and thoſe no ſmall imperfections: For, the ſpirits of wine by a great degree of cold, contracted into a leſs ſpace, do too ſlowly obey the approaching heat: And it is obſerv'd (a remarkable inſtance of the imperfection of this inſtrument) that two thermometers do ſcarce more than once ſhow together the ſame points, which, indeed, hinders that the changes of heat in one and the ſame place, much leſs in different places, cannot be accurately known: And which is a principal thing, you cannot in any intelligible manner meaſure the heat and diſtinguiſh it into degrees, which notwithſtanding is very neceſſary, if we are to compare together thermometrical obſervations made in different parts; and hence deduce the ratio or difference of heats. But I am confident that the inſtrument juſt now deſcribed, will eaſily perform all this; providing we had an eaſy method of properly meaſuring its capacity, which will probably ſtill remain a difficulty: But as we muſt know the capacity of the whole inſtrument, as alſo the capacities of the ball and tube apart; ſo it ſeems expedient in practice, if a narrower tube be taken; nor indeed is there occaſion for its being longer than that by its capacity it equal the ſixth part of the ball: And if two ſuch inſtruments be compar'd together only once, and the points they ſhow at the ſame time be noted, we ſhall hence have all the points, which they ought to ſhow at the ſame time.

The Hiſtory of the Invention of the Phoſphorus. *By* G. G. L. *From the* Miſcellanea Berolinenſia. Tom. I. p. 91.

Tranſlated from the LATIN.

IT importeth the ſciences, that the hiſtory of memorable inventions be rightly deliver'd. Among the inventions of our age, the *phoſphorus igneus* is to be reckon'd none of the leaſt: It differs from other naturally ſhining bodies in this; namely, that in reality it is nothing other than a kind of conceal'd fire, which diſcovers itſelf by its light and ſmoke, but if you rub it harder, it will break out into a flame. This diſcovery appear'd about the year 1677, when a little before, *Balduin*'s *phoſphorus* gave hopes of it, which is an artificial imitation of the natural *Bolognian* ſtone; and on which *Fortunius Licetus* formerly wrote a treatiſe, entitled *Lithoſphorus*; and not long ago Count *Marſili* of *Bologna* publiſh'd experiments and obſervations on it: And at *Berlin* Dr. *Chriſtian Menzelius* in a particular treatiſe compar'd the natural and artificial *phoſphorus*. *Chriſtopher Adolphus Balduin*, governor or bailiff of a certain place in *Miſnia*, happen'd to diſſolve chalk in *aqua fortis*, or ſpirit of nitre, which laſt he again brought over by the fire; and he found the remaining body to imbibe the light, when expos'd thereto, and retain it for ſome time, and carry it along with it into a dark place, as a ſponge does the water it has imbib'd. This experiment did not a little ſtartle the *Carteſians* (very few of whom had ſeen the *Bolognian* ſtone) that light ſhould of a ſudden become a groſs and portable thing, whoſe rays they ſuppos'd to conſiſt in preſſion only, and to be propagated in an inſtant of time. *Balduin* concealedly deſcrib'd his experiment in a treatiſe, entituled *Aurum Auræ*.

The *phoſphorus* what, and the time of its diſcovery.

Next follow'd *Brand*'s *phoſphorus*, namely that which I call the *igneus*, as alſo the *pyropus*, and which afterwards had the name of *phoſphorus* by way of eminence; of whoſe inventor there appear'd in 1692 an account in *French* by an excellent perſon, converſant in the experiments on this *phoſphorus*; but in ſeveral places, and thoſe of conſiderable moment, he departs from matter of fact; and, in my opinion, his account is taken either from the relations of people too partial, or even from uncertain reports. Upon peruſing it, I ſent my animadverſions to my friend, and adviſ'd him to correct what was amiſs, but all to no purpoſe; either becauſe his prejudice was too great, or becauſe it ſeem'd to be a matter that muſt be further enquired into: And therefore, leſt the truth of the matter of fact, at this day probably known but to a few, ſhould be loſt, I have now reſolv'd to publiſh theſe remarks, after firſt having given the above relation itſelf, that its difference from the matter of fact, and the neceſſity of my animadverſions may the better appear.

Brand's *phoſphorus*.

Account thereof by a *French* Author.

That account, therefore, which was publiſh'd in 1692, is to the following purpoſe. 'The firſt invention of this *phoſphorus* is owing to chance, 'as many other excellent inventions are. A certain *German* chemiſt, 'call'd *Brand*, living at *Hamburg*, a man obſcure, and of mean parentage, 'moroſe and phantaſtical in his humour, and who affected to be myſterious 'in all his actions, found out this luminous matter, while he was in queſt 'of ſomething elſe. He had from his youth applied himſelf to the art of 'glaſs-making; but he threw this up, that he might have more leiſure 'to apply himſelf to the *philoſopher's ſtone*, with the hopes of which his 'head was fill'd: Perſuading himſelf, therefore, that the ſecret of the 'ſtone conſiſts in a preparation of urine, he for a long time, and in different manners, labour'd on it in vain. At length in the year 1669, after 'a ſtrong diſtillation of urine, he found in the receiver a lucid matter, 'which afterwards got the name of *phoſphorus*. This he ſhow'd to ſome 'friends, and among others to *Kunkel*, chemiſt to the Elector of *Saxony*; 'but he took care not to ſay any thing, by which the compoſition might 'be diſcover'd; and he died without communicating his ſecret to any 'one. After his death, *Kunkel*, not bearing that ſo excellent a ſecret 'ſhould be loſt, attempted the revival of the invention; and reflecting that '*Brand* had all his life long labour'd on urine, ſuſpected that in it he was to 'look for the *phoſphorus:* He, therefore, applied himſelf to it; and after an 'obſtinate labour of four years, he at length hit on it. He did not affect 'to be ſo myſterious as *Brand*, but communicated the ſecret to ſome perſons about the year 1679. In *France* and *England* Dr. *Kraft* of *Dreſden* is 'reckon'd the inventor of this *phoſphorus*; becauſe he firſt brought it to 'theſe parts: But in reality he was only the diſpenſer of it, having 'receiv'd it from *Kunkel* to ſhow it to learned foreigners; nay, *Kraft* at 'that time when he went about, did not know the compoſition'.

Animadverſions on the above account.

This is the account. But I wonder that *Brand*, a man but little known, is us'd in it with ſo much contempt, and that from uncertain relations; ſeeing we are oblig'd to him for a very excellent diſcovery: But it is more to be wonder'd at, that he is ſaid to be dead at the time that *Kraft* and *Kunkel* communicated the *phoſphorus* to the world, both in writing, and by word of mouth; and that *Kunkel* reviv'd the art, which died with the inventor: Since it is very certain, that *Kunkel* went to *Brand* and obtain'd the ſecret of him; and that *Brand* long ſurviv'd this, and complain'd of *Kunkel*; nay, as far as I have learned, he was ſtill living in the year 1692, at the time the above account came out: And ſo far was the good-natur'd *Brand* from being difficult, moroſe and myſterious in communicating his ſecret, that he ſuffer'd himſelf to be prevail'd upon by ſome ſmall preſents, and the hopes of greater rewards, to diſcloſe it to *Kraft* and *Kunkel*. Whether he was of ſo very obſcure and low parentage, as to deſerve to be contemptuouſly ſo call'd, I cannot affirm; but this I know that *Kunkel* in

his

his youth applied himſelf to the art of glaſs-making; on which ſubject he has publiſh'd a uſeful treatiſe in *High Dutch*; and probably, his father might have been a glaſs-maker. I am, therefore, apt to think that the above relation has ſhifted the perſons. *Brand*, as far as I have learned, was, when a young man, in the army; and was diſtinguiſh'd in it by ſome ſuperior rank: He alſo married a woman with ſome money; but it was ſaid, he ſpent his patrimony in alchemy; nor did he ſo much apply himſelf to the *philoſopher's ſtone*, as to particular proceſſes; and he likewiſe diſpos'd of chemical preparations for medicinal uſes.

The manner of the diſcovery of the *phoſphorus* by *Brand*.

The invention of the *phoſphorus* happen'd thus; *Brand* had fallen on a certain chemical proceſs, extant in a printed book, which taught how to prepare from urine a liquor fit to ripen a particle of ſilver into gold; And in labouring on this he found out his *phoſphorus*. He had ſome acquaintance with *Jo. Daniel Kraft*, then of the council of commerce to the Elector of *Saxony*; and by his means with *Jo. Kunkel*, one of the ſaid Prince's bed-chamber; but who under that character perform'd chemical proceſſes. On perſuading *Brand* that this *arcanum* might be ſold to the Great at a high price; and offering him their aſſiſtance, they obtain'd the compoſition from him. And upon going from *Dreſden* to *Hamburg*, they both ſaw and learn'd from him the proceſs of the *phoſphorus:* But *Kunkel*, upon his return home, had committed ſome miſtake in the proceſs, and for a long time could not hit upon the *phoſphorus*; and he ſent a letter of complaint to *Brand*, which I have ſeen, and in which he bewails that the ſecret was not communicated to him ſincerely enough; but *Brand* repenting that he had been ſo eaſy in the communication, delay'd the ſetting him to rights. *Kunkel*, in the mean time, after various trials, corrected the error of himſelf; whence he pretended to be the inventor; of this *Brand* bitterly complain'd.

An account of *Kunkel*.

Kunkel was chemiſt to *Joh. George* III. Elector of *Saxony*; and as formerly the Elector *Auguſtus* was certainly thought in thoſe parts to be poſſeſs'd of ſome profitable alchemical *arcana's*; the writings (partly in this Prince's own hand) which are extant at *Dreſden*, and are thought to contain ſomething of the ſecret, were entruſted to *Kunkel*, to try if he could diſcover any thing from them: And ſome of theſe came alſo into my hands. *Kunkel* had a laboratory given him at *Anneberg*, but nothing worthy of expectation was diſcover'd. After this when *Caſſius*, a phyſician of *Hamburg* (whoſe treatiſe on gold is extant) had diſcover'd the artificial ruby by help of gold and tin, which was a long time one of the *deſiderata*; *Kunkel*, converſant in glaſs-making, and the art of ſmelting, did not a little improve the method, and he taught how to make pretty large veſſels of it; and by that means he obtain'd the favour of *Frederick William, the Great*, Elector of *Brandenburg*, who was curious in ſuch matters; and he went into his ſervice on no contemptible terms, and not long ago he died at *Berlin*.

Kraft's character. *Jo. Daniel Kraft* of *Miltenberg* had in his youth applied himſelf to phyſick, and having got the degree of doctor, he was phyſician to the miners at *Cellerfeld* in *Hartz:* After this he went to *Holland*, *England* and *North-America*, and acquir'd a conſiderable ſkill in thoſe things, which relate not only to the knowledge of nature and to chemiſtry, but likewiſe to works of art, handicrafts and commerce; He was, therefore, very acceptable to princes, fond of curioſities, and bent on the improving and enlarging the ſkill of handicrafts and commerce; and eſpecially to *Joh. Philip*, Elector of *Mentz*, and to the Electors of *Saxony* and *Brandenburg*; and under the Elector of *Mentz* and *Saxony* he was of the council of commerce: He was a man of erudition and eloquence, whether he was to write or ſpeak: His only defect was, that at times he was diverted from more certain and uſeful purſuits by ſome inbred turn, or rather diſeaſe, to alchemical conceits.

Becher's character. *Joh. Joach. Becher* of *Spire*, phyſician to the Elector of *Mentz*, and afterwards of the council of commerce at *Munich* and *Vienna*, was a man of ingenuity, and ſkill'd in the *German* writings, but he indulged too much his pruriency of ſcribbling, and huddled together certainties and uncertainties, as for the moſt part he took what he wrote from the relations of others; this man, I ſay, profited very much by the converſation and labours of *Kraft:* He was one that could little bear the fatigue of chemical proceſſes, as his friends found by his laboratory at *Munich*, which he mentions in the title to his *phyſica ſubterranea:* As at length he loſt all favour at Court, and as the great promiſes made him came to nothing, he propos'd to the *Dutch* gold ore from thoſe hills of ſand, which they call *Dunas:* He afterwards died at the tin-mines in *Cornwall*, being brought very low by his extravagance: A man who deſerv'd a better fate, and which he might have had, had he been without that malignant humour of banter, by which he alienated both his friends and patrons; and in his good fortune, had he been without that pride, profuſion and vanity, and without that licentiouſneſs of fiction, of which he himſelf boaſted among his acquaintance, either when he would gain credit to his words, or ſlander others. Various judgments, and thoſe in extremes, have been paſs'd upon him by thoſe, who only knew him by his writings; ſeeing ſome, upon obſerving every where the raſhneſs of the author, deſpiſe all he has writ; whereas others again eſteem him as a great philoſopher, and almoſt as an adept. *Kraft*, moreover, who was an honeſter man, being by my means on the point of entering into the Elector of *Brunſwick*'s ſervice, died a few years ago in *Holland.* I thought it proper on this occaſion to obſerve theſe things of men, who excell'd in genius and the knowledge of nature; and with whom I myſelf had a more intimate acquaintance; and who, if they had had proper encouragement, and a ſteadineſs of temper, equal to the vigour of their genius, and a greater deſire for truth than an ambition of raiſing themſelves by ambiguous

guous arts, would have acquitted themſelves, ſo as to deſerve to be reckon'd the ornaments both of their time and country.

Brand's phoſphorus communicated to the world by *Kraft*.

But to return to *Brand*'s *phoſphorus*: *Kraft* undertook to vend the diſcovery among the Great; and in his way to *England* he made me a viſit at *Hanover*, and ingenuouſly mention'd to me both the matter of the proceſs and the author *Brand*; and he likewiſe ſhew'd the experiment of the *phoſphorus* to the great ſurprize of Duke *John Frederic*; and afterwards in *England* to King *Charles* II. Prince *Rupert*, the illuſtrious Mr. *Boyle* and others, of which there is an account by Dr. *Hook*. But he never, as far as I know, mention'd himſelf as the inventor; neither did he, as the above relation ſeems to hint, carry the *phoſphorus* into *France*; ſeeing it was firſt ſent thither by me to *Huygens*; and at length the compoſition itſelf was by the illuſtrious *Tſchirnhauſen*, upon his firſt return from *Germany* into *France*, communicated from me to the *Royal Academy*, to whom *Huygens* had already ſhewn the thing: That *Boyle* had got but an imperfect deſcription of it appears from his diſſertation on the *phoſphorus*; for, his *phoſphorus* differs from *Brand*'s only in this, that it is more imperfect.

Brand communicates the proceſs to Duke *John* of *Hanover*.

But Duke *John Frederic*, as he was a magnificent and generous prince, order'd that I ſhould ſend for the inventor: *Brand* therefore came to *Hanover*, and faithfully communicated to us the proceſs; for, whatever he did, I imitated in another laboratory. Upon collecting a large quantity of urine, *Brand* came to us, and without the city he went thro' the proceſs. Upon *Brand*'s return to *Hamburg*, the duke ſettled an annual penſion upon him, which was punctually paid him till the duke's death: And this, probably, was the only encouragment of moment he reap'd from his *phoſphorus*.

Another kind of *phoſphorus*.

I myſelf ſhew'd to the ſame prince, who was very curious in theſe matters, another kind of *phoſphorus*, which we may call the *thermophoſphorus*, which does not acquire its ſhining quality from light, as the *Bolognian* and *Balduin*'s *phoſphorus*, but from heat. There is a kind of *fluor* in mines, with the powder of which if you draw letters and figures on an iron-plate and lay the plate upon burning coals, the ſtrokes ſhine, tho' the plate be in no wiſe ignited, nor tho' the light with its rays cannot penetrate from the coals to the figures.

Heat and fire produc'd by attrition.

It is a thing commonly known, that hard bodies acquire heat, and at laſt take fire by motion; and the flame, produced by the attrition of two pieces of wood, was by the ancient *Saxons* regarded as a religious ceremony, which they call'd *nod-fyr*, that is, *fire produc'd, in defect of fuel, in a caſe of neceſſity*, as appears from *Charlemagn*'s *Capitular*, in which that ſuperſtition together with others is prohibited; and very lately, traces of this ſuperſtition were found remaining among the Boors of *Brunſwick*; and in ſome parts they were wont, on the firſt day of the year, to put out the fires in a whole village, and to carry that produc'd by the attrition of two pieces

of

of wood to all the houſes; and ſome of them purified their cattle at a pile of wood, kindled from that fire, as a charm againſt diſeaſes: But we are not ſo well acquainted with the manner, in which ſmiths at our mines kindle the fire extinguiſh'd in their forges: They ſtrike with a hammer an iron bar on its very edge, and which is wont to come from the mines in form of a quadrangular priſm: This bar they ſhift that the edge may be alternately ſtruck, now on the right, and again on the left; and thus it immediately becomes hot, and after repeated blows glowing hot, ſo as to ſet on fire any inflammable matter.

Joh. Bernouilli's phoſphorus.

We have, beſides, other kinds of *phoſphori*, in which there are no traces of fire; among which the principal is that, which we owe to *Joh. Bernouilli*, who has improv'd the obſervations of others on mercury ſhining *in vacuo*, and carried it ſo far, that now it may be produced at pleaſure; whereas before, mercury was rarely and by chance made to ſhine. It is credible, that this *phoſphorus* always retains its ſhining quality, or at the leaſt, for a long time; becauſe it does not ſtand in need of the free air to make it ſhine, as the *phoſphorus igneus* does, but emits a light by only ſhaking it in a glaſs, hermetically ſeal'd; and with this the King of *Pruſſia* was ſo well pleas'd, that he rewarded the inventor with a gold medallion: And I underſtand, that M. *Dutal* at *Paris* and others, have labour'd with remarkable ſucceſs in eſtabliſhing and promoting this *phoſphorus*. It would be worthy enquiry, what quantity of light might be produc'd by many ſuch *phoſphori*, continually ſhook; for, a continu'd ſhaking may be eaſily effected by means of a machine, and the light of many *phoſphori* may be collected either by refraction or reflexion; a thing, I wonder, has not been hitherto attempted.

Of the Ball of Fire which was ſeen in Sileſia, Lauſnitz, Poland, Pruſſia, *and* Hungary, *on* Auguſt 10, 1717; *together with hiſtorical Reflections thereon. From the* Breſlaw Collection, Auguſt 1717, Claſs IV. Art. II. p. 157.

Tranſlated from the HIGH-DUTCH.

An account of the fire-ball, as it appear'd at Breſlaw.

ON *Auguſt* 10, about half 9 in the evening, in a clear ſky, towards the eaſt, there was plainly ſeen by every body at *Breſlaw*, as alſo in other parts, what is call'd a *fire-ball*, which like a maſs of fire ſuddenly and ſwiftly fell down to the earth; and indeed, ſo far as one could judge by the ſwiftneſs, there appear'd a ſudden brightneſs aloft in the air, during which ſhort flaſh, the inflam'd matter, as it were, came together, and in form of a ball came down towards the eaſt, ſuddenly and nearly in a direct line, at the leaſt but a little inclin'd; but in its fall it alſo ſeem'd to

ſpring

ſpring into pieces, and in its burning and motion it continu'd no longer than about 15 or 20 ſeconds; yet ſo, that as this falling *fire-ball* trail'd along a bright tail, after the extinction of the maſs of fire, this tail was ſtill obſerv'd for ſome time in form of a whitiſh and bright ſtreak: By it the atmoſphere was now enlighten'd in ſuch a ſudden and ſtrong manner, that ſeveral perſons were apprehenſive of an approaching burning, and in this concern they ran to the windows to obſerve the quarter, where this ſwift and near fire was: This fire was alſo ſo penetrating and ſenſible, that it was thought to exceed lightning itſelf: Whence it was obſerv'd by all and in all places to be ſo near, that many people imagin'd it fell down over their heads, or before their feet; ſo that many alſo affirm'd they had ſeen it ſpring into pieces before their eyes on the earth, which was far from being true; in the ſame manner as people in other parts would have it thought, that it emitted different rays from it like a ſhooting ſtar; yea many, and thoſe both perſons of rank and learning would perſuade us, that they perceiv'd a manifeſt ſulphureous ſmell: No noiſe was obſerv'd in its falling down, eſpecially on the account that the *phenomenon* happen'd in a clear ſky. The ſky mov'd from north north-weſt; the weather was cool and without any wind ſtirring; the ſky remain'd alſo clear in the night and pretty freſh; and many unuſual ſhooting ſtars were obſerv'd by us and other people in *Breſlaw*, who were otherwiſe wont to obſerve the heavens in the night-time; and this was the nature of the *phenomenon* at *Breſlaw:* The heedleſs and ſuperſtitious populace with apprehenſions fram'd to themſelves many chimera's about it; ſometimes that they had ſeen a ſword, then a broom, and again, ſome other groundleſs appearance, ſuch as people in ſickneſs or a raging fever fancy to themſelves; among others, a young and ſound woman near *Wartenberg*, who, on the appearance of this meteor was in the open field, was ſo frighten'd by it, that all her limbs began to ſhrink, and no remedy could be of any ſervice.

Its appearance in different parts.

We have had accounts of this meteor from ſeveral places in *Sileſia* and other parts; yet all agree, that in general it was obſerv'd in the ſame manner. According to the accounts from *Schweidnitz*, *Glogaw*, *Jauer*, *Lignitz*, *Wolaw*, *Oels*, *Brieg*, *Grotgau*, *Teſchen*, *Trachenberg*, *Wartenberg*, *Militſch*; and in a word, all over *Sileſia*, as alſo in *Lauſnitz*; and beſides, in *Poland*, eſpecially in *Maſovia*, in *Cracow*, in *Reuſſen*, in *Caliſch* and *Poſna*; and farther, in *Pruſſia*, *Courland*, *Samogitia*, and in other parts; and in fine, alſo in *Upper Hungary*, as at *Käſemarck*, *Epperies*, and in many other places; but not at *Leipzig*, as we were expreſsly inform'd. 1. It happen'd at the ſame time and hour of the day; to wit, *Auguſt* 10, between 8 and 9 o'clock. 2. In the ſame form, like a ball or maſs of fire, with a long bright ſtreak trailing after it. 3. And chiefly, according to outward appearance, like a ſwift mounting fire. 4. Its motion alike, to wit, obliquely from on high, yet with this difference, that in *Sileſia* it appear'd to fall almoſt towards *Hungary*,

gary, but in *Hungary* towards *Sileſia*, that is, towards the eaſt in *Sileſia*, and towards the north north-weſt in *Hungary*. 5. It was of equal duration, it continuing no where above half a minute in its burning form.

At *Epperies.* To this we think proper to ſubjoin the different accounts ſent us by learned men; and that we had from a learned phyſician at *Epperies* is to the following purpoſe: After a tract of cloſe weather for ſome days before, yet intermixt with rains at times; at laſt, on *Auguſt* 10, about 9 o'clock in the evening, in a warm and clear ſky, in the north was of a ſudden obſerv'd to ariſe ſuch a bright ſhining fire, that many people at firſt thought there had been a ſudden burning; the ſuperſtitious populace, indeed, form'd to themſelves ſurpriſing figures; ſeeing, ſome of them fancied, that the whole heavens were open'd, others imagin'd a fiery ſword, rods, and other abſurd conceits: On the contrary, by means of a true and exact obſervation made here and in other parts (as this meteor was ſeen in this kingdom for 10 *Hungarian* miles from this place) it preſented itſelf at firſt in form of an upright burning pillar; as it ſtood a ſhort time in this manner, it bent itſelf at firſt different ways, and ſoon after ſprung into many fiery ſparks, in which form it alſo fell down and vaniſh'd ſpeedily. Many people had different notions of this *phenomenon*; but for my own part I took it for a pure natural effect; as I was aware, that the inflammable matter collected on the preceeding very cloſe days (by means of which one may be apprehenſive of a dreadful ſtorm to enſue) might coaleſce in ſuch a form, that after it is ſet on fire, it might repreſent what is call'd a *trabs* or *beam*, eſpecially in a calm hot air, as was the caſe all that day; and alſo as neither then nor the foregoing days, this matter was not conſum'd by any ſtorm of lightning.

At *Kaſemarck* in *Hungary.* The obſervation from *Kâſemarck* in *Hungary* is as follows; this *phenomenon* appear'd *Auguſt* 10, about 9 o'clock in the evening; and all at once, like a bright fire, which illuminated the whole city; and the people obſerving it, imagin'd that there was fire in all the ſtreets. As I myſelf was not appriz'd of ſuch a *phenomenon*, and as I ſaw the clear light, I imagin'd the whole city to be on fire; but as I look'd about me, I only obſerv'd an arch in the heavens, which indeed at firſt was in a ſtreight line, but afterwards ſwerv'd from it, and form'd different large windings; nay, even at laſt it was obſerv'd, that the continuity of this arch was broken, and it ſeem'd as if it conſiſted of ſtars ſtanding cloſe by each other, till at laſt it entirely diſappear'd: The light, that was obſerv'd, reſembled lightning, only that it laſted longer, but it afterwards changed into a bright arch, which with its extremities reſted on the horizon towards north north-weſt and ſouth ſouth-eaſt; and thus it ſtood for upwards of an hour: But at the extremity towards the ſouth ſouth-eaſt it diminiſh'd, till at laſt it gradually vaniſhed; but under what form this *phenomenon* appear'd and from what quarter it came, I cannot tell, ſeeing I was not appris'd of any ſuch appearance.

From

From *Brieg*, not far from *Olau*, we had the following account; this fiery meteor of *Aug.* 10, was not only obſerv'd here and in the neighbourhood, but alſo at *Olau* and beyond *Strelen*, and that at the ſame time. I ſaw but little of it, only that it paſs'd by the windows like a flaſh of lightning; upon which I went directly to the top of the houſe, ſuppoſing it to be a *draco volans*, as ſome people alſo who ſtood in the court imagin'd it to be; but in the morning as I underſtood, that it was obſerv'd at *Wanſen* and other parts, I aſk'd further what its proper form was; and moſt of the deſcriptions agreed, that it fell from the heavens like a four ſquare veſſel, with a long tail behind. Now as it was ſeen in ſo wide a diſtance, and that at the ſame moment of time, I reckon it muſt have been very high, and poſſeſs'd a very large ſpace, as an ordinary ſtorm is wont to do: Whence I take it to be a *chaſma*. From the relations I conclude, that the beginning of it was ſouth-weſt, but its end north-eaſt. At *Brieg*, &c.

From *Oels*, not far from *Julius-burg*, the account is as follows; the meteor of *Auguſt* 10. was alſo obſerv'd here every where with ſurpriſe; it aroſe in the evening about 8 o'clock, came from the weſt to the eaſt and laſted for half a minute, and was like a dreadful ſtorm of lightning; it left behind a ſtench of burning and ſulphur; the common people took it for a *dragon*, and ſaid they had ſeen him ſeveral times fly thus; ſome deſcrib'd it as a ball or maſs of fire; others of an oblong figure, about two foot in length, with a tail, as it were. This burning in the air was obſerv'd far and near, even as far as *Poland*: Many thought it portended moiſt and rainy weather, which alſo enſu'd. A ſervant of mine, who was obliged to watch a field of wheat ſaw about midnight with ſurprize the heavens open and fiery. At *Oels*.

From *Mittelwalda* in *Medzibor* we had the following account; the ball of fire on *Auguſt* 10. fell from the ſky half an hour before 9 in the evening; and was not only obſerv'd here but alſo in other places, and with an extraordinary brightneſs, appearing as if every thing was full of fire, and moſt people were greatly frighten'd: This fire, as it fell down towards the eaſt, left behind it a ſhining track like a ſemicircle; and ſhone for half a quarter of an hour, and was diſtinguiſhable; others would contradict this, and affirm that it fell from the eaſt to the weſt; others, as they thought, ſaw it fall in different places, but the remaining ſhining track plainly ſhow'd in what manner it ſhot down towards the eaſt; and ſuch parallax is a ſign that it muſt have been ſet on fire high in the air. At *Mittelwalda*.

And in this manner were the obſervations ſent us from ſeveral places, but which we do not think proper to relate, ſince all of them agree together; only from *Brandenburg Pruſſia* we are inform'd, that this meteor was obſerv'd at the very ſame time there and in the neighbouring country. The ſame likewiſe happen'd in *Lithuania* and other provinces of *Poland*, where this meteor was taken for a ſign of ſome future calamity and partly for a comet, neither of which can be evinced. In *Pruſſia*, *Lithuania*, &c.

Hiſtorical Reflections on this Meteor.

In order ſtill more and more to promote the rational knowledge of nature, which is the principal view of our *Collection*, we have thought proper to add the following hiſtorical reflections; and 1. That this meteor was obſerv'd the whole length of *Sileſia* eaſtwards, in *Pruſſia* and the neighbouring countries, in *Great* and *Little Poland*; and as far as *Theys* in *Hungary*, that is, from about 48 to 52 degrees of latitude; and from 34 to 45 degrees of longitude (according to *Homman*'s maps) eſpecially in the north-weſt parts. 2. That its vertical place appears to have been between *Hungary*, *Poland* and *Sileſia*, ſince with us it was obſerv'd towards the north-eaſt or north-north-eaſt: Whereas in *Hungary* towards north-weſt or north north-weſt; and poſſibly for its horizon it might have had the *Carpathian* mountains, in which opinion we were afterwards confirmed by a learned friend at *Epperies*, who in general was of the ſame opinion, only that the particular place cannot hitherto be ſo exactly determin'd: at the leaſt this is certain, that ſuch *phenomena* are moſt commonly obſerv'd to appear as well at ſea as in mountains. 3. That, doubtleſs, in theſe parts of *Hungary* ſome days before, the calm, cloſe and clear weather might partly have ſupplied the matter to this meteor, and partly on account of its expanſive and rarefying power have promoted its aſcent. 4. That it muſt have ſtood very high, and much higher than an ordinary ſtorm; ſeeing, according to the above accounts, it was obſerv'd in its north-weſt length to be about 80 miles diſtance in latitude and 170 in longitude. 5. That this inflammable matter muſt have been very ſubtile, ſeeing it mounted ſo high, and alſo emitted ſo penetrating and clear a light; and the rarity of the air, as being without thick clouds, promoted the elevation of this matter. 6. That undoubtedly it could produce no real lightning and thunder, as it ſtood ſo high and without any clouds. 7. Yet that it muſt have been accompanied with a great deal of groſs matter not ſo apt to take fire, among other things may be concluded from its long remaining track or tail. 8. That this inflammable ſubſtance was no other than the matter of lightning, only diſtinct from it, as there happen to be clouds or no. 9. That all theſe fiery aerial meteors, as the *trabs*, *columna*, *draco volans*, *chaſma*, *ſtellæ cadentes*, &c. have in general the ſame matter, only that they vary, according to the mixture of a more or leſs groſs matter, according to their *matrix* and receptacles, their elevation, the point of the wind or air, the motion of the inflamed matter, according to the diverſity of the matter, and according to its ſimultaneous or ſucceſſive accenſion; nay even according to the ſituation of the eye; and in fine, according to the greater or leſs degree of judgment in the ſpectator, by which two laſt conditions theſe prodigies of *ſwords*, *rods*, *armies*, *artillery*, *letters*, &c. are in general obſerv'd to owe their being. 10. That from ſuch meteors as theſe, that have their manifeſt natural cauſes, and an entirely harmleſs, yea, in general, a very common exiſtence, nothing

nothing ominous can be concluded, unleſs by thoughtleſs and ſuperſtitious minds; as 11. Parallel examples ſhow, that ſuch meteors commonly appear in the evening, in northern countries, in hot weather and a clear ſky; for the moſt part in and towards the harveſt, in winter and ſpring. 12. Wherefore we have thought it proper, in order to throw greater light on the ſubject of this meteor, to alledge ſome parallel examples.

Some parallel inſtances.

April 8, 1684, before 11 in the evening, in *Swônitz* in *Saxony* a *fire-ball* was obſerv'd to fall from heaven, with a great noiſe as if it thunder'd. *December*, 1682, at *Rochlitz* and *Anneberg*, a ſulphurous *fire-ball* was ſeen to fall ſlowly in the form of an arch, from the air upon the horizon, from which afterwards flames in the form of ſnakes mounted up aloft, and run off ſpiring. *Auguſt* 15, 1683, between *Marienberg* and *Ruckerſwald* in *Saxony*, a large *fire-ball* fell down in the evening from the air, which ſprung into pieces, ſo that its ſhining luſtre was obſerv'd in *Anneberg*; and at that time there was alſo an account from *Leipzig*, that on *Auguſt* 12, four minutes before 9 o'clock in the evening, a very bright light aroſe high in the air, brighter than moon-ſhine, ſo that all the ſtreets were illuminated by it; its altitude was from 35 to 40 degrees, ſomewhat under the arm-pit of *Bootes* towards the *Great Bear*; where at firſt a ſmall ſtar ſtood, which ſoon became as large as *Arcturus*, which ſtood to the left; and increaſing ſuddenly it became as large as the moon, yet much brighter and whiter; and ſpeedily in form of a maſs of fire fell directly downwards, and left a white ſtreak behind it like a rocket: This light was obſerv'd at *Coburg*, *Bautzen*, *Dreſden*, *Gera*, *Schlätz*, *Altenburg*, *Naumburg*, *Eiſsleben*, as alſo in other parts of this tract. *March* 18, 1684, there was again, about 4 o'clock, a *fiery-ball* obſerv'd in the air over *Anneberg*. *November* 13, 1684, about 4 o'clock in the evening, there fell from the heavens, between *Joachims-Thal* and *Gottes-Gabe*, a *fiery-ball* as large as an ordinary diſh; ſo that it trail'd after it a ſharp-pointed flaming track, nine ells long, as far as could be judged by the eye, which at length divided into two and diſappear'd[a]. In our days, *October* 7, 1709, at *Durham* in *England*, between 7 and 8 in the evening, at north-weſt, an uncommon brightneſs aroſe, as tho' it had been day; this brightneſs divided itſelf into many rays, above which ſtood the ſtars, but under it a pitchy dark cloud, which at laſt broke out into thunder and lightning along with a thick fog. And even this very year towards the cloſe of *October*, in *Holſtein*, in a clear ſky to the north, two ſtars (as they are call'd) were ſeen ſtanding cloſe by each other, which ſoon united, but afterwards ſhot ſtrongly to the ſouth, and emitted a bright ſtreak; and afterwards diſſipated into a great number of ſmaller ſtars. On *December* 8th, the ſame year, was obſerv'd at *Marienburg* in *Pruſſia*, ſoon after midnight, towards the ſouth, a ſmall ſtar, which

[a] *Vide* Lehmans vom-Meiſſniſchen-ober-ertzt-Geburge, ſect. 6. c. 19. p. 386. ſeq.

at firſt ſhone very bright, but ſoon after became of a dark red: After this the heavens open'd, in the form of the large wings of a gate, on which there broke out ſo great a brightneſs as to be intolerable: At length from the ſaid ſtar, which ſtood to the left of the gate; there ſhot out forwards a long bright ſtreak, of a hand-breadth; and after this the gate ſuddenly ſhut; and thus this phenomen, after continuing for better than a minute, diſappear'd, being cover'd with clouds. *February* 26, 1711, there was an account from *Strasburg*, that for a little time in the night a dreadful fire, in form of a pillar, was ſeen over *Briſack* upwards of 2 hours; upon which it fell down with a terrible craſh; and like a waving ſtreak took its courſe ſouthwards towards the Canton of *Switz*. *Oct.* 4, 1714, in the Canton of *Bern*, about 11 in the evening, a great thunder-ſtorm burſt out from a thick cloud; but as the clouds were driven by the fire, a *fiery-ball* fell into the *Aar:* Upon which, in a clear ſky, was ſeen a beautiful ſtar of an uncommon bigneſs; yet without a tail. *October*, 1715, at *Ancona*, towards 5 in the evening, a great fire was ſeen in the air, which changed into a *fire-ball*, which emitted ſeveral fiery flames like darts, which diſappear'd in a ſhort time and brought on a great rain. The remarkable meteors ſeen in the evening of *March* 6, in *England*, &c. and particularly on *March* 17, at *Moſcow*, in *Poland*, *Pruſſia*, *Germany*, *Holland*, &c. are fully treated of by *Halley*, *Balthaſar Menzern*, *Paul Patern* at *Dantzick*, but eſpecially by *Wolfius* at *Hall.* We ſhall only add, that in the preſent month at *Medzibor* on the firſt inſtant, towards evening, a *fiery maſs* was ſeen to fall, call'd a *draco volans:* In which manner we alſo at *Breſlaw* on *Auguſt* 8. at 9 o' clock in the evening, in a ſtorm of thunder, obſerv'd a penetrating lightning, without thunder, from a like inflamed maſs of fire, which, probably, as it ſtood lower or freer than the other ſtorm-clouds, went off without any noiſe.

An eſſay towards an account of the Aurora borealis. *By* Fr. Chr. Maier. *From the* Com. Acad. Scient. Imp. Petropol. Tom. I. An. 1726, p. 351.

Tranſlated from the LATIN.

The deſign of the author.

1. AS the appearance of this *light* is ſo frequent in our northern parts, that the vulgar are no longer ſurpris'd at it, it was eaſy for me in a ſhort time to collect a great number of obſervations: Theſe I now communicate in the preſent eſſay, together with my reflections on the origin of the *northern light*, which, as being new, I have reſolv'd to ſubmit to the public judgment of the intelligent, that ſo I may learn by others what conſequence they may be of.

2. I

2. I propoſe ſo to handle the matter, as firſt to give a ſuccinct account of all the *phenomena*, collected from the obſervations I have already made: In the next place to deduce ſome concluſions from theſe, by means of which and of ſubſidiary propoſitions, fetch'd from natural philoſophy, I may attempt to enter into the nature of this *light*. Further open'd.

3. On account of the twofold appearance of the *lumen boreale* we may make two ſpecies of it; the firſt is common and more frequent in theſe parts, it poſſeſſes the north under the form of an arch, emits rays or lucid rods to the *vertex*, and ſhines with a calm light; the other which is leſs frequent occupies the heavens towards all points, is divided into parts, to which very ſhort, or for the moſt part, no rods at all adhere: Its light is generally thought to be undulating or tremulous: From what is to be ſaid farther on, it will be manifeſt that theſe two ſpecies do not in reality differ, and that this twofold appearance is produced by the ſituation alone. Two ſpecies of a *lumen boreale*.

4. The *phenomena* of the firſt ſpecies are as follows; 1. The lucid arch is diſpos'd in ſuch ſort towards the north, that its concave ſide regards the horizon, and its convex the vertex. 2. The higheſt part of the arch does always to ſenſe exactly occupy the north. 3. Its legs generally touch the horizon, 4. The higher the arch is, the more its legs are ſpread out. 5. I never obſerv'd the height of the arch to exceed 40 degrees, nor the amplitude of its legs, a ſemicircle. 6. The more depreſs'd the arch is, the neater and more regular is its roundneſs; and for the moſt part the higher it is, the more it is wont to be deform'd by interpoſing fiſſures, hiatus's, protuberances, flexures, *&c.* and ſometimes without any change of its altitude, an irregular arch falls ſenſibly into order and *vice verſa*. 7. It often happens that new arches are produced, which are uſually either higher or lower than the former; yet they always coaleſce with it, by which very thing it happens, that it ſeems to become either lower or higher. 8. Yet ſometimes it becomes higher and lower without the obſervable acceſſion of new arches. 9. The ſpace between the arch and the horizon is always dark; yet it very clearly tranſmits the rays of the ſtars, unleſs that ſpace be fill'd with dark clouds. 10. The interior rim of the arch is for the moſt part obſcure, the exterior lucid: But we cannot diſtinguiſh the confines of light and darkneſs; becauſe they gradually run into each other. 11. Rods, or ſometimes broader lucid tracts, extending in length, inſiſt on the exterior edge of the arch, and ſhine ſomewhat weaker than the arch itſelf: But it very often happens, that that part of the arch, from which the rods iſſue, ſhines more than the other parts. 12. All of them tend in a right line to the *vertex*, which they ſometimes reach, nay ſometimes ſeem to go beyond it. 13. Each rod is almoſt of the ſame breadth both in its beginning and end. 14. Each rod has almoſt an equable brightneſs, only that near the arch it is ſometimes obſerv'd brighter than near the *vertex*. 15. The duration of one rod is ſhort and uncertain; The *phenomena* of the firſt ſpecies.

it

it is uſually about 10 ſeconds. 16. Their riſe and diſappearing is generally ſudden; yet they ſometimes appear ſooner at the arch than in the *vertex*; and ſometimes this order is inverted: And thus likewiſe they ſuddenly diſappear in this or that order. 17. Sometimes, but rarely, the rods are not entire; and they ſeem to be cut, as it were, into pieces. 18. They generally move either towards the eaſt or towards the weſt; ſometimes ſlower and again ſwifter, ſometimes one is ſwifter than another; ſo that they overtake or outrun each other: But in the mean time neither is the ſtreightneſs nor the direction of the rods to the *vertex* changed. 19. They are ſometimes either few in number, or none at all, tho' the arch be very bright; and ſometimes they are ſo numerous, that the arch appears like a comb. 20. It often happens that ſeveral appear at the ſame time, and again diſappear at the ſame time. 21. The ſtars every where ſhine thro' them, except thro' the obſcure interior edge of the arch, which, if there be any, covers the ſtars. 22. It often happens that ſome clouds appear, which are higher than thoſe the *lumen boreale* has left under it; which, indeed, is manifeſt from the different colours and motions: For, it is impoſſible that clouds, ſeen in the ſame part of the heavens, ſhould diverſely move and be illuminated, unleſs on account of their height from the earth they differ much.

The *phænomena* of the ſecond ſpecies.

5. The *phenomena* of the ſecond ſpecies are the following; 1. At firſt ſight the heavens ſeem to be on flames; the light appears tremulous and flaſhing, almoſt in the ſame manner as in a heap of burning hot coals: But this coruſcation is ſometimes more, ſometimes leſs, and ſometimes ſcarce ſenſible at all. 2. Upon a cloſer attention we may obſerve little lucid clouds, or *nubeculæ* ſprinkled up and down; ſometimes this obſervation is eaſy; ſometimes difficult, either as the *nubeculæ* are denſe or rare, and as they burn ſlower or ſwifter. 3. When I have ſometimes obſerv'd ſuch a *nubecula* in the vertex itſelf, and it was now kindled, and now again extinguiſh'd, I obſerv'd it afterwards to become more obſcure, and gradually leave a black cloud beneath it, with which at length it was cover'd. 4. I afterwards obſerv'd the ſame thing in other *nubeculæ*, but I found that in the mean time, while they are kindled and extinguiſhed, they change their place and figure but little or nothing. 5. While they are kindled, they are wont to continue as long as the rods of the firſt ſpecies laſt[a]. 6. The *nubeculæ*, which are at a diſtance from the vertex, do ſometimes project lucid rods, but theſe ſhort and ſlender; and they are the ſhorter, the nearer they are to the vertex. 7. I have it from the relation of others, that ſometimes blue lightnings are interſpers'd with ſuch rods. 8. I rarely obſerv'd this ſpecies of the *lumen boreale* alone; it was for the moſt part accompanied with the firſt ſpecies above mentioned; and the one either preceeds or follows the other. 9. The light of theſe

[a] § 4. *ſupra* N. 15.

theſe *nubeculæ* is never ſo great as that of the arch uſually is [b]. 10. This light towards the horizon is often times more ſaturated than in the vertex; ſo that ſometimes the horizon all over ſhines, almoſt in the ſame manner as the northern arch itſelf [c].

6. The *phenomena* common to both ſpecies are the following; 1. Both ſpecies are wont to make their appearance from the autumnal to the vernal equinox: For, in ſummer I never obſerv'd them. 2. For the moſt part clouds, diſpos'd at firſt like ſo many ſcales, are wont to ſucceed the *light*, afterwards they are augmented, and gradually accumulated. 3. Both ſpecies for the moſt part chuſe to appear in a ſerene, or half ſerene ſky; yet I ſometimes obſerv'd them thro' denſe clouds, covering the heavens every where, and here and there opening. 4. The brightneſs of both *lights* is pale or whitiſh. 5. Both *lights* are ſometimes carried by a ſmall breath of wind towards any quarter of the heavens; but which is always contrary to the point towards which the wind in the inferior region of the air blows. I have hitherto found no inſtance that contradicts this *phenomenon*. 6. I have often obſerv'd that warm weather uſually preceeds or accompanies it; and that cold weather follows it. 7. If it happen to appear for ſome nights ſucceſſively, which is often the caſe, upon that the following *lights* become weaker, ſo as at length to be ſcarce viſible. 8. The duration of both lights is very variable; it is ſometimes for whole nights, and ſometimes for a few hours, as the air is either calm or agitated.

Phenomena common to both ſpecies.

7. From the conſideration of the above *phenomena* I conclude, that theſe two ſpecies only differ in appearance: For, moſt of their properties are common [d]; and ſuch as are thought to be peculiar to each of them, I ſhall hereafter explain from the diverſity of the ſituation alone, and this very diverſity is taken notice of §. 3. §. 4. N. 1, 2, 3. §. 5. N. 1.

The two ſpecies different only apparently.

8. As to the lucid rods I affirm, that they are produced from the reflection of the rays, emitted from the lucid matter, which is not in the place where we obſerve the rods. Whatever we ſee is by the means of rays, either direct, refracted or reflected: If the rods were ſeen by direct rays, their lucid matter, extended in length, muſt neceſſarily be, 1. In planes vertical to any ſpectator [e]; but theſe planes in the places of other ſpectators are inclined to the horizon; it would therefore, follow that the matter is every where in vertical and in inclined planes at one and the ſame time, a thing impoſſible. 2. This matter, in parts removed from the ſpectator, muſt be broader, and in nearer diſtances proportionally more ſlender: For, otherwiſe they could not every where appear equally broad [f]; but according to the different ſpectators this variety of breadth ſhould at the ſame time be various, as appears from optics, and the matter ſhould be diſpoſed according to the ſituation of the places, which different ſpectators,

The lucid rods accounted for.

[b] § 4. *ſupra* N. 1. [c] § 4. *ſupra*. [d] § 6 *ſupra*.
[e] § 4. *ſupra* N. 12. [f] § 4. *ſupra* N. 13.

tors occupy; but that is impoſſible, and therefore the direct viſion of the rods is impoſſible. If inſtead of different ſpectators you aſſume ſome *phenomena* obſerv'd at different times by the ſame ſpectator, the ſame concluſion muſt be made: For, there is no reaſon, why all the *lights* are always diſpos'd in a conſtant direction to the ſame ſpectator. If it was by refracted viſion, the lucid matter which is now kindled and again extinguiſhed[g], which is agitated by winds[h], which leaves groſs vapours behind it[i], and which flaſhes[k], muſt lie beyond the region of the refracting vapours. But all theſe things ſeem not to agree to that region. I add, that the ſun, moon, or the brighter ſtars ſhould likewiſe at ſome times produce ſuch rods, by refraction, which yet never happens in this manner; nor can it be ſhewn by optical principles, or by ſimilar caſes how it can be done: And thus likewiſe refracted viſion is excluded, and there only remains reflex viſion, which was the thing to be proved.

The place of the lucid matter, where?

9. As to the place of this lucid matter I affirm, that it is in that region of the air, where the clouds uſually ſtand: For, the inferior obſcure edge of the arch, to which the lucid arch is always contiguous, is to be reckon'd a cloud or vapour[l], and that principally, becauſe it is agitated by the winds[m]; ſeeing beſides, the *light* itſelf is wont to run into the clouds[n], nay, appears under the form of a *nubecula* or lucid vapour[o], and becomes denſer towards the horizon[p]. It appears that this matter has all the conditions of clouds, and conſequently their place and diſtance from the earth.

The figure of the inferior ſurface of the clouds.

10. That we may be able to form ſome more concluſions, I ſhall adduce ſome ſubſidiary propoſitions from phyſics; the firſt of which let be this: The clouds do hang in calm air in ſuch ſort that their inferior ſurface is plain, and every where equidiſtant from the centre of the earth: For, ſince the ſpecific gravity of the air in equal diſtances from the earth's centre is the ſame, but the clouds, which conſiſt of vapours of the ſame kind, ſtop there, where their ſpecific gravity coincides with that of the air, it is plain that the clouds reſt in that place which is every where equidiſtant from the earth's centre, and conſequently are expanded into a plain, parallel to ſenſe to the earth's ſurface, and that the more exact, the calmer the air is.

Vouch'd from experience.

11. This propoſition is vouch'd from experience, by which it appears that the nearer the clouds are to the horizon, their baſe, which is always parallel thereto, is the more rectilinear: The reaſon of which is, that the inferior plain of clouds, placed at a diſtance, is ſeen ſideways, and thus it appears like a line.

From reaſon.

12. It appears, beſides, both from reaſon and experience, that clouds hang over clouds: that is, that the plain of one cloud is at a greater diſtance

[g] § 5. *ſupra* N. 3 & 4. [h] § 6. *ſupra* N. 5. [i] § 5. *ſupra* N. 3. § 6. N. 2.
[k] § 5. *ſupra* 7. [l] § 4. *ſupra* N. 10. [m] § 6. *ſupra* N. 5. [n] *Ibid.* N. 2.
[o] § 5. N. 2. [p] *Ibid.* N. 10.

tance from the earth than that of another, which is ſometimes evidently obſerv'd upon the appearance of the *northern light*[q].

13. Another *lemma* is, that objects which are equally high in the air, ſeem the nearer to the horizon, the more remote they are from the eye of the ſpectator; and on the contrary, objects equally high, the nearer they appear to the horizon, they are likewiſe the more diſtant from the eye of the ſpectator: Theſe things we have borrow'd from optics, where they are rigidly demonſtrated. The appearance of objects as they are near the horizon or remov'd from the eye.

14. From the former *lemma* is alſo underſtood the following; if a line be pendulous in the air, placed at a diſtance from the vertex, and be extended along a parallel to the earth, and be equally diſtant from it, it will appear under the form of an arch, in the manner as the arch of the *northern light* does[r]: And on the contrary, if a line at an equal diſtance from the earth appear under the form of an arch, whoſe greateſt height is exactly towards the north, it will be extended in the air in a parallel to the earth. Theſe things will be eaſily underſtood by ſuch as are acquainted with optics; for which reaſon I may at preſent wave the demonſtration. The appearance of a line in the air, parallel to the earth.

15. Suppoſing theſe things, I affirm that the matter of the *northern light* is diſpos'd in the air almoſt in a parallel to the earth: For, this matter lodges in the region of the clouds[s]; it is, therefore, equidiſtant from the earth[t]: It moreover appears under the form of an arch, whoſe greateſt height is directed to the north[u]: And hence by § 14 it follows, that it occupies a tract in the air extended in a parallel to the earth; but I ſay nearly: For, the curvity of the northern arch is not always very exact[v]. The poſition of the *lumen boreale* in the air.

16. It is, moreover, well known from optics, that a body of an irregular and unequal figure is thought to have a more regular and equable figure, the more it is remov'd from the eye; and hence we underſtand, why the northern arch appears the more compleat, the nearer it is to the horizon[w]: For, in that caſe it is more remote[x]. The appearance of an irregular figure at a diſtance.

17. If a number of bodies be at random diſpers'd and thrown in any plain, they will likewiſe appear to the eye as disjoin'd, if it happen to be placed perpendicular to that plane; but the more the eye views this plane obliquely, the objects will ſeem to come the nearer to each other; nay, at length they will appear to form one continued body: In like manner the light or colour of each object will be increas'd and become more ſaturated. Theſe things again I ſuppoſe as very certain from optics. How bodies ſcatter'd in a plain appear to the eye in different poſitions.

18. The plains of the clouds about the vertex are view'd perpendicularly, but thoſe which incline to the horizon are view'd at a diſtance and obliquely. This *lemma* is underſtood from § 10. 11. Appearance of plains of clouds about the vertex and in the horizon.

19. On theſe I build the following propoſition about the *northern light*; the matter of this *light* is disjoin'd, and diſpers'd among bright *nubeculæ*. The *lumen boreale* accounted for.

But

[q] § 4. *ſupra* N. 22. [r] § 4. *ſupra* N. 1, 2, 3, 4. [s] § 9. [t] § 10. [u] § 4. *ſupra* N. 1, 2, 3, 4. [v] § 4. *ſupra* N. 6. [w] *Ibid.* [x] § 13.

But the former ſpecies of the northern light appears continued[y] and clearer[z], on this account, that in this caſe the matter of the *light* is viewed at a diſtance and obliquely: For, ſince this matter is diffus'd into a plain parallel to the earth[a], it appears in the vertex in the manner in which it is diffus'd; but it appears disjoined by §§ 17. 18. and therefore it is disjoined[b]: Beſides, ſince the former ſpecies only differs in appearance from the latter[c] it neceſſarily follows, that the matter of the former ſpecies is alſo disjoined: The matter, therefore, of both ſpecies is diſpers'd into lucid *nubeculæ:* But the former ſpecies always inclines to the horizon[d]; and therefore, it is view'd obliquely[e]: It muſt, therefore, neceſſarily appear continued and brighter[f]. Q. E. D.

The different *phenomena* of both ſpecies how explain'd.

20. From what has been ſaid it appears, in what manner the *phenomena*, by which both ſpecies differ from each other, may be explain'd.

The *phenomena* of the rods accounted for.

21. Now in order to explain the *phenomena* of the rods, I ſhall premiſe a propoſition or two; 1. If any lucid point do from above illuminate a horizontal plain ſomewhat wavy, and conſiſting of poliſh'd parts, and reflect the rays to the eye, then it will appear to the eye as a line or lucid rod, which from the lucid point is extended in a right line to the eye: This propoſition may be demonſtrated from optics; and we even learn it from daily experience: For, the moon or any bright ſtar irradiating the ſurface of ſtill water, repreſents to the eye ſuch a rod as I have been deſcribing.

Farther accounted for.

22. On this is founded another propoſition, namely that the inferior ſurface of clouds or vapours do again reflect downwards, in the form of a lucid rod, the lucid points that ſhine upwards: For, the inferior ſurface of the clouds is wavy, plain, and conſiſts of aqueous or poliſh'd icy particles[g]; but beſides, I learn'd the truth of this propoſition by experiment: For, I happen'd in the night-time, upon occaſion of a fire at the diſtance of 2 or 3 verſts from my lodging at *Peterſburg*, to run to the window with a friend of mine; and upon lifting up our eyes to the heavens we both ſaw a glowing rod, extended from the quarter of the fire to our eyes or to the *vertex*, and reflected by ſnowy clouds, and now increaſing and again decreaſing, according as the burning increas'd.

Farther confirm'd by a *phenomenon* of the ſun.

23. This propoſition is confirm'd by another *phenomenon*, which is not ſo uncommon at *Peterſburg*, as in *Germany* or *France:* It happens ſometimes in winter, that the ſun, either riſing or ſetting, is thought to project vertically upwards a lucid and whitiſh tail, and it is deſcribed in the *Memoirs* of the *Royal Academy* of *Sciences* at *Paris*[h], and it was very like that which was form'd by the above burning: For, this tail ariſes from the ſolar rays reflected upwards from the horizon into plains of vapours conſiſting of icy particles, and reflected to the eyes of the ſpectators, entirely in the ſame manner in which the lucid rods are produced on the ſurface of water[i].

Having

[y] § 4. N. 1. [z] § 5. N. 9. [a] § 9. 10. [b] § 5. N. 2. [c] § 7. [d] § 4. N. 5. [e] § 18. [f] § 17. [g] § 10. [h] An. 1703. p. 78. [i] § 22.

Having premis'd theſe things, I ſay that the rods of the *northern light* ariſe from the reflexion of the light in lucid *nubeculæ*[k], namely as theſe *nubeculæ* project the rays upwards into plains of very ſubtile vapours ſtanding above each other, from which it is again reflected under the form of rods; the rods ariſe by reflection[l]; therefore, from lucid *nubeculæ*[m]: For, there is no other light at that time in the air, and the brightneſs of the rods continues as long as the flaſhing of the *nubeculæ*[n]. But the reflecting plain of the vapours is above the *nubeculæ*, as appears from the alledged *phenomena*[o]; conſequently, it forms the rods in the manner mention'd §§ 21, 22, 23. By this propoſition are explain'd the *phenomena* § 4 n. 11, 12, 13, 14, § 5. n. 6.

The rods ariſe from the reflection of the light in *nubeculæ*.

25. If we, moreover, ſuppoſe that both the plains that hang over each other and the lucid *nubeculæ* may be agitated by a gentle wind, we ſhall eaſily explain the *phenomena* § 4. n. 16, 17, 18, 19, 20.

Some other *phenomena* of this light accounted for.

26. In like manner becauſe the lucid matter has above it vapours which it illuminates, and below it none, the reaſon of the *phenomenon* § 4, n. 9. is manifeſt.

Another *phenomenon* accounted for.

27. If liquor contain'd in any veſſel be on its upper part agitated towards any point, the inferior part of the liquor at the bottom will move to the contrary point: The truth of this is eaſily made appear both from reaſon and experience. It is, moreover, eaſy to conclude how the *phenomenon*, alledged § 6. n. 5. may be produced.

Another accounted for.

28. The explications hitherto advanced I take to have ſome degree of certainty: But there remain behind other *phenomena*, whoſe explication I promiſe not to be ſo certain. I ſhall declare, in ſhort, my opinion of them, after premiſing ſome ſubſidiary propoſitions.

Other *phenomena* not ſo eaſily accounted for.

29. I think it is evident from lightnings, that the air is all over full of inflammable ſpirits or very ſubtile vapours from the continual exhalations of the earth, abounding every where with ſulphur, nitre and ſalts; from the *caput mortuum's*, which extract from the air vitriols, ſalts, *&c.*

The air full of inflammable ſpirits or ſubtile vapours.

30. If ſuch inflammable ſpirits be copiouſly collected into too narrow a ſpace, they take fire and burn ſpontaneouſly. This propoſition is likewiſe prov'd by many phyſical experiments commonly known.

How they come to be collected and fir'd.

31. By chemiſtry we likewiſe learn, that the more ſubtile ſpirits are contracted by cold into a leſs ſpace; ſome with greater eaſe and others with greater difficulty. I ſpeak not here of that collection of ſpirits, by which they are condens'd and reduced into a fluid form, but of that only whereby they are brought into a narrower compaſs.

Accounted for chemically.

32. While the ſun recedes from the equator towards the ſouth, the northern regions of the air become cold, and that the more, the more northerly they are, and the farther the ſun removes: Beſides, the regions

From the abſence of the ſun:

[k] § 19. [l] § 8. [m] § 19. [n] § 4. N. 15. § 5. N. 5. [o] § 4. N. 9, 10, 11, 22, § 12.

of the air of the ſame parallel or climate, are affected with almoſt the ſame degree of cold, I ſay almoſt: For, there are alſo other concurring cauſes beſides the ſun; yet, doubtleſs, the abſence of the ſun is the principal cauſe of cold. This propoſition is manifeſt, and ſtands in need of no farther proof.

Theſe inflammable ſpirits mix'd with watery vapours.

33. To theſe I ſubjoin a propoſition, which indeed I cannot pretend to be very certain; yet I am oblig'd to ſuppoſe it, on account of what is to follow; and it is this; inflammable ſpirits are by means of heat blended and intangled with aqueous vapours; and they are afterwards ſeparated again upon the acceſſion of cold, as watery vapours unite ſooner than inflammable ſpirits.

By the action of the ſun or warm winds.

34. Now I ſay, the ſun being in the northern regions, or hot winds blowing, the air is heated; and the ſubtileſt aqueous vapours are mounted into it, and mix'd with the inflammable ſpirits[p]: Upon the receſs of the ſun to the ſouth, the ſucceeding heat, equally diſtributed in the ſame climate[q], collects the inflammable ſpirits, blended with the aqueous vapours, into very ſubtile *nubeculæ*[r], from which the inflammable ſpirits gradually extricate themſelves, and are collected above them[s], a ſufficient quantity of which being collected takes fire and burns[t]; and this being conſum'd, new ſtore is collected and ſet on fire: And thus the ſame ſcene is repreſented for as long a time as may be. And to this I think agrees what *Wolfius* has ſaid, when he call'd the matter of the *northern light* the *immature matter* of lightning.

35. From what has been ſaid we eaſily underſtand the generation of the lucid matter[u]; the diſpoſition of the ſame, according to the tract of any climate[x], and the ſo often repeated accenſion and extinction of the lucid *nubeculæ*[y]; and probably alſo the repeated flaſhes in ſummer time have a like original.

Other *phenomena* accounted for.

36. As the aqueous vapours are ſucceſſively depriv'd of the inflammable ſpirits, they become heavier, they ſubſide and become viſible; and ſuppoſing this and what was mention'd above § 17, we underſtand the reaſon of the *phenomena* § 4. n. 10. § 5. n. 3, 4. § 6. n. 2.

The diſtance of the lucid matter from the earth determin'd geometrically.

37. In this manner I have in ſome meaſure explain'd almoſt every thing which uſually relates to the *aurora borealis*: But the matter is more copious than that I could have entirely exhauſted it; I have been, therefore, forced to ſay a great many things conciſely for brevity's ſake. If opportunity and the ſubject bear it, I may ſome time hence enlarge on the diſtance of the lucid matter from the earth: For, I can determine it geometrically, the altitude of the arch and the horizontal amplitude of the legs being given, and if you alſo allow of the hypotheſis I advanced above § 15: For, let the ſine of the elevation of the pole be = *q*, the ſine of the greateſt

p § 29, 33. q § 32. r § 19, 31. s § 33. t § 30. u § 19. x § 15. y § 5. N. 3, 4.

greateſt altitude of the arch $= m$, the ſine of half the amplitude of the legs $= g$, the ſemidiameter of the earth $= a$, and the ſine of the angle, which is equal to the greateſt altitude of the arch and the altitude of the equator taken together be $= b$; thus the diſtance of the matter in the *vertex* of the arch from an obſerver $= \frac{2amqqgg}{r \times rrbb - ggqq}$. The invention of this rule and its application I ſhall give on ſome other occaſion.

38. At the cloſe of this Eſſay I thought fit to note, that the *northern light* was equally known to the ancients as to us. There were ſome who reckon'd it in the number of prodigies, and others took it for a meteor; and they inveſtigated its cauſe. Among the latter is *Ariſtotle*, who in his *meteorology* [a] deſcribes it very clearly. The light I call vertical he compares to the flame of ſtraw burning in an open place; and he calls the tremulous flames, αἶγες, *capræ*, and the other arch'd ſpecies, *chaſma*, a term uſual at that time and borrow'd from the interior black ſpace of the arch, which fittly repreſents a gulph, and he calls the rods, which he ſays aſcend from the *chaſma*, δοκοι, *trabes*. *Pliny* [b] in his *Natural Hiſtory* does alſo deſcribe moſt of the *phenomena* of the northern light. Such as reckon'd this meteor, as a thing extraordinary and ſurpriſing, are many in number. I ſhall add two ancient teſtimonies, ſupplied me by M. *Bayerus:* The firſt is extant in the *Chronicon Edeſſenum* [c] (which is found in *Jos. Simonii Aſſemani Biblioth. orient.* Tom. I.) in theſe words: 'In the year of the 'Seleucidæ 813 a great fire was ſeen in the north, which burnt all night.' The other is that of *Robertus Monachus*, who in *Lib.* V. *Hiſtoriarum Hieroſolymitanarum* for the year 1097 thus ſpeaks; 'in that night a comet 'ſparkl'd amongſt the other ſtars of heaven, and produced the rays of its 'light, and a fiery redneſs flaſh'd in the heavens between north and eaſt.' I add to theſe *Marcus Squarcialupus*, who in a diſſertation on comets has given a pretty good figure of the *light*, along with the following deſcription of it. 'The ſky in 1575 at the time of vintage in the month of *October* 'burnt for the whole night, or ſeem'd to burn; a thing never before ſeen 'by me; and, indeed, dreadful to all mortals: A great *light*, the moon 'being hid, aroſe in *Sileſia* and *Sarmatia*, like the dawn of the morning: 'There was in the horizon a part rais'd and lengthen'd into an arch; and 'from that lucid tract, from its uppermoſt extremity, large rays, now in 'one place, and again in another, burſt out in right lines: Which rays 'either ſtood for a long time immoveable and in form of a top, or they 'were diſſipated, and new ones immediately iſſu'd out, and (which I 'view'd with ſurpriſe) from the intervals of the rays broke out large tremulous flames, which immediately mov'd very ſwiftly one after another 'to the *vertex*; in which place not a few remain'd for ſome time; and 'again ſome evaniſh'd. I ſaw in the dead of the night from both extremities

The northern light no uncommon thing to the ancients.

[a] *Lib.* 1. *cap.* 4, 5. [b] *Lib.* 2. *cap.* 26, 27. [c] *F.* 407.

'mities of the *light* rays hurrying to the zenith and driving full-butt 'againſt each other like two armies; and at the zenith there was a juſtling 'and confuſion of the rays, advancing and charging on their adverſaries; 'and again retiring, mounting and writhing themſelves with an incredible 'variety of colours, as ſcarlet, violet, yellow and red. In this fight and 'engagement in the heavens, the eaſtern part giving way, the weſtern 'rays appeared the more powerful and victorious: And credulous people 'affirm'd, that a bloody war between us and the *Turks* was at hand, *&c.*' And hither I think are referable moſt other relations both ancient and modern about *armies*, *ſpears*, *military armour*, &c. ſeen in the heavens.

A remedy in an atrophy of the eye; together with obſervations thereon. By Joach. Georg. Elſnerus. *From the* Miſcellanea Naturæ Curioſorum. An. 1. Dec. 1. Obſ. XII. p. 37.

Tranſlated from the LATIN.

A remedy in a waſting of the eye.

AN atrophy or waſting of the eye ariſes either from a defect of the nutritious juice, from a diſcontinuing of a due degree of moiſtening, or from an exceſſive waſte of ſpirits. This diſorder, it is true, is rare and very difficult to cure; and in it medicines taken by the mouth, can ſcarcely be of ſervice: But a moiſtening ſpecific remedy muſt be applied, to be externally drop'd into the eye; as appear'd from a beginning atrophy in a young man, who was otherwiſe naturally dry, and who had got this diſorder by exceſs in venery and by hot provocatives thereto: So that the ball of his eye ſeem'd to be leſſen'd, together with a dryneſs and a ſlight heat with pain. And upon applying to me for advice, a ſingular moiſtening and cheriſhing medicine, in diſorders of the eye, ſeaſonably occur'd to me; and which a few weeks before I diſcover'd by chance in diſſecting the eye of a woodcock, which when I had ſqueez'd too much after a deep inciſion, I made the aqueous humour to ſquirt into my own eye; whereby it was moiſten'd and my eye-ſight improv'd; and I found it to relieve the pain and dryneſs with which my eye was then affected by too much poring. Upon this I adviſ'd the patient to drop into his eye this liquor, collected from the eyes of woodcocks and others of the cock kind; and uſe for his diet pullets boil'd with endive: And moreover to abſtain from exceſs in venery, and from the uſe of too hot medicines and food: And thus I brought about that his eye-ſight was ſoon improv'd, and that the balls of his eyes were reſtor'd to their former plumpneſs.

Scholium.

We are to obſerve, 1. That if we are to uſe this humour in medicine, it is not neceſſary, that it be always taken from the eyes of woodcocks: For, in my opinion, that from other animals, eſpecially ſuch as are more ſharp-ſighted, will have the ſame effect.

2. I reckon this natural compoſition to excel many of the moſt expenſive chemical liquors.

3. If any one has an opportunity of collecting this humour from the eyes of animals, and if he is only careful to conſerve it, by uſing other things, which ſhall not leſſen, but rather heighten its virtue, he will really have a ſingular remedy, and he may mix it up with other ſpecifics to improve it ſtill the more.

4. While we are treating of the eye and of a liquor appropriated to many diſorders thereof, we may carry our ſpeculations higher, and examine whether this liquor can be of ſervice, when the humours of the eyes are vitiated and exhauſted. No one will readily doubt of the reſtitution of the aqueous humour: For *Galen*[d] has ſeen its regeneration; and *Coiter* has likewiſe obſerv'd it[e]; and *Benevenius*[f] alſo adds his ſuffrage, and *Schenkius*[g] has illuſtrated theſe inſtances with ſome others. Now if nature be ſpontaneouſly employ'd in reſtoring the loſt aqueous humour, it will the better ſucceed by the co-operation of this truly appropriated liquor.

Nay moreover, I have no doubt but it may be alſo ſerviceable in reſtoring the vitreous humour: Yet its effect would be greater, if it were daily applied along with the vitreous humour; becauſe *Duncan Liddel*, an excellent phyſician, formerly ſupplied the defect of this humour by the whites of eggs; and that not without reaſon, becauſe the vitreous humour is entirely ſimilar to the whites of eggs, and theſe laſt are a vulnerary; and by conſolidating the coats they may effect the regeneration of the waſted humour. Thus *Henricus ab Heer*[h] writes, that he reſtor'd both the vitreous and aqueous humour to a cock, and alſo to a certain young woman by the juice of meadſweat, collected in the month of *May*. Whether it may alſo be of ſervice to reſtore the cryſtalline humour, will indeed be very hard to determine; for, almoſt all who have hitherto applied themſelves to this, ſeem unanimouſly to deſpair of the reſtoration of this humour; except a few, who, by the acuteneſs of their genius and their indefatigable labour, have arriv'd to ſuch a pitch, as after deſtroying the three humours to effect, by pouring in the juice of celandine, not only the reſtoring all the humours, but even the ſight to its priſtine vigour. *Caſpar Schottus*[i] has a few years ago furniſh'd us with an experiment, affirming that it was perform'd at *Prague* by a certain ingenious *Engliſhman* in the preſence of Dr. *Marcus*; but which is more, about a year ago *Franciſcus Joſephus Burrhi* in a letter to *Thom. Bartholin* has not only deſcrib'd this experiment, but has exactly delineated the ſecret, and by what artifice the humours are to be ſqueez'd out, and in what manner they are to be reſtor'd; and he has confirm'd the truth of this invention by many experiments: And that very accurate obſerver *Thom. Bartholin* writes to *Philip Jac. Sachs à Lewenheim* in

[d] L. 1. *de ſympt. cauſ. cap.* 2. [e] *In. Obſ. Anat. chir.* [f] *Cap.* 74. *de abd.* [g] *In Obſ. medicis.* [h] *Obſ. ſpad.* 4. [i] *In tech. curioſ. lib.* 11. *mirabil. Miſcellan. cap.* 22.

in a letter, dated *September* 30, 1669. to the following purpoſe; 'I 'doubt not but you have read of the contrivance of reſtoring all the 'humours of the eyes, of which the illuſtrious *Burrhi* writ to me: The 'experiments ſucceeded in a gooſe, tho' the wound made in the eye was 'ſomewhat with the deepeſt.' From which it very clearly appears, that it is poſſible by art to reſtore even the cryſtalline humour: But ſuppoſing this humour may be reſtor'd by art after ſqueezing it out by a ſkilful hand; yet if it be ſqueez'd out by chance, it is hardly poſſible to reſtore it.

For, a wound, made by chance or by a blow, is given with ſome violence; whereby it is impoſſible but that either the optic nerve muſt be hurt or the deeper fibres, which ſpring from the optic nerve, or the coats; which being hurt even in an artificial expreſſion, no reſtitution can be hop'd for.

An obſervation about the proportion of the conſtituent parts of the Blood. *From the* Acta Eruditorum. An. 1682. p. 126.

Tranſlated from the LATIN.

The conſtituent parts of the blood.

THE maſs of blood conſiſts of three parts, to wit, an aqueous *ſerum*, a gelatinous or fibrous ſubſtance and a ruddy tincture, or the blood, by way of eminence, ſo call'd: But becauſe in the blood, drawn off by veniſection, and afterwards coagulated, the abovementioned gelatinous portion is partly entangl'd in the ruddy tincture, and contributes to its thickneſs, and partly is diſſolv'd and diluted by the aqueous *ſerum*, there has hitherto been obſerv'd and ſuppos'd only a twofold ſubſtance, to wit, the ſerous and red part; till about the middle of the preſent century a more accurate examination of this animal fluid had diſcovered that gelatinous nutritious ſubſtance; but what proportion it bore to the other conſtituent parts of the blood was deſign'd for further enquiry: I was, therefore, for ſome time in great doubt about the organ and manner of ſanguification; or rather I conjectur'd, that poſſibly the proportion of the red part was but very ſmall, about whoſe efficient cauſe and manner of production ſuch diſputes were rais'd among Anatomiſts of great note, and which requir'd ſuch an apparatus and compaſs of *viſcera*, as the liver, ſpleen, heart, *&c.* towards ſanguification: Beſides, by the microſcope are obſervable in the blood ruddy globules floating in the limpid *ſerum*; and upon comparing the maſs of theſe globules with that of the *ſerum*, I found the former very unequal, and by far leſs in quantity than the latter: Yet becauſe it is probable, that ſtill much of this gelatinous ſubſtance is entangl'd in theſe red globules; nay as it was very certain, that I could not take upon me to diſtinguiſh and determine barely by the eye how much of this ruddy tincture was ſtill remaining in the vital blood; by the help of other contrivances I found in different animals and likewiſe in different human

man ſubjects, that the proportion of the *ſerum* and gelatinous part is to the red tincture, ſometimes as 10, ſometimes as 11, and ſometimes more parts, but never fewer, to one part of the ſaid tincture: But the laſt experiment, which I made on account of this theory upon the blood of a very ſound perſon, was as follows; to wit, I ſuffer'd ſo much blood running out of an open'd vein to mix with a pound of warm water, till I obſerv'd the weight of the water to increaſe three ounces and a drachm: Hence ſo much blood was abſorb'd and diluted by it. Upon filtring this ſolution, it left behind in the ſtrainer half an ounce and a drachm of a more viſcid gelly, while the remainder of it yielded by a gentle diſtillation a pound, an ounce and ſix drachms of an aqueous ſubſtance, with two drachms and a half of a dark red, grumous part, remaining at the bottom of the retort: So that three drachms and a half of the aqueous ſubſtance was either imbib'd by the filtring paper, or exhal'd in diſtillation. Yet becauſe the different colour of this *cruor*, which I obſerv'd by the microſcope, ſhew'd that it ſtill contain'd ſome ſmall matter of the gelatinous parts, I again macerated in warm water that little maſs, that I might elixate all the gelatinous part, and I afterwards filtred it; and after a gentle evaporation, there only remain'd of the grumous part or red tincture, two drachms and three grains, that is, ſcarcely a twelfth part of the ſanguineous maſs; which, therefore, ſhew'd, that what gives it the ſpecies and name of blood is very ſmall in proportion.

Of the Ore of Quickſilver. *By* Erick Odhelſtierna. *From the* Acta Literaria Sueciæ. Trimeſtre tertium Anni 1720. p. 59.

Tranſlated from the LATIN.

QUickſilver, as has been long ſince known, is found in its own peculiar and proper ore, as other metals are: And indeed, in the mine at *Idria* (ſubject to the archdukes of *Auſtria*, and ſo abounding in this metal, that all the quickſilver employ'd in *Europe*; nay, and a great part of that us'd in *America* is principally prepar'd here) it grows in ſuch ſort in its own peculiar grooves and veins, that, beſides this metal, there is no other found there; and even the very recrement of the vein, after the quickſilver is ſeparated from it, and the *minium*, which we call cinnabar, contain nothing beſides a lean and inſipid earth, entirely void of all other metal; nay of any mineral, at leaſt manifeſt and perceptible to us; neither is it obſerv'd in other grooves but very rarely, nor is quickſilver found in veins along with the nobler metals, as they are call'd, nor even with the baſer ones; at leaſt, for my particular, I never happen'd to ſee it, while I viſited the metallic mines in foreign countries, which are wrought

Quickſilver found in its peculiar ore.

at this day; nor could I get any clear or certain account either from the miners or inhabitants about it: Yet I own there is ſome mention made of this thing in the writings of good authors, who have treated of metallurgy; for, I have found the following words in *Joh. Mattheſius:* 'In that valuable and rich vein of St. *Laurence* groove, as alſo in the drift of St. *Dorothea* at *Schottenberg*, was likewiſe found a rich ore of mercury; and beſides, from the mines at *Plana* in *Bohemia* there was tranſmitted to us a pure pellucid ore like a carbuncle, and taken for rude red ſilver; but it was really found to be quickſilver upon its ſudden evaporation along with a fume in the fire.' And *Alonſo Barba*, who has deſcrib'd the metals of *America*, relates, that a certain ore from a mine of *Chalatiri*, four leagues diſtant from *Potoſi*, upon fuſing it, yielded a large maſs of ſilver, conſidering its bulk; and beſides, that in the leſs warm corners of the ſmelting furnace quickſilver was obſerv'd: Upon which the miners ever after treated this ore in a different manner; to wit, in that other manner by which quickſilver is uſually extracted from its peculiar ſtone; and they obtain'd a greater quantity of it, than even that noble ore of *Guancavillica* could ever yield.

Why mercury is not found in *Sweden*.

But there have been many obſtacles why we could not expect to find any ſuch thing in *Sweden*; for, the intenſe degree of cold, which prevails in our parts for a great part of the year, ſeem'd to many to hinder by its force and efficacy the ſubterraneous exhalations; and beſides, an abounding *acor* and a predominant ſulphur, with which our country and all our minerals are impregnated, and that far more plentifully than in other places, ſeem'd to ſuppreſs thoſe vapours, that they might be fixt in their aſcent, and conſequently loſe by this means their fluidity.

Yet ſome found at *Sahlberg*.

Yet we were told by men of credit, that when about the year 1660 two adventurers at their own private riſque ſunk that ſhaft in the great mine at *Sahlberg*, call'd *Penninge-ſhaft*, about the places of that groove, which have the name of *Juthylls-felt-orten*, upon breaking thro' the rock they fell on a certain bluiſh earth, that was denſe and very cloſe; and upon opening it, quickſilver trickled out of it.

And afterwards in greater plenty.

We are likewiſe told, that in the year 1689, when in the above-mention'd groove, *Juthylls-felt-orts-ſhaft*, an impending rock on the weſt ſide had tumbled down, being almoſt 100 ton in bulk, and afterwards as is common, when the rubbiſh of the rocks was broken to pieces, the workmen obſerv'd ſomething of the quickſilver, but trickling in ſuch ſort among the fragments of the veins, that but a very little of it could be collected; and thus the matter lay unregarded till of late, to wit, in 1696 in the abovementioned place, repreſented by *g*, a certain digger in ſearch of the veins obſerv'd drops of quickſilver plentifully trickling down. At the ſame time, and in the ſame place a ſmall ſtone, of five ounces weight, was cut out, which manifeſtly tranſuded drops of quickſilver, and view'd by the micro-

Plate III. Fig. 1.

Fig. 1.

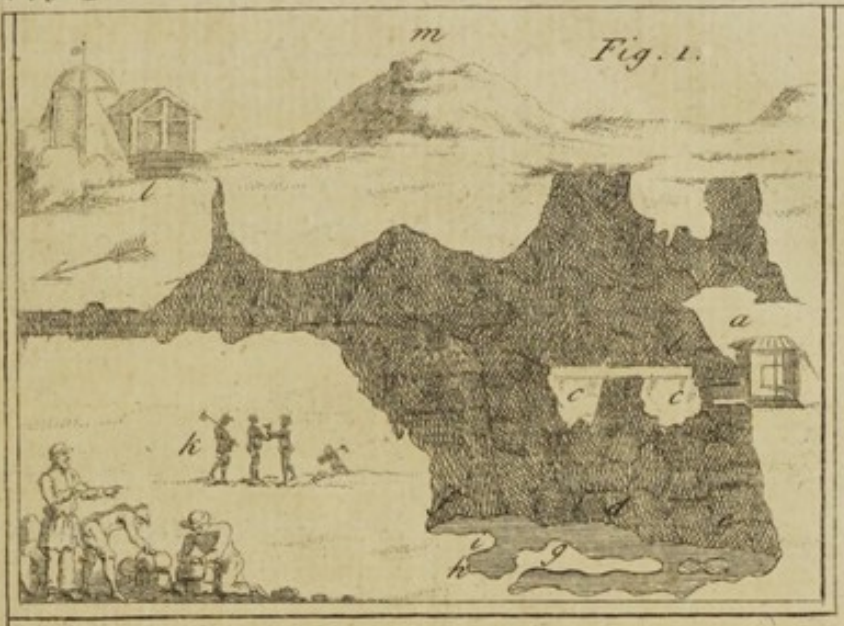
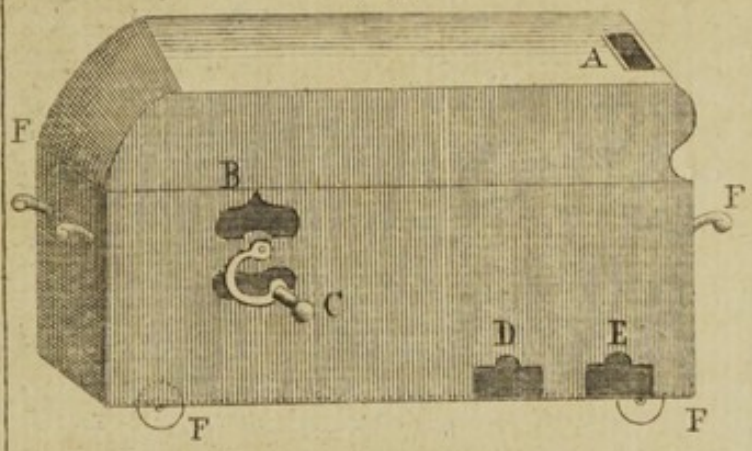


Fig. 5.



p 134

Fig. 6.

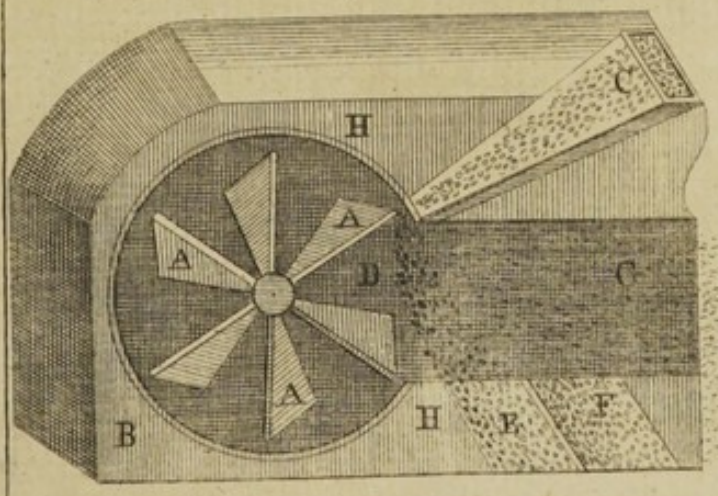


Fig. 16.

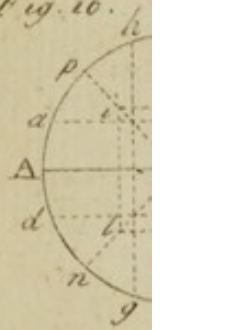


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PLATE. III.

Fig. 1.

Fig. 2.

Fig. 3.

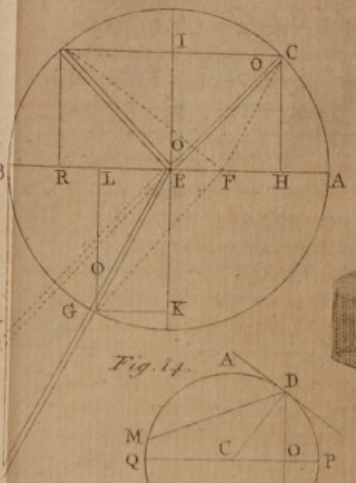


Fig. 4.

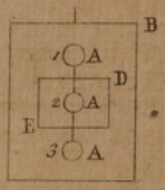


Fig. 7.

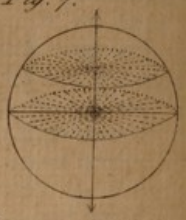


Fig. 5.

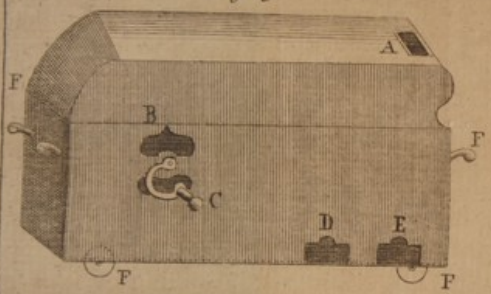


Fig. 8.

Fig. 9.

Fig. 11.

Fig. 14.

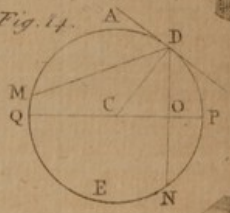


Fig. 16.

Fig. 10.

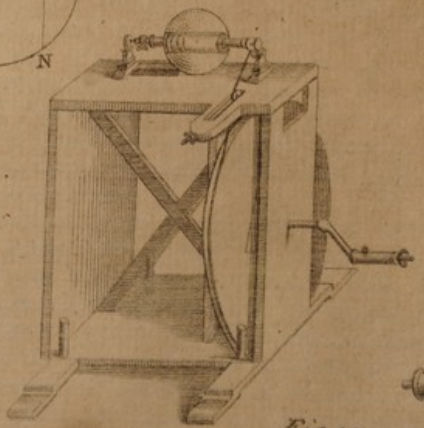


Fig. 12.

Fig. 6.

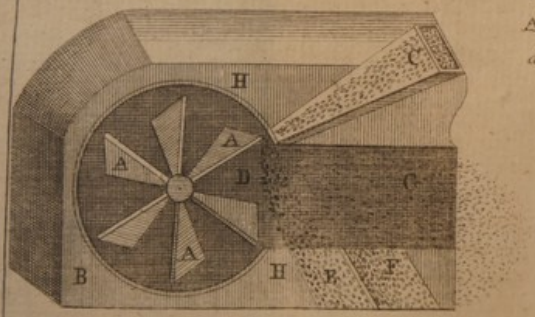


Fig. 17.

Fig. 13.

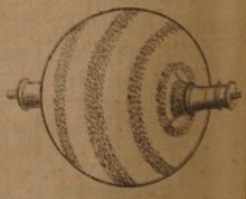
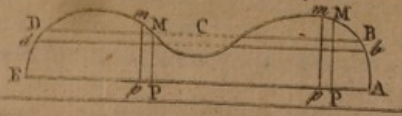


Fig. 15.



9. Smith del.

Hulett Sculp.

microſcope, appear'd all over cover'd with mercurial globules. From this, therefore, the opinion prevail'd and was more aſcertain'd, that the ore of this groove was mixt with quickſilver; which was indeed hitherto call'd in queſtion by ſome, till again a ſtone of four pound weight was brought to me from the ſame drift, on which mercurial globules appear'd very thick, not only by the microſcope, but to the naked eye; ſo that they might be ſtruck off with the edge of a knife: But when the level was to be driven towards *h*, and without the metallic vein, which was between *d* and *i* from north to ſouth, nothing was found but a kind of barren ſubſtance; ſo that all further hopes of obtaining quickſilver vaniſh'd, eſpecially ſince now another kind of rock offer'd to the miners; and the ſilver vein itſelf was gradually ſtruck out: In fine, if any quickſilver happen'd to adhere to the coat of the vein, it muſt have been quite diſſipated and carried off by the continual fires, by which the rock in mines is to be ſplit: But in the month of *February* this year, the workmen were order'd to purſue that rich ſilver vein, which they had before left in the rock near *d*; and conſequently make their fires between *e* and *f*: Then again the quickſilver appear'd in a broken piece of 20 pound, and manifeſtly diſcover'd mercurial globules: When therefore, by this means, all doubt was at length remov'd, and it appear'd to every one, that this noble vein extended its mercurial produce farther than at firſt it ſeem'd to do, and that it was not included in ſmall ſtones, ſcatter'd up and down the rock; upon this orders were given, that two tons of the metallic ſtone of the above-mention'd drift, as alſo a quarter of a ton of the barren rock next the vein ſhould be brought, which, indeed, at firſt ſight differ'd but little from the uſual ore of this groove: Yet after they were brought to the teſt in the king's laboratory, and more cloſely examin'd by fire and water, we found the metal throughout all its parts to contain ſuch a quantity of quickſilver, that tho' on account of the predominancy of the ſilver it cannot, indeed, be call'd an ore of mercury, but more properly a kind of mercurial ore of ſilver; yet it ſufficiently evinced, that this mercury was equally diffus'd thro' all the vein, ſeeing it yielded ſuch a quantity as was ſufficient to compare its nature with common mercury: The ore, therefore, purſued in this manner, having ſufficiently ſhewn that more quickſilver might have remain'd in it, had not the rock been ſplit by fire, by which the greater part of the metal, either during the flames or after they are extinguiſh'd, was forc'd out by the heat remaining in the ſtone. The uſual method by fire was, indeed, for ſome time laid aſide, and the ſplitting the rock attempted by other methods; but it was ſo very hard and refractory, that in whatever manner the cleaving of it was attempted, the ſucceſs was but little; and now as, on account of this mercury, the uſual working for ſilver could no longer be interrupted; the workmen were again allow'd to burn out the drift, and that till ſome new ore caſting up ſhould make them alter

their meaſures; and this was the event of the attempt. Yet the following things ſeem to deſerve our accurate and careful thoughts. 1. That this is the only ſubterraneous place in the *Sahlberg* mines, in which, as far as appears, quickſilver is found; and that chiefly indeed in that ſide which extends from *e* thro' *d* towards *f*. 2. A kind of ſlender fibre of a white and ſoft *aſbeſtos* was obſerv'd all over this drift from *g* towards *h*, dividing the rock horizontally; and the ſame was ſeen in the oppoſite ſide *d*: But from *g* towards *h* the ſame fibre diſtill'd a kind of milky and peculiar liquor, ſeveral bottles of which were collected and kept; and this we call a metallic *gur*. 3. Upon examining it after inſpiſſation, it every where ſhew'd traces of ſilver. 4. In the upper groove of this mine, as alſo in a deeper and lower one, ſilver was found in its peculiar ſtone, rude, white, and plated. 5. Near *g* and *i*, where likewiſe the quickſilver diſcover'd itſelf, ſeveral little ſtones were found, which only by the fire, uſually employ'd in breaking the vein, had drops of pure ſilver ſpontaneouſly fus'd, and ſticking very thick on their ſurface, ſuch as the ore of *biſmuth* uſually ſhews in roaſting, which, indeed, is unuſual in ſilver ore. 6. Every vein that gave ſilver yielded at once four or five ounces of ſilver; and this in the ſame manner when the ſilver was roaſted, or either before or after the mercury was ſeparated from it. 7. The vein gave its quickſilver without any addition, whether it was powder'd ſmall, or left in entire ſmall pieces; yet it was more readily, and in a ſhorter time, driven out of theſe pieces than out of the powder. 8. It does not hitherto appear that the coat of the vein, or the rock next the ore, contains any mercury.

Reflections on what has been ſaid.

From what has been ſaid above, we may be led to the following reflections; 1. Whether and how far that milky liquor, which we have call'd a metallic *gur*, contributes to the growth of metal, or along with the ſubterraneous waters contains in itſelf thoſe mineral exhalations that aſcend from the bottom, and retains and fixes the ſame in their proper *matrix*, to wit, at that time when the above-mention'd *gur* has acceſs to the vein thro' patent chinks; and that before it is infected and tainted with other more ignoble minerals and wild juices, whoſe burning exhalation afterwards hinders ſome prime and nobler metallic matter from taking place? 2. Whether quickſilver, however it may owe its original to other pre-exiſtent matters, is requiſite to the production of metals in a certain nearer degree than is commonly thought? 3. Whether a ſoft or hard kind of rock is together with the mercury requiſite to the production of that rude, plated or capillary ſilver? Or whether ſuch vegetation is not diſturb'd by ſulphureous fumes? So that thereby ores may be produc'd, if not always baſer, yet quite different in appearance: On which occaſion we may at the ſame time enquire into the difference between that virgin mercury of the vein of ſilver, and that commonly call'd mercury, or that even call'd the mercuries of bodies, that is, ſuch as are prepar'd by art from metals already com-

compleated? Where probably at the ſame time the cauſe of that *phenomenon* might be diſcover'd, which is obſerv'd, when the ore of lead, thrown alternately with nitrous ſalts thro' a retort furniſh'd with a tube, is roaſted, where indeed the metal is ſtrongly diſſolv'd, but at the ſame time the workmen are in imminent danger of loſing their lives. 4. And laſtly, whether we may not find ſtrong arguments for refuting thoſe who perſuade themſelves, that at this day no metals are generated? But that they ſtill perſiſt in the ſame ſtate in which they were at the creation of the world, or at leaſt, when by the various breaches and ruins of the earth every thing was diſſipated and blended.

Of the Cure of the Bite of a Mad Dog. From the Breſlaw Collection, Auguſt 1717. Claſs IV. Art. V. p. 169.

Tranſlated from the HIGH-DUTCH.

The bite of a mad dog cur'd by dipping in the ſea.

AT the beginning of this month Prince *Philip* of *Bavaria* had the misfortune at *Rome* to be bit by a mad dog; and the phyſicians upon a conſultation came to this reſolution; to wit, that the Prince ſhould be brought to the ſea, and there dipt in ſalt water; which was accordingly done three ſeveral times; whereby, as we are inform'd, he was effectually freed from all the grievous conſequences of this bite: We have ſufficient reaſon to obviate this dangerous evil in time, without reſting ſecure in the fond hopes, that poſſibly the bite was not given with that tooth of the dog, which, as ſome would falſely have it, is alone infected, and which others again ſuppoſe not to be noxious; a fable which deſerves no more credit than the worm *litta*, ſaid to be under a mad dog's tongue: It is certain, that without ſuch *chimera*'s we have ſufficient reaſon to provide againſt the otherwiſe extenſive ill conſequences of this bite, which either ſoon or often in ſome time, as in 40 days or more, uſually brings on grievous ſymptoms; and in particular the *hydrophobia* or *pheughydron*, that is, the dread of water, its grand *pathognomonic*, and commonly afterwards, death. The cauſe of this extraordinary ſymptom is hitherto an inſolvable ſecret in phyſic, as in the ſting of the *tarantula*, the deſire to dance. *Aetius*[a] has obſerv'd that mad dogs tho' very thirſty, yet dread to drink; and it is well known, and which *Joſephus de Aromatariis*[b] in particular has fully ſhown, that this madneſs is nothing other than a peculiar ſpecies of *angina* or *cynanche*, in which the throat and tongue are inflam'd, that when they would ſwallow down any drink, it cauſes great uneaſineſs; and hence it is again diſcharged at the mouth and noſe: So that by all means they uſually avoid drinking. This diſeaſe is commonly caus'd in dogs, when either in very

[a] L. 6. c. 14. [b] *Tr. de rabie contagioſa.* part 2. cap. 7. in fine. and part 3. throughout.

very hot or in very cold weather they greedily lapp what is either too cold, or too warm[e]: Beſides, a mad dog with other ſymptoms has alſo this, that he is giddy and ſtaggers; and conſequently, on that account dreads water, tho' not for this reaſon, becauſe he hates to ſee his own image therein.

The riſe of this cure.

Nothing hitherto has been found more effectual againſt this bite and the whole diſeaſe, as dipping the wounded member or rather the whole body in ſalt water, and eſpecially ſea water: Yet with this obſervation, namely, that where either there is a perfect *hydrophobia*, or the wound has been unſeaſonably clos'd up, this means is of little or no avail, of which *Foreſtus*[d] alledges an inſtance. As, therefore, the riſe of this cure appears to be hence, that as the patient, even in the greateſt degree of thirſt, extremely avoids water and all drinks, either the phyſicians or other people on this occaſion took the hint of curing contraries by contraries; and ſo violently attempted to throw the patient into the water. At firſt this was done only in freſh cold water, of which there is no ancienter teſtimony, as far as we know, than that of *Celſus*[e], who ſays, 'the grand remedy is to 'throw the patient ſuddenly into a pond, and if he cannot ſwim, ſome-'times to keep him under water and make him drink, and ſometimes 'pull him up again; but if he can ſwim, to plunge him, that he may 'drink whether he would or no: And thus both his thirſt and dread of 'water are remov'd': And in this manner alſo *Apollonius Thyanæus*[f] cur'd the mad dog, which he threw into the river *Cydnus*, and cauſed ſwim for ſome time. In modern times in particular, either as the place was more commodious, or from a particular regard to the ſalt or ſome other quality, ſea-water has been us'd; and that eſpecially in *France*, the *Netherlands*, and other ſea-coaſts[g].

The *hydrophobia* not unknown to the ancients.

We ſhall only add, that this diſeaſe of the *hydrophobia* was not entirely unknown in the days of *Ariſtotle* and *Hippocrates*, as *Hier Mercurialis*[h] has fully ſhewn, on which account he has been oppos'd by *Joſephus de Aromatariis*[i], and by *Caſpar à Reyer*[k]: At the leaſt *Plutarch* expreſsly ſays, that both the *hydrophobia* and *elephantiaſis* were firſt known in the days of *Aſclepiades*, who liv'd at *Rome* under *Pompey*, *the Great*; Whence alſo *Ovid*, who liv'd but a little after *Aſclepiades* teſtifies, that at that time there was ſtill no remedy known againſt this diſtemper.

Nec formidatis ulla (medicina) *medetur aquis.*

Till at laſt in *Celſus*'s days a remedy was found, namely the dipping in a pond, but of which he alſo ſays, that it was the only one at that time that was wont to be us'd againſt it.

A new

[e] Vide *Reyer camp. Elyſ.* qu. 61. p. 787. [d] Lib. 10. Obſ. 28. [e] Lib. 5. cap. 27. § 2. [f] Philoſtratus *in vit. Apollon.* lib. 6. cap. 18. [g] Vid. *Foreſtus l. c Condronchus de hydrophobia* l. 2. c. 8. p. m. 200 [h] *Variar. lect.* lib. 1. c. 2. p. m. 2. ſeq [i] Part 1. cap. 9. ſeq. [k] l. c. p. 794.

A new Hypotheſis about Vapours By J. Chauvinus. *From the* Miſcellanea Berolinenſia. Tom. I. p. 120.

Tranſlated from the LATIN.

1. THAT vapours and exhalations furniſh the matter to meteors, as fogs, clouds, rain, ſnow, thunder, *&c.* and that they are carried aloft and for ſome time remain pendulous in the air, is what we muſt conclude: And indeed, all philoſophers unanimouſly do ſo. But how both theſe things happen, we ſhall attempt to explain. The deſign of this eſſay.

2. And in the firſt place we contend, that there are, or at leaſt that it is poſſible for numberleſs bubbles to be made up of air and water, much like thoſe ſoap-bubbles which are uſually produced by blowing thro' a pipe, put into ſoapy water; but ſo far are theſe bubbles form'd, as the air is collected, as it were, into a ball, or preſs'd by the circumambient water, a thin plate of which at leaſt does continually on all hands equally preſs and encompaſs the included air; nor do I aſſume this without proof, for, experimental phyſics do not only prove, but alſo demonſtrate, that in a natural way bubbles are made up of air and water: For, upon putting a glaſs-veſſel half full of water under the glaſs-recipient of an air-pump; and afterwards exhauſting ſome part of the air, it is eaſy to obſerve that a great many particles of air, conceal'd in the water, riſe from its inferior pores to its uppermoſt ſurface; nay, and emerge a little, or run into bubbles or ſpherules, which indeed exhibit to the eyes of the ſpectators nothing other beſides particles of air, cover'd over, as it were, with thin pellicles of water. The manner how bubbles of air and water are form'd.

3. In the ſecond place we contend, that the aereo-aqueous bubbles emerging from fluid bodies are ſometimes rais'd aloft by the air, and then conſtitute vapours, and that from theſe are produced vaporous exhalations, where very ſubtile particles of terreſtrial mixts, chiefly ſulphureous or ſaline, are included in very fine particles of water: But they are, therefore, rais'd either as vapours or exhalations, becauſe while the above-mentioned bubbles are formed, the elaſticity of the air, of which they conſiſt, is very much weaken'd or diminiſh'd; and ſo they are the leſs able to reſiſt the preſſure of the circumambient air, whoſe elaſticity is either entire, or at leaſt ſtill very vigorous. How they are rais'd in the air.

4. That theſe things may appear the more clearly, we are in the firſt place to premiſe, that by the elaſticity of the air I underſtand its expanſive force, by which the circumjacent bodies are preſs'd, impell'd, *&c.* In the ſecond place that the elaſtic force of the air is the greater, the more its parts are compreſs'd or forced into a leſs ſpace; and that it is the more and more diminiſh'd, and at length entirely deſtroy'd, as the ſame particles of air diffuſe into a greater local ſpace, till they acquire the greateſt poſſible And that by its elaſticity.

poſſible degree of expanſion. In the third place, that that expanſive force of the air exerts itſelf, or unfolds more and more, ſo long as the circumjacent bodies do leſs and leſs reſiſt it. And in the fourth place, that at length it is entirely deſtroy'd, when there are no bodies, which are capable of compreſſing and inflecting the particles of air: Thus the expanſive force of the arms, folded together, or of the fiſt, clench'd cloſe, is broken, and ſucceſſively more and more diminiſh'd, as the arms are ſtretch'd out into wider arches, or as the fingers do more unfold themſelves; nor at length can they dilate further, when, upon removing every obſtacle, either the arms or fingers undergo no inflexion or curvature at all.

Farther prov'd.

5. After premiſing theſe things, no one, doubtleſs, will deny that bubbles, made up of air and water, may be forced or driven upwards by the circumambient air, nay oftentimes actually rais'd aloft, if it ſhall firſt appear, that it is endued with the greateſt elaſticity, or at leaſt its elaſtic or expanſive force weaken'd the leaſt poſſible, but that the air, included in the above-mention'd bubbles, has the leaſt degree of elaſticity remaining and almoſt none at all: But this is made out in this manner, namely that the external air being in nowiſe alter'd, or preſerving its elaſticity entire, which at leaſt it before had from its native conſtitution, the air running into a bubble expands itſelf as much as may be, till it is reſtrain'd by an involving pellicle of water, and contain'd within its compaſs; and of this you may be convinced by your own eyes, if you obſerve the particles of air aſcending from the bottom of the glaſs veſſel, mentioned above: For, in their aſcent they are more and more enlarged, till they ariſe in ſpherical bubbles; but they are, therefore, increas'd and enlarged, becauſe after exhauſting the air incumbent on the outmoſt ſurface of the water, they are preſs'd by a leſs weight: And being freed from ſo ſmall a weight by their own elaſticity, they remove a little the water incumbent on them; and therefore, they ſwell a little, as it were, and as they approach nearer the ſurface, being ſtill preſs'd by a leſs weight, they exert a greater elaſticity and dilate themſelves the more, and thus they more ſtrongly propel the ſuperior parts of the water; and at length in part break out, nay and very often eſcape involv'd in the outmoſt particles of the water; but as theſe things happen, their expanſive force muſt be ſucceſſively diminiſh'd, as is manifeſt to any one: And therefore, they are eaſily rais'd aloft by the incumbent elaſtic air.

The bubbles not rais'd by the weight of the external air, but by its elaſticity.

6. Some one may perhaps affirm, that theſe bubbles do not conſiſt of air alone, but likewiſe of aqueous particles, to which alſo are often added ſulphureous or ſaline particles: And that hence we gather that theſe cannot be propell'd upwards ſo eaſily, nay not at all by the circumambient air, tho' conſiderably elaſtic, and tho' the elaſticity of the air of the bubble be weaken'd; becauſe the weight of the aqueous and terreſtrial parts, with which the bubbles are involved, is an obſtacle. But this objection is of

no

no great weight: For, the force of the air protruding upwards thoſe mixt bubbles is not aſcrib'd to the weight of the external air apart; but chiefly to its elaſticity, as we have plainly hinted. The air, indeed, preſſes by its weight, and as by gravitating it tends downwards, it does alſo preſs and protrude downwards the bodies on which it is incumbent; and this preſſion is ſo great as the quantity of the air is conceiv'd to be: But we doubt not to aſſert, as it is a thing that may be demonſtrated from the ſwelling and breaking of a bladder, that the air has another ſort of preſſure from the conſtitution of its parts, or from its elaſticity, which diffuſes itſelf every way. But it appears by the ſame experiment, that the preſſive force of the air ariſing from its elaſticity is far greater than from that of its innate gravity; as in iron, wood, and other more ſenſible bodies, which are bent or inflected, the preſſion ariſing from their elaſticity is far greater than that from their native gravity: Whence it is immediately concluded, that the air, however lighter than theſe mixt bubbles, is by its elaſticity able to propel and drive the ſame upwards, and that with a great force, till they become in *æquilibrio* with the upper air; which the higher it is, has the leſs degree of elaſticity, ſo that theſe exhalations do then remain pendulous therein.

Chemical Gold, or the Tranſmutation of the baſer Metals into Gold. By Philip Jac. Sachs à Lewenheimb. *From the* Miſcellanea Naturæ Curioſorum. An. 1. Dec. 1. Obſ. 17. p. 65.

Tranſlated from the LATIN.

Arguments againſt tranſmutation, from the impoſtures in it.

IT is ſtill a diſpute, whether any other gold, beſides that which nature prepares in the bowels of the earth, can be produc'd by art, entirely ſimilar to natural gold, or much more noble than it, as the philoſophers by fire and the adepts would have it? There are a great many who abſolutely deny it, and that for various reaſons, and from the inſtances of ſo many impoſtures; as of ſome who dip into ſolutions of gold and ſilver wooden ſticks, with which they ſtir theſe metals, and impregnate them therewith: Others mix powder'd coals with ſolutions of gold and ſilver: Others make an ink of gold and ſilver, with which they inſcribe on paper the matter to be reduced: Others inſtead of ſand, ſprinkle with *calx* of gold and ſilver the letters written on paper: Others employ crucibles with a double ſpace between, the lower of which is full of gold and ſilver, and this they break in the proceſs: Others employ ſticks internally hollow and full of gold and ſilver: Others fill the coals with gold, and cover the crucibles with them: Others ſecretly and by ſlight of hand throw in gold and ſilver: Others inſtead of common mercury take an amalgam of gold; beſides

beſides many other methods which impoſtors have contriv'd, and which are rehears'd by *Crugnerus*[a], *Kircher*[b] and *Michael Mejerus*, who in his *examen* of chemical cheats, deſcribes above 29 other impoſtures[c].

From the diſagreement among chemiſts.

Such as deny the tranſmutation alledge the great diſagreement among chemiſts themſelves about its proper matter, while ſome ſearch for it in ſulphur; others in vitriol; others in mercury, fixt in a maſs of alum; others in arſenic; others in an uncommon mercury, ſuch as the returning ſun in the month of *March* diffuſes every where, and which is to be gather'd ripe in the month of *October*[d]; and ſome even in cheaper materials: Hence *Kircher*[e] would chuſe the mean way, and neither aſſert the impoſſibility of tranſmutation, nor even that it is perform'd in the manner alchemiſts ſuppoſe, ſo as to be genuine and much more noble and pure than the natural gold; and he rejects that operation of the ſtone, which conſiſts in calcination, in the ſeparation, conjunction, putrefaction, coagulation, cibation, ſublimation, fermentation, circulation, and in fine, projection of the four elements: But againſt this opinion of *Kircher*, *Solomon de Blawenſtein*[f], as alſo *Valerianus Bonvicinus*[g] have written with great acrimony. But *Zwölffer*[h] oppoſes *Kircher* with greater moderation. Many on the contrary aſſert the tranſmutation as a certainty; and they attempt to teach its preparation. *Joh. Dan. Mylius*[i] gives us a catalogue of them from the *Arabs*, *Greeks*, *Spaniards*, *French*, *Italians*, *Engliſh* and *Germans*. And *P. Borellus*[k] enumerates their writings.

The facts that favour tranſmutation.

It is not my deſign to ſet up for umpire in this diſpute, nor do I adduce the teſtimonies of paſt ages and the inſtances of *Raymond Lully*, *Arnoldus de Villanova*, *Paracelſus*, *Sendivogius*, *Anton. Bragadinus*, a *Venetian*, *Treviſanus*, *Turnheiſerus* and others, who are ſaid to have made chemical gold; ſeeing in our curious age ſome very certain experiments were made, outweighing the reaſons adduced to the contrary; and the preſenting theſe to the reader, may, it is hop'd, be acceptable, as they are taken from authentic accounts.

Dan. Sennertus[l] ſays that the other metals may be reduced into gold, a thing that has been often prov'd in our days; and what *Alexander Seaton*, a *Scotſman*, has done at *Cologne*, *Baſle* and other places, is very well known; on which head may be ſeen the hiſtory of the tranſmutation of metals by *Ewaldus de Hogelande*, and the writings of *Andr. Libavius*, which he publiſh'd in defence of the art of tranſmutation.

To derogate from the teſtimonies of ſo many excellent perſons, ſays *Cornelius Martinus*[m], of *Antwerp*, who in their writings ſolemnly affirm, that

[a] *Informator chymicus*, p. 53. [b] *Mund. ſubter.* lib. ii. ſect. 2. f. 281. [c] *Examen fucorum pſeudochymicor.* p. 32. 37. [d] *Fons chymicus philoſ.* p. 90. [e] *Mund. ſubter.* lib. ii. f. 2. c. 1. f. 250. [f] *In interpellatione brevi ad philoſophos contra alchymiſticum. Mund. ſubterran. apud Bernates*, 1667, *edita.* [g] *In lance tripatetica.* [h] *Mantiſſ. Spagyr.* part 1. cap. 1. f. 324. [i] Tractat. iii. *Baſil. chym. præf.* l. 1. [k] *Bibliothec. chymic*, Paris 1654 Edit. 12. [l] *Nat. ſcientiæ.* lib. 5. cap. 1. [m] *Analyſ. Logic.* cap. 8.

that they had ſeen with their very eyes, and not only felt with their hands, but that they had accompliſh'd the tranſmutation of one metal into another, would ſeem to be acting the part of an imprudent perſon, and not that of a philoſopher. When in a public diſputation this *Cornelius Martinus* refuted by many arguments the notion of the ſtone, a certain nobleman ſtanding up in the company, order'd coals and lead to be brought him; and in the preſence of *Martinus* and others, throwing a certain tincture into the fus'd metal, by means of it he tranſmuted the melted lead into gold; and upon this *Martinus* recanted his former opinion[n].

Joh. Baptiſta Van Helmont[o] confeſſes of himſelf; 'I am obliged to 'believe the ſtone that makes gold and ſilver, becauſe at different times 'with my own hand I made the projection of one grain, I think, upon 'ſome thouſand grains of hot quickſilver; and to the admiration of many 'who were preſent, the buſineſs ſucceeded in the fire, as books do promiſe. 'That ſtranger who gave me the gold (for he gave me about half a 'grain, with which I tranſmuted nine ounces and three quarters of quick-'ſilver) had at leaſt ſo much of it, as was ſufficient to tranſmute '200,000 pounds into gold.' He confirms the ſame thing in his treatiſe *de vitâ æternâ** towards the end; and more fully in his treatiſe, entitul'd *Demonſtratur theſis*[p].

In 1648, one grain was ſent to *Prague* to the Emperor *Ferdinand* III. with which three pounds of mercury were converted into gold[q]. The ſtory is more accurately told thus by others; the nobleman, who in the preſence of his Imperial Majeſty reduced with one grain of the powder, mercury into gold, was call'd *Richthauſen*, and whom the Emperor made a Baron, with the title of *De Caos*. From this tranſmuted gold his Imperial Majeſty order'd to ſtrike a medal with particular inſcriptions on each ſide; on one ſide, the figure of a naked young man, with a ſun inſtead of a head, and in his right hand lifted up holding *Apollo*'s lyre; and in his left hand hanging down, *Mercury*'s *caduceus*, with this device, *divina metamorphoſis exhibita Pragæ* XV *Jan.* 1648, *in præſ. S. Cæs. Maj. Ferdin.* III. On the reverſe, *raris hæc ut hominibus nota eſt ars, ita rarò in lucem prodit. Laudetur Deus in æternum, qui partem infinitæ ſuæ ſcientiæ abjectiſſimis ſuis creaturis communicat.* This medal, afterwards found in the Emperor's ſcrutore, was by the Emperor *Leopold* given to *Zwölffer* to be ſtruck and grav'd in braſs, as *Zwölffer* himſelf teſtifies in his *Mantiſſa pharm. Spagyr.*[r] where we have a figure of it, as alſo in *Becher*'s *Oedipus chymicus*[s]. In what manner, and from whom this *De Caos* had the powder, *Monconnys* gives an account[t] (as the Electoral Biſhop of *Mentz* at the diet of *Ratiſbon* in 1664 had informed him) whoſe words are to the following purpoſe; 'there

n *Zwölff. Mantiſs. Spagyr.* f. 328. col. 2. o *Tractat. arbor. vit.* p. 793. *p. 743.
p S 58. ſeq. p. m. 671. Edit. Amſtel. q Harſdörffer *in ſpeculo hiſtoric. hiſt.* 80. r f. 329.
s p. 185. t *Voyag.* Tom. II. p. 378.

'there liv'd one *La Buſardiere* in the houſe of a certain nobleman (ſup-
'pos'd to be the Count *de Schlick*) at *Prague*; this man, falling ill and at
'the point of death, writ to his acquaintance *De Caos*, and begg'd of
'him to come to *Prague*, as ſoon as poſſible; but the ſick man died ſome
'hours before *De Caos* came, and after his arrival enquiring whether he
'had left any thing, the maſter of the houſhold ſhews him a certain pow-
'der, entruſted to his care, tho' he did not know its uſe. This powder
'was carried off by ſtealth by *De Caos*, and with it he made ſeveral pro-
'jections; the firſt of which was made in the preſence of the late empe-
'ror, who caus'd ſtrike a medal of this gold, on one ſide of which was
'the character of mercury, and on the reverſe, the day and year it was
'ſtruck.' This far *Monconnys*, who in the deſcription of the medal which he had not ſeen, differs from *Zwölffer*, who was an eye-witneſs, and conſequently is of greater credit in his account of it.

Beſides, *Monconnys*[u] was told at *Ratiſbon* by Count *de Par*, chamberlain to the late emperor, that an unknown perſon had offer'd the emperor a little of a powder that remain'd at the bottom of a ſmall box, which powder along with the box, being put on a fuſed maſs of equal parts of mercury and ſilver, exhibited, without burning the box, ſo ſtrong a tincture, that after that extraordinary red maſs was broken and cut thro', it internally exhibited a great many red veins like blood, an indication that the powder was ſtill too ſtrong. After re-fuſing that maſs with the addition of new matter of the ſame weight as at firſt, all that was converted into gold was upwards of 24 carats in reſpect of colour. This perſon had receiv'd the powder from another, and therefore he knew not the ſecret of preparing it.

The ſame Count *de Par* told, that at another time a certain old man came to the emperor, and brought him a little of a certain powder, and begg'd that it might be tried, becauſe he believ'd it would poſſibly be of ſome uſe. The emperor orders, that he ſhould return within three days; and upon trying the powder, eight ounces of mercury were converted into perfect gold: Upon which the emperor order'd to bring the man, but by this time he was gone, and never after ſeen[w].

Strobelberger, an apothecary at *Ratiſbon*, told *Monconnys* how a certain merchant of *Lubeck*, (who but little applied himſelf to merchandiſing, but was maſter of the art of fixing and converting lead into gold) gave *Guſtavus Adolphus*, king of *Sweden*, a maſs of gold of 100 pound weight, of which the king order'd to coin ducats; and to diſtinguiſh them, on one ſide was the king's effigies, and on the reverſe, the royal arms, with the chemical characters of ſulphur and mercury on each ſide: And from the above-mention'd apothecary *Monconnys* had one of the pieces. The merchant after his death, tho' for many years before he had given over trade, and tho' he

[u] Ibid. p. 371. [w] Moncon. *Voyag.* Tom. II. p. 371.

he was never ſucceſsful in it, left an eſtate of 17,000,000 crowns[x]. I myſelf had a preſent made me of one of theſe ducats by *Ludovicus de Schonleben*, and mark'd with the characters of ſulphur and mercury, of which I have given a figure, as alſo of that other of the biſhop of *Mentz*; that not only the truth of what was ſaid might appear, but that if the like coin ſhould happen to fall into the hands of others, they might be able to diſtinguiſh them. Fig. 2. Plate III.

Georgius Fredericus de Greiffenclau, archbiſhop of *Mentz*, order'd to coin ducats from mercury converted into gold, and they are mark'd with the character of mercury, as in the figure, and ſuch a one I have in my *muſæum*.

Beſides the projection, made by *De Caos* in the preſence of the emperor, he perform'd another before the great vicar of *Mentz* and the archbiſhop himſelf; and this, as the elector himſelf told *Monconnys*, he effected with all the precautions which philoſophers uſually employ in ſuch an operation: He took a ſmall pill like a lentil, prepar'd from that powder with gum tragacanth, that uniting together they might the better cohere, he roll'd up this pill in wax, which he put into the bottom of the crucible, and laid upon it four ounces of mercury, and put it into a fire of ſuppreſſion. After a ſtrong blaſt-heat for half an hour, upon removing the coals, the gold was ſeen fus'd, yet with very red rays, which are otherwiſe commonly green. He, therefore, thought that the gold was ſtill too generous; and that, therefore, it was neceſſary to take it down by the addition of ſilver. The elector himſelf threw in ſome bits of ſilver; and after a perfect fuſion, when it was pour'd into the ingot, there was a beautiful maſs of gold, but which was found ſomewhat acrid, the cauſe of which *De Caos* aſcrib'd to the ſmell of braſs, which happen'd to be found in the ingot, that, therefore, it was very proper to ſend it to the mint to be run, after which it was very beautiful and ſweet; and the warden of the mint affirm'd, that he never ſaw a more beautiful piece, that it was above 24 carats; and what is greatly to be admir'd is, how that acidity could be taken off by one ſingle fuſion; and the elector promis'd *Monconnys* a bit of this gold[y]. *Becher* in his *Oedipus Chymicus*[z] does alſo confirm this very thing; 'the ſame perſon, *ſays he*, who gave the tincture to the emperor *Ferdinand*, 'repeated the ſame thing ten years ago at *Mentz*, in the preſence of the 'elector and other great perſonages, in a pretty large quantity: And this the 'warden of the mint there, who coin'd ducats of this gold, can teſtify.'

The ſame elector affirm'd, that with one grain of powder he had ſeen three marks of gold made from two pounds of mercury; and that, upon taking them out of the crucible, as they were too high colour'd, by the addition of three or four drachms of ſilver they were all converted into gold[a]. In

[x] Id. *ibid. p.* 381. [y] *Ibid. p.* 378. [z] *Tit.* 7. §. 6. *p.* 186. [a] Moncon. *Voyag.* Tom. II. *p.* 372.

In what manner an unknown perſon, meanly dreſs'd, and pretending to be born in the north of *Holland*, came *December* 27, 1666, to *Joh. Frederic Helvetius*'s houſe at the *Hague*, and gave him a bit of powder, as big as a rape-ſeed; with which, roll'd up in wax and thrown into ſix drachms of melted lead, the lead was tranſmuted into gold, the ſame *Helvetius* relates in a treatiſe, entitul'd *Vitulus Aureus* [b]. This gold, put into the hands of *Borelius*, general aſſayer of the mint in *Holland*, and examin'd by quartation, was found ſo extraordinary, that it ſtill tranſmuted ſome part of the ſilver thrown into the gold in the aſſay.

The honourable Mr. *Murray*, in a letter to *Monconnys* [c], dated *Auguſt* 17, 1664, likewiſe teſtifies that prince *Rupert* had it from the preſent elector of *Mentz*, that the projection of gold was ſucceſsfully perform'd in his preſence; and that the ſame prince *Rupert* had, in 1662, given to king *Charles* a large piece of gold, made at *Inſpruck* by the ſame perſon, who gave the powder to the elector; and this ſtory Mr. *Murray* mention'd in the preſence of *Moncqnnys*, as alſo the aſſay he had made of the gold by the king's orders.

The grand principle of Optics, Catoptrics, and Dioptrics. By G. G. L. *From the* Acta Eruditorum An. 1682. p. 185.

Tranſlated from the LATIN.

The common principle of optics, catoptrics, and dioptrics.

THE primary hypotheſis, common to theſe ſciences, and from which every direction of the rays of light is geometrically determin'd, may be this; light comes from the radiant to the point to be enlightned in the eaſieſt way poſſible; which way is in the firſt place to be determin'd with reſpect to plain ſurfaces, but it is accommodated either to concave or convex ſurfaces, taking in the conſideration of their plain tangents: Yet I have here no regard to ſome irregularities, which probably take place in the generation of colours and in other extraordinary *phenomena*, which in optical practice are not regarded.

The way of a direct ray. Fig. 3. Plate III.

Hence in ſimple optics the direct ray comes in the ſhorteſt direct way from the radiant C, to the point to be enlightned E; namely, the medium remaining the ſame, that is, in the right line CE.

The angle of incidence equal to that of reflexion.

In catoptrics the angle of incidence CEA, and of reflexion DEB, are equal: For, let C be the radiant, D the point to be enlightned, and AB a plain ſpeculum, the point E of the ſpeculum reflecting the ray to D is ſought; I ſay it is ſuch, that the whole way CE + ED is the ſhorteſt of all, or ſhorter than CF + FD, if, to wit, any other point F of the ſpeculum were taken: This ſhall be obtain'd, if E be taken ſo, that the angle CEA and DEB are

[b] *Cap.* 3. *p.* 26, *ſeq.* [c] Moncon. *Voyag. Tom.* II. *p.* 70.

are equal, as is plain from geometry. *Ptolemy*, and others of the ancients, have employ'd this demonſtration; and it is extant both in *Heliodorus Lariſſæus* and other authors.

The co-fines of the angles of incidence proportional to thoſe of refraction.

In dioptrics, the fines of the complement EH and EL of the angles of incidence CEA and of refraction GEB have always the ſame ratio, which is reciprocal to the reſiſtence of the medium's. Let IE be air, EK water, or glaſs, or any other medium denſer than air, the radiant in air C, the radiand under water G; the way of the ray is ſought, or that E be the point in the ſurface of the water AB that refracts the ray coming from C to G, this point E ſhould be ſo taken as to be the eaſieſt way poſſible: Now in different medium's the difficulties of the way are in the compound ratio of the length of the ways, and of the reſiſtence of the medium's. Let the right lines m and n repreſent the reſiſtence with reſpect to light, the former that of air, and the latter that of water; the difficulty of the way from C to E will be as the rectangle under CE and m; from E to G, as the rectangle under EG and n: Therefore, that the difficulty in the way CEG may be the leaſt poſſible, the ſum of the rectangles $CE \times m + EG \times n$ ſhould be the leaſt poſſible, or leſs than $CF \times m + FG \times n$; aſſuming any other point F beſides E, E is ſought: Since therefore the points C and G, as alſo the right line AB are given in poſition; we ſhall, therefore, call the right lines perpendicular to the plane CH, c; and GL, g; and HL, which is alſo given, h: But EH, which is ſought, we ſhall call y; and EL will be $h - y$, and CE the $\sqrt{cc + yy}$, which we ſhall call p, and EG will be the $\sqrt{gg + yy - 2hy + hh}$, which we ſhall call q: $m\sqrt{cc+yy} + n\sqrt{gg + yy - 2hy + hh}$, (or $mp + nq$) ſhould, therefore, be the leaſt quantity poſſible; and that it may be ſuch, y is ſought. By my method *de maximis & minimis*, which, above all others hitherto known, ſurpriſingly contracts the calculus, at firſt ſight, and almoſt without any calculation, it appears, that mqy will be equal to np; $h - y$, or np to mq, as y to $h - y$, or the rectangle $CE \times n$ to the rectangle $EG \times m$, as EH to EL: Therefore, ſuppoſing CE and EG equal, n the reſiſtence of the water in reſpect of light will be to m the reſiſtence of air, as EH the fine of the complement of the angle of incidence CEA in air, to EL, the fine of the complement of the angle of refraction GEB in water, or the fines of the complements will be in the reciprocal ratio of the reſiſtence of the medium's, which was the thing aſſerted: If, therefore, EL in one inſtance, or experiment, be found to be $\frac{2}{3}$ of EH, it will be alſo in all others, wherever C and G are taken, the former in air, the latter in glaſs; if E be in air and G under water, EL will be $\frac{3}{4}$ of EH nearly.

The principle mention'd above deduced from final cauſes.

We have, therefore, reduc'd all the laws of rays, verified by experience, to pure geometry and calculation; by employing one principle only, taken from the final cauſe, if you rightly conſider the matter: For, neither does the ray proceeding from C conſider, how it may in the eaſieſt manner arrive

arrive to the points E, D, or G; nor is it of itſelf referr'd to them; but the Creator of the univerſe has ſo form'd light, that from its nature that beautiful *phenomenon* ſhould ariſe: They, therefore, greatly err, to uſe no harſher expreſſion, who with *Des Cartes* reject final cauſes in phyſics; ſeeing beſides the occaſion of admiring the divine wiſdom, theſe cauſes likewiſe furniſh us with a very beautiful principle for finding the properties of thoſe things, whoſe more intimate nature is not hitherto ſo clearly known to us; that we may be able to uſe the proximate efficient cauſes, and to explain that machinery the Creator has employ'd to produce thoſe effects, and to obtain his ends: We hence alſo underſtand, that the thoughts of the ancients upon theſe things are not ſo deſpicable, as ſome moderns hold: But it ſeems probable to me, that theſe great geometricians, *Snellius* and *Fermat*, men very converſant in the geometry of the ancients, have transferr'd to dioptrics the method the ancients us'd in catoptrics; and indeed, I ſuſpect, that *Snellius*'s theorem, which *Iſaac Voſſius* adduces from his three books of optics, which were not publiſh'd, was diſcover'd by a method almoſt ſimilar, tho' I think not with ſuch eaſe of calculus, as I have here employ'd: But that it follows from my calculation, I ſhall thus ſhew: Let the circle CBG be deſcrib'd from the centre E with the radius EC or EG, and let CE meet its tangent at B produc'd in V and EG in T; let the eye be in C, and the object which is ſeen under the water in T, and the point T will appear to be in V; becauſe we ſeem to ſee it along the right line CEV: Yet ſince we really ſee it by the broken line CET, it is plain that EV is the ſecant of the angle of incidence CEA, or its equal VEB; and that ET is the ſecant of the angle of refraction GEB; but, from a known propoſition in trigonometry, the ſecants are reciprocally as the ſines of the complement; therefore, directly EV is to ET as EL to EH, or (by our *theorem*) as *m* to *n*: The eye C, therefore being in a different medium than the object T, the apparent ray EV in the medium of the object (water) to the true ray ET in the ſame medium of the object (water) as *m*, the reſiſtence of the air, the medium of the eye, to *n*, the reſiſtence of water, the medium of the object; which ratio, as it is always the ſame, the medium's remaining the ſame, the ratio, therefore, between the true ray ET and the apparent ray EV will be always the ſame, which was *Snellius*'s theorem.

Fig. 3. Plate III.

The reaſon why the co-ſines of the angles of refraction and incidence are proportional not well explain'd by *Des Cartes*.

In the ſame manner ſeeing the ratio of EL and EH, the co-ſines of the angles of refraction and incidence, is, according to us, reciprocal to the reſiſtence of the medium's; it will always be the ſame, which is *Des Cartes* theorem; tho' his opinion about the reſiſtence of medium's be different from, nay contrary to mine: Wherefore, not without reaſon, does *Spleiſſius*, a man very converſant in theſe ſtudies, upon obſerving this coincidence of concluſions, doubt whether *Des Cartes*, when in *Holland*, had not ſeen *Snellius*'s theorem; for, he obſerves that it was a common thing

thing with him to omit the names of authors, and he gives his *vortices* as an inſtance, at which *Jordanus Brunus* and *Joh. Kepler* had hinted in ſuch a manner, that they ſeem to have only wanted that term: Add to this, that *Des Cartes* ſetting about to demonſtrate this theorem by his own ſkill, fell into great difficulties: For, becauſe he ſaw that the ray CE, carried from air into water, is there refracted in EG, and thus towards the perpendicular EK, and therefore, render'd more ſimilar to that ray (whoſe action is ſtronger) namely the perpendicular ray, he ſuſpected that it met with leſs reſiſtence in water, or glaſs, than in air: Whereas ſuppoſing the contrary, which is much more agreeable to reaſon, and employing our principle of the eaſieſt way, we may arrive at the ſame concluſion. Whence *Fermat* rightly gather'd, that *Des Cartes* had not given the true reaſon of his theorem; and likewiſe the compariſon, by which he endeavours to illuſtrate his explication, is but little to the purpoſe. Let the ball A, running on a ſmooth table BC, in the place 1A meet in the middle of its courſe part of the table DE, cover'd with tapeſtry, when it will run ſlower in 2A: In the ſame manner, therefore, he thinks, that glaſs, or any other ſolid body, leſs hinders the rays of light than air, which is not ſo ſmooth; but (not to mention that the parts of water are ſufficiently yielding, according to *Des Cartes* himſelf) it is ſufficient to conſider that the ball, when it comes from 2A, after having paſs'd over the tapeſtry DE, again comes to a ſmooth part of the table in 3A, and cannot there recover its former celerity, which it had in 1A, before it met the tapeſtry; yet ſince the ray of light does again enter from a greater reſiſting medium into a leſs reſiſting medium ſimilar to the firſt, and recovers its former ſtate; and ſuppoſing that the ſurfaces of two ſimilar medium's, to wit, the firſt and the laſt, be parallel planes, it may receive a direction by the latter refraction, parallel to that which it had before the former refraction. Fig. 4. Plate III.

Yet the manner in which *Des Cartes* explains both reflexion and refraction of light, in imitation of the motion of other bodies, ſeems to be worthy of his genius, and not to be rejected but only amended: For, as to reflexion, he ſhould have in the firſt place explain'd, why any ball as I, falling along the perpendicular IE on the plane AB is from thence reflected: For, we obſerve that ſome bodies, namely ſuch as are ſoft, are not equally reflected, the true cauſe of which reflexion is the elaſticity either of the ball or plane, or both; for, an elaſtic plane will yield a ſmall matter, as we obſerve a ſtretch'd membrane or inflated bladder do to a falling pebble; and indeed, it will yield ſo much the more as the ſtroke is ſtronger; and reſtoring itſelf with ſo much the greater force, it reflects the impinging body towards the ſame parts, and with the celerity it came: For, tho' *Des Cartes* could not bear this explication of reflexion, advanc'd by ſome of his cotemporaries, as appears from his letters, yet at this day it

Des Cartes manner of explaining refraction and reflexion not to be rejected but amended. Fig. 3. Plate III.

it is verified both by reaſon and by experiments. Since, therefore, the
Fig. 3. Plate III. ball comes from C to E in the right line CE, and conſequently with a motion, compounded of two others, to wit, the horizontal, as CI or HE, by which it comes from CH to IE, and the perpendicular as CH or IE, by which it comes from CI to HE, both beginning at C and terminating in E: And as the ſurface AB does not oppoſe but is parallel to its horizontal *conatus*, coming into E from CH towards IE in the right line CI or HE; it will, therefore, retain unchang'd both the celerity and direction of its horizontal motion; and the ſame ſpace of time it ſpent in coming from CH to IE, it will likewiſe ſpend in coming from EI to RD, ſuppoſing the intervals between CH and IE, as alſo between IE and RD to be equal: But the perpendicular motion, whereby it came from CI to HE, retaining its velocity, will be chang'd into the contrary direction, that it may ſpend as much time in which it may return from ER to ID; ſince therefore ER is equal to EH, and RD equal to CH, the triangles CHE and DRE will be ſimilar and equal; and conſequently, the angle DEB will be equal to the angle CEA. All this will be more manifeſt, if we ſuppoſe the ruler CID parallel to the ſurface AB, and retaining its paralleliſm thro' CH and DR to impinge on AB in HR, while in the mean time a ball in the ruler CI is carried from C to I: Whence in reality the whole compound motion of the ball will be in the diagonal CE; but the ruler CID reflected by the ſolid ſurface AB will return with the ſame celerity, and by the ſame way it came, and in an equal time will again come to CID; while in the mean time the ball continuing its motion in the ruler, has advanced with the ſame celerity; and therefore, in the ſame time arrives from I to D thro' ID = to CI: For, the celerity remaining the ſame, equal ſpaces are run over in equal times: The ball, therefore, with a motion compounded of its own motion upon the ruler thro' ID and that of the ruler along EI, to wit, returning from HR to CD, will be carried from E to D along the right line ED.

Refraction how explain'd. In order to explain refraction, we are to conſider that the greater reſiſting medium to light (yet without opacity) ſeems to be that which more hinders the diffuſion or diſtribution of light thro' more parts of the medium; and it may be call'd leſs illuminable: For, the nature of light endeavours to diffuſe itſelf. On the contrary, by how much more the light equably affects the parts of the medium it illuminates, or communicates its force to a greater number of inſenſible particles of the illuminated place, the medium will be the more illuminable, and leſs reſiſt light: Whence the more ſolid and ſmall the parts of the medium affected by light are, or the leſs ſpace they leave between them for another heterogeneous matter, not affected by light, the medium will be ſaid to be the more illuminated: But it appears from mechanical principles, that the ſame ſtroke, impreſs'd on ſeveral bodies at the ſame time, communicates a

leſs

leſs force to each than if the ſtroke had been given to one of them: It will, therefore, happen that in a medium which more reſiſts the diffuſion of light, or which is affected in a leſs number of its parts, each part is ſo much the more ſtrongly affected; in a more illuminable medium more parts are affected, but weaker and with a more languid impreſs'd ſtroke: Aſſuming now the motion of the ball inſtead of the ray, and ſuppoſing the ball coming from G to E, there to impinge on a medium, which ſhall retard its celerity or *impetus* in a ſeſquialteral ratio, ſuppoſe: If, therefore, in a minute of time it comes from G to E in the former medium KE; in the new medium EI the ſame ball will come from E to C in a minute and a half, ſuppoſing EC and GE to be equal in whatever point C is. But ſince the ſurface AB that ſeparates the medium's ſhall not oppoſe the horizontal celerity in GK, LE and the parallels thereof upon the balls firſt entering into the new medium EI, or in the very point E (for, the horizontal motion LEH only grazes along the ſeparating ſurface AB) but in the firſt moment of its entering or in the point E (conſidering the ball as indefinitely ſmall like a point, as rays themſelves are uſually conſider'd without breadth) the inclination of the line CE is to be preſently determin'd: It is, therefore, to be taken at the very firſt; ſo that, in reſpect of the horizontal motion, the velocity may remain the ſame, and ſuch as it was aſſum'd at the beginning of its ingreſs into the new medium, ſuch it remains therein: The ball, therefore, while it went in the former medium from G to E, had abſolv'd in a minute of time with the horizontal direction, the interval GK or LE (between GL and KE) it now in a minute and a half of time, in which it ſhould move from E to C, will accompliſh in the ſame horizontal direction the interval EH or IC, (comprehended between EI and HC,) which ought to be ſeſquialteral of the former LE; becauſe the horizontal velocity remaining the ſame, which is not changed by refraction, the ſpaces are as the times: EH, therefore, is to EL in the direct ratio of the times, or the reciprocal ratio of the celerities or reſiſtences; for, we have ſhewn in the caſe of the light, whoſe diffuſion is impeded by the reſiſtence of the medium, that the velocity or *impetus* increaſes according to the reſiſtence, and languiſhes according to the greater facility of diffuſing itſelf in each part. On the contrary, that the ray recovers its force, and conſequently, its direction, when again it comes into a medium where there is a leſs diffuſion, and more rays are employ'd in impelling a fewer number of parts; and this recovery *Des Cartes*, as we mention'd above, could not explain by his compariſon of the tapeſtry, or any other rough body.

Of the Iron-works at Malmitz *near* Sagan *in the Principality of* Glogau *in* Sileſia. *From the* Breſlaw Collection, September 1717. Claſs IV. Art. III. p. 61.

Tranſlated from the HIGH-DUTCH.

Inſtances of the growth of iron-ore.

THE preparing iron from the ſtone at *Malmitz* is indeed no new work: But as not long ſince a fiſtulous ore of iron was obſerv'd among it, ſuch as ſome time before was alſo found at *Lauſnitz*, and according to *Aldrovandus* in his *Muſæum metallicum* at *Sagan*; where ore is dug, and the grooves afterwards fill'd up with earth, in ten years, good ore may again be found therein; and as *Staniſl. Rein. Acxtelmeier*[a] relates of the iſland *Elba*, near *Florence*, that in like manner iron grows there; ſo that in ten years, there is again as much iron as was at firſt taken out.

Deſcription of a fiſtulous ore.

This fiſtulous ore of iron is of a yellow brown caſt, pretty hard, and a finger thick, and long more or leſs, and of ſuch a form as *Aldrovandus* in his *Muſæum metallicum*[b] repreſents, and calls *ſtalactites fiſtuloſa:* But whether our ore may be thus denominated, can remain no doubt, as it alſo runs from a trunk into branches; and like the *oſteocolla* of *Maſlaw*, or the arboreſcent foſſil found there in the ſand [c], it alſo runs into the drain'd iron-ſtone, and may be likewiſe had in entire pieces, if the brittleneſs of the ore, before it is harden'd by the air, do not hinder, or rather if it is not ſpoil'd by the heedleſſneſs of the workmen: And mixt in ſmall pieces, along with the common iron-ſtone, and commited to the furnace, it gives good iron, only that on account of its ſtubbornneſs it is ſomewhat hard to run.

Teſtimonies about the growth of this ore.

Aldrovandus undoubtedly borrow'd the remark about the growth of iron from an author alledged by *Hennelius* [d], who ſpeaks to the following purpoſe; '*George Agricola*, a man converſant in metals, and greatly 'ſkill'd in metallurgy, and of extraordinary diligence and learning, ex-'preſsly aſſerts it[e]: And *Jodocus Willichius* on *Tacitus*'s *Germania*, as alſo '*Petrus Albinus* in his *Chronicon Miſniæ metallicum*[f], teſtify the ſame thing; 'and *Georgius Fabricius*[g] relates, that iron dug up in *Sileſia* is ſupplied by a 'new increaſe; and that the earth and the trunks of trees do in that increaſe 'acquire the matter of iron, at the firſt, like a kind of thick liquor, which 'is afterwards more and more hardened'. And this *Hennelius* himſelf muſt have believ'd, ſince a little before he writes; 'the iron which is 'dug up out of the meadows of *Sileſia* near *Sagan*, is again in ten years 'ſupplied by a new growth, and again dug up; in the ſame manner, as the

[a] Idea *harmon. correſpond.* p. 199. [b] Lib. 1. p. 143
[c] Vide *Leon. Dav. Hermanni* Maſslographia, part 2. cap. 11. p. 182. lin. 188.
[d] *Sileſiographia renovata* cap. 3 p. 340. Ed. Vratiſl. 1704. quarto.
[e] *De Veter. & nov. Metallis*, lib. 2. cap. 15. [f] Tit. 7. [g] *Obſ. Metal.* cap. 8.

'the iron of the iſland *Elba*, the lead of the *Monte Feſulano*, and the 'copper near *Apollonia* in *Dalmatia*: So that there is always a conſtant 'ſupply of iron.' The account we had of this *Malmitz* ore is as follows: 'the grooves, out of which the ore is dug, are again fill'd up; but that 'earth yields no iron-ſtone, it is rather the ſubtile irony ſubſtance, which 'along with the ſand is waſh'd from the ore and paſſes through the ſieve, 'that yields the ſtone; this irony matter ſucceſſively begins to ruſt, ſo 'that in five or ſix years they may there dig again; yet the matter 'is not ſo good as what has been a growing for ſeveral years together: 'And it is alſo eaſy to conclude, that it is not ſo tractable as the old ſtone; 'much leſs yield ſuch a quantity as the old *Malmitz* ore, which is reckon'd 'the beſt of all.' Now as in this manner the generation of this ſtone is, according to the above-mention'd authors, not ſufficiently confirm'd by the above account, it is very poſſible, that the above deſcrib'd fiſtulous ore was at one time or other taken for trees and branches of trees; tho' we are not alſo ignorant of what ſome authors have maintain'd about the truth of this mutation, and that not without ſome grounds[h].

An account of the place where it grows.

The place where this iron-ſtone is found in greateſt plenty is in the territory of *Malmitz*, which lies in the principality of *Glogau*, a mile from *Sprottau*, and two miles from *Sagan*: the country is very marſhy and deep, with alders, wild pine and birch trees up and down; and the mine itſelf is two large miles in compaſs: They dig up the iron-ſtone immediately under the green ſod; and the only inconvenience is that the workmen cannot go deep enough, on account of the water that pours in from above, and the great number of ſprings: Theſe ſprings yield a very fine water for drinking, yet it has a ſtrong mineral taſte of the iron-ſtone: The cattle hereabouts, which drink of it, receive not the leaſt harm by it: The corn in a very dry ſeaſon cannot thrive ſo well on account of the hot mineral bottom; and when the ſeaſon is too wet, it ſuffers as uſually in other fields: The trees, which, as was mention'd above, grow here of various kinds, tho' they ſtrike deep root in this iron-ſtone, are not in the leaſt hurt by it.

What ſort of iron ſtone here is beſt, and how prepar'd for ſmelting.

Of this iron-ſtone the ponderous is the beſt, and in particular the entirely light-blue, which appears like ſmalt, and is pretty tender: There are alſo pieces found among it, as hard as a *pyrites*, but of little uſe, except for yielding a flux in the ſmelting. This ſtone dug in the pit is paſs'd thro' a ſieve, brought into a heap, meaſur'd, and from thence carried to the iron-cinder, in an open place behind the forge: As much of the ſtone, as they deſign to uſe, is brought to the ſmelting-houſe, and laid on gradually, after firſt mixing lime with it, that it may thereby give a light and good body, and that the iron may obtain its proper temper; the ſmelting is perform'd in the following manner. They

h *Vide* Joh. Georg. Liebknecht *diſcurſus de deluvio maxim. occaſione inventi nuper in comitatu Laubacenſi & ex mira metamorphoſi in mineram ferri mutati ligni.*

The furnace where the iron ore is run.

They firſt make a platform ſhelving againſt a brick wall, over which a wide flew is built, and behind which the bellows hang, but under theſe is a trench for letting out the *ſcoria* or *ſlag*: This ſhelving part has a pit in the middle, and over this they hang the noſe of the bellows in ſuch ſort, that the ore ſhall not be expoſed to too ſtrong a blaſt; into this pit are ſhot coals, and over theſe, layers of coals and iron-ſtone, and fire ſet to them, and coals ſhot in till the ſtone run; and in five or ſix hours after they ſhoot in coals and iron-ſtone gradually, till the pit below is pretty full of the ſmelted ſtuff; and then the iron lies as a ſpongy unfluxile maſs at the bottom, after firſt removing the coals from the top of it, and the air has acceſs to it, and it is heav'd a little up, that the *ſcoria* ſtanding on it may run off thro' the tap-hole into the trench under the bellows, the remaining maſs is heav'd out with levers, and roll'd to the forge, which is hard by; where with a ſtrong ſwing it is laid on the anvil under the hammer, which being untrigg'd, it is beat ſo long till it becomes a flat round piece, as large as an ordinary hat, and an hand-breadth thick; by the firſt blows the maſs is not only wedged cloſe together, but it is made plentifully to diſcharge the *ſcoria* ſtill remaining in it; and in this caſe the workmen muſt be very cautious they are not burnt by it. This flat piece is afterwards cut into long pieces by means of the ſame hammer, and put into a ſmith's forge, which is hard by, and compleatly divided and hammer'd into plates. They ſometimes alſo pour water upon it to make it ſmooth and gloſſy; and laſtly the mark of the place is ſtruck on it, and it is weighed and expos'd to ſale.

The quantity of ſtone work'd in a year uncertain.

The quantity workt in a year cannot ſo properly be aſcertain'd: For, the ſeaſons are not alike, ſometimes there is a hard winter, ſometimes a great deal of water; and again too little water: So that many times for ſome weeks together, and in very long hard winters they cannot work a quarter of a year. The quantity of iron-ſtone properly requiſite to one cake or pig is not always the ſame: For, according as the ſtone is prepar'd, more or leſs of it is us'd; but when the ſtone is pure and good, to one pig they uſe 18 buddled quarters, *Breſlaw* meaſure, from which they obtain about two centners of pure iron. It is ſent to the principality of *Glogau* and *Sagan*, as alſo to *Poland* and *Saxony*, where it ſells well, as of this kind of iron it is found to be the tougheſt.

Of the Mermaid, &c. *By* Thomas Bartholin. *From the* Miſcellanea Naturæ Curioſorum. An. 1. Dec. 1. Obſ. 23. p. 85.

Tranſlated from the LATIN.

A mermaid ſeen in the harbour of *Copenhagen*.

THERE was a report of a mermaid appearing near the harbour of *Copenhagen* in the ſummer of 1669: And there were a great many ſpectators on our ſhore, who faithfully related what they had ſeen; yet they differ'd

differ'd as to the colour of the hair; ſome aſſerting it to be red, others black: They all confirm'd that ſhe had a human face without a beard, but a forked tail, which is different from that whoſe diſſection I have given in my *hiſtoriæ rariores*, ſome of whoſe bones I ſtill keep: For, the tail of this conſiſted of an unform'd maſs of fleſh, as I have there repreſented it[a], unleſs we ſhould take it for a diſtinction of ſex or age: But it is of the ſea-calf kind. The apparent difference of the hair probably depends on the different ſituation of the body, and the different incidence of the ſolar rays.

The great number and variety of ſea animals.

As the extent of water and ſea, in reſpect of the earth, was ſo vaſt and capacious, the number of the inhabitants of the ſea muſt likewiſe have been in proportion, and the ſpecies of fiſhes themſelves have been much more numerous than thoſe of birds or terreſtrial animals; on which account water animals muſt have a variety of forms, and likewiſe a reſemblance to other things: Whence we ſee that ſea-animals even reſemble celeſtial things, as there are fiſhes call'd from their reſemblance *Luna* and *Stellæ*. In the ocean at the Equator there are flying fiſhes, who ſkim the air and make their way to ſhips: There are ſea-hawks and ſea-ſwallows: In the ſea there are likewiſe innumerable ſpecies of trees and ſhrubs, and fiſhes that take their denomination from plants, as *urticæ* and *paſtinacæ:* There are others reſembling artificial things, as wheels, ſwords, ſaws, needles, *&c.* There are alſo in the waters, animals analogous to lions, cows, horſes, dogs, rhinoceros, wolves, oxen, and calves: And why ſhould we doubt, that animals reſembling men may not be found therein; ſince ſo many eye-witneſſes concur in this: For, if on land there are animals produced expreſſing the external form and geſtures of men, tho' deſtitute of perfect reaſon; as is plain in monkeys and wild men, mention'd in curious relations; and if there is ſuch a creature as the *ourang outang* from *Angola*, which was made a preſent to *Frederic Henry*, prince of *Orange*, and deſcrib'd and delineated by *Tulpius*[b]; and likewiſe a wild woman, covering her face with her hands, ſhedding tears plentifully, ſighing and expreſſing other human actions, except ſpeech, and deſcrib'd by *Jacob. Bontius*[c], why might not the ocean, the fruitful parent of prodigies, produce ſuch like ſea-animals; and which, for the moſt part, are comprehended under the ſea-calf kind?

Fiſhes reſembling men call'd *Tritons*, and the reality of their exiſtence.

The ancients call'd theſe piſciform men, *Tritons*[d]. Among the moderns *Alexander ab Alexander*[e] mentions a *Triton*, ſeen in *Spain* and *Epire:* And *Schottus*, in his *Phyſica Curioſa*[f], makes mention of many others from different authors[g]. *Geſnerus*[h] alſo deſcribes a merman, which he calls a ſea-monk, becauſe of the reſemblance, and alſo another, with a biſhop's mitre;

[a] *Cent.* 2. *hiſt.* 11. [b] *Lib.* 3. *obſ.* 56. *p.* 275. [c] *Lib.* 5. *hiſtor. Indor. medic. cap.* 32. [d] Plin. *lib.* 9. Pauſan. *lib.* 9. [e] *Lib.* 3. Gen. D. *cap.* 8. [f] *Lib.* 3. *cap.* 3. § 362, *ſeq.* [g] Majol. dier. canic. *colloq.* 9. *p.* 349. Nierenberg *lib.* 5. *hiſt. nat. cap.* 14. Scalig. *Exerc.* 226. § 12. [h] *Hiſt. animal. marin. ord.* 12. *de cetis f.* 174.

mitre; yet authors differ in their deſcription of them, while ſome make them end in fiſh-tails; and others give them human feet: And ſuch was that merman, who perfectly reſembled a man, with feet and a long beard, and in 1619 was ſeen walking on the ſea by the counſellors of *Denmark*, on their return from *Norway* to *Copenhagen*, and carrying a bundle of graſs under his arm, but allur'd by a gammon of bacon, tied to a rope, he was dragg'd into the ſhip; but when he ſpoke, and threaten'd to ſink the ſhip unleſs he was let go, they again ſuffer'd him to jump into the ſea, according to the relation of *Joh. Philip Abelinus*[i]; unleſs we ſhould chuſe to reckon him rather a *Demon* than a natural *Triton*; becauſe of his ſpeech and predictions.

Fiſhes reſembling women call'd *Sirens*, and that there are really ſuch animals.

Such fiſhes of the female ſex are call'd *Sirens*; nor is the thing entirely fabulous, tho' their ſinging be ſo. Of the *Siren*, or mermaid, ſeen by *Theodorus Gaza* on the ſhore of the *Peloponneſus*, *Alexander ab Alexander*[k] and *Schottus*[l] make mention; and this laſt diſtinguiſhes *Nereids* from *Sirens*, and reckons thoſe of the number of *Nereids*, which have human feet, ſuch as is that mention'd by *Johnſton*[m]. In 1403 in a lake in *Holland* was taken a mermaid, thrown in there by the ſea, ſhe ſuffer'd herſelf to be cloath'd, and would eat bread and milk, and learn'd to ſpin from the diſtaff; yet ſhe always continu'd mute: That mermaid which was taken in *Denmark*, and which, according to *Bartholin*[n], could ſpin, ſpeak, and foretell future events, is rather to be reckon'd a Demon. Other mermaids end in tails, and in their upper part either exactly reſemble a woman or in part only: Of the firſt kind was that ſeen by Capt. *Smith* in *New-England* in 1614, which ſtory is related by *Joh. Lud. Godofredus*[o], and by *Georgius Stengelius* in his treatiſe *de Monſtris*[p]. This Capt. *Smith*, being ſcarce a pike length from the ſea, eſpied a mermaid ſwimming towards him; ſhe was extremely handſome; her eyes, noſe, ears, cheeks, mouth, neck, forehead, in a word, all her countenance had the appearance of a very beautiful young woman; her hair was of an azure colour, and flow'd down her ſhoulders; all below the navel had the appearance of a fiſh: Yet there are mermaids repreſented in ſomewhat a different manner by ſome authors, and which differ but little in their upper parts from a woman. *Bartholin*[q] relates from *Bernardinus Gennarus*[r], that in the vaſt river *Cuama*, near the cape of *Good Hope*, there are mermaids, which in their middle upper part reſemble a human form with a round head, but immediately join'd to the *thorax* without a neck, and exactly like a woman in their ears, eyes, lips, and teeth; and that upon preſſing their breaſts there runs out a milk. *Kircher*[s] relates, that at certain times of the year ſuch fiſhes of a human form are taken in the *Eaſt-India* ſea: At the *Vaſſayas* and *Philippine* iſlands

[i] *Theatr. Europ. Tom.* I. *f. m.* 321. [k] *Lib.* 3. *Gen. D. cap.* 8. [l] *l. a. c.* 4. *p.* 466. [m] *Thaumatograph. claſs* 10. *cap.* 5. § 9. [n] *Cent.* 2. *hiſt. rar.* 11. *p.* 187. [o] *Hiſt. antipodum part* 1. *f. m.* 193. [p] *Cap.* 2. § 8. *p. m.* 58. [q] *l. a. p.* 189. [r] *Lib.* 1. *cap.* 9. *Itiner.* [s] *Ars magnet. lib.* 3. *part.* 6. *cap.* 2. § 6. *Edit. Rom.*

iſlands according to the relation of *Didacus Bobadilla*, procurator of theſe iſlands; and that they are call'd *Peche Muger*, and by the inhabitants *Duyon*; and he gives them a round head join'd to the trunk without any neck, that the noſe differs from a human noſe, that the other parts are like thoſe of a woman, and the breaſt cover'd with a white ſkin; that their breaſts are not flabby, but round like thoſe of a young woman; that their arms are broad where-withal to ſwim, but without any fore-arms, hands, or joints.

To theſe things agree the *Triton*, whoſe ſkin in *May* 1647 *Monconnys*[t] ſaw at *Torre*, a town and harbour on the *Red* ſea, whoſe words are to the following purpoſe; 'theſe *Tritons*, *ſays he*, are large fiſhes as big as a 'camel, and taken in the *Red* ſea; their head is like that of an ox, with 'a tail like a fiſh; the reſt of the body from the belly upwards is like a 'man, or rather a woman (for, they are of both ſexes) they have breaſts, 'arms and hands like a man, only that their fingers are webb'd like a 'gooſe-foot, or a bat's wing, according to the relation of thoſe who ſaw 'them; yet I afterwards ſaw a hand, but without the ſkin'. The ſame *Monconnys* ſaw in the ſame place the ſkin of a mermaid, which was ten foot long, and thicker than the hide of the largeſt buffle, and harder than wood, of which they make targets that are muſket-ball proof, as alſo ſoles for ſhoes, which laſt three years.

The ſkin of a *Triton* ſeen at *Torre*.

In 1565 *Chriſtopher Fürerus de Heimendorf*[v] ſaw the ſkin of a mermaid at the ſame *Torre* hung up with its breaſts and navel, the arms and head being cut off, and in its extreme part it reſembled a fiſh. With this agrees the mermaid diſſected by *Peter Paw*, profeſſor at *Leyden*, and deſcrib'd by *Bartholin*[w]. At *Prague* in the Emperor's treaſury was ſhown the hand of a mermaid, and another hand at *Rome*, in *Corvini*'s *Muſæum*. *Kircher*, indeed, denies that this fiſh has a fore-arm and joints in its arms and hands: Yet *Monconnys*[x], together with *Bartholin*, allows that it has a *radius* and a *cubitus*, tho' very ſhort, for the greater eaſe in ſwimming, and ſcarce four fingers breadth long, and that the compaſs of its ſhoulders is no wider. According to *Petrus Petrejus de Eleſunda*[y], they are alſo found out of the ſea in freſh rivers. On the other ſide of the province *Lucomoria*, ſays he, which is at the extreme confines of *Muſcovy*, in the large river *Tachni*, the *Ruſſians* relate, that there are fiſhes found there, which reſemble a man in their head, eyes, noſe, mouth, hands, feet, and other members, tho' they are deſtitute of ſpeech and reaſon; and that they are very delicious to eat.

Another at *Torre*.

New

[t] *Voyag Egypt.* Tom. I. p. 252. *hiſt. rar.* 11.
[v] *Itiner. terr. Sanctæ.* p. m. 122.
[w] *Cent.* 2.
[x] *Voyag.* p. 189.
[y] *Hiſt. Moſcowit.* p. m. 88.

New Rules for the conſervation of Heat in Rooms. *By* Emanuel Suedenborg. *From the* Acta Literaria Sueciæ. Trimeſtre Secundum. An. 1722. p. 282.

Tranſlated from the LATIN.

Rules to conſerve heat in rooms.

IN northern countries heat is conſerv'd in a quite diffierent manner from what it is in thoſe that are more ſoutherly; and done by ſtoves, by help of which, the heat in charcoals and other coals, exhales and penetrates into the room, and ſo fills it; and of this you may have the benefit all day long. In other places the method is different: But I would incline to furniſh rules, whereby heat may be conſerv'd in ſuch rooms, whoſe ſtoves conſiſt of plates, *&c.*

Rooms built of wood warmer than thoſe of ſtone.

1. Rooms, built of wood, are warmer than thoſe built of ſtone; that is, walls made up of wood ſupply a greater heat than ſtone-walls do; the reaſon is, becauſe ſtones continually exhale ſome degree of cold, which weakens the heat that approaches the walls: Whence the more ſtone there is in the walls of any room, the colder it is, but the more wood, the warmer. To prove this by experiments; put a large ſtone into the fire, and you will preſently obſerve the fire loſe much of its force; becauſe the cold exhales from the ſtone: And thus near any ſtone you will feel it always cold: If you walk upon a ſtone pavement, in ſome time you will feel the ſoles of your feet cold, and afterwards the cold ſtrike to your whole body; and if you ſit upon a ſtone for a quarter of an hour, you will feel a great deal of cold: Lay a piece of ice either in the corner of the room, or under the table, and you will perceive a pretty intenſe degree of cold proceeding from it, and that at a good diſtance from the ice: And the quantity of this exhalation is proportional to the bigneſs of the piece of ice.

The more wood in a room, the more heat.

In like manner, the more wood there is in a room, the more heat it has; ſo that if the walls, tables, ſeats and other things be of wood, they neither diffuſe heat nor cold: But upon the acceſſion of the leaſt degree of heat, there immediately and for ſome time after exhales an inſenſible heat.

Stone walls wainſcotted, *&c.* warmer than if naked.

If ſtone-walls be wainſcoted or hung with tapeſtry, there may be a greater degree of heat in the ſame room than if the walls were naked: For, wood and tapeſtry prevent the cold from exhaling too far from the ſtone, and from weakening the approaching heat: And hence by means of theſe, heat may be very much conſerv'd.

As alſo plaiſter'd ſtone-walls.

And in like manner it is, if ſtone-walls be cover'd with a thick plaiſter: For, the plaiſter does not exhale ſo much cold as the naked ſtone: Whence it not only abſorbs the cold, but likewiſe drives it back, that it ſhall not enter the room.

Walls,

Walls, made of common grey ſtone, emit more cold; and likewiſe the larger the ſtones are, or the thicker the walls, they emit ſo much the more, as we perceive in churches; but brick-walls emit leſs. Brick-walls warmer than ſtone walls.

The more porous and light the ſtone is, the leſs cold it emits, and the eaſier it receives the heat, as *ſcoriæ* of iron and calx's; ſo likewiſe the more porous wood is, and the more abounding in ſulphur, the better it conſerves the heat. The more porous ſtone and wood is, the warmer.

2. The thinner ſtone-walls are, they contain and conſerve heat in a room better than thick walls, which ſeems to contradict the principles of many: For, they imagine that the thicker the ſtone-wall is, the better the external cold is kept out from penetrating thro' chinks; but ſuch people do not conſider, that an intenſe cold exhales from the very ſtones, and the more ſo, the thicker the walls are: And again they can ſcarcely be warm'd in a long time. And experience likewiſe teaches, that in places where there has not been a fire for ſome time, the cold exhaling from the walls is felt for a long time. For further confirmation of this, let us ſuppoſe that the glaſs of the window, tho' it be very thin, be of the nature of ſtone; yet ſtill no cold exhales from it, becauſe it is thin. In like manner a piece of thinner ice has a leſs degree of cold than a thicker piece of ice: Whence if the walls conſiſt only of one courſe of bricks, the room is render'd warmer than if it was built of the ſtrongeſt ſtone. The thinner ſtone-walls are, the warmer.

3. The leſs compaſs a wainſcotted room takes, the warmer it is: Hence a ſquare room is warmer than a round one; and an oblong room warmer than a ſquare one, and the more oblong the better. The warmth of rooms depends on their figure.

The greater ſpace in the flooring and walls, that the fire burning in the ſtove can occupy with its rays or heat, the warmer the room is: Thus lower rooms are warmer than higher ones, both becauſe the compaſs of the wall is but ſmall, as becauſe the heat does not aſcend ſo high: For, the heat remains under the cielings; the contrary happens in rooms, which conſiſt of naked ſtone-walls. The more that rooms are expos'd to the heat of the fire, the warmer.

4. The upper parts of the houſe, the more cloſe, compact, and the freer of chinks they are, the better is the heat conſerv'd therein; the reaſon is, that the heat burſts out like a flood: But it is otherwiſe if the chinks be in the lower part of a room: For, the heat does not deſcend, but aſcend: Whence no heat eſcapes through the lower parts, but the wind and the external cold enter there, and preſs and urge the heat in the upper parts to go out: Therefore, the rule is, the fewer chinks there are in the upper parts, or the more compact, the better. The cloſer the upper part of the houſe, the warmer.

The farther a chink is from the roof, the leſs harm it does, and the leſs heat paſſes thro' it; but the nearer the roof, the more. The heat eſcapes more at upper than lower chinks

The higher the windows are, and the nearer they are to the roof, the heat is conſerv'd with the greater difficulty, and *vice verſâ*. You will often find, that The higher windows are, and the nearer to the roof the leſs heat they conſerve.

that a wide and pretty large chink near a flooring, cauſes no waſte of heat.

Directions in a wooden building.

Hence we are to mind; 1. That the joining of the angles in wooden buildings be well executed, and mutually fit. 2. That the upper joinings at the roof be on every ſide cloſe. 3. That the ſtove be very cloſe, to wit, that the plates fit exactly to their places, without any gapings. 4. That there be no opening at the uppermoſt part of a window. 5. Nor in the upper part of a door. 6. Whence double windows and doors are beſt. 7. Doors which lead into any cellar or lower part of a houſe, draw a great deal of cold air, and cauſe a wind in the adjoining rooms.

How Vapours and other Bodies, which on Account of their Hollowneſs float in the Air, may be rais'd therein. By G. G. L. *From the* Miſcellanea Berolinenſia. Tom. I. p. 123.

Tranſlated from the LATIN.

Vapours conſiſt of bubbles of water and included air, and how rais'd.

1. WHY vapours are rais'd by heat is no inconſiderable queſtion? And among other things, we do not improperly ſuppoſe in theſe vapours inſenſible bubbles conſiſting of a pellicle of water and included air; ſuch as our ſenſes ſhow us in frothy liquors. And when a young man, I formerly made uſe of ſuch kind of bubbles in a phyſical hypotheſis in order to explain a great many things: Such a bubble, therefore, being given, but which may contain air rarer than the circumambient, it is poſſible, that the rarity of the included air may have greater force than the weight of the including pellicle of water: And therefore, that the entire bubble may be lighter than circumambient air of equal bulk, whereby the bubble, by the laws of hydroſtatics, will aſcend in the manner as a cloſe veſſel of iron full of air ſhould aſcend in water, if in proportion to its weight it have a ſufficient capacity; nor is the elaſtic force of the ambient air of greater force in this caſe than the gravity of a column of air; becauſe the elaſtic force in each part ariſes from the gravity of the column, and is equipollent thereto.

A two-fold force in air, the innate and adventitious.

2. But here there offers a great difficulty, namely that the circumambient air leſs rare than the included air ſeems by its elaſtic force, as if it would compreſs the bubble; and thus the included air will become of a denſity equal to that of the circumambient air: We are here, therefore, to obſerve, that there is a two-fold force in air, whereby it dilates itſelf, or preſerves its dilatation; the one innate, the other adventitious. The former is what we call the elaſtic force, which exerts itſelf, not only when it is compreſs'd into a leſs compaſs than uſual, as in wind-guns; but likewiſe in our common air, which we have learn'd, and that eſpecially by the contrivance of the exhauſted receiver, formerly diſcover'd by that excellent

excellent perſon *Otto Gueric*, that when preſs'd by the incumbent air, upon removing that preſſure, it expands itſelf, if no other air be equally compreſs'd, or any other impediment hinder: For, flaccid bladders are ſpontaneouſly inflated in ſuch a receiver, nay even in the free air, if they are carried from a valley to a high hill; becauſe thus they are leſs compreſs'd.

What the adventitious force is.

3. The adventitious expanſive force of the air, which ſupplies the place of its elaſticity, is either heat or ſomething elſe analogous to heat in fermentation, or the like natural operation. Thus it is poſſible, that the air included in the bubble and rarer than the circumambient air, may yet maintain itſelf and not ſuffer a compreſſion from it, which is manifeſt to the eye by the experiment of thermometers; and the greater the heat is or any other force that internally dilates the air, the more will the aqueous pellicle be extended and become the thinner: But here a new queſtion ariſes, namely, how ſuch bubbles can be form'd, ſeeing the heat both of the included and circumambient air ſeems to be the ſame? I anſwer, that the included air ſhall acquire a greater degree of heat than that which even the particles of the external air have; becauſe the circumambient air has both a greater and a different motion from the bubble: Whence new hot particles thereof continually flowing to the ſame bubble like a hot wind, communicate a new degree of heat to the pellicle, and thro' it to the included air by the continued contact of new air, as we feel that the hand grows either warmer or colder, if mov'd in hot or cold water, than if it was at reſt therein: And it is the ſame thing, if the water be mov'd about the hand, and not the hand in the water; becauſe many aqueous particles ſucceſſively touch the ſame part of the hand, and communicate their quality thereto. From this principle it appears, that wine in a glaſs-bottle, ſwiftly mov'd up and down in cold water, or the water mov'd about the bottle, is the ſooner cool'd.

How vapours fall down again.

4. Now if we underſtand the cauſe, why the bubbles of vapours aſcend, it will be no difficult matter to explain why they fall down again: For, upon the heat gradually vaniſhing, the bubble will be compreſs'd by the circumambient air; ſo that the included air, upon the ceaſing of the adventitious dilatation, ſhall return to a like denſity therewith, upon which the aqueous pellicle can neither aſcend in the air nor ſupport itſelf therein, no more than an iron-veſſel can float or aſcend in water, if it is fill'd therewith.

By a coalition of ſeveral bubbles.

5. However, it is poſſible and it uſually is ſo, that the vapours that are even ready to fall down, remain a little ſuſpended in the air, in the ſame manner in which duſt is ſuſtain'd therein; becauſe air, as all other fluids, has a certain degree of tenacity or coheſion of its parts; ſo as to require ſome degree of force, however ſmall, to break thro' it, and which is proportional to the ſurface of the body which is to break thro' it: And becauſe very ſmall bodies have a ſmall weight in proportion to their ſurface, yet notwithſtanding their weight, they often remain ſuſpended, and they

are

are only toſs'd up and down by the motion of the ſuſtaining air: The ſame thing, therefore, happens to bubbles and very ſmall drops; but if a great number of drops concur, which is done by that very toſſing and motion, they coaleſce into a larger one; and becauſe the ſurfaces increaſe only as the ſquares, but the weights as the cubes of their diameters: Hence it is, that a bubble, or drop, by growing larger, acquires a ſufficient force to fall down; and even the ſuperior bubbles falling on the inferior ones, coaleſce with them and become bigger.

How heavy bodies may be made to aſcend and float in a ſpecifically lighter liquor.

6. Beſides, from the ſame geometrical reaſon the contrary ariſes, namely, that heavy bodies, reduced into the form of a veſſel do, on account of the included *vacuum*, float or aſcend in a liquor, tho' of a leſs ſpecific gravity, as appears from an iron-veſſel in water, and an aqueous pellicle in air. I remember ſome time ago at *Hanover*, that in the time of Duke *John Frederic* the people flock'd together, as if it were ſomething miraculous, that iron ſhould float in water: In the Duke's kitchen, ſituated on the river *Peina*, there was a large iron-pot faſten'd to a chain and in a great flood of this river, the water reach'd the pot and made it float up and down therein: For, from *Archimedes*' rule it appears, that if a veſſel contain a weight of water greater than its own weight, it will float therein; but if ſtill greater veſſels be taken, the weights of the veſſels increaſe nearly as the ſurfaces; but their capacities as the ſolidities, that is, the weights of the veſſels are as the ſquares of the diameters, the capacities (and conſequently the weight of water they can contain) as the cubes; and thus by augmenting the capacity of the veſſel, the weight of the veſſel is immediately overcome by the weight of what it can contain, and the veſſel may float.

Whether it is poſſible to make a globe of metal to aſcend and float in air.

7. From this principle *Franciſcus Lana*, an ingenious jeſuit, in an *Italian* treatiſe, entitul'd *prodromo della arte Maeſtra*, had conceiv'd hopes, that a braſs-globe might be made of ſuch a capacity, that when exhauſted of air it might aſcend and float therein; and for this purpoſe he was of opinion that 16 feet in diameter was ſufficient; but I found by calculation, that we muſt have a globe of an immenſe bulk, and which cannot be eaſily prepar'd by human ſkill, or one that ſhould withſtand the immenſe force of the incumbent air: And this I thought proper to ſhew by a calculus; becauſe it will, at the ſame time, appear how great the tenuity of aqueous particles in vapours muſt neceſſarily be, in proportion to the rarity of the included air, that ſuch vapours may mount upwards.

This attempted by a calculus.

8. It is verified by experiments, that the ſpecific gravity of water is about 800 times greater than that of common air: But let us ſuppoſe it to be d times greater than the ſpecific gravity, or the denſity of the air included in a bubble; and that the weight of common air of the ſame bulk with a bubble of the vapour, of which we are treating, to be p; let the centre of the bubble be A, and AB the radius of the ſphere of included air, but AC the radius of the ſphere of the whole bubble, the ſpace of included air will be

be as the cube of AB, the ſpace of the whole bubble as the cube of AC, and the ſpace which the pellicle occupies as the difference of theſe cubes: Let us ſuppoſe that ſpace of the pellicle to be to the ſpace of the whole bubble as 1 to r, the ſpace of the pellicle will be as the cube of $\frac{AC}{r}$, which is equal to the cube of AC — the cube of AB: Therefore, the cube of AB is equal to the cube of AC — the cube of $\frac{AC}{r}$ equal the cube of AC $\times$ 1 $\frac{-1}{r}$ equal the cube of AC $\times \frac{r-1}{r}$: And therefore, the cube of AB is to the cube of AC as $r-1$ to r. But the weight of the included air is to that of common air of equal bulk with the bubble, or to p in the compound ratio of the volumes (of the cube of AB to the cube of AC, or $r-1$ to r) and of the ſpecific gravities (1 to d) that is, in the ratio of $r-1$ to rd: The weight, therefore, of the included air will be $p \times \frac{r-1}{rd}$: The weight of the including pellicle of water will be in like manner to the weight of common air of equal bulk with the bubble in the compound ratio of the volumes (1 to r by the hypotheſis) and of the ſpecific gravities (800 to 1 by experiments) the weight of the pellicle, therefore, will be $\frac{800p}{r}$; but adding the weight of the pellicle to the weight of the included air, we ſhall have the weight of the whole bubble, which will be $\frac{p \times r-1+800d}{rd}$ and that ſhould be leſs than p the weight of common air of equal bulk with the bubble, that the bubble may aſcend therein; and $r-1+800d$ will be leſs than rd: And therefore, $rd-r$ will be greater than $800d-1$; and therefore, r will be greater than $\frac{800d-1}{d-1}$, or the ratio of the ſpace of the bubble to that of the pellicle will be greater than $800d-1$ to $d-1$: Whence if d be 10, or if common air be 10 times denſer than the included air, the ratio of the ſpace of the bubble to that which the pellicle occupies will be greater than the ratio of 7999 to 9, or greater than 888.777, *&c.* to unity; where 888 are unities, but 777, *&c.* is a decimal fraction, to wit, $\frac{7}{10}+\frac{7}{100}+\frac{7}{1000}$, *&c.* as you would incline to be more exact: And therefore, the ſpace of the whole bubble will in this caſe exceed that of the aqueous pellicle upwards of 888 times.

9. But if any one would determine not only the ratio's of the ſpaces or volumes, but alſo the ratio of the thickneſs of the pellicle to the radius of the ſpherical bubble, that is, not the ratio of bodies but of lines, he will have occaſion for the extraction of the cube root, which we have hitherto avoided: For, the thickneſs of the pellicle is to the radius of the bubble, which is AC as AC — AB to AC; but AB is to AC as $\sqrt{\frac{r-1}{r}}\Big|^{\frac{1}{3}}$ to $\sqrt{r}^{\frac{1}{3}}$: The thickneſs, therefore, of the pellicle is to the radius of the bubble as $1-\sqrt{\frac{r-1}{r}}\Big|^{\frac{1}{3}}$ to unity: Beſides $r-1$ is to r as $\frac{r-1}{r}$ to unity; and ſince r is greater than $\frac{800d-1}{d-1}$, $\frac{1}{r}$ will be leſs than $\frac{d-1}{800d-1}$; and $1-\frac{1}{r}$ will be greater than

than $1 - \frac{d-1}{800d-1}$, or than $\frac{800d-1-d+1}{800d-1}$, or than $\frac{799d}{800d-1}$: Therefore $\sqrt[3]{\frac{r-1}{r}}$ is greater than $\sqrt[3]{\frac{799d}{800d-1}}$: Therefore, at length $1 - \sqrt[3]{\frac{r-1}{r}}$, or the thickneſs of the pellicle, if unity expreſs the radius of the bubble, is leſs than $1 - \sqrt[3]{\frac{799d}{800d-1}}$, that the bubble may aſcend in common air.

The magnitude and thickneſs of a metalline ſphere that ſhall float in air determin'd by calculation.

10. And becauſe by a like calculus, and likewiſe with more eaſe, it may be eſtimated what the bigneſs and thickneſs of the metalline ſphere, exhauſted of air, ſhould be; ſo that it may float in our air, I ſuppoſe the ſpecific gravity of the metal to be to that of air as m to 1: And as inſtead of a pellicle of water we uſe a hollow metalline ſphere, therefore, for 800 there will be m; and inſtead of $\frac{800d-d}{800d-1}$, there will be $\frac{md-d}{md-1}$: But as upon ſuppoſing the greateſt ſenſible exhauſtion of the ſphere, the denſity of the air remaining in it may be reckon'd none, we ſhall have d (a number expreſſing the ratio of common air to included air) an infinite number; and thus $md - 1$ will be $= md$; and therefore, inſtead of $\frac{md-d}{md-1}$, we ſhall have $\frac{md-d}{md}$, or $\frac{m-1}{m}$, the number d vaniſhing, by which the different denſities of the air are compar'd; the ratio therefore, of the thickneſs of the metal to the radius of the ſphere, will be leſs than the ratio of $1 - \sqrt[3]{\frac{m-1}{m}}$ to unity. The ſame thing would have come out, if at the very firſt we had neglected the weight of the included air, nor ſhould we have occaſion for an infinite number; but ſuch a number was of uſe that the caſes of rarefied and entirely exhauſted air might be compriz'd in one calculus. The gravity of copper is about 9 times greater than that of water: It will, therefore, contain the gravity of common air 7200 times, and $\frac{m-1}{m}$ will be $\frac{7199}{7200}$, or $\frac{7199 \times 30}{8 \times 27 \times 1000}$, or 215970 divided by $8 \times 27 \times 1000$, where the cube root may be exactly extracted from the diviſor, and it gives $2 \times 3 \times 10$ or 60; and therefore the cube root of $\frac{m-1}{m}$ will be the cube root of 215970 divided by 60; therefore, the cube root of $\frac{m-1}{m}$ will fall between $\frac{59997}{60000}$ and $\frac{59998}{60000}$, that is, $\frac{59997}{60000}$ will be leſs than the ſaid cube root, and $\frac{60000-59997}{60000}$, or $\frac{3}{60000}$, that is, $\frac{1}{20000}$ will be greater than $1 - \sqrt[3]{\frac{m-1}{m}}$, whoſe ratio to unity is greater than the ratio of the thickneſs of the metal to the radius of the ſphere; the ratio, therefore, of $\frac{1}{20000}$ to 1 or 1 to 10000 will be ſtill greater than the ratio of the thickneſs of the metal to the radius of the ſphere; the thickneſs of the metal, therefore, is to be aſſum'd leſs, or if that be given, greater than the ſphere: At length, therefore, the radius of the metalline ſphere will contain the thickneſs of the metal more than 20000 times, that the exhauſted ſphere may float in water; and therefore, if the thickneſs of the metal be 1 inch, or 2 or 3 inches, the diameter of the metalline ſphere will be 3333, or 6666, or 9999 feet;

feet; and in the mean caſe, to wit, that of 2 inches and 6666 feet, the diameter of the ſphere will be more than 1000 paces; but if the radius of the ſphere were only 8 feet, as *Franciſcus Lana* would have it, the thickneſs of the metal ſhould have been $\frac{1}{2500}$ of a foot, that is, leſs than $\frac{1}{200}$ of an inch, which is impoſſible.

11. Nor is it, indeed, to be ſuppos'd that the thickneſs of 2 inches is ſufficient to ſuſtain the immenſe incumbent bulk of the air: For, how could ſo ſmall a thickneſs ſuſtain a weight as great as that of water diffus'd for 1000 paces and riſing to the height of 30 feet, which weight would be equal to that of the air; and neither can that accurate uniformity of a ſpherical arch, which would be requiſite, be obtain'd in practice; ſince neither the uniformity of materials can be obtain'd: And making the thickneſs twice or three times greater, the incumbent weight is 4 or 9 times greater, not to mention any thing of the ſphere's own weight; and tho' it ſhould be granted, that by a thickneſs of the arch 2 or 3 times greater, its reſiſtence is more than 4 or 9 times: And this in theory (that is, if we could actually perform what we conceive poſſible) the problem would at length be poſſible, yet in practice to form ſpheres of ſo immenſe a bulk, and that of metal, as copper, or iron, exceeds human power: And here, therefore, God has put a bar, ſo to ſpeak, to human attempts; and that not without reaſon, to reſtrain the wickedneſs of thoſe who ſhould attempt to fly in the air.

Tho' true in theory, yet not practicable.

Of the Diſeaſes of Corn, as Tares, Mildew, and Smut. From the Breſlaw Collection, September 1717, Claſs IV. Art. VII. p. 73.

Tranſlated from the HIGH-DUTCH.

AMONGST the principal, and at the ſame time moſt noxious diſeaſes of corn, have always been reckon'd the following, *viz.* 1. Tares, when the form of the rye itſelf ſeems to degenerate; 2. Mildew, when ſome ſorts of corn exceed in bulk, form, and colour; and 3. Smut, when the ſubſtance of the corn is entirely vitiated, as if it were deſtroy'd by a mortification; yet ſome ſort of this corruption is worſe than other.

The ſeveral diſeaſes of corn.

1. What tares properly are is ſufficiently known, without expatiating into a long deſcription on them; only we muſt premiſe this obſervation, that many conſider them not ſo much as a bare degeneration of corn, as rather a particular ſpecies of corn: Whereas, on the contrary, moſt huſbandmen themſelves uſually regard them as nothing other than a degenerate corn. As in *Sileſia* there was a great crop of tares, yet in one place greater than in another, we have been credibly inform'd, that in reality

Tares what?

they are nothing other than a real corn, but of a degenerate nature; and we had the following circumſtances communicated to us both by men of quality and learning, as well as by farmers, *viz.* 1. That they really grow from actual pure corn. 2. In a wet and moiſt ſeaſon. 3. In low, deep, ſour lands, eſpecially woody lands, and woods turn'd into corn-land, and likewiſe on poor, ſharp bottoms, that have been ſown for ſome years ſucceſſively; as there are ſome ſuch places, where if corn has been ſown for three years running, the laſt year it generally degenerates into tares. 4. Moſt of all in deep furrows. 5. Principally and almoſt ſolely from winter, but not from ſummer-ſowing. 6. That the good ſeed of the tares in a good, warm and dry ſeaſon, on freſh, dry and otherwiſe good land, is again actually chang'd into good pure corn; whereas 7. When the tare-ſeed is not very good and heavy, it uſually does not come up: And to illuſtrate this the more, we ſhall alledge the teſtimony of a gentleman of *Wartenberg*, as both a learned and intelligent huſbandman. He informs us, that in harveſt if the fields are ſown wet and ſmeary, as it were, it certainly proves a good year for tares; the reaſon is, that as the ſeed muſt lie for a long time in the cold and wet in the earth, before it can come up, the fruitful part thereof is corrupted and tainted; yet there ſtill remains a little mealy or milky ſubſtance therein; which, when the genial warmth of the ſpring comes on, will not remain in the earth, but diſcover how little fruitful it is; but as it has not a ſufficient ſtrength to produce true corn, it yields a ſpecies in ſome meaſure reſembling it, yet by far not ſo mealy, and then this is what we call tares: Now that tares have their original from corn I prove thus; being ſown on high, dry, yet good land, they again change into corn, and again reſume their firſt form, which could not be the caſe, if in tares there were not the ſpecies and quality of rye or corn conceal'd: But ſuch tares as are ſo little mealy and, as it were, nothing but hulls, do not ſpring up, but moulder away. In the ſame manner we have been aſſur'd by another learned perſon of *Brieg*, that a neighbour of his had the preceeding year ſown a quarter of the beſt tares in a good ſoil, from which he reap'd much corn and but little tares; the ſoil is ſomewhat greyiſh: And thus *Bruyerinus*[a] has alſo remark'd; 'tares, 'ſays he, proceed from wheat, and wheat from tares.' As we have been well aſſur'd of this transformation from ſeveral quarters, ſo alſo from *Hungary*, with this additional circumſtance, that indeed all tare-ſeed does not turn to corn, and that if once it becomes hully: And it is certain, that ſometimes bad huſbandmen give occaſion to a rich crop of tares, when either out of thoughtleſſneſs or neceſſity, and often alſo out of knavery, they ſow impure and baſe tarey ſeed, as happen'd ſome time ago in a certain farm, where the farmer ſow'd tares and again reap'd tares. On the contrary, his ſucceſſor, upon ſowing good ſeed, alſo reap'd good pure corn from

[a] *De re cibar. lib. 5. cap. 3. p. 247.*

from the ſame field: And poſſibly were the method among the *Engliſh* taken, which is, not to ſow the ſeed again in the ſame field where it grew, but always freſh ſeed from other parts[b], we might poſſibly often reap purer corn and leſs tares; tho' indeed it muſt be own'd, that a bad ſour ſoil cannot bé improv'd even by the beſt ſeed, eſpecially when the ſoil is more apt to produce tares than good corn, as we have been aſſur'd of this from *Thuringen*. Yet among all the diſeaſes of corn tares are the beſt, ſeeing they yield meal, yet but little in quantity and of ſomewhat a bluiſh caſt; but they are in a particular manner improv'd by the following method; to a buſhel of tares is added the ſame quantity of barley and corn; and as the miller is oblig'd to give as much meal from the worſt as from the good corn; ſo in this manner there is a greater profit than from the good corn, tho' the good may be ſold for a better price than the tares: The bread bak'd of it is, indeed, ſomewhat dark, and yet not unſavory, yet in baking it does not riſe ſo well, and therefore it requires a ſtronger leaven. They uſe in ſome places of *Sileſia* a kind of fanning mill for ſeparating the good corn from the tares, *&c.* whereby the cleanſing of corn is perform'd ſpeedily and better than with the fan, tho' ſtill ſomewhat of the heavy tares remain behind; it has four wings, yet that with ſix is better; and that ſuch kind of winnowing mills were a ſmall time ago firſt begun to be known in *Saxony* and *Brandenburg*, *Wolfius* teſtifies[c] in his *Aerometria*. This kind of baſtard-corn has this year been pretty plentiful in *Sileſia*; ſo that few corn-proofs have been found entirely without it: The reaſon of which was the moiſt ſeed-time the preceeding year, and a wet cold ſpring, as alſo bad ſeed. Pl. III. Fig. 5. 6.

2. As we have had here and there this harveſt no ſmall ſtore of mildew'd corn, ſo that often on one ear many ſuch grains ſtood jutting out, and ſufficiently ſhew'd the luxuriancy of the ſap by the bigneſs of their growth: Yet it is alſo certain, that they were not ſo commonly obſerv'd as the preceeding year, ſince in ſeveral places there were few or none at all: They ow'd their riſe chiefly to the following wet weather in *July*, or alſo, as was ſuppos'd, to the preceeding honey-dews in bloom time; yet we have no where found, that they have been in any uncommon manner prejudicial to the health, tho' by moſt of the old phyſicians, and in particular by thoſe of *Lauſnitz*, *Saxony*, &c. an epidemical convulſive diſtemper has been aſcrib'd to them: Whereas, on the contrary, a certain learned phyſician has ſent us an eſſay, wherein he ſhews the inſufficiency of ſuch a cauſe. 1. That when this diſeaſe raged at other times, as in 1596 in *Cologne*, *Weſtphalia*, &c. no ſuch cauſe was aſſign'd. 2. That the experiments about this corn on beaſts are inſufficient and inadequate. 3. That the circumſtances of this diſeaſe are founded on hearſay, and the opinion of the patients. 4. That if this corn were poiſonous, whole families, nay vil- Mildew what?

[b] Monconnys *Voyage Angleterre p. m.* 516. [c] § 195.

lages muſt have been infected with it. 5. That many had this diſtemper who never eat of ſuch corn. 6. That people have been ſtill dubious about the efficacy of this cauſe, ſince alſo other cauſes were complain'd of, as poiſonous dews, fogs, hot bread, bad garden fruits, a bad ſummer, *&c.* 7. As moreover neither men nor beaſts ſicken'd on whom theſe dews or fogs fell. 8. Not to mention, that this corn was alſo exported and laſted for a long time, without cauſing this diſtemper. 9. Beſides, this diſeaſe has its period and paroxyſms, whereas poiſon, on the contrary, exerts a continu'd effect. 10. As the ſymptoms gave no ſigns of poiſon, but were in common with other ſpaſmodic affections; tho' it is not to be denied, that bad proviſions have been the occaſion thereof in many, already diſpos'd to ſuch diſorders, but whoſe principal cauſe we are to ſeek for in the concurring moiſt, cold, ſummer weather, in which manner alſo *Joh. Georg. Hoyer*[d] (in his epiſtolary diſſertation to *Luc. Schroeckius* of the epidemical conſtitution at *Muhlhauſen* in 1700) mentions, that that year in and about *Muhlhauſen* there rag'd ſpaſmodic affections, and by ſome aſcrib'd to mildew'd corn, which plentifully grew in *Thuringen* the preceeding year; yet he could not prevail with himſelf to be entirely of this opinion, as the then concurring cold, wet and open weather was the principal cauſe of this diſorder, which ſoon became more tolerable, as the weather became better: And we ourſelves could have no account, that ſuch diſorders either this or the preceeding year were caus'd by the ſaid mildew'd corn; tho' beſides, eſpecially this year, in moſt parts of *Sileſia*, a great deal of mildew and honey-dew fell, which ſometimes entirely moiſten'd and cover'd with a paſte, as it were, the ears of corn, that it often hung therefrom in form of drops, or icicles, and alſo produced many maggots and catterpillars: And beſides, we have been aſſur'd by a farmer, that in his youth along with his comrades he had gather'd this mildew'd corn, and eat handfulls of it, without the leaſt prejudice to his health, tho' he could not deny, that if one eat much of it, it taſted ſomewhat nauſeous: So that thus in epidemical diſeaſes we are to make a great difference between the material, continent and efficient cauſe, and the occaſional, ſuccedaneous and remote cauſe: However, *Camerarius*'s obſervation in the *Miſcellanea Naturæ Curioſorum*[e], on the nature and noxiouſneſs of this mildew'd corn, deſerves to be perus'd.

Smut what?

3. A great deal of ſmut was obſerv'd this year among the wheat, but in few places among the rye, which is leſs ſubject to this diſeaſe than wheat: And this blight or ſmut was obſerv'd in the month of *Auguſt*, and 1. principally in wet and deep lands; 2. or where the ſowing was too late; 3. or where the ſeed was already blaſted; not indeed, as if the blighted corn could come up, which is a thing impoſſible, but the good ſeed was polluted

[d] *Miſc. Nat. cur. cent.* 1. & 2. *app. p.* 48, *ſeq.*
[e] *Cent.* 5. & 6. *Obſ.* 82. *p.* 343, *ſeq.*

luted with the ſmut-duſt, and infected with it, as with a contagion: As it is reckon'd the peculiar plague of corn, which in threſhing, ſmutts both the corn and the threſher all over, that after a great deal of waſhing it cannot be entirely got out of the corn; 4. to which ſome would add, that when the ſowing has been perform'd by a double light, that is, when either in the morning or evening the ſun and moon are obſerv'd at the ſame time in the heavens; 5. but in particular, while here and there new wheat is ſown moiſt; 6. not to mention, that the honey-dew and the wet weather in *July* did remarkably contribute thereto: And to this we ſhall add a curious paſſage from the account of the above-mention'd gentleman at *Wartenberg*, and which is as follows: 'As to ſmut, it is for the 'moſt part found in wheat and millet; and in my opinion proceeds hence, 'namely that new wheat is ſown moiſt, before it is well dried and 'air'd in the loft; becauſe when wheat which is more than a year old is 'ſown, we need not in the leaſt be afraid of ſmut; yet with this precau-'tion, that that year old wheat is better, which has ſtill remain'd in the 'ears in the barn, and has been threſhed out a little before it is ſown, 'than what has lain for a year on the loft; ſeeing a great deal of the 'generating quality of this laſt is already evaporated and loſt: Wherefore, 'all prudent huſbandmen avoid uſing old ſeed, as often ſcarce the half 'thereof comes up. Yet intelligent farmers will alledge, that when a 'poiſonous mildew falls upon the wheat in bloom, it is afterwards ſubject 'to much ſmut. The remedies againſt ſmut are manifold, but for the 'moſt part ſuperſtitious: I ſhall only advance one, which I have ſeen 'uſed with good ſucceſs, not only in the *Netherlands*, but likewiſe in '*Germany*. To a coomb of wheat they take from one to one peck and 'a half of unſlack'd lime, which they beat ſmall to meal, and afterwards 'ſift it on the wheat, and then ſhovel them well together; and again 'ſweep them up with a new broom, and this they ſow in the old of the 'moon. The beſt means againſt ſmut in millet, is before ſowing to let 'it run ſoftly thro' a burning wiſp of ſtraw, which I myſelf have found 'to have anſwer'd, tho' I have been contradicted therein, and told that 'I muſt uſe old thatch; but this ſavours of ſuperſtition. Others alſo 'ſcald the millet with boiling hot water, but as thus it may be very 'readily boil'd, the firſt method is the ſurer'. And poſſibly it may be of ſome ſervice here, if according to the manner among the *Engliſh* farmers, as mention'd above, ſeed be always bought from other parts, and your own produce us'd in other conſumption; or if by means of a cord the dew were ſhaken off the wheat, or the ſeed ſteept for 24 hours in ſea or ſalt water, mixt with bole[f]. To this we add, according to the obſer-vation, made in the above account (to wit, that of keeping the ſeed till ſeed-time in the ears) that in the Canton of *Switz* corn may be kept good for

[f] Monconny's *Voyage*, p. m. 534.

for 80 or 100 years, if it is preſerv'd in the ear[g]: And to this in the laſt place we ſubjoin, that *Rud. Jac. Camerarius* in 1709 had a learned diſputation at *Tubingen*, entitul'd *de Uſtilagine Frumenti*, wherein the above cauſes are illuſtrated with ſeveral examples and reaſonings.

The explication of Fig 5. Pl. III. The external view of the fanning mill.

A the place where the corn is ſhot in.

B the air-vents near the wheel.

C the handle, by which the wheel is turned round.

D a hole at which the clean corn comes out.

E the hole for the tares on the other ſide.

F wheels and handles for carrying along the mill.

Fig. 6. The internal view of the fanning-mill.

A the wheel with ſix flat wings.

B the ring in which the wheel moves.

C the place where the corn is ſhot in.

D the place where the corn falls down freely, and is fann'd by the wings of the wheel.

E the place where the heavy and pure corn falls.

F the place where the tares and light corn fly away.

G the place where the duſt and the hulls are blown away.

NB the upper part of the caſe of the mill, which is made to take off, in order to have acceſs to the wheel.

g Id. *ibid. p. m.* 528.

An experimental Diſſertation on the Direction of heavy Bodies in a ſpherical Vortex, and on the Figure of the Nucleus. *By* G. B. Bülffinger. *From the* Comment. Acad. Scient. Imper. Petropol. Tom. I. p. 245.

Tranſlated from the LATIN.

The occaſion and deſign of this experiment. 1, THERE are many years, ſince on occaſion of a letter of *Jac. Bernouilli*'s to *J. Chr. Sturmius*, and publiſh'd in the *Acta Erud. Lipſ.*[a] it ſeem'd to me that ſuch reaſon'd well, who from the motion of a ſpherical *vortex*, ſuch as *Des Cartes* ſuppos'd, revolving round the axis of a ſphere, conclude, that heavy bodies by means thereof ought rather to tend to the axis than to the centre of the earth: For, ſuppoſing, as *Des Cartes* would have it, that both the æther and air conſiſt of corpuſcles more ſuſceptible of a violent motion than terreſtrial bodies, and adding to this, and which appears by common experiments, that bodies diſpos'd to a more violent motion, do more ſtrongly tend to the periphery,

[a] *Anno* 1686 *M. Febr. p.* 92 *ſeq.*

phery, if they happen to move in a circle; and therefore, that other things are propell'd by them to the centre of that circular motion: It is certain, that terreſtrial bodies are by that impulſe brought together from the periphery to the centre; but what centre? Is it the centre of the ſphere itſelf, and of the entire *vortex*, or the centre of a circle, parallel to the equator of the *vortex*.

Gravity and the ſpherical figure of the earth how explained by the *Carteſians*.

2. The *Carteſians*, to make their explication come the nearer to the *phenomenon* of gravity (for explaining which theſe hypotheſes of the *vortices* were intended by *Des Cartes*) have deriv'd from that action of the *vortex* a *conatus* to the centre of the ſphere itſelf, and by that means they have endeavour'd to explain the direction of heavy bodies and the ſpherical figure of the earth.

That explication oppos'd by *Huygens*.

3. Amongſt a great many others *Chriſt. Huygens* has in particular oppos'd the *Carteſians*; for, he ſuppoſes, that from that motion of the *vortex* there follows an impulſe of heavy bodies not to the centre of the whole ſphere, but to that of the circles parallel to its equator, or to its axis; which is exactly what *Kepler* had ſaid before *Des Cartes* and explain'd by a figure in his *Epitom. Aſtron. Copern*[b]. Fig. 7. Plate III

And in this follow'd by others.

4. This at firſt bluſh is more plauſible; for, it ſeems conſonant to reaſon, that if two bodies moving at the ſame time in any circular plane have unequal *conatus*'s; and conſequently, the weaker body be repell'd by the ſtronger, that the former be repell'd in the ſame plane in which both have a *conatus* to go on in their motion; this reaſoning, therefore, a great many more have given in to

Gravity and the ſpherical figure of the earth accounted for by *Huygens*.

5. *Huygens*, that he might not ſeem only to refute an error, and that he might find ſomething proper to explain the *phenomenon*, has (in order to obtain the directions of heavy bodies, perpendicular to the horizon, and the nearly ſpherical figure of the earth, generated by a *vortex*) ſubſtituted inſtead of *Des Cartes*' gyration another, by which the ſubtile matter included in a ſpherical ſuperficies, moves therein with an infinite variety of directions, along the ſmall arches of the great circles of a ſphere: Almoſt of the ſame kind is that, which *Joh. Chriſt. Sturmius*[c] hints at in a letter to *Hen. More*; namely that the circles or rather the arches, deſcrib'd by each particle of the ſubtile matter, are to be conceiv'd ſo, as that all of them may be taken to acquire the *impetus* of their gyration from one point of the ſphere. A great many others, and lately *Wolfius* in his ſyſtem of phyſics have follow'd *Huygens* in this opinion of the *conatus*; but as to the difficulty, or rather impoſſibility of ſuch a kind of *vortex*, *Jac. Bernouilli*[d] has oppos'd *Sturmius*, and *Saurin*, *Huygens*.

Saurin's defence for the *Carteſian* vortices.

6. *Saurin* has reinforc'd the *Carteſian* cauſe, and endeavour'd to re-eſtabliſh it fully in its tottering condition, having for this purpoſe publiſh'd two

[b] *P.* 97. [c] *Colleg. Curioſ. P.* II. § 23. *p.* 23. [d] *l. c. Act. Erudit. Lipſ.*

two diſſertations, the firſt of which is extant in the *Journal des Sçavanes* in which he has not only labour'd to invalidate *Huygens*'s reaſonings againſt the *Carteſian vortices*, but likewiſe to demonſtrate, that from the re-action of a ſpherical ſurface encompaſſing a fluid *vortex*, a *niſus* towards the centre of the ſphere is generated: The ſecond is publiſh'd in the ſame *Journal*[f]; and in the firſt place he urges for *Des Cartes*, that if the *vortex* were at firſt conceiv'd to be cylindrical, yet that by its preſſure on the adjoining fluid it would be reduced either into a ſpherical or ſpheroidical figure: And again that the motion of the *vortex* revolving about the axis of the earth from weſt to eaſt is much more agreeable to the *phenomena* of nature than thoſe interrupted portions of gyrations, perform'd, according to *Huygens*, in great circles. I find by the *Memoirs of the Royal Academy of Sciences at Paris* [g], that *Parent* and *Montrè* have oppos'd ſome things to *Saurin*'s firſt diſſertation; but which have been ſo far from diverting that ingenious author from his opinion, that he has rather taken what he has oppos'd to *Huygens* for things perfectly demonſtrated.

The authors opinion on the diſpute.

7. May I, therefore, be allow'd to own, without the diſpleaſure of any one, that in ſo difficult a matter and involv'd in ſo many circumſtances, I have always had ſome doubt about the evidence of the demonſtrations, hitherto given; and therefore, have often wiſh'd, that the matter might be decided by plain experiment, eſpecially as I ſaw, that the greateſt men, as for inſtance, *Jac. Bernouilli*[h], were in doubt, whether from the nature of a ſpherical ſurface it may be deduced, that the *niſus* of corpuſcles, propell'd from the periphery, tends rather to the centre of the ſphere, than to that of the parallel circle; for, tho' I thought I underſtood the reaſon, why it ſhould not happen, that the corpuſcles tend to the centre of the ſphere; yet in a matter of difficulty I inclin'd not to interpoſe my judgment, or to precipitate a concluſion before nature was conſulted by experiment.

Huygens's experiment to account for the cauſe of gravity not ſatisfactory. Fig. 8. Plate III.

8. *Huygens*'s noted experiment, uſually employ'd in the cauſe of gravity, came eaſily into my mind, wherein aſſuming a cylindrical veſſel of $8-10''$ in diameter, and $4-5''$ in height, he fill'd it with water and ſhavings of *Spaniſh* wax; he cover'd it above with a glaſs, and laid it on a wooden table, by means of which it might be turn'd round very ſwiftly; for, by this ſwift motion of the veſſel, and again ſuddenly ſtopping it, it happen'd, that the water ſtill for ſome time continued its gyrations and collected the ſhavings of the wax about the centre of the baſe of the cylinder in a heap like a hemiſphere; yet this did not ſatisfy my deſign, becauſe it ſeem'd to me, that there were ſuch circumſtances in this experiment, as neither the *vortices* of *Des Cartes* nor thoſe of *Huygens* admit of; if there are any ſpherical *vortices* in nature; and eſpecially the production of

[c] *An.* 1703 *p.* 38. *ſeq. Ed. Bat.* [f] *An.* 1707. *M. Maii. p.* 327 *ſeq.* [g] *An.* 1709. *p.* 167. [h] *l. c.*

of a *nucleus* only hemiſpheroidical, and a cylindrical *vortex*, and the bottom of the veſſel ſupporting the bodies ſeem'd to be circumſtances little ſuitable to determine this queſtion.

Whether that experiment might not be improv'd.

9. I, therefore, in the firſt place began to think, whether matters might not be ſo order'd, that inſtead of a half, an entire *nucleus* might be produced: For, the deſign of the *vortices* in the heavens, aſſum'd by *Des Cartes* and *Huygens*, is the geneſis of a ſphere; and here it eaſily came into my mind, that if a cylindrical veſſel were divided in the middle by a partition, parallel to the baſis, and in its lower part, corpuſcles not much ſpecifically lighter than water were mixt therewith, it might probably happen, that below, half the *nucleus* would be collected in the middle of the partition, as well as above, greater or leſs according to the greater or leſs quantity, or different ſpecific gravity of the matter employ'd. I tried ſomething to this purpoſe, and not altogether without ſucceſs; yet the manner of doing this experiment dextrouſly is difficult, and the *vortex* ceaſes not to be cylindrical: Not to mention the influence of the gravity and levity of the corpuſcles, mixt with the water, upon the figure of the *nucleus*; for, ſuch *nuclei* as I obtain'd were not, indeed, ſpherical. Fig. 9. Plate III.

Farther improv'd

10. I, therefore, thought it ſtill proper to lay aſide ſuch cylindrical *vortices* as more remote from this *phenomenon*; and to imitate nature more nearly by cauſing rather a ſpherical *vortex*, in which, in imitation of *Huygens'* experiment, corpuſcles ſpecifically heavier ſhould at firſt indeed be carried away by the water moving in the revolving veſſel; and therefore, as I conjectur'd, that during the gyration of the veſſel, they would poſſeſs the ſides; but upon the ceaſing thereof they would be driven to the more internal parts by the water continuing its motion longer; and would exhibit a figure, as might be eaſily gueſs'd, either ſpherical or cylindrical.

The author's *apparatus* for determining this matter.

11. It is only ſome few weeks ago, that I had an opportunity of putting this deſign in execution, tho' I had had ſuch a thought for three or four years before, having for this purpoſe employ'd glaſſes and machines, ſuch as *Hauksbee* at firſt, and afterwards others have hitherto us'd to excite light by the friction of the hand; and that with greater ſucceſs than I had at firſt imagin'd: For, intending to obſerve the figure, which, upon the ceaſing of the motion of the glaſs, and the water only revolving therein, the parts of the wax, propell'd by the water, would acquire; the air, which forced itſelf upon me and every where ſeparated itſelf from the water, during the gyration both of the glaſs and water, put on ſuch a figure, that I was not a little pleas'd, that the motion of the wax and water, returning to a ſtate of reſt, was diſturb'd by it; and conſequently, that the geneſis of the figure, which I had expected from the particles of the above wax, did not ſucceed.

The circumſtances of this experiment.

12. The more remarkable circumſtances of that experiment, ſeveral times repeated before the *Society*, are the following.

Experiment.

Pla. III. Fig. 10.

I took a glaſs in ſome meaſure ſpherical; for, the diameter of the equator is greater than the other diameters; and the poles terminate as in a kind of truncated cone: It is furniſh'd about its poles with metalline cylinders with prominent axes, in one of which is ſeen a leſſer wheel fix'd, round which a thread may be paſs'd, having a groove in it for that purpoſe. I fill'd that glaſs by the hole of the other cylinder with water, and with a little of the powder of black *Spaniſh* wax and iron filings, and fitted it to the machine, by means of which the rotations of the like glaſs-ſpheres for exciting light by friction are otherwiſe uſually perform'd.

13. I then began to turn round the handle of the machine, that the glaſs might begin to revolve, and I obſerv'd; 1. That in the upper part of the glaſs was ſeen a bubble (as it is call'd, or rather a ſegment) of air, which upon the rotation diverted to that part, towards which the rotation was directed. 2. But that it was cut in its middle before it diverted, by the water tending to the outmoſt parts of the ſphere. 3. Upon continuing the motion for a little time, the wax and iron-duſt adhered to the ſides of the glaſs about the equator of the motion, in manner of a zone. 4. After firſt being thrown upwards by a few impulſes it had again fallen down by its gravity. 5. Upon the ceaſing of the motion of the glaſs, the air by its aſcent diſturb'd the motion of the water; and ſo hinder'd that the expected impulſe of the wax and filings to the centre or axis could not be regular: This was the firſt eſſay.

14. Having, therefore, again fill'd the glaſs, ſo that upon inverting it no bubble of air could be obſerv'd at its upper part, I again renew'd the gyration and I obſerv'd; 6. Leſſer bubbles of air burſt out up and down in the water, and collected into larger ones; and the motion afterwards ceaſing, I ſaw a great many of them adhering to the particles of the *Spaniſh* wax; 7. Upon a quicker motion theſe particles of air came afterwards from the ſide towards which they diverted N° 1. nearer to the axis of the ſphere and rotation; 8. And at length exhibited an elegant cylinder, which 9. As the motion was ſwifter became more ſlender, in which notwithſtanding, 10. Theſe bubbles of air were not contiguous to each other, but revolv'd among the water: 11. Upon remitting a little the ſwiftneſs of the motion, that aqueo-aereal cylinder became of a greater diameter; and conſequently, ſo to ſpeak, of a looſer texture; 12. Whether upon increaſing the ſwiftneſs of the motion thoſe bubbles might be collected into a continued cylinder, I would not try, for fear of hurting the glaſs, being hitherto the only one I had for this experiment; 13. If by the remiſſer motion the bubbles, ſeparated before, came together into larger ones, their figure was not ſpherical but broader at that part, from which the impulſe of the revolving water came, and more enlarged at the oppoſite part:

part; 14. It was a very elegant ſight, that upon admitting the air in a greater quantity, and the cylinder ſtill continuing very broad, ſome bubbles of air did not go beyond the centre of the ſpherical *vortex*, but from the right ſide, whither the deſcending water tended, form'd, as it were, elliptical *gyri*; others, going beyond the centre of the *vortex*, form'd ſpiral lines, ſuch as *Caſſini* has deſcrib'd for the motion of the planets[i]. Let L M N O be a ſection of the equator, or of a circle, parallel thereto in the ſpherical glaſs; let A B C D be the ſection of a cylinder, *a b c d* will repreſent one gyration, and E F G H I other gyrations more freely repreſented. 15. When the motion of the glaſs was ſtopp'd, and the aereo-aqueous cylinder was ſomewhat larger, I ſaw in a very little time, that that cylinder ſtill revolving was brought into a narrower compaſs, and then at laſt become larger again and diſſolve. 16. The aereal bubbles at length aſcend to the top, but moſt of them larger, rather with a retrograde than direct motion. Let A B C expreſs the direction of the water in the veſſel now at reſt, let B be its top, and let the bubble revolve along *p q r s*; it very rarely happen'd that it would come from *p* through *q* to B, but thoſe coming from *q* through *r* to *s* return'd back from thence to B, there afterwards to continue.

Pl. III. Fig. 11.

Fig. 12.

15 The other things occaſionally obſerv'd in theſe trials were much to the following purpoſe: 17. The *Spaniſh* wax and the filings of iron form'd a zone or kind of zodiac about the equator; 18. Yet of an unequal denſity, and if we would be more accurate in the obſervation, of an unequal breadth; 19. There was a part of it, which, upon the velocity of the rotation remitting a little, ſeparated itſelf from the reſt, and receded more or leſs from the equator, repreſenting a tropic or polar circle. 20. It was moveable, either as the motion intended or remitted a little; and therefore, forming ſpirals on the concave ſurface of the ſphere; and 21. If the ſwiftneſs of the motion was much diminiſh'd, that part hid itſelf in the polar cylinders. 22. If the motion of the glaſs was ſtopp'd, part of the duſt about the equator of the *vortex*, fell down by its gravity, but irregularly, by reaſon of the diſorders, produced by the aereal bubbles aſcending here and there.

Fig. 13.

16. In the former trials not a hundredth part of the capacity of the veſſel was fill'd with air; but when a greater quantity of air was admitted, ſo as to occupy a fourth, fifth, and ſixth part of the veſſel, and the velocity of the gyration was ſomewhat intended; 23. The air was collected into a cylinder about the middle of the ſphere, free from any water and whoſe inmoſt ſurface appear'd very ſmooth; 24. Nor is there requiſite a great ſwiftneſs of rotation for preſerving this cylindrical *nucleus*, after it is once produced; 25. And it continued ſo long, tho' the motion

[i] *Mem. de l'Acad. An.* 1709. *p.* 328.

of the ſphere was ſtopp'd, till the revolving water loſt both its motion and *conatus* by the friction at the ſides of the glaſs.

Concluſions. 17. Having hitherto narrated the *phenomena*, it might be an eaſy matter to enquire into the cauſes of each in particular, as alſo to ſhow the laws of *vortices*, by which *phenomena* might be obtain'd that have hitherto been deſpair'd of, as for inſtance, the alternately greater and leſſer ſpirals of the celeſtial bodies, and the like; but that does not belong to our preſent deſign, wherein we only labour to define the figure of a *nucleus* to be generated by a ſpherical *vortex*; and by that very thing to pave the way for the ſolution of the mechanical problem, whereby the laws of *vortices* are requir'd to be ſuch, that a ſpherical *nucleus* may ariſe.

18. We have, therefore, inſerted here principally two concluſions, the one regards the thing, the other the manner of reaſoning about *vortices*; and both of them ſeem uſeful and neceſſary in explaining the cauſe of gravity.

19. It, therefore, appears by experiment and by the eye, that in a ſpherical *vortex* revolving about the axis of a ſphere, the ceding corpuſcles, that is, ſuch as are driven by the impulſe of the vortical fluid from the periphery towards the centre, do not coaleſce into a ſpherical but a cylindrical *nucleus*; and therefore, that from ſuch a *vortex* alone, the direction of bodies ceding towards the centre of the *vortex* is not exactly enough deduced but that that direction tends to the axis of gyration.

20. The doubt, therefore, is removed, by which hitherto the learned have run into different opinions, ſince nature has diſcover'd by an obvious inſtance what it does concealedly when it turns round *vortices*, according to *Des Cartes'* mind; and I think that in this experiment the conditions of the deſir'd *vortex* is expreſs'd to pretty good advantage. We have a fluid included in a ſpherical ſurface, and made to revolve about the axis of a ſphere.

21. It is true, that the rotatory motion is impreſs'd on the water by the action of the ambient ſurface, and that it is carried along with the water towards the ſame part. You may, probably, alledge for *Des Cartes*, that the vortical motion is in nature otherwiſe impreſs'd, and that the including ſurface is at reſt; but that will not affect our inference. Whatever be the manner wherein the motion is at firſt impreſs'd on the *vortex*, we conſider it in a continuing ſtate, in which caſe reſt is no obſtacle to the outmoſt ſurface, as we have ſeen N° 15 and 25 in the experiments: What we have alledged § 19 ſtands, therefore, good.

22. Let the other be this; in order to judge of the direction of the centrifugal force of the particles of the fluid revolving about an axis, that plane which is parallel to the equator ought to be taken into the account, but not the plane of a meridian or other great circle on the ſphere. This appears

appears from the cylindrical figure of the *nucleus*, by means of which the direction of the ceding bodies is perpendicular to the axis in planes parallel to the equator.

23. But it is of ſervice to obſerve this, becauſe if we would employ reaſoning alone, the thing might appear dubious: On one ſide I infer thus, becauſe the motion itſelf, from which the centrifugal force ariſes, is not along the meridian of the *vortex*, or any other great circle interſecting the equator, but along circles parallel to the equator, the direction of the centrifugal force of any particle will, therefore, be in planes parallel to the equator.

24. But on the other ſide, taking in the conſideration of a ſpherical ſurface, different deductions have been made by others. *Jac. Bernouilli* in the place alledg'd above ingeniouſly hints, that the planes of a parallel circle, as the tropic, and of a great circle, as the ecliptic, interſect each other in a line, which is a tangent to both circles: If, therefore, the point of contact beginning to revolve along the tropic has a *conatus* of receding along the tangent, we may ſo far equally reckon upon it, that it recedes from the centre of the ecliptic, and from that of the tropic, ſeeing they both have the ſame tangent; that, therefore, there is no reaſon, why the pulſion of the globules is made in a vertical plane rather than in the plane of a parallel circle, or in any other plane; ſince that tangent, along which the globule endeavours to recede, is common to infinite planes. This excellent perſon, therefore, does here doubt, and that from the nature of a ſphere.

25. In another place, from this very conſideration, he pronounces in favour of *Des Cartes*; for, after having in the ſame *Acta Eruditorum Lipſ.*[k], remark'd about the preſſion of the fluids againſt the ſides of the veſſels, that it was perpendicular to the containing ſurface, he from that inferr'd, that the direction of the corpuſcles impell'd back was towards the centre of the ſphere, which alone is perpendicular to the ſurface.

26. In another ſomewhat different manner *Saurin* came to the ſame concluſion[l]. He (granting that the ceding particles were carried directly to the axis, if a circle parallel to the equator were conceiv'd apart, or conſtituted in a cylindrical *vortex*) yet denies that the ſame holds, if a fluid be included in a ſpherical ſurface. This ingenious remark deſerves to have a place here; 'It is plain, *ſays he*, that the fluid matter, which in the plane 'of the parallel circle, whoſe diameter is DN, has a *conatus* of removing Fig. 14. Pl. III. 'from the point O along OD, and which by its *conatus* propels to the 'point C the ſpherical ſurface, whoſe circle PAQE is a ſection thro' the 'axis: It is plain, *I ſay*, that that matter is no otherwiſe repell'd by the 'ſurface, which it propels, than it would be by a plane which would 'touch this ſurface at the point D. Thus, according to the laws of me-'chanics,

k *An.* 1695. *p.* 547. l *Journ. des Sçav. An.* 1703. M. Jan. *p.* 40, 41.

'chanics, its effort in this point is reflected againſt the fluid, which is 'lateral, according to the chord DM = DN: Now this effort being ſup-'ported by the re-action of the fluid along the ſame chord MD, it fol-'lows, that the ſpherical ſurface is preſs'd at the point D by two equal 'forces; one of which acts along OD, and the other along MD; from 'whence there reſults in this point of the ſurface an impreſſion according 'to the direction CD, which is that of the diagonal of the parallelogram, 'made by the two chords MD and ND. If we now place in the point 'D a groſs body, which has no *conatus* of its own, the fluid matter which 'acts along OD, and that which exerts its re-action along MD will pre-'vail with an equal effort, and propel it along DC towards the point C, 'which is the centre of the *vortex*, and not towards the point O, which is 'the centre of the parallel circle: And as the ſame reaſoning holds good 'what plane ſoever of the circle we conſider, and in what point ſoever of 'the plane we ſuppoſe the groſs body to be, it appears evident to me, 'that in *Des Cartes'* hypotheſis heavy bodies ought every where in falling 'to obſerve the ſame direction, which tends to the centre of the earth, 'conformable to experience, and contrary to the propos'd objection, *&c.*'

27. But to what purpoſe are theſe things? It is to ſhew us, that what may be doubtful to men however great, but who only reaſon, is very obvious and plain even to the moſt unſkillful who takes the experiment, to wit, we are to take the perpendicular lines from the periphery of a circle deſcrib'd by rotation rather than from the ambient ſurface; becauſe the direction of the ceding corpuſcles is not ſo much perpendicular to the including ſurface as to the axis of gyration § 19: And what do you think would be the conſequence, if the ſuperficies were elliptical, parabolical, or any how generated by the rotation of the curve ABCDE about the axis? Fig. 15. Am I miſtaken? ſhould it be conceiv'd, as conſiſting of an infinite number of contiguous little cylinders, generated by the rotation of the elements PM*mp?* Or if you will, from infinite cylindrical ſmall rings within each other, and having the ſame axis?

28. At the leaſt this is certain, that by *Des Cartes'* *vortices* cylindrical *nuclei* are generated.

A conjecture. 29. We aſk, what ſhould be done, that ſpherical *nuclei* may be produced? Having premis'd what I have ſaid, this problem is not difficult; take here the method which led me to the ſolution.

30. We have ſeen, that upon cauſing a ſpherical *vortex*, whoſe axis Fig. 16. AB may be parallel to the horizon, we alſo obtain the cylinder *abcd*, whoſe axis AB is parallel to the horizon. Let us now ſuppoſe the axis of rotation EF to be vertical to the horizon; and let us abſtract from that difference, which either the gravity or levity of bodies may cauſe, we ſhall alſo obtain the cylinder *efgh*, whoſe axis EF is vertical to the horizon. If you ſuppoſe both motions to be conjoin'd on account of the other action,

which

which depends on the rotation according to the axis AB, the cylinder *efgh* will be urged from *h* towards *i* and from *e* towards *k*, from *g* towards *l*, and from *f* towards *n*; and *vice versâ*, on account of the action depending on the rotation according to the axis EF, part of the cylinder *abcd* will be urged from *a* and *d* towards *i* and *l*, and from *b* and *c* towards *k* and *m*, what sort of figure does hence arise?

31. It seems, indeed, at first sight, that there arises the common section of the two cylinders *abcd* and *efgh* (but which acquire a somewhat larger diameter) represented here in some measure by *iklm*; and therefore, the body will be angular, whose angles in *i*, *k*, *l*, *m*, may coincide with the middle of the quadrants AE, EB, BF, FA: And which, therefore, cannot be avoided, unless by a new rotation according to the axes *no* and *pq*, upon supposing which the angles may again fall in with the middle of the spaces EO, OB, *&c.* so that at last in order to avoid all angles, we must have recourse to *Huygens'* hypothesis of the rotation according to all possible axes, or, which is the same thing, of the recess of the revolving fluid according to all great circles.

32. But it is, indeed, easy to avoid these inconveniencies, if we attend to the genesis of the cylinders *abcd* and *efgh*; for, the cylinder *abcd* arises hence, namely, that upon the gyration about the axis AB, each bubble tends towards some point of the axis AB; and the cylinder *efgh* arises hence, namely, that upon the gyration about the axis EF, each bubble tends towards some point of the axis EF; both rotations, therefore, being conjoin'd, each bubble tends towards each axis.

33. To make it tend to a point common to both axes, and consequently, to the centre of the sphere, you may effect thus. Let both *vortices* be equally strong; let the ratio of the revolving fluid, and of the particles immers'd therein be such, that the centripetal forces of the ceding corpuscles be directly as the distances from the axis: It is manifest, that in a ceding corpuscle a compound *nisus* arises, whose direction TO is the diagonal of the sides TQ and TP, tending to the centre of the sphere: This twofold rotation being, therefore, combin'd, there will arise a spherical *nucleus*; for it is a thing receiv'd, that the spherical figure of the *nucleus* may be deriv'd from the direction of the corpuscles towards the centre.

34. But if you doubt of it, suppose an angular body, whose section, for instance, let be *abcd*, by the hypotheses § 33, the force of each particle tending to the centre will be proportional to its distance from the centre *bo*, *eo*, *fo*: And therefore, the more remote particle *b* will remove laterally the particles *e* and *f* next thereto, till all be in *æquilibrio* and equidistant from the centre, that is, till there be a spherical *nucleus*. Fig. 17.

35. Let these things abstractly said suffice for understanding what may be requisite and sufficient towards the genesis of a spherical *nucleus* in a *vortex*. How it may be obtain'd by an experiment, I shall explain in an ensuing

enſuing diſſertation; and then, at the ſame time, I ſhall ſhew how far theſe things may, or may not be applied to the mechanical or phyſical doctrine of gravity; for, I imagine I have made ſome progreſs in that argument, but that more remains ſtill behind*.

* What I here promiſe about gravity was afterwards proſecuted in a particular diſſertation, publiſh'd at *Paris* in 1728, becauſe the illuſtrious *Academy* thought it worthy of a prize: In what is to follow, I do not, therefore, ſo much regard the application of this doctrine, as its confirmation and enlargement.

Of the Sugar Plantations in Braſil. *From the* Breſlaw Collection, September 1717. Claſs IV. Art. VIII. p. 79.

Tranſlated from the HIGH-DUTCH.

Sugar yielded by two different plants, and a great quantity of it in *Braſil.*

BOTH the *Eaſt* and *Weſt-Indies* ſupply us at this day with ſugar, yet from a different plant; in regard that the *Eaſt-India* ſugar is made from a natural tree, but the *Weſt-India* is taken and manufactur'd from a ſhrub: The leaves of this laſt are like thoſe of the wild reed, but the ſugar-cane itſelf has many joints; yet ſo that the larger theſe parts are, the ſugar-crop is wont to be the richer. Now this ſugar-cane grows moſtly in *Braſil*, whither the plants were at firſt carried from the *Canaries*, and to this day have been plentifully propagated there: So that ſugar, tobacco and *Braſil* wood are the principal commodities of the *Portugueze* trade to *Braſil*; of this ſugar were formerly every year 1,000,000 *Arobba's* (each *Arobba* reckon'd at 32 *Dutch* pounds) imported to *Portugal*, and from thence to the other parts of *Europe*. The principal ſtaple town for ſugar is *Olinda* in *Braſil*, from whence ſometimes 40 ſhips laden with ſugar have ſail'd in one day, and left behind in the warehouſes as much as they carried away. This ſugar-manufacture is carried on for the moſt part with ſlaves or *Negroes* from *Afric*, of which yearly a great number, and in 1621 and the two following years only, 15430 were carried to *Olinda* for the ſugar-mills[a]: But afterwards by means of the *Portugueze* inquiſition, the number of labourers, who pretended to be *Jews*, was greatly diminiſh'd, and thus the manufacturies were greatly weaken'd: So that this year 1717, there was ſuch a great decay of ſugar, that at the cloſe of ſummer they were advis'd at *Liſbon* from *Bahia de Todos los Santos*, that the ſugar plantations were entirely ruin'd, and that this year little ſugar was to be expected in *Portugal*, as it accordingly happen'd; for, in the month of *October* there came no more than one ſingle ſhip with 60 or 70 cheſts of ſugar only, and each cheſt reckon'd to 20 or 30 *arobba's*, in all about 2170 *arobba's*, with 1986 rolls of tobacco. But at length on the 25th of *November* the whole fleet, conſiſting of 26 ſail, arriv'd at *Liſbon* with 6844 ſugar-

[a] *O. Dapper. America lib. 2. cap. 4. p. 436.*

ſugar-cheſts and 2864 rolls of tobacco, with 14860 hundred weight of *Braſil* wood, together with other commodities and riches, and with this additional advice, that there was only left behind 5500 cheſts of ſugar, and 7000 rolls of tobacco: So that the remaining ſhips muſt have been freighted only with ſalt. Yet the ſcarcity of this year was greatly increas'd by a natural cauſe, ſeeing the preceeding ſummer and harveſt of *An.* 1716 till *February* this year, that is, for ſeven long months, there was a great and continu'd drought without any rain all over *Braſil*, whereby the ſugar-cane, which requires a great deal of moiſture towards its growth, as alſo the tobacco, were almoſt entirely parch'd up.

The ſoil and management for the ſugar-cane.

It is well known of this ſugar-cane, that it grows as well on unwater'd hills and eminencies as in fat meadows, particularly about *Pharnambuc*, where it uſually grows in greateſt plenty; yet ſo that it principally requires a great deal of moiſture, but on the contrary, is eaſily ſpoil'd and dried up by exceſſive drought; and the more moiſture it has, the better does the cane ſhoot up and yield the more ſugar: Whence the ſlips of the cane, which are laid in the plough'd field croſs-wiſe, and cover'd with mould, require more earth in ſummer than in winter, on account of the ſummer-heat, which otherwiſe would eaſily parch up the cane, as it lies ſhallow: And upon this each joint ſhoots out a new cane, which in ten or twelve months is ripe and cut off; and the intelligent planters uſually ſet them in the month of *Auguſt*, as being the laſt winter month; and at which time the earth is entirely moiſten'd with rain. Now when thus the cane is ripe they cut it off the firſt year, and alſo ſometimes not till the ſecond year, when it is call'd old cane, in which time it ſhoots out new canes, which along with the old produce is alſo gather'd; but what ſtands above two years till the third year is of little uſe, and is already quite dried up. In this manner the firſt planting continues ſucceſſively without further culture in fat fields for 40 or 50 years: Whereas in dry and poor ſoils they do not thrive above five years. Now if a continu'd heat and drought come on, the plants are burnt up to the root, and cauſe great loſs to the proprietors; as alſo on the contrary, from exceſſive floods the plants are chill'd too much, and in like manner deſtroy'd: Not to mention, that they are eaten up and deſtroy'd at the root, eſpecially in marſhy fields, by a kind of black wing'd worm, which the *Braſilians* call *guirapea coca*, but the *Portugueze*, *pao de galinha*.

The manner how ſugar is made.

Now after that the cane, which we ſhall only mention curſorily, is cut, it is clear'd of its leaves, made into bundles, and carried to the mills, where, by means of two thick rollers moving upon each other, the juice is expreſs'd, which in this its firſt conſiſtence is by the *Spaniards* call'd *caldo*. This, as in 24 hours it becomes ſour and unfit to make ſugar, is immediately wont to be boil'd in three large coppers, one after another, from the coarſer parts, and purified from the ſcum, call'd *cagaſſa*, and

which is given to cattle; and pouring to it ſome pretty ſtrong lee, all the impurities are forc'd up to the top, which are ſkimm'd off with large copper ſkimmers: After this it is ſtrain'd thro' a linen cloth, and purified from the other remaining recrements, which ſerve for food to the ſlaves. From this juice is uſually made wine, brandy, vinegar, mead, and laſtly, alſo ſugar itſelf; and this laſt in the following manner: The juice is boil'd in ſmall ſhallow coppers to the conſiſtence of a ſyrup, and here to prevent too great and prejudicial a boiling, a little olive-oil or butter is dropp'd into it; and it is remarkable, that if you pour the ſaid oil into the firſt larger coppers, wherein the *caldo* is, as alſo if the lee be pour'd into the laſt ſmall coppers, as well as into the large ones; or even if ſome lemon-juice or any other ſour thing be thrown in, no ſugar can be made. Now after this juice is become thick and begins to ſettle, it is pour'd into wooden moulds, which are brought to a particular bench for that purpoſe, and done over with moiſt clay, whereby it happens, that the browniſh liquor ſeparates, and thereby the ſugar becomes white. Upon this the ſmall hole, which is below in each mould, is open'd, that all the remaining impurities of the ſugar may run off. Laſtly, this condens'd ſugar is taken out of the moulds, the white ſeparated from the black, (which is call'd *maſcovado*) dried in the ſun, and put into cheſts. The greateſt ſecret conſiſts in the giving the ſugar a beautiful white colour; but this is what the manufacturers will not readily diſcover. To all this there is requir'd a great deal of pains and charges, particularly a great number of labourers and cattle; ſo that we may eaſily ſee, that beſides the exceſſive drought, the ſcarcity of labourers occaſion'd no ſmall prejudice this year to the ſugar-plantations.

I add this remark, that in walking over the fields, one may greatly refreſh himſelf by the generous juice of the broken freſh reed, which taſtes like ſugar; yet it eaſily cauſes, if taken too plentifully, bad *diarrhœa's*: Whence ſtrangers muſt be caution'd on this account; whereas the inhabitants of the country are not ſubject to this danger; as all this is fully and circumſtantially deſcrib'd by *Guil. Piſo*[b], who likewiſe gives a figure of the ſugar-mills; and by *O. Dapper*[c], as alſo by *De Rochefort* in his deſcription of the *Antilles*[d]. But the ſeveral ſpecies of ſugar, the refining and the trade thereof is deſcrib'd by *Marperger* in the *merchant's magazine*[e].

[b] *Hiſtor. Mat. & Med. Indiæ lib.* 4. *cap.* 1. *p. m.* 108.
[c] *America lib.* 3. *cap.* 4. *p.* 432, *ſeq.*
[d] *Part* 1. *cap.* 10. *num.* 7. *p.* 174, *ſeq.* and *Part* 2. *cap.* 5. *p.* 92.
[e] Tit. Zucker, *p.* 1424, *ſeq.*

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A method of bringing up young Children by Hand. From the Acta Erudit. Lipſ. An. 1682. p. 197.

Tranſlated from the LATIN.

AFTER ſeveral other late diſcoveries about the nutrition of *fœtus's* in the *uterus*, there ſtill remains behind the ſupplying them with a wholeſome and always equal food after the birth, and that without the aid of nurſes; ſince ſuch food is but little to be expected from theſe, on account of their ſeveral diſorders both of mind and body, and by reaſon of many other inconveniencies. We are told in the *Journal des Sçavans*[a], that the thing was actually put in practice both in *England* and *Bavaria*, even by perſons of the greateſt rank, and the method of doing it is there at the ſame time explain'd: This matter was likewiſe propos'd in *France* to the overſeers of the hoſpital for foundlings, the greateſt part of whom is otherwiſe loſt by bad nurſing and the negligence of the nurſes: And for this end ſome were pleas'd to propoſe furmety, others, pap, and others again, haſty-pudding; till the parliament of *Paris*, *Aug.* 19, 1680, reſolv'd to refer the matter to a certain number of phyſicians and ſurgeons, as alſo to two ſworn women, who ſhould communicate to them their opinions. It, therefore, appear'd to theſe, that tho' nurſes are very neceſſary, ſo that it were very much to be wiſh'd, that they might be had for four months at leaſt, to obviate thoſe frequent dangers to which ſo tender infants are ſubject; yet that it was no impoſſible thing to bring up ſuch children without a nurſe, tho' the methods above propos'd were only ſuitable to robuſter children, and ſuch as were almoſt fit to be wean'd: But as it is dangerous to try means, not yet confirm'd by experience, and a raſh thing to tamper with ſuch delicate bodies, without ſufficient reaſon; and reaſon does but little favour the means above propos'd, if we only conſider the ſtate of newborn infants, their low degree of heat, the weakneſs of their ſtomachs, and the liquors diſſolving the aliments, almoſt choak'd up by too much humidity: On theſe accounts it was entirely neceſſary, that a nouriſhment ſhould be ſubſtituted inſtead of the milk of the nurſe, that ſhould approach ſo near to the nature of chyle, as to require little or no heat for its digeſtion, that ſhould ſtay but a ſhort time in the ſtomach, be eaſily diſtributed; and above all, in order to avoid any ſudden change, which is dangerous to more tender infants, be very ſimilar both to that nouriſhment with which the mother ſupplies the infant in the womb and to that ſupplied by the nurſe, inſtead of which it comes to be us'd: And as theſe properties are not to be found in furmety, which is crude and heavy, and leſs capable of being alter'd by the weak heat of tender infants, and which undoubtedly would diſpoſe them to fevers or fatal *diarrhœa's*; nor in haſty-pudding or pap, which are groſſer food, and which but very rarely agree with

Whether infants may be brought up by hand.

[a] *An.* 1680. *journ.* 6.

new-born infants, and is only fit for children of ſix or ſeven months old, when they firſt begin to breed teeth, that from hence it very evidently follows, that inſtead of women's milk, that taken from animals is to be receiv'd; as it is evident from hiſtory, that ſeveral children have been ſuckl'd by wild beaſts; and according to the modern practice, children that have remarkably ſuffer'd by the ſmall-pox, have with ſucceſs been put to ſuck goats. In defect of this method, which is ſomewhat more difficult, cows milk is to be uſed, yet with the proper precautions; among which the principal is this, namely, that it be taken by the infants in the way of ſuction, in which by the motion of the jaws the ſalivary ducts may be the better open'd, as the mixture of the *ſaliva* with the aliments does ſurpriſingly promote their diſſolution: But that this may be attempted without raſhneſs, reaſon not only perſuades, but the thing has anſwer'd well even with ſome of their own friends, as alſo with ſeveral poor women; till by this means the dangers of that firſt ſtate of life being over, recourſe may be had to more ſolid food, as haſty-pudding, pap, and furmety.

This propos'd to be done by cow milk, and artificial breaſts.

Theſe things being thus determin'd, they hint that there ſtill remain three other conditions, highly neceſſary towards the better ſucceſs in this matter, to wit, 1. That the milk be of ſo exact a temperature, as if it came directly from the breaſts of a ſound woman, ſeeing the ſtomachs of children can otherwiſe leſs bear it. 2. That it be always kept up to this degree of natural heat. And 3. That it be taken by the child with as much eaſe, as if it ſuck'd a good nurſe; and for obtaining theſe requiſite conditions, M. *du Val*, engineer and king's architect, has taken ſome pains; as to the two firſt, indeed, he takes a large tinn'd copper veſſel, wherein he heats the cows milk to the ſame degree of heat with that of the milk juſt drawn from the nurſe's breaſts; and this temperature is to be determin'd by a phyſician, by putting a little of each on his hand, and accurately examining them; and that that equal temperature may be always kept up, he externally employs the flame of a lamp with ſpirits of wine, ſet under the veſſel; but internally he puts into the veſſel a thermometer, whoſe determin'd height is an infallible rule for continuing the ſame degree of heat in the milk; a figure of which machine may be ſeen in the *Journal des Sçavans*[b]. But the third condition, to wit, the eaſy ſuction he fulfills by artificial breaſts, contriv'd in imitation of thoſe of a ſound nurſe, and artificially furniſh'd with ſmall tin-tubes, and he frames them of goat's ſkins, or other limber materials; or, as theſe are leſs durable, and on account of their limberneſs the ſooner ſubject to relax and ſoften by the ſucking of the child, he prefers thin taffety, as being more durable: But that they may always remain turgid, he ſtuffs them with horſe-hair, prepar'd in a peculiar manner; for, thus they will be both ſoft and tractable, that children may apply their gums to them without receiving any hurt, and by the motion of the jaw the diſcharge of the *ſaliva* be at the ſame time promoted.

A new

[b] *l. c.*

A new Method of curing the Gout. By Dr. Conrad Barthold Behrens. *From the* Miſcellanea Berolinenſia. Tom I. p. 128.

Tranſlated from the LATIN.

THIS method of curing the gout has happily ſucceeded for ſeveral years together; and the illuſtrious *Zimmermann* Privy Counſellor to the Emperor, firſt made uſe of it, and he has render'd it very famous; ſo that tho' it be a little tedious, yet other great men by his example have us'd it always with like ſucceſs, and it is perform'd by a decoction of the woods, as *guaiacum*, *ſarſaparilla*, and the root *china*, to which is added a certain quantity of polypody and hermodactyl; and all is boil'd in wine and twice the quantity of water: But it is taken down in large draughts; ſo that in three days (in which time the cure is always compleated and the patient again walks about) almoſt 24 pounds of it are drank. A remedy for the gout.

And this effect ſucceeding always in all and thoſe even different circumſtances, made me that in my *Selecta Medica*, lately publiſh'd, wherein I have vindicated ſpecific remedies for diſeaſes, I call'd this decoction a ſpecific in the gout. Being a ſpecific therein.

But this invention is not quite new, ſince about 200 years ago the phyſicians of *Genoa* recommended to the Emperor *Charles* V. the root *china*, as an antiarthritic; and from that time decoctions of the woods have been frequently us'd in the gout: Yet the method of uſing them, as far as I know, is new, ſeeing the firſt doſe of theſe decoctions was formerly taken in the morning a-bed which caus'd ſweating, but the ſecond at dinner and ſupper: But here in my cure of the gout the patient even ſits up in his chair, then takes it down plentifully every hour, nay every half hour a cup of it, and even at meals. And again he is put into a gentle breathing ſweat for three days; and ſome even have a diſcharge of urine, and others alſo an open belly. How to be taken and its effects.

Nor is this cure without its foundation, ſeeing by this method, which the weight of the decoction, ſtrongly tinctured with the medicines, does promote, the ſharper ſaline *ſpicula*, collected in the blood and eſpecially about the joints, and wounding the *perioſteum*, ligaments, tendons and nerves, are diluted and plentifully diſcharg'd out of the maſs of blood, and as it were, elixated; and the cure ſucceeds ſooner and with more ſafety than by antiarthritic tinctures, as they are commonly call'd, as being in too ſmall a quantity, and even than by cathartics or topical applications: For, tho' cathartics may ſometimes happen to produce their effect, as a certain nobleman by my direction does now for ſome years upon the very firſt attack of the gout always uſe with the deſired ſucceſs ſome ſtrong purging pills; yet ſuch cathartics do not promiſcuouſly agree with every body, The manner of its operation.

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as they put the body and blood into a very great ferment, and as they irritate the ſpirits, and often heighten the pain, and very often on this account protract the paroxyſm: Nor is the cure by topical applications always ſo ſucceſsful, nor does it ſeem to me a ſafe method, whether attempted by repellents, as by theſe nature is not without danger hinder'd in its operation, and the ſaline matter more firmly impacted on the joints; or by reſolvents and anodyne plaiſters for the ſame reaſon: For, thus I ſuppoſe that *tophi* ariſe, becauſe the diſſolving of the ſaline matter is by ſuch a method impeded, and that matter thereby collected: So that it is with me a certain truth, that the cure of the gout is beſt of all perform'd by decoctions of the woods, which are ſuited to all temperaments and conſtitutions. When this method began firſt to be known, there were three objections made to it. 1. That the ſtomach muſt be greatly weaken'd by taking down ſuch a large quantity of the decoction. 2. That the weakneſs of the affected part cannot be ſo eaſily corrected, in accompliſhing which, nature ſometimes takes up ſome weeks. 3. And laſtly, that ſometimes notwithſtanding this method relapſes do enſue. As to the firſt and ſecond objections experience itſelf ſhows their weakneſs; and except one patient, who after the uſe of the decoction complain'd for ſome weeks of a loſs of appetite, I know of none other: And yet his loſs of appetite was owing to ſomething elſe too tedious to relate here; and by the uſe of ſtomachics his appetite has continued good to this day, and the weakneſs of the part affected cannot be ſo great, if the ſalts be diſſolv'd by the decoction, taken immediately on the firſt onſet of the paroxyſm, before they weaken the part more and more by a longer delay: For, if this be the caſe, it is not to be wonder'd at, that ſome weeks are ſpent in recovering the part to its tone again; nor do I deny, that relapſes may ſometimes happen from new cauſes, but even then the decoction is repeated with a like effect, as I had a remarkable inſtance of it laſt year in a certain patient of this place, who about the beginning of ſpring having kept his bed for ſeveral weeks, ſometimes by pains in his feet, then in his hands, and again in his arms and ſhoulders, he at length took the decoction, which at firſt he could not be prevail'd on to uſe, and it immediately remov'd the paroxyſm, but in a ſhort time after falling into a great paſſion he had a relapſe, with wandering pains in the joints and plentiful night ſweats; but he repeated the decoction with ſucceſs.

This remedy ſuitable to almoſt all conſtitutions.

But whether it may be of ſervice indiſcriminately to all patients may be no improper query? But as it is the part of a prudent phyſician to accommodate his remedies to the temperament and other circumſtances of each patient, the ſame thing is alſo ſometimes to be done by this decoction. And in the firſt place, I am of opinion, that we are to regard the ſtrength of the *viſcera*; yet patients of different ages and temperaments have happily follow'd this method; and even ſuch as ſeem'd to incline to a

conſump-

conſumption, the ſtone, a *cachexia* and the ſcurvy: And very lately a certain nobleman who had a bleeding of the internal hemorrhoids, and who had the gout in his hand, by my advice directly took a draught of the decoction, which he now always uſes with ſucceſs for theſe two years, as I judged it ſafer firſt to diſpel the pain before it ſhould be more firmly lodged in the part, by the length of time employ'd in putting a ſtop to the hemorrhoids, and then the bleeding might alſo be reſtrain'd; and if the hemorrhoids ſhould happen to be provok'd by that decoction, that notwithſtanding it was better to uſe it at firſt than after the hemorrhoids are ſtopp'd, and they ſhould break out again; and it ſucceeded well, as the hemorrhoids were no more affected by the uſe of the decoction, nay rather thereby ſtopp'd for about a day; and the gout in the hand remitted in leſs than three days, but the hemorrhoids afterwards diſappear'd by an electuary made of detergents and aſtringents.

Deaf and dumb Perſons made to hear and ſpeak. By Dr. Petrus à Caſtro; *together with Obſervations thereon by* Philip Jac. Sachs à Lewenheimb. *From the* Miſcellanea Naturæ Curioſorum. An. 1. Dec. 1. Obſ. XXXV. p. 112.

Tranſlated from the LATIN.

THERE are many inſtances of perſons of noble families in *Spain*, who were dumb in their infancy, either thro' a natural defect or by accident, as the rumbling of a coach, or the exploſions of great guns (for, theſe cauſes may occaſion dumbneſs) who afterwards learn'd to pronounce words diſtinctly; and tho' they always continued deaf, yet not dumb. Such were the ſon of the Prince of *Savoy*, the Marquis *de Priego* and the Marquis *del Freſno*, brother to the Conſtable of *Caſtile*, who were formerly dumb, yet now ſpeak without any difficulty or heſitation, only the deafneſs is ſtill obſerv'd. There are many other inſtances of different private perſons, who receiv'd this benefit from *Emanuel Ramireſius de Carione*, which extraordinary ſecret I learn'd, partly by converſation with the author himſelf, and partly by dint of cloſe meditation; and it ſucceeded very well[a]; but what he there ſcruples to diſcover was perform'd by him in the following manner; the whole buſineſs conſiſts in application, dexterity and patience; and *à Caſtro* himſelf affirms, that at *Vergana*, a town of *Cantabria*, he in this manner reſtor'd a boy that was deaf and dumb from his birth, with the greateſt aſſiduity, and tho' it took up ſome time, and that in two months: So that he could perfectly pronounce his words, and expreſs his thoughts.

Dumb perſons taught to ſpeak.

In the firſt place the body is to be purged according to the conſtitution of the ſubject, then a ſpecial cathartic of black hellebore is to be adminiſter'd

The manner how this is to be perform'd.

[a] Petr. à Caſtro *in Tract. de coloſtro cap.* 3. *p.* 18.

niſter'd, or the extract thereof exhibited in pills, or one drachm of a decoction of the root. Of this decoction the author took three ounces, in which over night he infus'd two drachms of agaric, and after ſtraining he added two ounces of *ſyr. de epithym.* The head being purged once or twice by this medicine, as the caſe requires, the breadth of the hand is ſhav'd above the coronal future, and then the following liniment is often rubb'd into the ſhav'd part. ℞. *aqu. vit.* ℥iii. *ſalpet. ſive nitri purificat.* ℥ii. *ol. amygd. amar.* ℥i. Let them boil together till the ſpirits of wine are conſum'd, then add an ounce of *aq. nymphæ*, and then let it be well mix'd with a *ſpatula*, and made into a linſment, with which the ſhav'd part is to be anointed once every day, eſpecially in the evening at bed-time; but in the morning after he has clear'd all the paſſages of the brain, as the ears, noſe and palate, eſpecially by chewing a grain of maſtic or a bit of liquorice, or which is better, a lozenge of the juice liquorice, maſtic, amber and muſk, likewiſe combing back the hair for ſeveral times with an ivory comb, and then waſhing well the face, he ſpeaks to the dumb perſon above the ſhav'd part; and it is ſurpriſing that the deaf and dumb perſon perceives the ſound ſo diſtinctly, tho' by no means by the ears: If he cannot read you muſt begin with giving him the letters of the alphabet, and often repeat each one of them, till he himſelf can pronounce it; and you are to proceed with ſuch induſtry, that the manner of pronouncing may be gradually inſtill'd into him, and this you are to continue for ſeveral days, till from letters he proceeds to entire words; and let the ſeveral common things about the houſe be ſhown him, whoſe names he may learn. Again ſpeak often and much to him, that he may take the manner of joining words: For the firſt 15 days he ſurpriſingly learns names, which he could not retain without the ſtrongeſt memory; and every day following the thing becomes eaſier; and it is ſurpriſing with what anxiety he always meditates to break out into words.

Obſervations thereon.

Perſons dumb from their birth are generally wont to be deaf at the ſame time; tho' *Dominicus Panarollus*[b] has ſeen a boy of 12 years of age, who indeed was dumb from his birth, but not deaf: Whence being call'd on from behind he would turn about his face, the cauſes of which the ſaid *Dominicus* aſſigns, both as the nerves for ſpeech in this lad were at leaſt hurt, as alſo on account of the different conformation of the nerves, ſo that the auditory nerve enter'd into the ear alone, and not any where elſe; and in fine, from his fooliſhneſs, on which account he could have learn'd nothing. And thus practical writers alledge a threefold cauſe, why dumb perſons are for the moſt part deaf at the ſame time.

Cauſes of deafneſs.

1. By reaſon of the conjunction of the nerve of the fifth conjugation, the larger branch of which uſually runs to the ear, the leſſer to the tongue and *larynx*[c].

2. Others

[b] *Pentecoſt.* 4. *Obſ.* 17. *p.* 121.

[c] Camerar. *Cent.* 8. *Memorabil. Med.* § 82.

2. Others aſcribe it to a ſmall cartilaginous canal reaching from the ſecond *meatus*, or the *tympanum* of the ear to the mouth and palate, ſo that the air paſſes and repaſſes freely from the mouth to the ear, and from the ear to the mouth, eſpecially if that *meatus* reaching from the *tympanum* to the palate be naturally large[d]. Whence a reaſon may be aſſign'd for what *Beubeſius* told *Paulus Marguardus Schlegelius*, namely that he knew a deaf woman, who put a horn into her mouth, and deſir'd ſuch as would ſpeak to her to apply their mouth to the farther end of the horn, by which means ſhe heard what they ſpoke, as I ſome time ago found this in *Schlegelius*'s MSS. and ſaw the account given of it by *Hieronymus Welſelius*[e]; for, by means of this canal, ſtring'd muſical inſtruments, held between the teeth and ſtruck upon, do convey a ſound thorough the mouth[f]; and *Laz. Riverius*[g] affirms, that by means of this patent *meatus* it happens, that tho' both ears be ſtopp'd, if muſical inſtruments be touch'd and held between the teeth, they are heard the more diſtinctly; and on the high road the tread of a perſon at a diſtance is better perceiv'd, provided that one end of a ſword be ſtuck in the ground, and the other end held between the teeth.

3. Others aſſign this reaſon for deafneſs from the birth, as alſo dumbneſs, or at the leaſt a difficulty of ſpeech, namely becauſe the minds of deaf perſons are not made acquainted with ſound, and not knowing how to form theſe unheard words, they can neither conceive nor expreſs them, ſeeing ſpeech is only regularly learn'd by hearing other people talk. To this opinion inclines *Franc. Mercur. Helmont*[h]. Such as labour under this misfortune, namely want of ſpeech, are for the moſt part, properly ſpeaking, only deaf; for, they are not depriv'd of voice, nor of the motion of the mouth and tongue; but the want of ſpeech ariſes hence, namely that their organs of hearing being vitiated, they cannot hear others ſpeak; conſequently they cannot form by the motions of their tongue and voice the ordinary diſtinctions of human ſounds, according to the common method of ſpeaking. Upon this principle *Petrus Pontius*, a *Benedictine* monk, taught perſons born dumb to ſpeak by no other art than firſt teaching them to write down the names of things, and then pointing to the things that anſwer'd to the characters, according to *Franciſcus Valleſius*'[i] teſtimony.

Franc. Mercur. Helmont[k] has diſclos'd the method of reſtoring ſpeech to the dumb and deaf, which hitherto has been a ſecret, and it is founded upon the following principles. The principles on which this method is founded.

1. Such as are thus deaf are for the moſt part very ſharp ſighted: ſo that if one talk to ſuch people about domeſtic affairs, they very readily and

d Veſling. *Syntagm. anat. c.* 16. *Cent.* 2. *mem.* § 71. *Hebraico Colloq.* I. *p.* 1.
e *Epiſagmat. Obſ. Med.* 24. *p.* 16.
g *L.* III. *prax. c.* 1. *p.* 187.
i *In philoſ. ſacra. c.* 3. *p.* 57.
f Camerar.
h *In alphabet. Natural.*
k *l. a. colloq.* 1.

and even at a diſtance underſtand what is ſaid, as if they read the words, and that only by a ſomewhat more accurate obſervation of the ſpeakers mouth, as we have it confirm'd by the hiſtories that ſhall be mentioned anon.

2. They learn in the ſame manner, that illiterate perſons firſt learn to read; for, as theſe at firſt make uſe of larger characters, and afterwards proceed to ſmaller ones, and even to abbreviations, which they very eaſily attain to, tho' ſome things are not fully expreſs'd till the end of the ſentence: Thus ſuch deaf perſons ſeem at firſt to obſerve more exactly thoſe, who with a loud voice order ſome thing to be brought them; and taking a more particular notice of their tongue, lips, cheeks, chin, throat, *&c.* as alſo of their different motions and changes, they make uſe of theſe, as of the larger characters, in order to obtain the ſenſe of the ſpeakers, and being confirm'd in theſe, they ſeem to proceed to the more gentle and ordinary motions of the ſpeakers, till at length they underſtand their meaning from the firſt commencing of theſe motions; tho' the whole be not yet compleated, more eſpecially when aſſiſted therein by cuſtom. The principles therefore, by which ſuch deaf perſons underſtand, are the different motions in the tongue of the ſpeaker; from which, as from the firſt elements of writing, they underſtand his true meaning.

3. After having thus underſtood words, *Helmont* thinks it no difficult matter for them likewiſe to read writing readily, if the letters be depicted to them in the ſame manner they ſaw them form'd by the tongue of the ſpeaker, and they may be brought to the uſe of ſpeech, if any one would teach them before a looking-glaſs to imitate with their own mouth theſe very motions, and afterwards animate them, as it were, with a ſtrong breath.

4. The ſame *Helmont*[l] aſſerts, that this ſucceeds better in the oriental languages; for, the eaſtern people on account of their warmth require a fuller breath; whence they ſpeak with open mouth and wide throat, that any one may very eaſily obſerve the motion of the tongue; but in *England* and places more northerly the mouth is open'd but little, and they ſcarce move the lips.

Inſtances of the ſucceſs of this method.

Helmont[m], therefore, teſtifies, that he made an experiment on a deaf muſician, whom he brought ſo far in three weeks time, as to anſwer any queſtion aſk'd himſelf ſlowly and with open mouth; and in a ſhort time after he learn'd the *Hebrew* by himſelf. What *Helmont* perform'd in the *Hebrew*, Dr. *Wallis* of *Oxford* did a few years ago perform in the *Engliſh*, teaching deaf, nay dumb perſons to ſpeak, and that in two inſtances: And *Olaus Borrichius* in a letter to *Bartholin* from *London*, dated *Auguſt* 10, 1663[n] ſpeaks of it thus; ‘ I ſaw, *ſays he*, a young gentleman with Dr.

[l] *l. a. p.* 3. [m] *l. a. p.* 5. [n] *Cent.* IV. *epiſt.* 92. *p.* 527.

'Dr. *Wallis*, who, I know not by what misfortune, became deaf in the 'fifth year of his age, and dumb in ſix months after; and now for 20 'years he could not ſpeak a word. Dr. *Wallis* writes down on paper the 'letters and ſyllables, then he repeats them himſelf, cauſing the other to 'make the ſame motions with his tongue; nor was the Dr. diſappointed 'in his thoughts; for, he has now brought the young man ſo far, that 'he can pronounce ſome things pretty diſtinctly, tho' he ſtill continue 'deaf.' *Monconnys*[o] alſo gives an account, that when he was at *Oxford* in *June* 1663, he ſaw at Dr. *Wallis*' houſe, a young gentleman both deaf and dumb from his birth, whom the Dr. taught to read; that he read juſt like any other perſon, only with this difference, that he pronounced but one ſyllable at a time; and that this was the ſecond perſon on whom the Dr's experiment had ſucceeded. Dr. *Holder* has lately publiſh'd a diſſertation on the elements of ſpeech, in order to ſhow how deaf and dumb perſons may be taught to ſpeak, of which you may ſee more in the *Philoſophical Tranſactions* of the *Royal Society* at *London*[p].

This attain'd by the motion of the ſpeaker's lips without a teacher.

What theſe dumb and deaf perſons have acquir'd by the induſtry of a maſter, other deaf perſons have by mere inſtinct, and from a great fondneſs to learn, attained by the motion of the lips, yet ſtill continuing deaf. *Borellus*[q] gives an account of a ſailor, who from the fifth year of his age became deaf by a violent diſtemper, and together with it had a difficulty of ſpeech; he hears people ſpeak, tho' they mutter only, can underſtand what they ſay, and anſwer queſtions put to him. *Nicholas Tulpius*[r] makes mention of *Simeon Dietericus*, a *Dutchman*, who became deaf by a fall from the tower of *Purmerndan*; and that he underſtood what was ſaid from the bare motion of the lips of the ſpeakers, and as their lips happen'd to be ſmooth or rough, thinner or thicker, he underſtood their meaning better or worſe. At *Saltzborn* in *Sileſia* liv'd a ſcrivener, who after the ſmall-pox became deaf, he had a natural bent to mathematics; ſo that he learn'd by himſelf the art of painting and mixing colours. He underſtood ſuch as only whiſper'd better than thoſe who ſpoke aloud, and all this by the motion of the tongue and lips of the ſpeaker, which he view'd very attentively, and made pertinent anſwers.

An inſtrument for helping deafneſs.

For ſuch as are not quite deaf human ſkill has diſcover'd an excellent contrivance. We are told of *Joh. Baptiſta Lallius Nurſinus*, a lawyer and poet, that having begun to loſe his hearing at 40 years of age, he was oblig'd to make uſe of a ſmall ſilver tube, which he applied to his ears for receiving the words ſpoke to him[s]. And a like inſtrument the *Spaniards* at this day make of ſilver or copper, and they call it *ſarbatana*; and if they have any defect in their hearing, they carry it about with them as other people do ſpectacles. It is ſaid to be like a funnel, whoſe wider part is turn'd

o *Voyag. d'Angl. Tom.* II. *p.* 50. p *Num.* 47. *p.* 958. q *Cent.* IV. *Obſ.* 33.
r *Lib.* 4. *c.* 18. s Nicii *Pinacothec. part* 1. *imagin.* 73. *p. m.* 131. *Ed. Colon.*

turn'd towards the perſon that ſpeaks, and the narrower end applied to the deaf perſon's own ear.

An inſtrument to help ſtammering.

For ſuch as ſtammer chance has alſo diſcover'd an inſtrument, and art has perfected it in a man, who, having a part of his tongue cut out, could not ſpeak ſo diſtinctly, and it is deſcrib'd and delineated by *Paræus*[t]: It is a piece of rounded wood, which is held between the inciſors; ſo as not to ſtand out of the mouth; its inferior and thinner part is cloſely applied to the membranous ligament under the tongue; it is internally ſomewhat hollow, and as often as it is properly fix'd in the mouth, the perſon ſpeaks diſtinctly, ſo as to be underſtood by every body. I know a very curious and learned man, who taught a young gentleman of the family of *Falckenhain* in *Sileſia* to ſpeak diſtinctly, and that in a few months; and he ſhew'd from the nature of the oriental languages, how from the diverſity of the letters, as ſome are gutteral, others labial, others dental, and others linguai, the inſtruments of ſpeech may be diverſely mov'd and inflected, by not only ſhewing the young man thoſe motions exactly in himſelf, but likewiſe often inflecting his tongue and lips, till he learn'd perfectly to expreſs the words. At *Saumur* in *France*, a certain perſon loſt his tongue by the ſmall-pox, and yet he could readily talk; he could not, it is true, exactly pronounce ſome of the letters; but ſuch of them, as are pronounc'd without the motion of the tongue, and which are form'd by the throat, as A, or by the lips as B, to better advantage[u]. *Jac. Rolandus*, a ſurgeon of *Saumur*, on account of this extraordinary caſe, publiſh'd a treatiſe, entitul'd *agloſſoſtomagraphia*, or a mouth without a tongue that ſpeaks perfectly, wherein mention is made of an extraordinary caſe of a perſon of the *Lower Poictou*, who, when a boy of five years old, loſt all his tongue by the ſmall-pox; and yet he could perform all the five functions aſcrib'd to this part, as ſpeaking, ſpitting, taſting, and chewing, as alſo ſwallowing, to the admiration of every body.

Engaſtromythi what? And their impoſtures.

In fine, ſome people pretend to be dumb, and they ſeem at leaſt to ſpeak from their belly, and they are denominated *engaſtromythi*, or *ventriloqui*: Of theſe *Digby*[w] ſpeaks thus; 'ſuch as are call'd *ventriloqui* impoſe 'on ignorant people, perſuading them, that ſome demon or other emits 'ſounds from their belly; by a peculiar art they draw in their breath, 'whereby it happens, that the words ſeem not to proceed from them-'ſelves, but from ſomething within them, tho' they ſeem at leaſt to 'come from them; for, if you do not advert to it, you will imagine they 'proceed from ſome diſtant place.' And *Joh. Walæus*, formerly profeſſor at *Leyden*, ſaw ſuch a perſon in *France*[x]. *Fr. Mercurius Helmont*[y] affirms that it is done by means of the *epiglottis*, which, like a clack in a pair of bellows,

[t] *Chirurg. lib.* 22. *cap.* 5. *f.* 489.
[u] Thom. Bartholin. *Cent.* II. *hiſt. rar.* 22.
[w] *De nat. corpor. tr.* 1. *c* 28. *p.* 319.
[x] Alb. Kyperus *in inſtitut. phyſic. lib.* 10. *cap.* 2. *th.* 12. § 2.
[y] *Alph. Hebraicum cap.* 3. *p.* 22.

bellows, covers and closes the beginning of the *aspera arteria*, and by drawing the breath inwards into the belly and shutting close the mouth; as some impostors in our days pretend to prophesy, which *Helmont* himself understood from undoubted experience.

Of the separation of salt and fresh Water, and a new kind of chemical Separation. By G. G. L. *From the* Acta Eruditorum Lipsi. An. 1682. p. 386.

Translated from the LATIN.

THE separating of fresh water and the salt contain'd therein may be done with a twofold view; either we want fresh water, without minding the salt, for the use of sea-faring people; or on the contrary, we want the salt and neglect the fresh water, in order to lessen the expence of fire, by means of which the water evaporates; a thing that would be of no small service in those parts where the sun has not sufficient force for this purpose. The separation of salt and fresh water twofold.

As to the first, it is plain not only from the account of *Linschotten* but of a great many others, that pretty good fresh water to drink may by distillation be got from sea-water: And I should think that for that purpose very compendious furnaces might be contriv'd, that would require but little fuel, and such as are not hitherto us'd. I know that salt may be precipitated by zink, *lapis calaminaris*, &c. nay lead is of some service in this case. But the most simple way of obtaining fresh water I take to be by filtration; for, it appears by experiments, that even wine, urine, and other liquors lose not only their colour but their taste, by repeated filtrations thro' simple sand. And when in *France* I saw a kind of stone, which by once filtring made the liquors insipid. And that salt water may be the more easily strain'd thro' a larger quantity of sand, and so be made fresh by one, or at most two filtrations, a compressing or sucking engine might be us'd. But if any one would incline to use litharge, or any other *calx* of lead, instead of simple sand, the thing would probably answer still better. Moreover, from these things I got the hint of a new kind of chemical separation: Let us suppose, that a liquor is often filtred thro' common or a particular sort of sand, or any other body, till it become insipid, there is no doubt but the sand must be impregnated with some essential salt of the liquor. Let that salt be again extracted from the sand, by pouring common water thereon, and afterwards evaporating part of the water, and let it concrete into crystals, or in some other way be reduced to dryness. But lest any one should imagine, that it is needless to restore to the salt, which is to be extracted from the sand, the water we before separated therefrom by The first done by filtration.

by filtring, he muſt obſerve, that by this means a large quantity of ſalt, which before was diſpers'd in a large quantity of liquor, is now concentred into ſo ſmall a quantity thereof, as is ſufficient to diſſolve it; and that then there is a deal of difference between the firſt water, which is naturally in wine or any other liquor, that would not ſo eaſily have let go this cognate ſalt, and between common water now pour'd upon it, which as it at firſt attracted this eſſential ſalt, does immediately freely let it go. If any one, omitting elixation, would fain try what would be got by diſtilling the ſalt from the ſand, or by the vitrification of the ſand, he, no doubt, would make a great many new diſcoveries, and likewiſe, probably, produce ſome peculiar earths. Thus, by means of this ſubtile filtration, we ſhall have a new analyſis of ſeveral bodies, and a great deal of matter for uſeful experiments.

The ſecond ſeparation by ſimple motion.

It remains to treat of the ſecond head, namely the ſeparating the ſalt from the water, without regarding the water. This ſeparation may be ſeveral ways render'd eaſier, ſome of which we have already mention'd; for, even thoſe compendious furnaces will evaporate the water with leſs charges; and then if the ſalt left behind in the ſand be had by ſtraining, it will be concentred by elixation into a water much richer than the former, conſequently more eaſily boil'd in. But not to mention at preſent the influence of the ſun and air which has not been ſufficiently applied, it will ſuffice to mention in what manner the water can be ſeparated by ſimple motion without any fire. I had the hint of this thought from thoſe ſalt-works, call'd *leck-wercke*, where a great part of the wild or heterogeneous water, which is mix'd with the brine, is diſſipated by motion and by falling down: But I thought the operation might be improv'd, when I conſider'd thoſe well known bellows that work by means of the wind generated by the fall of water. For, hence it manifeſtly follows, that if ſalt water, falling down once and being rais'd up again by means of an engine, ſhould fall down a ſecond time, that at length, when all the water was evaporated, the ſalt alone would remain behind at the bottom.

Some new experiments made in Sileſia, *on the encreaſing or multiplying of Corn. From the* Breſlaw Collection, September 1717. Claſs V. Artic. VII. p. 110.

Tranſlated from the HIGH-DUTCH.

Improvements in vegetation.

SCARCE ever did mankind apply themſelves more aſſiduouſly to exalt the powers of vegetables, than they have done of late years, by ſeveral new experiments, contriv'd, partly to improve, and partly, and that chiefly, to multiply their produce: And to this purpoſe the following ones were made in *Sileſia*.

1. In

1. In farms,[a] where dunghills lie expoſed to the open air and rains, let the dark brown water, which runs from them, be ſaved in proper veſſels, to be ſet in pits, dug near the dunghills: This water is the beſt ſubſtance of the dung, and ſupplies vegetables with their moſt perfect nutritious juices; tho' generally it is ſuffer'd to run off to waſte and ſoak into the ground. 2. Collect human urine, and let it be brought to putrefaction, particularly by a previous evaporation at the fire. 3. Let both be mix'd together, and made to digeſt and ferment in a copper by the fire. 4. Into this liquor ſhoot the grain, and let it ſoak therein for four days and four nights. 5. And then ſow it: And thus it will not only yield a much richer crop, but the field will never require dunging or fallowing. Experiment I.

Half a peck of wheat, being ſteep'd for 48 hours in bullock's blood, then dried, and thin ſown, grew up into large tufts of corn-ſtalks. Experiment II.

This third experiment,[b] which is Dr. *Hermann*'s, conſiſts in the following particulars: 1. At ſeed-time, either in ſpring or harveſt, make a proper lee, as half a quarter *Breſlaw* meaſure (or about half a peck, *Engliſh*) to each buſhel of corn. 2. Take half a quarter of ſheep-dung, either boil'd with the lee, or expreſt into it. 3. Diſſolve therein three or four pounds of ſaltpetre. 4. Throw into this liquor a buſhel of clean freſh corn. 5. Let the corn ſoak therein for eight hours. 6. Set the ſeed to dry in an airy loft, and where there is but little ſun. 7. Repeat this operation once more: And laſtly ſow it; and in three days it ſpires. In this manner the pooreſt and moſt ſandy ſoils anſwer well; but they muſt be thin ſown: Beſides, they require no dunging; ſo that this method is very advantageous, where there are few cattle, and little dung made: And you need only ſow half the quantity you otherwiſe would; and often one grain yields 10, 12, and more ſtalks. Experiment III.

The ſucceſs of this experiment, *An.* 1715, was, that one buſhel of corn, manag'd in this manner, and ſown on poor land, yielded 8 ¾ buſhels, which was an extraordinary increaſe: Beſides, the corn order'd in this manner is not apt to ſmut or mildew. Succeſs of the Experiment.

Profeſſor *Le Mort* communicated the following vegetable liquor:

Take flower of meal and lintſeed, from which the oil has been expreſt, 10 pound, horſe-hoof ſhavings 20 pound, wood aſhes 40 pound, quick-lime 10 pound, ſtale human dung 80 pound, dregs of lintſeed oil 15 pound, a ſufficient quantity of urine, to make all of the conſiſtence of a gruel. In the month of *October* let theſe ingredients be mix'd together in a caſk, and let them ſtand all the winter, ſtirring them every day with a ſtick, that being perfectly mix'd, their inteſtine motion may be kept up: To one part of the above compoſition take 150 parts of *March* rain-water for ſteeping your ſeeds. This experiment may be of ſervice, but as it is too troubleſome and laborious, the following may be ſubſtituted for it. A liquor to promote vegetation. Experiment IV.

Take

[a] Caſp. Schrœders Feld-Bau, Part II. c. 2. p. 94, ſeq.

[b] Agricolæ Verſuch der Univerſal-vermehrung aller baume, &c. Part I. ſect. 1. c. 2. p. 11, 12.

Experiment V. Take *ſal gemma* 10 pound, quick-lime five pound, calcine them in a potter's furnace, and then mix them with ſtale dung; let them ſtand ſummer and winter under cover; ſprinkle them often with human urine: Then take, for inſtance, 20 pound of this matter, common aſhes 10 pound, and mix them together in a pail of rain-water.

Succeſs of the Experiment. Upon ſteeping in the above liquor one buſhel of wheat, and ſowing it in a field, that had been ſown three years running, it yielded five buſhels; 1 ½ buſhel of oats, ſteep'd in the ſaid liquor, yielded 10 buſhels. Garden ſeeds, thus ſteep'd, do not anſwer in *Sileſia*, but are readily kill'd by the froſt: The beſt way is to water theſe carefully with this liquor as ſoon as they chit. Fruit becomes larger and better taſted by ſuch watering; and the trees themſelves thrive better: But I have obſerv'd, that if the ſprinkling be omitted the following year, the fruit degenerates.

Experiment VI. A dry, ſandy and barren field being ſprinkled *An.* 1715 with potaſh; for the firſt year three buſhels of barley yielded 18; and upon ſowing wheat therein the following year, *viz.* 1716, the crop proved ſtill richer: And ſuch fields require no improvement for many years after: Soap-boilers aſhes, which were formerly thrown away as uſeleſs, are now employ'd in *Sileſia* to advantage on dry ſoils. We ſhall only mention, that there is ſuppos'd to be an extraordinary virtue in the putrefied parts of animals, as appears from *Vallemont's*[c] noted compoſition of the water, prepar'd by putrefaction from bones, leather-ſhavings, horns, hoofs, *&c.* As alſo that at this time about *Breſlaw* comb-makers ſhavings are employ'd to good purpoſe. In what manner the ſeed vegetates with the foul water from bare horſe-dung without ſtraw, and how it may be ſown to great advantage with chopped ſtraw; and how in *England*, by means of ſea-water, or the aſhes of plants, mixed with ſea-ſand, ſuch experiments may be made with profit, may be ſeen in the *Miſcellanea Naturæ Curioſorum*[d]; as alſo in a diſſertation at *Wittemberg An.* 1695, entitul'd *de Pane Lucrando.*

Different ſoils require different ment. But in all theſe experiments, the different qualities of the ſoils are to be regarded; for, ſome require the ſaline, others the ſulphureous principle, and others again want fallowing, *&c.* for their improvement.

[c] *Curioſitez de la nature*, p. 157, ſeq. [d] Dec. 1. Ann. 2. Obſ. 112. p. 185, ſeq.

Of the Origin and ancient Seat of the Scythians. *By* Theophilus Sigefridus Bayerus. *From the* Comment. Acad. Scient. Imper. Petropol. Tom. I. p. 385.

Tranſlated from the LATIN.

The deſign of this diſſertation. THAT every one may know at the firſt what my opinion is about the *Scythians*, I enter a caveat, that I by no means derive from them the *Sarmatians*, *Ruſſians* and *Sclavonic* nations, nor the ancient *Hunni* and the modern *Hungarians*; nor in fine, the *Tartars*; but the *Lithuanians* and

and the ancient inhabitants of *Pruſſia*, as alſo the *Courlanders*, *Livonians*, *Aeſtii*, *Finns* and *Laplanders*, and ſome others. So open a confeſſion will ſtick in the minds of the readers, till in the progreſs of this diſſertation, they find it gradually eſtabliſh'd by me. As I allow not the *Ruſſians* to be the ſuppoſititious offspring of the *Scythians*, I reap this advantage, namely that I do not ſuffer their original to be confounded, and an otherwiſe noble people to be ingrafted on a foreign ſtock: And I at the ſame time gain this farther advantage, that as to that country, which was anciently ennobled by the *Scythian* name, and is now an acceſſion to the large Empire of *Ruſſia*, by enquiring into antiquity I extract, or as it were, expreſs what either may be true or very nearly ſo; not to mention, that I may be aſſiſting to thoſe, who, in tracing the origins of the *Hungarians*, *Poles*, *Tartars*, *Turks*, and other nations, being driven, as it were, by ſtreſs of weather to the *Scythians*, anchor there as in a place of ſafety.

The miſtakes of authors as to the *Scythians*.

For, ſuch as have treated before us of the *Scythian* affairs have been involv'd in one remarkable great error, againſt which if we do not provide, we loſe all our labour and pains in reſtoring the antiquity of that nation, and corrupt the origin of many other people. I might quote many great men, did I not chuſe rather to draw a vail over their miſtakes, and not to mention men from whom we daily reap advantage in other things, than to triumph over them upon this account; for, they extend the name of *Scythians* to vaſt tracts of land, almoſt from the riſe of the *Danube* and from the *Weiſſel* and *Baltic* ſea along the northern ocean, the *Euxine* and *Caſpian* ſeas, as far as the outmoſt parts of the eaſt. Ancient writers have likewiſe gone before them in this error, and were a cauſe of ſtumbling to the moderns. *Ephorus* is the firſt of them ſo far as we know, who in his fourth book of hiſtories has divided the earth among the *Scythians*, *Indians*, *Ethiopians* and *Celtæ*. *Coſmas Indicopleuſtes* has preſerv'd in his *Topographia Chriſtiana* a fragment of that paſſage[a]. I am not ignorant, that *Diodorus Siculus*[b] objects to *Ephorus* his negligence of truth, and, as it were, a kind of ſtupidity: But I would incline to judge very favourably of him, ſince his hiſtories are now loſt; ſo that we cannot form a judgment of them: I, therefore, find, that *Ephorus*, when he would claſs under certain heads and explain the poſition of places, has applied the names of the more remarkable nations to the larger tracts with no bad deſign but unhappily; for, whatever *Ephorus* writ was taken by moſt of the *Greeks* and *Romans* for certainties; and thus the error ſpread among poſterity: And, therefore, ſo many nations and thoſe of different original, not only confin'd within the limits of one common country, had all the common name of *Scythians* given them by theſe authors, but even from that appellation of the country they were made one and the ſame people; and thus the hiſtory of the *Cimmerii* is confounded with that of the *Scythians*, the *Scythian* hiſtory with

 that

[a] *f.* 148. [b] *f.* 26. *Ed. Steph.*

that of the *Sarmatians*, *Ruſſians*, *Hunns* and *Tartars*; and there are ſome who confound not only the countries, but even the periods; for, whatever names of theſe countries or people they find among the writers of any age, theſe they apply in their geographical deſcriptions: We are, therefore, to be careful, that we do not juſtly incur the ſame reprehenſion; and that no one deprive us of this juſt defence, namely, that we would not advance any thing without juſt grounds, and publiſh uncertainties for certainties.

Scythians whether the poſterity of *Magog*.

Moſt authors relate, that the *Scythians* are deſcended from *Magog*, the ſon of *Japhet*; among whom *Samuel Bochart* claims the principal place. There is no author of this opinion of greater antiquity than *Joſephus*[c], who indeed mentions the *Scythians* by name; but he ſeems to have taken this from *Ezechiel*[d], who places the country of *Magog* to the north of mount *Caucaſus*, between the *Tanais* and *Volga:* But the ſame *Ezechiel*, when he calls the *Scythians Gog in the Land of Magog*, ſhews pretty evidently, that another people, *Magog*, inhabited thoſe parts before the irruption of the *Scythians*, which have ſtill retain'd their ancient name among the *Aſiatics*. *Ezechiel* is, therefore, ſo far from deriving the *Scythians* from *Magog*, that he even oppoſes this opinion. Others alſo ingraft the *Turks* and *Tartars* on the ſtock of *Magog*, whom *Ezechiel* had call'd *Magog* from their *Aborigines*, as it were; I therefore think, that the firſt progenitors of the *Scythians* are not known; yet this I think I have gather'd from no mean arguments, that the anceſtors of the *Scythians* probably came from *Armenia* to the ſouth, and then proceeded to the north-eaſt, till they ſettled to the north of the *Caſpian* ſea, being urg'd on by other ſucceeding families: And from that time I find they dwelt to the north of the *Caſpian* ſea, and on the *Volga* near the *Maſſagetæ* and *Iſſedones*. The *Scythians* themſelves have related in *Herodotus*[e], that they were 1000 years older than *Darius'* expedition. The *Scythians* have foiſted into this place a fable, namely that *Targitaus*, the father of the *Scythians*, and ſon of *Jupiter*, by a daughter of the river *Boryſthenes*, had three ſons, whoſe names are *Leipoxais*, *Arpoxais*, and the youngeſt *Colaxais*: *Colaxais* obtain'd the empire by a divine prodigy, from whom is deſcended the nobleſt family among the *Scythians*, namely, that of the kings, which are call'd *Paralatæ*; from *Leipoxais*, the *Auchatæ*, and from *Arpoxais* the *Catteari* and the *Traſpies*. *Colaxais* again divided the nation among three ſons; and all of them call themſelves *Scoloti*, which is the ſirname of the kings. They are only call'd *Scythæ* by the *Greeks*, as *Herodotus* plainly hints: But the name proceeded hence, namely that the *Greeks*, who liv'd among them in the colonies of *Pontus*, obſerving their great dexterity in ſhooting arrows, and hearing archers call'd *Scythians* by them, gave that name to the whole nation, and the term ſtill remains in languages of *Scythian* origin: and at this day among the

[c] Antiq. Jud. *lib.* 1. *c.* 7. [d] *c.* 38. 39. [e] *lib.* 4. *c.* 7. *Ed.* Gron.

the *Lithuanians*, *Szauti* denotes both to ſhoot with the bow, as alſo an archer, from which in *Conſtantinus Szyruidus*, *Szaudu* ſignifies to ſhoot with bow and arrow, and *Szaudikie*, an arrow or dart: And among the *Finns* and *Livonians*, as alſo the *Courlanders*, *Aeſtii* and *Laplanders*, *Skytta* and *Kytta* or *Kyt*, ſignifies an archer: And in fine, among the ancient *Pruteni*, as *Prætorius* informs us in his *Orbis Gothicus*, it was call'd *Szythi*; and it alſo paſs'd into the languages of other people of a different original; and among the *Greek* writers the name *Scythæ* became more famous than that of *Scoloti*, their true but obſcure name: Yet the name of *Scoloti* continued among the *Athenians* as a term of reproach; for, the publick ſervants and watchmen at *Athens* were call'd Τολοται, as alſo Σκυθαι and Τοξοται (*Tolotæ* corrupted from *Scoloti*) as alſo *Scythæ*, becauſe they were archers and liv'd in the middle of the *forum* under ſkins. Thus among the *Romans*, by way of contempt, their ſlaves had their names, as *Phryx*, *Dacus*, *Syrus*, and *Geta* from theſe ſeveral nations.

Enquiry into *Herodotus'* account of the *Scythians*.

I think proper to enquire what truth may ſeem to be in this account of the *Scythians* in *Herodotus*: for my part I am far from deſpiſing ſuch ancient monuments of nations; and probably, the reaſon why *Herodotus* imagin'd, that *Targitaus* was the ſon of *Jupiter* by the daughter of *Boryſthenes*, was, that one *Pappaeus* was his father (for, the *Scythians* call'd their ſupreme God *Pappaeus*, and *Herodotus* thought it was his *Jupiter*) and his mother a *Cimmerian* on the *Boryſthenes* and deſcended of the royal famſly. Under *Targitaus* the *Scythians* united into one body and commonwealth; and afterwards were divided into three tribes among his three ſons: And moſt people have trac'd their origin from the firſt eſtabliſhment of their commonwealth, or from ſome remarkable revolution. The *Chaldeans* told *Calliſthenes*, as he enquir'd about their antiquity, a number of 1903 years, according to *Porphyrius* in *Simplicius de cælo:* From whence we gather, that the *Chaldeans* fixt the original of their nation later than the flood by 115 years, from the time they became a republic: As therefore, the *Scythians* give out, that they were 1000 years before *Darius'* expedition, they diſcloſe to us the beginning of their republic. If we place *Darius'* expedition before the year 4200 of the *Julian* period, the *Scythian* hiſtory takes its riſe about the year 3200 or 1514 years before the *Dionyſian Æra*, about the latter end of the *Jewiſh* captivity in *Egypt*.

And of their country.

As to the ancient country of the *Scythians*, *Herodotus** was thus inform'd, that the *Scythians* were *Nomadæ*, and liv'd up and down in huts, in places fit for paſture beyond the *Araxes*, and that being driven from hence by the *Maſſagetæ*, they made war on the *Cimmerii*, who dwelt on the *South Sea*, or the *Pontus Euxinus*. To theſe he adds, as but little conſonant, from the *Arimaſpea* of *Ariſteas Proconneſius*, that the *Arimaſpi* drove out the *Iſſedones*, the *Iſſedones* the *Scythians*, that the *Scythians* could not defend themſelves, but by giving way to ſuch troubleſome neighbours; and therefore, invaded the

*L. 4. c. 13.

country of the *Cimmerii*. But *Herodotus* remarks[f], 'that *Ariſteas* does not 'agree with the *Scythians*, as to the country they firſt inhabited:' But we may aſk, wherein do they differ? The *Scythians* ſay, that they originally dwelt beyond the *Araxes*, but *Ariſteas* near the *Iſſedones*, that is, to the eaſt of the *Caſpian* ſea: The caſe is this, *Herodotus* was ignorant of the *Araxes* meant by the *Scythians*, and thought that it was in *Media* ἐκ Ματιηνῶν[g], which is a province to the ſouth bordering on the *Armenians*[h]; but that *Araxes* is however very far from the *Iſſedones* and the eaſt: But *Herodotus* was not aware, that from this river the *Scythians* could not pour in into the country of the *Cimmerii*; for, what a great way about muſt it be? if the *Scythians*, opening a way thorough the provinces of *Media*, and paſſing the *Araxes*, had made irruptions into the country of the *Cimmerii*, and from hence purſuing the enemy and being deceiv'd by them in their flight, thro' a miſtake of the way, had upon their return unawares fallen into *Media* the ſame way they came: And *Herodotus* ſeems to be appriz'd of this objection. He[i], therefore, calls the country from the *Danube* to *Cercinitis*, ancient *Scythia*, as if the anceſtors of the *Scythians* had remov'd from that country thro' the *Thracian Boſphorus* into the *Leſſer* and *Upper Aſia*, and paſſing the *Araxes* thro' mount *Caucaſus* came into the country of the *Cimmerii*: And whether in this, or in any other manner the matter is order'd by *Herodotus*, he is on all hands involv'd in difficulties.

The Author's opinion.

To ſpeak my own mind, I ſhall not ſo much regard *Herodotus*, as thoſe whoſe teſtimony he uſes; and they ſaid, that the *Scythians* liv'd beyond the *Araxes* near the *Iſſedones* and *Maſſagetæ*; and that, the *Scythians* being driven out, the *Maſſagetæ* poſſeſs'd the parts beyond the *Araxes*[k] to the eaſt of the *Caſpian* ſea, overagainſt the *Iſſedones*, where the country extends itſelf into a very wide plain[l]; and they ſaid that that *Araxes* vied with the *Danube* in bigneſs, and had many iſlands in its mouth, as big as *Leſbos*: None of theſe things agree to the *Araxes* of *Media*; neither the ſituation of the *Maſſagetæ*, nor the bigneſs of the river, nor ſo many and ſo large iſlands in its mouth; but all theſe things agree to the *Volga*: The ancient *Maſſagetæ* were to the eaſt, the length of the river is one third greater than that of the *Danube*; its mouths are 80 and upwards, which contain large iſlands[m]. What *Herodotus* ſays, 'that the *Araxes* is ſaid to be both greater and ſmaller 'than the *Danube*,' likewiſe confirms, that he heard ſpeak of two rivers, one of which, to wit, the *Volga* greater than the *Danube*, and the other, which is now call'd *Rus*, the ſmaller; and I am pretty certain that in ancient times the *Volga* was call'd *Araxes*, or *Rus*, *Ros* and *Rhas*. *Onomacritus*, and the uncertain author of the *Periplus Ponti Euxini* affirm, that the *Tanais* diſembogues from the *Araxes* into the *Palus Mæotis*; *Ariſtotle* likewiſe

[f] *Lib.* 4. *c.* 13. [g] *Lib.* 1. *c.* 202. or rather Ματιηνῶν, as *Gronovius* has rightly publiſh'd it. [h] *Lib.* 5. *c.* 48. [i] *Lib* 4. *c.* 99. [k] *Lib.* 1. *c.* 201. [l] *Lib.* 1. *c.* 202.
[m] Nic. Witſenius *Noord en ooſt Tartaryen f.* 700.

likewiſe in his meteorology [n] has authorities, that from *Parnaſus* (he intended *Paropamiſus*) the largeſt mountain to the north-eaſt, the *Bactrius*, *Choaſpes*, and *Araxes* flow: 'From this *Araxes*, *ſays he*, the 'Tanais being divided (for it is a part thereof) diſcharges itſelf into the 'Palus Mæotis.' The miſtake aroſe from the vicinity of the *Tanais* and *Araxes*. To this we add *Agathemerus* [o], who writes, that the *Iaxartes*, *Oxus*, *Rhymnus*, *Rhos* (which is the *Araxes* of *Media*) *Cyrus* (which is the *Kur* mixing itſelf with this *Araxes*) and in fine, that the *Araxes* diſembogue into the *Caſpian* ſea. Every one plainly ſees, that from the eaſt he paſſes along the *Caſpian* coaſt, till at the north he end at the *Volga:* But *Ptolemy* calls the *Volga*, *Rha*, a term ſtill frequently uſed by the *Ruſſians*; ſo that it could not be obliterated by length of time, and the ſurpriſing revolutions of nations.

Among other things *Ptolemy* ſpeaks thus; 'there is another mouth of 'the *Rha* near that of the *Tanais* [p].' *Voſſius* on *Mela* corrects the expreſſion ἐκβολὴ into ἐπιστροφὴ; but *Ptolemy* is to be left in his miſtake, who thought, that the *Volga* and *Tanais* mix'd, and that the eaſtern channel of the *Volga* diſembogu'd into the *Caſpian* ſea, but the weſtern into the *Tanais*. *Pomponius Mela* [q] alſo mentions two mouths of this river, but in the *Caſpian* ſea only, 'many large and ſmall rivers, *ſays he*, run into the *Caſpian* ſea; 'but the moſt noted, call'd *Rha*, comes down in one channel from the 'Montes Ceraunii, and in two channels enters into the *Caſpian* ſea.' *Ammianus Marcellinus* [r] ſays, 'near this *Tanais* is the *Rha*, a river on whoſe banks a 'certain root grows of the ſame name, of various uſes in phyſic.' I take it that he ſpeaks of the *Rhabarbarum*; and it ſeems that that name *Rhos* and *Rha*, and the like, was deriv'd from the ancient and common language of mankind, to the *Scythians* and other nations, by which they expreſs'd a river. Among the *Arabs* it is *Roba*; among the *Turks* and *Perſians*, *Rud*; and among the *Ruſſians*, *Reca*, and among the *Greeks* PEIN; and perhaps *Rhenus*, *Rhodanus*, *Rhaduna* at *Dantzick*, as alſo *Eridanus* or *Rhudon* of *Ptolemy* and *Marcianus Heracleotes* (now *Duna* at *Riga*) and *Ruſſa* in *Pruſſia*, which are all appellations of a river, are no other than remains of the ancient language: And hither is referable *Eris*, a river mention'd by *Lycophron* [s], when *Caſſandra* ſays, that the *Amazons* left the *Eris*, *Lagmus*, *Telamus* and the *Thermodon*, and invaded the *Athenians:* And *Johannes Tzetzes* makes them to be rivers of *Scythia*. From the vicinity of the *Thermodon* we learn, that the *Eris* was in *Pontus*. *Xenophon* [t] calls it *Iris*, and from him alſo probably *Pliny*. There were two rivers in *Meſopotamia* call'd *Roha* by the *Arabs*, which denotes rivers; the one at *Edeſſa*, which the *Macedonian* colony call'd *Scirtus*; the other lower than it, which is call'd by *Ptolemy* and

[n] *Lib.* 1. *c.* 13. [o] *p.* 235. Ed. Gron. [p] Ἔστι καὶ ἑτέρα τῶ Ῥᾶ ποταμῶ ἐκβολὴ πλησιάζουσα τῇ τῶ Τανάϊδος. [q] *Lib.* 3. *c.* 9. [r] *Lib.* 22. *c.* 16. [s] *v.* 1333. [t] ἐν Ἀναβάσει *lib.* 5. *c.* 6.

and at this day by the *Arabs*, *Chaboras*, of which the *Greeks* made χαλλιρρόη, as I have ſhewn in the hiſtory of *Edeſſa:* And of this *Xenophon*[u] himſelf made *Araxes*, different from that in *Media*, which *Xenophon* did not mention: And afterwards the name *Araxes* remain'd corrupted; for, an *Arabian* geographer, which *Joſeph Scaliger*[w] examin'd, ſays, that the town *Carceſia* is waſh'd by the river *Al Harias*, call'd *Al Chabor*. *Harias* is from the *Araxes* of the *Greeks* in *Meſopotamia*, and *Araxes* from *Roha*. So nice were *Greek* ears, that they could not bear barbarous ſounds; and therefore, they either fram'd from their own language new names of nations, places, and men; or they ſo adapted the barbarous words to a *Greek* mouth and ear, that ſcarce any trace remain'd of their origin. Of this cuſtom *Plato* has a diſpute in his *Cratylus*; and in his *Timæus* he could not retain the words of the *Atlantic* language, unleſs they were pronounc'd after the *Greek* manner: But this itch of pronounciation was uncertain and undetermin'd by any laws, as we may chiefly learn from the *Perſian*, *Median*, and *Armenian* names.

Whether the *Volga* is the *Araxes?*

The *Volga*, therefore, is that *Araxes* to the eaſt of which the ancient *Scythians*, the neighbours of the *Maſſagetæ* and *Iſſedones*, dwelt; for, not only *Herodotus*, but likewiſe all the ancients, place the *Maſſagetæ* to the north-eaſt of the *Caſpian* ſea. *Laonicus Chalcocondylas*[x] places them to the north of the *Caſpian* ſea; and he moreover adds, that before that time they dwelt on the other ſide of the *Araxes*; but that now paſſing that river they poſſeſs'd the hither part; and any one may plainly ſee, that this *Araxes* is the *Volga*; and as this river is of a very large extent, and poſſeſs'd by many nations, it is no wonder if it gave its name to ſome of them; as now the *Bulgarians* coming from the *Volga* retain the name they took from the river: And thus I ſuppoſe the *Ruſſians* are call'd from the ſame river *Roxalani*, the *Alani*, as it were, on the river *Rus*; and the *Boruſci* of *Ptolemy* for the ſame reaſon.

Araxes where *Cyrus* was defeated by the *Maſſagetæ* what?

I take this to be that *Araxes*, near which *Cyrus* was defeated by the *Maſſagetæ*. When *Herodotus* heard, that *Cyrus*, after paſſing the *Araxes*, had gone in queſt of the *Maſſagetæ*, and that from *Babylon*, he thought it was the *Araxes* of *Media*; and ſuch as underſtood him amiſs, would find out another *Araxes* in the eaſt, for *Cyrus* to croſs and attack the *Maſſagetæ*. *Iſaac Voſſius* has choſe *Oxus*, and in this he is follow'd by *Cellarius*; yet they have nothing that makes for that opinion, and the *Maſſagetæ* were farther from the *Oxus*; on which account ſome ancients, according to *Pliny*, placed the altars of *Cyrus* beyond the *Iaxartes*, as if it were the *Araxes*. But the *Scythians*, as *Pliny* ſays[y], or whatever other people inhabited on this river, call'd the *Iaxartes*, *Silyn*, or probably *Sihyn*, a name which

[u] Ib. *lib.* 1. *c.* 4.
[w] *De emendat-temp. f.* 399.
[x] *f.* 62. and 67. Ed. Pariſ.
[y] *Lib.* 4. *c.* 16.

which ſtill remains: And yet there is no probability in favour of *Iaxartes*. *Cyrus* went into this expedition, as it ſeems to us, not againſt the *Maſſagetæ* alone, but principally againſt the *Scythians*; for, it ſtill ſtuck in the minds of the kings of *Perſia* how weakly the *Scythians*, after conquering the *Medes*, had acted in the *Upper Aſia*: And that war, the origin of ſo many others, is related by *Herodotus*, who very carefully applied himſelf to ſhew by what cauſes wars aroſe from wars. *Cyrus* took *Babylon*, according to *Uſher*'s calculation, in the year 4176 of the *Julian* period; and a little more than a year after, if we credit *Xenophon*, he ſubdu'd the nations from *Syria* as far as the *Red* ſea: And hence there are ſtill behind ſeven years at leaſt to the death of *Cyrus*; and in all this time he could have acted both in the *Leſſer Aſia*, at Mount *Caucaſus* and in *Scythia*, till having open'd a way into theſe countries by his arms, and paſſing over the *Volga* in ſhips, and by a bridge he caus'd to make, he attack'd the *Maſſagetæ*.

A Chronological Enquiry into the periodical Revolution of the Comet An. 1668 *and* 1702. *By* Alphonſus des Vignoles. *From the* Miſcellanea Berolinenſia, Tom. I. p. 251.

Tranſlated from the LATIN.

IN *March*[a] 1668, at which time that excellent aſtronomer, *Joh. Dominicus Caſſini*, was ſtill at *Bononia*, he obſerv'd a certain light in the heavens, which he judg'd to be a comet, and from its bigneſs, figure, motion, and ſite among the ſtars, he ſuſpected it to be the ſame *phenomenon* with that obſerv'd 2000 years ago, and of which *Ariſtotle*[b] makes mention, and from him *Seneca*[c]. Thirty-four years after, to wit, in 1702, *Maraldi*[d] obſerv'd a like light at *Rome*, and in the ſame month of *March*, which immediately brought into his mind a conjecture of *Caſſini*'s 34 years before. Upon underſtanding this, *Caſſini*[e] undertook to confirm his conjecture by various arguments: And in the firſt place he aſſerted, that *Ariſtotle*'s comet was ſeen in the year 373 before *Chriſt*; and that from a threefold chronological character. 1. From the year in which *Aſtæus*, call'd by *Ariſtotle Ariſtæus*, was *Archon* at *Athens*. 2. From the time of the earthquake in *Achaia*, when the towns *Helice* and *Bura* were deſtroy'd, of which *Ariſtotle* alſo makes mention. 3. From the battle at *Leuctra*, in which the *Lacedemonians* loſt their ſovereignty two years after the appearance of the comet. In the ſecond place reckoning backwards from *Anno* 1668, 60 revolutions of 34 years each, which make 2040 years, he found the above year to be

The comet in 1668 and 1702 ſuppos'd to be the ſame with that ſeen in *Ariſtotle*'s days under the *Archon Aſtæus*.

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[a] *Journ. des Sçav. An.* 1668, *Journ.* 5. *n.* 6. [b] Ariſtot. *meteor. lib.* 1. 6. [c] Quæſt. *natur.* VII. 5. [d] Memoir. *pour l'hiſtoire des Sciences à Trevoux An.* 1703, *Juillet. Art.* 2. [e] Mem. *de l'Acad. des Sciences An.* 1702. *p.* 106, 107, 108. Ed. de Paris.

373 years before Christ: Whence he concludes, that a period of 34 years is to be assign'd to that comet.

This opposed by *Dutal*.

This opinion was oppos'd by *Dutal*, physician at *Paris*, in the *Nouvelles de la Republique des Lettres*[f].

And in the first place he animadverts on *Maraldi* and *Cassini*, for saying that *Astæus* was *Archon* in the fourth year of C olympiad, who was in that office in the fourth year of CI olympiad, as appears from *Diodorus* and *Pausanias*, whose words he adduces; and that, therefore, they mistake a whole olympiad.

Defended by the author.

But in the first place we are to observe, that *Maraldi* made no mention of *Astæus* the *Archon*, nor of the interval of years, of which we shall treat in the second place. I own that the *Memoires de Trevoux* might in some measure have given occasion to this mistake, in which *Maraldi*'s observation is not accurately enough distinguish'd from *Cassini*'s: But the observations of both astronomers are to be seen distinct in the *Memoirs of the Royal Academy of Sciences* at *Paris*[g].

Besides, I find no real error in *Cassini*, but only a slip of the pen; for, seeing *Cassini* refers these things to the year 373 before Christ, he most certainly means the fourth year of the CI olympiad[h]; as may be seen in the following scheme[i]; and which *Dutal* often owns. Again the other characters noted by *Cassini*, as the earthquake in *Achaia* and the battle of *Leuctra*, do most certainly show that *Cassini*, when he would define the time of the appearance of the comet, meant the aforesaid year, to wit, the fourth of CI olympiad; it was, therefore, a mere slip of the pen, or an error of the transcriber, who writ C for CI.

I would have it also observ'd, that *Dutal*[k], as often as he mentions the above *Archon*, or when he speaks in his own person, or when he quotes others, he always calls him *Arstæus*, who has been unanimously call'd *Astæus*, (as *Cassini* calls him) not only by *Diodorus*[l] and *Pausanias*[m], whom he himself quotes, but even by his cotemporary *Demosthenes*[n] in six different places, and in the *Arundellian* marble[o] at *Oxford*, wherein the more celebrated *epocha's* of the *Greeks* are exhibited; to whom may be added *Scaliger* in his *Collectiones historicæ* publish'd with *Eusebius*[p]. *Aristotle*[q] is the only one who call'd the *Archon*, *Aristæus*, and none of the ancients, as far as I know, call'd him *Arstæus*.

2. *Maraldi* is also free of another mistake, alledged to him. 'From 'the fourth year, says *Dutal*, of C olympiad (which is to be read CI, as 'I have already hinted) down to *Maraldi*'s observation, there are 2078 'years elaps'd; and not 2040 only'.

But

f *An.* 1716. *Decem. Art.* 1. *b p.* 606. *c. p.* 611. g *p.* 101. 102. h Journ. des Sçav. *An.* 1707. *Jan. p.* 217. Ed. Amst. i Nouvel. &c. *p.* 607, 612. k Ibid. *p.* 605. 614. l XV. *p.* 482. Ed. Græc. Steph. m VII. *p.* 589. & IX. *p.* 713. Ed. Kuhnii 1696. n In Neæram *p.* 522. & *Adv.* Timoth. *p.* 700 *seq.* Ed. Græc. Lut. Basil 1572. o Marm. Oxon. *epoch.* 72. p Scal. Eusebian. Græc. *p.* 326. q Meteor. I. 6.

But theſe things can in no manner affect *Maraldi*, as I obſerv'd above. The words alledged are thoſe of a certain letter of *Blondel*, which the authors of the *Journal de Trevoux* have inſerted into their *Memoirs*[r]. *Blondel* explicitely owns, that he writ it only ſo far as his memory could ſerve him; for, he ſpeaks thus at the very beginning; 'I ſend you a 'relation, as faithful as my memory could ſupply me with, *&c.*'[s] And towards the cloſe, 'this, *Sir*, is as far as my memory could ſerve me.'[t]

Again *Caſſini* corrected this error, however, in the *Memoirs of the Royal Academy* for the year 1702, as *Dutal* himſelf owns, whoſe words are theſe, 'M. *Caſſini* has corrected this anachroniſm, reckoning 2040 'years between the obſervation of *Ariſtotle* and his own of 1668, and not 'of 1702, as *Maraldi* had done[v]'.

3. It is objected to *Caſſini*, that he ſhould have ſaid that *Diodorus* referr'd that *phenomenon* to the times of *Aſtæus*, ſince it appears that *Diodorus* referr'd it to the times of *Alciſthenes*, who ſucceeded *Aſtæus*[w]. Upon conſidering *Caſſini's* words, it will appear, that they bear another meaning, they are to the following purpoſe; '*Diodorus Siculus* ſays, that this *pheno-* '*menon*, which appear'd in the days of *Aſtæus*, conſiſted in a great long 'light like a beam'[x]; for, theſe words, *which appear'd in the time of* Aſtæus, may be underſtood, as reſpecting what went before, to wit, *Ariſtotle's* account, in whoſe time this *phenomenon* appear'd, not as if *Diodorus* had ſaid this, but that the thing was ſo.

Yet there remains ſomething in *Caſſini's* words, at which I ſtick, and which I could wiſh were farther explain'd by him.

P. Jul.	A Ch.		Olymp.	
4341	373			
		Aſtæus	CI 4	
4342	372			Comet, Earthquake.
		Alciſthenes	CII 1	
4343	371			
		Phraſiclides		2. Battle at *Leuctra*.

1. We all take it for an undoubted truth, that, according to *Ariſtotle*[y], the comet appear'd in the year *Ariſtæus* was *Archon* at *Athens*, whom others

[r] *An.* 1703. [s] *Fevrier. art.* 2. [t] *Juillet art.* 2. [v] Nouvel. *&c. p.* 608.
[w] Nouvel. *&c. p.* 610. [x] Ibid. *p.* 609. & Mem. de l'Acad. *p.* 107. [y] Meteor. I. 6.

others call *Aſtæus*, that is, in the fourth year of the CI olympiad, which began in the year 373 before the birth of Chriſt, or as chronologers chuſe to ſpeak, in the year 4341 of the *Julian* period: To this I add the teſtimony of the *Arundellian* marble[a]; for, there we read the following words, with *Selden's* ſupplement thereto: 'While *Aſtæus* was *Archon* at *Athens*, 'there ſhone in the heavens a large comet[a]'. *Pauſanias*[b] adds his ſuffrage, but more obſcurely, who while he relates at full length the earthquake, in which *Helice*, a town of *Achaia*, was ſwallow'd up, among other things he ſays, 'that at that time there were ſeen fires with long 'tracts of flames running up and down in the heavens[c]; as alſo that unuſual 'forms of ſtars ſtruck a great terror into mortals[d]:' And he ſubjoins the words quoted by *Dutal*[e], namely 'that *Helice* was entirely deſtroy'd, 'when *Aſtæus* was *Archon* at *Athens*, in the fourth year of CI olympiad, 'in which *Damon* the *Thurian*, was for the firſt time declar'd conqueror 'at the *Olympic* games'. We have, therefore, three concurring witneſſes who affirm, that the above comet appear'd in the magiſtracy of *Aſtæus*, which doubtleſs muſt be granted to *Caſſini*, tho' *Dutal* oppoſes it.

Time of the year this comet appear'd.

2. I ſhall only enquire into the ſeaſon of the year, wherein that comet made its appearance. What has a regard to this is but ſlightly touch'd on by *Caſſini* in the *Memoirs of the Royal Academy*, in which he only mentions this from *Ariſtotle*, to wit, 'that it was ſeen at laſt to appear at the 'ſouth-weſt and in a time of froſt, that this *phenomenon* daily retir'd 'towards the eaſt, and aſcended towards the belt of *Orion*, where it ceas'd 'to appear[f].' He had more fully expreſs'd himſelf in the *Journal des Sçavans*[g] twenty years before in the following words; 'this philoſopher '*ſpeaking of this* phenomenon, ſays, that it appear'd to the ſouth-weſt;' *he adds*, 'that the great ſtar, of which he ſpoke before, appear'd in the 'winter in froſty and very clear weather about the evening; that the firſt 'day it did not appear, being ſet before the ſun; that the following day 'it appear'd a little, becauſe it ſet a little later; and that it aſcended to 'the belt of *Orion*, where it diſappear'd.'

About the vernal equinox.

I am much miſtaken, if we muſt not conclude from all this, that the comet appear'd about the vernal equinox; for, 1. It is not yet winter at the autumnal equinox, nor is there (but very rarely) froſty weather, eſpecially in *Greece*. Again 2. The comet was then near the ſun, and not ſeen at firſt, becauſe it ſet before the ſun; but advancing a little according to the order of the ſigns, it was ſeen about evening, as it ſet after the ſun. 3. And laſtly, If it had happen'd about the autumnal equinox, the comet could not have come to the conſtellation of *Orion*: Theſe

[a] Marm. Oxon *epoch.* 72. Ἄρχοντος Ἀθήνησιν Ἄσεως Κατεχάη δὲ τοτὲ καὶ [ἐν τῳ οὐρανῳ μέγας Κομήτης] [b] VII. *p.* 585. [c] *p.* 586 [d] *p.* 589. [e] Nouvelles &c. *p.* 607. [f] *An.* 1702. *p.* 107. [g] *An.* 1683. *Journ.* II. *p.* 139. Ed. Amſt.

Theſe things, therefore, happen'd about the vernal equinox, as I have already ſaid, which this far agrees with the comets of 1668 and 1702.

3. Having laid theſe things down, it ſeems, that the comet obſerv'd by *Ariſtotle* is not referable to the year 373 before the birth of Chriſt, but to the year 372, or to the year 4342 of the *Julian* period. It is a thing well known to all the learned, that the years of the olympiad began about the ſummer ſolſtice; and with theſe (at leaſt at this time and afterwards) coincided the *Attic* years, at the beginning of which the *Archons* at *Athens* enter'd on their magiſtracy: Whence it neceſſarily follows, that *Aſtæus* was *Archon* from the ſummer of 373 to the ſummer of 372 before Chriſt: The vernal equinox, therefore, when *Aſtæus* was *Archon*, fell in the year 372; and conſequently, the comet was ſeen in 372, and not in 373: And this I would hint in the firſt place. And doubtleſs, *Calviſius* took it ſo, who refers the comet to the year 370 before the birth of Chriſt, which he ſuppoſes to be the true *epocha*, that is, to the year 372 before the vulgar *Æra*: But as to what he adds from *Diodorus*, *when* Alciſthenes *was* Archon, will be explained anon. *An.* A. C. 372.

4. *Diodorus Siculus* confirms our opinion, to whom *Dutal* objected, as differing from *Ariſtotle* by one year. 'When *Alciſthenes* was *Archon* at 'Athens, *Aſtæus*' ſucceſſor, ſays *Diodorus*, was ſolemniz'd CII olympiad, 'in which *Damon*, the *Thurian*, was the ſecond time conqueror at the 'Olympic games, then a large light was ſeen to ſhine for ſeveral nights in 'the heavens, *&c*[h].' *Scaliger* has the very ſame words in his *Collectio hiſtoriarum*[i]. If theſe words are repugnant to *Ariſtotle*, as at firſt view they ſeem to be, it is ſurpriſing, that *Dutal* ſhould prefer *Diodorus*, who writ 400 years after, to *Ariſtotle*, in whoſe time the comet had appear'd[k]. *Ariſtotle*, *ſays he*, being then only eleven years of age, might be very eaſily miſtaken. But what if we ſhould add to the teſtimony of *Ariſtotle* the *Arundellian* marble? He would probably object the *hiatus* therein: And what if we ſhould adduce *Pauſanias?* He would object his obſcurity. I allow that *Diodorus*' work is excellent and greatly to be valued; yet let us hear *Voſſius*[l] on this head, '*Diodorus*' miſtakes are ſo many in the years 'of the olympiads and the *Roman* magiſtrates, that it is probable, he 'made uſe of corrupted and defective *Faſti*: And on this account he is 'taken to taſk not only by *Bodinus*, but likewiſe by *Sigonius*, *Stephanus*, '*Pighius* and other chronologers.' Yet *Dutal* has preferr'd this hiſtorian to *Ariſtotle*, a natural philoſopher, and treating on a natural *phenomenon*, and who far more accurately ſets down the time of the comet's appearance. Confirm'd by *Diodorus Siculus*.

It does not ſeem to us a difficult matter to reconcile *Diodorus* and *Scaliger* his tranſcriber with *Ariſtotle*, the *Arundellian* marble and *Pauſanias*; *Diodorus* reconcil'd with *Ariſtotle*, *&c.*

h Diodor. XV. *p.* 483. i *In* Euſebianis Græcis *p.* 325. *edit.* 1658. k Nouvelles &c. *p.* 614. l *De* Hiſt. Græcis I. 2.

nias; for, I have often obſerv'd, that *Diodorus* anticipates by ſome months the years of the olympiads, which began about the ſummer-ſolſtice, as alſo the magiſtracy of the *Archons*, who were created at the beginning of the year[m]: And that they generally commence from the time in which the *Roman* conſuls, whoſe names he uſually prefixes to each year, enter'd on their magiſtracy. 1. Either *Diodorus*[n], ſirnam'd *Siculus* from his country, and living for a long time at *Rome*, would accommodate the years of his hiſtory to the way of reckoning among the *Romans*, who began their years from the calends of *January*; or 2. That the campaigns of each year might be uninterruptedly related, which appears to have been *Thucydides'* method before him; or 3. and laſtly, becauſe the beginning of the ancient *Attic* year was after the winter-ſolſtice, as very lately Dr. *Potter*[o] has affirm'd; and which *Joſeph Scaliger*[p], the Prince of *Chronologers*, has ſhewn in ſeveral places. Whatever may have been the reaſon, having more than once had experience of the thing, I could ſhow it by ſeveral inſtances, were I not perſuaded, that it is a thing certainly known to the learned: But if any one would call it into queſtion and would require arguments to prove it, let him only read the life of *Alexander, the Great*, in *Diodorus'* XVII. book, as being a part of ancient hiſtory that is very well known, and let him compare it with *Plutarch*, *Arrian* and *Quintus Curtius*, and he will obſerve that *Diodorus* generally, nay always anticipates the true years of the *Archons* by ſeveral months.

How *Diodorus'* years are to be reckon'd.

This being laid down; the firſt part of each year in *Diodorus* is to be referr'd to the end of the preceeding year of the olympiad: And from this we have an anſwer to *Dutal's* objection, and our opinion is confirm'd; for, if the comet obſerv'd by *Ariſtotle* appear'd about the vernal equinox of the year 372 before Chriſt, as we have ſhown above, it really happen'd, while *Aſtæus* was ſtill *Archon* at *Athens*; but according to the above method it ſhould be referr'd by *Diodorus* to the times of *Alciſthenes*, tho' he was only created *Archon* ſome months after.

Caſſini's ſecond chronological character fixes it to 372.

5. As to the other chronological character (by which *Caſſini* has confirm'd his opinion, to wit, the deſtruction of *Helice* and *Bura*) it ſeems to make more for determining the year 372, than to be againſt it.

For, 1. *Ariſtotle*[q], when he ſays, that the comet appear'd about the time of the earthquake in *Achaia* and the inundation, ſeems to hint, that there was a ſmall interval of time between the comet and the deſtruction of theſe towns. And again 2. *Pauſanias*[r] aſſerts, that this inundation happen'd in winter. 3. *Strabo*[s] before him ſaid, that this calamity happen'd in the night time and in winter. All which, join'd with the vernal equinox, of which in N$_o$ 2, entirely favour our opinion, and cauſe us to refer this calamity to

[m] *Vid.* Suidam *in* Εισιτηρια & Heſychium *in* Εξιτηρια. [n] *Præfat.* [o] Archæol. Græc. II. 26. *col.* 425. Ed. Amſt. 1702. [p] Emend. temp. *p.* 34. 42. 55. & Can. Iſag. *p.* 232. 238. [q] Meteor. I. 6. [r] VII. *p.* 587. [s] VIII. *p.* 370, 371 Ed. Baſil. 1549.

to the year 372; to which year alſo not only *Salianus* quoted by *Dutal*[x], but likewiſe *Bucholcerus* and *Buntingus*, no mean chronologers, have likewiſe referr'd it.

6. It remains, that I ſay ſomething of the battle of *Leuctra*, which *Caſſini* has alſo employ'd here; for, in enumerating the chronological characters of the above comet, after the magiſtracy of *Aſtæus* and the ſubverſion of *Helice*, he lays down in the third place the battle of *Leuctra*, 'by 'which the *Lacedemonian* commonwealth was overturn'd, and it happen'd 'two years after the appearance of this *phenomenon*[r].' I could have wiſh'd, that *Caſſini* had by ſome teſtimonies, or arguments, prov'd that interval of two years. *Diodorus*[t] has only ſaid, 'that in a little time after the 'comet the *Lacedemonians* were defeated in a great battle, and all of a 'ſudden, which no one would have thought, loſt their ſovereignty;' which is almoſt the very ſame thing with what *Polybius*[u] ſays, 'that the 'town of *Helice* was ſwallow'd up by the ſea a little before the battle of '*Leuctra*;' tho' the word *paulo (a little)* is added by the tranſlator: Nor do I believe that *Caſſini* had thought of the *Arundellian* marble[w], whoſe date will be conſiſtent, providing 13 months intervene between the time of the comet's appearance and the battle of *Leuctra*, as ſhall appear anon. He had, probably, a regard to a paſſage in *Strabo*[x], wherein he ſays, 'that *Helice* was ſwallow'd up two years before the battle of *Leuctra*.' But neither are theſe two years to be taken ſtrictly, as if two whole years were elaps'd: For, ſince the battle of *Leuctra* happen'd about the ſummer-ſolſtice, as we ſhall ſee anon, it would hence follow, that the comet alſo appear'd about the ſummer-ſolſtice, which, from what was ſaid above, appears not only to be impoſſible, but likewiſe repugnant to *Ariſtotle*'s deſign, who adduces the inſtance of this comet in order to prove the falſhood of what ſome affirm'd, to wit, that comets only happen when the ſun is about the ſummer-ſolſtice[y]. *Caſſini*'s third chronological character.

7. If the calculation is rightly made, we ſhall, indeed, find a year and a quarter interven'd between the time of the appearance of the comet and the battle of *Leuctra*. *Dionyſius* of *Halicarnaſſus*[z] relates, that at *Lacedæmon* peace was ſtruck up between the *Greeks*, except the *Thebans*, at the time that *Alciſthenes* was *Archon* at *Athens*, which falls in with the firſt year of CII. olympiad. To this alſo agrees *Diodorus*[a], as alſo his tranſcriber *Scaliger*[b], who have the ſame *Alciſthenes* and the ſame year; but *Plutarch*[c] in *Ageſilaus* more accurately ſays, that the peace was made on the 14th of the month *Scirophorion*, that is only 16 days before the cloſe of the year of the olympiad. The ſame *Plutarch*[d] adds, that the battle of *Leuctra* happen'd 20 days after the peace, to wit, on the 5th of the month About a year and a quarter interven'd between the comet's appearance and the battle of *Leuctra*.

[x] Nouvelles, &c. *p.* 611. [r] *Mem. de l'Acad. p.* 107, 108. [t] Μικρὸν δ' ὕστερον XV. *p.* 483. [u] *Lib.* 2. *p.* 128. Ed. Francfort 1609. [w] Marm. Oxon. *epoch.* 72, 73. [x] VIII. *p.* 370. [y] Ariſt. *l. c.* [z] Lyſia *T.* II. *p.* 85. Ed. Lypſ. 1701. [a] XV. *p.* 483. [b] Euſebian. Græc. *p.* 325. *a.* [c] *T.* I *p.* 611. *f.* Ed. Francfort 1620. [d] *p.* 612. init.

month *Hecatombæon*; and again in *Camillus*[e] he assigns the 5th of *Hecatombæon* for the battle of *Leuctra*, which was the first month of the year of the olympiad, in which a new *Archon* was created at *Athens*. Hence it is, that the *Arundellian* marble[f] asserts, that the battle of *Leuctra* happen'd under the *Archon Phrasiclides*, who succeeded *Alcisthenes*, that is, the second year of the same olympiad CII. And from this differ not *Diodorus* and his transcriber *Scaliger*, to whom may be added *Pausanias*[g], whose words are these; 'the *Lacedemonians* were defeated at *Leuctra*, when *Phrasiclides* 'was *Archon* at *Athens*, in the second year of CII. olympiad, in which '*Damon*, the *Thurian*, was the second time conqueror at the *Olympic* 'games.' From all which it appears, that between the appearance of the comet and the battle of *Leuctra* there interven'd one year and a quarter, namely, the space of time from the vernal equinox of the year 372 to the summer-solstice of the year 371 before *Christ*: But this by the bye, since from the battle of *Leuctra* nothing certain can be deduced for determining the exact time of the comet's appearance.

8. To conclude; from what has been said above, a difficulty arises about the period of 34 years, which *Cassini* has assign'd to this comet; for, if to the year 372 before *Christ* less by one quarter we add the years elaps'd, *viz.* 1667, together with one quarter from the beginning of the *Christian* æra down to the comet observ'd by *Cassini* at *Bononia*, we shall have only a total of 2039, and not 2040. Whence it appears, that the 60 revolutions, each of 34 years, are not complete, but that the total is one year short: We must, therefore, suppose a shorter revolution, which *Cassini*[h] has not thought improper; or the hypothesis is to be salv'd by some anomaly or other; or the matter is to be set to rights in some other manner. We are greatly indebted to *Cassini*, that in 1668 he hinted what the year 1702 has seem'd to verify; but, after some more revolutions, posterity will with the greater certainty judge of the whole matter.

Vegetable Gold; *by* Phil. Jac. Sachs à Lewenheimb. *From the* Miscellanea Naturæ Curiosorum. An. I. Dec. I. Obs. CXXXI. p. 290.

Translated from the LATIN.

Several instances of vegetable gold.

IN his Imperial Majesty's repository, among other curiosities of nature and art, is kept a sort of vegetable gold, which sprung out of the earth like a twisted thread: This pure gold, call'd *aurum obryzum*, was found by a boor in the river *Tartza* near the village of *Tartza*, four miles wide of the city of *Epperies* in *Upper Hungary*; and this thread was found to weigh half an ounce and two drachms, and to be almost an ell long.

[e] *p.* 138. init. [f] *Epoch.* 73. [g] VIII. *p.* 656. [h] *Mem. de l'Acad. p.* 105.

long. It is, indeed, a ſurpriſing thing, that metals, laying aſide their metallic nature, ſhould ſometimes ſpring out of the earth in the manner of vegetables, and grow up in the form of a plant. *Fortunius Licetus*[a] relates from *Ariſtotle de admirandis*, that gold, buried or thrown into the earth, has ſometimes grown up; and from *Fulgoſius*, that near *Firmium*, a town of *Pannonia*, ſometimes in the vines were found real gold-tendrils; and that pieces of gold have been coin'd of them.

To this may be added the ſeveral following inſtances. *Petr. Martyr*[b] relates, that in the iſland of *Hiſpaniola* in *America*, which abounds very much in gold, there are trees in ſome mountains with living veins of gold; and that wherever it has a paſſage it ſends forth from the root thro' the open and ſoft ſprings branches to the uppermoſt brow of the hill, which never ceaſe growing, till they get into the open air; and they have obſerv'd, that then it forms buds of gold. In *France* in the year 1602, upon finding very rich ores of gold in a vineyard near the village of St. *Martin la plaine*, in the territory of *Lyons*, one of the pieces of this virgin-gold ſo artificially repreſented a golden palm-tree with its buds, that it was preſented to *Henry le Grand* to his great ſurpriſe, as this is related by *Petr. Matthæus*[c]. That ſome vines on the *Maine* and *Neckar* have ſome twigs and often whitiſh leaves germinating from pure gold and coaleſcing together, is related by *Alexander ab Alexandro*[d], *Gaudentius Merula*[e], *Anton. Mizald*[f], and *J. Bapt. Porta*[g]. The like alſo happen'd a few years ago in the vineyards of *Germany* about *Dreſden* on the *Elbe*, where a vine-dreſſer obſerving a ſtring ſhooting out from the ſoil of a certain fruitful vineyard, he drew it out gently to the length of ſome ells, till it broke: What he had drawn out appear'd by the touch-ſtone to be pure gold. In *Hungary*, a country much abounding in minerals, in 1651 *Matthæus Held* ſaw in the fortreſs of *Batak*, near *Tokay*, the grape-ſtones ſhining with hard particles of gold; and this account I had afterwards from his own mouth. *Joh. Joachim Becher*[h] ſaw in *Hungary* a vine growing above a vein of gold, whoſe trunk was not only all over cover'd with threads of gold, as it were, but in ſome of the grape-ſtones were found grains of pure gold. Dr. *Martin. Henric. de Franckenſtein*, a phyſician of *Epperies*, inform'd me, that he was poſſeſs'd not only of ſome grape-ſtones found about *Tokay*, that were impregnated with grains of gold; but he alſo communicated to me the following account, that in *Hungary* a certain nobleman, call'd *Walpotaky*, had a vine-dreſſer who obſerv'd a kind of yellow matter ſpringing out of the earth, and attempting to pull it up, he obſerv'd it ſtrike root deep into the earth and adhere to it very cloſely; and at length, with a great ado, he pull'd out an ingot of gold, which he ſhew'd to a goldſmith, who told him it was

Particularly in the vine.

[a] De ſpontan. vivent. Oſtu. *lib.* 4. *cap.* 72. [b] *In* Reb. Oceanicis *Decad.* 3. *l.* 8. *p. m.* 296. [c] Hiſt. Gall. *Tom.* II. *l.* 5. *narr.* 1. *p. m.* 209. [d] *Lib.* 4. *gen. dier. cap.* 9. [e] Coſmograph. *lib.* 10. *cap.* 27. [f] *Cent.* 2. *memorab.* § 1. [g] Phytogn. *lib.* 2. *cap.* 62. [h] Metallurg. *part.* 1. *c.* 1. *p.* 2.

was very fine. In ſome time after he obſerv'd another ingot ſpringing, which he pull'd up; and this he repeated ſo often, till there enſu'd a law-plea between him and the nobleman; and at length with the prince himſelf, about the right of poſſeſſion to this vineyard. And *Frankenſtein* teſtifies, that this diſpute was a thing well known in thoſe parts. And moreover, that a few years ago a Boor being at plough near *Epperies* pull'd out of the earth ſome ells of gold thread.

As alſo in other vegetables.

Beſides the vine, other trees according to *Joh. Chryſoſt. Magnenus*[i] produce metals near the gold mines in *Monomotapa*. In *Sileſia*, near the confines of *Moravia*, a few years ago about *Oppavia* a thread of gold was found with its proper root ſpringing out of the earth, and of no inconſiderable weight; and ſeveral ſuch threads were afterwards found there: And one of theſe threads was in the poſſeſſion of the baron *de Reiſewiz*, which he alſo ſhew'd me.

Inſtances of vegetable ſilver.

What has been ſaid of gold is alſo mention'd by others of ſilver. *Oſwald Grembs*[k] relates, that in mines ſilver has often a capillary appearance. In the *Muſæum* of *Ferdinando Imperati* at *Naples* is ſhewn a natural ſhrub of ſilver, which was dug up in a ſilver-mine.

This vegetation accounted for.

The cauſe of this vegetation in metals is variouſly explain'd by authors: Some are of opinion that, thoſe metallic tendrils grow in the ſame manner as the horns of deers do; that if gold adheres to trees like bind-weed, it is owing to its toughneſs and ſoftneſs out of its native ſoil, and that it may alſo happen from its native ſoftneſs on account of the narrowneſs of the place, whereby, as it is forced out of the earth, it is twiſted round: And in fine, that vines and trees attract by their roots the metallic humour, in which there was ſome particle of gold before generated; for, that the matter of the generation of metals is a fluid, and therefore eaſily yielding: And of this opinion is *Kircher*[l], if plants have a natural propenſity to places where metals grow, that they aſſume the nature of that metal over which they grow, ſince the nouriſhment expiring from the metallic vapour is attracted by them. In fine, *Jo. Faber Lincæus*[m] having told us, that there are *zoophyta*, i. e. an intermediate ſpecies between animals and plants, he alſo relates, that the illuſtrious prince *Cæſius* firſt diſcover'd and obſerv'd an intermediate ſpecies between plants and minerals, who was to treat expreſs on them in his books *de Metallophytis*.

[i] Democrit. Rediv. *p.* 295. [k] Arbor. homin. *l.* 1. *c.* 7. *ſ.* 5. § 18. [l] *De* Magnete *l.* 3. *p.* 5. *c.* 3. *p.* 631. [m] *In Not. ad* Hiſt. Mexican. *ſ.* 573.

A mathematico-phyſical eſſay towards finding the height of the Atmoſphere. By S. K. *From the* Acta Literaria Sueciæ Trimeſtre I. An. 1723. p. 385.

Tranſlated from the LATIN.

Theorem.

IF the denſity of the air be proportional to the force compreſſing it, and the heights be taken in an arithmetical progreſſion, the denſities will be in a geometrical progreſſion.

Let

Let the heights AB, AC, AD, AE, *&c.* be taken in arithmetical progreſſion, by which very thing the diſtances BC, CD, DE, *&c.* become equal; let the perpendiculars B*b*, C*c*, D*d*, E*e*, *&c.* be rais'd, which may be underſtood to be reſpectively proportional to the denſities in B, C, D, E, *&c.* And let the perpendiculars *c*β, *d*γ, *e*δ, *&c.* be let fall; then ſuppoſe the denſity in F to be continu'd invariable to E, that in E to D, that in D to C, *&c.* whence the quantity, and conſequently the weight of air, contain'd between F and E, E and D, D and C, *&c.* will be expounded by the ſpaces F E*ε f*, E D*δ e*, D C*γ d*, *&c.* or by the right lines F*f*, E*e*, D*d*, *&c.* reſpectively proportional to theſe ſpaces: Beſides, let the weight or quantity of air, incumbent on the point F, be expounded by the given quantity P. Demonſtration. Fig. 1. Pl. IV.

Now becauſe the denſity of the air is proportional to the compreſſing force (by the hypotheſis) and conſequently to the weight of the incumbent air, F*f*, E*e*, D*d*, C*c*, *&c.* will be proportional to P, P + F*f*, P + F*f* + E*e*, P + F*f* + E*e* + D*d*, *&c.* reſpectively, and the differences of the former *ε e*, *δ d*, *γ c*, *&c.* will be proportional to the differences of the latter F*f*, E*e*, D*d*, reſpectively: Wherefore, ſince the right lines F*f*, E*e*, D*d*, *&c.* are proportional to their differences *ε e*, *δ d*, *γ c*, *&c.* they will be in continual proportion.

Laſtly, let it be ſuppos'd, that the number of right lines B*b*, C*c*, D*d*, E*e*, *&c.* is augmented, and that at the ſame time the diſtances BC, CD, DE, *&c.* are diminiſh'd *in infinitum*; yet ſtill thoſe right lines B*b*, C*c*, D*d*, E*e*, *&c.* now cull'd out by equal ſkipping, will likewiſe be proportional: And by that means the denſities will, by the hypotheſis, be proportional to theſe right lines. Q. E. D.

Hence it appears, that the height is proportional to the logarithm of the denſity; and conſequently, if in two given heights the denſities be known, the altitude correſponding to any other denſity may be found; namely, if any one of the given denſities being aſſum'd for unity, the logarithm of the other be ſought, and you infer, as this logarithm to the difference of the given heights, ſo is the logarithm of any third denſity to the difference of the heights between this third denſity and that aſſum'd for unity. Corollary.

According to theſe principles, and an experiment made in *September* 24, 1722, with a barometer in the turret of the cathedral church at *Upſal*, it is found by a calculus, that the altitude of the point, to which the denſity correſponds, (which is to the denſity near the earth as 1 to 14,000) is 7 miles and 14567 *Swediſh* ells: And if this denſity be the leaſt, which the air can have, the height found will be nearly that of the atmoſphere itſelf. Scholium.

Of the Hungarian *Wines. From the* Breſlaw Collection, October, An. 1717, Claſs III. p. 190.

Tranſlated from the HIGH-DUTCH.

What influence the weather has on the wines of different countries.

THE vine is the principal and peculiar glory of the month of *October*, as by its warmth the moſt diluted and tart *German* wines are ſufficiently concocted. In *Auſtria*, and particularly in different parts of *Hungary*, on the contrary, the wine is not ſufficiently good, mellow, and palatable, unleſs, amongſt other things, ſome froſt happen either before or in the time of vintage, which in theſe parts is obſerv'd to impart a remarkable mellowneſs to the wine, eſpecially if a warm ſummer and moiſt harveſt happen to preceed.

Raiſin-wine what? Two ſpecies thereof, and how prepar'd.

Such grapes as begin to dry upon the vine are preſs'd and yield a generous wine, commonly call'd raiſin-wine, yet improperly, as the true raiſin-wine is prepar'd in the following manner. In good wine-years, when the cluſters ripen well, ſuch grapes or even cluſters are pick'd out, as are entirely ſhrivell'd up and appear like raiſins; and from theſe raiſin-wine is made in a twofold manner; 1. After pouring preſs-wine on theſe grapes, and then expreſſing the juice, a more pungent and a more generous wine is had from them. 2. If theſe dry grapes, or raiſins be preſs'd by themſelves, without pouring to them the above muſt, they then yield the quinteſſence of wine, as it is call'd, which is like an oil, yet in a far leſs quantity. At *Oedenburg* in *Lower Hungary* no raiſin-wine is uſually made, but the grapes and cluſters are left together: Hence it is that the *Oedenburg* wine is reckon'd the beſt in *Lower Hungary*. In St. *Georgen-ſtadt*, on the contrary, a great deal of raiſin-wine is made; and always a ſufficient quantity of it even in bad wine-years; and then they often make uſe of large raiſins and even ſugar. When the grapes are pick'd from the vine, they are ſhot into a butt or veſſel, and ſtamp'd with the feet, the juice or muſt whereof is taken up, which afterwards yields what they call their ſtamp'd wine: Afterwards theſe ſtamp'd grapes are put into the preſs and their remaining juice ſqueez'd out, and this is call'd preſs-wine: If it is a good wine-year, the preſs-wine is better than the ſtamp'd wine; but if the grapes are not arriv'd to their true perfection, the latter is preferable to the former: Yet all this muſt neceſſarily be underſtood according to the ſituation of the ground, namely, as one hill ſtands better to the ſun than another.

Of the different ſorts of *Hungarian* wines.

We ſuppoſe it will not be diſagreeable to the reader to give ſome account from the relations communicated to us, as to the produce of wine in *Hungary:* And 1. As to the difference of the wines in *Upper* and *Lower Hungary*. As to the *Upper Hungary* it is well known, that their wine is commonly divided into *Upper Hungarian* in general, and into *Tockay* in particular;

ticular; but taken together they are ſweeter, as alſo for the moſt part more ſpirituous than the *Lower Hungarian* wines; yet of the *Upper Hungarian* wines ſome are better than others. The beſt are about *Santo* overagainſt *Caſchau*, yet compar'd with the following they are but ſmall. Thoſe about *Talia* are better, and thoſe of *Mada* ſtill better; but the beſt of all are about *Tockay* itſelf, as alſo thoſe of *Kereſtur* and *Tozwa*; all which commonly paſs for *Tockay* wine, ſince theſe places lie within a few miles of *Tockay*. The *Liſker* wines (which place is about five miles from *Tockay*) are not ſo good as thoſe of the five abovemention'd places; and leaſt of all thoſe of *Micotzer*; but this laſt may at firſt ſometimes deceive a pretty good judge of wine, as they are very pleaſant and taſte pretty pungent at firſt, but in a little time they pall and turn; the reaſon of which is, that the vine-hill is not ſo high, nor does it lie ſo directly to the ſun; for, this is the principal reaſon of the goodneſs of the *Upper Hungarian* wines beyond thoſe of *Lower Hungary*, to wit, that the hills of the former are very high and lie directly againſt the ſun's rays, which beat upon them in the ſtrongeſt manner in a direct line; and which by their reflexion impinge upon, and conſequently ripen the grapes well: Whereas, on the contrary, the hills in *Lower Hungary* are much lower and flat, and do not always lie ſo directly to the ſun: Whence he ſhines upon them only ſuperficially, and does not with ſufficient force reach the root; and conſequently cannot have ſo ſtrong an effect upon the vine; as even the vine in the valleys near the beſt hills of *Upper Hungary* does not yield ſo good a produce as in the higher part of the hill: Beſides, low hills have more moiſture than the high, which, thereby are more apt to dilute the ſpirituous parts. Of the *Tockay* wines we are to obſerve, that it is a common miſtake to pretend to find their ſpecific quality and goodneſs in their being muddy, ſince this is always a ſign, that the wine has not been well wrought and laid off; and ſuch a muddy wine is either new, or if it be old and alſo muddy, it is owing to the negligence of the vintner. This muddineſs may, among other things, be remedied and its clarifying promoted thus; namely, taking a part of a caſk of old tunn'd wine, and drawing the new muddy wine thereon; and in 8 or 10 days it fines down, which before would not happen in 6 weeks or more. The method of managing wine in *Upper Hungary* is commonly not ſo good as in *Lower Hungary*, in regard that in *Upper Hungary* in filling the butts they throw into them a deal of the ſtalks and huſks and whole grapes, which are left therein: And hence their wine is ſooner wont to turn; whereas in *Lower Hungary*, on the contrary, their method is much neater. *Upper Hungary* alone delivers yearly a great quantity of wine, reckon'd in general at 10,000 butts; and each butt reckon'd from two and a half to three rundlets of wine.

Of the goodneſs of the *Hungarian* vintage each year, the intelligent can judge from our *Breſlaw* grapes by the following experiment; they take a grape

A way of judging of the goodneſs of the *Hungarian* vintage.

grape between their lips and ſuck the juice out of the ſtalk-hole, but lay hold of the huſk with their fingers; if the juice come entirely out of the huſk, and if the huſk is quite empty and thin, they judge that they have an infallibly good vintage in *Hungary:* On the contrary, if there is much pulp in the huſk and the huſk remains thick, the vintage is thought to be not ſo good.

Of the nature and preparation of Sperma Ceti. By Joachim Georg. Elſnerus. *From the* Miſcellanea Naturæ Curioſorum. An. I. Dec. I. Obſ. CXXXVI. p. 302.

Tranſlated from the LATIN.

What *ſperma ceti* truly is.

HE, who firſt gave the name *ſperma ceti*, has impos'd on many; for, this was the reaſon that they thought, that it really was the *ſperma* of the whale. Others, obſerving that its ſubſtance had no affinity with *ſperma*, were of opinion with *Schröder*, that it was nothing but a fatty ſubſtance, that ow'd its riſe to ſulphureous exhalations from the earth, and was coagulated by the ſalt water and the agitation of the waves. *Geſner*[a] is, indeed, of opinion that it is a marine ſubſtance, but not a *ſperma*, yet ſomething like it, or rather the fat of ſome ſea-animals, as thoſe of the whale-kind, who are of a huge bulk, and contain a deal of fat; that theſe fall upon each other, and mutually kill each other: Whence the above author thinks it probable, that a great deal of fat floats on the ſurface of the ſea; an opinion which we think is not entirely groundleſs, nor do we reject all natural *ſperma ceti*, tho' at preſent we ſhall ſhew, that our modern *ſperma ceti* in the ſhops is merely factitious and compounded.

Factitious *ſperma ceti* twofold.

Factitious *ſperma ceti* is twofold; one ſort prepar'd from the brains of the whale; another from his fat, a thing I learn'd in *Holland*. The following account was communicated to me by *Verny*, ſworn druggiſt at *Montpelier*, which he had from a friend of his from the iſland of St. *John de Luca*, and is to this purpoſe; 'Upon diligent enquiry whence *ſperma* '*ceti* was taken and prepar'd, I underſtood it was from the brains of the 'male whale, as the female has none of it, but inſtead of it a kind of 'liquid fat, of which oil is made for lamps: But no ſuch oil can be had 'from the ſubſtance of the brains of the male, but from it is made the 'above *ſperma ceti*; but I could not learn the manner of preparing it.'

The ſecret of preparing it.

This aſſertion is very much confirm'd by *Jac. Paul Contant*[b], wherein he has not only explain'd the nature of *ſperma ceti*, but communicated the ſecret of preparing it, as follows; 'I learn'd from the inhabitants of the place,

[a] *Corollar. ad Tract.* Valer. Cord. de ſperm. cet. *p.* 30.

[b] *Comment. ſupra* Dioſcoridem *l.* 1. *c.* 51. *p.* 63.

'place, that they have often ſeen an animal from which is taken what is 'falſely call'd *ſperma ceti*, that it is no other than the male of the whale-'kind, which in *Bayonna*, *Bayaris*, and in the iſland of St. *John de Luca*, 'and in the places where it is taken, is call'd *Cachalut*. This animal is '25 foot long, and 12 foot high; its jaws are nearly 10 foot, and arm'd 'with heavy teeth, which weigh a pound more or leſs, of which they 'make hafts for knives. As to the part, from which the *ſperma* (but 'improperly ſo call'd) is prepar'd, it is the head, and in reality it is 'nothing other than the brains of that fiſh; for, in melting it, I myſelf 'have often found thin membranes, with which the brain is otherwiſe 'naturally envelopp'd, which are roll'd up with that fat that the maſs might 'remain the more compact. The proceſs, by which the brain is purified, 'that it may appear white and ſcaly, is this; after the brain is melted, it 'is pour'd into a pot, in which at other times they refine ſugar; then 'ſtopping up the lower hole it is left till it harden, but it muſt be left in 'a moderately warm place, then the pot is to be tapp'd: Thus it is 'purified, and in the ſpace of a few days the whole maſs will be found 'white and ſcaly: And this is what I ſaw and learn'd about this prepa-'ration. But that which the northern people call *ſperma ceti* is a kind of 'fat, which they gather in certain places from dead and ſtranded whales, 'which fat, after being purified and prepar'd with verjuice, is ſqueez'd in 'a preſs; whence it becomes white, ſcaly and light, with a ſea-ſmell; 'and this matter is afterwards call'd *aloſanthos*.' And that laſt aſſertion *Geſner* alſo proves in the place above-mention'd: 'There are, *ſays he*, 'who put into a cold cellar the fat of any whale receiv'd in a veſſel, 'then preſs it, that the thinner parts may run out, which is like an oil, 'and has the ſame virtues with the groſſer part which remains behind, 'tho' thinner;' and this laſt is ſold for *ſperma ceti*, whoſe virtues, it is true, it exhibits, but not ſo ſtrongly.

Remarks. 1. We are to obſerve, that *ſperma ceti* is not only prepar'd from the brains of the whale, but that the brains of all large fiſhes are fit for this purpoſe. 2. That the oil, preſs'd out in the preparation, is of greater virtue than the *ſperma ceti:* And among other things it is an excellent anodyne.

Account of the *ſperma ceti* whale. We have the two following accounts from the *Philoſophical Tranſactions* of the *Royal Society* at *London*; one by *Richard Norwood* from *Bermudas*[c]: 'I do not hear that they found any *ſperma ceti* in any one of theſe 'whales; but I have been credibly inform'd, that there is a kind of them 'at *Elutheria* and others of the *Bahama* iſlands (where there is often found 'a deal of ambergris) which have the *ſperma*; and that thoſe have large 'teeth (which ours have not) and are very ſinewy. One *John Perinchief* 'of this iſland of *Bermudas*, found one dead and driven on the ſhore; and 'he

[c] Phil. Tranſ. *N.* 30. *p.* 565.

'he got a great quantity of *ſperma ceti* out of it. It ſeems they have not 'ſo much oil as ours, but the oil, as I hear, is at firſt like *ſperma ceti*, 'but they clarify it by fire.'

The other is from Mr. *Richard Stafford* from *Bermudas:* 'We have in 'theſe ſeas about *Bermudas* great ſtore of whales, which uſe our coaſt in '*March*, *April* and *May:* Theſe we kill for their oil. But there have 'been *ſperma ceti* whales driven on the ſhore; which *ſperma* (as they call 'it) lies all over the bodies of thoſe whales. At the *Bahama* iſlands I 'have found ſome of the ſame ſort of whales dead on the ſhore, with '*ſperma* all over their bodies; they are ſtrong and inlaid with ſinews all 'over their body, which may be drawn out 30 fathom long.'

A new Method of determining expeditiouſly the Tangents of Curve Lines. By D. T. *From the* Acta Eruditorum Lipſ. An. 1682. p. 391.

Tranſlated from the LATIN.

The uſe of the method of tangents.

HOW great the uſe of tangents is, is plain to ſuch, as are appris'd, that while the tangents of curves are determin'd, by that very thing the quadratures of curvilinear ſpaces may alſo be exhibited: Wherefore, general methods of determining the tangents have been invented by the moſt excellent mathematicians. But as for the moſt part they require a very prolix calculus, ſuch promote geometry in the beſt manner, who ſupply us with ſome eaſy method in a thing of ſo great uſe; and this *Sluſius* in particular has done by a general and very ſimple rule.

A general rule for determining them.

Whence having hit on a rule, which determines the tangents much more generally and with greater ſimplicity than any hitherto given, I thought I ſhould not begrudge to communicate it to the ſkillful in theſe matters.

For geometrical curves.

Let BDE be any geometrical curve, as *Des Cartes* calls them, let the *abſciſſa* BC be $=x$, the ordinate CD $=y$; and let the line determining the tangent AB be $=t$, let moreover the nature of this curve be given, which for inſtance, let be ſuch that $y^3+x^3+xxy=xyy-a^3+aay-aax+axx-ayy$: Theſe things thus ſuppos'd, let the terms of this equation be order'd in ſuch manner, that the greateſt power of the ordinate CD or y be on one ſide of the equation: Hence now y^3 will be $=-x^3-xxy+xyy-a^3+aay-aax+axx-ayy$; but if the greateſt power of the quantity y be entirely wanting, let all the terms be put $=0$.

Fig. 2. Plate IV.

Let there be made a fraction and its numerator in this manner; namely let all the terms, wherein the known quantity is, be taken with all their ſigns; and if the known quantity be of one dimenſion, let unity be prefixt to that term, if of two dimenſions, 2, if of three, *&c.* 3, And in the

the preſent example the numerator will be $-3a^3+2aay-2aax+axx-ayy$.

Let the denominator be made in this manner, aſſuming the terms wherein the *abſciſſa* x occurs and retaining the ſigns, if the quantity x be of one dimenſion, prefix unity as above, but if of two dimenſions, 2, and it will be $-3x^3-2xxy+xyy-aax+2axx$. But diminiſhing each of theſe by x, the denominator will be $-3xx-2xy+yy-aa+2ax$.

I ſay that this fraction is equal to the quantity AB; and therefore in the preſent caſe t is $=\frac{-3a^3+2aay-2aax+axx-ayy}{-3xx-2xy+yy-aa+2ax}$. And thus in an eaſy and general way the tangents of all geometrical curves are exhibited.

But I ſhall further ſhow, that the tangents of infinite mechanical curves may be determin'd by the ſame method; for, let there be any curve BDE, and let any portion thereof BD be put $=x$; but let DF be y; and let any curve BF be form'd, for inſtance, according to the former equation $y^3+x^3+xxy=xyy-a^3+aay-aax+axx-ayy$. To determine, therefore, the tangent AF of the curve BFG, I proceed thus, let a fraction be aſſum'd as was done above, and to it add the quantity x, and this will be equal to AD, a portion of the tangent of the curve BDE: And therefore, For mechanical curves. Fig. 3. Plate I.

In the preſent caſe if AD be drawn touching the curve BDE in D, and it be aſſum'd equal to $\frac{-3a^3+2aay-2aax+axx-ayy}{-3xx-2xy+yy-aa+2ax}+x$, the right line AF being drawn, will touch the curve BFG in the point F. By the ſame method the tangents of the cycloid and of infinite mechanical curves are very expeditiouſly determin'd, and in ſo general a way, that where hitherto, by any analytical method, the tangent of one curve only is exhibited, here always at one and the ſame time the tangents of infinite curves may be determin'd; for, inſtead of the curve BDE we may ſuppoſe infinite curves that the tangent t may be always determin'd by $AD=\frac{-3a^3+2aay-2aax+axx-ayy}{-3xx-2xy+yy-aa+2ax}+x$, ſuppoſing the nature of the curve BFG to be ſuch, that $y^3+x^3+xxy=xyy-a^3+aay-aax+axx-ayy$, and the curve $BD=x$, the right line $DF=y$.

I ſhall give the demonſtration of all theſe things in their proper place, which yet any one but little converſant in analytics may eaſily draw from the methods hitherto exhibited by *Des Cartes*, *Fermat*, *Sluſius*, &c.

Of

Of a Milk Diet as a ſpecific in the Gout. *By* Phil. Jac. Sachs à Lewenheimb. *From the* Miſcellanea Naturæ Curioſorum. An. I. Dec. I. Obſ. CXLI. p. 310.

Tranſlated from the LATIN.

A new method of curing the gout.

THIS method of cure by a milk-diet has in a few years been receiv'd with great applauſe by great perſonages. I may call it a new remedy, which, after having lain long dormant, appears at length as in a new dreſs. The author of it is by ſome in our days ſuppos'd to be a Religious, who liv'd at the Count *de Megen*'s, Governor of *Namur*; yet that it is a very ancient method of cure appears from *Pliny*[a], 'there 'are inſtances, *ſays he*, of thoſe who have been freed from the gout by 'drinking aſſes milk.' Nay, according to the ſame *Pliny*[b], cows milk was reckon'd a *panacea*; 'for, *ſays he*, the *Arcadians* do not uſe phyſic, 'but milk about ſpring time, becauſe then the herbs are very juicy and 'medicinal; and they drink cows milk, becauſe they feed almoſt on all ſorts 'of herbs.' And *Cornelius Celſus*[c] ſays, 'that ſome people living on aſſes 'milk ever after eſcape the gout.' It is, therefore, within theſe few years, that the method of cure by milk has been reſtor'd, at the ſame time obſerving a very ſtrict diet, and that nothing but pure milk be taken; and it is to be own'd, that by it arthritic pains, ariſing from acid and ſaline corroſive humours, as theſe are temper'd and ſucceſſively ſoften'd by the ſweetneſs of the milk; and if the diet be otherwiſe ſimple, without thoſe various mixtures of meats and drinks, and if the conſtitution be ſuitable, may receive a great relief from this cure; and ſuch a diet may be ſufficient, ſince, according to *Varro*[d], milk is the moſt nouriſhing of all things we take: Whence *Athenæus*[e] relates, that one *Philinus* all his life long uſed no other food or drink.

By a milk-diet.

The following account of the cure of the gout by a milk-diet was communicated to me by *Frederick Kopff*, Baron of *Neiding*, &c. This illuſtrious perſon had bound himſelf ſo ſtrictly to this milk-diet, that as before the uſe of it he could neither move hand or foot, ſo afterwards he could walk without a ſtick, mount a horſe, *&c.*

As follows.

His method was as follows, 1. Let the milk you take be from a red or black cow, and neither with calf or old; it is beſt, if it can be had, from a cow from which the calf has been taken up, and which has not been bull'd again. 2. Every one is to drink more or leſs of it, according to the conſtitution of his ſtomach: If the ſtomach be weak, it is to be drank four or five times a day; if five times, you are to order it ſo, as to intermit three hours; if four times you are to repeat drinking the milk every four

[a] *Lib.* 28. *c.* 9. [b] *Lib.* 25. *c.* 8. [c] *Lib.* 4. *c.* 24. [d] *De* Re ruſt. *lib.* 28. *c.* 9. [e] *Lib.* 11.

four hours. I myſelf only drink it three times, to wit, about 6 in the morning, about 12, and about 7 in the evening, at each time four pounds and a half at leaſt; but in other reſpects 16 or 18 pounds are to be drank a day. 3. Before this method of cure be enter'd upon, the body is to be purged two or three times, and that in the ſpace of 10 or 14 days, and the purging to be manag'd according to the complexion of the patient. 4. After this you are to begin with drinking the milk; and it is properer to do ſo warm, as it comes from the cow. 5. To prevent the curdling of the milk, you may, if you will, put as much ſugar to it as you pleaſe. 6. If you are bound in the belly, take of a morning 20 grains of the powder of *rhubarb* in the firſt draught of milk, drinking the reſt of the milk upon it, or about evening take eight or ten grains of the eſſence of *rhubarb* along with the milk; and this to be ſo often repeated as there is occaſion. 7. Some people, eſpecially in the firſt 10 or 12 weeks, take each month between whiles a gentle purge, if it ſhall ſeem neceſſary; but if the belly be open, and the milk does not ſtay in the ſtomach, the rhubarb may be ſufficient. 8. If the milk happen to cauſe a *diarrhœa*, before you drink of it, let it boil a little, adding a little ſalt thereto; and thus drink it warm; if this does not ſucceed the firſt time, let it be repeated twice or thrice. 9. If any degree of heat be caus'd by the uſe of the milk, let the third part of a ptiſan of barley and currans be pour'd to the milk. 10. If you are dry between the whiles of drinking the milk, drink ptiſan of barley and currans, or in defect of that, a draught of cold ſpring water. 11. During this drinking of the milk, no other food is to be taken, eſpecially at firſt. 12. After this about noon take if you pleaſe an ounce or two of the crum of fine manchet, to be dipp'd in the milk, and eat them up together: If now for ſome weeks you have drank the milk, you may then twice a week take a poach'd egg, with ſome fine manchet, but without ſalt; you muſt entirely abſtain from leaven'd bread, for fear of curdling the milk on the ſtomach. 13. After uſing the milk for 14 weeks, you may with more ſafety take of the following foods, yet ſo as not to overcharge your ſtomach, nor leſſen the quantity of the milk. 14. For other food you may, therefore, take rice boil'd in milk, poach'd eggs or eggs fried with freſh butter, and freſh butter with fine manchet, haſty-puddings of milk and other milk diſhes, yet ſo as to uſe no ſalt in any of them. 15. In ſummer the cows that ſupply the milk are to be fed on the beſt paſtures, and on dry and not on marſhy grounds; in winter they are to be fed with hay, wheat-ſtraw, and wheat-bran. 16. The ſpace of time for taking the milk cannot be exactly determin'd; the longer it is drank, the more perfect is the cure; ſome very gouty patients, to prevent a return, have drank it conſtantly for a year, and others for a year and a half: Some, having us'd a milk diet for half a year, upon their return to their old diet, and upon their exceeding therein by mixtures

of different foods, have again been ſeiz'd with the gout; but taking again to a milk-diet, the gout was remov'd.

In theſe things conſiſts the whole method of cure by a milk-diet, as it was communicated by the above Baron *de Kopff*; and by his example ſeveral great perſonages at *Prague*, *Vienna* and other places tried the ſame method on themſelves, but not always with the ſame ſucceſs. I know a certain nobleman in *Sileſia*, about 40 years of age, very much afflicted with the gout, who was ſo far from receiving any relief from a milk-diet, that his body was ſwell'd and bloated to ſo very dangerous a degree, that he was oblig'd to lay it aſide.

This method, therefore, is not indifferently to be applied to all conſtitutions. By way of concluſion I ſhall ſubjoin the judgment of *Gabriel Fonſeca*, chief phyſician to Pope *Innocent* X. and the ſucceeding Popes; 'I have, *ſays he*, ſeen and perus'd the method of taking milk for the 'gout, to which nothing other ſeems to be wanting, ſince every thing is 'exactly deſcrib'd, than that we examine and conſider well the conſtitu-'tions with which it may agree; and as to this I am of opinion, that if 'the gout proceed from a bilious, thin and hot matter, and from exceſ-'ſive heat in the liver, cows or aſſes milk is proper to be taken for 40 'days ſucceſſively; after which the patient may return to his ordinary 'diet, but which muſt be moderate: But if the gout ariſe from a cold 'cauſe, or a defluction from the head, milk does not ſeem to be proper 'for ſuch a complexion.'

Dr. *Joh. Georg. Greiſel*, phyſician at *Vienna*, has publiſh'd a treatiſe, entitul'd *Medicus de curâ lactis in arthritide*, wherein after having enquir'd into the nature of milk and of the gout, he at length by arguments and from experience propoſes a milk-diet as the beſt method of curing the gout.

Beſides this treatiſe, *Joh. Jac. Wenceſlaus Dobrzenſky de Negroponte*, Profeſſor at *Prague*, has promis'd to publiſh very ſoon a book of conſultations of the ſeveral phyſicians of *Italy*, *France*, *Spain* and *Holland* about this method of curing the gout by a milk-diet.

Some Hints towards the choice and ordering of Cows for a greater increaſe of Milk, &c. *From the* Acta Literaria Sueciæ. Trimeſtre I. An. 1721. p. 137.

Tranſlated from the LATIN.

Some obſervations about milk-cows and other cattle.

COWS of a red and black colour are preferable to ſuch as are white; and of this laſt colour there ſhould be but one, if poſſible, in a whole herd. Thoſe call'd the *Dutch* breed and the larger ſort of cows cannot

cannot be ſufficiently maintain'd in *Swedland*; but the breed, which we call mixt, may be had. Of theſe we are to chuſe a bull, which is to be well fed and kept from coition till the third year; for, from too early coition, we have that baſer and ſmall breed, we uſually obſerve. The firſt calves are to be rejected and even ſuch as are calv'd after the twelfth year: The third, fourth, and fifth calves are the robuſteſt and calv'd between St. *James*'s day and *Lent*; for, ſuch cows became with calf about *May* and *June*, the gayeſt ſeaſon of the year: And in fine, ſuch as have eight teeth in their jaw (but if ten) are by far the beſt. The teeth muſt be white, the breaſt broad, and the tail long, the veins of the belly diſtinguiſhable, the trace of the navel large, a broad forehead, and large black eyes, wide noſtrils and rough ears. The principal care about the calves ſhould be, that they be fed with the dam's milk with the longeſt poſſible; then you are to give them fine hay and a luke-warm drink made of meal, as alſo ſour milk, whey and kitchen-waſh. With their other drink you are to mix juniper-leaves boil'd along with the berries; and this is of excellent ſervice; there are ſeveral good qualities conceal'd in this ſhrub; for, its leaves diſtill'd along with malt ſpirits, heighten them, and a decoction of the berries may ſerve inſtead of ale. The calves are to be kept in a warm coop; and their litter to be often ſhifted, that they may ſtand dry footed. You are likewiſe to provide againſt their being too much ſpent by the heat of the ſun, and againſt their ſcouring by the new graſs in ſpring-time: And for that purpoſe you are to uſe the leaves of the aſpen-tree, the ſallow and ſervice-tree, as alſo nettles and other herbs, which you have gather'd beforehand. Their teeth are to be waſh'd with ſalt and urine, and after a year they are to be accuſtom'd to chaff. The heifers are to be put apart, that they be not bull'd too ſoon; for, this is to be put off till the fourth year; but when they are bull'd, you are to ſet it down, that the houſewife may know when ſhe is to have new milk for her family. The bull is to be well fed, and ſalt at times to be given him. One bull is ſufficient for 15 cows; but his vigour does not laſt above two years. Milk is a ſurpriſing work of nature, and far exceeding all our chemical diſtillations and ſublimations. Over-fat cows yield leſs milk, but ſuch as appear lean, and yet have plenty of milk, are the beſt; for theſe, therefore, you are to reſerve your beſt hay. Chaff with oats may ſerve horſes; yet ſo that one third of their fodder be hay, and given them in the night. Drinks made of meal, however, make horſes ſhort-winded, but in general, all cattle are fatten'd by the remaining phlegm of ſpirits of wine and grains. The farmer's principal care is to be employ'd on his paſtures and meadows; and therefore, he is to ſow in them the ſeeds of trefoil, angelica, pimpernel, cumin, and aniſe; but about the walls of the houſes, and on the inſide of the hedges he is to ſow lovage. The hay ſhould be cut down before its ſeeds fall off. Sour milk is

agreeable in ſummer-heats; it is alſo of ſervice in burning fevers, but the cream of milk is not ſo wholeſome, before it is made into butter. The ſtalls ſhould not be built in low places, nor be narrow, dark and dirty like ſo many priſons, but wide, ſpacious, bright and furniſh'd with windows and ſhutters; as the life of animals entirely conſiſts in heat, yet ſuffocating vapours are noxious. Cattle are to be fed for the firſt time between 5 and 6 in the morning; and again between 8 and 9, at which time they are to be brought out to water, and fed for the third time juſt at noon; and in the evening they are to be water'd again, and then fed. Wooden curry-combs are to be us'd, eſpecially on the approach of the ſpring, when they ſhed their hair, which, however, is to be ſav'd; for, of it coarſer coverlets are made. Cattle ought to be encourag'd by the voice and by ſinging, with which they manifeſtly appear to be delighted. To milk-cows you are to give pure water plentifully; but when near calving it is to be given them luke-warm. The birth is promoted by ſaffron, hemp-ſeed and the reddiſh coats of common onions and warm ale. After calving you are to give them a drink made of meal with a little ſalt. Rye-ſtraw promotes the increaſe of milk; but oat-ſtraw dries it up; and therefore it is fitter for ſheep. Cows properly fed yield four pails of milk in 24 hours: And even in the province of *Scania* above that quantity. In the *Netherlands* they yield 8 pails, but then they muſt be carefully fed. You are to milk thrice a day in an equal and not in a ſlow and intermitting manner. Good milk ſtands upon the nail, but if watery it runs off; and this defect is corrected by giving the cow ſalt; and one pound of ſalt is to be given one cow in a year. Of ſalt-water and meal you are to make balls as big as eggs. From one cow you are to expect as many pails of milk as there are days in the year, to wit 365, but ſhe muſt be well fed: It is, therefore, better to provide well for a few cows than ſtarve a great many. As to the medicinal uſe of milk, it appears that even grievous diſtempers are removed by it. The milk may alſo be render'd medicinal if you give the cattle ſome ſorts of herbs, which are commended and in daily uſe among our farriers.

Of a very ſimple kind of Micrometer. By G. Kirchius. *From the* Miſcellanea Berolinenſia. Tom. I. p. 202.

Tranſlated from the LATIN.

A new kind of micrometer.

AFTER that in the laſt century the teleſcope was invented, occaſion was thence taken of meaſuring ſmall diſtances without the incumberance of quadrants, ſextants, octants, *&c.* to wit, ſuch diſtances as the tube could take in. And 1. from the conſideration of the moon the capacity of the tube is known, as for inſtance, when the tube could take in

in the moon's ſemidiameter, and a fixt ſtar appear'd near any planet, which to the naked eye ſeem'd to be hid; yet by means of the tube it could be eſtimated how many minutes they were ſtill diſtant from each other, namely, upon conſidering what part of the capacity of the tube, whether the third, fourth, ſixth, or half, it then was, when the ſemidiameter of the moon was reckon'd at 15 or 16 minutes. Aſtronomers, afterwards not ſatisfied with a bare eſtimation, accompliſh'd real diviſions of the tube, to wit, by croſs threads or wires, *&c.* and then they obſerv'd, how many ſuch parts the moon (whoſe diameter was ſuppos'd to conſiſt of 30, 31, or 32 minutes) contain'd; by which it was afterwards eaſy to compute, how many minutes ſuch a ſmall part of the threads conſtituted. But becauſe all diſtances do not anſwer exactly to ſo many parts of the threads, and the remainder notwithſtanding muſt be collected by bare eſtimation, hence they attempted to do the thing ſtill more accurately; and for this purpoſe they employ'd ſcrews, by help of which all diſtances, which a tube can take in at once, may be accurately meaſur'd; ſuch an inſtrument, therefore, is call'd a *micrometer*; one kind of which is deſcrib'd in the *Journal des Sçavans*, and another in the *Phil. Tranſ.* Beſides theſe two, which are not made and adapted without ſome labour, I have devis'd a third kind ſo eaſy, that it may be very readily made by any lock-ſmith; for, on *January* 17, 1679, as I was obſerving *Saturn*, when retrograde, covering a certain ſtar in the ſouth horn of *Taurus*, I was deſirous of knowing what his diſtance in his direct motion would afterwards be from the ſame ſtar: And in defect of either of the aforeſaid micrometers, I muſt ſet about one in a different manner; I, therefore, applied to a common lock-ſmith, and caus'd make me an iron-ring, which I might fit to my three foot teleſcope; this ring I divided with a pair of compaſſes into two equal parts; and there I order'd it to be furniſh'd with ſcrew-holes, into which I put ſcrews, exactly anſwering to the holes, overagainſt each other, but of ſuch a length, that being ſcrew'd in, they might touch each other: All which appears more clearly by the figure. Fig. 4. Pl. IV.

As *Saturn*, therefore, by his direct motion approach'd to the above ſtar, which on *January* 17, he cover'd corporally, I made *Saturn* appear in my teleſcope at the end of one of my ſcrews near *a*; but I ſcrew'd or unſcrew'd the other ſcrew to *b*, till the fixt ſtar appear'd accurately at its end *b*; I afterwards ſcrew'd one of them, for, it is no matter which, till they touch'd each other, and I told the number of turns; meaſuring at length the moon's diameter, I told the turns of the ſcrew anſwering thereto; and then indeed, aſſuming the moon's diameter of 30 minutes, which is near the truth, *Saturn*'s diſtance from the ſtar might be eaſily computed: And this, therefore, was the firſt micrometer of the kind invented by me; by means of which, notwithſtanding, I could reduce the diſtance into minutes by a three foot teleſcope, repreſenting objects erect and conſiſting of four glaſſes. The method of uſing it.

glaſſes. I afterwards caus'd make a braſs ring with fine braſs ſcrews, that the obſervation might be the more accurate. But to attain to a greater exactneſs in the obſervations, I was not ſatisfied with numbering entire revolutions of the ſcrew, but I alſo employ'd quarter-revolutions, as often as the diſtances requir'd them; and I, therefore, compos'd a table, from which I might compute the degrees or minutes, *&c.* of the micrometer anſwering to quarter-revolutions of the ſcrew.

How to be fitted to the teleſcope.

This micrometer, as alſo others, cannot be applied to any teleſcope at pleaſure, but only to ſuch a one as conſiſts of convex glaſſes alone, as is well known, and the thing does not anſwer when the eye-glaſs is concave. When the teleſcope was firſt invented, namely, in the year 1609, it conſiſted of two glaſſes only, of which the eye-glaſs was concave, but the object-glaſs convex; by its means, therefore, diſtances could only be eſtimated according to the capacity of the tube; and ſuch a tube *Kepler* muſt have us'd, when on *December* 14, 1627, N. S. he obſerv'd *Saturn* near a certain ſmall ſtar in *Virgo*, when they were diſtant from each other the ſixth part of the capacity of his tube, which he eſtimates to two or three minutes: Such a tube, therefore, muſt only have taken in the moon's ſemidiameter. After this a method was found of uſing a convex inſtead of a concave-glaſs, which indeed repreſents the objects revers'd, but may take in a much greater ſpace; and tho', at length, a method is found of erecting again the objects by means of three eye-glaſſes; yet in viewing the heavens a tube that reverſes the objects is rather to be employ'd, becauſe we ſee more accurately by fewer glaſſes than by a greater number of them. But whatever be in this, whether the tube reverſes the objects or not, it is no matter, providing the eye-glaſſes are convex; for, in that caſe the micrometer may be rightly employ'd. But the place, where it is to be fixt in teleſcopes, reverſing the objects, is that, wherein the rays of the eye and object-glaſſes, or the rays of viſion, interſect each other, or rather where they converge into one point, or in the common focus of both, that is, at that diſtance from the eye towards the object-glaſs, which is the diſtance of the eye-glaſs from the eye. In this place the ſcrews of the micrometer are accurately and diſtinctly ſeen in their juſt magnitude; and near the ſaid place making a ſmall hole in the tube a pin may be fixt, and the pin bent from or towards the eye, and thus you may try which is the propereſt place of ſeeing the point of the pin in the diſtincteſt and cleareſt manner; and then in that place the iron, or braſs-ring, may be externally applied to the tube, and taking out the ſcrews ſmall holes may be made in the tube correſponding to thoſe of the ſcrews; and then the ſcrews may be ſcrew'd in, after which you will have every thing fit for your purpoſe. The ring alſo, if it is neceſſary, may be firmly faſten'd with two other ſcrews, that by its unſteadineſs the obſervation be not marr'd, or the ſcrews ſpoil'd. In teleſcopes that erect the objects, the micrometer is plac'd in

the

he middle between the two former eye-glaſſes, or in the focus of the firſt ye-glaſs.

Of the culture of Tobacco, and the planting of Madder; as alſo of Cole-worts in Sileſia. *From the* Breſlaw Collection, October 1717. Claſs III. p. 194.

Tranſlated from the HIGH-DUTCH.

TOBACCO (which is an *American* plant, and particularly growing in *New Spain* on the iſland *Tabacco* or *Tabaſco*, afterwards call'd the iſland of *B. Maria Victorioſa*) was about 1520 firſt brought to *Liſbon* by *Franciſco Hernandes de Toledo*, who, by the command of king *Phillip* II. was ſent to *America* to write the natural hiſtory of that country, which he did in XVII Tomes, entitul'd de *Americanâ hiſtoria naturali civilique*, after the expence of 60,000 ducats; and in the library of the *Eſcurial* this work is ſtill to be ſeen very beautifully done, in which all the figures, and thoſe barely of plants to the number of 1200, are painted in their natural colours. From this work at length *Nardus Antonius Recchus*, by order of the ſaid king *Philip*, made an abridgment, which, with ſeveral additions, was publiſh'd at *Rome* in 1651, in X books in *Folio*. From *Liſbon* tobacco was ſent by the *French* ambaſſador *Joh. Nicot* in 1559 to *Paris*, or according to others and the author himſelf, it was ſent thither in 1556 by *Andr. Thevet* out of *Brazil*; but from *Paris* it was directly ſent by the legate *Nicol. Tornabonius* into *Italy* to the biſhop *Alphonſus Tornabonius*; and from the pope's *Nuncio*, the cardinal *de Santa Cruce*, it was ſent from *Liſbon* to *Rome*; but it was brought to *England* by *Richard Greenwil*, who in 1585 was ſent to *Virginia* by orders of queen *Elizabeth*, and at the expence of Sir *Walter Raleigh:* And hence aroſe both the uſe of ſmoaking tobacco (which was firſt learn'd by the mariners in *America*, and afterwards by them made known to the *Europeans*) as alſo the planting of tobacco, which ſpread in *Holland*, and from *Holland* in *Germany* far and near: So that at this day this plant is wont plentifully to be propagated about *Bremen*, *Hanau*, *Heſſe*, *Francfort* on the *Oder*, in the territory of *Magdeburg*, and particularly about *Magdeburg* and *Hall*, as alſo about *Deſſau* and other parts; and laſtly, alſo in *Sileſia*, and chiefly in the Dutchy of *Brieg*, about the little town of *Wanſen*, *Bore*, and at this day even about *Breſlaw*, as alſo near *Neumarck*, and in other places. Tobacco when firſt known in *Europe*.

Of the culture of tobacco at *Wanſen* we had the following account, communicated to us by a learned friend. 'As early as poſſible in the ſpring, commonly in the month of *March*, after the full of the moon, the ſeed, which 'pretty nearly reſembles that of marjoram, only that it is a little bigger, is Culture of tobacco.

'ſown:

'ſown: Some, it is true, ſow it in harveſt, in order to have the plants 'the ſooner ripe; and yet they come not nearer to their purpoſe than 'thoſe who ſow it betimes in the ſpring. Glaſs-beds may be of great ſer-'vice in this caſe; ſo ſoon as the plants become no bigger than that one 'can lay hold of them, they are tranſplanted as other plants uſually are, 'and the ſooner this is done the better the tobacco ripens: But when it is 'very dry weather the plants muſt be ſtronger, and even a finger in length. 'The ground is broke up with grubbing axes, and then each plant has a 'little tump made round it, ſo that the root may have moiſture for its 'better growth. Firm black bottoms, as about *Wanſen*, where the ground 'is ſo hard, that if it happens not to rain in 14 days, there is no breakingit 'up, muſt be the oftner dug, a thing not neceſſary in looſer ſoils; this digging 'muſt not be perform'd in dry weather, that the earth may not become 'looſe, and conſequently the drying of it up be the more promoted; but 'it is uſually perform'd when it has rain'd the day before. The tranſplant-'ing is in the months of *May*, *June*, and *July*: Thoſe ſet late prove ſeldom 'good, as the leaves cannot be well ripen'd: Thoſe that are firſt planted 'ripen beſt; and hence they taſte more agreeably, to which contributes 'very much the breaking off the middle ſprout, that the vegetative juice 'may riſe into the leaves, whereby they become long and thick, as alſo 'of a more agreeable taſte, but before this is done the plants are ſuffer'd 'to grow up, till they have about 10 or 12 leaves, or till they are about 'two ells high: But where this operation is not perform'd, they have, it is 'true, more leaves, but they remain ſmall and taſte bitter; and this is the 'reaſon why moſt of the tobacco of *Wanſen* taſtes ill; but as by this 'breaking off the ſprout the ſeed is loſt, you muſt leave ſome untouch'd; 'for, tho' the middle ſtalk remains, the ſeed that grows thereon is not fit 'to ſow, but of it oil is made. When the flowers, which are ſomewhat 'of a lighter colour than thoſe of peaches, are ready to fall, they muſt be 'taken off; for, when they remain lying on the leaves, and it happen to rain 'thereon, they get holes, tho' alſo it uſually blooms for a long time after 'the loweſt and beſt leaves are taken off. The flowers are of different 'colours; ſome of a light blue, as the tobacco itſelf hereabouts is not always 'of the ſame colour. The ſeed comes firſt to ripen after *Michaelmas*; its 'oil is prepar'd in the ſame manner, as that from lintſeed; namely, it is 'dry'd, ſtamp'd, warm'd, and laſtly preſs'd: Its uſe conſiſts herein, that 'it is burnt in lamps, and it yields no ſmoke. A quarter of this ſeed yields 'from 5 to 6 and 8 quarts of oil. As to the leaves, they do not all be-'come equally ripe, but the loweſt ripen firſt; and they are yellow, and 'then pick'd off; and this is commonly done in the full of the moon. 'Harveſt-times are very prejudicial to this plant, and render it bitter.'

Sileſian madders. *Sileſia* is among other vegetables remarkable for madder, which is produced plentifully in that country, particularly about *Breſlaw*; and at this day

day in ſeveral parts of the country, as well in the territory of *Breſlaw*, as in other principalities: So that in *Breſlaw* alone there is yearly ſold 70,000 ſtone. It is not propagated from the ſeed, but by ſets, which are taken up early in the month of *May*, after they have ſhot high and yielded leaves, and are laid thick on one another croſs-wiſe in rows, in the ſmall furrows of a well prepar'd field; and after four weeks, in the month of *June* they are dug up for the firſt time; and in the month of *July* laid deeper in new furrows, and cover'd with mould, that the eye of the ſtalk may ſtrike new root, and thus the madder be multiplied; upon which then the earth is once ho'd and clear'd of weeds: But laſtly, in the month of *October*, the plant is cut off and the root thrown up, yet ſo that a part thereof with the plant is left all winter on the field, which the following ſpring muſt ſerve for new ſets. The culture of this plant may be ſeen in a book, entitul'd the *Sileſian Huſbandry*[a]; and from this author in *Paul Marperger's Sileſian Merchant*[b]. Now this madder, according to the time of throwing or digging it up is twofold, as ſhoot-madder and harveſt-madder; of which the former are ſuch roots, as after taking off the ſhoot-plants remain over in the ſpring, and it is reckon'd preferable to the harveſt-madder, which laſt is eſpecially in the month of *October* taken up, dry'd and beat into powder. This uſeful plant, beſides its medicinal virtues, is highly ſerviceable in dying. In the warm and pretty moiſt weather of this preſent year, *viz.* 1717, the madder turn'd out entirely good, yet better in one field than another, and beſt of all in ſandy ſoils, where, namely, to the fat bottom ſome ſand is mix'd. In too fat, black, and moiſt bottoms, on the contrary, it proves not ſo good as in the former, as being more woody and ſtrawy, as alſo its roots ſmaller and not ſo ſubſtantial, and as being graſſy: Whereas, on the contrary, ſandy ſoils yielded a thicker, larger, fatter, and purer madder; and this was aſcrib'd to the wet weather in *July* and *Aug.* which was of ſervice in ſandy bottoms, but in fat ſoils the madder run more into leaves and graſs than into roots; and here and there it rotted. We commonly obſerve, that when the madder in moderately dry and warm harveſt weather ſhoots well, and a good winter enſues, ſo that the ſlips are not kill'd by the froſt, that the increaſe of madder the following year is uſually very good; but it principally requires a fat and black ſoil, or at leaſt mixt a little with ſand.

Among the moſt uſeful plants cabbage is the principal, as there is not only a great conſumption of it in its natural ſtate, but as it is much us'd for pickling. *Bruyerinus*[c] entirely rejects the common method of over-boiling coleworts and rather recommends parboiling them, and then ſeaſoning them with ſalt and oil, whereby the herb not only retains its beautiful green colour, but alſo acquires an agreeable taſte; and this method was alſo us'd among

Account of coleworts.

[a] *Lib.* 1. *p.* 127. [b] *Cap.* 8. *p.* 303. [c] De re cibar. *Lib.* 8. *cap.* 9. *p.* 366.

among the ancients [d]. As coleworts in particular were greatly us'd among the *Greeks* and *Romans*, ſo *Chryſippus* has writ a particular treatiſe in praiſe of this plant: And as among the *Romans*, *Cato*, *Columella*, and others thought they could not praiſe it overmuch, ſo it was given out, that the *Romans* had for 600 years no other phyſic than this vegetable; which the above *Bruyerinus* [e] would not have to be taken ſtrictly, but only that the *Romans* from their ſimple way of life and frugality made uſe barely of herbs; and among theſe of coleworts in particular, and continu'd healthful without any uſe of medicines. But that the *Romans* were particularly curious as to this plant appears among other things from the different ſpecies of it among them, which are no longer clearly known in our days, as the *Braſſica Aricina*, *Pompeiana*, *Sabellica*, *Brutiana*, *Cumana*, *Tritiana*, &c.

A method of preſerving coleworts and cabbage from mildews and catterpillars.

We think proper to add here the following experiment communicated to us by a learned farmer in *Sileſia*, whereby coleworts and cabbages are preſerv'd from poiſonous mildews, and more happily eſcape catterpillars; 'Take the colewort and cabbage-ſeeds, ſteep them in a mixture of ſoot, 'aqua vitæ, and human urine, in equal quantity, let them ſtand for half an 'hour, afterwards dry the ſeeds in the ſun, and then ſow them.'

[d] Apicius Cœlius *de* Obſon. & condiment. *ex edit.* Liſteri *Lib.* 3. *cap.* 1. *p.* 71. [e] *l. c. p.* 365.

A twofold direct method of dividing a Semicircle in a given Ratio, whereby Kepler's *problem about finding the places of the Planets at any given time is ſolv'd. By* Jac. Hermann. *From the* Comment. Acad. Scient. Imper. Petropol. Tom. I. p. 142.

Tranſlated from the LATIN.

The problem as propos'd by *Kepler*.

1. *KEPLER*, as far as I know, firſt taught, that the path of the planets is elliptical; and that each of them revolve in its orbit, ſo as to ſweep area's proportional to the times. Theſe beautiful diſcoveries, drawn from *Tycho*'s obſervations by an artful *calculus*, and exactly agreeing with later obſervations, have given a quite new face to aſtronomy; but there offer'd therein a difficult problem to be ſolv'd, to whoſe ſolution *Kepler* had no direct way, and which he was, therefore, oblig'd to attempt by that call'd the *rule of falſe*. *Kepler*, at the end of his commentary on the planet *Mars* [a], expreſſes the problem in theſe words: 'The area of a part of a ſemicircle being given, as alſo the point of the 'diameter, to find the arch and the angle at that point; by the legs of 'which angle, and by which arch the given area is comprehended:' *Or*, 'From any point of the diameter to cut the area of a ſemicircle in a given 'ratio.' Subjoining, it is ſufficient for me to believe, that it cannot be ſolv'd *à priori*, becauſe the arch and ſine are heterogeneous.

2. The

[a] *Part.* 3. *f.* 300.

2. The first, as far as I know, who attempted to merit the fame of the great *Apollonius*, was Sir *Christopher Wren*, who really attempted the direct method, and constructed the problem by means of the protracted cycloid; for, Dr. *Wallis* has publish'd his construction at the end of his treatise on the cycloid: But whether he has strictly taken the method, which *Kepler* required, I very much doubt; for, Sir *Isaac Newton*[b], who has repeated almost the same construction, own'd, that on account of the difficulty of describing this curve, it was better to employ a solution by approximation, such as he has exhibited by a converging series of angles: And yet I know not whether it be expeditious enough. Dr. *Gregory* and *Keill* have, as in other things, so in this imitated the illustrious author; for, both of them have given a solution of *Kepler*'s problem by an infinite series, the latter in his *Astronomical Lectures*, and the former in his *Geometrical Elements of Astronomy*. *Phil. de la Hire* and *Jac. Cassini*, men who have deserv'd greatly of astronomy, applied themselves to the solution of this problem without the use of series', and they have publish'd their solutions in the *Memoirs of the Royal Academy of Sciences* for the years 1710 and 1719. There appear'd another by *Peter Horrebow* in Tom. IV. of the supplements to the *Acta Erudit. Lipsi.* Its solution attempted by several.

3. It will, probably, appear superfluous again to attempt a problem, after solutions of it by so many great men. Yet I shall venture upon it, since different methods of solving one and the same problem are not without their usefulness. My method is twofold; the one purely geometrical, and the other arithmetical and more accommodated to an astronomical *calculus*. The problem is this; A twofold manner of solution by the author. The geometrical solution.

To divide the semicircle AQD by the line BE, so that the trilinear figure ABE be to the semicircle AQD in a given ratio of DN to DH = AD. Problem. Fig. 5. Pl. IV.

In the semicircle DGH = to the other AQD inscribe the *quadratrix* DLGH of such a nature that from any point thereof L drawing the lines LK, parallel to the diameter DH, and LM perpendicular thereto, the corresponding arch of this division, namely DK, be always to the *abscissa* DM, as DKG to the radius DI; then take in the radius CK, produced upwards and perpendicular to the diameter, CP = to the quadrant AQ and join PE; but from the point N draw the line LN parallel to the other EP, meeting the *quadratrix* any where in L, from which point afterwards drawing LB parallel to the diameter AD, it will meet the semicircle AQD in the desir'd point B; for, joining BE, the triangle ABE will be to the semicircle AQD in the given ratio of DN to DH. Construction.

For, from the nature of the line DLG, AB (DK) is to AQ (DG) as DM to AC (DI) and therefore AQ × DM = AB × AC = 2 sect. ABC. On account of the parallels PE and LN the triangles PCE and Demonstration.

[b] Princip. phil. Nat. *lib.* 1. *prob.* 31.

LMN are ſimilar, and give CP (by conſtruct. AQ) to CE as LM (BF) to MN; wherefore, $AQ \times MN = CE \times BF = 2 \triangle CEB$, and by addition $AQ \times DM + AQ \times MN = 2$ ſect. $ABC + 2 \triangle CBE = 2$ trilin. ABE; wherefore, $AQ \times DN = 2$ trilin. ABE; and 2 ſemic. $AQDA = AQ \times AD$ or $= AQ \times DH$; wherefore the trilinear figure ABE is to the ſemicircle AQDA (as $AQ \times DN$ is to $AQ \times DH$) as DN to DH. *Q. E. D.*

DLG is, indeed, a tranſcendental curve, ſeeing it is a ſpecies of the line of ſines; yet it is the more rightly applied to the conſtruction, as it may be more eaſily deſcrib'd thro' points than the protracted cycloid; for, by the continu'd biſſection of the quadrant DKG and of its parts, ſo many points of the curve, and thoſe ſo near to each other, may be found as you pleaſe, only drawing thro' each diviſion of the quadrant lines parallel to the diameter, and thro' the like diviſions of the radius DI lines perpendicular to the ſame diameter; the meeting of theſe perpendiculars with the diameter and their parallels furniſh ſo many points of the curve.

I ſaid, that the curve DLG is a ſpecies of the line of ſines; for, LM is the ſine of the arch DK, and DM is proportional to this arch: Wherefore the *abſciſſæ* DM repreſent the arches, and the ordinates LM their ſines; and for this reaſon, the curve DLG is the line of ſines.

This curve, which others call *Tſchirnhauſen's quadratrix*, becauſe mention is made of it in *Tſchirnhauſen's medicina mentis*, where ſome of its properties are rehears'd; this line, I ſay, has an excellent uſe in the conſtructions of thoſe problems, which depend on circular arches, which this very conſtruction of *Kepler*'s problem ſhews.

The arithmetical ſolution.

4. The given conſtruction alſo ſupplies us with the arithmetical ſolution of the problem; for, calling the arch $AB = a$, the radius $AC = r$, the ſine of the arch $BF = s$, the quadrant $ABQ = q$; and in fine, $DN = b$, and $CE = e$, on account of the curve DLG it will be $DM = \frac{ar}{q}$; but the ſimilar triangles CPE and MLN give $MN = \frac{es}{q}$; wherefore, ſince it is $DM + MN = b$, it will be $\frac{ar+es}{q} = b$, or $ar + es = bq$.

But by what *Leibnitz* has prov'd in the *Acta Erudit.* [c] from the differential *calculus*, and by what I have deduced on occaſion of the angular problem by common geometry [d] it is $s = a - \frac{a^3}{6r^2} + \frac{a^5}{120r^4} - \frac{a^7}{5040r^6} +$, &c. Wherefore, ſubſtituting this value of the ſine in the equation above found, to wit, $ar + es = bq$, we ſhall have $\overline{r + e} \times a - \frac{a^3e}{6r^2} + \frac{a^5e}{120r^4} - \frac{a^7e}{5040r^6} +$ &c. $= bq$.

If now in this ſeries all the terms except the firſt be ſuppos'd to vaniſh, there will reſult $\overline{e + r} \times a = bq$, that is, this analogy AE : DN :: AQ : AB, which analogy now yields a commodious approximation of the arch AB.

But

[c] *An.* 1693. *p.* 179. [d] Ibid. *An.* 1703. *p.* 351.

But if two, three, or more of the first terms of the series be assum'd, there will arise equations of three, five, seven, *&c.* dimensions, which, indeed, do not seem proper for astronomical use: Wherefore, I proceed to the arithmetical method of solving this problem.

5. Let the arch AM expres the mean anomaly, and let CE be the excentricity, and join ME; and drawing from the centre C of the semicircle the line CN parallel to EM, let EN be drawn; I say, that the angle AEN is the coequate anomaly very nearly. But this anomaly will be found more accurately, if now the arch NM be call'd a and the radius $AC = r$, and if it be $x = \frac{a^2}{6r^2} - \frac{a^4}{120r^4} + \frac{a^6}{5040r^6} - \&c.$ And the angle $NEB = \frac{NC \times ax}{BE^2}$, the angle AEB will be the coequate anomaly. Fig. 6. Pl. IV.

For, the trilinear NEB will be = to the segment of the circle, contain'd between the arch NM and its subtense; wherefore, since the triangles NEC and NMC, constituted on the same base NC, and between the same parallels NC and ME are equal, the sector AMC will be = to the trilinear ABE; but the sector AMC is to the semicircle AMDA as AM to AMD; therefore also ANBE is to the semicircle AMDA as AM to AMD, that is, in a given ratio. *Q. E. D.*

As to the angle BEN it will be found from this, that the segment of the circle between the arch MN and its chord MN should be equal to the sector BEN: Now that segment is equal to half the product of the difference of the arch MN, and its sine into the radius CN; but since the arch MN (by hypothesis) is a; and its sine $= a - \frac{a^3}{6r^2} + \frac{a^5}{120r^4} - \frac{a^7}{5040r^6} + \&c.$ the arch MN − its sine will be $= \frac{a^3}{6r^2} - \frac{a^5}{120r^4} + \frac{a^7}{5040r^6}$ *&c.* (that is, because $x = \frac{a^2}{6r^2} - \frac{a^4}{120r^4} + \frac{a^6}{5040r^6}$ *&c.*) $= ax$. But the sector BEN is equal half the rectangle of NE × Bb, letting fall the perpendicular from B on EN; for, the sector on account of the smallness of the angle BEN may be consider'd as a rectilinear triangle; and the perpendicular Bb as the small arch describ'd from the centre E with the radius EB; but as the segment MN should be equal to the sector BEN, it will be EN × Bb $= ax \times$ CN; and therefore, the small arch $Bb = \frac{CN \times ax}{EN}$: But as EB to the arch Bb, so the radius CN to the angle $BEN = \frac{CN^2 \times ax}{EB \times EN}$ or because EN and EB may be consider'd as equal, the angle BEN will be equal to $\frac{CN^2 \times ax}{EB^2}$, as was laid down.

With *Keill* let CE = 0,01691, AC being equal 1, the coequate anomaly AEB is sought, if the mean anomaly AM = 30°; wherefore the angle ACM = 30°; and in the triangle MCE, the angle MEA will be found = NCA = 29° 31′ 38″ = the arch AN; wherefore NM = 28′ 22″: But in the triangle NCE the angle NEA is found = 29° 3′ 7″, and this Example.

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is the coequate anomaly; for, the angle NEB will not be equal to $4''''$; and therefore it does not deſerve to be regarded.

Example. In fine, let it be ſaid, as the ſine total to the ſine of the angle PCE (namely erecting in E a perpendicular to AD) ſo is the tangent of the angle found AEN or AEB to the coequate anomaly in the *ellipſis*. *Keill* by his ſeries found the angle AEN ſuch as we have obtain'd it here without any ſeries by the ſole reſolution of the two triangles MCE and NCE; for, the uſe of the preceeding ſeries has only ſhown to me what ſhould be the quantity of the angle NEB to be added to NEA now found: But as by calculation it is found not to amount to $4''''$, it is deſervedly overlook'd.

An Obſervation and Experiments about the external Uſe of Spirits of Wine in ſtopping Hemorrhages. From the Acta Eruditorum Lipſ. An. 1683. p. 153.

Tranſlated from the LATIN.

The ſtiptic quality of ſpirits of wine, and the experiments made therewith. NO one, who is not regardleſs of the phyſical and medical diſcoveries of this preſent age, is ignorant of the uſe of that ſtiptic liquor, ſome years ago diſcover'd by one *Vivient*, a *French* colonel, and which has been ſo famous in *France*, *England*, *Denmark*, *Germany* and other parts, that after various trials made of it, King *Charles* II. purchaſed the manner of preparing it at 5000 crowns. Moſt people conjectured, that this medicine conſiſted of vitriol and alum, but with what truth we ſhall not now enquire; tho' the liquor itſelf (which about 8 years ago I had from a certain gentleman, who ſolemnly averr'd, it immediately came from the inventor himſelf) diſcover'd by various circumſtances the above ingredients. But as ſeveral people at that time affirm'd, that it exerted its ſtiptic virtue by rendering the blood grumous, and by that means ſtopping up the wounded or lacerated veſſels; and as I myſelf alſo happen'd to obſerve the like *phenomenon* upon its application, I began to think, whether ſpirits of wine might not have the ſame effect, that is, whether they might not ſtench a flux of blood; for, it was what other people obſerv'd as well as myſelf, that that ſulphureous ſpirit coagulates or makes the blood highly grumous, which it receives in a very fluid ſtate from a vein, and makes it reſemble compacter fleſh, not to mention the coagulating power it alſo exerts on the bile, as we learn from mechanics: This theory of mine will not, therefore, be reckon'd entirely paradoxical, whereby in the ſame manner I conjectured it would probably alſo act on the vital blood, that is, coagulate ſome portion thereof, and hence ſtop hemorrhages in wounds even of the larger veſſels; but as I here found, that

that bare reaſoning without experience is like a ſhip without a pilot, expos'd to an ocean of doubts, I for this purpoſe made ſeveral experiments on dogs; and that not only on the ſmaller veſſels, as thoſe in the leg, but likewiſe on the larger veſſels, as the crural and jugular, both veins and arteries; ſometimes I cut the artery alone, and ſometimes its ſocial vein at the ſame time, now lengthwiſe, and again tranſverſely; and by applying only the ſpirits of wine, they were in a few minutes clos'd up, and the blood ſtopp'd; and the event always anſwer'd my expectation: And tho' I remember I did not uſe one and the ſame method in cutting aſunder and tearing the veſſels, nor in applying the ſtiptic; yet by repeated trials I would not begrudge to remove every doubt, and thereby examine each circumſtance; and in the operation I obſerv'd the following methods; 1. I carefully remov'd the external integuments, as the ſkin with the fat and muſcles, which ſometimes ſtood in the way, that the veſſels to be cut aſunder might be laid bare; and that neither the bulk nor the contraction of theſe parts might by compreſſing, obſtructing, or in any other manner ſtopping up the veſſels, after they were once opened, effect what I had aſcrib'd to my liquor. 2. I cut the veſſels oftner lengthwiſe, more rarely tranſverſely, but leaſt their extremities, being either corrugated by their own proper contraction, or compreſs'd by the adjoining parts towards which they are retracted, ſhould without the uſe of any medicine ſuppreſs the hemorrhage; as I here ſuppoſe it well known from ſurgery, that it proves a remedy in the hemorrhage of veſſels, lacerated in the muſcular parts, after all other means prove ineffectual, to cut them aſunder tranſverſely; yet 3. I made theſe fiſſures pretty long; and very lately in the external jugular vein, which in a dog is far larger than the internal one, I made a fiſſure of a fingers breadth, and yet with the deſired ſucceſs. 4. In the application of the ſpirits of wine I managed it ſo, that I firſt let ſome blood run, to ſhow that the veſſel was really open'd: Hence, without any compreſſion, either of the artery in its upper part, or of the vein in its lower part, I laid upon the wound a compreſs, ſometimes ſingle, ſometimes double, drench'd in the liquor, preſſing it down with my own fingers, or with thoſe of the aſſiſtants in the gentleſt manner, that is, no harder than is uſual in feeling the pulſe. 5. And after ſtenching the blood, I ſometimes applied the ſame bolſters, drench'd a-new in the ſpirits with proper rollers; and I took care to keep the animal quiet for ſome hours, yet oftner I let him go without any bandage; and I never obſerved ſo much as a drop of blood, did he roll himſelf or walk, *&c.* in any manner whatever. 6. And laſtly, I never continued the compreſſion, nor the application of the liquor above a quarter of an hour, as thoſe who aſſiſted me in theſe experiments can teſtify; nay, I remember I have often let the animals go in a few minutes after. I always found the more dephlegmated ſpirits to produce the quicker effect.

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How ſpirits of wine produce their effect.

But being ſatisfied as to the truth of the experiment, I reſolv'd to enquire into the manner of the operation; that is, whether the ſpirits, as I, indeed, formerly thought, produced their effect by coagulating the blood, or rather by conſtringing the veſſels; and upon removing the pledgets I ſcarce ever remember to have ſeen any coagulated blood about the wound: But I ſhall relate what a few days ago I found in a dog, the trunk of whoſe crural artery juſt under the *abdomen* I open'd; and after cloſing it, I open'd the external jugular vein, after which I immediately caus'd ſtrangle the dog. In three hours after, having ſufficiently view'd the wound, after it was clos'd up and obſerving no grumous blood about it, I enter'd a probe thro' the upper part, and which lies within the *abdomen*, to try whether paſſing it downwards to the lower parts, it would not open the wound of the veſſel; but tho' I mov'd it upwards and downwards, yet this happen'd without tearing the veſſel, as I was apprehenſive. I open'd the lower part of the ſame artery, that by it the knob of the probe might come out, which yet protruded no grumous blood: Hence I cut the affected part itſelf, which was harder and of an obſcurer red than the reſt of the artery, and I neither found in its lips or channel any grumous blood. The wound of the jugular vein was opened, yet without any grumous blood externally, by haſtily putting in the probe at the upper part, which was probably owing to the far ſhorter application of the ſpirits to it than to the ſaid artery, or that its ſubſtance was much thinner, or that the inſtrument was too forcibly driven in; and thro' the wound there alſo came out along with the fluid blood a little coagulated blood, which I would have ſuſpected to be owing to the ſpirits of wine, had not I myſelf and the aſſiſtants directly obſerv'd the like *moleculæ* of blood in other veins of the internal parts, as in the *vena portæ*: I alſo put a probe, (moving it from above to their extremities) into the right crural arteries and veins of another ſubject, which were cut tranſverſely, and in a few minutes conſolidated: And in theſe I obſerv'd a remarkable narrowneſs, as they admitted the inſtrument with ſome difficulty; nay, its knob being protruded thro' the aperture, ſeem'd to carry along with it a kind of thinner *membranula*, probably, like to that very thin pellicle, which the *Acta Haffnienſ.* mention, as produced by the *French* ſtiptic in the wounds of veſſels: Beſides, the ſpirits of wine do not directly render the blood grumous; on the contrary, by a momentaneous contact, as it were, they cauſe a remarkable firmneſs, nay, in tract of time, a hardneſs in the more ſolid parts of the body, as the fleſh, the ſubſtance of the brain and liver, the nerves, *&c.* namely by conſtringing their fibres, and inſtead of relaxing, making them denſer. And now about four years I keep in my *muſæum* a heart taken from a human ſubject, which, after lying in ſimple ſpirits of wine for ſome days only, acquir'd almoſt a bony ſolidity; and is therefore, ſtill without any ſigns of corruption, ſo that we may probably

conjecture

conjecture that this liquor does by conſtringing or condenſing act rather on the veſſels than on the blood, and thus ſtench hemorrhages; which will ſeem leſs paradoxical to ſuch as are appris'd of its great virtue in conſolidating wounds and removing gangrenes.

A ſpecific in the Pleuriſy. By. Dr. Petr. à Caſtro. *From the* Miſcellanea Naturæ Curioſorum. Obſ. X. An. I. Dec. I. p. 29.

Tranſlated from the LATIN.

The method of preparing this ſpecific.

TAKE citruls, a ſpecies of pompions, hang them in a cloſe place out of the ſun's rays, cut them into pieces, throw away the pulp, ſave the peel and ſeparate it well from the pulp, ſo that the peel be no thicker than a crown piece. Take of this peel 1 *lb.* of the oldeſt oil-olive (of 10, 20, nay, if poſſible, 100 years old) 3 *lb.* in this oil boil the peel, till all its humidity is conſumed; and it is a ſign of its being well boil'd, if a ſtraw, dipt into the oil and applied to a burning candle, takes fire without hiſſing, as alſo if the peel appear almoſt burnt, and as it were, reduced to a coal; then ceaſe boiling, ſtrain the oil, and after that take an iron-pot with two orifices, or at leaſt one in its ſide for the oil to paſs thro'; make the pot red hot and pour the oil into it thro' the one orifice, that it may come out at the other into a veſſel, ſet below to receive it, and this oil is to be us'd for anointing the ailing ſide.

The ſucceſs of uſing this ſpecific.

Dr. *Petrus à Caſtro*, famous for his ſucceſsful and frequent practice, firſt in *Biſcay* in *Spain*, and then in *Verona* in *Italy*, and afterwards in the ſtation of chief phyſician to the Duke of *Mantua*, did by this ſpecific perform extraordinary cures on pleuritic patients, of whom there is a great number in *Italy*, both on account of their temperament, as alſo on account of the climate and air, and ſnatch'd them even from the jaws of death.

The manner of publiſhing it to the world.

After the Dr's death, which happen'd about nine years ago at *Mantua*, a certain perſon at *Ferrara*, well knowing the great uſefulneſs of this remedy, thought fit not only to publiſh it to the world, but to ſend printed copies of it to the more noted hoſpitals of *Europe*. A like copy was printed at *Ferrara* in 1669, with the licence of the ſuperiors, by *Alphonſ.* and *Joh. Baptiſta Mareſti*, and ſent to *Breſlaw* in 1670 to St. *Matthias'* hoſpital, which was communicated to me, and is as follows;

I *N. de N.* who have experienced the extraordinary virtue of a certain oil, which in a few hours cures the pleuriſy, have for many years paſt cur'd all ſuch patients as made uſe of it; and that to the ſurpriſe of the phyſicians, ſo that it never fail'd: I, therefore, thought it honourable, nay, a work of very great charity, if I ſhould publiſh the ſaid ſecret, to wit,

wit, the manner of preparing and applying the above-mentioned oil and communicate it to all the hoſpitals of *Italy*, nay of *Europe*.

Another method of preparing the above ſpecific.

Take citruls after they are grown to a due bigneſs and that for this reaſon, that they may not be too hard, but at leaſt of ſuch a thickneſs, that they may take in the oil; ſcrape them as you do radiſhes; but take care you do not pare them as you do apples, only ſcrape them and take off that thin pellicle which covers them, and whereby they appear green; after this cut the citrul lengthwiſe, quite round into ſlices as thick as a crown piece, after which weigh the ſlices, clearing them internally from the pulp, and take the ſame weight of oil-olive; the better the oil is, the more ſerviceable it will prove; and if your peel weighs two pounds, you muſt take as many pounds of the oil, and conſequently, the weight of the oil muſt be always equal to that of the peel. After this put the oil and peel into a new and pretty ſtrong earthen pan, for the reaſon hereafter to be mentioned, and let them boil over a coal or wood fire, providing there is no flame, till the pieces of the peel become entirely dry, and, as it were, burnt up; then take it out of the oil with a ſpoon and throw it away, becauſe it is of no uſe; then thro' the oil paſs heated iron, (and not ſteel) never before us'd, and that for 17 or 18 times, heating the iron well every time: And I myſelf proceed in the following manner; I cauſe the pan with the oil to be carried to a ſmith's forge, and I order to be put into the hearth ſix pieces, ſomewhat bigger than half a palm, of virgin iron, or ſuch as has not been us'd before; and when they are red-hot, I put one after another and quench them in the ſaid oil, and then I throw the iron again into the fire, and when I have repeated this three times, as there are ſix irons, this will make 18 times, which is ſufficient for giving the oil its perfection.

I never prepare leſs than 8 or 10 pounds of it, but you may make a greater or leſs quantity of it at pleaſure, provided you take as much oil as peel. But as the red hot iron put into the oil, is apt to cauſe it to take fire, you muſt have at hand a lid to cover the pan and extinguiſh the flame; but as it may alſo happen, that the ſuppreſs'd flame may burſt the pan; I, therefore, hinted above, that you muſt uſe a ſtronger pan; and I myſelf, for the greater ſecurity, before the ignited iron is put into the pan, put the pan into another earthen veſſel for fear of loſing the oil, ſhould the pan break in the operation. When the oil is cold I pour it into a glaſs bottle and keep it for uſe.

The method of uſing this oil.

Take a little of this oil on a plate, and heat it well, ſo as it may be bore, and pour the oil on the part and anoint it; then take a dirty towel, which has been us'd, and fold it four times, and alſo heat it as the patient can bear it, and lay it on tow and faſten it, leſt by its motion the oil ſhould ſhift from the part affected; and becauſe ſometimes the pain is

alſo

alſo communicated to the other ſide, that is alſo to be anointed in like manner, and the tow and towel to be laid on: And becauſe ſometimes the pain moves from one rib to another, continue to anoint wherever the pain ſhifts; and if the patient, when anointed in the ſaid manner, does not begin to ſpit, renew the inunction five hours after, but rarely is there occaſion to repeat it, ſeeing we find by experience, that the impoſthume breaks in a few hours. Thus far the *Father*.

The deſcription of this oil differs but little from *à Caſtro*'s preparation, yet agrees with it in its virtue; and for its uſefulneſs ſhould be introduc'd into the ſhops. Remark thereon.

Of the Situation of Scythia, *ſuch as it was in* Herodotus' *Days.* *By* T. S. Bayerus. *From the* Comment. Acad. Scient. Imper. Petropol. Tom. I. p. 400.

Tranſlated from the LATIN.

ONomacritus and *Æſchylus*, are the firſt of all the *Greeks*, whoſe works are now extant, that writ any thing of the *Scythians* after the arrival of *Anacharſis* the *Scythian*, into *Greece*. This *Anacharſis*, as *Herodotus* teſtifies, was the ſon of *Gnurus*, and brother to *Saulius*, king of the *Scythians*: *Gnurus* was the ſon of *Lycus*; *Lycus* the ſon of *Spargapithis*; tho' *Lucian* in *Scytha* calls his father *Daucetus*, and not *Gnurus*, but from what authority I know not: And *Diogenes Laertius* calls his brother *Caduides*. He came to *Athens*, according to *Soſicrates*, the *Rhodian*, and the αναγραφη Ολυμπιαδων in the firſt year of XLVIII olympiad, when *Eucrates* was *Archon*, who by one year ſucceeded *Solon*, 17 years after the *Scythians* loſt their ſovreignty in *Aſia*, and were engaged in the *Servile war* at home; from which I think it happen'd, that none of the affairs of the *Scythians* were ſo famous in *Greek* ſtory, as what they had heard from *Anacharſis* of their late civil war. *Anacharſis* had a *Greek* to his mother, or, to give credit to *Diogenes Laertius*, that he ſpoke *Greek*, rather than to *Lucian* and the fictitious epiſtles of *Anacharſis*, that he only underſtood the *Scythian* language. Yet it ſeems that the ſituation of the places in *Scythia* could not hitherto be very clearly known. And *Anaximander*, the *Mileſian*, being about 20 years of age, could have known *Anacharſis* in *Athens* or ſome other city in *Greece*. He is reckon'd by *Agathemarus*[a] among the firſt who made geographical maps: And probably from him *Onomacritus* borrow'd his accounts, when in the LXV olympiad he publiſh'd his *Argonautics* at *Athens* under *Orpheus*' name. *Pindar* has, indeed, mentioned, that *Abaris*, whom ſome ſuppoſe to have been a *Scythian*, At what time the *Greeks* came acquainted with the *Scythians*.

[a] *p.* 1. Ed. Hudſon.

others an *Hyperborean*, came to *Athens* about the time of *Crœsus*; but he ſeems to have had *Anacharſis* in his view, who was at *Athens* much about that time: And I doubt not, but that *Euſebius* and St. *Jerom* were miſled by his authority, when they hold, that *Abaris* came from *Scythia* to *Greece* in the ſecond year of the LIV olympiad, and in the beginning of *Crœſus'* reign. *Hippoſtratus* contends, that he came thither in the III olympiad, others in *Harpocration* in the XXI olympiad; nay, *Firmicus Maternus*, as *Joſeph Scaliger* and *Mauſſacus* have corrected him, makes him cotemporary with the *Trojan* war: But in thoſe days the *Scythians* could not be known; ſo that with *Herodotus*, *Harpocration* and the *Scholiaſt* on *Ariſtophanes'* Ἱππεων, I would rather chuſe that *Abaris*, the *Hyperborean*, was meant and trace him from the *Greek* colonies ſent to *Pontus*; which *Hyperboreans* I ſuppoſe ſent ſacrifices and ambaſſadors to *Delos* and *Athens*, as I ſhall hereafter ſhow in another diſſertation; unleſs *Herodotus* in his *Melpomene* is rather to be credited, who ſays that this *Abaris* is a groundleſs fable. No *Scythian*, however, ſeems to have accompanied *Anacharſis* into *Greece*, if his brother out of his hatred to a foreign religion ſlew him with a dart, as he was aſſiſting at the ſacred rites among the *Greeks:* Tho' I am not ignorant, that there are other authors who make *Anacharſis* to have liv'd to 100 years of age. There are many trifling and ſilly things in *Onomacritus*, whether he borrow'd them from *Anaximander* or any other author, which relate to countries and nations that were ſtill unknown: Yet ſome things are more certain as coming nearer to *Herodotus'* account; for, as to *Onomacritus'* hero's they direct their courſe along the ſouth ſhores of the *Pontus*; and the names of theſe places are well known and true; but when they direct their courſe to the weſt and eaſt, then neither do the *Amazons* nor *Tauri* inhabit their own country; and the ſprings of the *Thermodon*, *Phaſis* and *Tanais* are deriv'd from the river *Araxes*, which is tolerable in ſo great a length of time, and at ſo great a diſtance, the courſes of rivers admitting of fictitious accounts; but to the north *Onomacritus* confounds every thing, and places here and there at random people whom he ever happen'd to hear mentioned: But his greateſt blunder is, that he joins the *palus Mæotis* in one continued channel with the northern ſea: There he places the *Pacti*, the *Arctei*, the *Lælii* and the *Scythians*; and he makes the *Argonauts* travel thro' the *Tauri*, the *Hyperborei*, the *Nomades*, the *Caſpii*, the *Riphæi* to the *Hyperborean* ocean, as far as the *Macrobii*, and to the *Cimmerii* living in darkneſs between the *Riphæan* and *Caſpian* mountains, and afterwards to *Ireland*, and through the ſtreights of *Gibraltar* to *Hercules'* pillars; and this, to make the ſtory the more ridiculous, in the ſpace of a few days. This clumſey manner, wherein *Onomacritus* frames his ſtory, diſcovers his ignorance, as he ſcarce knew any thing more than the name of the *Scythians* and of ſome neighbouring nations: We are, therefore, carefully

carefully to guard againſt quoting this man (who would entertain his readers with things he knows nothing about, and with idle tales) as a good and accurate author on theſe countries, as ſome learned men have done before us. Such as after him writ *Argonautics* gave an account of nations viſited by the *Argonautæ*, not ſuch as really dwelt there in the moſt ancient times, but ſuch as they had heard liv'd there in their own days, or at ſome other time. As to theſe we are, therefore, to be more upon our guard than thoſe learned men above-mentioned have been, who, by comparing the inconſiſtencies in *Onomacritus* and the other *Argonautic* writers, have thereby caus'd univerſal confuſion.

Æſchylus' opinion about the ſituation of the *Scythians.*

Æſchylus in his *Prometheus Vinctus* agrees with *Onomacritus*, that the *Scythians* dwelt above the *Mæotis*; he alſo places their country among deſarts, and makes it extend to the ocean, with which the *Mæotis* may mix: He alſo knew the *Chalybes*, the *Amazons*, and the ſtreights of the *Mæotis*.

When *Scythia* began firſt to be known.

That ignorance of the country of the *Scythians* continued till *Darius'* expedition; for, at that time it was, that by means of the *Ionians* and other *Greeks* who were in his army, was diſcover'd what was unknown till that day. From among them *Scylax Caryandenſis* was ſent by *Darius* to ſurvey the coaſt; and his *Periplus* is ſtill extant. He has deſcrib'd the coaſt of the *Pontus* more accurately than *Onomacritus*, and ſome other places of thoſe tracts to better purpoſe than *Herodotus*. *Herodotus* had known, that *Scylax* was ſent by *Darius Hyſtaſpes* to ſurvey the coaſt of *Aſia*; but he did not know that he alſo ſurvey'd the coaſt of *Europe* and *Scythia*. *Dionyſius* of *Halicarnaſſus* in his firſt book of *Alexandria* relates, that *Scylax* dedicated to *Darius* his *Periplus* of *Europe* and *Scythia*, as an uncertain author has it in his *Elogium* on *Scylax*, firſt publiſh'd by *Hoeſchelius*. Whether he ſurvey'd theſe coaſts by *Darius'* orders or of his own head, or whether he only writ down the relations of other ſailors, (for, *Caryanda*, his country, was adjoining to *Caria*; and the voyages of the *Carians* are very well known[b]) nothing is more certain than that his *Periplus* ſhould be referr'd to this time. I am not ignorant, that Mr. *Dodwell*, for whom I have always had a very great regard, makes this *Scylax* much later than *Herodotus'* days; but he ſeems to have entirely loſt himſelf in that whole diſpute; for, *ſays he*, there are ſome things in *Scylax's Periplus* which refer to later times: I own that it is ſo; but ſome of theſe, according to Mr. *Dodwell* himſelf, are to be referr'd to the CXI olympiad, others to the CXVI olympiad, and ſome again to the CXXXV olympiad, which is an interval of 96 years. On the contrary, you may find in *Scylax* certain marks of greater antiquity; and this *Dodwell* has alſo acknowledg'd in ſeveral inſtances, and particularly in one, namely, that *Scylax* calls *Tyre* an iſland, which after *Alexander's* expedition to *Perſia* was a *peninſula*; he, therefore, liv'd

[b] *Lib.* 1. *cap.* 171.

liv'd before that war: Beſides, *Scylax* muſt have writ at a time when the coaſt of *Afric* and *Aſia* was more known than that of *Italy*, *Gaul*, and *Spain*; he, therefore, only has the *Volſci*, the *Campani*, and the *Samnites*, but makes no mention of *Rome*, whoſe fame had not hitherto reach'd *Greece*: Whence it appears to me as a thing beyond diſpute, that the other things in this author, agreeing to other times, were added to him by the tranſcribers, and afterwards taken into the text, as was the caſe with many other authors, eſpecially thoſe of this claſs. After this time the *Athenians* were ſo eager in knowing theſe countries, that their *great men ſpent whole days in the* forum *with ſuch as ſail'd from the* Phaſis *or* Boryſthenes *to learn ſtrange ſtories from them*, as *Ariſtotle* in *Athenæus* has it[c]. But ſuch ſtrange accounts produc'd thoſe wild ſtories about the *Scythians*, to which *Mauſſacus* ſeems not without reaſon to have referr'd the *Abaris* of *Heraclides*.

Herodotus' manner of collecting his hiſtory, and his extent of *Scythia*.

But *Herodotus* was a man of another ſtamp, who ſo behav'd among the *Olbitæ* and other inhabitants of *Pontus*, as not entirely to reject their fables, being aware, that ſometimes ſome truth is conceal'd under them; yet he enquir'd with ſagacity what, in every relation, ſeem'd to be the trueſt. I ſhall, therefore ſhew, as we have it from *Herodotus*, in what parts the *Scythians* dwelt about the time of *Darius'* expedition; for, they poſſeſs'd the country between the *Boryſthenes* and *Tanais*. They had the *Tanais* to the ſouth, as our author ſays, but there were no *Scythians* on its farther bank, excepting the rebels, or ſuch as were baniſh'd from the reſt of the body, and driven from the banks of the *Tanais* farther to the eaſt. Now *Herodotus* writes, that there is ten days journey from the *Danube* to the *Boryſthenes*; and from the *Boryſthenes* to the *Palus Mæotis* as many. From the eaſt of *Scythia* to the weſt he reckons 20 days journey, and as many from *Pontus* to the *Melanchlæni* overagainſt *Scythia* to the north. He reckons 200 *ſtadia* to a day, and this (namely as to the *ſtadia*) cauſes the greateſt difficulty: But I think I have hit on a way, whereby we may come to the truth as near as may be. *Eratoſthenes*, as *Strabo* relates, aſſign'd 700 *ſtadia* to 1 degree of the equator; but *Ptolemy* from careful obſervation, as he ſays, only 500 *ſtadia*, whom a great many of the ancients follow. *Herodotus' ſtadia* agree with thoſe of *Ptolemy*, as appears plainly, upon comparing *Herodotus'* meaſures, which I here ſubjoin with *De L'ile's* very accurate tables, which we have follow'd in ſettling theſe tracts of the earth. *Herodotus* ſays,

Herodotus' meaſures.

That the *Pontus Euxinus*, where broadeſt, is in breadth	3200 *ſtadia*.
The mouth of the *Pontus*, or *Boſphorus*	4
From the mouth of the *Pontus* as far as the *Propontis* is in length	120
That the *Propontis* is in breadth	500
And in length	1400

[c] *f.* 6.

Accord-

According to these numbers, therefore, of *Herodotus*, as to the countries in question, to one degree of longitude there will be reckon'd 347 *stadia*, each of 600 feet, as *Herodotus* expressly requires, or 208200 feet. Now we shall reduce to a *calculus* the dimensions of *Scythia*. Dimensions of *Scythia*.

	Days.	*Stadia.*	*Degr.*	*Feet.*
From the *Danube* to the *Borysthenes*	10	2000	5	159000
From the *Borysthenes* to the *Mæotis*	10	2000	5	159000
From the east to the west of *Scythia*	20	4000	11	109800
From the *Pontus* to the *Melanchlæni*, or to the north	20	4000	11	109800

The two first measures of *Herodotus* are not very wide of the truth, if you travel from the *Danube* to the *Borysthenes* along the coast; and this is the reason, that the *Mæotis* is also at the same distance from the *Borysthenes*; for, either way the course is interrupted by the running in of the coast. But in *Scythia*, an open and champaign country, which is neither interrupted by woods nor ridges of mountains, there is a direct course. There is one difficulty, namely, *Herodotus* writes, that from the west to the east is 20 days journey. But *Herodotus* excellently well explains his meaning, when he includes *Scythia* between the *Agathyrsi*, *Neuri*, *Androphagi*, and the *Melanchlæni*: And this we must always carry in our eye to make every thing hang well together. And thus having connected and compar'd every thing well together, I hope it shall be found either that this was the situation of the *Scythians*, or because there can be no such great certainty in these matters, that I have not been very wide of the truth. *Scythia*, therefore, is situated nearly between 45 and 57 degrees of longitude, and between 47 and 55 degrees of latitude; colonies from which crossing the *Borysthenes* possess'd some extent of land as far as *Tiras*.

As to the order of the rivers in *Herodotus*[d] it is as follows; from *Scythia* run five rivers, which empty into the *Danube*; the *Porata* (according to *Ammianus Marcellinus*, *Porota*) a large river, coming from the east, retains to this day its ancient name *Prut*, into which run the *Colazinus*, *Cosmanus*, *Zuzur*, *Zur*, *Bassenus*, *Caroccia*, *Caminea*, *Caldarussa*, *Zizia*, *Valemare*, *Valebratuleni*, *Mosna*, *Nirnova*, *Calmazuia*, *Sapusna*, *Strimba*, *Serata* the east and west, *Cigieza*, *Larga* and *Ilana*, as Prince *Cantemir* calls them in his MS. history of *Moldavia*. The *Greeks* afterwards, according to *Herodotus*, chang'd the name *Porata*, so as to be corrupted into Πυρετ☉: Whence *Constantinus Porphyrogenetes*[e] makes it Βρετ☉, and at this day *Prut*. The *Tiarantus* of *Herodotus* is the river *Alaut*; for, according to *Herodotus*, there are three large rivers between *Tiarantus* and *Porata*, the same number as at this day between this river and the *Alauta*: Besides, *Ptolemy* thus also places his *Alauta*: But of the three, *Ordissus* is one, which still retains its ancient name; for, it is call'd *Argischa*, and by the *Greeks* after The *Scythian* rivers, *&c.* in *Herodotus* settl'd.

[d] *Lib.* 4. *c.* 47, 48. [e] *De* adminstr. Imperio *f.* 108. Ed. Band.

after *Herodotus* Αρδεϊσκος, as appears from the *Scholia* on *Heſiod.* The *Naparis* of *Herodotus*[f] is the *Ialoniza:* The *Ararus*, the *Hieraſtus* of *Ptolemy* (which Prince *Cantemir* took to be the ancient name of the *Prut*) the Σερετος of *Conſtantinus Porphyrogenetes*, from its ancient corrupted name is at this day alſo call'd *Siretus*, and by ſome *Moldoua*; for, it is a river proper to *Moldavia*, running from its outmoſt confines towards *Poland*, and diſemboguing, according to Prince *Cantemir*, at two mouths into the *Danube*, and encompaſs'd on each ſide with mountains and woods. Next to theſe rivers offers the *Maris*, which from its ſource ſtill retains its ancient name, *Maroſch* or *Meriſch*, till at *Sigeth*, after loſing its name, it mixes with the *Tibiſcus* or *Teiſs*, with which it diſcharges itſelf into the *Danube:* But the *Maris* is by *Herodotus* ſeparated from the *Scythian* rivers, nor ſhould it be mention'd by us, did not *Herodotus* place the *Agathyrſi* upon it. The next is the *Tiras*, call'd by the *Turks*, *Turla*, retaining ſomething of its ancient name, and by *Conſtantinus Porphyrogenetes* and other *Greek* authors call'd *Danaſtris*; whence at this day it is call'd *Dniſter:* It riſes from a lake, which ſeparates the *Scythians* from the *Neuri*, I ſay a lake, upon the authority of *Herodotus*, whatever be its ſource. Next to the *Tiras* is the *Hypanis*, now the *Bog*. *Rudbeckius* took it to be the *Pripelius*; but I think I have clear'd this up in another place[g]. *Hypanis* riſes from a lake, which by *Herodotus* is call'd Μητηρ Υπανις, and in *Scythia* is ſituated to the weſt, near which places are *wild white horſes*. *Dio Chryſoſtom*[h] thus deſcribes the mouth of this river, 'near the ſea it forms a 'large lake, it is ſlimy and calm in ſtill weather, the river itſelf is deep 'and rapid, its banks marſhy, cover'd with reeds and trees, ſo that ſome 'of the trees appear alſo in the lake like maſts of ſhips, and there is 'plenty of ſalt there.' Into the *Hypanis*, according to *Herodotus*, a ſmall and bitter river falls, call'd *Amaxampes* by the *Scythians* (which he ſays ſignifies to the *Greeks* Ιερας Οδους) which is the boundary of the *Alazones* and *Scythæ Aratores*; but it is 800 *ſtadia* diſtant from the ſea; for, in a courſe of four days from the *Amaxampes* to the ſea, the *Hypanis* is ſaid to run bitter. In another place *Herodotus*[i] places the country Εξαμπαιος between the *Boryſthenes* and the *Hypanis*; and he ſays, that from that country the river *Exampes* runs, which before he had call'd *Amaxampes*, ſeeing to this very river, almoſt at an equal diſtance, the *Hypanis* and *Tiras* run; a little below the bitter river, the *Tiras* takes a compaſs round, and the *Hypanis* alſo diverges, according to *Herodotus*; characters, which induced me to place *Amaxampes* where now the ſmall river *Sinauda* is. The *Boryſthenes* is the next to the *Hypanis*, call'd by the uncertain author of the *Periplus Ponti Euxini*, *Danapris*, from which it is now call'd *Dniper* by an old *Scythian* word. After *Herodotus* ſome who yet have ventur'd to write

p. 261. Ed. Heinſii. g *De* Numo Rhodio *p.* 9. h *f.* 437. i *f.* 157.

write of things at a greater diſtance back, and of which they had no certain account, trace the ſource of the *Boryſthenes* from the *Montes Alaunici*, as they are call'd; but it is not to be wonder'd at, if the heads of rivers are by ancient geographers placed either in lakes, marſhes, or mountains, that they might not ſeem to be ignorant of any thing: And, indeed, *Matthias Miechovius*, a canon of *Cracow*, has obſerv'd, that the ſource of the *Boryſthenes* takes its riſe in a plain of *Sandomir* and not in mountains, of which there are none in that territory. The *Boryſthenes*, according to *Herodotus*, is a river inferior to none but the *Nile*; it glides in a very pure channel, and near its banks are fruitful fields; its mouth is ſtor'd with plenty of ſalt and large fiſhes, which the inhabitants broil and feed upon. The river was known to the *Greeks* from the country *Gerrhus*, which was 14 days ſailing diſtant from the ſea. At 10 days journey from the ſame country dwelt on the *Boryſthenes* the *Scythæ Aratores*; at their mouth the *Boryſthenes* and *Hypanis* mix'd together into one lake before they diſembogu'd into the *Pontus:* The breadth of each mouth was equal, and the lake extended for 200 *ſtadia.* The promontory, ſituated in the middle between both rivers, was call'd *Hippoleon*, famous for a temple of *Ceres:* And in that promontory, overagainſt which the rivers fell from the lake into the ſea, was in *Dio Chryſoſtom*'s time the fort *Alectoros*, ſo call'd from the conſort of a king of the *Sauromatæ.* To the eaſt the *Panticape* running from a certain lake to the north, and paſſing along the territory of *Hilæa*, fell into the *Boryſthenes.* I place it there where at this day the *Samara* is, or a little below this river; for, the *Scythæ Agricolæ*, who were allied to thoſe of the ſame name, living on the weſtern bank of the *Boryſthenes*, dwelt 11 days journey from the *Panticape*, that is, as far as *Gerrhus:* The *Panticape*, therefore, was not far from the ſea. *Dionyſius Periegetes*, however, and others deſcribe its mouths as not far from the *Pontus*; from whence I think it happen'd, that ſome, comparing the *Panticape* with the *Hypanis*, ſaid, that below *Olbia*, or the town *Boryſthenes*, it mix'd with the waters of the river of the ſame name[k]. Next to *Panticape* the *Hypacris* falling from a lake thorough the middle of the country of the *Scythæ Nomades*, and leaving the *Hylæi* on the right, diſembogu'd at the town *Cercinitis* into the *Pontus:* But the river *Gerrhus* even at its ſource, bordering on the territory of that name, ran in the middle between the *Scythæ Nomades* and *Regii*, till it diſcharg'd itſelf into the *Hypacris.* In *Ptolemy* there is nothing but confuſion; the *Hypanis* is deſcrib'd ſome degrees more eaſterly than the *Boryſthenes*, ſo that one may hence ſuſpect that in *Ptolemy* it ſhould be written *Hypacris.* The river *Cercinitis* is different from that in *Ptolemy*, which diſcharges itſelf into the *Sinus Cercinitis* and the *Pontus*, as *Herodotus* ſays of the *Gerrhus* and *Hypacris:* But the *Gerrhus* is by *Ptolemy* made more eaſterly, as if it mix'd with the *Palus Mæotis:* And that we may not be ſo much

[k] Plin. *Lib.* 4. *c.* 12.

ſurpris'd at this, we are to know, that the numbers of the degrees in *Ptolemy* are corrupted; for, if you examine him rightly, the *Hypacris* is in expreſs terms plac'd to the weſt of the *Boryſthenes*; the *Cercinitis*, therefore, of *Ptolemy*, is the ſame with what was the *Hypacris* of *Herodotus*: But how it happen'd, that the *Gerrhus* ſhould ſeem to *Ptolemy* to run into the *Palus Mæotis*, which according to *Herodotus* mix'd with the *Hypacris* and *Pontus*, I ſhall eaſily remove that difficulty from a remarkable but corrupted paſſage in *Pliny*[l]; 'the bay, *ſays he*, is call'd *Carci-* 'nitis, the river, *Pacyris*; behind, the lake *Buges* falls into the ſea by 'an artificial canal, and *Buges* itſelf is ſeparated from *Coretus*, a bay of the 'Palus *Mæotis*, by a rocky ridge; it receives the rivers *Gerrhus* and *Hy-* 'panis, which come from different parts; for, the *Gerrhus* ſeparates the 'Baſilides and *Nomades*: The *Hypanis* runs in an artificial canal thro' the 'Nomades and *Hylæi* into *Buges*, and in a natural channel into the *Core-* 'tus.' Where *F. Harduin* has already obſerv'd, that the *Pacyris* is the *Hypacris* of *Herodotus*; and he has alſo hinted, that the *Buges* is the Βυχης Λιμνη, the *Byces* of *Valerius Flaccus*, and the *Buces* of *Mela*. But there ſtill remains a difficulty, namely, that he did not advert, that *Coretus* ſhould be read *Cercinitis*, and that from *Herodotus*, whom *Pliny* has follow'd in this place; for, how could the *Gerrhus* diſcharge itſelf to the eaſt into the lake *Byces*, and the *Hypacris* from the weſt into the *Coretus*, or beyond *Byces*; 'and yet two rivers, *as* Mela *ſpeaks*, diſembogue 'at one mouth from different ſources, and in different channels.' And fall into the *Cercinitis*, as *Pliny* plainly hints. The caſe is, therefore, this, the *Hypacris* and the *Gerrhus* diſembogu'd at one mouth into the *Cercinitis* and the *Pontus*; yet by an artificial canal reaching to *Byces* and the *Palus Mæotis*, by which it diſcharg'd itſelf at another artificial mouth: This is that famous canal which *Herodotus* relates to have been made by the ſlaves of the *Scythians*. *Conſtantinus Porphyrogenetes*[m] ſays, that in his time that canal was fill'd up with earth, and overrun with wood. The *Tanais*, the laſt *Scythian* river, at this day the *Tan* and the *Don*, ran, according to *Herodotus*, from a great lake, now call'd *Juan*, and fell into the *Mæotis*; but it is very obſcure what rivers *Herodotus* means, when he ſays, *that the* Lycus, *the* Oarus, *and the* Syrgis *fall into the Mæotis*. *Ptolemy* alſo has the *Lycus* to the weſt three degrees nearer than the *Tanais*: It is, therefore, poſſibly the river *Silik*, which has retain'd ſomething of its ancient name, unleſs that be its ancient name, of which the *Greeks*, according to their cuſtom, made *Lycus*, that it might ſound the leſs barbarous: But the *Oarus*, if it is the *Agarus* of *Ptolemy*, confounds *Herodotus*' account; for, it ſhould be plac'd to the weſt of the *Lycus*; now, indeed, it is uncertain where it muſt be plac'd: Yet it is certain, that *Herodotus* places it between the Lycus and the *Tanais*. The *Syrgis*, in another place call'd Τυργις,

[l] *Lib.* 4. *c.* 12. [m] *l. c. f.* 113.

Τύρις by *Herodotus*[n], runs into the *Tanais*; it muſt, therefore, be what is call'd the *Leſſer Tanais* and the *Sevierſky*, which is a trace of its ancient name. *Herodotus*[o] ſays, that theſe rivers run from the *Thyſſagetæ*, not from the country of the *Thyſſagetæ*, but from a neighbouring country; for, a little after that, he places the *Oarus* in a deſart, which was below the *Thyſſagetæ*, or to the ſouth of them: The remaining river is the *Araxes*, or the *Volga*, as I have already ſhewn*. The *Pontus Euxinus* and the *Caſpian Sea* are too well known to ſay any thing of them. *Ariſteas Proconeſius* calls the *Pontus* the *South Sea* with reſpect to the *Scythians*, but *Herodotus* calls it the *North Sea* with reſpect to *Greece*. What ſhews the great accuracy and truth of *Herodotus* is, that he makes the *Caſpian Sea* to be longer in proportion to its breadth, as was a few years ago diſcover'd by the *Ruſſians*, and not ſquare, as ſome moderns would have it. To the weſt of the *Caſpian Sea* he places the *Caucaſus*, but to the eaſt a very ſpacious plain, the largeſt part of which the *Maſſagetæ* poſſeſs: This plain is very famous in *Arabian* and *Perſian* authors by the name of *Kaphgjak* and *Daſcht*, which ſignifies a *plain*. In fine, he deſcribes, yet without giving them any name, the mountains farther to the eaſt; for, the *Volga* to the weſt is included within a higher bank: Whence that country is at this day call'd *Nagorna*, that is, *mountainous*. Yet there are no hills there, but a plain with a higher bank; but to the eaſt there is a large plain, which tract is, therefore, call'd *Lugavoia*, that is, *champaign*; theſe mountains, therefore, mention'd by *Herodotus*, are no other than what at this day are call'd *Vergaturii*, of old *Riphæi*.

And thereby the nations themſelves ſettled.

After having thus ſettled in their proper ſituation the ſeas, rivers, mountains, and plains, which no tract of time nor reverſes of fortune could alter, I ſhall uſe theſe aids to deſcribe the nations in their proper countries. *Timonax*[p] in his firſt book *de Scythis* writes, that there are 50 different nations of them: But as it is uncertain at what time *Timonax* writ this, and whether we are to underſtand him of the people of his own time, or whether he borrow'd it from the writers of former times, I lay no ſtreſs upon his teſtimony: I ſhall, therefore, follow, as it were, the order of nature, and determine the poſitions of nations from *Herodotus*, and eſtabliſh my opinion by proper arguments, where it ſhall ſeem neceſſary. Now from the *Danube*, on the coaſt of the *Pontus*, we meet with the *Tiritæ* near the mouth of the river *Tiras*, where now is *Belgorod* and the *Butziacks*. The *Scythæ Aratores* poſſeſs'd the inland country from the river *Tiarantus* as far as the *Tiras*, which *Herodotus* has, therefore, reckon'd among the rivers of *Scythia*: They, therefore, poſſeſs'd *Walachia*, *Moldavia*, and a ſmall tract of *Tranſylvania*. The *Agathyrſæ*, a nation even of *Scythian*

[n] *Lib.* 6. *c.* 123. [o] Ibid.

* *Vide* ACTA GERMANICA, *&c.* of the origin and ancient ſeat of the *Scythians*, *Vol.* I. *p.* 163, *ſeq. Ed. Anno* 1742.

[p] *Ap.* Schol. Apollonii Rhodii, *Lib.* 4. *v.* 321.

original, were more weſterly beyond the river *Maris*, that is, in the weſtern *Tranſylvania*. After paſſing the *Tiras*, on the coaſt were the *Callipidæ* and above theſe the *Alazones*, both of them between the *Tiras* and *Hypanis*. The ſituation of the *Alazones* is more certainly known than that of the *Callipidæ*; for, the ſource of the *Hypanis*, according to *Herodotus*, ſeparates the *Alazones* from the *Scythians*. To the eaſt are the boundaries of the *Alazones*, and overagainſt them the *Hamaxampes*; and now there is left a country as far as the ſea for the *Callipidæ* near the *Olbitæ*, as *Dionyſius* of *Halicarnaſſus* has it. The *Olbitæ* dwelt above the *Hypanis* and the *Alazones* upon it, both of them to the weſt of the town *Olbia*; yet the *Alazones* are more northerly than the *Callipidæ*: The *Alazones*, therefore, were in the ſouth part of the Palatinate of *Podolia* at *Caminieck*, and in the territory of *Braclau*, where it extends between the *Bog* and the *Nieſter*: But the *Callipidæ* in the eaſtern tract of *Braclau* and in the territory of *Ozacow*. Between the *Hypanis* and *Boryſthenes* were the *Olbitæ*, a *Greek* colony, where now are the *Dzike Pole*, the *deſert plains*, and ſome part of the territory of *Ozacow*. The *Scythæ Aratores*, who were allied with thoſe *Scythians* (whom I placed above in *Walachia* and *Moldavia*) both by blood and the ſimilitude of their manners, poſſeſs'd the farther parts. The union of the two bodies of the *Aratores* was, as it were, broke to the north at the ſource of the *Tiras* by the *Neuri* and by the *Alazones*, by means of the *Hypanis* itſelf, as far as the *Hamaxampes*. The *Gerrhus*, a country to the eaſt of the *Boryſthenes*, is diſtant from the ſea 14 days journey; from that country for 10 days journey the *Scythæ Agricolæ* inhabited as far as the *Olbitæ*: They, therefore, poſſeſs'd the Palatinate of *Braclau*, and all that extent of country from the ſource of the *Bog*, as far as *Kiow*, between the *Boryſthenes* and *Hypanis*, only that at the conflux of the two rivers the *Olbitæ* inhabited. From the ſource of the *Tiras* the *Neuri* dwelt above the *Scythæ Aratores*, as far as the *Boryſthenes* in the eaſtern part of the Palatinate of *Lemberg*, *Belczo*, and *Volhynia*; which country was from them call'd *Neuris*. The *Geloni* and *Budini* are more weſterly[q], where now is the Palatinate of *Chelm* and *Brieſcia*. Anciently the *Neuri* inhabited to the eaſt of the *Boryſthenes* above the *Scythæ Agricolæ*, and were call'd Νευροι or Νευριται by *Greek* writers[r]: But one generation before *Darius*' expedition[s], becauſe ſuch a great number of ſerpents was produced in their country, and came from the north out of the deſart, that they could no longer continue in that country, they went over to the *Budini*, to whoſe neighbourhood they were receiv'd. In the year 4199 of the *Julian* period *Darius* recover'd *Babylon*, and after that, he enter'd upon the *Scythian* war, as *Herodotus* teſtifies in the beginning of his *Melpomene*. *Herodotus*[t] ſeems to deſcribe one

[q] Herodot. *Lib.* 4. *c.* 51. [r] Ib. *c.* 105. [s] Euſtathius ad Dionyſii *v.* 310. [t] For, in *Lib.* 1. *c.* 7. he reckons 505 years to 22 generations of men not compleat: And *Lib.* 2. *c.* 42. *he ſays*, that 3 generations make 100 years.

one generation from 23 to 24 and 30 years. The *Neuri*, therefore, pass'd the *Boryſthenes* about the year 4176 or 4165 of the *Julian* period: Yet *Herodotus* adds nothing, from which it may ſufficiently appear where the *Neuri* inhabited before, or where the *Geloni* and *Budini* dwelt. I ſhall relate from what reaſons I was induced to place them in their proper ſeats: The *Budini*, a populous nation, were of *Scythian* extraction, but being driven out anciently from the reſt of their own body, they remov'd from *Scythia* to the weſt of the *Boryſthenes*; for, from this aroſe the ſtory among the *Greeks* of the two brothers, *Gelonus* and *Agathyrſus*, being baniſh'd from *Scythia*, which is related by *Herodotus*. But as the *Agathyrſi* remov'd to the weſt, ſo did alſo the *Budini*; but the *Geloni*, a *Greek* colony, according to *Herodotus*, being mixt with the *Budini*, partly retain'd ſomething of the *Greek* manners, and partly adopted thoſe of the *Scythians*: From this it happen'd; that the *Budini* went alſo by the name of *Geloni*: But this in *Herodotus*' judgment is erronous, as the *Geloni* were of a different original and different in their manners, and us'd a mixt language of *Greek* and *Scythian*, whereas the *Budini* only us'd the *Scythian*; and as the *Geloni* follow'd agriculture and gardening, and dwelt in towns, but the *Budini* only applied themſelves to the care of their herds and flocks: Yet from this confuſion was fram'd the ſtory of *Gelonus*, as the father of the *Scythians*, tho' he had no relation to the *Budini*, much leſs to the *Scythians*. The town *Gelonus*, ſituated among the *Budini*, gave to theſe *Geloni* their original and ſirname; it was encompaſs'd with a wall, each of whoſe ſides meaſur'd 30 *ſtadia*; all their houſes were of brick, the temples and altars were thoſe of the *Grecian* Gods, but their ſtatutes were of wood. *Stephanus Byzantius* places the town among the *Sarmatæ*. This migration of the *Budini* and *Neuri* is a memorable period in the hiſtory of the north; for, as we learn from the northern mythology, from that time *Odin* the firſt and the *Fenni*, or the *Neuri* and the *Budini* went to the *ſinus Bothnicus* and to *Scandinavia* itſelf: The *Neuri*, therefore, dwelt before on the river *Deſna*, but afterwards in the loweſt part of *Lithuania* and in a certain part of *Volhynia*; but the *Budini* and *Geloni* on the borders of *Breſſici*. Above the *Neuri* and *Budini* *Herodotus* places a deſart to the north, adding, *ſo far as I know*; for, as *Plutarch* has it in his *Theſeus*, ſuch, as deſcrib'd the ſituations of ancient countries, if they did not know them, feign'd that the country was all ſands and parch'd up, marſhy lakes, ridges of mountains and a frozen ſea, leſt they ſhould leave any void ſpaces in their maps; of which they ſhould ſeem to know nothing; yet the *Venedi* and the iſlands *Electrides* in the *Baltic* ſea, and the *Eridanus*, which is now *Duna* near *Riga*, were names known to *Herodotus*, as we have mention'd elſewhere[u].

Beyond

[u] *Vid. Diſſertationem de* Numo Rhodio.

Beyond the *Boryſthenes* on the coaſt is the country *Hylæa*, included between the *Panticape* and the *Hypacris*, the only woody country of all *Scythia*; and at this day it is the *Leſſer Tartary*. Above this tract extend to the eaſt along *Panticape* the *Scythæ Agricolæ* for three days journey and 11 days up the *Boryſthenes*; and therefore as far as the river, now call'd *Deſna*, in the tracts of the eaſtern *Ukraine*; there lay the country *Gerrhus* and the burying place of the *Scythian* kings: Above it was a large deſart, and beyond it the *Androphagi*, a peculiar nation and by no means *Scythian*, in the tracts of the territory of *Smolensko* and *Vitepsko*, afterwards a deſart and uncultivated place, *as far as we know*, ſays *Herodotus*. After paſſing the *Panticape*, the *Scythæ Nomades* incline to the north along the river *Gerrhus*; and part of them is ſituated to the weſt of the *Hypacris*. In the *Cherſoneſus* the *Tauri* inhabited a large tract to the weſt; for, the *Scythæ Regii*, call'd Αριοι, or *Optumi*, poſſeſs'd the weſtern part of the *Peninſula*, who extended from this country to the *Gerrhus* and the *Sinus Cercinitis*, and beyond the canal made from the *Gerrhus* to the *Byces* northwards to the lake, from which the *Tanais* ariſes, and to the eaſt as far as the mouth of the *Tanais*, which country is now poſſeſs'd by the *Crim Tartars*, *Nogaians* and the *Coſſacks*. Above the *Scythæ Regii* are the *Melanchlæni*, a nation by no means *Scythian*, in the territory of *Moſcow*, and in the neighbouring tract to the eaſt. What extended farther to the north was by *Herodotus* fill'd with lakes, marſhes and deſarts. *Plutarch*[w] had been inform'd by thoſe who travell'd *Scythia* and *Thrace*, that there were frequent lakes and marſhes in thoſe parts, to which *Poſſidonius* imagin'd was owing the extremity of cold in theſe countries. Beyond the lakes and deſarts they related, that the air was *ſo full of feathers*, as to blind travellers; and this *Herodotus* explains of the great quantity of ſnow that falls there: Yet poſterity gave way to this idle ſtory of the *Scythians*, by giving the appellation of *Pterophoron* to this country, *from the continual fall of ſnow, reſembling feathers*, as *Pliny*[x] ſays. *Herodotus* calls the country on the *Mæotis*, thro' which the *Lycus* and *Oarus* run, the *Mæotis*. Beyond the *Tanais* in the inmoſt bay of the *Mæotis* dwelt the Αξιοι, or rather Λαζιοι *Sauromatæ*: Its inmoſt bay lies where the *Mæotis* runs very far into the coaſt of *Aſia*, where it receives the *Tanais*. Theſe *Lazii Sauromatæ* dwelt 15 days journey towards the north. The reaſon why I cannot compare theſe days to *ſtadia* is, that as all that country is mountainous, ſeveral *ſtadia* and thoſe of an uncertain number make up a degree; as when *Herodotus* ſays, that it is 30 days journey from the *Mæotis* to the *Phaſis*, and that is a diſtance of four degrees, thro' mountains and by-ways: Whereas in a plain 30 days according to *Herodotus* made 12 degrees

[w] T. 2. f. 959. [x] Lib. IV. c. 12.

degrees. I have, therefore, placed the *Lazii* in thoſe parts where they dwelt long after *Herodotus'* days. *Herodotus*[y] was here miſtaken, when he thought, that the Λαξιοι were ſo call'd from Λαξις, *a chuſing by lots*; for, alluding to this etymon, he ſays, that the *Budini* obtain'd *the ſecond lot* above the *Lazii* more to the north. *Herodotus* writes, that the *Amazons* came from the *Sarmatæ* near the *Danube*, and the coaſt of the *Pontus* and *Mæotis* to the north, and made a deſcent upon the *Cremni*, and in the manner of robbers, over-run that tract, which is between the *Cremni* and the mouth of the *Tanais*, that they ſettled to the north, and being afterwards blended with the *Scythians*, took a reſolution of paſſing the *Tanais*[z]. Here they ſettled between the *Lazii* and *Budini* to the ſouth of both; their language was *Sarmatian*; they with difficulty learn'd the *Scythian* language (ſo that *Herodotus* ſays that they ſpoke a corrupt language) from the *Budini*, whoſe embraces they courted. Above the *Budini* to the north is a deſart extending for ſeven days journey, to wit, from the river *Syrgis* and the ſources of the *Lycus* and *Oarus*: Higher than that deſart dwelt the *Thyſſagetæ*, the *Thyrſagetæ* according to *Valerius Flaccus*, a numerous people, and not of *Scythian* original; and with them the *Iyrcæ* dwelt in the ſame parts towards the ſouth-eaſt. The *Scythæ Rebelles* or *Exules* were more to the eaſt, who were baniſh'd by the *Scythæ Regii*: All their country is *champaign*. From the *Scythæ Exules* the country began to be rugged and ſtony, which at length roſe into high mountains. Now there are no mountains in theſe countries except the *Riphæi* beyond the *Volga*, now call'd the *Vergaturii*: And theſe ſhall be our direction in arranging the ſituation of theſe nations: And indeed, the entire weſtern bank of the *Volga* is call'd *Nagorna* or *mountainous*; but ſuch as have ſail'd on that river have obſerv'd no mountains, only that the bank was higher, ſince the eaſtern bank is marſhy and one large plain: There are, therefore, no other mountains but the *Riphæi*; and at the bottom of theſe mountains *Herodotus* places the *Argippæi*, call'd alſo *Sacri* and *Calvi*, from their *baldneſs*, which both the men and women have always had from their birth. Theſe *Calvi* (who, according to Herodotus, *had flat noſes and long beards*) were great maſters of equity and the laws: Their religion, and not their arms, of which laſt they had none, were their ſecurity againſt their neighbours. The *Scythians* and *Greek* merchants from the *Boryſthenes* and from all parts of *Pontus* maintain'd a commerce with them; and the *Scythians* gave out, that this correſpondence was kept up between them by means of ſeven interpreters and as many languages. Many leſſer nations, therefore, of different originals, which are now unknown, muſt have lain between them. No one has penetrated beyond the *Argippæi* to the north, on account of the high mountains, at the foot of which the *Argippæi* dwelt. The *Argippæi* related

[y] Lib. IV. c. 21. [z] Lib. IV. c. 110.

related, that the *Ægipodes* dwelt among thoſe mountains, and that beyond theſe dwelt ſuch as ſleep for ſix months, which points at the outmoſt parts of the north. To the eaſt of the *Argippæi* dwelt the *Arimaſpi*; yet ſo that the *Ægipodes* and *Gryphes*, the *guardians of gold*, were alſo to the north of theſe. The *Hyperborei* are placed above them all in uncertain tracts under the pole; and all theſe nations above the *Argippæi* and *Iſſedones* were not known either to the *Scythians* or *Greek* merchants. The *Argippæi* and *Iſſedones* were the only people who mention'd any thing of them. Now the *Maſſagetæ* poſſeſs'd to the eaſt and beyond the *Araxes* large tracts of land on the *Caſpian* ſea over-againſt the *Iſſedones*; but the *Iſſedones* had the *Argippæi* for their neighbours to the weſt, the *Arimaſpi* to the north, the *Maſſagetæ* to the ſouth and probably alſo to the eaſt, and they reach'd to the *Caſpian* ſea.

Thus, therefore, have we (taking *Herodotus* for our guide) deſcrib'd the ſituation of theſe nations, according as the nature of the tracts and probable indications ſeem'd to bear. I ſhall briefly ſhow, how widely *Olaus Rudbeckius* differs from us, and how he places at random thoſe people all over the north; 'the *Callipidæ*, *ſays he*, are on the *Boryſthenes*; 'the *Halizones*, where now ſtands *Halizum*; the *Scythæ Aratores* in 'Poland and *Livonia*; the *Neuri* on the eaſtern bank of the *Weiſſel*, 'as far as *Narva*: And in fine, the *Scythæ Agricolæ*, who were to the 'eaſt of the *Boryſthenes*, are in the territory of *Moſcow*. The *Scythæ* 'Regii are the *Crim Tartars*. The *Melanchlæni* are thoſe of *Moſcow* as 'far as the *Ladoga* and *Onega*. The *Budini* are on the *Baltic* ſea. The 'Thyſſagetæ are in *Carelia* and *Sauolaxia*: The *Iyrcæ* are in *Ruſſia* at 'Iyrgowitz: The *Scythæ Calvi* are the *Laplanders*: The *Sacri*, the 'Uplanders: The *Argippæi* are the *Swedes*, ſo call'd from a *Swediſh* term 'Arkippar, which ſignifies *to fight with darts*, with whom the *Scythæ* 'maintain'd a correſpondence by means of ſeven languages, as the *Poliſh*, 'Ruſſian, *Lithuanian*, *Eſthonian*, *Finnic* and *Lapponic*: And in fine, 'the *Iſſedones* are by him placed in *Eſthen*.' I ſhall not ſpend time in confuting theſe things, ſeeing any one may eaſily underſtand from what we have ſaid, that he has gone in too vague and looſe a manner from the *Boryſthenes* to *Scandinavia*, without regarding the ſituation of rivers, mountains or marſhes; and that he has ſcatter'd up and down at random the *Scythians* of *Herodotus*.

Nicolaus Witſen in the firſt edition of his *Northern* and *Eaſtern Tartary*[a] has in the firſt part treated of the ancient inhabitants of theſe countries, and quoted *Herodotus*, but he has no where explain'd him; but in the ſecond edition[b] he has entirely omitted that firſt part. To conclude, that no one may be ſurpris'd, that we have placed the *Eridanus* of *Herodotus* and the *Venedi* in theſe parts, we have given the reaſon in our differ-

[a] *f.* 107. Amſt. 1692. [b] Amſt. 1705.

dissertation *de Numo Rhodio*; and we shall treat of it in another place, when we shall have an opportunity of explaining several other things, which we have here omitted.

An Account of the great Fog in October 1717, *with Reflections thereon. From the* Breslaw Collection, October 1717. Class IV. Art. I. p. 206.

Translated from the HIGH-DUTCH.

AS in this and in the beginning of the ensuing month there fell an extraordinary great fog for 12 days together; so it seems to be worth the while to subjoin here the particular observations we made on this remarkable *phenomenon*; for, after the surface of the earth had been pretty well soaked by a great deal of rain, till *October* 20. and a continued southerly warmth ensued thereon; there was at length observ'd from *October* 22, and especially as the wind began to blow from the east, early every day till noon, and afterwards again in the evening, an extraordinary thick fog; as to which, we think proper to give a particular account of what we observ'd abroad in the open fields on *October* 24, and 25. This fog, it is true, was observable very early in the morning; but it was moderately thick and expanded itself rather somewhat upwards: Whence the sun might be seen about six and seven to shine thro' it without emitting any rays, and resembling a round disk; and like the moon, suffer'd itself to be view'd, without either dazling or causing any pain, in regard the rays were damp'd and weaken'd below by the fog: But as the fog had a manifest motion and different degrees of thickness, so at one time it uncover'd the sun's disk, and again entirely cover'd it. About 9 o'clock it fell very thick to the earth; and it was so dark, that not the least part of the sun's body could be seen, but even persons, trees, and houses, at a few paces distance, were no longer distinguishable. The moistness of this fog was so sensible, that in falling it resembled the finest mizling rain, tho' on account of its subtility it for a long time, and almost unobserved, fell to the earth. Every thing was so moisten'd thereby, that thick drops were observable on them, and especially on the hair. Along with this was felt a sensibly moist cold, and the air began to move a little. This sensible cold produced no strong wind, especially where the fog was higher and intercepted the rays of the sun by its thickness. However, it was not equally thick, even where it lay low; and in several places one could see a little way off, tho' in adjoining places on the same level, scarce 10 paces off: One could better see directly upwards thro' the fog, and view the azure sky, tho' indistinctly, than directly forwards and horizontally: So that it is manifest, that the height of this fog was not considerable, but

The history of this fog.

that it fell low to the earth. Nay, towards 8 o'clock, before the fog fell lower and in greater plenty on the ſurface of the earth, the ſun as he mounted up, was obſerv'd to drive it downwards before him towards the weſt and north-weſt, as if a thick vapour came down obliquely and ſlowly towards the latter point, in the ſame form as we uſually obſerve dark clouds that are equally expanded: And this motion of the fog was plainly diſcernible; and now the earth and the trees were ſo wet, that the latter dropp'd plentifully, in the ſame manner as in a ſhower of rain. But as all the fields and buſhes (but not the trees) were cover'd with fine and very cloſe wrought cob-webs; ſo this moiſtening fog ſtood very thick in ſmall round ſpherules upon their cloſe threads, yet always apart, without running into one another, tho' as ſoon as you touch'd them they came together, and cauſed a moiſtening. By this equal expanſion of the threads, the fields appear'd entirely white, as if they were cover'd all over with rime or ſnow, as *Menzelius*[a] had alſo obſerv'd; yet with this difference, that the trees and their boughs appear'd equally moiſt without this whiteneſs. This fog ſeem'd alſo in ſome meaſure to ſtink, like a ſtrong damp that falls plentifully on the breaſt and affects the freedom of reſpiration, and like what happens from the ſteam of wort and new beer in winter. About 10 o'clock and towards 11 the ſun appear'd more and more, and the air became clearer; yet round about, eſpecially towards the weſt, the fog was ſtill obſerv'd in the atmoſphere like vaporous pieces of clouds; but afterwards it entirely diſappear'd, and the air became perfectly clear and warm: Upon which at noon the fields and ſhrubs ſoon began to dry again. Now this fog increas'd from day to day; and as at firſt it only appear'd early in the morning till 6, 7 or 8 o'clock, but afterwards till towards 11, ſo a little after it again appear'd towards the weſt; ſo that at laſt on the 26th and the following days the air was no longer clear with us, but continued conſtantly overcaſt.

Reflections thereon.

This fog in its peculiar nature was nothing other than 1. a pure moiſture, which took its riſe from our earth alone, and in its ſubtile particles mounted up into the air, till at length it was perfectly fit to riſe to the height of our atmoſphere. 2. A real cloud on the earth, as it had the properties thereof in all its principal *phenomena*; in regard it had partly at a diſtance and horizontally, and partly afterwards obliquely, the appearance of a cloud; and plainly ſhow'd a progreſſive motion aggregately, had its different figures, was thicker in ſome places than in others; and at laſt form'd real clouds aloft in the air, and alſo produced the effects of a real cloud, in regard it moiſten'd and put the air into motion. 3. This fog, even where it lay low, actually mov'd the air, yet gently, and produced a ſenſible, cold, moiſt and gentle wind, which alſo became ſtronger, the higher the fog ſtood. 4. Theſe nebulous vapours are, on account of their ſubtility

[a] Miſcel. Nat. Cur. *Dec.* II. *An.* V. *p.* 276.

ſubtility perfectly fit to mount aloft into the air, and form an actual cloud, eſpecially when they cannot be diſpers'd with ſufficient force by the ſun; and when the air is warmer, and receives this fog in greater plenty; which probably will happen ſtill the more, if the air come to it from the moiſt weſterly quarter: Yet theſe ſeparate vapours, if they ſtand long below, and have no ſtrong progreſſive motion, may from their mild nature eaſily come together, become heavier, fall down to the earth, and cauſe a ſenſible moiſtneſs; yet ſo that a great part of them is alſo diſſipated and rarefied by the warmth of the ſun. 5. Now this falling moiſture form'd pure round globules of different ſizes, namely, as the particles being ſubtilely combin'd, fell ſlowly in form of drops upon pure, ſubtile and ſeparate threads of cob-webs, by which means they could not touch each other in all their parts, and ſo run together, but might be fitly collected into ſuch round globules, which was alſo ſo much the more promoted by the cool of the morning. 6. But that theſe foggy and cloudy vapours did not mount together into the air, appears to be owing to this, namely, as the heat of the ſun in the day-time draws up a deal of moiſture, which in time is eaſily diſſipated, and which in the following night by a continued *impetus* upwards and in an open country is always rais'd ſtill higher, ſo at laſt by the additional cool of the morning; and eſpecially on a cold eaſterly wind enſuing, this moiſture is forced downwards, and not rais'd aloft, diſſipated and diſpers'd: Whence 7. it alſo fell down, not in form of large but very ſubtile drops, as they had not a great way to fall, whereby they might become larger in their paſſage. 8. But that in one day there fell a greater or leſs fog than in another, as the wind blew conſtantly from one quarter, appears to be owing to its own progreſſive motion, and even to that of the wind, as poſſibly the fog was thicker in one place or diſtrict than in another, or as it divided itſelf, or fell down on hills and eminencies; and conſequently there was on one day a greater or leſs quantity, denſity and collection thereof, than on another.

A new Method of determining the Maxima *and* Minima. *By* D. T. *From the* Acta Eruditorum Lipſ. An. 1683. p. 122.

Tranſlated from the LATIN.

AS ſome of my friends, upon ſeeing my method of tangents*, publiſh'd in the *Acta Erudit.* for the month of *December* p. 391. *ſeq. Anno* 1682. have greatly deſir'd to know, by what method I might hence determine the *maxima* and *minima*, and whether this might not probably be done by the ſame method; ſo I have reſolv'd ro communicate ſome things here in order to ſatisfy their deſire.

We

*Vide ACTA GERMANICA, &c. Vol. I. p. 182. ſeq. An. 1742.

The determination of the *maxima* and *minima* what? and how found. Fig. 7. Plate IV.

We are, therefore, to obſerve in the firſt place, that the determination of the *maxima* and *minima* is nothing other than the determination of a ſpecial caſe about the tangents of curves; and to underſtand this the more eaſily, I ſhall illuſtrate it by an example. Let any indeterminate quantity BC be $=x$, which is to determine ſome *maximum*; let a denote ſome given line BH, and let the *maximum* to be determin'd be $aax^3 - 2ax^4 + x^5$. Let this *maximum* be repreſented by the line FG, which put $=y$; $aax^3 - 2ax^4 + x^5$, will therefore be $=y^5$, which equation expreſſes the nature of any curve by means of two indeterminate quantities: But now to find this *maximum*, nothing other is required than that the greateſt ordinate of this curve BDFH be determin'd; but as this ordinate is the line FG, where the line EF, parallel to the axis BH, is the tangent of this curve, there is nothing other neceſſary than to find the tangent of this curve BDFH in any point generally, and then all the ſpecial caſes will be likewiſe determined, and conſequently this caſe too, where the line EF, or the tangent, is parallel to the axis; in the preſent caſe therefore, let AB be $=t$; According to the rule I have given for tangents it will be $t = \frac{2aax^3 - 2ax^4}{3aax^2 - 8ax^3 + 5x^4}$.

We are to obſerve in the ſecond place, as it is very evident, that if the tangent EF be parallel to the axis, the denominator of this fraction is $= 0$: Whence we ſhall have $3aa - 8ax + 5xx = 0$, an equation, by means of which the quantity x, and conſequently the *maximum*, is determined.

We are to remark in the third place, that in order to determine the ſame quantity BG, if any *maximum* be given, yet ſtill another equation may always be found by ſeeking the tangent on the other ſide of this curve: But as thus two equations may be had including the ſame unknown quantity, it will be no difficulty for the ſkillful in theſe matters to determine what is ſought: Thus putting LH $= z$, the *maximum* will be $a^3zz - 3aaz^3 + 3az^4 - z^5 = y^5$. And hence according to my rule of tangents HM will be $= \frac{3a^3zz - 6aaz^3 + 3az^4}{2a^3z - 9aaz^2 + 12az^3 - 5z^4}$: Whence now, according to the ſecond remark, the denominator of this fraction $2a^3 - 9azz + 12az^3 - 5z^4 = 0$; in which equation, if inſtead of z you ſubſtitute $a - x$, which is equal thereto, you will have $-3axx + 5x^3$, or $x = \frac{3a}{5}$, the ſecond equation, by means of which the length BG is found.

And thus I have diſclos'd a principle, from which is deriv'd as expeditious a method of determining the *maxima* and *minima*, as I have hitherto ſeen; and it is as follows.

Let BH any given quantity be $= a$, in reſpect of which any *maximum* or *minimum* is ſought; put BG $= x$, and GH $= z$: Now 1. it will be $z = a - x$. 2. Let the *maximum* be form'd by means of the quantity z, ſo that x do not enter into this expreſſion; and let, for, inſtance, that *maximum*

mum be $a^3z^5 - 3aaz^6 + 3az^7 - z^8$, in which quantity let 2 be prefix'd to the term where z has 2 dimensions, 3, where 3, but 4, where 4, *&c.* and thus let the exponent of the power of z be always prefix'd to the same term; but let the whole aggregate thus produced be $= 0$: It will therefore be in the preſent example $5a^3z^5 - 18aaz^6 + 21az^7 - 8z^8 = 0$, or $3a^3 - 18aaz + 21azz - 8z^3 = 0$. 3. In this laſt equation let $z = a - x$ be reſtor'd; and a very ſimple equation will be found for the quantity x, which determines the requir'd *maximum* or *minimum*, as in the preſent inſtance, if in the equation, *viz.* $3a^3 - 18aaz + 21azz - 8z^3 = 0$, $z = a - x$ be reſtor'd, x will be found $= \frac{3a}{8}$, by means of which the *maximum* requir'd is determin'd.

The Diſſection of a Mole. *By* Guntherus Chriſtophorus Schelhammerus. *From the* Miſcellanea Naturæ Curioſorum, An. I. Dec. II. Obſ. CXXX. p. 323.

Tranſlated from the LATIN.

1. THE ſkin of this animal is very hard and entirely ſinewy, ſo as to require the ſharpeſt knife to cut it thro'; which, beſides the ſinewy ſubſtance of the ſkin, ſeems to be owing to this, namely, that as this animal is of a colder conſtitution, and perpetually lives under ground in cold places, its body perſpires but little; conſequently, the pores of its ſkin are, probably, by far ſmaller than thoſe of larger animals; and nature muſt have provided, leſt the cold ſhould ſtrike too readily thro' theſe pores and affect the *viſcera*; on which account alſo we obſerve its hair to be very fine, and therefore ſofter than any ſilk, in order to ward off the cold: And that it is ſo fine is doubtleſs owing to the ſmall pores thro' which the hairs muſt paſs; for, I obſerve in ſuch animals as have ſtronger hairs like briſtles about their mouth, as in a cat and a hare, that the pores in theſe parts are far larger, and plainly diſtinguiſhable, but ſmaller in other parts: Beſides, in a hare (to mention this by the bye) at the origin of theſe hairs I always find a follicle full of a white liquor; this follicle is pretty large, ſuch as is ſometimes obſerv'd even in human hair; and in venereal patients theſe hairs ſeem'd to me to be more turgid: But whether this be always the caſe I cannot aver. Beſides, which is equally uncommon, there is this to be obſerv'd about the ſkin of a mole, *viz.* Deſcription of the ſkin of a mole.

2. The *panniculus carnoſus* ſo firmly adheres to it, that it ſeems to grow thereto; for, it cannot be ſeparated from it but by ſcraping: And beſides its corrugating the ſkin, it is greatly adapted to keep out the cold; for, this fleſhy ſubſtance, as is uſual in the ſmaller animals, is even far more denſe and compact than in the larger animals, as its fibres are ſmaller and more tendinous. Of the *panniculus carnoſus*.

3. Next

Of a peculiar membrane covering the *abdomen*, &c.

3. Next to this pannicle offer'd to view a very thin and pellucid membrane, covering the whole *abdomen* together with the *thorax*, and which could be entirely ſeparated therefrom without tearing; and

Of the muſcles.

4. Under this lay the muſcles, ſo that probably it may be call'd the common membrane of the muſcles; but for what end it is ſuperadded is not ſo eaſy to determine; for, the parts above-mention'd might ſuffice to ward off the cold: It ſeems to have been the intention of nature, that the ſkin ſhould be entirely ſeparate from the muſcles, that it might be the more moveable; and among other reaſons for this, namely, that its feet, which lie almoſt conceal'd under the ſkin, might move the quicker; for, in other quadrupeds the ſkin is ſeen to adhere looſer about their feet, eſpecially, about the upper back parts: But in this ſhorter animal almoſt the whole ſpace between the ſkin is requiſite for their motion, as ſhall appear anon.

5. The muſcles of the lower belly were in all two, conſiſting of longitudinal fibres, like thoſe of the *recti* in men, but broader, and at length degenerating into a membranous ſubſtance, at the place, where they very firmly adher'd to the *peritonæum*. Here I would willingly learn from others, who hold that larger animals are furniſh'd with oblique muſcles, either for reſpiration, or the diſcharge of the excrements, (which no one will deny to be neceſſary in this animal) why theſe are wanting in this ſubject? However theſe longitudinal muſcles ſeem at the ſame time to do the office of the tranſverſe muſcles, which are really and ſolely deſign'd for the diſcharge of the *fæces*: But here the caſe is quite different from what it is in man, who being furniſh'd with a ſhorter belly, and ſquatting down to do this work of nature, requir'd its contraction in breadth, or rather depth; but this animal, while it diſcharges the excrements, contracts its longer belly towards the breaſt, whereby it may become ſhorter, and the diaphragm be impell'd higher, which is common to it with dogs, and many other quadrupeds; but that the *muſculi recti* are given it for this end appears from their fibres, as is plain to any one, who is not a ſtranger in theſe matters: But to come to the *viſcera* themſelves, I obſerv'd in the lower belly

Of the guts.

6. That the guts, cover'd by the *omentum* (which laſt is wanting in ſeveral animals) are not divided into thinner and thicker ones; but are of one thickneſs throughout, only that the extremity of the *rectum* is wider; but all of them are furniſh'd from their beginning to their end with *cellulæ* for retarding the chyle, as is the caſe even in a human ſubject, where the thinner guts are not without ſuch letts, a thing the generality of anatomiſts are ignorant of. I am ſorry I did not find in my obſervations what ſort of excrements was contain'd in them; for, I ſuſpect that all animals deſtitute of the thick guts diſcharge liquid excrements.

7. The

7. The ventricle poſſeſs'd the left ſide, and under it lay the ſpleen: But the liver did not fill the right ſide only, but all the upper part of the belly: And I find this always to hold, that it may give way to the ventricle, nor can it otherwiſe happen, but that it muſt be forced to the left ſide by a larger liver; and this alſo happens ſometimes in a man, but not always: But when the ventricle is full, it muſt neceſſarily be extended towards the left, if the liver does not give way; a thing to be remark'd by phyſicians. All birds have a larger liver, probably to compenſate the want of a ſpleen, leſt the blood ſhould not be ſufficiently comminuted; a thing I alſo think worthy of remark. The figure of the ventricle was almoſt the ſame as in a ſquirrel and other animals. In the right orifice of the ventricle, or in the *pylorus*, I obſerv'd a conſtricture, as if it was tied round with a thread: The inſertion of the *œſophagus*, which was in the middle of the ventricle, ſeems to have been done for this reaſon, becauſe it was not proper, that either the *œſophagus* ſhould recede from the *vertebræ* of the back, or that the ventricle ſhould be placed in the middle; and therefore, one part of it was to recede to the left; and conſequently, this inſertion was the moſt commodious. The ſtomach was internally all over rugous, and it contain'd a ſubſtance, which appear'd to be earth-worms; for, on theſe and other worms under ground does this animal live; and for this end, that both when he digs the earth and when he raiſes and throws it up with his ſnout, he may thus hunt the worms the more carefully, and catch them when forc'd out of their lurking holes; which he does more eſpecially morning and evening, as he is then urged by hunger, but always after rain; becauſe then he diſcovers them more eaſily by the ſcent, and the earth is looſer, ſo that it may be eaſily turn'd up. Of the ventricle ſpleen, and liver

8. The gall contain'd in the gall-bladder had a manifeſt ſweetneſs with ſome degree of bitterneſs; a thing, indeed, which I have found in all animals, and every one who taſted of it own'd it was ſo, but which has not been commonly adverted to. Of the gall.

9. Under the inteſtines I obſerv'd in the meſentery a glandulous body of a remarkable bulk; ſo as to reſemble one of the thick guts, which I take to conſiſt of lacteal glandules collected here together; for, it was of the conglomerate kind. Of a remarkable glandulous body in the meſentery.

10. To both the kidneys there were alſo adjoining a very white gland, which I could not then examine more accurately: But it deſerves remark, that the kidneys themſelves have the appearance of a threefold ſubſtance; for, externally there appear'd a ruddy border, reſembling the ſpleen in colour: The ſecond ſubſtance run from this part into the *pelvis* with continu'd *ſtriæ*: The third ſubſtance was the *pelvis* itſelf, furniſh'd with four caruncles; a thing which deſerves to be more carefully examin'd. However, the reaſon of this diverſity eaſily appears; for, the firſt ruddy ſubſtance is that into which the blood pours, and is ſeparated from the *ſerum*; Of the kidneys.

but

but the whitiſh *ſtriæ* are the *tubuli*, thro' which it flows into the *pelvis*; for, theſe *ſtriæ*, a thing firſt diſcover'd by *Malphigi*, may be plainly ſeen in this ſubject, tho' not in larger ſubjects.

Of the genital parts.

11. But the moſt ſurpriſing things were obſervable about the genital parts; for, 1. The *penis*, as is uſual in animals, lay almoſt entirely hid; and it was very long, ſo as to be almoſt half as long as the animal itſelf. 2. The *teſtes* did not hang down, but lay under the ſkin, and were bigger than the kidneys. 3. The *paraſtatæ* did not only adhere to the *teſtes*, but as they could not contain them, great part of them was moreover included in a peculiar *ſaccus*, conſiſting of fleſhy fibres; and from this *ſaccus* at length came out the *vas ſeminale*. 4. Bodies, externally manifeſtly fleſhy and conſequently very ruddy, and internally nervous, were furniſh'd with a very hard nervous channel, which was inſerted apart into the *penis* long before the *veſiculæ ſeminales*: Beſides, 5. About the bladder, which is very thick, rugous and nervous, was obſerv'd another globoſe body, externally fleſhy, internally nervous, and ſituated in the *penis* itſelf, into which as there was both a paſſage from the bladder, and as the *vaſa deferentia* terminated therein, it hence appear'd, that they were the *proſtatæ*. But at length, after this inſertion, thoſe nervous canals ran apart from the ſaid round bodies into the *penis*. And this was the ſtate of the genital parts in this animal, wherein ſuch a ſurpriſing *apparatus* juſtly claims our admiration; ſeeing as to other animals, beſides very ſmall *teſtes*, whoſe *paraſtatæ* are *appendices*, and beſides the *proſtatæ* and *veſiculæ ſeminales*, nature has furniſh'd them with nothing elſe: Whereas ſhe has ſupplied this animal with very large *teſtes* and *paraſtatæ*, &c. and beſides, a new ſeminal body, different and ſeparate from theſe, and furniſh'd with new ducts; as alſo a *penis*, the longeſt, if I miſtake not, in any animal. From which we may gather, that this deſpicable and mean animal has, beyond all others, an extraordinary pleaſure *in coitu:* But it principally deſerves regard, that all theſe parts are defended with fleſhy integuments, from which it is manifeſt, that they are contracted, and thus propel the ſeminal matter; and that it may not be ſtopp'd, it is to paſs thro' nervous parts, and ſuch as are not at all apt to yield; for otherwiſe, by their ſides eaſily ceding, that paſſage would be weaken'd; ſo that the ſeed could not reach the deſtin'd parts: And here we may wonder, that no anatomiſts have obſerv'd, that in man the *ſemen* is protruded into the *urethra* entirely by pulſion, from whatever cauſe that pulſion ariſe, and that with ſo great a force as to be thrown a pretty way, which could not happen without a very great and ſingular effort. Whence I ſuſpect, that our knowledge of the genital parts is not hitherto compleat; but that there ſtill remains ſomething which propels the *ſemen* with ſome degree of *impetus*. What it is in this animal is plain; and ſince in our body all motion is perform'd by muſcles alone, I imagine the ſame thing here, yet I cannot at all think that it is done by the *erectores penis*.

12. In

12. In the *thorax* is found neither *pericardium* nor *mediaſtinum*, but the heart is forced to the left ſide, the lungs being placed on the right, and, which is ſurpriſing, below the heart: Whether this was preternatural in this mole I cannot ſay, however the cauſe thereof is not evident. Of the heart and lungs, &c.

13. The *vena cava* proceeding from the heart, not at the back, but thro' the middle cavity of the *thorax*, hung freely every way and paſſed to the liver. I obſerv'd a peculiar mechaniſm in the make of the feet; for, as has been already ſaid, only the extremity of the feet appears out of the ſkin, which are broad and furniſh'd with ſhort toes, but ſtrong and fitted for motion, and arm'd with claws to dig the earth; yet I found all the other parts conceal'd internally under the ſkin. Next the foot, properly ſo call'd, is a twofold bone which is evidently to be call'd the *radius* and *cubitus*; but inſtead of a *humerus*, there is a broad triangular bone, leſt by its roundneſs it ſhould compreſs the ſubjacent parts, and inſtead of a *ſcapula*, becauſe it wanted room to extend itſelf breadthwiſe, there is a pretty long bone, which is by a very ſtrong ligament connected on the back with the *ſcapula* of the other ſide; and theſe were furniſh'd with a great number of muſcles. The glands appear'd both very large and numerous, ſo that in proportion to its bulk no animal methinks has ſo many and ſo large glands; and probably, theſe are placed here to facilitate by their continual diſcharge the motion within the ſkin; for, here they are collected together, which in other ſubjects run out very far without the ſkin. Of the *vena cava*, feet, &c.

14. In examining into the auditory organ I found very ſmall bones and cavities, together with a *tympanum*, but without an external ear, ſeeing it is not neceſſary here to collect the auditory rays from afar; yet it hears nearer ſounds diſtinctly enough. The *meatus auditorius* is cartilaginous, flexile, and pretty long. Of the organ of hearing.

15. Eyes I found none, only rudiments of eyes, to wit, a ſmall, but harder, black point, and, if I miſtake not, ſolid, which has no communication with the brain, but is entirely external, and, as I ſaid, lies conceal'd under a very thick ſkin. With theſe it does not ſee, nor could it under ground: But whether it perceives the rays of light in any meaſure, cannot be known, nor is it of any importance. Of the eyes.

The Elephantiaſis and Phthiriaſis cur'd by Mercury. *By* Joh. Lindeſtolpe. *From the* Acta Literaria Sueciæ. Trimeſtre IV. An. 1723. p. 476.

Tranſlated from the LATIN.

ONE *Peter Hook*, a ſailor of *Enecoping*, labouring under an *elephantiaſis*, was ſcaly and rough all over his body, his eyes hollow, with red pimples on the end of his noſe, his mouth and tongue black, his lips blub- Mercury us'd in the *Elephantiaſis*.

blubber'd and turn'd inſide out, his body emaciated, and his legs very ſlender, and when he ſpoke he peep'd like a chicken, he ſtunk intolerably, and had a very diſagreeable aſpect. I ſaw that gentle remedies could have no effect: I, therefore, proceeded in the following manner; after having firſt adminiſter'd a gentle purge, by which the patient diſcharg'd ſome long white worms, I anointed his joints with a gentle mercurial unguent; whence on the ſecond day his mouth ſmarted, his face ſeem'd to be heav'd and his gums ſwoln, and he gradually began to ſalivate: And thus as his ſalivation daily increas'd more and more for 12 days together, the cruſts began to fall off, and the ſkin to ſcale: But as he happen'd to ſcratch himſelf very much, there were thereby produc'd *phagedænæ* and wounds of a very bad nature, which yet were dried up by an inunction of a mercurial coſmetic: And thus he was cur'd. But I was told he died the following year, either from the leprous venom not being well cur'd, or from the mercury falling upon his lungs.

The cauſe of this diſtemper.

Strangers will be ſurpriz'd to find, that ſuch diſorders ſhould happen in ſo northerly a climate as ours, as they are only peculiar to more ſoutherly places; yet the hoſpitals of *Helſingfort* in *Nyland*, at *Carlſhafen* in *Oſtrobothnia*, and a great many villages of the pariſh of *Wendoo* are almoſt yearly full of ſuch patients: And this diſtemper is only owing to their eating of young ſea-calves, which are reckon'd great dainties in thoſe parts: There was formerly a great difference between the leproſy of the *Arabs* and that of the *Greeks*; as in the former the humours were very acrid and putrid by the exceſſive heat of the ſun; but in the latter, as from their ſomewhat more northerly ſituation, the humours were milder: Beſides, ſome part of *Arabia* is waſh'd by the ſea, but *Greece* as to the greateſt part thereof: I would not therefore readily advance, that in both nations the ſame diſtemper proceeded from the ſame cauſe. I could readily think, that the *Greeks* contracted this diſtemper from their eating of fiſh and ſea-calves: But it ſeems probable, that the *Arabs* became leprous as *Jews* from their eating of bacon.

Mercury us'd in the *phthiriaſis*.

One *Nicolaus Lund*, a mariner, labouring under a true *phthiriaſis*, was ſent into the hoſpital: As I view'd him for the firſt time, I found him emaciated and very weak, and almoſt all his body full of ulcers, which ſwarm'd with lice, that form'd in each ulcer a hemiſpherical cluſter, which could not eaſily be ſeparated: It was about the cloſe of *Auguſt*, and the cold ſeaſon was approaching. After anointing the patient for three evenings with a mercurial unguent he began to ſalivate; and ſuch of the lice as ſurvived began to fly into a corner of the room, where creeping one upon another they form'd a ball as big as a child's head; and the patient was cur'd.

Inſtances from antiquity.

The ancients, as in many other things, ſo alſo in this, have left us upon record no contemptible inſtances. The *Greeks* tell us of the poets, *Alcmanus* and

and *Pherecydes* having died of this diſtemper. *Pliny* relates, that *Lucius Sulla*, a *Roman* ſenator, died of a like diſeaſe. In the IId book of *Maccabees* we read, that King *Antiochus* died alſo of it. And *Joſephus*[a] teſtifies, that *Herod*, the father of *Archelaus*, died in a miſerable manner by vermin, which continually multiply'd in the putrify'd member: Beſides, *Pomponius Lætus* relates, that the Emperor *Maximinus* died of vermin coming out of his groin.

[a] *De* bello Jud. *lib.* 1. *c.* 21.

A general method of determining the points of ſtation of the Planets in their Orbits. *By* J. Hermann. *From the* Miſcellanea Berolinenſia. Tom. I. p. 197. and Tom. II. p. 59.

Tranſlated from the LATIN.

Apollonius Pergæus formerly applied himſelf to this aſtronomical problem, *viz.* to find the places of the planets in their orbits, when one appears to be ſtationary with reſpect to another, and he hinted what geometricians ſhould effect to be aſſiſting in this caſe to aſtronomers: But in the judgment of *Kepler* he neither perform'd himſelf what he wanted of others, or if he had perform'd it and ſolv'd the problem, he would not in that matter have ſatisfied aſtronomers; for, of the many cauſes of the variety in the limits of theſe ſtations, he has added but a few things, and left more untouch'd. This problem attempted by *Apollonius.*

Kepler, reſuming this problem, was ſatisfy'd with an aſtronomical approximation, without being ſolicitous about a rigorous geometrical ſolution; for, after various trials he deduced the angle comprehended between the *radius vector* (drawn thro' the ſun and ſuperior planet) and the line of viſion, that is, he found the planet's elongation from the ſun; and that by a method which is of great affinity with the rule of *poſition*, or the rule of *falſe*. By *Kepler.*

In this whole diſquiſition he ſuppos'd the orbit of the planet and the plane of the ecliptic to be in the ſame plane; and that both the orbits were concentrical circles; by which ſuppoſition the *calculus*, being ſurpriſingly facilitated, does not, it is true, exactly exhibit what is ſought, yet pretty near the truth, which may ſatisfy aſtronomers.

Before him *Nicolaus Copernicus*[a], handling this problem with his uſual ſagacity, accommodated *Apollonius'* notion, which was founded upon *Ptolemy*'s ſyſtem, to his own hypotheſis (which it ſeem'd to contradict) of the motion of the earth and the immobility of the ſun in the centre of the annual orbit. By *Copernicus.*

[a] *Lib.* 5. *c.* 35. *de revolution.* Orbium cœleſtium.

At

By Dr. *Gregory*. At length *David Gregory*, in his *geometrical elements* of aſtronomy[b], has devis'd another method of determining the points of ſtation, which he contends to be very much adapted to a calculation; yet he has only hinted at the principle of the arithmetical *calculus* without compleating it, and with other aſtronomers has ſuppos'd the orbits of the planets to be concentric and in the ſame plane; which hypotheſis renders the problem very ſimple and very eaſily ſolvable.

By Dr. *Halley*. But I know of none, who has exhibited a general ſolution of the problem, founded on *Kepler*'s elliptical hypotheſis, and extended to orbits, inclin'd to each other under given angles; yet we are to except Dr. *Halley*, who in a letter of M. *De Moivre*'s, writ to me ſome time ago, is ſaid to have given a general ſolution of this problem; yet *De Moivre* ſaid he had not ſeen that ſolution. I propoſe to attempt the ſame problem, and, as I hope, not entirely without ſucceſs.

A ſolution of the problem in its ſimpleſt caſe. 1. A *ſtation* is thus defin'd by aſtronomers, namely, that it is ſuch a ſituation of two planets with reſpect to each other, that the line of viſion, drawn thro' the centres of the planets, may fall on the ſame point of the zodiac, with reſpect to longitude, as it did the day before: But theſe lines of viſion cannot fall on the ſame point, but they muſt be either parallel, or at leaſt be found in parallel planes; ſhould it happen otherwiſe that one of them ſhould tend to one point and another to another point of the zodiac, this would be contrary to the above definition. The problem may be thus generally conceiv'd,

Fig. 8. Pl. IV. 2. Two planetary orbits, either circular or elliptical, CYWH, DZXA, being given in poſition, whoſe ſemi-axis let be CG, DK, to find in their circumferences two points H and B of ſuch a nature, that the planet B paſſing in any ſmall time from *b* to B; but the planet H in the ſame ſmall time from H to *b*, the line of viſion *b*H may acquire by this motion a ſituation parallel to the former B*b*. In *Kepler*'s hypotheſis the orbits YWQ, ZXA will be elliptical, whoſe common focus is M, and let MX be that line wherein the planets W and X are when they began their motion together towards G and A; join the points *b*M, *b*M.

3. I ſhall preſently ſhew, that the triangles BM*b*, HM*b*, are to one another in a given ratio; for, it appears, that the triangle BM*b* is to the triangle HM*b* in a ratio compounded of the ratio of the triangle BM*b* to the whole area XBZX, and of the ratio of the area XBZX to the area WHYW, and of the ratio of the area WHYW to the triangle HM*b*; but the area XBZX is to the triangle BM*b* as the periodical time XBZX to the periodical time B*b*, and the triangle HM*b* is to the area WHYW, as the periodical time H*b* to the periodical time WHYW; and becauſe the periodical time B*b* is equal the periodical time H*b*, it will be the triangle BM*b* to the triangle HM*b*, in a ratio compounded

[b] *Lib.* 3. *prop.* 38.

pounded of the ratio of the area XBZX to the area WHYW, and of the ratio of the periodical time WHYW, to the periodical time XBZX, which is as the area XBZX, multiplied into the periodical time WHYW, to the area WHYW, multiplied into the periodical time XBZX; therefore, the triangle BM*b* is to the triangle HM*b* as the area XBZX divided by the periodical time XBZX is to the area WHYW divided by the periodical time WHYW, which is a given ratio, and let it be call'd *n* to *c*. *Q. E. D.*

4. Before we proceed any farther we propoſe to give the ſolution of the moſt ſimple caſe of the problem, which is when the orbits XBZ, WHY, are circular, concentric and in the ſame plane; then the points MCD will coincide, that ſo a figure may ariſe, where the two circles ABZ, GHY, have a common centre C; let the ſemi-diameters CG, CA, be call'd *a* and *b*; and let the planets be in the points G, A, of the right line CA, as they are ſuppos'd to begin their motion together and move towards B and H: Moreover, let us ſuppoſe the velocity of the planet A to be to that of the planet G, as *n* to 1; let fall on the line HB produced towards H the perpendicular CM: Which being ſuppos'd, let MH = *p*, MB = *q*. Now on account of the ſimilar triangles H*φb*, HMC (*φb* being perpendicular to HB, as well as *bβ* is) it will be HC to HM as H*b* to *bφ*; and becauſe the triangles B*bβ*, BCM are ſimilar, it will alſo be BM to BC as *bβ* to B*b*; and multiplying the terms of each analogy it will be HC × BM to CB × HM, as H*b* × *bβ* to B*b* × *bφ*; but by the hypotheſis *bβ* = *bφ*, it will be HC × BM to CB × HM, as H*b* to B*b*, as 1 to *n*, as *aq* to *bp*; therefore *naq* = *bp*. From the point B draw the tangent BL and let it be call'd *c*, and it will be $qq - pp = cc = bb - aa$; therefore, in the equation $nnaaqq = bbpp$, inſtead of *pp* let its value $qq - cc$ be ſubſtituted, and it will be $nnaaqq = bbqq - bbcc$: Whence $q = \frac{bc}{\sqrt{bb - nnaa}}$; and $p = \frac{nac}{\sqrt{bb - nnaa}}$: Hence the ſquare of CM = $\frac{aabb - nnaa + nnaacc}{bb - nnaa}$ (in which if $bb - aa$ be ſubſtituted inſtead of cc) = $\frac{1 - nn \times aabb}{bb - nnaa}$ (or putting mm inſtead of $1 - nn$) = $\frac{mmaabb}{bb - nnaa}$; therefore, CM = $\frac{mab}{\sqrt{bb - nnaa}}$: Now if the ſine total be call'd *r*, it will be CH to CM, as *r* to the ſine of the angle CHM; therefore, $\frac{mbr}{\sqrt{bb - nnaa}}$ = the ſine of the angle CHB, or of the elongation of the planet B ſeen from H, and $\frac{mar}{\sqrt{bb - nnaa}}$ = the ſine of the angle CBH, or of the elongation of the planet H ſeen from B: But $\frac{mbcr - mnarc}{bb - nnaa}$ = the ſine of the angle of commutation HCB; and becauſe the arch BA is to the arch HOG as *n* to 1, it will be *n* × HO + *n* × OG = BA: But BA and OG are ſimilar arches: Whence

Fig. 9. Pl. IV.

BA

B A is to G O as b is to a, as C A is to CG; therefore $\frac{b \times GO}{a} = BA$: Whence $n \times HO + n \times GO = \frac{b \times GO}{a}$ or $GO = \frac{na \times HO}{b - na}$.

Conſtruction. Hence the problem will be thus conſtructed; let the angle ACB be form'd; which let be to the angle of commutation HCO, already known from its ſine, as na to $b - na$, and let the angle HCO be made equal to the known angle of commutation, and the lines CB, CH, will cut their circles in B and H, which indicate the places from which one planet will appear ſtationary to another, and the line HB joining theſe points, will be the line of viſion ſought Q. *E. I.*

Bernoulli's method. I ſhall farther add a ſtill more ſimple method of ſolution, which *Bernouilli* communicated to me.

Plate IV. Fig 9. 6, In the ſame figure let the tangents BT, HT meeting together in T be drawn thro' B and H: Now becauſe bb is parallel (by the hypotheſis) to HB, it will be TB to TH as Bb to Hb, as n to 1: Whence is immediately deduced $BT = \frac{nc}{\sqrt{1-m}}$, and $HT = \frac{c}{\sqrt{1-m}}$. Retaining the ſame ſymbols, as before, the reſt will be eaſily deduced from what we have explained above.

A general method of finding the points of ſtation in an ellipſis. The general method of finding the points of ſtation of the planets in the elliptical hypotheſis, and where the orbits are variouſly inclin'd to each other, is as follows.

Fig. 10. 7. Let the ellipſis AKB be the orbit of any planet, and EIG the projection of the orbit of another planet in the plane of the former, which will likewiſe be an ellipſis or a circle; I and K are the places reduced to the ſame plane, when one planet appears in conjunction or oppoſition to the other with the ſun in the common focus C; if the area KCB being always to the area ICG in the given ratio of n to 1, the points G, B, be join'd by the right lines GB, both the planets proceeding together from the points I, K, or from ſuch as correſpond to theſe in their orbits, will be always found in the right lines GB; and if beſides, deſcribing at the ſame time the infinitely ſmall arches Gg and Bb, they arrive to the ſituation of the line gb, which produced will meet the other GB ſome where in O, by an infinite number of ſuch interſections there will be form'd ſome curve line, which by its various flexures will ſhew when one planet ſeen from the other ſhall appear direct, retrograde, and in fine, ſtationary; this laſt caſe obtains as often as GB coincides with any aſymptote of the curve; or which comes to the ſame thing, as often as the point of courſe O is at an infinite diſtance from the points G and B: But that the magnitude of the line GO may be had univerſally; let GB and BR the tangents of the ellipſes meeting in the point R, be drawn thro' G and B, on

B, on which let fall from the focus C of the ellipſes the perpendiculars CP and CQ; and in fine, let the ſmall line $G\gamma$ be drawn parallel to the tangent BR. Which being ſuppos'd, becauſe the triangles $G\gamma O$ and BOb are ſimilar, it will be $G\gamma$ to Bb as GO to BO (or aſſuming the common line GR) as GO×GR to BO×GR; and the ſimilar triangles $gG\gamma$ and GRB give Gg to $G\gamma$ as GR to BR (or aſſuming the common line BO) as BO×GR to BO×BR; therefore, *ex æquo*, Gg is to Bb as GO×GR is to BO·BR: But the triangle BCb is to the triangle GCg, as n to 1, as $Bb \times CQ$ to $Gg \times CP$; and therefore, Gg is to Bb as CQ to $n \times CP$: We ſhall, therefore, at laſt have GO×GR to BO×BR, as CQ to $n \times CP$; and multiplying the extremes and means, $n \times GO \times GR \times CP = BO \times BR \times CQ$; and at length we ſhall obtain this analogy, GO is to BO as $BR \times CQ$ is to $n \times GR \times CP$; and by converſion GB is to GO as $BR \times CQ - n \times GR \times CP$ is to $BR \times CQ$; and therefore, GO will be equal $\frac{GB \times BR \times CQ}{BR \times CQ - n \times GR \times CP}$. Now becauſe this fraction cannot be infinite, unleſs its denominator be infinitely ſmall or nothing; therefore, that one planet may appear ſtationary from another, the denominator $BR \times CQ - n \times GR \times CP$ muſt be nothing; or which comes to the ſame thing, $BR \times CQ$ muſt be equal $n \times GR \times CP$, which indicates, in the caſe of the ſtation of the planets, that the triangle BCR or half the rectangle $BR \times CQ$ is to the triangle GCR, half the rectangle $GR \times CP$, in the given ratio of n to 1, or in the ratio of the trilinear BCK to the trilinear GCI.

Before we conclude, we ſhall communicate to the curious a very eaſy ſolution of the problem about the ſtation of the planets revolving in circular and concentric orbits, which requires no calculation; and yet by means of which the problem is ſolv'd by plain trigonometry.

An eaſy ſolution of the problem in circular orbits by plain trigonometry.

8. Let, therefore, the circles BZ and OY be concentrical about the centre C, and in the points B and H of the circumferences let the planets be found, when the one appears ſtationary to the other; draw CB and CH, and letting fall the perpendicular CM to BN, let HP be drawn thro' the point H parallel thereto, meeting the radius CB in P, from which point, as alſo from the point O let PR and OQ be drawn parallel to the right line BN; which being done, ſince the right line bh connecting the extremities b and h of the infinitely ſmall arches Bb, Hh, deſcrib'd by the planets in the ſame time, is parallel to the other BH, the ſmall right lines $b\beta$ and $h\varphi$, drawn thro' b and h, will be parallel to MC and equal: And beſides becauſe the triangles $Bb\beta$, CBM and COQ are ſimilar, it will be Bb to $b\beta$, as CQ to OQ; and the ſimilar triangles $Hh\varphi$ and HCM give $h\varphi$ or $b\beta$ to Hh, as HM or PR to HC, or OC; therefore, *ex æquo perturbatè* Bb is to Hh as PR to OQ: Now the ſmall arches Bb, Hh deſcrib'd in the ſame time, are as the velocities with

Conſtruction. Pl. IV. Fig. 11.

with which they are run over; therefore, $\frac{PR}{QQ}$, or $\frac{PC}{OC}$ is equal to the velocity of the planet B divided by the velocity of the planet H; therefore, putting this ratio of the velocities as 1 to n, it is only neceſſary to divide the radius OC in P, that the part PC be to the whole OC as 1 to n, and biſſecting the remainder BP in S, from this centre and with the diſtance SP or SB, be deſcribed the circle BHP, which will cut the inferior orbit OY in the deſired point H. *Q. E. F.*

9. But the angles in the triangle BCH will be eaſily found by plain trigonometry; for, becauſe the radii BC, OC are given, a part thereof $\frac{OC}{n}$, which is PC, will be given in the ſame manner as PB and its half SP or SH; therefore, in the triangle SCH there are given three ſides, as SC, half the ſum of the lines, BC and PC, SH or SP, half their difference, and in fine, CH the radius of the circle OC; therefore, by the known rules of trigonometry, from thoſe three ſides the angles may be found as SCH and CSH, or its half CBH, from which ſhall alſo be found the third CHB or its ſupplement CHM to two right angles.

Of the Manufacture of China-ware. From the Breſlaw Collection, October, 1717. Claſs V. Art. III. p. 242.

Tranſlated from the HIGH-DUTCH.

An account of porcellain and its ingredients.

THE annals of *Feouleam* (according to *F. d'Entrecolles*, one of the miſſionaries to *China**) relate, that ever ſince the ſecond year of the reign of the Emperor *Tam* or *Te*, that is, according to our manner of reckoning, ſince the year of *Chriſt* 442, porcellain has been wrought for the emperors of *China*; yet it is probable, that it might have been in uſe before that time, and be gradually brought to perfection and us'd by the richer *Europeans*. In the above annals there is no mention of the author of porcellain, or what gave riſe to it, only that it was of the moſt beautiful white colour, and that the veſſels made of it were call'd the precious jewel of *Jaotcheon*; yet the fineſt porcellain, both as to white and blue colour, comes from *Kimtetchim*, from which place the emperors would fain carry the manufacture to *Peking*, but without ſucceſs. *Kimtetchim* alone has kept its reputation; and it ſupplies the whole world with porcellain; and from thence the *Japoneſe* have it. Porcellain is not properly a *Chineſe*, but a *Portugueſe* word, and denotes a *bowl* or *cup*: Whereas in *China* porcellain is commonly call'd *Thſki*. The matter of porcellain conſiſts of two ſorts of earth, one of which is call'd *Petuntſe*, the other *Kaolin*; the former is mixt with ſome ſparkling particles; whereas the latter is entirely white and feels very ſoft. Both ſorts are in form

* *Recueil* XII. des lettres edifantes & curieuſes des Miſſionaires à la Chine.

form of tiles brought in ſhips from *Kimuen* to *Kimtetchim*; for, *Kimtetchim* yields no materials for porcellain: And the *Petuntſe* is nothing other than pieces of rock, which are brought in the above form. The firſt proceſs conſiſts in this; the ſtone is firſt beat ſmall with an iron mallet, then put into a mortar and powder'd very fine, afterwards it is thrown into a large veſſel full of water and ſtrongly ſtirr'd about with an iron *ſpatula*, then it is ſuffer'd to reſt a little, and there ariſes a-top a ſort of cream, which is taken off and put into another veſſel full of water, and ready for that purpoſe: In the mean time the matter in the firſt veſſel is kept ſtirring a-new, and the cream is taken off in like manner: The groſs matter that falls to the bottom is again beat ſmall, and the ſtirring and ſkimming is repeated as above, till at laſt no more of this ſubtile matter is obtained. Now when this fine matter uniting together in the ſecond copper or veſſel ſettles gently to the bottom like a dough and the clear water is gently pour'd from it, this dough is put into particular moulds, dried and afterwards divided into ſmall ſquare pieces, which, on account of their figure and colour, are call'd *Petuntſes*; but as theſe are uſually adulterated by the *Chineſe*, they muſt be at laſt brought to *Kimtetchim* in order to be purified a-new.

The *Kaolin*, as the ſecond ingredient of porcellain, requires leſs trouble than the *Petuntſe:* It is found in lumps very deep in the mountain, and cover'd with a reddiſh earth, and it is work'd in the ſame manner as the *Petuntſe*, and reſerv'd for farther uſe in the porcellain manufacture. *F. d'Entrecolles* is of opinion, that the white earth from *Malta*, commonly call'd *terra* S. *Pauli*, is of the ſame nature and goodneſs, yet without any of thoſe ſilver particles in this laſt as are obſerv'd in the *Kaolin*. This *Kaolin* gives the porcellain its hold, and is on account of its ſoftneſs very ſerviceable to the hard ſtony *Petuntſe*; and hence as the *Dutch* and *Engliſh* once brought the *Petuntſe* to *Europe* in order to make porcellain, they could not ſucceed therein, as they did not bring along with it the *Kaolin*. Both theſe ingredients are carried by water to *Kimtetchim*, as alſo another whitiſh and fluid ſubſtance, which gives the porcellain its perfect whiteneſs and gloſs, and which F. *d'Entrecolles* takes for that ſort of oil, which in *China* is call'd *Tſy*, and in *Europe* varniſh, which alſo comes from ſtones as the *Petuntſe* does; and ſuch ſtones yield the beſt oil as have ſpots like the leaves of the cypreſs, or ſuch as are red ſpotted and whoſe ground appears dingy: But this petrol is not only employ'd therein, but likewiſe another ſort, which gives it its very ſoul as it were. The compoſition is as follows, large pieces of quicklime are ſlack'd by ſprinkling water thereon, ſo that they fall to a powder, on which is made a layer of dry ferns, and on that a new layer of unſlack'd lime, and thus alternately; after which the ferns are ſet on fire; and when the whole is conſum'd, this aſh is divided into new ſuch layers with more ferns, and this for five or ſix times ſucceſſively; and the oftner this

this is done, the better the oil is: Beſides theſe ferns, as the hiſtory of *Feouleam* mentions, they alſo make uſe of the wood of a certain tree, whoſe fruit is call'd *ſetſe* and which F. *d'Entrecolles* takes for a kind of medlar-tree; but which is now no longer us'd therein, as it is, perhaps, become ſcarcer. Whence, probably, it comes, that the modern porcellain is not ſo beautiful as the ancient. This aſh of lime and fern is thrown into a veſſel full of water, and one pound of *chekao*, which reſembles alum, is always diſſolv'd in 100 pound of the water, and the whole is well ſtirr'd together and ſuffer'd to ſtand till a thickiſh cruſt ſettle a-top: This cruſt is taken off and put into another veſſel, and then a paſte ſettles to the bottom, from which the clear water is pour'd off; and ſo this other oil is mixt with the firſt, both which muſt be of a like thick conſiſtence; and the beſt mixture conſiſts herein, that to 10 meaſures of the above petrol, there is taken one meaſure of this other oil, which is made of lime and fern. The making of the porcellain itſelf requires a great deal of labour; and one piece, before it is put into the furnace, muſt go thro' 20 hands, yet without any diſorder or confuſion. They firſt purify a-new the *petuntſe* and *kaolin*, as was mention'd above, of both they take equal parts to the fine porcellain; to the middling ſort four parts of *kaolin* and ſix of *petuntſe*; and to the worſt ſort one part of *kaolin* and three parts of *petuntſe*. The maſſes are ſhot into a well cemented veſſel, and then kneaded to their due degree of hardneſs. Of theſe are taken pieces, ſpread upon a broad plate and further kneaded and roll'd, yet ſo that no grain of ſand or hair mix therewith, as theſe mar the work. After this at laſt the porcellain is either wrought upon the wheel or barely in certain moulds, and at length finiſh'd with a knife, almoſt in the uſual manner of our earthen ware; yet ſo that each piece muſt paſs thro' 60 hands, before it attains to its perfect form. The porcellain is afterwards varniſh'd and bak'd, after which it is painted and gilded, and then bak'd once more. All this proceſs muſt by no means be perform'd in the cold, and great care muſt be taken that all be equally dry, in regard the contain'd moiſture makes the porcellain ſpring; for which end, therefore, they ſometimes make a fire in their work-houſes. As to the painting, the maſters therein, who in general are no great artiſts, yet deſerve ſome praiſe in painting porcellain, are call'd *hoapei*. This painting goes alſo thro' many hands, one of whom makes the outmoſt circle round the rim, a ſecond ſketches out the figures, which are coloured by a third, *&c.* The colours themſelves are of different ſorts; and in particular the figures on a white ground are more beautiful than any we have in *Europe*. Formerly there was only white porcellain before they found out the blue, which is now us'd in this work, and which was diſcover'd by a dealer in porcellain, upon his being ſhipwreck'd on a deſart coaſt, where were found many ſtones yielding the fineſt blue, with which he laded a whole ſhip. This colour, after ſtamping, is roaſted for 24 hours in a furnace,

furnace, and then ground to a fine powder in a large porcellain mortar. The red colour is made out of vitriol, call'd *haoſan*. They alſo have a peculiar ſort of white colour, different from the porcellain white, and which is employ'd in ſome figures. It is, in like manner as the blue, burnt from a tranſparent marcaſite, half an ounce of which is powder'd and mixt with a whole pound of ceruſs; and afterwards employ'd in all ſorts of colour-mixtures; as for inſtance, green, yellow, *&c.* Theſe colours (according to the *Chineſe* account) are laid with ceruſs, ſalt-petre and vitriol; or (as the *Chriſtians*, who work thereon, give out) barely with ceruſs alone, on the porcellain bak'd for the firſt time, after firſt diſſolving theſe in gum-water; and then the porcellain is once more bak'd, and the colours appear perfect. They make among other ſorts a peculiar red-blown porcellain, which is more coſtly and rare than the others. The black alſo, call'd *oumi*, is not without its value and beauty. The gold gives a new luſtre to this ſort of porcellain. This black colour is imparted to it with three ounces of azure or blue and ſeven ounces of petrol: When this colour is dry, the porcellain is bak'd; and then the gold is laid on, after which the veſſel muſt be bak'd a-new in a peculiar furnace. They alſo make a ſort of china with holes, in whoſe middle is the bowl or cup for holding the liquors, as alſo another ſort in which the *Chineſe* and *Tartar* women are painted to the life: And when they give the porcellain no other oil than that prepar'd from the marcaſite, it yields a peculiar ſort thereof which is entirely marbl'd and furniſh'd with veins, that one would take it for broken china; it is otherwiſe call'd *tſoniki*. The gold is rubb'd with gum-water and ceruſs laid thereon. After the painting and gilding are dry, the china is put into the furnace, which when ſmall may be made of iron; but it is commonly made of earth, of the height of a man and almoſt as wide as a large wine-butt; its bottom ſtands half a foot high from the ground; it is wall'd round and this wall is furniſh'd with three or four air-vents: Now when the furnace is fill'd with the china-ware, beſides one aperture in the middle, thro' which one may ſee the china, there is made a coal-fire above and below and on the ſides, and the china bak'd ſo long, till it ſparkles and the colours become lively, upon which the fire, and alſo the china are remov'd. The *Chineſe*, however, very much regret their having loſt the art of painting fiſhes and other beaſts on porcellain, which could not be diſtinguiſh'd before the china was firſt fill'd with a certain liquor; and this ſort they call'd *kiatſim*; and, according to F. *d'Entrecolles*, before the oil was laid on, the porcellain muſt have been previouſly poliſh'd to take off all the inequalities, and in the painting they made uſe of a pencil of the fineſt feathers, which they wetted and run over the china. The laying on of the oil itſelf requires much art, ſo that neither too much nor too little be given, but that it be equally laid on. Very thin porcellain has two coats of this oil; what is pretty ſtrong only one. The former is done by ſprink-

ling, but the latter by dipping, and on that the varniſh is immediately laid; but the foot, which is ſolid, is previouſly bor'd and then painted, varniſh'd and laſtly brought to the furnace. The fire muſt be well managed, and all the china muſt, according to its bigneſs and ſtrength, have its proper degree of fire, elſe the baking miſcarries. The *Chineſe*, according to F. *d'Entrecolles*, worſhip a particular God, who preſides over the china, and whom they call *Ponſa*. The occaſion of which was this: As once the emperor would have the porcellain wrought according to a certain form, but the impoſſibility thereof being in vain repreſented to him; and, after a great deal of trouble and expences, the thing appearing impracticable, at length one of the workmen out of deſpair jump'd into the glowing furnace, wherein he was ſoon conſum'd, and upon this the porcellain was taken out exactly of the form the emperor would have it; and from this they rever'd this deſperado as a great hero and a god, who preſides over porcellain. The *Chineſe* in particular highly eſteem the old porcellain, tho' ſome prefer the new to it. And ſuch as are fond of the old porcellain regard chiefly its colour. F. *d'Entrecolles* denies, that the porcellain, as has been hitherto thought in *Europe*, attains to its perfection after lying long buried in the earth: And the *Chineſe* themſelves laugh at this conceit. It is true, that in the rubbiſh of old buildings and in cleaning wells they have often found beautiful pieces of porcellain; but its beauty was not owing to its lying there, but barely to its retaining its ancient beautiful form; and this depends merely on the fancy of the *Chineſe*, who are wont to give a great deal of money for ſuch old china, eſpecially ſuch as the ancient emperors *Yao* and *Chun* made uſe of, who reign'd many ages ago, and at the time when the emperors firſt began to uſe china. The whole value of this old buried porcellain depends on its colour, from which its antiquity is known; and ſuch a piece of porcellain has ſometimes been ſold in *China* itſelf for 80 rix-dollars. The mandarin of *Kimtetchim* has publiſh'd at court, that he was maſter of the art of making old faſhion'd china, for which purpoſe he employs a yellowiſh earth dug up about *Kimtetchim*. That ſort is very thick. The proceſs differs little from the former, only that the oil for it is taken from a yellow ſtone and mixt with the common oil; from which the porcellain acquires a ſea-green colour; after it is bak'd it is thrown into fat broth and bak'd once more; after that, it is laid in a common ſewer, where it is ſuffer'd to lie for a month, and then it paſſes for 3 or 400 year old china. The *Chineſe* have a peculiar method of mending broken china; with a diamond they drill a hole thro' the pieces; and put a very fine braſs-wire or thread thro' the holes and faſten the pieces ſo firmly and with ſuch nicety, as the crack can ſcarcely be obſerv'd.

A Deſ-

A Deſcription of a new and very uncommon Phenomenon *obſerv'd in the Heavens in the beginning of Spring* 1683, *at* Paris. *By* Joh. Caſſini. *From the* Acta Eruditorum Lipſ. Anno 1683. p. 274.

Tranſlated from the LATIN.

A Certain *light*, like that of the *milky way*, yet brighter in the middle and weaker towards the extremities, expanded itſelf thro' the vernal ſigns. I began firſt to obſerve it at the *Royal Obſervatory* on *March* 18. in the evening, two days before the equinox; when after having obſerv'd the changes which happen'd in *Saturn*, I fix'd my eyes on the firſt ſtar of *Aries*, which thro' a teleſcope is ſeen as conſiſting of two ſtars, diſtant from each other the ſum of their diameters. Three quarters of an hour after 7, and half an hour after the *crepuſculum*, the conſtellations of *Aries* and *Taurus* were far brighter than uſual. To the weſt that *light* was terminated only by vapours, elevated two or three degrees above the horizon, and its brighter part was eight or nine degrees in breadth, it was extended obliquely along the zodiac nearly, with its northern ſide touching the two brighteſt ſtars in the head of *Aries*, whoſe body it cover'd; in length it extended over the *Pleiades*, and gradually vaniſhing about the head of *Taurus*, it ended in a ſharp point. The hiſtory of this *phenomenon*.

In that tract the heavens were very clear, ſo that ſtars of the ſixth and ſeventh magnitude could there be diſtinguiſh'd by the naked eye; and that brightneſs, in ſome meaſure reſembling a ſmall cloud, enlighten'd by the ſun, did not hinder theſe ſmall ſtars from being ſeen in its very middle, where it appear'd denſer, as uſually happens to thoſe who view a-croſs the tails of comets; yet its breadth was greater than that it could be reckon'd to be the tail of any comet, as being three or four times broader than the largeſt comets I have hitherto ſeen; as to the reſt it reſembled them not only in brightneſs, but in colour and in ſituation with reſpect to the ſun, to which in length it was almoſt directed.

A little after it was alſo obſerv'd to follow the motion of the heavens towards the weſt; and being carried by this motion it continued in the ſame ſigns, and with them was hid under the vapours about the horizon.

I was in doubt, whether by its ſlow proper motion it was not carried northwards; for it afterwards took in theſe two brighter ſtars of *Aries*, which at firſt it touch'd with its northern ſide, which was afterwards verified by the obſervations on the following days; yet I could not be entirely certain of this either at that time or many days after, becauſe the extremity of this *light*, being on every ſide too indetermin'd, became gradually languid, ſo that it was very difficult preciſely to define it; beſides, on account of the different clearneſs of the air on the enſuing days, according to

to the diſtance of the *crepuſculum*, it was obſerv'd more or leſs extended: Whence on its firſt appearance, which happen'd an hour after ſun-ſet, a more ſenſible *light* only diffus'd itſelf in breadth to the brighter ſtars of *Aries*, and in length to the *Pleiades*; both which it a little after poſſeſs'd: But as to its middle, as far as could be perceiv'd by the eye, it always appear'd in the ſame tract towards the middle of *Aries*.

After the conſtellations of *Aries* and *Taurus* had ſet, I continued obſerving whether any trace of this light ſtill remain'd at that height and in that ſituation wherein it was ſeen, yet I found nothing uncommon there. From which it was manifeſt, that in its diurnal revolution about the earth it follow'd the above ſigns, in regard that on the enſuing days ſetting together with them, it was in the ſame place with them where it was ſeen the preceeding days, which according to the *Copernicans* is the ſame thing as to remain fixt in the ſame place of the heavens within the diurnal revolution of the elementary ſphere from weſt to eaſt about the axis of the earth.

In this ſtate I, therefore, obſerv'd that *light* from *March* 18. to *March* 26. as often as the ſky to the weſt was clear, without obſerving any ſenſible change, only that by the laſt obſervation of *March* 26. it did not extend ſo far towards the horns of *Taurus*, as it had done on the preceeding days; but ſeem'd to extend ſomewhat more northerly. The brighter ſtar of *Aries*, which at firſt was cloſe to its ſide, was now above a degree immers'd in this *light*.

In this laſt obſervation I could not diſcover the firſt ſtar of this conſtellation, becauſe it was lower and lay deeper in vapours, which at the ſame time diminiſh'd the expanſion of the *light* to the weſt more than in the preceeding obſervations: It therefore appear'd, that, beſides this impediment and that occaſion'd by the *crepuſcula*, it would happen, that in a day that *light* would be ſeen extended more towards the weſt and very near the ſun, who about its beginning was in the laſt degree but one of *piſces*, only 30 degrees from the firſt ſtar of *Aries:* And in the laſt obſervation of *March* 26. it was diſtant a little more than 22 degrees; ſo that if this *light* could have been view'd when the ſun was up, it would probably place round him the appearance of a *buſh of hair*.

From this time, the ſky in the evening being overcaſt to the weſt, I could not certainly know, whether this *light* was diſſipated, till on *April* 14, 22, 24, and 28, and then tho' (the *crepuſculum* being over) *Aries* was now ſet, the ſame *light* appear'd in *Taurus* extending to his northern horn, and with its north ſide it reach'd *Meduſa*'s head and *Perſeus*' ſouth knee, whoſe ſouth foot was immers'd in its brightneſs.

By theſe laſt obſervations, therefore, it appear'd far more evidently than by the preceeding, that this *light* advanc'd northwards, which was the reaſon, that it could not be ſo ſoon extinguiſh'd by the evening *crepuſculum*, as the ſun in the mean time was advancing to *Taurus*.

It

It will be a difficult matter in the history of past times to find a *phenomenon* in all respects like this new *light*, as it appear'd for several days in the same signs, without any evident proper motion, and so much extended, especially in breadth, and without the appearance of any comet, to which it might have ow'd its origin.

This *phenomenon* compar'd with other the like *phenomena*, together with a remarkable reflection about this matter.

Yet as to this last circumstance, and the other circumstances of its duration, state and direction towards the sun, greatly agrees what I observ'd at *Bononia* in 1668; it was a luminous track, or path, like the tail of a comet, which possess'd a space of 30 degrees in length, and little more than 1 degree in breadth.

On *March* 10. I observ'd it come out of vapours, which were near the horizon, and cover'd *Cetus*, with its east side directed towards *Orion*'s foot, and with its west towards the place of the sun: Its length, as well as that of this *phenomenon*, was referr'd to the signs of *Aries* and *Taurus*; but it had a remarkable breadth southwards, and chang'd its situation among the *fixt* stars with a proper motion towards the east and towards the north, by which in a day it approach'd more to *Orion*. It appear'd till *March* 19. and in all these nine days it pass'd by different stars of *Eridanus*, yet so as not to cover them.

M. *Chardin* in his book of the coronation of *Solimann*, king of *Persia*, relates, 'that the same *phenomenon* of 1668 was observ'd in the metropolis 'of a certain province in *Persia* on *March* 7. which was the second day 'of its appearance, and at *Ispahan*, which is the metropolis of the king-'dom, at 7 o'clock in the afternoon *March* 10. that it appear'd in the 'south, and follow'd the *primum mobile* with 30° 32′ in length, *which agrees* '*with our observation*, and that it was every way equally broad 6 degrees 'nearly;' which is 4 times greater than it appear'd to me at *Bononia*, where yet there were some who reckon'd it broader; yet it was a difficult matter to define its breadth, as towards the extremities it was weak and sensibly languid. M. *Chardin* adds, 'that its more elevated part lay 'towards the belt of *Orion* and towards *Eridanus*.'

It appear'd to me towards *Eridanus*, *Orion*'s belt being far more northerly and westerly. The longitude of 72° which he gives it, and its latitude of 3° from the ecliptic do not differ from the above situation; in which numbers of M. *Chardin* it is plain there must be some mistake.

He subjoins, 'that *Cetus*, or the flexure of *Eridanus* bounded its inferior 'extremity;' which exactly agrees with my observation, which places it at the belly of *Cetus*, where it touches the flexure of *Eridanus*. He says, 'that the *Persians* call'd it *Niazach*, that is, a *small lance*, from the resem-'blance of its figure; that they said, they had never seen nor heard from 'others of any such *phenomenon*, tho' it was reckon'd a comet, whose head 'was set, so that it could not be observ'd above the horizon.'

Yet

Yet on this occaſion I have ſhewn, that this *phenomenon* had a ſurpriſing affinity with ſuch another 2000 years ago, namely, with that which *Charimander*, according to *Seneca*[a], relates to have been obſerv'd by *Anaxagoras* of a great and uncommon *light* of the bigneſs of a large beam, which ſhone for ſeveral days; or with that which the ſame author ſays was obſerv'd by *Caliſthenes* with the appearance of a fire extended in length, before the large cities of *Achaia*, *Buris* and *Helice* were in an earthquake ſwallow'd up by the ſea, and which *Ariſtotle* took to be a comet; which at firſt, on account of its great burning, did not appear, but at laſt was ſeen when its burning abated a little.

Ariſtotle[b] ſpeaking of this *phenomenon*, which was obſerv'd in the heavens at the time of the earthquake and inundation in *Achaia*, at one time calls it a great comet and again a great ſtar, and he relates, 'that it appear'd 'about the ſouth-weſt,' *as our comet alſo did*; and after rehearſing many other inſtances of the like *phenomena*, he ſubjoins, 'that that great ſtar 'appear'd in winter, in very cold weather, and in a very clear evening, 'the year *Ariſtæus* was *Archon* at *Athens*; that the firſt day it did not ap-'pear as it was ſet before the ſun; that the following day it was ſeen but a 'little, as ſetting and leaving the ſun at a ſmall diſtance before it; that it 'extended its light to a third part of the heavens in form of a *lawn*, and 'that on this account it was call'd a *way*; that it aſcended as far as the 'belt of *Orion*, and was there diſſipated;' which alſo happen'd to the *luminous way* of 1668.

Seneca, who took this *phenomenon* for a comet, reprehends *Ephorus* for ſaying that it was divided into two ſtars, a thing he alone maintain'd, tho' it was obſerv'd all over the earth, and reckon'd a preſage of the inundation of thoſe two cities: Tho', therefore, the apparent magnitude of that *light* was certain, and ſupported by the teſtimonies of all obſervers, yet all do not agree in determining its ſpecies; as this has alſo been the caſe as to the like *phenomena* in our days.

There are other hiſtories of ambiguous comets, of which there has only been ſeen a certain great *light*, ſuch as was obſerv'd after *November* 10. till *November* 23. of 1618, towards *Hydra* in the ſouthern hemiſphere, before the remarkable comet which came in the northern part of the heavens about the cloſe of the above month, and laſted till the end of *January* 1619.

Of the nature of this light.

This uncommon *light* is not without its matter that emits rays to the earth, whether it be luminous of itſelf, or whether it reflects or refracts the rays proceeding from the ſun, or from any other luminous body, either immediately or by means of other bodies: And indeed, its direction, which its length has to the ſun, ſupplies a handle of affirming that it is deriv'd from the ſun himſelf.

In

[a] Quæſt. Natur. *Lib.* 7. [b] Meteorol. *Lib.* 1. *c.* 6.

In the ſynopſis of my obſervations of the comet of 1681 N° 12. I have maintain'd, that a matter may be diffus'd in the *æther* fit to reflect light, as happens in our atmoſphere; and that that matter may be found in the orbit of comets, where the *æther* is at different times more or leſs pure, and may produce the *phenomenon* of the tails of comets, and the other changes they undergo.

As, therefore, this *light*, both as to colour, clearneſs, tenuity, and as to its ſituation with reſpect to the ſun, is like the light of comets, it is credible, that the matter, reflecting that *light* to us, is of the ſame nature; whether a comet be there conceal'd under the ſun's rays, from which that *light* may take its riſe (which yet I dare not aſſert, as this *light* differ'd ſo much in its breadth from the tails of all the comets hitherto obſerv'd) or whether it receives its rays immediately from the ſun.

For, as we obſerve *phenomena* in the air produced by the refraction and reflexion of the ſolar rays coming immediately, and of other the like rays coming by the intervention of the moon, ſuch as are rain-bows and *halo*'s about one ſtar or other; it will be no inconſiſtence, that the like *phenomena* may alſo be form'd by the ſun in the matter diſpers'd through the *æther*, either immediately, or by the interpoſition of ſome cometic body; that very matter may reflect to us the light of ſome ſtar, ſuch as happens to certain *fix'd* ſtars, which ſometimes put on a *buſh of hair*; which not only happen'd, according to the obſervations of the *Egyptians*, but *Ariſtotle* alſo teſtifies, that he obſerv'd the like himſelf. In this manner was ſeen one of the ſtars in the thigh of *canis major*, at firſt, indeed, more obſcurely, yet by a more intent view, pretty manifeſtly.

We are to obſerve that our *light* appear'd in the ſame tract, which many comets of this age, namely, thoſe of 1652, 1665, 1672, 1680, and many others of preceeding ages travers'd, *viz.* in that *faſcia*, which, on account of the frequent paſſage of comets, I have call'd *zodiacon cometarum*.

A conjecture about the diſtance of this luminous matter.

As to the diſtance of the matter, which is the ſubject of this *light*, or the medium, by which it reaches our earth either by reflexion or refraction, it cannot be accurately enough determin'd by the parallax; eſpecially on account of its ambiguous limits, which hinder'd the comparing it accurately with the *fix'd* ſtars at different hours of the night, and in different parts of the earth; yet that it is conſiderable you may learn from the circumſtance of its diurnal motion in 24 hours, whereby it emulated the ſtars; for, in the common hypotheſis what force of wind for a whole month together could propel this matter thro' the air without diſſipation, with ſo great an *impetus*, as in one day to encompaſs the whole earth, and ſo regularly as always to regard the ſame ſtars? And in the *Copernican* hypotheſis with what force could it continually reſiſt the diurnal motion of the elementary ſphere from weſt to eaſt, ſo as neither to be carried along with it, nor diſſipated thereby? We muſt, therefore, neceſſarily own, that this matter ſtands above the

the elementary ſphere; and conſequently, in the *æther*; and likewiſe conſidering its proper motion, which was but very little, we ſhall be oblig'd to ſuppoſe, that it was very far elevated towards the region of the *fix'd* ſtars.

It was not without reaſon that the ancients judged, that ſuch of the planets were more elevated towards the *fix'd* ſtars, as came nearer their common motion, and had a leſs degree of proper motion; nor had they any other reaſon of raiſing *Saturn* above all the other planets, and of placing *Jupiter* below him, of which no aſtronomer ever after doubted for more than 20 or 30 ages.

They were confirm'd in this by new hypotheſes, which ſerve to repreſent the *phenomena* of their motions, however they may differ among themſelves, and in ſome things contradict each other, as the *Copernican* hypotheſis does the *Tychonic* and *Ptolemaic:* Each of theſe hypotheſes demonſtrates the order of the ſuperior planets, eſtabliſh'd by the ancients, by principles peculiar to them, as it is impoſſible to do this independently of any of theſe hypotheſes; theſe two planets having no ſenſible parallax on account of the ſmall proportion of the diameter of the earth, and that of their orbits.

It is not, therefore, incongruous to determine the ſituation of new objects in the world, by comparing their motion with that of bodies which are known to us; ſuch as by the obſervations of aſtronomers are plac'd at different diſtances, according to the different degrees of their apparent velocity.

Of the German *Moxa. By* Georg. Wolfgang. Wedelius. *From the* Miſcellanea Naturæ Curioſorum An. I. Dec. II. Obſ. VI. p. 14.

Tranſlated from the LATIN.

Moxa what? and its uſe in the gout

IT is not many years ago ſince the *Chineſe moxa* was firſt known both to the world, and to the phyſicians of *Europe*. It is a new name and a new medicine, and chiefly cried up as a cure in the gout, that incurable, as is thought, or at leaſt obſtinate diſeaſe of the Great. It was firſt taken notice of by *Herman Buſchovius*, he having publiſh'd a treatiſe about it in *Low* and *High Dutch*, to which here and there he has added experiments, partly ſucceſsful and partly otherwiſe.

This author *de curat.* podagræ *part* II. *c.* 4. *p. m.* 91. ſays, that *moxa* is a downy and ſoft ſubſtance, prepar'd by art from a certain herb, whoſe name and preparation he knew not, yet that it was certainly the nobleſt of plants, and that it might juſtly be call'd *mater herbarum (mother-wort)*. He adds, that the *Chineſe* and *Japoneſe* conceal'd the manner of preparing the *moxa*, tho' it may be had in great plenty.

Here

Here we meddle not, whether the author really did not know the herb and the manner of the preparation, or whether he fram'd this on purpoſe, to conciliate the greater authority to the medicine. Let it ſuffice, that he has given a broad enough hint of it to the intelligent: But both candour and gratitude, virtues we highly prize if found in a phyſician, do oblige us not to arrogate this diſcovery to ourſelves.

Joh. Hartmannus Kornmann Von Hornſbach, counſellor and chief phyſician to the Prince of *Heſſe*, has diſcover'd to us both the herb and the manner of preparing *moxa*. *Moxa*, whenceſoever it had its name, is the down of mugwort.

Take as much as you will of the leaves of mugwort, well dried and ſtript from their ſtalks; rub them with the hands, till after ſhaking off the green duſt, the internal downy fibres arranged beneath like a woof, remain behind; but if the hands are wetted by their humidity, the rubbing is to be repeated, till the fibres become ſufficiently tender. The manner of preparing it from mugwort.

He diſcover'd this to be the manner of the operation upon examining a parcel of *moxa* ſent him, wherein he found the ſmall leaves adhering to the down, when view'd with a microſcope, entirely to reſemble mugwort; and making an experiment thereon it ſucceeded to his mind, yielding a like down, or rather *moxa*. How diſcover'd.

He alſo farther improv'd it by teazing it in the manner of wool, that thereby it might become ſtill better and more tender, and be alter'd the more: And therefore, if the *Chineſe moxa*, done up with its aromatic ſtalks, does not directly agree with it in all reſpects, (externally indeed it does but not internally) but ſeems to differ from it a little, we are to reckon that the fault is partly owing to this, namely, that the herb was not gather'd at one and the ſame time, and partly that it was more ſlightly or more carefully prepar'd; but it is an eaſy matter to extract its greenneſs by pouring ſpirits of wine thereon; and after that to teaze the dried leaves with the common inſtrument for wool, and whiten them with alum-water, or even attempt it with the fume of ſulphur. Farther improv'd.

That this is the genuine proceſs is evinced by two extraneous arguments, to wit, the ſenſes and the effect; both which teſtify that *moxa* is *moxa*; and by one argument founded on the author's own confeſſion, tho' not at firſt ſight obvious to the reader; for, in the above cited place he calls *mater herbarum* (*mother-wort*) the mother of *moxa*, but that the common broad leav'd mugwort is thus call'd by Botaniſts is very evident from the teſtimony of *Lobelius*, *Dodonæus*, and others. This matter evinc'd by ſeveral arguments.

But to illuſtrate this the more we are to obſerve, 1. That the down of plants is twofold; the one external, as in coltsfoot, the *gramen lanigerum*, knot-graſs, and others: The other internal, as that in the root of colts-foot, which *Scaliger*[a] commends for tinder, and ſuch as is found in that well known Farther illuſtrated.

[a] Exerc. 180. *n.* 2. *p. m.* 585.

known thing, lint; and ſuch is alſo the *moxa* of mugwort. 2. That this method of curing pain by actual inuſtion is no new thing; which yet derogates nothing from its commendation, but rather adds weight thereto. We ſhall in this matter quote *Hippocrates* alone, the moſt ancient parent of medicine, who in his book *de affection. cap.* 30. *f.* 12. ſays, 'if pain ſeizes 'on any one part and ſettles, and cannot be remov'd by medicines, burn 'whatever part the pain is in, but burn it with raw flax.' And, indeed, both as to the matter, the diſeaſe wherein it is to be applied, and the method of cure itſelf, he could not have given a better deſcription of *moxa*, which is ſo much cried up. And that this may the better appear, we are to obſerve, that, by *raw flax*, he does not mean ſuch as has nowiſe been prepar'd, but what hitherto has not been drawn into threads. *Proſper Martianus*[b] has learnedly and nervouſly deſcrib'd the whole proceſs, as follows: 'Take raw flax, and rolling it up hard bring it into a pyramidal 'form; the place to be burnt will ſhew what ſhould be the bigneſs or 'broadneſs of its baſe, and you muſt know, that the burning becomes 'ſomewhat broader than is the baſe of the pyramid; ſetting fire, therefore, 'to its top, lay it on the place to be burnt, and let it lie thereon till the 'whole is conſum'd; for, the fire gradually coming to the ſkin cauſes a 'burn, and which ſeems ſurpriſing, almoſt inſenſibly and without any 'pain; after the fire is extinguiſh'd *Hippocrates* laid on a boil'd leek, till 'the *eſchar* dropp'd off. In *Germany* they apply butter with a colewort, 'and afterwards the wound may be kept open at pleaſure.' This agrees in every reſpect with the modern matter of burning, *viz. moxa*; and in the above-cited place may be ſeen the ſeveral matters with which others have perform'd ſucceſsful burnings. The ſame effect is produc'd by any dry, filamentous, or lanuginous and porous bodies, by cob-webs (by applying which, in the ſame manner, the above gentleman has taken off warts from the hands without any pain; the wart being taken off after burning, and laying on a plaiſter, in a day or two the cure is compleated) by the ſpunk of trees, the pith of ruſhes, of elder, *&c.* 3. That the burning by *moxa* is of greater ſervice in deep pains, and ſuch as are not accompanied with heat and redneſs. It has been obſerv'd to have been of excellent ſervice to ſome, and of detriment to others, nay, to have threaten'd a gangrene. The ſame diſcretion, therefore, is entirely neceſſary here as in veſicatories, or even actual cauteries. This kind of remedy will with ſafety be of greater ſervice where there are ſerous, cold, conſiſtent humours (there being no contraindicant) to be diſcharg'd and conſum'd. But if you promiſcuouſly apply it, the diſeaſe may be eaſily heighten'd, and become worſe; whereas, on the contrary, by giving an outlet to the *ichor*, this remedy may be of ſervice above all other things, making a diſcuſſion at the ſame time that the part itſelf is in ſome meaſure ſtrengthen'd by the burning. *Cor-*

[b] *Comm. in Lib. de* affect. *f.* 2. *v.* 25. *p.* 170.

Corresponding Observations of the Eclipses of Jupiter's *Satellites in different Parts of* Europe, *with Remarks thereon, as also a Remark, wherein in particular is deduced almost the whole extent of* Europe *in Longitude*, &c. *From the* Commentar. Scient. Imper. Petropol. Tom. I. p. 467.

Translated from the LATIN.

Anno	N. S.	True Time.			
1726	*July* 10.	12h	47′	0″	The immersion of the first satellite observ'd with *Campani*'s tube of 15 foot: But the excessive brightness of the *crepusculum* at that time and other things besides, marr'd the observation. Whence the time could not be defin'd beyond minutes. At *Petersburg* by *Jos. Nic. de L'isle*, and *Lud. de L'isle de la Croyere.*
	Aug. 9.	14	51	30	The immersion of the first satellite observ'd with the same tube of 15 foot, and with another of 20 foot and a half; but for the same impediments as above, the time assigned cannot be depended on, within a quarter of a minute.
	18.	11	15	46	The immersion of the first satellite by a tube of 15 foot.
		11	15	52	By a tube of 20 foot and a half, the sky serene, the air calm, and the moon not far from *Jupiter*.
	Sept. 10.	11	32	51	The immersion of the first satellite by a tube of 15 foot.
		11	32	56	By a tube of 20 foot and a half, the weather very serene and calm.
	22	16	13	20	The immersion of the second satellite by a tube of 15 foot, the weather pretty serene, notwithstanding there were a few small clouds.
	Oct. 19	12	21	46	The emersion of the first satellite by a tube of 15 foot; and the satellite very near *Jupiter*.
	28	8	47	8	The emersion of the first satellite by a tube of 15 foot, within a few seconds.
	Dec. 6	7	11	18	The emersion of the first satellite by a tube of 20 foot and a half.
		10	30	31	The emersion of the second satellite by a tube of 20 foot and a half, exact.

Anno

Anno	N. S.	True Time.			
1726	*Dec.* 6	10^h	30$'$	38$''$	By a tube of 15 foot, exact.
	29	7	15	36	The emerſion of the firſt ſatellite with a tube of 20 foot and a half, exact.
		7	15	48	With a tube of 15 foot, exact.
1727	*Jan.* 2	10	59	46	The immerſion of the third ſatellite by a tube of 15 foot, the ſky foggy.
		11	0	17	By a tube of 20 foot and a half; and I think this other obſervation more certain and exact within a few ſeconds: And tho' the ſky ſeem'd ſerene, yet *Jupiter* appear'd not ſo diſtinctly, as he was wont to do at other times, becauſe he at times paſs'd thro' vapours, which diſfigur'd him and tinged him with colours.
	7	10	9	56	The emerſion of the ſecond ſatellite by a tube of 20 foot and a half.
		10	10	4	By a tube of 15 foot.
	Febr. 1	7	17	15	The emerſion of the ſecond ſatellite by a tube of 20 foot and a half, exact.
	Aug. 5	11	52	23	The immerſion of the third ſatellite by a tube of 22 foot, the ſky ſerene and calm; but the ſlow motion of the ſatellite hinder'd the certainty of the immerſion to ſome ſeconds; 4 or 5 minutes had already paſs'd from the beginning of the diminution.
	7	10	59	27	The immerſion of the firſt ſatellite by a tube of 22 foot; but *Jupiter* being very near the horizon, marr'd the obſervation.
	8	13	37	9	The immerſion of the ſecond ſatellite by a 22 foot teleſcope.
	21	14	50	30	The immerſion of the firſt ſatellite by a 22 foot teleſcope.
	30	11	15	18	The immerſion of the firſt ſatellite by a 22 foot teleſcope, the ſky ſerene and calm.
	Sept. 2	10	43	57	The immerſion of the ſecond ſatellite with a 22 foot teleſcope, the ſky ſerene and calm.
	6	13	11	24	The immerſion of the firſt ſatellite by a 22 foot teleſcope; and *Jupiter* was not dif-

Anno	N. S.	True Time.			
					discover'd before, till the ſatellite was now diminiſh'd.
1727	*Sept.*	9	13^{h}	21$'$	35$''$ The immerſion of the ſecond ſatellite by a 22 foot teleſcope, the ſky ſerene.
		10	9	34	30 The emerſion of the third ſatellite by a 22 foot teleſcope; the ſky calm, but not every where ſerene.
		15	9	36	32 The immerſion of the firſt ſatellite by a 22 foot teleſcope, the ſky ſerene and calm.
	Oct.	31	10	8	48 The immerſion of the firſt ſatellite by a 15 foot teleſcope; ſomewhat doubtful by reaſon of the wind, clouds and vicinity of the moon.
	Dec.	2	8	46	30 The emerſion of the firſt ſatellite by a 22 foot teleſcope, exact: The weather very ſerene, notwithſtanding the nearneſs of the ſatellite and *Jupiter*.
		12	14	6	0 The emerſion of the third ſatellite by a 22 foot teleſcope, the ſky calm, but not entirely clear.
1728	*Jan.*	8	12	14	44 The emerſion of the ſecond ſatellite by a 15 foot teleſcope, certain only within a few ſeconds, becauſe of the ſtrength of the wind.
			12	33	34 The emerſion of the firſt ſatellite by a 13 foot teleſcope within a few ſeconds, by reaſon of the ſame wind.
		10	5	58	7 The emerſion of the third ſatellite by a 22 foot teleſcope, uncertain by a few ſeconds, by reaſon of the ſtrong winds,
			7	0	12 The emerſion of the firſt ſatellite by a 22 foot teleſcope; the winds were a hindrance.
		17	7	56	31 The immerſion of the third ſatellite by a 13 foot teleſcope.
			8	53	4 The emerſion of the firſt ſatellite by a 22 foot teleſcope, exact.
			9	55	14 The emerſion of the third by a 22 foot teleſcope, good.
	Febr.	16	10	59	26 The emerſion of the firſt ſatellite with a 22 foot teleſcope, within a few ſeconds.

Anno

Anno	N. S.	True Time.		
1728	*Feb.* 18	5^h	$28'$	$20''$	The emerſion of the firſt ſatellite with a 15 foot teleſcope, the ſky ſerene, but the *crepuſculum* ſtill bright.
	25	7	24	10	The emerſion of the firſt ſatellite with a 22 foot teleſcope, the ſky ſerene.
	27	6	40	5	The emerſion of the ſecond ſatellite with a 22 foot teleſcope, the ſky ſerene and calm.
	29	8	0	29	The immerſion of the third ſatellite by a 22 foot teleſcope, the ſky ſerene and calm; yet this obſervation is uncertain within 10 or 15 ſeconds, the ſatellite diſappearing and returning again for ſome time.
	Mar. 10	11	18	19	The emerſion of the firſt ſatellite by a 1[illegible] and 15 foot teleſcopes, the ſky clear and calm.
	Apr. 12	8	16	12	The immerſion of the third ſatellite by a 15 foot teleſcope, the ſky ſerene and calm.
		10	30	40	The emerſion of the third by a 15 foot teleſcope, the ſky ſerene and calm, and tho' *Jupiter* was not much elevated above the horizon, the obſervation is certain within a very few ſeconds.

Remarks on theſe obſervations.

The firſt obſervations were, till the month of *February*, 1727, made with a 15 and 20 foot and a half teleſcopes by my brother *de la Croyere* and myſelf. My brother very often employ'd *Campani*'s 15 foot teleſcope, but I another of 20 foot and a half, by means of which I obſerv'd the immerſions of the firſt and ſecond ſatellites later by ſix or ſeven ſeconds than my brother did by his tube. On the contrary, I ſooner diſcover'd the emerſions, entirely in the manner as we very often made trial of this in *France*, and as alſo appears from our obſervations of *Auguſt* 18, *September* 10, *December* 6, 1726, as alſo of *January* 7, 1727. There however alſo offer'd a difference of 12 ſeconds in the emerſion of the firſt ſatellite *December* 29, 1726: Not to mention other differences ſtill greater, to wit, of 21 ſeconds in the immerſion of the third ſatellite *January* 2, 1727; but this laſt difference is to be aſcribed to the ſlowneſs of the motion of this ſatellite, as alſo to the circumſtances of the time; which are mark'd on the ſide of the obſervation.

After

After that my brother was ſent to *Archangel* in *April* 1727, and had carried along with him the 20 foot and a half teleſcope, I in the other obſervations very frequently made uſe of a 22 foot tube, by means of which, as I had frequently found at *Paris*, I obſerv'd the immerſions of the firſt and ſecond ſatellites later by five or ſix ſeconds, than by the 20 foot and a half tube.

In theſe laſt obſervations I ſometimes alſo made uſe of *Campani*'s 15 foot teleſcope, and of another of 13 foot, made in *England*, and which exhibited the objects with great clearneſs: Nay very often the obſervations were made by theſe three different tubes of 13, 15 and 22 foot, being aſſiſted therein, after the departure of my brother, by M. *Krafft* and *Vignon*: But as it did not always happen that the moments of obſervation were preciſely at ſuch an interval from each other, as the lengths of the tubes required, I thought that that was to be aſcribed to the different make of the eyes; I therefore, thought it more adviſeable to rehearſe from all theſe obſervations ſuch as I myſelf for the moſt part determin'd by the help of the longeſt of all our teleſcopes: And even from the very firſt, when my brother was ſtill with me, we ſometimes labour'd under this diſadvantage, that for ſome days, eſpecially in winter, the ſun was not to be ſeen; which alſo was ſufficient to cauſe ſome error in the time. Such obſervations, whoſe true time is uncertain from this very cauſe I have aſſign'd, are chiefly thoſe of *October* 19, 28, 1727.

In the following times of the years 1727 and 1728 I was more certain of the true time, reducing oftner than at other times the motion of the clocks to the ſun, namely as the occaſion favour'd, that in the beginning of the ſpring of 1727 I might draw a meridian line according to my method in the *Memoirs of the Royal Academy of Sciences An.* 1719, p. 54.

Anno N. S. True Time.

1726 *Aug.* 9 $12^h\ 59'\ 49''$ The immerſion of the firſt ſatellite obſerv'd at *Paris*. — Correſponding obſervations of *Jupiter*'s ſatellites in the *Royal Obſervatory* at *Paris* by *Caſſini* and *Maraldi* with a 17 and 18 foot teleſcopes.

14 51 30 The ſame obſerv'd at *Peterſburg* by a 15 and 20 foot and a half tubes.

1 51 41 The difference of meridians.

But becauſe the time at *Peterſburg* at that time was not exact, but within a quarter of a minute, namely as the exceſſive *crepuſculum* and other obſtacles hinder'd, which remov'd the ſatellite too ſoon from our view, the difference of meridians ſhould thence come out ſomewhat greater: I ſhall, therefore, ſuppoſe it from this obſervation $1^h\ 51'\ 50''$. — First obſervation.

16 14 55 4 The immerſion of the firſt ſatellite exactly obſerv'd at *Paris*. — The ſecond obſervation.

	Anno	N. S.	True Time.	
		1	$18^h\ 28'\ 53''$	The period of this ſatellite by the tables.
	1726 *Aug.*	18	9 23 57	The emerſion of the firſt ſatellite as it ſhould have appear'd at *Paris*.
			11 15 49	The emerſion obſerv'd at *Peterſburg*, taking the mean time between the 15 and 20 foot and a half teleſcopes.
			1 51 52	The difference of meridians, which I take to be very near the truth, tho' in this place the vicinity of the moon was a hindrance to us. The ſame alſo happen'd at *Paris*; therefore, the difference of meridians could not thereby be varied.
The third obſervation.	1726 *Sept.*	8	15 12 5	The immerſion of the firſt ſatellite obſerv'd at *Paris*.
			1 18 29 10	The period of the firſt ſatellite according to the tables.
		10	9 41 15	The immerſion, as it ſhould have been obſerv'd at *Paris*.
			11 32 54	Obſerv'd at *Peterſburg*, taking the mean between the times of the 15 and 20 foot and a half teleſcopes.
			1 51 39	The difference of meridians.
The fourth obſervation.	1726 *Oct.*	19	10 29 53	The emerſion of the firſt ſatellite obſerv'd at *Paris*, ſomewhat dubious.
			12 21 46	The ſame obſerv'd at *Peterſburgh* by a 15 foot teleſcope.
			1 51 53	The difference of meridians.

I have ſaid in the preceeding notes to my obſervations, that I am not entirely certain about the true time of this obſervation: The ſame at *Paris* is ſomewhat dubious, as the ſatellite in both places was too near *Jupiter*, who was in oppoſition to the ſun only ſix days before; yet as the difference of meridians does not thence come out too different from the preceeding, this obſervation is not to be reckon'd ſo faulty: Yet I ſhall take away three ſeconds, as this emerſion was obſerv'd at *Peterſburgh* with a ſhorter tube than at *Paris*; ſo that by this obſervation the difference of meridians is $1^h\ 51'\ 50''$.

Anno

Anno N. S. True Time.					
1726 *Oct.*	28	$6^h\ 54'\ 35''$		The emerſion of the firſt ſatellite at *Paris*.	The fifth obſervation.
		8 47 8		The ſame at *Peterſburgh* by a 15 foot teleſcope within a few ſeconds.	
		1 52 33		The difference of meridians, which ought to be leſſen'd by $3''$, on account of the different length of the tubes, and by ſome more ſtill, by reaſon of the error which crept into the obſervation at *Peterſburgh*, and which caus'd the emerſion to appear to me later than the truth: But however this obſervation may be treated, yet it produces a difference of meridians no leſs than $1^h\ 52'\ 20''$, which is much greater than any of the preceeding: But I take the principal error to ariſe thence, namely that about this time we were ſome days without the ſun, as I have already obſerv'd; wherefore, I think that this obſervation is not to be regarded.	
1726 *Dec.*	6	5 20 20		The emerſion of the firſt ſatellite at *Paris*.	The ſixth obſervation.
		7 11 18		The ſame obſerv'd at *Peterſburgh* by a 20 foot and a half teleſcope, ſomewhat dubious.	
		1 50 58		The difference of meridians, which increas'd by $5''$, as the different lengths of the tubes require, makes the difference $1^h\ 51'\ 3''$, which is alſo to be rejected, becauſe our obſervation was ſomewhat dubious.	
1727 *Jan.*	7	8 19 0		The emerſion of the ſecond ſatellite at *Paris* obſerv'd amidſt ſmall clouds.	The ſeventh obſervation.
		10 10 0		The ſame at *Peterſburgh*, taking the mean between the tubes.	
		1 51 0		The difference of meridians, which, on account of the clouds, doubtleſs, retarding the obſervation at *Paris*, ſhould be increas'd by ſome ſeconds: But as the quantity of this retardation cannot be eſtimated, this obſervation alſo ſhould not be admitted into a deciſive *computus*.	
1727 *Aug.*	21	12 58 30		The immerſion of the firſt ſatellite at *Paris*, where, as the ſatellite was entering the ſhadow, it was loſt by the wind ſhaking the tube.	The eighth obſervation.
		14 50 30		The ſame at *Peterſburgh* by a 22 foot tube.	

Anno N. S. True Time.

$1^h\ 52'\ 0''$ The difference of meridians, which ſhould be diminiſh'd by ſeven or eight ſeconds, on account of the different length of the tubes, and by ſome ſeconds more, becauſe of the agitation of the wind, which marr'd the *Pariſian* tube, and remov'd the ſatellite too ſoon from the view: We may, therefore, ſuppoſe the difference to be $1^h\ 51'\ 50''$, not very different from the others.

The ninth obſervation. 1727 *Aug.* 30 11 15 18 The immerſion of the firſt ſatellite obſerv'd at *Peterſburgh* by a 22 foot tube, the ſky clear and calm.

1 18 29 5 The period of this ſatellite according to the tables.

28 16 46 13 The immerſion as it ſhould have happen'd at *Peterſburgh*.

14 54 7 The immerſion obſerv'd at *Paris*, where the ſatellite eſcap'd the view, *Jupiter* falling in among thin ſmall clouds.

1 52 6 The difference of meridians to be diminiſh'd by ſeven or eight ſeconds, as the preceeding, becauſe of the different length of the tubes, and by ſome ſeconds more, on account of the ſmall clouds that intercepted the view of *Jupiter* at *Paris*. Whence it will be pretty ſafe from this obſervation to ſuppoſe the difference of meridians $1^h\ 51'\ 50''$.

The difference of the meridians of *Paris* and *Petersburgh* with the longitude of *Petersburgh* from the firſt meridian paſſing thro' the iſland *Ferro*.

If now from the nine obſervations above delivered you take away the 5th, 6th, and 7th for the reaſons there given, the mean between the other ſix will come out $1^h\ 51'\ 50''$, not much wide of the truth: Whence I ſcruple not to aſſume this difference of meridians of *Paris* and *Petersburgh* for the true difference, namely in time; for, a more exact cannot be had, unleſs by a greater number of uninterrupted obſervations at both places, otherwiſe than has happen'd in the few correſponding ones we have adduced. But by the obſervations made by F. *Feuillée* in the *Canary* iſlands, in the year 1724 and compar'd with thoſe at *Paris*; the longitude of *Paris*, in reſpect of the moſt weſterly part in the iſland of *Ferro*, which is itſelf the moſt weſterly of the *Canaries*, was found preciſely of 20°, exactly as my elder brother more than 20 years before had made it, as may be ſeen in the *Journal des Sçavans Anno* 1700: And which determination he always employ'd in conſtructing his geographical maps, notwithſtanding the oppoſition of all other aſtronomers and geographers.

Con-

Converting, therefore, into degrees the difference of the times at *Paris* and at *Peterſburgh*, found above, and adding 20 degrees, the true longitude of *Peterſburgh* from the firſt meridian comes out in degrees 47° 57′ 30″.

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1726 *Aug.* 18 11ʰ 15′ 46″ The immerſion of the firſt ſatellite obſerv'd at *Peterſburgh* by a 15 foot teleſcope, the ſky clear and calm, and the moon and *Jupiter* near each other.

Obſervations of the eclipſes of *Jupiter's* ſatellites correſponding to thoſe at *Peterſburgh* made at *Bononia* in *Italy* by *Manfredi*. The 1ſt obſervation.

1 18 28 53 The period of this ſatellite at that time.

16 16 46 53 The immerſion of the firſt ſatellite as it ſhould appear at *Peterſburgh*.

1726 *Aug.* 16 15 29 0 The ſame obſerv'd at *Bononia* by a tube of 11 *Bononian* feet, or 13 *Pariſian* feet; dubious.

1 17 53 The difference of meridians, which ought to be diminiſh'd by 3 ſeconds, becauſe of the different length of the tubes: It will, therefore, be in round numbers 1ʰ 17′ 50″. But the *Bononian* obſervation was dubious: Whence alſo *Manfredi* has only ſet down the minutes.

Dec. 6 7 11 18 The emerſion of the firſt ſatellite at *Peterſburgh* by a 20 foot and a half teleſcope; dubious.

The 2d obſervation.

1 18 28 9 The period of this ſatellite at that time.

4 12 43 9 The emerſion, as it ſhould appear at *Petersburgh*.

4 11 27 45 Obſerv'd at *Bononia* by a 13 foot tube; dubious.

1 15 24 The difference of meridians, which ſhould be increas'd by about 10 ſeconds, becauſe of the different length of the tubes; it will, therefore, come out 1ʰ 15′ 34″: But the obſervation at *Peterſburgh* and *Bononia* was dubious.

29 7 15 48 The emerſion of the firſt ſatellite obſerv'd at *Peterſburgh* with a tube of 15 foot, exact.

The 3d obſervation.

5 59 26 The ſame obſerv'd at *Bononia* with a 13 foot tube.

1 16 22 The difference of meridians, to which muſt be added 3″ on account of the different length of the tubes; the difference, therefore, will come out 1ʰ 16′ 25″, which ſeems to be exact,

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exact, seeing the observation at *Petersburgh* was so, and seeing nothing marr'd the observation at *Bononia*.

The 4th observation. 1727 *Jan.* 7 10^h 10′ 4″ The emersion of the second satellite observ'd at *Petersburgh* with a 15 foot tube.

8 54 12 The same observ'd at *Bononia* by a 13 foot tube.

1 15 55 The difference of meridians. This observation is also nowise dubious, and therefore to be reckon'd exact, being first increas'd by 3″, on account of the different length of the tubes; whence by this observation the meridians will be distant 1^h 15′ 55″.

The 5th observation. *Aug.* 21 14 50 30 The immersion of the first satellite observ'd at *Petersburgh* by a 22 foot tube.

13 34 39 The same observ'd at *Bononia* by a 13 foot tube.

1 15 51 The difference of meridians. This observation, since it is not set down as dubious, should be retain'd, only taking away 12″ on account of the different length of the tubes; by this observation, therefore, the difference of meridians will be 1^h 15′ 39″.

The 6th observation. *Sept.* 6 13 11 24 The immersion of the first satellite at *Petersburgh* by a 22 foot tube; when *Jupiter* no sooner appear'd than the satellite began immediately to be diminish'd.

11 55 17 The same at *Bononia* by a tube of 13 foot.

1 16 7 The difference of meridians, to be diminish'd 12″, because of the different tubes, that it may come out 1^h 15′ 55″, which is to be assum'd for the true difference; for, tho' here at *Petersburgh* *Jupiter* did not appear till the satellite was diminish'd, yet that did not hinder me from pursuing him to his total immersion.

The 7th observation. 1728 *Feb.* 16 10 59 26 The emersion of the first satellite at *Petersburgh* by a 22 foot tube within a few seconds.

9 43 8 The same at *Bononia* by a 13 foot tube.

1 16 18 The difference of meridians to be increas'd by 12″, because of the different tubes, that so it

it may come out $1^h\ 16'\ 30''$ within a few ſeconds, beyond which degree of exactneſs this obſervation at *Peterſburgh* does not extend.

By the ſeven obſervations enumerated above, this difference was found as follows, to wit, By the 1ſt —— —— $1^h\ 17'\ 50''$ The difference of meridians of *Peterſburgh* and *Bononia* in *Italy*.

By the 2d —— —— 1 15 34
By the 3d —— —— 1 16 25
By the 4th —— —— 1 15 55
By the 5th —— —— 1 15 39
By the 6th —— —— 1 15 55
By the 7th —— —— 1 16 30

From which, if the 1ſt be taken away as differing too much from the reſt, and the mean between the other 6 be taken, we ſhall have the difference of theſe meridians $1^h\ 16'\ 0''$, which is to be receiv'd till exacter obſervations can be had in both places.

Anno. N. S.

1726 *Aug.* 9. $14^h\ 51'\ 30''$ The immerſion of the firſt ſatellite obſerv'd at *Peterſburgh* with a 20 foot and a half teleſcope, dubious by $15''$, becauſe of the *crepuſculum*. Correſponding eclipſes of the firſt ſatellite of *Jupiter* to thoſe at *Peterſburgh*, obſerv'd at *Liſbon*, by F. *Carbone* by a tube of *Campani's* of 30 *Roman* palms, or 20 and a half royal feet.

12 13 30 The ſame at *Liſbon*.

2 38 0 The difference of meridians, which may be increas'd by ſome ſeconds, becauſe of the clearneſs of the *crepuſculum*, which at *Peterſburgh*, doubtleſs, remov'd the ſatellite too ſoon from the view: I may, therefore, ſuppoſe from this obſervation $2^h\ 38'\ 10''$. The 1ſt obſervation.

Sept. 10 11 32 56 The immerſion of the firſt ſatellite obſerv'd at *Peterſburgh* by a tube of 20 foot and a half. The 2d obſervation.

8 54 54 The ſame at *Liſbon*.

2 38 2 The difference of meridians, undoubtedly very near the truth, ſince nothing can be excepted againſt both obſervations, and this difference likewiſe almoſt agrees with the preceeding.

Oct. 28 8 47 8 The emerſion of the firſt ſatellite obſerv'd at *Peterſburgh* by a 15 foot tube within a few ſeconds. The 3d obſervation.

6 8 52 The ſame at *Liſbon*.

2 38 16 The difference of meridians, to be diminiſh'd $7''$, on account of the different length of the tubes;

tubes; this difference will therefore be 2 38′ 9″ correct.

It was found by the 1ſt obſervation	2ʰ	38′	10″
By the 2d —— ——	2	38	2
By the 3d —— ——	2	38	9
Of which the mean is —— ——	2	38	7

A remark on theſe obſervations wherein is deduced almoſt the whole extent of *Europe* in longitude.

The above recited obſervations made at *Liſbon* and correſponding with thoſe at *Peterſburgh*, are, perhaps, the firſt that ever were made in *Europe* with any exactneſs at ſo great a diſtance: As, therefore, *Liſbon* is the moſt weſterly city of all *Europe*, and as hitherto there have been no other accurate obſervations made in *Ruſſia* (the moſt eaſterly part of *Europe*) beſides thoſe made at *Peterſburgh*, the preceeding difference of meridians of *Liſbon* and *Peterſburgh* may be reckon'd as the greateſt extent of *Europe* in longitude, ſo far as could hitherto be accurately determin'd by immediate obſervations: The above difference of meridians, converted into degrees of a circle, becomes 39° 31′ 45″.

Of the true meaſure of a Copenhagen *Foot and Ell, the magnetic Variation, and of the Longitude and Latitude of* Copenhagen, *&c. By* Eraſmus Bartholin. *From the* Acta Haffnienſia. Tom. I. An. 1671, 1672. p. 215.

Tranſlated from the LATIN.

The meaſure of the *Copenhagen* foot.

I Obſerve that ſuch as have careſully ſet down the meaſures of different nations, have not been ſufficiently inform'd as to thoſe of *Denmark*; for, *Snellius*, in his *Eratoſthenes Batavus*, has made the *Copenhagen* foot of 934 ſuch parts as the *Leyden* or *Rhinland* foot is 1000. But as he confounds the *Copenhagen* with the *Bremen* foot, I ſuſpect, that thoſe, who tranſmitted this meaſure to *Snellius*, took the meaſure of that foot, which probably the *Bremen* merchants us'd then at *Copenhagen*; for, it appears, that thoſe of *Bremen* formerly had a mart at *Copenhagen* (where now is the royal arſenal) and which in *Daniſh* is call'd *Bremerholm*, doubtleſs, taking its name from the merchants of that country living there. When we of *Denmark* have occaſion to employ the *Copenhagen* foot, we uſe half an ell, the ſtandard whereof made of iron is affix'd to the door of the Guildhall at *Copenhagen*; yet I found it by no means to agree with that proportion publiſh'd by *Snellius*; for, applying myſelf to inveſtigate that meaſure, I found that the *Copenhagen* ell was of 2008 ſuch parts, as the *Rhinland* foot is 1000; and conſequently, that the *Copenhagen* foot or half ell is 1004, and alſo that the cube root of the *Copenhagen* gallon is 0,392: But as the preceeding year, *viz.* 1671, M. *Picart* carried along with him a very exact meaſure of the

the *Paris* foot, to the end that he might compare the meaſures of different nations with his own; we tried what proportion the *Copenhagen* ell might have to the *Paris* foot, and making this laſt of 1440 parts, as alſo the *Leyden* foot of 1390, the exact proportion of the *Paris* toiſe to 3 *Copenhagen* ells was found as 720 to 701: But let poſterity obſerve, that we here make mention of the *Copenhagen* ell according to the ſtandard at this day; for, probably it may be different from the ancient, as the old ſtandard of the *Copenhagen* ell was ſome years ſince loſt in the ſiege of the city: Whence there might eaſily creep a miſtake into the new one, and its diviſions. But as to the meaſure of the preſent ell there is no ſcruple; and the curious in meaſures may ſafely uſe the proportion above-mention'd.

The magnetic variation at *Copenhagen.*

It is now commonly thought, that the magnetic declination is ſubject to a more perplex'd motion, and that in the ſame places it ſometimes inclines to the eaſt and ſometimes to the weſt. Authors teſtify, that they have found this by ſeveral experiments, and in 1649 I find, that at *Copenhagen* the needle varied 1 degree and a half to the eaſt, according to *Hermann Luchtemacher*, the king's compaſs-maker at that time. But as the unwary eſpecially may be eaſily deceiv'd by a fallacious obſervation, we thought proper to make trial of this matter in the garden adjoining to my houſe with a very exact needle, which the above-mention'd *Picart* brought with him; and by this obſervation we found, that it declin'd from the north to the weſt 3 degrees 35 minutes. In the iſland of *Huen* the declination by the ſame needle ſhew'd to our ſurprize 2 degrees 35 minutes; a difference of a whole degree in 3 miles diſtance.

The latitude of *Copenhagen.*

The illuſtrious *Chriſtianus Severini Longomontanus* had formerly deduced from his obſervations the elevation of the pole at *Copenhagen* 55° 43′, with which we were hitherto ſatisfied, as being very agreeable to the truth, till with exacter inſtruments in our *Obſervatory* we could define it with more certainty; and tho' the obſervations were made with a larger ſextant and which is ſtill extant, and tho' there is no doubt to be made of the fidelity and induſtry of ſo experienc'd a perſon; yet as the diviſions of the limb do not come up to the perfection of *Tycho*'s inſtruments, we may juſtly hope for more accurate obſervations for eſtabliſhing the latitude of this place. *Riccioli* from his obſervation of the ſun's parallax concludes, that this elevation is too little, and he thinks that 55 degr. 45 min. are more agreeable to the truth. We made trial of this matter along with M. *Picart*, with very exquiſite inſtruments brought from *Paris*, being the very ſame with which he had before diſcover'd in *France* the quantity of a degree of a great circle in miles: But we obſerv'd it rather greater by 1 minute and a half than too little. From theſe very accurate obſervations, therefore, we have the exact elevation of the pole, or the latitude of *Copenhagen*, 55 degr. 41 min. 30 ſec.

The longitude of *Copenhagen*.

That we might with certainty define the longitude of *Copenhagen*, or the difference of meridians between our *Observatory* and *Uraniburg*, on account of the advantage we hope to reap from the obſervations of *Tycho*, it was no difficult matter in ſo ſmall a diſtance to attempt the thing in different ways; and we principally employ'd ſurveying, taking a very long baſe, of a certain determinate number of toiſes, in the iſland of *Huen*, and often repeating the obſervation to avoid any ſenſible error; and then it appear'd, that the diſtance between the *Obſervatory* and

Helſingor	——	20242
Uraniburg	——	13494
Landſcron	——	13651 *Paris* toiſes.
Lunden	——	19937
Malmoe	——	14420

Obſervers were alſo ſent into the iſland of *Huen*, under the direction of *Olaus Romer*, with a very correct clock, teleſcopes, and an aſtronomical quadrant, in order to obſerve the eclipſes of *Jupiter*'s ſatellites, while we in the *Obſervatory* applied ourſelves to the ſame thing: And laſtly, we often us'd burning torches in that window of the *Obſervatory* which looks towards the iſland of *Huen*, which torches at certain intervals of time we hid again, and to thoſe in the iſland they exhibited a ſight not unlike the eclipſes of *Jupiter*'s ſatellites; for, we charg'd them accurately to obſerve the times of occultation, either by the eye or by the teleſcope: And by theſe experiments we found, that the *Obſervatory* at *Copenhagen* is 29 ſeconds of time more weſterly than *Uraniburg*.

The determination of a meridian line in the *Obſervatory* at *Copenhagen*.

It will not be foreign to treat of this matter, as there is ſome ſuſpicion about the variation of the meridian line. I had the preceeding year, along with M. *Picart*, paſs'd over into the iſland of *Huen*, in order to diſcover the traces of the caſtle of *Uraniburg*, and to obſerve the place where for ſo many years aſtronomical obſervations were made. It would have been a difficult matter for us exactly to determine the place itſelf, had I not had the obſervations of the angles of poſition in one of the volumes of obſervations, formerly ſet down by *Tycho* himſelf, with a deſign of drawing a true meridian line there; and then we were all greatly ſurpriz'd at the difference between them, and thoſe ſet down in the ſecond volume of obſervations, and carefully repeated ſeveral times; nor were we ignorant of the errors ariſing from the obſervations themſelves, or the diverſity which may be caus'd from the variety of the inſtruments employ'd; for, the line of aim is more certain by teleſcopic than by common ſights. But ſo conſiderable errors, as we had diſcover'd, ſeem incompatible with the extraordinary induſtry of *Tycho* in a no difficult obſervation, and which is the baſis of the reſt: Wherefore, tho' our *Obſervatory* may ſome time or other feel the calamities of time, yet from the following obſervations poſterity may judge, whether the meridian line is ſubject to variation.

Helſingor

	Degr.	Min.	Sec.	
Helſingor —— —— ——	3	26	40	N. E.
The right ſide of the turret of the church in *Huen*, by *Tycho*	13	52	40	N. E.
The place of *Uraniburg* mark'd by us —— ——	16	40	0	N. E.
The middle between the two turrets of *Lunden* ——	86	1	0	N. E.
Malmoe —— —— ——	73	3	10	S. E.
The middle between the two turrets of *Rotſchild* ——	82	21	15	S. W.

The angles of poſition obſerv'd from the middle of the *Obſervatory* at *Copenhagen*, *An.* 1672. with an iron quadrant and teleſcopic ſights.

Aug. 24. In the morning the ſpot was firſt obſerv'd in the ſun's eaſtern limb. A ſolar ſpot obſerv'd *An.* 1671.

Aug. 29. The ſame ſpot, which appear'd to conſiſt of three bodies, was in the meridian after the ſun's centre 15 ſeconds of time, and was 1 min. 40 ſec. more ſoutherly than the ſame centre.

Sept. 1. The ſpot in the meridian preceeded the ſun's centre 10 ſec. of time, and was 1 min. 25 ſec. more northerly.

Sept. 2. In the morning it preceeded the ſun's centre 33 ſec. of time, and was 4 min. 50 ſec. more northerly.

Sept. 6. In the morning the ſpot was no longer ſeen.

March 12. About 9 in the evening the comet was obſerv'd below *Meduſa*'s head; the head of the comet appear'd ſmall, unform'd, and but little luminous; the tail was broader, but ſcarce a degree in length; it was diſtant from *Meduſa*'s head 5 degr. 50 min. and from *Andromeda*'s foot 10 degr. 30 min. A comet obſerv'd at *Copenhagen* in 1672.

Mar. 13. About 8^h 20′ in the evening it was diſtant from *Meduſa*'s head 5 degr. 32 min. and from *Andromeda*'s foot 12 degr. 25 min.

Mar. 16. At 8^h and a half in the evening, the comet was ſeen (in the manner repreſented by the Fig.) between two ſtars, which are not found in the catalogue of ſtars. Fig. 12. Pl. IV.

Mar. 17. At 8^h and a half in the evening, the comet was diſtant from the ſouth foot of *Perſeus* 4 degr. 23 min. 20 ſec. and from *Perſeus*' knee 8 degr. 32 min. 30 ſec.

Of the Coral-Fiſhery, &c. *From the* Breſlaw Collection. December 1717. Claſs IV. Art. IV. p. 430.

Tranſlated from the HIGH-DUTCH.

IT is well known of coral, that, beſides its medicinal uſe, it is commonly employ'd, and that chiefly as an ornament, and partly alſo on a religious account in roſaries; and for the moſt part with us in toys (which are The manner of fiſhing for coral.

the moſt uſual ornaments of the common people, whence conſequently, there is a great conſumption of it) yet, according to its different degrees of bigneſs and beauty, coral gives a different price; tho' generally among all other precious things it is the cheapeſt: Whereas in *Aſia*, on the contrary, its value is much higher, and it is eſteem'd among them as much as pearls among us[a]. So that this great conſumption of coral would ſeem to require its being very plentiful; and yet it is found no where but in one particular tract, namely, in the *Mediterranean* and *Tuſcan* ſea about *Majorca*, *Corſica*, *Sardinia*, and *Sicily*, as alſo near *Catalonia*, and on the *African* coaſt, *Tabarco*. Here the coral-ſhrubs, growing on the rocks at the bottom of the ſea, are fiſh'd for from *April* till the cloſe of *July*; and this fiſhery is carried on with upwards of 200 ſmall veſſels, which are built at *Genoa*, and are very light and carry a large ſail, and run ſo ſwift that a ſhip cannot eaſily come up with them. Each of them is mann'd with ſeven hands and a boy: Upon this they proceed to the coaſt where the coral is to be found. They join together two large beams croſswiſe, and in the middle fix a large piece of lead for the timbers to ſink. Theſe croſs-beams are wound round with ſeveral coarſe, looſe-twiſted, and rough ropes that hang down; and, by means of a rope that hangs with one end at the forepart, and with the other at the hinder part of the ſhip, they are let down into the ſea. Now as the ſhip ſails along the rocks, and drags the croſs-beams after it, the coral-twigs are entangl'd in the locks of the ropes; and in this manner they are hal'd up with the beams; but to this more than one ſhip is commonly neceſſary, and yet there always falls into the ſea more of the coral than is taken up; then it is clear'd of the ſlime and rind, and by the turners form'd into coral, with which they carry on a great trade far and near, particularly in *Italy*, and more eſpecially at *Genoa* and *Leghorn*[b].

Different ſorts of factitious coral.

Several people have ſhewn different methods of making coral by means of art; partly with fine ſhavings of harts-horn, diſſolv'd in a *lixivium* of the aſhes of the aſh-tree and with cinnabar; and partly with *calx* of plaiſter of *Paris*, *minium* and cinnabar, by means of the whites of eggs and a calx-lee and wine; partly with harts-horn, plaiſter, tragant, gum-arabic and cinnabar; partly with ox-horn ſhavings, diſſolv'd in a ſtrong lee, and afterwards boil'd and with cinnabar, and partly in another manner: And that its colour may be the darker, ſome uſe *ſanguis draconis*, *hæmatites*, ſaunders, *&c*[c]. Whereas, on the contrary, the turners at *Nuremberg* are maſters of a more ſimple contrivance of making bones red, in ſuch manner that the balls turn'd of them may deceive a great many people: Nay

Anſelm

[a] *Tavernier* Voyag. *lib.* II. *c.* 28.

[b] *Vid.* Aſiat. und African. Denckwurdigk *p.* 316. —— Kunckel's glaſs-macher-kun *p.* 457. —— La Sardaigne Paranymphe *p.* 9. —— Marperger Kauffmann's Magazine *p.* 33 *ſeq.* beſides many others. Valentin. Muſæum Muſæorum *p.* 104.

[c] *Vid.* Ganſii *hiſtor. Corall. cap.* 10. *p.* 116, *ſeq.*

Anſelm. Boetius de Boot[d] ſhows how to imitate entire branches and ſhrubs of coral by means of ſticks of old wild pear-tree, and a paſte of cinnabar, colophony and wax. And *Chæffelius*[e] was maſter of the like ſecret. Yet all theſe cheats are by ſeveral methods very eaſily diſcover'd. We have lately ſeen another factitious ſort of coral, entirely different from the above counterfeits, in regard that this artificial coral was exactly of the colour of true coral, and not of a bright red, but almoſt of a purple or blood-colour, entirely ſmooth and hard, and neither heavier nor lighter than other coral. Upon ſcraping it with a knife it yielded a fleſh-colour powder, exactly like the true coral. The ſurface of this coral was, it is true, by this means white, but by gently wetting it, it immediately became red again, and the whole ſubſtance thereof was throughout of a like redneſs. It made as ſtrong an efferveſcence with ſpirit of nitre as true coral does, and yielded a yellowiſh *magma*, as well as that other, and in biting it, it imparted to the teeth as grating a ſenſation as the genuine coral: And yet for all this it was not the leſs counterfeit; as partly appear'd by its internal ſubſtance, which ſparkled throughout like ſmall cryſtals, and alſo ſhewed a texture as gritty as marble, and conſiſting of the like ſmall *moleculæ* with it; partly as it was not ſo hard as the genuine coral; partly as it yielded no ſharp *calx* by calcination, as the true coral does, which indeed loſt its colour and only became a little ſofter, as all calcin'd ſtones do, but did not change its taſte; yet there was found this difference, namely that as the genuine coral with ſpirit of vitriol taſtes entirely vitriolic, as M. *Lemery* remarks in *l'Hiſt. de l'Acad. Royale des Scienc. An.* 1711; this factitious coral had no ſuch taſte. And we are of opinion, that this matter is nothing other than a ſort of red marble, ſuch as is found in great plenty in the mines at *Annaberg*, at *Hildeſheim*, in *Bohemia*, and in other parts[f].

A new kind of Lamp. *By* Joh. Chriſtophorus Sturmius. *From the* Acta Eruditorum Lipſ. An. 1683. p. 304.

Tranſlated from the LATIN.

THIS new kind of lamp conſiſts of two parts; one, the lamp itſelf A, with its noſe B, made after the common manner for receiving the wick; the other, a ſmall veſſel C, for gradually pouring out the oil into the lamp, and which at the ſame time ſerves for a cover: It is cloſe above, and below at the bottom it is pierced with ſeveral holes; in the middle of its bottom is ſolder'd a ſomewhat wider pipe EDF, ſo as not to reach the upper parts of the veſſel about E, and about F to enter about a quar- Deſcription of this lamp. Fig. 13. Pl. IV. Fig. 14.

[d] Gemmar & lapid. *hiſtor. lib.* II. *cap.* 156. *p.* 159.
[e] Miſc. Nat. Cur. *Dec.* I. *An.* 6. & 7. *app. p.* 67.
[f] *Vid.* Albini Meiſſn. Berg. chron. *tit.* 21. *p.* 163. Agricola *de nat.* foſſil *lib.* VII. *c.* 4. *p.* 627. *Kentmann.* Nomenclat. *rerum foſſil tit. Marmora p.* 54.

a quarter of an inch within the cover of the lamp, which has 4 large holes; and the orifice of the pipe is to be exactly in a level with the cover and parallel thereto; through this orifice F, upon inverting the veſſel, the oil is pour'd in without any great precaution; and when it is fill'd, and the orifice F ſtopp'd with the finger, it again returns into its proper ſituation, and upon removing the finger below, it is nimbly put on the lamp and faſten'd by its hooks, affixt to the cover, ſo as to appear in the form repreſented by Fig. 15. Pl. IV. Fig. 15. In this conſtruction of a lamp, which I believe is leſs operoſe than any other, the following things happen.

Obſervations thereon.

1. No oil runs out thro' the holes of the bottom D, as long as the lower orifice is ſtopp'd by the finger and the external air excluded.

Fig. 14.

2. But upon removing the finger (which ought not to be done before the cover is juſt near put on the lamp) the oil, forced in ſmall threads thro' the holes of the bottom by the ingreſs of the air thro' the pipe E F, is collected through the larger apertures of the cover into the internal cavity of the lamp, till with its uppermoſt ſurface it touches the orifice of the pipe F: But then

3. That the air, moreover, may not enter and force itſelf into the veſſel through the tube now clos'd by the oil, the flux of the oil is ſtopp'd, which is afterwards to be gradually conſum'd by the burning of the wick in B.

4. But if the oil is conſum'd ſo much, that its uppermoſt ſurface does no longer reach the lower orifice F of the pipe, the air, having free acceſs thro' the holes of the cover, ſuddenly inſinuates into the open tube, and tending upwards forces out again as much oil as is again ſufficient to ſtop up the pipe below: And this afterwards happens alternately ſo long, till the veſſel C is exhauſted: But this veſſel may be commodiouſly taken off the lamp by undoing the hooks of the cover, be again fill'd, and at length put on again, the flame of the lamp in the mean while being neither extinguiſh'd, nor in any ſort diſorder'd thereby.

5. But in regard I have learn'd by experience, that on account of the almoſt inſenſible conſumption of the oil, only a very ſmall portion of air is admitted at each time, and few drops of oil are forced out thereby, I found that a great number of ſmall holes in the bottom were not ſo neceſſary, but that three or four narrow pipes, exactly anſwering to the holes of the cover, might ſuffice; in which caſe a ſmaller and more managable capacity of the lower lamp would abundantly anſwer, and we ſhould have the leſs reaſon to be afraid of dirt, and the upper veſſel (which may be commodiouſly made of glaſs, and nicely ſolder'd to the metalline rim D E, that the want of oil therein may be the more eaſily obſerv'd by the eye) might be of any bigneſs at pleaſure, ſo as to ſuffice to feed the lamp for ſome months ſucceſſively.

Fig. 16.

Of

PLATE IV.

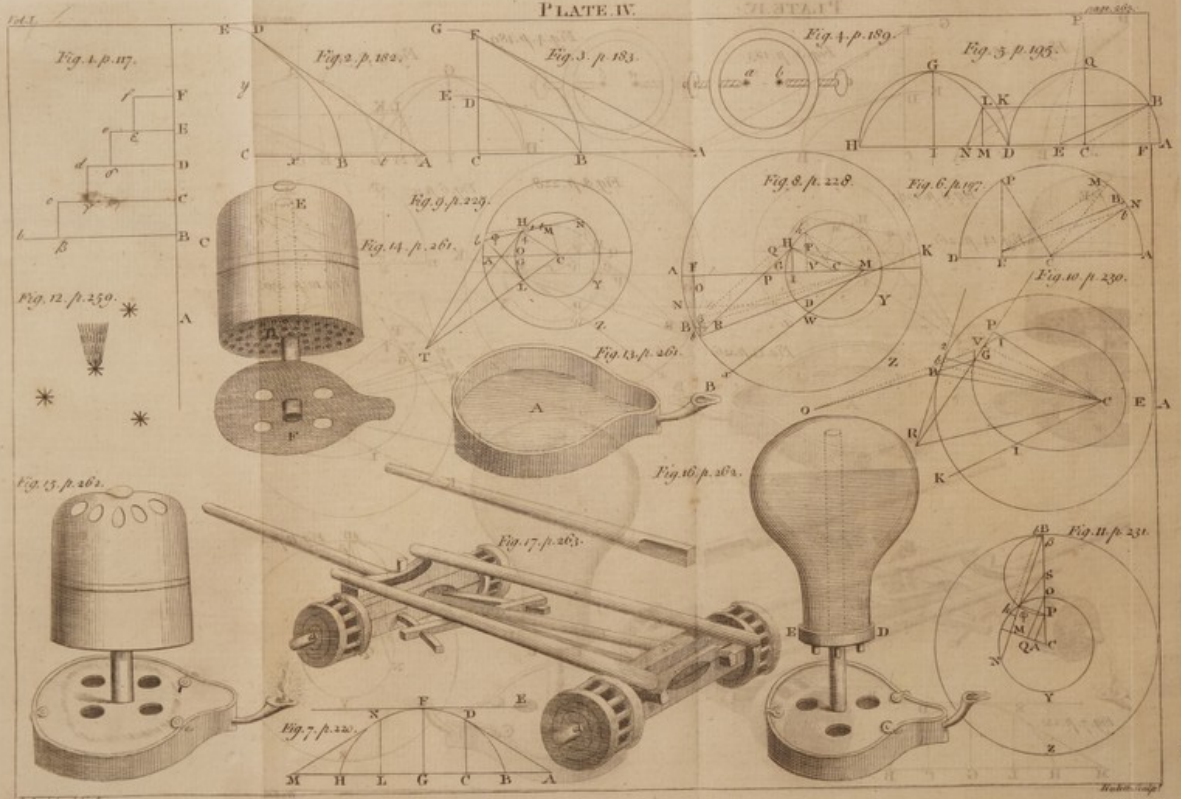
Fig. 1. p. 117.
Fig. 2. p. 182.
Fig. 3. p. 183.
Fig. 4. p. 189.
Fig. 5. p. 195.
Fig. 6. p. 197.
Fig. 7. p. 221.
Fig. 8. p. 228.
Fig. 9. p. 229.
Fig. 10. p. 230.
Fig. 11. p. 231.
Fig. 12. p. 259.
Fig. 13. p. 261.
Fig. 14. p. 261.
Fig. 15. p. 262.
Fig. 16. p. 262.
Fig. 17. p. 263.

Of a new and easy sort of Wheel carriage for great Loads. From the Breslaw Collection, Nov. 1717. Class V. Art. IV. p. 360.

Translated from the HIGH-DUTCH.

THIS machine consists of a wheel-carriage, which is otherwise of a common structure except as to the wheels, whereby the greatest loads may be carried by a very small or easy impulse. The first invention of this machine was owing to the ingenious mathematician, *Hartmann*, who made use of it at *Gotha* for carrying a very heavy statue, and by it, by means of four men, the statue was brought with all imaginable ease to the desired place, which otherwise would be difficult to effect with a great number of horses. As soon as we were inform'd of this invention, we caus'd make a model of the machine; and we found in fact, that two of the strongest men, and of a pretty good weight standing on it, might by means of two levers, be carried along by a single man, nay by a child, and that very commodiously and without any straining. And as in the presence of a great personage about 20 hundred weight were carried along by four boys, so it is probable, that upwards of 80 hundred weight might be driven along by four strong men. The whole mechanism of this machine depends on the wheels, as the rest of this sort of carriage, may, according to the uses it is design'd for, be accordingly fram'd. These wheels consist of a pair of trucks, which at the rims are fastened to each other with cross-staves, yet so that these staves stand pretty near each other, and require no greater opening between them than what may receive the lever. Each wheel, when the load is great, requires one man; and these four men together, can by means of levers stuck into the interstices of the staves, and whereby the wheels are mov'd, drive the carriage with the load backwards and forwards; and by a fifth person the machine may be directed and turn'd; and this is done with much greater ease and advantage than is possible by means of horses; in regard a greater number of these is requisite, and even then they cannot be made to draw equally; and besides, they require more room, which in crooked and narrow places is not always to be had. It is true, that by this machine the carriage is more tedious than by horses, and it likewise has some disadvantages in claiey bottoms and deep roads, tho' it is not to be denied, but that in hilly, crooked and other impassable places, as also in arsenals, large buildings, stone-bridges, it may be us'd for carrying along large statues, *&c.* with much greater commodiousness and advantage than by horses, especially if one applied himself to bring this machine to greater perfection by some additional improvements.

Description of this machine. Pl. IV. Fig. 17.

Of

Of the nature of Amber, and Experiments thereon. From the Acta Haffnienſia, Tom. I. An. 1671 and 1672, p. 110.

Tranſlated from the LATIN.

Of the nature of amber.

FROM the new pits of *Copenhagen* were dug ſeveral pieces of amber of various ſizes. We are to obſerve, that the diggers remark, that wherever they find amber, they there find along with it its *matrix*, to wit, the barks of the oak, near which it does not only lie, but firmly adhere to them, as may be plainly ſeen in various pieces. There is alſo another mineral body, to wit, a black, and as it were, burnt wood, to which the amber alſo adheres; yet I could readily take it for ſome *bitumen* or other, or for a black amber, did not its ſmell, which in burning is diſagreeable, diſſuade me from this opinion; and that it is rather to be taken for the remains of that burnt wood; yet *Camden* in his deſcription of *Whitby* relates, that ſuch black amber or agate is alſo to be found in *Britain:* And we have ſeen it dug out of the pits of *Copenhagen.* Whatever it be, it is no eaſy matter to determine, whether amber grows in theſe mineral bodies, or whether by the waſhing of the *Baltic* ſea, to which formerly a great part of *Copenhagen* lay expos'd, it be driven hither from other countries, where either oaks or other reſinous trees tranſude this matter. We remember, that ſometimes in the inland hills of *Zeeland* were found pieces of it; and not long ſince a piece of amber of the bigneſs of a man's head was thrown up by the plough in the farm of *Tygeſtrup.* But as no part of the iſland is free of the adjoining ſea, ſo our diggers have obſerv'd, that they find no amber in the city pits, before they come to a bottom anſwering to the depth of the ſea. That all amber was originally ſoft appears from various experiments; 1. *Andreas Aurifaber* ſaw a flexile and ſoft piece managable like wax: and there is ſuch a piece in *Wormius'* poſſeſſion. 2. In ſome pieces there floats a liquor or fluid drop; and ſuch a piece I lately ſaw with *Ivarus Scholerus.* Upon raiſing the amber upwards the drop moves and puts on in three places, firſt a globular figure, and then in its progreſs an oblong form, and at laſt becomes plain, which, doubtleſs, is owing to the figure of the containing place. What this liquor is, is no eaſy matter to determine: It may, probably, be petrol, kept here uncorrupted for ages; for, the ſame *Scholerus* ſhow'd another piece, which, but gently touch'd with the finger, would yield the ſcent of petrol. *Daniel Hermann* in his *Diſcurſus philoſophicus de Succino Pruſſiaco,* ſuſpects, that he obſerv'd water floating in a like piece, and increaſing with the moon, and without any waſte thereof; and he wonders, why the water is not dried up, whether the amber preſerves it uncorrupted, or that it is not common water; and that this laſt is true appears from that piece of *Scholerus'*, becauſe the liquor aſcends like ſpirit and oil; nor could

could it be included air, which muſt have eſcap'd long before. 3. Many inſects, *animalcula*, and other things are ſeen in amber, which were entangl'd in its formerly ſoft ſubſtance, as in a glue, and were harden'd in that poſition of the body wherein they were entangl'd. As to flies, gnats, ſpiders, ſtraws, *&c.* it is a thing commonly known. The above *Scholerus* has one piece of amber, wherein an entire cricket floats extended, and another piece, wherein two gnats are obſerv'd *in coitu*. *Joh. Wigandus*, in *Hiſtor. Succin. Boruſſ.* relates, that *Jo. Gobelius* had a piece of amber, in which was ſeen, as if alive, a green frog, which uſually ſits on the leaves of trees. And *Dan. Hermann* relates, that a lizzard was found in amber: And *Frederic* the Third, king of *Denmark*, had ſuch a piece. *Andr. Aurifaber*, *cap.* 1. has related, that fiſhes and their ſpawn are involv'd in amber. And that we may not doubt of its vegetable origin, a cone of firr has been obſerv'd in a piece of amber, of which *Scholerus* made a preſent to *Picart*. 4. A plain proof of this is a piece of ſoft amber thrown into the ſea, wherein was included a paper, on which was mark'd the year it was done, that poſterity might learn, whether that ſoft piece of amber would, in tract of time, undergo any change. In an age after, the ſame piece thrown out by the ſea, was ſolid and hard, with its included paper: And hence it appear'd to the curious, that it ow'd its hardneſs to the ſalt of the ſea; and this I was told by *Hen. Crentzfeldius* from a diſputation of *Andreas Concius*, profeſſor of mathematics at *Konigsberg*, *Anno* 1660. We, therefore, doubt not but it was a liquid roſin, or the tears of a tree, concreted and harden'd by the ſalt of the ſea, or by length of time on the ſea-ſhore; tho' others from probable reaſoning ſuſpect, that it is compacted into this ſolid form from a fatty *bitumen*.

The generation of amber will be illuſtrated by its analyſis. Naturaliſts doubt not, but that it may be diſſolv'd again, and after diſſolution be coagulated, or made into a ſolid maſs; they keep the method of doing this as a ſecret, tho' *Anſhelmus Boetius*[a] enigmatically diſcloſes it, and propoſes it to be divin'd by a true naturaliſt. I have tried ſeveral experiments along with *J. Gothofredus Becker*, an ingenious apothecary, which I ſhall briefly relate, and thereby give a handle to others farther to inveſtigate theſe myſteries of nature. Experiments on amber.

1. Amber, being groſsly pounded and put into hot wax, could not be obſerv'd to become ſoft; that indeed it united with the wax, but by the taſte diſcover'd its roughneſs.

2. We tried the ſame with roſin of firr, as being of affinity with it; but the maſs coagulated from it, by its unequal appearance, fruſtrated our hopes.

3. Infuſing it in oil of ſpick, in petrol, and in oil of turpentine, it did not ſuffer itſelf to be entirely diſſolv'd, but by the taſte it diſcovered ſome grittineſs.

[a] *Lib.* 2. *cap.* 159, 162.

4. The experiment ſucceeded in diſtill'd oil of lavender; for, by a gentle heat in a glaſs the amber was, as it were, reſolv'd ſenſibly into a mother of oil, which by the taſte was entirely equal and ſoft; other diſtill'd oils will produce a like effect, as alſo rectified ſpirits of wine: Whence an excellent remedy is got from amber, impregnated with its own oils.

5. It runs with a vehement flame, but it loſes its brightneſs; it becomes brittle, if coagulated, like a roſin.

6. To make it again concrete and harden, there is an eaſy method by evaporating the diſtill'd oil.

7. In a cloſe and well luted crucible, with a moderate fire, the duſt of amber does, like a glebe, collect into a ball, but it is eaſily beat ſmall; in a ſtrong fire it melts and being harden'd, it adheres to the ſides, with the ſmell of burning amber, tho' it collects by heat alone, without a flame.

8. Oil of amber is not coagulated by pouring ſpirit of ſalt to it, as ſome give out, but the oil floats a-top, and does not mix with it.

9. It is well known to ſuch who uſe amber in lac-works, that in lintſeed oil it may be boil'd to a liquid conſiſtence; I doubt not, but it may be diſſolv'd and coagulated, by other methods, as a *Dutchman* at the exchange at *Copenhagen*, knows how to diſſolve pieces of cryſtal, and blow them into new elegant glaſſes.

Olaus Borrichus, communicated to me an elegant experiment, tried by him ſome years ago: He committed petrol to a gentle heat in an alembic for three weeks, after which, with a ſtronger fire, he forced out its oleaginous humidity, and by repeated diſtillation, he abſtracted the remaining liquor, if there was any, whereby there was left behind a ſolid body, harden'd by the fire, and emulating amber both in brightneſs and electricity; yet this maſs was more brittle than true amber.

An Account of Tea and the manner of preparing it, &c. *From the* Breſlaw Collection, December, 1717. Claſs V. Artic. I. p. 443.

Tranſlated from the HIGH-DUTCH.

Tea and the ſeveral ſorts thereof

THE tree that yields the tea has a ſtem from top to bottom, furniſh'd with many branches; the wood thereof is very hard, firm, and provided with a thin brown rind; the leaves, both in ſize and other reſpects, come neareſt to thoſe of the four cherry, and when freſh, they are without any ſmell; but in harveſt the bloſſoms grow upon ſhort ſtalks behind the leaves of the tree, and conſiſt of ſix white ſmall blades, which ſmell diſagreeably and taſte bitter; from which there comes a fruit not unlike the pods of the *American Palma Chriſti*: So that one, two, nay three of them, as big as ſloes, hang together on one ſtalk, whoſe outmoſt huſk burſts at laſt, and out of it falls a ſmall round nut with a thin ſhell, not unlike a cheſnut, whoſe kernel, like a hazel-nut, is again encompaſs'd with

with a brown downy ſubſtance; but the kernel itſelf is white, firſt of a ſweetiſh and then of an oily, diſagreeable taſte, which together with the flowers is of no ſervice to the inhabitants. As to the planting of theſe trees, they are propagated by the ſeed; ſo that, particularly in *Japan*, they ſet them in furrows and ridges of the fields, but not nigh each other, that they may not caſt too large a ſhade, and prove prejudicial to other plants. The ſeed itſelf, before it falls out of the outmoſt huſk, is ſet in the earth from one to one and a half foot depth, ſo that at leaſt there are put from 6 to 12 nuts in one place, as commonly not the fourth or fifth of them is wont to come up. After they come up, the young trees are laid round with horſe-dung and thus manur'd, and this is repeated yearly by good planters. After three years they begin to pick off the leaves below for the firſt time, and that pretty plentifully, which gives the beſt tea. In 8 or 10 years they attain to the ordinary bigneſs of a man, at which time, as in proportion they ſend forth few and conſequently hard leaves, they are again cut down, which is the reaſon that a great number of new ſuckers ſpring from the root, which yield more leaves than the tree did before. The firſt crop happens before the vernal equinox, and is gather'd by a peculiar number of hands, and tho' in this crop the ſmalleſt leaves are obtain'd, yet they are, as being young, and for the moſt part not quite ſpread out, the beſt and moſt valuable tea, and is only us'd by great and rich people; wherefore in *Japan* it is call'd *Imperial* tea, and in *China*, *Thea buu*. The other crop is in *April*, and the bloom together with the buds, that grew cloſe together, are gathered; the laſt are pick'd out, and according to their goodneſs, are reckon'd equal to thoſe of the firſt crop: But at laſt in *May* all is fully gather'd; which crop, indeed, yields the greateſt plenty of leaves, and more than both the other crops together; but they are reſerv'd for the uſe of the poor and common people. Theſe three aſſortments have therefore different names: So, that in *Japan* in particular the firſt is call'd meal-tea; the ſecond, *Chineſe* tea; the third, ordinary tea; and then the worſt of all, common tea.

All theſe ſorts are previouſly prepar'd in the following manner: The new pick'd off leaves are dry'd or roaſted, 'till they become criſp, upon an iron plate, under which a fire is made; and by this means the leaves are not only preſerv'd from corruption and become more commodious for packing, but they are alſo freed from their ſtrong and noxious quality; wherefore, to obviate this, they in *China* beſides, as was mention'd above, ſcald the tea with hot water. In each city there are publickly built ſuch drying houſes; and in one of theſe there are oftentimes upwards of 20 furnaces, which are three foot high, and cover'd above with an iron plate, ſo that no ſmoke, which would otherwiſe ſpoil the tea, can come to it. The freſh leaves thrown thereon run together on the hot plate, and to prevent their burning, they muſt be continually turn'd with the hand: Afterwards they

How prepar'd.

are thrown upon a long mat, which lies upon a table, and they are roll'd with the palms of both hands, till they are entirely cold; and this operation they repeat ſeveral times, and when they would be exact in it, even till five times. In the mean time there ſweats out of the leaves a greeniſh yellow juice, which muſt be again waſh'd out with warm water, if the leaves ſhall retain an agreeable green colour. The tea thus prepar'd is well kept from the air, and put into tin-caniſters; and theſe are put into a box of firr, eſpecially when they are to be carried to *Europe*.

Tea how us'd in *China* and *Japan*.

In *China* tea is us'd moſt commonly, as with us, in infuſion; but the great and rich, eſpecially in *Japan*, take fine ground tea, and throw a ſmall ſpoonful of it into a cup of hot water, ſtir it well about, and ſip it warm, and this they call thick tea. The common people uſe to throw early in the morning ſome handfuls of the worſt ſort of tea into a large copper full of water, and boil it; and out of this every one, who has a mind to drink, takes ſome; and when it is too hot, they have cold water at hand to cool it therewith.

Some *European* herbs preferable to tea.

We in *Europe* need not much regret our being depriv'd of this tree, as we have many herbs, which are not only more wholeſome, and in particular better taſted, or at the leaſt come very near tea; and we may in particular, on account of its agreeable and like taſte, recommend lung-wort, mixt with a little *aniſum ſtellatum*, and drank in infuſion, which will not be diſagreeable to any one to drink, but more pleaſant than tea.

To promote health *Gerardus Feltmann*[b] has ſubſtituted the herb ſpeed-well inſtead of tea, as it is not brought genuine to us, but oftentimes mix'd with tea, that has been us'd before, or with ſomething elſe, and ſpeed-well is of ſervice in the gout. *Johannes Francus*, in a treatiſe, entitl'd *Veronica*, has ſhewn, that ſpeed-well is far preferable to tea in all diſeaſes; and this curious phyſician has in particular been more explicite in a ſupplement, which he afterwards publiſh'd under the title of *Veronica Theezans*. This matter is learnedly handled in a particular diſſertation of Dr. *Frederic Hoffmann*, under the following title *de infuſi veronicæ efficaciâ præferenda herbæ theæ*.

He that would farther be inform'd about tea may conſult *Jacob Maffæus* rer. Indic. *Lib.* VI. & XII. — *Matth. Ricius de* Chriſtian. expedit. *ap.* Sinas *Lib.* I. *cap.* 7. — *Joh. Bontius* dialog. VI. med. Indor. — *Joh. Linſcotus cap.* 26. — *Alex. de Rhodes* ſommaire *des* divers Voyages & Miſſions Apoſtoliques. — *Bernhard. Varenius in* deſcript. Regn. Japoniæ *cap.* 23. — *Olearius* in itin. Perſ. *p. m.* 315. — *Joh. Jac. Waldſchmied.* & *Joh. Dolæus* in epiſt. Amœbæis *de* rebus med. & philoſ. In particular *Engelbertus Kæmpfer in amœnitatibus exoticis*, who has lateſt of all travell'd this country; and many more beſides.

Of

[b] *De Dracedagra* cap. 37.

Of the Bones of the Animal, which the Ruſſians *call Mamont. By* Baſilius Tatiſchow. *From the* Acta Literaria Sueciæ. Trimeſtre II. An. 1725. p. 36.

Tranſlated from the LATIN.

THESE bones are found in the colder provinces of *Siberia*, in *Jacutſko*, *Bereſow*, and in the adjacent parts, as alſo in *Jeniſeiſko*, *Tomſko*, *Jututſko*, and in other parts, but not in ſo great plenty as in the above-mention'd places. There is no ſearching for theſe bones; they are only met with by chance by the *Ruſſians* who live there, and by the *Pagan* natives, when they roam about on the account of hunting or fiſhing: Yet they are met with on the banks of rivers, or in the rivers themſelves, or they jut out of the earth, and commonly in thoſe places where the earth has been before waſh'd away by floods of water; and ſometimes they have lain buried 10 fathoms deep. They are not, however, ſo ſcarce, that, in my opinion, if they were collected together from all parts round, they would every year amount to 50, nay 100 *put*, which is equal in weight to 40 *Ruſſian* or 39 *Swediſh* marks. Theſe bones, where found.

Theſe bones differ in bigneſs; the larger bones are 10 foot in length, and their thicker extremity is almoſt nine inches in diameter; the ſmaller bones do not exceed four foot in length, and two inches and a half in breadth; their figure is almoſt ſemicircular, and twiſted to one ſide like ox-horns; at the wider extremity, they have a conical cavity about two foot deep; the anterior point of the bone is always found cut, as it were, and ſmooth on one ſide. It has been obſerv'd, that the larger of theſe bones weigh 240 pounds, but they are very rarely brought entire to us; for, as they are found in remote, deſart, uncultivated, and woody places; and beſides, as they cannot be carried far, on account of their weight and irregular figure, they are uſually cut into ſmaller pieces, and ſold about the towns. Deſcription of theſe bones.

Their ſubſtance and internal conſiſtence is not inferior to ivory; for, it has both its whiteneſs and ſolidity, and in working it takes its politure. When they are quite freſh and ſound, they have internally a milky colour, but externally they are yellowiſh: But of ſuch as are ſpoil'd by rottenneſs, ſome are of a paliſh white; others are obſerv'd of a yellowiſh colour, either dilute or obſcurer; yet this hinders not their being fram'd (unleſs they are entirely rotten) into various and elegant pieces of work.

Theſe bones, therefore, differ very much in their conſtitution: The freſh ones reſemble the beſt ivory; the half rotten ones, whether white or yellow, may be eaſily cleav'd into plates: The third kind, which is entirely rotten, and which alſo retains partly a pale and partly a yellow colour,

lour, crumbles between the fingers into a duſt, reſembling either cream of tartar or ground coffee.

The uſes of theſe bones.

I know of no other uſe to which theſe bones have been put, than that turners and comb-makers make various wares of them; but for the moſt part theſe bones are uſually carried into *China*. Whether they may have any uſe in medicine does not appear.

The tradition of the inhabitants about theſe bones

The following is the ancient tradition and opinion of the inhabitants of this country as to theſe bones, namely, that there is a certain huge animal they call *mamont*, which lives under ground, furniſh'd with theſe two bones, which it uſes as moveable horns, and makes a paſſage for himſelf, when he would proceed any where; and that this animal is of ſuch a nature, as that he cannot live in the open air; and therefore, when it happens, that he gets out of the earth, and is expos'd to the open ſky, he dies by a draught of air.

Beſides, they tell, that ſome have obſerv'd the earth rais'd into mounds, which happen'd while this animal was buſy below in digging; and when he proceeded farther on, that the earth ſubſided again; and that, therefore, he left a tract or certain pit in the ſurface of the earth, as the trace of his ſubterraneous paſſage.

No one has hitherto, however, been found who could aver, that he had ſeen the animal entire and alive; yet ſome have related, that they have found and dug up bones, which were not only freſh but bloody.

The different opinions of the learned about them.

I ſhall now rehearſe the opinions of learned men, which however do very widely differ from each other. There are ſome who fully perſuade themſelves, that theſe bones are the genuine teeth of elephants, nor does it appear to them anywiſe credible, that a huge animal, ſuch as this is, can live and walk under ground: Beſides, that theſe bones are in all reſpects like ivory, and have not a horny ſubſtance; and if in any inſtance the external figure happen to differ from that of the tooth of an elephant, that might have happen'd from the weight of the incumbent earth; and if they have ſometimes put on a certain mineral nature, and loſt their bony nature, that that ſhould be aſcrib'd to their having lain longer under ground, whereby loſing their native heat, they have at laſt contracted a certain mineral coldneſs; but the principal difficulty remains ſtill behind, to wit, how elephants could be carried into the outmoſt parts of *Siberia*. Some are of opinion, that it might have happen'd in the univerſal deluge, ſo that the drowned bodies of elephants were by the waves driven thither from the *Eaſt-Indies*, and upon the waters afterwards ſubſiding, or the flood retiring, they ſtuck in the mud, till they were afterwards buried by the earth being gradually heap'd upon them, in this matter following the opinion of Dr. *Woodward* and others.

But

But ſuch as reject this opinion ſuppoſe, that theſe elephants were carried thither and left there by ſome army or other. Others, in fine, to explain this, adduce the paradoxical hypotheſis of *Cluverius* about the mutation of the axis of the earth; from which it ſhould happen, that places, formerly very hot, ſhould now, upon changing their poſiture, become cold: And conſequently, that at this day *Siberia*, which is ſituated in the frozen zone, has now no living elephants, as formerly it had; however, that it ſtill ſhews the remains of thoſe it formerly had. There were alſo other learned men, who were perſuaded that theſe bones dug out of the earth, were even produced therein; and that they were not the remains of animals, but a certain *luſus* of vegetating nature, as ſhe forms many other things in her boſom analogous to various parts of the animal kingdom, ſo alſo theſe huge ſubterraneous horns. Others, in fine, tell us from teſtimonies from *ſacred writ*; and eſpecially from a paſſage in *Job*, *cap.* 40. *v.* 10. that no other animal can be more properly meant by the *Behemoth* of the *Hebrews*, than this our *mamont*. But not to mention any more,

It remains, therefore, that I now adduce what I myſelf have found: I, therefore, chiefly applied myſelf to procure theſe bones, or horns entire; and at length, after much labour and expence, I hit on two; one of them weigh'd 183 pound, which is now in the public repoſitory of his Imperial Majeſty; the other I made a preſent of to our univerſity; a third much larger than any of theſe, but cut into pieces, I myſelf made into various pieces of work; for, it ſeem'd very freſh, and nowiſe ſpoil'd by age. I, beſides, examin'd in the manner of aſſayers the external cruſt of theſe bones, which ſeem'd to have contracted a kind of mineral nature under ground: Yet I could diſcover neither ſulphur, nitre, or vitriol: Wherefore, I judg'd, that the earth had not imparted to theſe bones any mineral nature, but rather diſſipated what it was before poſſeſs'd of, and chang'd it entirely into a *caput mortuum*. At length, after various endeavours, I hit on a part of the ſcull of this animal, but it was ſpoil'd by age, and it ſeem'd to me to be as big as a large head of an elephant. This ſcull was of a remarkable thickneſs; its internal capacity, which contain'd the brain, was but ſmall; on the external ſide, where horns uſually grow in brutes, this bone had a kind of protuberance, but very much wore off: So that I dare not aver for certain, that this ſcull was ever furniſh'd with horns, and that this was not rather ſome other protuberance. I alſo procur'd another bone entirely ſpongy, and which from its figure I judged to be inſerted in the cavity of the horn, in the manner that in other horned animals we obſerve, inſtead of marrow, or rather for ſupport, ſome other bone included in the exterior horny caſe. This bone was a foot and a half in length, three inches in breadth, and it alſo adher'd to a part of the ſcull. I, moreover, procur'd a grinder, ſpoil'd by age, yet entire, and 10 inches long and 6 inches broad: Not to mention other bones, as thoſe of the ribs, thighs, and legs.

The authors own opinion.

I after-

I afterwards enquir'd into thoſe pits, which this animal was ſaid to form as it walk'd under ground, and I view'd them in different places; and I think I have diſcover'd what they are, namely, cavities and paſſages form'd by ſubterraneous waters; whence the incumbent earth afterwards unexpectedly fell in; for, in *Permia*, upon examining ſuch a pit, I found a torrent of water gliding under a hill; but it run deeper than I could venture to go down by a rope; yet the noiſe of the gliding water ſufficiently ſhew'd, that it was no ſmall ſtream. This pit was upwards of ten fathoms deep. In a farm of *Baron à Stroganows*, call'd *Serga*, there burſts out of the earth a large ſtream, diſcharging white and fetid water in ſuch plenty, as continually to turn a water-mill with four pair of ſtones, and that ſo equally, that there is no perceivable increaſe or diminution of theſe waters; nay, not the leaſt alteration therein even in ſpring, when all other waters uſually ſwell. I examin'd the contents of this water, but I found nothing beſides a *calx*.

As to the above adduced opinions, partly of the Vulgar, and partly of the Learned, I own that I cannot give in to either in all reſpects; for, that the inhabitants, as being ſimple and credulous, may in their relations eaſily exceed the truth, appears even from what we have advanc'd above about the ſubterraneous paſſage and moveable horns of this animal. But that the opinions of the Learned about the bones of elephants, brought thither by the deluge, are improbable, is plain even from hence, namely, that it does not eaſily appear, how they ſhould be carried thro' ſo many tracts of land, and be collected in this one preciſe place; and in the ſame manner it may be a hard matter to prove, that theſe elephants were by ſome army or other, or in ſome warlike expedition, brought to thoſe northern remote countries, where they muſt have periſh'd by cold alone: Beſides, the load of earth, however various, could not have caus'd every where the very ſame difference in theſe bones, which at this day they have from thoſe of elephants. But it is no reaſon, why we may not take theſe bones for horns, tho' they differ from the nature of deers-horns, thoſe of elks and rain-deer; for, theſe very bones differ among themſelves in hardneſs, and in many reſpects from thoſe of oxen, goats, and ſheep: So that theſe foſſil bones, tho' harder and more ſolid than the above-mention'd, yet notwithſtanding theſe qualities, they may be real horns; and even the remarkable internal cavity in theſe bones ſeems to ſhew, that they are rather to be reckon'd to the claſs of horns than of teeth, and that they were parts of an animal different from an elephant.

Beſides, that oblong and ſpongy bone, of which I made mention above, and which I ſaid was in my poſſeſſion, tho' it cannot be poſitively affirm'd that it belong'd to theſe horns; yet at leaſt it clearly evinces, that there now is ſome animal in nature, or that formerly there was ſuch, furniſh'd with huge horns, and larger than we can imagine, or at leaſt than we have hitherto ſeen.

Such,

Such, as would have this animal to be the ſame with the *Behemoth*, principally regard the *Chaldaic* verſion, where the words literally expreſs moveable horns, but yet all difficulties are not thereby remov'd; for tho' no doubt may remain, that theſe bones are horns, and that is ſufficiently prov'd both from the ſpongy bone above alledged, and the traces of the inſertion of the horns in the ſcull; yet that that bone may be moveable, it can be ſo in no other reſpect than as it moves along with the head: I, therefore, conclude, that ſo long as any one cannot aver, that he has ſeen this animal, many doubts muſt ſtill neceſſarily remain, which muſt be left to time and farther obſervations to clear up.

Of the Benjamin and Camphire Trees. By Hermann Nicolaus Grimm. *From the* Miſcellanea Naturæ Curioſorum An. I. Dec. II. Obſ. CLII, CLIII. p. 370.

Tranſlated from the LATIN.

THE benjamin tree, which yields that excellent gum of the ſame name, grows in a wood near *Baros*, ſituated in the weſtern part of *Sumatra*; it is a tree of a beautiful form, of a ſtreight ſtem and ordinary tallneſs, and generally of the thickneſs of a man, tho', doubtleſs, it might become thicker, were it allow'd to grow, as it is not; for, the inhabitants ſuffer it not to grow above ſix years, but fell it, and pull it up as uſeleſs: However, they propagate a new nurſery from its fruit. What ſort of flowers this tree yields I could not learn, but its fruit is of a flat, round form, of the bigneſs of a ſmall hazel-nut, and included in a huſk, which is ſomewhat hairy; its leaves are tender and ſoft, below of a pale, but above of a deep green; the kernel of this fruit has a diſagreeable and bitter taſte, ſo that it cannot be eat. Deſcription of the benjamin tree

The manner in which the inhabitants collect this gum is, as follows: After that the tree is five or ſix years old, they cut it above at the beginning of the branches lengthwiſe, but ſomewhat obliquely, as deep as the wood; whence then this excellent gum runs out, which acquires its maturity and coagulation from the ſun and air: When firſt gather'd it is of a white colour, thin, viſcous, glutinous, and pellucid; but in tract of time it acquires a yellow colour. One tree yields not above three pound of gum. There are always two ſorts of this gum got from theſe trees; the firſt ſort is of a beautiful white and yellow colour; the ſecond, thicker, dingy and hard, with a recrementitious admixture, owing to the gum having continu'd longer in the trees, and to the cryſtalline ſand with which the mountains, where the natives inhabit, abound, which with other recrements is by the wind blown into the gum, eſpecially at the time of collecting it. Benjamin how collected.

Deſcription of the camphire-tree.

In the ſame place near *Baros* grows the camphire-tree, a large thick tree, but not among the mountains; its wood, on account of its hardneſs and firmneſs, is very fit to build with; it has a ſtreight ſtem, regularly expands its branches, and is of an elegant form; its leaves are large and fleſhy, ſharp forwards, and when rubb'd, they ſmell of camphire, which yet wears off, if kept for any time, on account of the volatility of this gum: It yields beautiful fruit, of the bigneſs of a ſmall hazel-nut, of an oblong round, included in a thin huſk, which again like a hazel-nut, is inclos'd in another coat of an elegant form, and of different colours, as red, purple, yellow and green; it covers the whole fruit, and opens above like a tulip.

Manner of collecting camphire.

Camphire is collected in the following manner: After the inhabitants, from external ſigns, which are well known to them, perceive the tree to be rich in camphire, they ſtrip it of all its leaves, bark, and external wood, as deep as the pith; which laſt they cleave; in this pith the camphire lodges in an elegant coagulated form, like a fine cryſtalline foliated ſalt, which they ſeparate from the pith. From this ſo large a tree they collect from one to three pounds at moſt, which is certainly a very ſmall quantity, and which with us in *Europe* they would not think worth trouble, much leſs fell ſo beautiful a tree on that account. But I am of opinion, that if theſe people were acquainted with the art of diſtilling, and if they ſliced the wood into ſmall pieces, they would obtain a far greater quantity of it; for, I obſerv'd, that the wood, tho' it ſeems to have no ſmell of camphire, yet ſtill contains a deal of it; for, if it is ſaw'd a-croſs, it ſmells of it, and diſcovers much gum, which the *Japaneſe* better know how to employ for their own uſe; for, they abſtract by diſtillation all this camphire from the wood, tho' they are ſtill unacquainted with the manner of refining it. They ſell this camphire to *Europeans*, at a cheap rate; and on the contrary, buy at a very high price the thinneſt ſort of camphire, as alſo that brought from *Borneo*, becauſe they put a high value on it in medicine. I was of opinion, that that ſort of tree in *Japan* was the ſame with that which grows in *Sumatra*, but by its leaves I found it to be a different ſpecies; for, they are thinner, ſofter, and for a long time yield the ſmell of camphire, and have as many veins and fibres as thoſe of *Sumatra*. As to the tree in *Borneo* it ſeems to be the ſame with that in *Sumatra*, becauſe the camphire, gather'd in the ſame manner, is of the ſame nature. The fruit of the camphire tree makes a grateful pickle, and retains the fine flavour of camphire, and it is an excellent antidote and alexipharmic. From the fruit, flowers and leaves may be made diſtill'd water, diſtill'd and expreſs'd oil, ſeeing the wood, when it is opened as deep as the pith, pours out oil in plenty.

Two new Meaſures ſubſervient to Mechanical Practice. By Chriſtopher Polhem. *From the* Acta Literaria Sueciæ, Trimeſtre IV. An. 1725. p. 108.

Tranſlated from the LATIN.

THAT the uſe of ſpeculative mathematics is twofold, is allow'd by all, who are ſkill'd in theſe matters; namely, one, that it is excellently ſubſervient to various arts, which either relieve the neceſſities of human life, or ſuch as adorn it and promote its conveniencies; the other uſe, and that not the meaneſt is, that its ſtudy endues the underſtanding with a certain ſenſe, and, as it were, habit of evidence, whereby it may proceed with greater eaſe and ſucceſs in underſtanding and cultivating the other ſciences. As to the firſt I take it, that both the learned and unlearned are agreed, but not ſo as to the laſt; for, there are who imagine that all application to the higher parts of mathematics is uſeleſs, on this ſcore, namely as they cannot ſee, what theſe barren ſpeculations, as they call them, and only recommendable from their difficulty, can conduce towards the increaſe of arts: And tho' I am of opinion that theſe men may be ſufficiently convinced of their error by various reaſonings and manifold experiments; yet I think there can ſcarce a ſtronger argument be made uſe of to oblige ſuch people to give the mathematical ſciences their due value than by ſhowing, that even theſe more abſtracted truths may be ſeveral ways made ſubſervient to the purpoſes of common life; and tho' this has been done very diſtinctly and learnedly by many, yet I thought it worth the while to adduce ſome things from the higher parts of the mathematics, whereby mechanical practice may at leaſt be facilitated, if not improv'd. At preſent it ſhall ſuffice to deſcribe two meaſures or feet, which I have devis'd, together with their uſe.

A two-fold uſe of ſpeculative mathematics.

The firſt of theſe meaſures ſeems from its uſe, to be adduced below, not to be improperly call'd a *minute-foot*; for, it has that ratio to the length of a ſimple pendulum, each of whoſe vibrations is perform'd in a ſecond of time, which 5 has to 18; conſequently, ſince by *Huygens'* experiments, the length of ſuch a pendulum is 3 foot 8 $\frac{1}{2}$ lines *Paris* meaſure, the minute foot will be 10 inches 2 $\frac{1}{3}$ lines, which in reſpect of our *Swediſh* foot, ſuppoſing the ratio of 100 to 1099, which is that of the *Swediſh* and *Pariſian* foot, makes 9 inches, 3 lines, 2 $\frac{3}{4}$ points; for, this meaſure, divided in the uſual manner into its decimal, centeſimal and milleſimal parts, is of that nature, that if there be made a pendulum, equal in length to that foot, the number of thirds, wherein that pendulum performs each vibration, will be $= \sqrt{1000}$: Whence it follows, that if the length of any other pendulum be had in the milleſimal parts of the minute-foot, and the

The minute-foot

ſquare root be thence extracted, I ſay, it follows, that that ſquare root expreſſes the number of thirds, in which that other pendulum vibrates.

Uſe. The uſe of this meaſure is as follows; if the time be required, in which any effect is produced, as for inſtance, the time in which the wheel of any machine performs one revolution, take a pendulum of any length, which yet let be given in the milleſimal parts of the minute-foot, and reckon the vibrations anſwering to one revolution; and then from the length of the pendulum, thus expreſs'd, extract the ſquare root, this multiplied by the number of vibrations, ſhows the number of thirds anſwering to one revolution.

Example. Let it be a great water-wheel, which revolves once, while a pendulum, (whoſe length let be two minute-foot and two inches, or 4400 points) performs four vibrations, the ſquare root of 4400 is 65 very nearly, which multiplied by 4, the number of vibrations, gives 260 thirds, or 4 minutes, 20 ſeconds for the time of one revolution.

Other uſes. It appears without my hinting it, that the ſame method may likewiſe be commodiouſly applied for diſcovering the quickneſs of the pulſe in ſick people, for finding the velocity of ſounds and the like.

The mechanical foot. The other meaſure, which I have here propoſed to deſcribe, I, for diſtinction ſake, uſually call the *mechanical foot*; it is equal to the height, which, a body, falling freely from a ſtate of reſt, runs over in the fourth part of a ſecond, that is, 1 foot, 3 lines, $7\frac{1}{2}$ points *Swediſh* meaſure.

Uſe. By help of this meaſure, the height of the fall, from the time given, as alſo the time, from the height given, may be eaſily found; for, if the time ſpent in falling be t ſeconds, the ſpace run over will be $= 16tt$ of the mechanical foot; and reciprocally, if the height, which a heavy body in its fall paſſes over, be put d foot, the time will be $= \frac{1}{4}\sqrt{d}$ ſeconds. The ſame method may be applied for computing the times of the ranges of bombs, as alſo for finding the quantities of water burſting out at flood-gates.

Examples. If the amplitude of the range of a bomb at the elevation of 45 degrees be d feet, the time of the range will be $= \frac{1}{4}\sqrt{d}$ ſeconds; if the ſine of the angle of elevation of the mortar be put $= f$, the radius $= r$ and the amplitude of the range of 40 degrees $= d$ feet, the time will be $= \frac{f\sqrt{d}}{r\sqrt{2}}$.

If the horizontal diſtance of the mark from the mortar be put $= b$ feet, the height of the mark above the level of the mortar $= \pm b$ feet, and the range of 45 deg. the time will be $= \frac{1}{4}\sqrt{b \mp b}$, or $= \frac{b}{4\sqrt{d}}$ ſeconds, ſuppoſing the horizontal amplitude is d feet.

Sup-

Suppoſing the ſame things, if the angle of the elevation be not a half right, but its ſine be given $=b$, and the radius $=r$, the time of the range will be $=\frac{f\sqrt{d}}{2r\sqrt{2}}+\frac{\frac{1}{4}\sqrt{2}f^2d}{r^2}+h$.

The quantity of water or any other liquor in one ſecond of time running out at an aperture, whoſe area is aa feet, is $8aa\sqrt{t}$ cubic feet, ſuppoſing the height of the preſſure $=t$. If the wheel, whoſe mean periphery is p, be turn'd by water and the altitude of the preſſion of the water be $=t$, and the height of its fall $=f$, each revolution will be perform'd in the ſpace of $\frac{p}{8\sqrt{f+t}}$ ſeconds.

Some new Anatomical Diſcoveries, as of the Hymen, the Menſtrual Veſſels, &c. *From the* Breſlaw Collection, November 1717, Claſs V. Art. I. p. 341, 481.

Tranſlated from the HIGH-DUTCH.

DR. *Heiſter* had this year open'd three bodies in the *Anatomical Theatre* at *Altorff*, and obſerv'd in them the following peculiarities; in the firſt, a ſervant-maid of about 14 years of age, he found the *membrana hymenis* compleat and entire, a thing ſo uncommon at this day; the other, a carrier's man, who after eating and drinking plentifully at a country-wake, fell ſuddenly into a water and was drown'd: In this ſubject he found the third day after his death the lacteals in the meſentery ſo numerous and ſo full of chyle as cannot readily be obſerv'd even in dogs, and other animals.

Of the *hymen.*

Of the lacteals in a human ſubject.

As it is alſo a diſpute among anatomiſts and phyſiologiſts, whether the *menſes* proceed from the *vagina uteri*, or from the *uterus* itſelf, ſome maintaining the former, and others the latter opinion, he found in a woman (22 years of age, who had murder'd her child, and who was executed about the time of her *menſes* ceaſing) a great many orifices of blood-veſſels and marks of blood in the cavity of the *uterus*, but none in the *vagina*; from which he concludes, that the *menſes* come from the *uterus* itſelf, tho' not in all, yet in moſt women.

From what part the *menſes* flow.

He alſo open'd, in the preſence of ſome phyſicians, ſeveral ſtudents and ſurgeons, an eye, in which was a compleat cataract; but he found no film therein, but the cryſtalline humour as opaque as a pearl and much ſmaller than uſual, as alſo firmly adhering to the *uvea*; hereby his opinion about the cataract was more and more confirm'd and ſtrengthen'd; and there were communicated to him from other parts the like experiments and obſervations.

What a cataract properly is.

We

Remarks on the observation about the *hymen.*

We cannot well in any reſpect doubt of the hiſtorical exactneſs and truth of theſe obſervations, as the accuracy of this author is ſufficiently known: However, it is credible, probably alſo according to the learned profeſſor himſelf, that from the preſent inſtance of a *hymen* cannot be drawn any concluſion for its conſtant and univerſal neceſſity and real exiſtence (as this membrane is nowiſe univerſally, regularly, and in all ſubjects actually to be found) but rather for the more remarkable corrugations of the membranes, which hence according to the diverſity of the ſubjects and the narrowneſs of theſe parts in women afford a larger or ſmaller aperture for the diſcharge of the *menſes*; ſometimes alſo, rather by an error of nature growing too cloſe, they in proceſs of time exhibit a real membrane. In this manner the *hymen* can in nowiſe be conſidered as a conſtitutive common part of the body, but rather as an excreſcence, and even as an error of nature, and which of itſelf is more apt to be prejudicial rather than anywiſe ſerviceable to the body; for, what ſome advance is not entirely improbable, *viz.* that when this membrane is ſomewhat too thick, or the cloſing together of the membranes is but little or not at all pervious, it may give no ſmall occaſion to the retention and difficulty of the diſcharge of the *menſes*, and that to ſuch a degree, that ſometimes a manual operation is neceſſary[a]; tho' here alſo the wounding of the membranes, either of the *vagina*, or neck of the *uterus*, may ſometimes have a greater effect in the diſcharge of the enſuing or apparent *menſes* than any actual opening of a real *hymen:* This however is certain, that it is contrary to the nature of the common parts in the body to pretend, that this membrane once torn can never after be reſtor'd; as it alſo commonly has, according to the opinion of moſt people, fleſhy fibres and ſeveral veſſels: Not to mention other things.

Remarks on the obſervation about the *menſes.*

In the third caſe the profeſſor has remark'd with good grounds, that in all women the *menſes* do in nowiſe flow from the *uterus*, and it ſeems probable to us, that they very rarely, and for the moſt part rather in a preternatural ſtate, take their courſe thro' the ſubſtance of the *uterus*, as among other things, the *uterus* in a natural ſtate is manifeſtly wont to diſcharge nothing but the *fœtus* with the ſecundines, and at the ſame time blood alſo, but blood, by a more violent wound; on which account alſo a woman in child-bed is to be regarded with reſpect to her *lochia*, as a perſon internally wounded: And conſequently before conſolidation ſhe muſt be treated with all imaginable care. And tho' indeed we muſt well diſtinguiſh between a violent ſolution of continuity and between a gentle ſpontaneous opening of the mouths of the veſſels; yet this is not of that weight, that hereby the ordinary diſcharge of the *menſes* through the very ſubſtance of the *uterus* can be ſufficiently ſupported, as the different conſtitution of the *uterus*, both entirely empty and immediately after the birth can ſufficiently decide the matter; as namely after the birth, the blood, upon wound-

[a] *Vid.* Diemerbroeck Annotat. *ad Anatom. p.* 64.

wounding the ſubſtance of the *uterus*, muſt not only neceſſarily flow, at leaſt paſſively out of the exceedingly dilated veins, but muſt alſo eſpecially be actively expreſs'd, that together with the *uterus* the veſſels may duely ſubſide, as being out of a ſtate of pregnancy about the thickneſs of a hair; but on the contrary, in the time of pregnancy as big as a writing pen: Whence it is eaſy to conclude, that in the latter circumſtance the blood muſt readily flow out and be expreſs'd; but in the former it is certain, it may be retain'd with the like eaſe, eſpecially as the *uterus* in young women is very firm and exceeding narrow, its ſubſtance very thick and cloſe, nay hard; and what is ſtill more, a part, generally ſo red and full of blood, is in them wont to be more whitiſh: Whence then it is not eaſy to conceive, how the blood ſhould flow from ſo ſmall, thick, and cloſe an *uterus* in young women eſpecially that have their courſes; beſides, from experience we are to conclude, that women with child often have their *menſes*, and that in great quantity, nay, ſuffer a perpetual flux of blood; which we muſt ſuppoſe to proceed not from the *uterus*, but from the veſſels of the *vagina* and of the neck of the *uterus*; and in reality, that the *menſes* principally and commonly proceed from the blood-veſſels of thoſe parts, daily practical obſervations do alſo ſhew; and by means of theſe one may every day remark a manifeſt conſent between the menſtrual veſſels and the *viſcera*, and parts of the *hypocondria*, as they both have a communication with the above-mention'd veſſels of the neck and *vagina* of the *uterus:* But that ſometimes, out of a ſtate of pregnancy, blood flows from the *uterus* is not entirely to be denied, yet this rather in a preternatural than natural ſtate: Whence in this caſe there uſually follow more uterine hemorrhages, grumous blood, nay, *mola*'s, with grievous ſymptoms, and that moſtly from miſmanagement in the birth, or from an abortion, or a dead child; but theſe things are not to be applied to the ordinary ſtate of the *menſes*. The marks of the bleeding veſſels, obſerv'd in the above-mention'd caſe, may, probably, not be referable to the natural ſtate of the *menſes*, as this ſubject had been a little before in child-bed; and ſuch criminals eſpecially under execution muſt be conſider'd in a quite different ſtate from the ordinary.

An account of the diſpute about the nature of a cataract.

As to the laſt caſe, obſerv'd by Dr. *Heiſter*, viz. the cataract; the ancients ſuppos'd it proceeded from a film ſettling in the aqueous humour, which ſtopp'd up the pupil in ſuch ſort, that the rays of light could not paſs to the cryſtalline humour; or, according to the modern opticians, not to the *retina*; whence conſequently blindneſs muſt have ariſen. But M. *Briſſeau* in *November*, 1705, offer'd to the *Royal Academy of Sciences at* Paris, an obſervation, wherein he rejected this cauſe aſſign'd by the ancients, and ſhew'd that a cataract rather poſſeſſes the cryſtalline humour. But this obſervation was not thought worth inſerting into the *Memoirs of the Academy*, particularly as it run counter to the hitherto openly defended opinion of ſeveral of the *Members*, tho' to ſome others the thing was not diſ-

diſpleaſing: So that at length this obſervation came out at *Tournay* in 1706. And in the mean while the affair drew a greater degree of attention in *France*, and was more favourably receiv'd by a great many, and at laſt with moſt people prevail'd, particularly after the experiments made by ſeveral phyſicians and ſurgeons, as *Dodart*, *Gandolph*, *Leman*, *Rauſſin*, *Mareſchal*, *Petit*, *Aubert*, *De la Hire*, and more eſpecially by *Maitre-Jean:* And tho' among others *Mery* ſtrongly oppos'd it, and in order to maintain the old *theſis*, diſſected before the *Academy* a dead man's eye, and endeavour'd to demonſtrate the hypotheſis of a film in the cataract, with which the dead perſon had been affected, yet to his ſurprize he found nothing other than the cryſtalline humour depreſs'd and darken'd; ſo that hence he alſo went over to *Briſſeau*'s opinion. And from this time, to wit, from 1706, what was hitherto taken for a cataract was believ'd to be nothing other than a *glaucoma*; and the ancient notion of a cataract, and of the preſence of a film therein, was exploded. After this, at length *Maitre-Jean* in his treatiſe, *des maladies de l'œil*, publiſh'd at *Troyes An.* 1707, fully maintain'd this opinion: Upon which it was alſo publickly defended by *Boerhaave* at *Leyden*, and moſtly by the above-mention'd *Briſſeau* in a new treatiſe, entitled *de la cataracte & glaucome*, and publiſh'd at *Paris An.* 1709. Now this opinion (which, indeed, was not unknown to *Laſnier*, *Gaſſendi*, and others, but only put in a new light) about the abſence of a film, and that the cryſtalline humour only was affected in a cataract, pleas'd *Heiſter*, while he was ſtill in *Holland*, ſo well, that he added this corollary to his *inaugural Diſputation*, 'That a cataract is the obſcuration of the cryſtalline, and 'not a defect in the aqueous humour: Hence in couching for the cataract, 'not a pellicle, as the common hypotheſis bears, but the cryſtalline hu-'mour is depreſs'd:' And as after this in 1710, he enter'd on the profeſſorſhip of anatomy and ſurgery at *Altorff*, he ſoon publiſh'd in 1711 his firſt diſputation *de cataracta & lente cryſtallina:* In 1712 a ſecond: In 1713 a third; as alſo in the ſame year a diſputation *de amauroſi ſalivatione curatâ*, all which this year he publiſh'd together at *Altorff*, much enlarg'd. Now *Wolhouſe*, an *Engliſh* gentleman and oculiſt to the late King *William*, ſtrongly oppos'd both this whole opinion chiefly, and particularly at firſt M. *Briſſeau* in two letters to *Le Brun*, which he alſo farther proſecuted in a letter to *Palfyn*; and further againſt *Maitre-Jean:* Not to mention other pieces relating to this controverſy, wherein he ſtrongly endeavours to maintain the notion of a film. In a letter to *Doppelmayr* at *Nuremberg*, dated *June* 1715, *Wolhouſe* not only particularly anſwer'd a letter *Heiſter* writ him the ſame year upon the merits of this controverſy, but he alſo violently attack'd him in a particular critique, and in other pieces to be found in the *Mercure Gallant*. And with him join'd againſt *Heiſter* the *Journal des Sçavans* for the month of *May* 1716: So that at length *Heiſter* was oblig'd to publiſh at *Altorff* in 1717, an apology, and a farther illuſtration of

of his ſyſtem about a cataract, *glaucoma*, and *amauroſis* againſt *Wolhouſe* and the *Journal*; in anſwer to which came out a very ſhort piece, full of nothing elſe but calumny, as both this and the other pieces on this controverſy are publiſh'd together, and recited in the *diſſertations Sçavantes & critiques de M.* Wolhouſe *ſur le* cataracte, *&c.* Beſides which we know nothing further about this controverſy.

An Eſſay on the Nature and Remedies of Friction in Machines, ariſing from the Superinceſſion of Bodies. By G. G. Leibnitz. *From the* Miſcellanea Berolinenſia, Tom. I. p. 307.

Tranſlated from the LATIN.

AMONG the accidental obſtacles to machines in producing their effects, friction is none of the leaſt, which you may define *the reſiſtence of the ſurface, over which the motion is made*; and it takes place, whether a liquid be in contact with a liquid, a ſolid with a ſolid, or in fine, a ſolid with a liquid; or which comes to the ſame thing, a liquid with a ſolid. A liquid is in contact with a liquid, and that frequently with a loſs of motion, as if a drop of liquor move in another liquor. A ſolid is impeded by a ſolid, as when a ſledge is drawn along on the ground: And in fine, the mutual contact of a ſolid and liquid diminiſhes the motion, as when water moves in a pipe, or on the contrary, when a ſhip moves in water: And it is well known, that a ſhip, that has made a long voyage, and beſet with moſs, makes the leſs way. Lately a figure of a ſhip reſiſting, *cæteris paribus*, the leaſt poſſible (tho' in that caſe a regard is had to the directions of the impulſe, and not to the aſperity in the ſurface) has been examin'd by very ingenious men from the principles of the higher mathematics, and by the infiniteſimal *calculus*, by help of a certain hypotheſis, the figure has been diſcover'd. Friction what?

But in this place we ſhall treat of the friction of a ſolid againſt a ſolid, ariſing from the inequality of ſurface, which is always ſomething, be the body never ſo much poliſh'd, as microſcopes ſhew to the very eye eminencies and cavities appearing every where alternately; whence, as it were, a kind of teeth, and conſequently, a ſaw conſiſting of teeth, or if you will, a kind of file preſents itſelf; and from the cloſe application of two toothed bodies to each other, there ariſes, ſo to ſpeak, a kind of *inſerrature*, as the eminencies of the one are inſerted into the cavities of the other. Ariſing from the inequality of ſurfaces.

But this aſperity reſiſts the ſuperinceſſion, becauſe the progreſſive motion, whereby one body ſuperincedes upon another, takes not place, unleſs the eminencies be either broke (and conſequently, abraded) or depreſs'd; or in fine, the teeth of one, as it moves on, be rais'd out of the cavities or inter- Why this aſperity is an obſtacle.

intervals of the teeth of the other, which is the caſe of *volution*, of which below. The eminencies after depreſſion do either entirely reſtore themſelves or remain ſomewhat depreſs'd: ſo far, therefore, as by a continued friction bodies become more poliſh'd and have a leſs degree of friction, in ſo far are the inequalities levell'd, and they are either abraded, or after depreſſion do not reſtore themſelves: But becauſe at length the matter comes to this, namely, that the friction is very little farther diminiſh'd, the conſequence then is, that the inequalities do by their elaſticity almoſt entirely reſtore themſelves, as when a ball runs over a hairy tapeſtry, or when a ſtring'd inſtrument is ſtruck by a bow, and thus the aſperity continues almoſt the ſame.

The friction how varied.

And the aſperity of the body remaining the ſame (to which it ſpontaneouſly reſtores itſelf after the ſuperinceding body has gone off, yet the friction may be varied, and conſequently intended and remitted by the increaſe or diminution of the inſerrature, of which above; for the more one body is in ſuperinceſſion appreſs'd to another, the more is the one wounded by the teeth of the other, and the more deeply do the eminencies of the one ſink into the cavities of the other; ſo far that during the ſuperinceſſion the one renders the cavities or inequalities in the other greater, tho' after its going off, the body by its own elaſticity returns to its bare roughneſs or ordinary inequalities.

The appreſſion how varied.

The appreſſion varies from different cauſes, but chiefly two, *viz.* from the weight of the ſuperinceding body, as when ſledges and wheel-carriages are very much loaded, and ſtrongly appreſs'd to the bottom; and from the *niſus* of ſuperinceſſion, which appreſſes one body to another, while the direction of the ſuperinceding body tends to the very ſurface of the other; as if the one body would by its motion penetrate into the other, and this may be obſerv'd in the teeth of wheels mutually acting on each other.

The effect of appreſſion.

The appreſſion from the weight of the ſuperinceding body cauſes alſo in wheel-carriages ſomething that is different from friction, tho, of affinity with it; for, if the bottom were hard, ſo as to ſenſe not to yield, it would be bare friction, as when ſledges move on ice; but generally the bottom yields, and ſo much the more, indeed, as it is ſofter or fuller of water; whence depreſſions enſue, which are not reſtored by elaſticity, but by the ſoftneſs of the matter flowing together, and then there concur both the difficulty of cutting the earth, as alſo the adheſion itſelf ariſing from its tenacity, as a ſlimy earth does not ſo readily let go the wheel. But theſe things belong not to this place.

Amontons' problem. Plate V. Fig. 1.

Amontons' problem is more to the purpoſe: Suppoſe a body with a plane ſurface CD, appreſs'd by the weight E, to ſuperincede on the plane AB: It was commonly thought, that other things remaining, the friction is diminiſh'd in the ratio, in which the contact or ſurface CD is diminiſh'd: But *Amontons'* has determin'd, that provided the incumbent weight remain the

the ſame, it matters not how great the ſurface of contact be; and from this argument I think, that the plane C D being increas'd, the contact is, indeed, increas'd, but then again the ſuſtaining parts are increas'd, and thereby the appreſſion in any one part is leſs, and conſequently, the reſiſtence or friction therein is leſs, and thus an advantage would be compenſated by a diſadvantage.

Amontons deſerves commendation, in that he oppos'd a vulgar error; for, it is very falſe for the reaſon mention'd, that, other things remaining, the friction is either increas'd or diminiſh'd in the ratio of the ſurface of contact: But yet in this he was out, in that he thought an advantage was compenſated by a diſadvantage, and conſequently, that the matter depended on the preſſing weight alone. It would be a demonſtrative argument, were the reſiſtence or friction proportional to the depreſſion, and the depreſſion proportional to the incumbent weight; but neither of theſe can well be allow'd, not the former; for, beſides the depreſſion, whereby the eminencies of the one are inſerted into the cavities or hollows of the other, the rigidity and figure of the eminencies muſt be eſtimated: Suppoſe a table full of inflated bladders and a ball running on it, it does not follow, that the ball ſinking an inch deep into the bladders, is juſt twice more impeded in its courſe than ſinking half an inch, as the reſiſtence may be varied according to the bigneſs of the bladders, and ſmaller bladders do with more difficulty ſuffer ſo great a degree of depreſſion, becauſe in their depreſſion there ariſes a greater compreſſion of the included air; not to mention other hypotheſes, from which a ſimilitude may be drawn. But neither does the latter take place; for, the depreſſion will not be double upon doubling the weight; as may be illuſtrated from the compariſon of elaſtic air: Suppoſe a piſton, by means of a weight laid on it, to be forced a foot deep into a hollow cylinder full of air, it is manifeſt, that upon doubling the weight it is not forced two foot deep, but that the difficulty increaſes, as alſo appears in charging wind-guns. And when the wheel of a loaded carriage ſinks ſix inches into the earth, upon doubling the load it will not, therefore, ſink a foot; for, the preſs'd earth becomes cloſer and harder to yield: Beſides if, as it moſtly happens, the weight E is not every where equally incumbent on the plane C D, the depreſſion every where will not be equal: Whence ariſe many varieties, which ſhall hinder the magnitude of the ſuſtaining body from accurately compenſating the difficulty ariſing from appreſſion.

Amontons wherein to be commended and wherein out in this affair.

We have ſaid that the friction is intended alſo from the *niſus* of ſuperinceſſion; and this happens, when the direction of the ſuperinceding body is not parallel to the ſurface of the other, but makes an angle with it, which the nearer it is to the perpendicular, the more violent is the appreſſion: Whence ariſes a kind of *coacture*, or ſtraining; and this eſpecially is obſerv'd in the teeth of wheels acting on each other; for, wheels often exert

Friction farther increas'd.

exert ſo great a preſſion on each other, that the teeth or cogs are broke, unleſs their firmneſs be greater than the reſiſtence of the weight to be overcome by the wheels: In this caſe, therefore, there is as great a degree of friction, as if one tooth were appreſs'd to another by a huge weight; and ſometimes it happens, that the very ſhafts of the wheels are forced out of their place, if they are not well fix'd.

The remedies of friction what?

I now come to the remedies of friction in machines; where laying aſide the phyſical remedy, ſuch as greaſe, which renders the ſurface leſs rough, we ſhall treat of the mechanical ones, which are of two kinds; the friction is either diminiſh'd, or for the greateſt part remov'd in ſuperinceſſion, or the ſuperinceſſion itſelf is diminiſh'd or remov'd for the greateſt part: The former, namely, the diminution of friction in ſuperinceſſion may be obtain'd by a certain manner of ſuperinceding, which we call *volution*; but the manner of ſuperinceding is either *radens*, *volvens*, or *mixt*: The *ſuperinceſſus radens* is when of two bodies in contact the ſame point of the one continually paſſes thro' different points of the other, or by its motion deſigns a line on its ſurface: Thus a ſledge moves on the ground, ſo that any nail fixt into its baſe may deſign a line on the earth.

Superinceſſus radens what?

Superinceſſus volvens what.

The *ſuperinceſſus volvens* is when the point of contact is continually ſhifting; and therefore, there is requir'd a line of the one to deſign the line of the track in the other; and this is *pure volution*, when the deſigning line in the one ſurface is equal to the line deſign'd in the other ſurface, ſuch as is the *volution* of a wheel, when it moves on the ground in ſuch ſort that you may meaſure the way by its revolution, and which would happen exactly, if the rope G H L M, whoſe one extremity G would be fixt to the wheel, the other M to the pavement N P, were wound round the wheel F; for, thus the wheel being impell'd either towards N or P will neceſſarily proceed by bare *volution*, as the ſame rope, which was the deſigning line in the wheel, becomes the deſigned line in the pavement; for, the rope in rolling is by the wheel laid down in the pavement, namely, if the wheel be impell'd towards N: On the contrary, if the wheel be impell'd towards P, it takes up the rope from the pavement, ſo that in the former motion there happens a *devolution*, in the latter an *obvolution*.

Pl. V. Fig. 2.

But without this precaution as to the rope or ſtring, it is manifeſt, that to the volution there may be mixt an element of a *motus radens*; ſo that the wheel may ſlide: Beſides, when it is a proper and bare *volution* the circle proceeding in a right line, does by a certain point of its circumference deſign in the air a *cycloid*, and moving on another circle, an *epicycloid*: In other reſpects, whether a circle or any other line rolls along, I by a general name call the line deſcrib'd by a fixt point, a *trochoid*.

Mixt motion what.

A mixt motion conſiſts of a *motus radens* and *volvens*, namely, when the line applied to the baſe of the ſuperinceding body deſigns a line in the baſe, but not equal to itſelf; which happens, while with a *volution* a *motus*

radens

radens is mixt, not indeed, assignable by a determinate time, but yet elementary, and repeated by an infinite number of infinitely small elements: Thus indeed, the point of one surface is not applied for an assignable time to the different points of the other surface, but for an elementary time only; yet during even that small time it is not at rest, as in bare *volution*, but it proceeds in the base; and consequently, glances on it, tho' for an elementary space only, as it immediately digresses from the contact, and makes way for another point. This composition of the volution with the *motus radens* may be thus commodiously exhibited; suppose the rope GHLM is in the manner above-mention'd wound about the wheel F, and one extremity G fasten'd to the wheel, but the other extremity M loose; so that it may be drawn on the pavement along with the wheel towards P. Thus, therefore, if during this drawing, the wheel F be at the same time impell'd towards N, and exert its *volution*, by that very thing the motion of the wheel upon the pavement will be compounded of the *motus volvens*, on account of the *volution* of the wheel itself upon the rope, and of the *motus radens* on account of dragging the rope on the pavement: And in this case the line, which the wheel designs on the pavement with its lowest point L always varying, will be less than the devoluted rope, or than the arch of the wheel applied to the pavement: But if during the dragging of the rope, the wheel F be impell'd towards P, the rope, indeed, will roll, but so as that it shall roll upon the wheel; but the line, which L, the lowest point of the wheel, designs in the pavement, will be greater than the obvoluted rope, or than the arch applied to the pavement, which takes up the rope: If, therefore, the rope were drawn on the pavement with a wheel without the *volution* of the wheel, it would merely be a *motus radens*, and the same point L of the wheel would always move over the pavement, if the rope were not dragg'd, but fasten'd to the pavement in M, and yet the wheel roll'd, it would merely be a volutory motion, the same point L remaining in the same place of the pavement, but for an unassignable time only, till by a continu'd *volution* it be rais'd from it; but now the motion is mixt, as during the element of *volution* the same point L proceeds at the same time in the pavement, tho' for an unassignable length. Again the mixt motion may also be exhibited thus, not to mention a great many other methods: Suppose the same axis QR, parallel to the horizon, to carry two vertical but unequal wheels S and T, fixt on that axis; and let T one of the wheels, by means of the rope GHLM and of the fixt nails G and M roll on the horizontal plane NP in the manner explain'd; then the motion, which the other wheel S would perform on the subjected horizontal plane UX, touching the wheel, would be mixt.

Pl. V. Fig. 2.

Fig. 3.

Let us now apply the *motus radens* and *volvens* to friction: Let the ruler YZ be horizontal, having its teeth perpendicularly erected, on which let the spur-wheel W be incumbent (whose teeth cut into the plane of the wheel,

The *motus radens* and *volvens* applied to friction. Pl. V. Fig. 4.

wheel, and continu'd would tend to the centre) and let it move on the ruler by *volution*; ſo that, during its motion, the teeth of the wheel may anſwer to the diſtances between the teeth of the ruler and *vice verſa*: In this caſe it is evident, that the aſperity, or the teeth of the ruler and wheel are no obſtacle to the motion: But if any one would move the wheel forwards on the ruler without rolling it, the ſame tooth of the wheel ſhould glance upon ſeveral teeth of the ruler, which cannot happen, ſo long as it is inſerted into the teeth of the ruler, and not rais'd, without breaking with great force, or at leaſt bending the teeth, or without itſelf be broken or bent. The ſame thing alſo happens, tho' inſenſibly in friction, that the ſuperinceſſion is retarded on account of the inſertion of inequalities, unleſs when a body by volution incedes on a baſe, as the wheel on the ruler: Whence it appears, that volution is a remedy againſt friction, and that the nearer mixt motion comes to volution, the leſs friction it has.

This principle applied in practice.

Now it is from this principle, that men have ſet wheels under carriages, nor are ſledges of ſervice but upon ice or harden'd ſnow; and ſometimes wheels, or rollers, or even balls are not affixt to the moveable load, but only put under it, which is the better way, when it can be done; for, thus the friction about the axis of the wheel or roller ceaſes: And beſides, when a roller or ball rolls upon the ground (the load in that caſe may roll on rollers or balls) it happens, that the load moves twice faſter on the ground than the ball or roller itſelf; for, it moves both by the celerity of the roller on which it is incumbent, and with its own celerity upon the roller; but a wheel proceeds with the ſame celerity with which the carriage itſelf does: Whence ſo far a free roller, on which the load is incumbent, is preferable to wheels faſten'd to a carriage; but on the other hand, there is this diſadvantage in a free roller, that thus in order to keep on moving there is occaſion for new rollers, or balls, becauſe the former are left behind by the load; or it is neceſſary that there be a perſon always to carry forwards thoſe left behind, unleſs the motion of the load be circular, and the load itſelf alſo of that form, in which caſe the ſame balls or rollers may remain always under the load, and commodiouſly carry it, ſince they are never left behind.

IV. Fig. 5.

Thus the horizontal circle $\gamma\delta$ revolving about its centre on rollers, in like manner horizontal and pointing towards the ſame centre, which is vertically under the former centre, tho' you lay a great load on, it may be turn'd round, the rollers themſelves being ſo fitted as always to keep the ſame diſtance among themſelves.

Volution is not only perform'd, when a firm body is in contact with another, but even with a flexile body, as when ropes or chains run upon pullies or cylinders, which they move, and it matters not, whether a circle moves under a line, or a line upon a circle; but the *motus radens* would happen, if a rope was to ſlide upon a cylinder, immoveable about its axis; for,

for, thus we find, that a remarkable friction and reſiſtence ariſes, which is eſpecially augmented, if a rope be roll'd round an immoveable cylinder: So that this rolling round being repeated for ſome times, the motion of the rope or ſtring is at length entirely impeded; and this is the effect of friction: And he who in *Galilæo* devis'd that little machine, whereby one might commodiouſly let himſelf down from on high by a rope, made uſe of this conſideration.

As rollers bear loads in a twofold manner, either ſo that like a wheel they have their axis faſten'd to the load, or ſo as to roll freely: Thus alſo pullies are mov'd in a twofold manner by ropes and ſtrings; for, either they have their middle axis fixt, as is commonly the caſe, or free, and ſuſpended between ropes, in which caſe not only the friction about the axis ceaſes, but alſo the excavated middle of the pulley gives place to other bodies, as in a certain inſtrument known to the more ingenious weavers for their tapeſtry work. Some alſo ſuſpend the axis of the horizontal wheel from a chain, where the axis itſelf does the part of a pulley, and thus the friction that was us'd to ariſe from the incumbent axis ceas'd; and this may be of ſervice in ſome caſes. From theſe things is underſtood, how friction may be remov'd by volution. The ingenious *Perault*'s machines without friction, which he exhibits in his notes on *Vitruvius*, are founded on the principle of ropes and cylinders, or pullies; and conſequently, on the principle of volution.

The illuſtrious Dane *Olaus Romer*, when at *Paris* in the *Royal Obſervatory*, formerly conſider'd the advantage of volution above the *motus radens*; for, he obſerv'd, that the teeth of wheels, as they are commonly made, without choice of any figure, move very awkwardly and incommodiouſly, as they violently glance upon the teeth of another wheel or ruler: He, therefore, devis'd another figure, by which one tooth ſhould move on the oppoſite tooth, not by *raſion* but by *volution*; and this figure, not without the aid of the profounder geometry, he found to be *epicycloidal*; and it were to be wiſh'd, that he would publiſh the whole method of this beautiful invention. We however have what the celebrated *De la Hire* afterwards diſcover'd about the mechanical uſe of the *epicycloid*, and ſuch conſiderations are worthy the putting in practice. But tho' the diſadvantage is uſually diminiſh'd by the ſhortneſs and number of the teeth acting together (which alſo is the reaſon, that the ſtreſs being divided among many, they are not ſo eaſily broken) yet no ſmall degree of reſiſtence often remains behind, which is chiefly obſervable in great works, as when by means of the cogs of a wheel the *tongue*, faſten'd to a huge and ponderous ſtamper, placed vertically, is laid hold on, and the ſtamper rais'd perpendicularly, and falling down again by the cog letting go the tongue, by the force of its fall it ſerves for the ſtamping of bodies, or for the expreſſion of their

The moſt proper figure of the teeth of wheels.

their juices: And here it is very ſerviceable, that the cogs and *tongue*, but eſpecially the latter, be of a convenient figure.

The removal of ſuperinceſſion a remedy for friction.

The only remedy, therefore, of friction is volution, in the caſe of ſuperinceſſion; but the other remedy is the removal of the ſuperinceſſion itſelf; and this in great meaſure, at leaſt, is perform'd by a crank, and it is better to employ it both for durableneſs, and alſo for the diminution of friction than dented wheels, or *Morland*'s oval wheel for raiſing weights, tho' the effect produc'd by a crank be not equable (as *Morland* objects in his mechanics); yet this is ſo far from being prejudicial in thoſe caſes where it is employ'd, that it rather has remarkable advantages, as when the quantity of water for turning the wheel is ſmall; for, that meaſure of water is ſufficient for beginning the motion, as its operation is alſo ſmall, namely, when a great portion of a circle makes a ſmall rectilinear propulſion; in the mean time a new quantity of water flowing in, and the laddles being fill'd, an *impetus* is conceiv'd, which at length is then alſo ſufficient, when in the progreſs of the rotation there is a great difficulty of propelling; but if the reſiſtence was always equal, the wheel at firſt would not act, till the laddles were fill'd: It would, therefore, reſt for intervals, which is often prejudicial. To prevent the inconveniency from the obliquity of the motion of the handles or ſweeps of pumps, or the like, may be effected in various manners, and is commonly obtain'd from the length of the rods, which the ſweep works, that there be no longer any ſenſible obliquity, when the motion reaches the piſton itſelf; but if the ſweeps are ſhort, they entirely want a remedy.

Many things may ſtill be uſefully perform'd about cranks, and one is, that by means of a crank one wheel may turn round another, tho' at a conſiderable diſtance, without any cogs, ropes, or the like, as commonly by cranks the rotation only effects a reciprocal rectilinear motion.

A new ſort of pump for mines.

J. C. Sturmius (in *p.* 305. of theſe *Miſcellanies*) gives us a ſcheme of a new ſort of pump for mines. I obſerve, *ſays he*, that the rods of common pumps are ſuſpended in the manner repreſented at A and B, where it appears, that upon working the ſweep C D, the rods A aſcend and the rods B deſcend; yet ſo that the point of ſuſpenſion A deſcribes an arch A E, the point B, the arch B F; and conſequently, that the rods are continually work'd backwards and forwards, and can only draw obliquely the piſton aſcending perpendicularly, and with how much labour it is done appears from the groans and creaks of the machine. I, therefore, began to think ſo to ſuſpend the rods that they ſhould raiſe the piſtons perpendicularly, as I was perſuaded that very great advantage would thence redound to theſe machines.

Pl. V. Fig. 6.

Fig. 7.

I would ſuſpend the rods from the oak-plank M N, ſix inches broad and four inches thick, and moveable upwards and downwards within the grooves of

of the two timbers RS and TV; thro' this plank at both ends I would paſs the crank ABX by means of the oblong ſlits PQ, arm'd in ſuch manner with ſmooth plates of braſs, that the aperture may retain a length twice the radius AB and a depth equal the thickneſs of the crank; to both axes I would apply the lantern Z to be mov'd by the ſpur-wheel O; where yet we are to remark, that it will oftner happen, that the radius of the dented wheel is at leaſt half the radius of the lanterns, which is here double: And at length I would place the iron gudgeons D both of the ſpur wheel and lanterns, each of them on two braſs truckles C; and I would make the ratio between the diameters of the gudgeon of the truckle C and of the gudgeon D, and of the truckle itſelf C, at moſt ſubtriple. Theſe things thus done, I ſhould not doubt but the machine might be mov'd without noiſe, and with much leſs force than the common ſort uſually are, and yet a no leſs effect be expected from it.

A Medical Diſſertation on Camphire. By Chriſtianus Henricus Haenel, *upon receiving his Degree of Doctor of Phyſic. At* Leyden, Anno 1739.

Tranſlated from the LATIN.

§ I. CAMPHIRE is a vegetable body, of a very penetrating odour, of a pretty ſtrong taſte, not ſoluble in water, ſolid, endu'd with ſome degree of tenacity, melting in the fire, and inflammable: It is, therefore, deſervedly to be claſs'd among roſins, as having their moſt perfect characters. Camphire defin'd

§ II. The following things conſtitute its ſpecific difference, whereby it is diſtinguiſh'd from all other roſins. By a gentler degree of heat than that of boiling hot water, yet by a greater than that of boiling alcohol, provided the camphire be very pure, it becomes entirely volatile, and that indeed in a ſolid form, ſuch as it formerly was, only that for the moſt part it leaves behind a dark ſpot, probably, owing to a heterogeneous admixture: When ſublim'd in cloſe veſſels by a ſtronger fire, it alſo aſcends in a ſolid form, without any *empyreuma*; when brought near the flame, if the camphire be very pure, it flies away without any, or but a very little remainder; but then it ſmuts the bodies laid over it: It, therefore, diſtinguiſhes itſelf from the other roſins of vegetables, 1. By its peculiar odour, depending on its proper *ſpiritus rector*, which is not exactly the ſame in any one vegetable. 2. That all roſins are more fixt than boiling hot water, unleſs perhaps you except ſome odoriferous bodies, which, while they are a-boiling with water, let go in a ſmall quantity their eſſential oil, but they never are entirely reſolv'd and ſublim'd into vapours (as camphire is) by pouring boiling hot water ſeveral times thereon, or Its ſpecific difference.

abſtracting it therefrom, much leſs when they are expos'd to ſuch a heat alone. 3. That other roſins, when diſtill'd by a ſtrong fire in cloſe veſſels, do always yield an oil; and therefore, are alter'd from their firſt conſiſtence; nay contract an *empyreuma*, and moſt of them alſo depoſit a pretty conſiderable coal in the diſtilling veſſel. Benjamin alone does in this reſpect agree with camphire; for, when ſublim'd in the ſame manner, it partly runs into flaky flowers, and partly into a ſolid, pellucid ſublimate, but yet there follows a little oil, and a coal remains behind: And thus benjamin itſelf ſuffers a remarkable alteration, otherwiſe than camphire does. 4. All other roſins, when calcin'd in an open fire, leave coals or aſhes behind; but the oil differs from mineral ſulphur, chiefly in this, to wit, that the latter is not only more fixt, but that ſet on fire it yields no black ſoot, and beſides, diſcharges a very ſuffocating, acid vapour, under the form of a white fume: Not to mention, that the colour, ſpecific weight, and eſpecially the conſiſtence, differ.

Corollary. As camphire flies off by a very gentle heat, it eaſily appears, that when expos'd to the open air, its whole ſubſtance at length evaporates; but then after the avolation of ſome part of it, what remains behind is as odoriferous as before, when it had loſt none of its maſs: It, therefore, differs in this, from other odorous roſins, as they immediately loſe in the open air their ſubtile eſſential oil along with their inherent ſpirit: It is, therefore, proper to keep camphire in cloſe veſſels, tho' it does not ſo ſoon evaporate, as is commonly thought, nor is it neceſſary to cover it down with lintſeed, which, as is falſely imagin'd, ſerves by its contiguity to fix camphire.

Scholium. It is diſputed by authors, whether camphire be a roſin, a coagulated oil, or a *ſal volatile oleoſum*; the laſt opinion, as being entirely abſurd, does not deſerve our attention; but the two former are eaſily diſtinguiſhable; for, camphire has, indeed, ſome characters, whereby it diſtinguiſhes itſelf as well from other roſins as from oils (§ II) but it has alſo ſome characters, and thoſe the primary ones, indeed, greatly agreeing with roſins (§ I); however, when it is demanded, whether any body be a roſin, we conſider, whether it is ſolid, or whether upon being brought to the fire it runs and burns, or whether it will not diſſolve in water: Now if ſuch a body has its original from the vegetable kingdom, it is call'd a roſin; for, all bodies, denominated roſins, have theſe characters. Nor do thoſe that differ in determining, whether any body be a roſin, enquire farther into the preſence of a coagulating acid, but they reſt ſatisfied with the characters already mention'd. Some people call ſome mineral bodies, as for inſtance, mineral ſulphur and bitumens, that are of the ſame nature, as has been mention'd, roſins of the earth.

Several ſorts of camphire. § III. This ſpecies of roſin is brought from the *Eaſt-Indies* and collected there in various places. Hence thoſe who have writ the natural hiſtory of theſe

theſe countries aſſert, that there is a fourfold camphire, to wit, 1. The native camphire, collected in the iſland of *Borneo* from camphire-trees in its own natural cryſtalline glebe, after cutting aſunder the fell'd trunks. 2. What is extracted from the root or bark of the root of the *Ceylon* cinnamon-tree by coction and diſtillation along with water. 3. That, which is in the ſame manner obtain'd in different parts of *India* from the roots of zedoary. 4. And laſtly, the *Chineſe*, or rather *Japoneſe* camphire, drawn by ſublimation from the roots, trunks, branches and leaves of the camphire-tree, thrown together into a copper full of water; this laſt kind of camphire is chiefly brought to *Europe* in wooden cheſts in form of greater or ſmaller maſſes, and almoſt of a cineritious colour, generally mixt with ſeveral bits of wood, to which the camphire not rais'd by that ſublimation ſtill adheres in greater or leſs quantity. The three former ſorts of camphire, and eſpecially that of *Borneo* are collected but in a ſmall quantity, and only procured and kept by the more curious; and that therefore, becauſe they are ſcarcely brought to *Europe*; and again it is not without reaſon doubted, whether the ſecond and third ſpecies may be call'd true camphire; but we do not dwell upon theſe.

But, we deſign at preſent to examine ſomewhat more accurately the laſt ſort, to wit, that of *Japan*, as it is the only ſort in our ſhops. The tree, to which we owe the camphire, is like to, or of affinity with the laurel, according to ſome writers, as *Hermannus*, *Breynius* and *Kæmpfer*. *Tournefort* calls it the laurel, as does alſo *Linnæus*[a]. If any one deſires a fuller account of the camphire-tree he may eaſily have it from the above cited authors. You may alſo conſult *J. F. Gronovius' Diſſertat. inaug. de hiſtoria camphoræ* at *Leyden* 1715.

§ IV. Hence it appears (§ III) that camphire is a native, vegetable production; for, tho' artiſts have made various attempts to prepare camphire by art, yet the thing did not altogether ſucceed, tho' it may be adulterated in various manners; for, there are ſeveral ſorts of oil conſiſtent in the heat of the atmoſphere and in a ſolid form, from which many attempt to prepare artificial camphire; but it widely differs from the true camphire, as in a dry fire and in cloſe veſſels it is never ſublim'd without a remainder, an *empyreuma* and the loſs of its conſiſtence; nor does ſuch ſort of factitious camphire yield the peculiar odour of camphire, which depends on the *ſpiritus rector*, by which it diſtinguiſhes itſelf from all other vegetables (§ II. *n.* 1.) as no ſpecific vegetable body, that we know of in nature, can by art be produced genuine from any other vegetable or body; and thus, eſpecially the *ſpiritus rector*, peculiar to each plant, is entirely inimitable[b]. Camphire not producible by art.

§ V. The camphire, brought from the *Eaſt-Indies* to *Amſterdam*, is infected with bits of wood and other traſh that remain after ſublimation, Camphire how refin'd.

[a] *Vid.* ejus Gen. plant 338. [b] *Vid.* Boerhaav. chem. P. II. p. m. 18.

(§ III) and for that reaſon it cannot well be applied to the deſtin'd uſes; it, therefore, wants depuration, whereby the heterogeneous bodies may be ſeparated from it. This depuration, as camphire may without any alteration (§ II) be ſublim'd by ſo gentle a heat, whereby no body contracts an *empyreuma*, is perform'd by the moſt ſimple ſublimation; nor is there any occaſion for additions, which artiſts would perſuade the ignorant to be abſolutely neceſſary. What, doubtleſs, gave riſe to this ſuſpicion was, that ſome people obſerv'd depurated camphire ſold in ſolid pellucid pieces; ſince they themſelves have obtain'd camphire, ſublim'd in the form of flowers, as they were ignorant of the due degree of fire which muſt be carefully obſerv'd here, as alſo of the juſt bigneſs and figure of the veſſels: But the whole matter comes to this; if camphire be ſo ſublim'd, that there be applied a gentler fire or a ſomewhat taller veſſel, and hence remaining always colder a-top, all of it aſcends in form of very white, ſhining, flaky flowers; but if it be ſublim'd in a low, ſpheroidical veſſel with a narrow neck, not above a few inches high, with ſo ſtrong a heat that the upper part of the veſſel be ſo hot as may make the camphire juſt ready to run; but in the mean time care be taken not to ſtop the orifice nor to apply too ſtrong a fire; and if this laſt ſhould be the caſe, the fire to be leſſen'd, and the orifice to be open'd by means of an iron-wire, thruſt in at times; the ſublim'd and half melted camphire concretes into a ſolid cake of a cryſtalline tranſparency; but this you ſhall not obtain, without chuſing ſuch a veſſel and obſerving the above degree of heat. But if it happen, that the camphire is very much infected with any oil, it may be ſeparated by the addition of a little chalk, exactly in the manner as volatile alcaline ſalts are by chalk depurated from their oil[c].

The proceſs in it.

§ VI. The camphire, thus depurated, is call'd refin'd; the proceſs itſelf, as it is now manag'd at *Amſterdam*, and as it was formerly done at *Venice*, is nearly in the following manner: They beat the crude camphire (§ III. *n.* 4.) after throwing away the larger bits of wood, into a groſs powder, and paſſing it thro' a ſieve with wider holes, they ſeparate the larger pieces. Of this powder they put about two pounds and a half into a glaſs-veſſel, like a flat ſpheroidal phial, furniſh'd with a narrow neck, ſome inches high; the furnaces are built in a ſpacious, high building, like a granary, ſo as that the ſides of the furnaces be join'd to each other; their exterior compaſs is about two foot, each of them is furniſh'd with a *balneum arenæ*; forwards there are apertures made for putting in the fuel and clearing away the aſhes; and in theſe *balnea* they put ſand to the height of ſome inches, into which they immediately put the veſſels containing the camphire, for this reaſon, namely that the alteration happening to the camphire within may be obſerv'd: Then ſuch a degree of fire is for ſome hours ſupplied, that the camphire may run like water, and its humidity

[c] *Vid.* Boerhaav. chem. P. II. p. 366.

humidity exhale, the neck of the veſſel being for this purpoſe open: But leſt the humidity ſhould apply itſelf in dewy drops to the upper and colder part of the veſſel, which falling back again would crack the veſſel, there are laid on round pieces of cloth, and that threefold, with a round hole in the middle for tranſmitting the neck of the veſſel: Theſe round pieces of cloth are of ſuch a depth as to cover almoſt half the veſſel, by which means its upper part is ſo ſtrongly heated, that the watery vapours can in nowiſe be coagulated, but forced out for the ſame reaſon; nor can the camphire apply itſelf there, but being diſſolv'd by the ſtronger heat, it either flows back again or is forced upwards; for, till all the humidity is exhal'd, the camphire never concretes into a pellucid and ſolid cake: But when a deal of camphire exhales at the ſame time, they lay on a conical *aludul*, made of filtring paper, to which the flowers of the camphire adhere: The fire thus continued for ſome hours, is brought lower, and the aludul, together with the cloths is removed, and inſtead thereof a like perforated diſh is applied, whereby it happens, that the camphire, which is ſublim'd, may accrete to this part of the veſſel, as being then ſomewhat cooler, yet ſtill ſo hot, that the camphire-particles beginning to melt may run into one ſolid pellucid maſs; the veſſel in the mean time is cover'd with an inverted cone of paper to hinder its free exhalation, the fire is again heighten'd, yet moderately, till the whole is ſublim'd, leaving the dirt behind at the bottom: But as the orifice of the phial may be quite ſtopp'd up by the flowers, they keep it always open by thruſting in an iron rod, whereby the flowers are thrown to the bottom; if they do not mind to do this, the veſſels burſt, and that not without ſome hazard. The veſſels are taken off the furnaces, after cooling of themſelves they are broken, and the camphire taken out in form of a cake; and the flowers, which accreted to its internal ſurface, together with a part of the ſublimate, are cut off with a knife and reſerv'd for another operation. Thus they have a cryſtalline cake of camphire, perforated in the middle: And herein conſiſts the whole proceſs recited (§ V) Now let us ſee what habitude camphire has to ſome of the principal *menſtruum*'s.

§ VII. Camphire is diſſolv'd by alcohol, and that in a greater quantity the more concentrated the alcohol is; but in a leſs, the more diluted it is. The greateſt quantity of camphire diſſolving in alcohol is almoſt equal the quantity of alcohol; the ſolution itſelf is very much promoted by heat; there is again a deal of camphire extracted from the ſolution when cold, by pouring on water; and in proportion to the quantity thereof, a proportionable quantity of camphire is precipitated: The abſtracted ſpirit, as it is more volatile than camphire, (§ II) carries along with it, it is true, ſome of the camphire, but it leaves the greateſt part of it at the bottom of the veſſel, which is ſublim'd apart. Such a weakened ſpirit, therefore, or even if but a little be diſſolv'd in alcohol, may eaſily be mixt with almoſt

The habitude of camphire to the principal *menſtruum*'s

almoſt an equal quantity of water, in regard common ſpirit of wine is nothing other than alcohol mixt with water, only that there is leſs acid in the alcohol; if alſo by pouring water to it, the ſolution ſhould become turbid, this muddineſs ſoon diſappears again. There is, therefore, no occaſion to diſtil from a retort, with an addition of ſalt of tartar, the alcohol ſaturated with the camphire, if you want a ſpirit of camphire, diluted with ſome water.

Scholium. Alcohol is very eaſily prepar'd with very dry pot-aſh, moderately hot, if one third of theſe be digeſted for ſome hours with ſpirit of wine, and then decanting the ſpirit from the ſubſiding alcaline ſolution, another and that a leſs portion of dry, warm ſalt be added, with which being digeſted for 24 hours it becomes entirely dephlegmated, all the acid being abſorb'd by the fixt alcali: But becauſe ſome neutral ſalt, produc'd from the vegetable acid and fixt alcali, is diſſolv'd in ſuch alcohol, in ſome caſes it is proper to rectify it. The ſame alcohol may be produced with common ſalt in the like manner, but with greater exactneſs; to wit, if common ſpirit of wine is by a bath-heat gently brought over thro' a very tall worm, there remains a certain portion of phlegm, which in ſuch an apparatus no longer aſcends: The ſpirit produced is by the like treatment twice digeſted with an equal portion of common ſalt, very hot, and abſtracted to ⅔; and thus we have a very pure alcohol, far preferable to that procured with fixt alcali.

§ VIII. Oil of vitriol, if in a certain reſpect you except mineral ſulphur, diſſolves all inflammable bodies, and at the ſame time it puts on a yellow colour; if in a greater quantity, a red; and in fine, a dingy and black colour; for, the pureſt oil of vitriol, highly concentrated, is by no means of a yellow, dingy or dark colour, but limpid like water, and colourleſs: There happens the ſame change of colour, if this acid diſſolve camphire, and there ſtrikes out at the ſame time a quite different odour from what camphire uſually gives, to wit, a fetid, bituminous ſmell, mixt with a ſulphureous acid; if the ſolution is heated, there aſcends a penetrating, volatile, ſulphureous ſpirit, not unlike oil of amber in odour. Camphire is precipitated from oil of vitriol by water, and returns to its natural ſtate; the ſame precipitation happens by the addition of alcali's, as they very ſtrongly abſorb the acid of vitriol. At length by ſublimation in a ſtrong fire, the camphire itſelf is in part recover'd, but at the bottom of the veſſel there remains a ſpongy coal, which by too great a degree of heat ſometimes froths and ſheds over the diſtilling veſſel, and ſpoils the whole. Spirits of ſulphur and alum, as they differ not from oil of vitriol, if equally concentrated, entirely exhibit the ſame *phenomena*. The quantity of camphire, ſoluble in oil of vitriol, does in the cold ſometimes exceed the quantity of the oil; but by the acceſſion of heat an incredible

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quantity of camphire melted along with the oil of vitriol, runs into a thick, dingy *bitumen*.

Oil of vitriol, produced by the moſt violent diſtillation, is rectified, if it be again diſtill'd from a ſmall glaſs-retort in a ſand-heat, in ſuch manner, that in a minute of time about 15 drops may fall, which will be a ſomewhat acid ſpirit, and ſometimes if the oil be freſh, a ſulphureous, volatile, penetrating ſpirit: It is diſtinguiſh'd by the dewy drops appearing on the ſides of the veſſels, till at length thick veins, counterfeiting oil, come over along with a thick grey vapour; and the drops, which are ſmaller than the preceeding, as they fall into the recipient to the former ſpirit, cauſe a hiſſing like that of a burning coal thrown into it. After this the receiver is removed, and another hung on, and that very dry and of a moderate ſize; here there is no occaſion for luting too cloſe the junctures of the veſſels. Thus a very ponderous, limpid, and colourleſs oil of vitriol comes over, whoſe firſt drops are as generous as the laſt. Scholium.

§ IX. A weak, diluted, vegetable acid leaves camphire almoſt entirely untouch'd; but yet that acid, concentrated by rectification, yet more by cold, and moſt of all by copper and a fixt alcali, diſſolves the more of the camphire, the more concentrated the acid is: But the weight of vinegar does ſome number of times exceed that of the camphire, diſſolv'd in highly concentrated vinegar: The ſolution at the ſame time is render'd ſo light, that tho' in the beginning of the ſolution the camphire floated, yet when thrown in towards the end it ſinks: The ſolution expos'd to a moderate heat is render'd highly ſaturated, and then after it is cold, a conſiderable part of the camphire again ſeparates in a flaky form. It is again precipitated without any alteration, by pouring on water; nay, even by abſorbents: By ſublimation and diſtillation it may again in part be ſeparated. When the greateſt part of the camphire, after the humidity along with the acid is abſtracted, remains behind, it is at laſt ſublim'd apart; but the other part, forced off along with the acid, remains diſſolv'd at the bottom of the recipient.

For this experiment the moſt concentrated vinegar by means of verdigreaſe ſhould be procur'd: The verdigreaſe is diſſolv'd in diſtill'd vinegar, filtred, and by repeated evaporations reduced to cryſtals, call'd cryſtals of verdigreaſe: Theſe, well dried with a moderate heat, are firſt urged by a gentle ſand-heat in a glaſs-retort, and thus the phlegm comes over in dewy drops, without any viſible vapour, till upon heightening the fire, the vapour begins to appear denſe and white; then the receiver is ſhifted, and another very dry one is applied; the fire is gradually heightened, till the ponderous, white vapours, and the oily veins, are no longer ſeen. This will be a very ſharp vinegar, which neither the tongue nor noſe can bear; but as it partakes of much copper, it muſt be rectified by repeated diſtillation; it is call'd *Zwælffer*'s vinegar. Vinegar in like manner is ſaturated Scholium.

with

with fixt alcali, and inſpiſſated to dryneſs, in order thence to procure the ſolid *tartarus regeneratus*; and afterwards it is again brought over by diſtillation from a retort, gently pouring on highly concentrated oil of vitriol: And thus there is obtain'd the ſharpeſt vinegar, call'd *acetum radicatum*. Obſerve here the following precautions, that both the recipient and ſand-heat be tepid, that the oil of vitriol be put in by drops, and that at firſt a very gentle degree of fire be applied, afterwards to be gradually heighten'd; for, theſe highly acid vapours, and of a milky colour, do ſuddenly burſt out with incredible violence; and there is the greateſt danger in this operation, leſt the retort, on account of the great degree of heat, ſhould burſt.

§ X. The more concentrated ſpirit of nitre is, the more camphire it diſſolves into an oily *liquamen:* In this manner, indeed, that the ſame quantity of acid diſſolves a larger quantity of camphire, the leſs it is diluted with water: While this ſolution happens, the ſuperfluous water, united with the acid, is forced out of the ſpirit of nitre, and remains behind at the bottom; but the acid conjoin'd with the camphire floats a-top: Hence the leſs phlegm there is in the ſpirit of nitre, the ſmaller is the maſs which is collected at the bottom of the veſſel; but the more there is of it, the maſs is alſo the greater. If ſpirit of nitre be highly concentrated, all of the ſpirit is receiv'd by the camphire, without the expulſion of the aqueous acidulous particles that lodge below. Hence it appears, that a conſiderable portion of water, and that in a certain and determinate quantity, enters into the ſolution of camphire by ſpirit of nitre, and dilutes it without precipitation; for, highly concentrated ſpirit of nitre, digeſted in a cloſe veſſel along with camphire, penetrates it, indeed, but does not convert it into ſo thin an oil; and rather gives it a thick, turpentine conſiſtence. If to this you add ſome drops of water, the camphire ſeems, indeed, to ſeparate from the acid in form of flakes; but after that the water is by ſhaking equally divided, the camphire forc'd out is again very quickly diſſolv'd. If you proceed cautiouſly to drop in the water, the ſolution is at length diluted like a thin oil: If at length you drop in more water, not only ſome little part of the camphire is ſeparated (and it is only to be diluted by the addition of more acid, or even by the application of heat) but alſo by ſtanding a few hours, if there is a ſufficient quantity of acid therein, a *molecula* of acidulous water begins to collect at the bottom; and this water is almoſt equal to weak ſpirit of nitre. Some ſmall part, therefore, of the acid is ſo firmly detain'd by the water, that the camphire cannot abſorb it. On the contrary, the water of camphire, diſſolv'd by an acid, attracts ſuch a portion of the acid, as is requiſite for its ſaturation to a certain degree, and not a greater portion. Hence it happens, that water pour'd on the ſolution of camphire with the acid of nitre, ſtrikes out the camphire, and as the water abſorbs only a certain portion of the acid, we eaſily gather, one drop of water does not ſtrike out all the camphire, but a certain part

of

of it only: And this, indeed, is not only to be remark'd about the ſolution with ſpirit of nitre, but likewiſe about other ſolutions. If any one knows how to temper the ſpirit of nitre in ſuch manner, as not to be too much concentrated, nor yet too weak, 12 times at leaſt, nay, 16 times the quantity of camphire is diſſolv'd, and then little or no liquid is collected at the bottom; nor yet is the ſolution too thick. If to this ſolution you add bodies that very ſtrongly abſorb the acid of nitre, the camphire is precipitated; and hence alſo by metals, and their purer ſolutions: But then it is neceſſary, that the ſpirit of nitre, which holds the camphire diſſolv'd, be not too much concentrated, and the weaker ſpirit lodge at the bottom eſpecially; becauſe in a too ſtrong ſpirit ſome metals, as for inſtance, ſilver, are leſs readily diſſolv'd. Camphire, when precipitated by abſorbents, or by water, or rais'd by ſublimation, where a coal not unlike that (§ VIII.) remains in the veſſel, is found entirely unchanged.

The beſt ſpirit of nitre is by ſolution got from nitre, adding a very little quantity of fixt alcali and quick-lime, depurated by digeſtion, filtration, evaporation, and a careful cryſtallization. This depuration is chiefly made for ſeparating the common ſalt that lies conceal'd in almoſt all nitre. The cryſtals of the firſt evaporation, well dried and comminuted by ſuch a degree of heat, as almoſt to run, are diſtill'd from a retort along with $\frac{2}{3}$ of oil of vitriol, and that in the ſame manner as *acetum radicatum* (§ IX. *Schol.*) only that here the recipient be kept as cold as may be. You will obtain a very ſtrong ſpirit, of a golden colour, and even in the greateſt degree of cold burſting out into very denſe fumes; it is to be kept in a veſſel with a very cloſe glaſs-ſtopper; and the veſſel is ſeldom to be open'd; and when open'd to be again very nimbly ſtopp'd, otherwiſe the beſt and moſt concentrated acid of the nitre ſoon flies off; and not only the ſpirit remains weaker, but even at the ſame time, eſpecially if the air be moiſt, much phlegm inſinuates into it: Whence, at length, it becomes more dilute in its colour, and weaker. The ſame thing holds of any concentrated acids, and if their beſt part does not fly off, on account of their fixity, as in oil of vitriol; yet in a ſhort time they contract humidity: And hence the different experiments made with ſuch ſpirits do not ſucceed, namely, in ſuch where a highly concentrated acid is requir'd. Scholium.

§ XI. The ſtrongeſt ſpirit of ſalt, prepar'd in the ſame manner as ſpirit of nitre (§ X. *Schol.*) and as *acetum radicatum* (§ IX. *Schol.*) does here diſtinguiſh itſelf entirely from all other acids; for, neither concentrated nor diluted, nor by any degree of heat, does it receive camphire into itſelf, tho' it precipitate it from other acid ſpirits, as alſo from ſpirit of wine itſelf.

§ XII. The acid ſpirits of nitre, vitriol and vinegar, dulcified by alcohol, very readily diſſolve a great deal of camphire, and that the more, the more acid predominates in them.

§ XIII. Saline liquors *per deliquium*, or their common ſolutions, alcaline and neutral, both fixt or ſemi-fixt, diſſolve not camphire, excepting the liquor of *tartarus regeneratus*, and of ſemi-volatile, neutral ſalt, prepar'd from vinegar and volatile alcali; for, as being purer they give ſome ingreſs to the camphire, a conſiderable portion of which may, notwithſtanding, if requir'd, be mixt by means of the concentrated ſpirit of vinegar (§ IX. *Schol.*) previouſly ſaturated with camphire.

§ XIV. Oils both diſtill'd and expreſs'd diſſolve camphire, but not ſo readily without a conſiderable degree of heat, and that not much inferior to that of boiling hot water. Hence ſuch a ſolution is beſt perform'd in a bolt-head.

§ XV. We are in the laſt place to remark, that camphire reſiſts the corruption both of animals and vegetables; ſo that hence almoſt all roſins and gum-roſins ſerve for embalming, as appears from the repoſitories of natural curioſities.

Its medical effects on the human body, and the vanity of explaining the effects of medicines by mechanics.

§ XVI. As the nature and habitude of camphire, with reſpect to menſtruum's, ſufficiently appears from what has been ſaid: Let us now conſider its medical effects upon applying it to the body. But in regard moſt phyſicians do now-a-days almoſt always undertake to explain the powers of medicines from mechanical and phyſical laws, and as they look for ſuch demonſtrations in medical writings, I ought at the very entrance to hint to the reader, that as I am convinc'd of the vanity of theſe explanations, and the unſeaſonable application of mechanical laws to medicines, at leaſt moſt of them, ſo I ſhall not advance one word that may ſeem to favour of ſuch principles: And I believe any one will eaſily come into my opinion, if he conſiders, 1. The incomprehenſible ſmallneſs of the ultimate parts of any body, which are not diſcoverable even by the beſt microſcope; I mean thoſe very ſmall parts which the ſchools call ſimilar, any one of which ſtill conſtitutes the ſame body; but which, after a farther diviſion, have no longer the nature of the body of which they are parts, but conſtitute different heterogeneous principles, from whoſe mixture the body was before made up. The ſchools have call'd theſe the conſtituent parts. 2. That one and the ſame effect is often produced by very different cauſes. 3. That we have no ſure principle, from which we may with certainty determine any thing about the figure of mixts. 4. That the mechanical properties of bodies alone, as their figure, hardneſs, denſity, and ſpecific gravity, are in no manner ſufficient to produce ſome effects; but that beſides, there is requir'd a determinate motion in reſpect of direction and power, whereby bodies may produce their actions: This moving force immediately manifeſts itſelf, as ſoon as two bodies are mutually applied to each other, and by naturaliſts call'd the *vis inſita*, and relatively conſider'd as to the bodies applied, it diſcovers itſelf by different effects. Now this force ſhould be diſtinctly underſtood by thoſe who attempt mechanically to explain the men-

menſtrual action of mixts. But pray whence is it known? Let a perſon take any one of the modern ſyſtems, and he will ſee, provided he is not involv'd in preconceiv'd opinions, that he muſt either have recourſe to hypotheſes, or that the *vis inſita* of bodies remains always conceal'd from our eyes; nor will it be certain that there is ſuch a *vis* but by experience. Again, if one, moreover, conſiders that the ſtructure and conditions of the human body differ very much, that its nature or the eſſence of its ultimate parts, both ſolid and fluid, are not thoroughly known to us; and hence, that from the various application of the ſame medicine quite different effects do ariſe, I am of opinion, he will not doubt, but that the powers of medicines are almoſt always to be determin'd from experience alone. As we ſhall, therefore, endeavour to explain the effects of camphire, we ſhall go merely upon experiments and obſervations, and the conſequences that by juſt reaſoning may be hence deduced. But that the whole may appear the more clearly, we ſhall premiſe ſome general things.

§ XVII. Upon increaſing the motion of the humours of our body certain effects immediately ariſe, to wit, the reciprocal action of the humours and veſſels upon one another, as alſo a ſtronger attrition of the humours among themſelves; and hence a change in all the ſecretions and excretions, and conſequently, in the whole body. That this happens, in proportion to the increaſe of the motion, appears of itſelf. Now let there be, 1. A body ſomewhat ſtronger and more rigid; let the humours be acrid, and neither ſo moveable, or let them be affected with any other morbid diſpoſition: In fine, let this quicker and ſtronger motion of the humours continue a little longer, in a ſhort time every thing will be much chang'd from its natural ſtate; the attrition will perpetually increaſe, heat ariſe, the blood, after diſſipating the more liquid part, be dried up, an inflammatory fizyneſs ariſe, together with the obſtruction, deſtruction and inflammation of the ſmalleſt veſſels, a beginning corruption, and all thoſe conſequences we learn from pathology. But 2. Let the body be of a looſer texture, and at the ſame time let there be a ſufficient quantity of mild and pretty moveable humours, tho' the quicker motion may continue for ſome time, there will ſcarce be any ſenſible alterations obſerv'd; nay, very often health will be thereby very much improv'd; for, as the veſſels and humours are more ſtrongly agitated, there is not only a cauſe producing a ſtronger fibre, but alſo upon increaſing the ſecretions and excretions, ſo far as they depend on an intenſer degree of circulation, crudities and obſtructions, which are probably preſent in the body, are concocted and diſſolv'd, and they are either excern'd by the proper outlets, or aſſimilated with the ſound maſs. Hence it appears, that in different bodies, different effects may be owing to the ſame cauſe.

As appears by inſtances.

§ XVIII. A quicker circulation of the blood is known from the number of pulſes; but from a quicker circulation all the ſounder phyſicians agree, that

there is a fever: As, therefore, a fever conſiſts in an increas'd circulation, what holds as to this, will alſo hold as to a fever; a fever, therefore, will produce the ſame effects (§ XVII.): Beſides, whatever cauſes a quicker circulation, cauſes a fever and its effects (*ibid*); but there are medicines, call'd ſtimulating, which cauſe a quicker circulation; they will, therefore, alſo produce a fever and the 'foreſaid effects.

§ XIX. All vegetable bodies, eſpecially the inflammable, which have a ſtrong odour or taſte, and chiefly ſuch as have both at once, being applied to the human body, are found to affect the nerves, rouze the ſpirits, heighten the oſcillatory or contractile force of the fibres, and hence the motion of the humours, both in a part and in the whole body[d]. And experience ſhews, that theſe things happen in proportion to the quantity applied to the body.

Scholium. Tho' here I have ſaid, that all vegetables, that are very odorous and ſapid, produce and increaſe the motion of the humours; and that hence alterations happen, as appears from what was ſaid above: Yet you muſt not imagine, that, therefore, all inſipid and inodorous bodies are excluded, or to be reckon'd inactive; for, the contrary appears from many bodies of the three kingdoms: As to the vegetable kingdom this appears from the root of black hellebore, the *cicuta aquatica* of *Geſner*, the deadly night-ſhade, *&c.*[e] As to the animal kingdom, ſome animal poiſons affirm the ſame thing: From the mineral kingdom let us take arſenic and glaſs of antimony, which are bodies entirely inſipid and inodorous in the heat of the atmoſphere, and yet when taken into the body, they are highly mortal poiſons.

§ XX. As therefore vegetables (§ XIX.) by affecting the nerves and ſtimulating the fibres, cauſe a briſker circulation (*ibid.*) excite a fever (§ XVIII.) and its effects (§ XVII.) they are, therefore, referable to the claſs of ſtimulating medicines (§ XVIII.).

§ XXI. Camphire is a vegetable body, inflammable, and of a penetrating taſte and odour (§ I. *& coroll.* § II.) applied, therefore, to the human body, it excites the circulatory motion of the humours (§ XIX.) it, therefore, produces a fever and its effects (§ XVII, XVIII.) it is, therefore, to be claſs'd with ſtimulants (§ XVIII, XX.)[f].

Scholium. Now let the reader conſider, that camphire (otherwiſe than other bodies of the ſame kind, both natural and factitious) is all of it very odorous and ſapid (§ II. *corol.*) and he will no longer doubt of the truth of this aſſertion. From many of thoſe bodies, if not from all of them, an active principle may be eaſily ſeparated (*ibid.*) the remainder being more inactive in reſpect to the human body: And when theſe are for a long time expos'd to the open

[d] *Vid.* Boerhaav. chem. *P.* II. *p.* 16. *&* Inſtitut. Med. § 1112. *n.* 2, 3.
[e] *Vid.* Boerhaav. chem. *P.* II. *p.* 24.
[f] Boerhaav. Inſtit. med. § 1112. *n.* 2, 3.

open air, that active principle exhales, and the remainder is found more inactive and more fixt (*ibid.*). Camphire in the open air is, indeed, diminish'd as to weight, but what remains of it has the same virtue as what exhal'd (*ibid.*) by distillation that active principle is easily separated under the form of a subtile and very penetrating oil (*ibid.*). And even that essential oil, repeatedly thus treated with spirit of wine or water, lets it go further; and there always remains behind a more inactive and resinous body [g]; but camphire is of a different nature (§ II. *cor.*). Whence also I think it evident, that that principle which constitutes the virtue of any vegetable, and which some call the *spiritus rector*, is in greater quantity and more closely united to camphire, and probably is inherent in a more subtile basis than in other vegetables: And hence also it seems to arise, that being added to some resinous vegetable bodies, as an appropriating medium, it facilitates their ingress into the subtiler *menstruum*'s, an instance of this we have in genuine gum-copal, which is otherwise scarcely soluble in alcohol, yet not all of it; but if the best alcohol be previously almost saturated with camphire, it is at length dissolv'd, tho' in a small quantity, and scarcely $\frac{1}{6}$.

Camphire in what cases to be us'd.

§ XXII. Whenever, therefore, a physician would restore the contractile force of the vessels, either in the whole body or in a part only, and increase the motion of the humours together with the functions depending thereon, that is, excite a fever, and at the same time a pretty large quantity of mild humours and fitted to the transmitting vessels be present, stimulants are indicated (§ XVII, XVIII, XIX, XX.) and therefore, camphire may also in that case be employ'd (§ XXI.) [h].

Camphire a sudorific.

§ XXIII. But physicians have observ'd, that the effect of camphire, taken into the body (§ XXII.) is principally directed to the skin or habit, that is, produces sweat and a *diaphoresis*; and hence they have class'd it among sudorifics; namely, the more ancient physicians, as they observ'd, that some medicines exerted chiefly their action on this or the other organ of our body, have impos'd various names upon them, for the most part taken from the liquors, excern'd by these organs: Hence they call'd those medicines, which more strongly move the humours thro' the whole body, and at the same time determine them towards the exhaling pores of the skin, diaphoretics or sudorifics. As, therefore, they observ'd the same thing in camphire, they deservedly made it of that class.

In what cases sudorifics are to be administer'd.

§ XXIV. The following circumstances shew that sudorifics are to be given, 1. A beginning or present critical sweat. 2. The tenuity of the morbid matter, dispers'd, or to be dispers'd thro' the whole body. 3. The peculiar temperament of the patient. 4. The known epidemical constitution. 5. The various obstructions every [where in the body [i]: But that they

[g] *Vid.* Boerhaav. chem. *P.* II. *p.* 130.
[h] *Vid.* Boerhaav. Instit. Med. § 1112. *n.* 2. β & § 1114.
[i] *Vid.* Boerhaav. Instit. Med. § 1192.

they may be exhibited with ſucceſs, it is requiſite, that the humours of the body be attenuated and diluted; and that the veſſels and their apertures be relax'd[k]. It, therefore, appears both from theſe things and from what was ſaid (§ XVII, XVIII, XX, XXI, XXII.) in what circumſtances, and with what precautions camphire ſhould be adminiſter'd.

Coction, reſolution and criſis what.

§ XXV. In all internal diſeaſes with matter, when it is to be changed into a ſound ſtate, the morbid matter is ſo to be ſubdu'd by the vital force, aſſiſted by medicines, and ſometimes by the ſpontaneous change of the matter[l], as to approach more to a ſound ſtate and do the leſs harm: And theſe things happening, a *coction* is ſaid to be produc'd. If now it be ſubdu'd ſo far as to be entirely aſſimilated to the ſound humours; and an equable circulation being reſtor'd, the whole diſtemper be laid, phyſicians ſay that there is a *reſolution* produced: But when ſtill, tho' the crude matter be concocted and render'd moveable, it retains ſome quality, which reſiſts an equable circulation and ſtimulates the veſſels, and it is at length diſcharg'd by ſome ſenſible evacuation, a *criſis* is ſaid to happen.

Camphire a ſtimulant.

§ XXVI. And that all theſe things may proceed well (§ *præced.*) there ſhould be a ſufficient and proportionate vital force, namely, that the morbid matter may be mov'd, ſecreted and excreted. If this force, therefore, be found to be languid, it is to be excited by various remedies, according to the conditions of the diſeaſe[m]. If, therefore, a phyſician ſhall know, that the humours are now leſs noxious and ſufficiently moveable, and that to complete the coction there is only wanting the circulatory motion, on account of the inactivity of the fibres alone, he muſt adminiſter ſuch medicines, as may excite the moving fibres to a ſtronger contraction, and move the veſſels and humours: In that caſe, therefore, ſtimulating medicines are indicated (§ XVIII, XX, XXII.) for, theſe, upon increaſing the motion, produce the effects, mention'd (§ XVII, XVIII, XX.) Again, if the indications (§ XXIV.) allow of it, he will order ſuch medicines, as force the concocted and moved matter (§ XXV.) to the excretory veſſels of the ſkin (§ XXII.) But now camphire (§ XXI, XXII, XXIII.) heightens the ſtrength of the veſſels, moves the humours, and determines them to the veſſels of the ſkin: Where, therefore, coction and a criſis are chiefly to be promoted by ſweat, you may employ camphire.

Its uſe in different caſes ſhould be determin'd by experience.

§ XXVII. From what has been hitherto ſaid (§ XVII, XXVI.) I think it follows, that the beſt effects may be expected from the ſeaſonable and cautious uſe of camphire; but in what diſeaſes chiefly it may exert its salutary virtues, as the powers of medicines ſhould be determin'd by experience (§ XVI.) ſhould be learn'd from the obſervations of credible medical authors; for, no one can contend, that it is proper in all caſes, where the indicants, mention'd (§ XXII, XXIV, XXVI.) are preſent: But as it would

[k] *Vid.* Boerhaav. Inſtit. Med. § 1191.
[l] *Ibid.* § 926.
[m] *Vid.* Boerhaav. Aphor. § 611, 612.

would be endleſs to recite all the caſes in which phyſicians commend camphire, I ſhall only adduce the more authentic; and therefore, I ſhall try, whether I can anſwer the following queries.

1. How may camphire be of ſervice in curing obſtructions? I anſwer, by conciliating a reciprocal motion to the veſſels: Hence, where an obſtruction is increas'd by a contraction, peculiar to the veſſel, it has no place[n]. The uſe of camphire in obſtructions.

2. How may it cure inflammations by reſolution? I anſwer, in the ſame manner as (*n.* 1.) it cures obſtructions; for, in both caſes, the fibres of the veſſels are diſtended by the ſtagnating matter: But an exceſſive tenſion deſtroys the elaſticity of the fibres. When, therefore, the obſtruction and inflammation are recent, and not too large, or by exhibiting proper remedies the ſtagnating matter is ſo diſpos'd, that the phyſician diſcovers from the ſigns, that only the inactivity of the fibres oppoſes its plenary diſcuſſion, that camphire is highly to be commended in this caſe both experience teſtifies, and what was ſaid (§ XVII. *n.* 2. XXI, XXII.) ſhews. In inflammations

3. Whether, therefore, it be of ſervice in all inflammations? I anſwer, this the generality of authors hold; yet they will give the cautions, mention'd (§ XVII, XXII. and *n.* 1, 2.)

4. Whether it may be of ſervice in acute fevers? I anſwer, the quicker contraction of the heart, together with an increas'd reſiſtence at the capillary veſſels, is the compleat idea of an acute fever[o]. The *lentor*, therefore, of the humours, blocking up the ſmalleſt veſſels, together with the *ſtimulus*, that irritates the heart, ſhould be corrected: We, moreover, know, that in acute fevers the matter is generally ſo diſpos'd in a certain time, that there happens a ſudden change of the diſeaſe, either to health or to death, which change is call'd critical; and to bring this about, a coction ſhould preceed (§ XXV.); but this requires a ſufficient vital force (§ XXVI.): If this force, therefore, be wanting, it is to be excited (*ibid.*) but camphire effects this in a ſurpriſing manner (§ XXI, XXII, XXVI.) In acute fevers, therefore, where the motion before coction is too languid, camphire will be of ſervice; and probably alſo where the nature of the fever and the epidemical conſtitution are known, while it promotes the cutaneous excretion (§ XXIII, XXIV.) it may be of uſe. In acute fevers.

5. Why phyſicians commend it ſo much in the plague and in peſtilential fevers? I anſwer, all phyſicians as in ſeveral diſeaſes, ſo eſpecially in the plague, revere the τὸ Θεῖον, or the incomprehenſible conſtitution of the air, whoſe effect we, indeed, ſee, but its nature we are entirely ignorant of: But whatever that be, which produces the plague in our bodies, is at preſent matter of indifference: It is enough, that phyſicians have obſerv'd, that thoſe affected with the plague feel a very preſent relief immediately upon the breaking out of a plentiful ſweat. Hence they have adminiſter'd In the plague.

[n] *Vid.* Boerhaav. Aphor. § 109, 126, 127. [o] *Ibid.* § 581.

miniſter'd proper ſudorifics; among which (§ XXIII, XXIV.) the deſir'd effect has taught them that camphire is none of the meaneſt. Peſtilential fevers, as they are not very different from the plague, according to *Sydenham*, are remov'd by the ſame remedies.

In petechial fevers. 6. What are its effects in *febrile exanthemata*, eſpecially the *petechiæ*? I anſwer, as theſe for the moſt part have for their matter ſomething which cannot paſs the ſmalleſt veſſels of the habit, but lodges there, but for their cauſe a preceeding fever; eſpecially as *Sydenham* teaches, if by a hotter regimen the thin humours are diſſipated, and the remaining become more acrid and thick; and hence the whole cure conſiſts in rendering the matter moveable by a large quantity of a mild thin liquid, and in the vital powers perſevering in a juſt temper (§ XXV, XXVI. [p]). But that theſe powers are then always languid, the vital actions, greatly impair'd, may ſhew; it is eaſily ſeen what good effect camphire may have; for, it is of ſervice by increaſing the vital powers, and diſcharging by the proper outlets the morbid matter, render'd moveable (§ XXI, XXIV.)

In *flatus'*. 7. How it diſcuſſes *flatus'* in hyſteric and hypocondriac caſes? I anſwer, while a man is in a ſound ſtate, and all the *viſcera* that elaborate the chyle are pretty ſtrong, he will never feel himſelf troubled with *flatus'*, unleſs, perhaps, he has taken down a conſiderable quantity of meat and drink, generating much flatulent matter, or actually fermenting: But as ſoon as theſe weaken'd *viſcera* are incapable of comminuting the aliments and aſſimilating them to our nature, all this is natural, and then the perſon begins to complain of *flatus'*. In hypocondriac and hyſteric patients the *viſcera* that elaborate the chyle are highly weak; the aliments, therefore, will acquire a diſpoſition ſuitable to their nature, cheriſh'd by heat, and they will produce *flatus'*: Beſides, ſuch perſons have their nervous ſyſtem ſo moveable, that by the ſlighteſt cauſe they are affected with ſpaſms: *Flatus'*, therefore, diſtending the inteſtines, their fibres are ſtimulated to a ſpaſmodic contraction: And hence thoſe excruciating pains and anxieties! Medicines, therefore, are indicated, which, by determining the ſpirits towards thoſe parts, may increaſe the ſtrength of the fibres, that they may reſiſt and expel thoſe *flatus'*; but this is what vegetables effect that are of a ſtrong odour and taſte (§ XIX.); and of this claſs is camphire (§ XXI.). It is, therefore, evident, that in ſuch perſons camphire diſcuſſes *flatus'* by determining the ſpirits towards the inteſtines, and corroborating theſe laſt.

In oppreſſion of the *menſes*. 8. How in the ſame women it may promote the ſuppreſs'd diſcharge of the *menſes*? I anſwer, as by ſtrengthening the fibres of the abdominal ſyſtem (*n. præc.*) it removes ſpaſms, the blood has again a free circulation thro' theſe parts, and that circulation promoted: Hence all the ſecretions and excretions are aſſiſted (§ XVII, *n.* 2.).

[p] Boerhaav. Aphor. § 725.

9. What

9. What, therefore, is the diſcuſſing and anodyne force of camphire, ſo much cried up by ſome? I anſwer, it conſiſts in this, that it reſtores the tone of the fibres, and thus ſets a going ſtagnating humours, and which by diſtenſion cauſe pain, and diſcharges them out of the body. Its diſcuſſing and anodyne force what.

10. What is its refrigerating virtue? I anſwer, in all diſeaſes with matter, after reſolution or a criſis (§ XXV, XXVI.) the ſymptoms ceaſe, and all the functions are reſtor'd. As, therefore, theſe things happen in inflammations (*n.* 2.) and acute fevers (*n.* 4.); together with the other ſymptoms, the heat alſo ceaſes; and that in this ſenſe a refrigerating virtue may be aſcrib'd to camphire any one will allow. Its refrigerating virtue.

11. Does, in fine, its diſcuſſing and refrigerating virtue depend on its great volatility? I anſwer, it ſeems not; for, from its volatility alone theſe virtues cannot be conceiv'd, as alcohol, much more volatile than camphire (§ II, VII.) does teſtify: But yet when it is taken into the body, it both coagulates the humours and produces heat. On what the two preceding qualities depend.

§ XXVIII. Every one, even without my hinting it, may ſee, that camphire alone is rarely to be us'd in diſeaſes; but that at the ſame time other medicines, anſwering to the other indications, are requiſite; as theſe, therefore, ſhall vary, the medicines alſo will be various: Yet generally there is internally occaſion for inciding, attenuating, paragoric, and antiphlogiſtic medicines, accompanied with much of a diluting liquid (§ XVII, XXII, XXIV.). Above all others, neutral ſalts deſerve the commendation confirm'd to them by experience, and among theſe, nitre, *tartarus tartariſatus*, *tartarus regeneratus*, and chiefly *ſal ſaiſum ſemivolatile*, in regard it is a ſalt almoſt of the ſame nature with our humours; hence it is very kindly to the human body, and at the ſame time highly penetrating. We may eaſily ſee, that camphire, united with ſpirituous ſubſtances, is with great caution to be adminiſter'd internally; as beſides, daily experience ſhews, that theſe ſpirituous ſubſtances are of greater ſervice than the external uſe of camphire. Cautions in uſing camphire.

§ XXIX. And in fine, the form, in which camphire is to be exhibited, may be eaſily determin'd, if either its external or internal uſe, and at the ſame time the medicines to be taken, are determin'd. Moſt people preſcribe a ſtrong doſe, and that from half a ſcruple to a whole drachm; it will, therefore, vary, according to the circumſtance of the patient and the intention of the phyſician. Internally it is beſt given with ſalts (§ XXVIII.) and other proper bodies in the form of powder along with a ſufficient vehicle; under this form it may enter into almoſt all the pharmaceutical preparations, which admit of powders: But if you would mix it with liquid medicines, you muſt obſerve, 1. That there ſhould be no intenſe heat for preparing the camphorated medicine, or that the camphire be then at laſt added, when the heat is over (§ II.). 2. That liquids do not oppoſe the mixtion of camphire; but that there ſhould be a liquid, approaching to the The form in which to be exhibited.

the nature of ſome *menſtruum* (§ VII, XIV.); for, by this means it may be afterwards mixt with liquids, otherwiſe not miſcible, without any apprehenſion of all the camphire being precipitated. Externally it is beſt applied, when reſolv'd in ſpirit of wine, or in oils (§ XIV.) in the form of unguents, or other the like thing; but it is beſt to employ ſpirit of wine not too ſtrong, becauſe pure alcohol, or ſpirit of wine, highly rectified, dries up the fibres too much, and coagulates the liquids[q]. The uſe of camphorated ſpirit of wine is ſufficiently known to ſurgeons, on account of its excellent uſes[r]; but it acts partly as alcohol, and partly as camphire, and that in the ſame manner as mention'd (§ XXVII. *n.* 1, 2, 3.).

Scholium. Camphire alone, on account of its tenacity, cannot be commodiouſly powder'd; for, in grinding it, it always coaleſces again; it is, therefore, proper to interpoſe ſuch bodies, as prevent its immediate contact and this its coalition; and for this end a drop or two of water are ſufficient, being ſprinkl'd either on the camphire or mortar: But if you have at hand ſomewhat humid ſalts or other bodies, there is no occaſion for water.

§ XXX. As the officinal preparations, in which camphire is an ingredient, are few, and as it may be judged what their effects are, and in what caſes they are proper, from knowing the other ingredients, and from what has been hitherto ſaid, theſe I readily wave.

[q] *Vid.* Boerhaav. Chem. *P.* II. *p.* 224. [r] *Ibid.*

Of the Origin of the Eſthonians, Finns, *and* Laplanders. *By* Olaus Rudbeck, *the Younger*. *From the* Acta Literaria Sueciæ. Trimeſtre III. An. 1727. p. 300.

Tranſlated from the LATIN.

The origin of the *Eſthonians*, &c. AS to the origin of the *Eſthonians*, *Finns*, and *Laplanders*, I am of opinion, that theſe nations are referable to the remains of the ten tribes of *Iſrael*, which *Salmanaſſer*, King of *Aſſyria*, carried captive out of *Canaan*, and caus'd convey into deſart and uncultivated places of *Perſia* and *Media*, ſuch as *Chalach*, *Chabor*, *Goſan*, &c. whoſe names are recited in *Scripture*: But it is ſurpriſing that, from the time the *Iſraelites* were carried into captivity, no hiſtorian made mention of them; whether they remov'd to any other part, or whether they were loſt in thoſe places wherein *Salmanaſſer* order'd them to ſettle: However, the words of the author of the IV. Book and 13th Chapter of *Eſdras* deſerve to be taken notice of; 'Theſe are, *ſays he*, the ten tribes, which were carried captive 'from their own land in the days of King *Hoſea*, whom *Salmanaſſer*, King 'of *Aſſyria*, carried into captivity; and he carried them beyond the river; 'and they were brought into another country: But they reſolv'd with

'them-

'themſelves to leave the multitude of the nations and go into a farther 'country, where mankind never inhabited, and there obſerve their own 'laws, *&c.* For, thro' that country there was a great way, a journey of 'a year and a half; for, that country is call'd *Arſareth:* Then they inha-'bited there even till latter days.'

I labour not to eſtabliſh the credit of this writer: However, if he ſpeaks the truth in this matter, I know not whither the *Iſraelites* betook themſelves, unleſs to that part of the north, where mankind never inhabited; and that journey from the *Euxine* ſea to *Lapland* requir'd, on account of their children, flocks, effects, *&c.* the time, he mentions, of one year and a half to accompliſh it. What ſtreſs is to be laid on *Aſareth*, which anſwers to the name of the town *Arſaratha* among the *Scythians*, according to *Beroſus*, the reader may judge. The *Oſericta* of *Pliny*, indeed, as it differs not much in its letters from *Arſaratha*, ſo is it an iſland on the coaſt of *Germany*, abounding in trees of the cedar-kind, from which amber trickles down upon the rocks. It is not without reaſon, that I take this iſland to be *Scandia* or *Scandinavia*; here is the juniper, in *Swediſh*, *enbær*, a ſpecies of cedar; there alſo is the firr or pine, which many of the Learned take for cedar, at leaſt they think it a ſpecies of it: And in *Scandia* there are whole woods of this ſort of trees. As to the etymon of the word *arſareth*, it is made up of the two *Hebrew* words *Arez*, that is, *land*, *country*, and *æres*, *cedar*, *pine*, which the *Chaldeans* and *Arabians* call *arza:* Whence *Arzareth* is the ſame, as the *country of cedar* or *pine*.

Whither the ten tribes remov'd after their captivity.

From this ſignification we ſeem to diſcover either *Oſerichta* or *Scandinavia*, which alone ſupplies all the world beſides with the greateſt quantity of amber. *Schindlerus*, in his *Lexicon Polyglotton*, has the following things of cedar, 'it is the talleſt of trees, a kind of firr, not unlike the juniper.'

To *Scandinavia*.

But there is no occaſion for other teſtimonies and arguments for claiming *Aſaratha* or *Oſericta* to *Scandia*, if there are nations therein whoſe language plainly ſhews, that they are the offspring of the *Hebrews*. Theſe nations are the *Laplanders*, *Finns*, and *Eſthonians*, which for a great part ſpeak *Hebrew*.

Prov'd from the language of the preſent inhabitants.

There is not, in my opinion, when hiſtory and the monuments and traditions of paſt ages are ſilent, a ſurer way for diſcovering the originals of people, than that which the greater ſimilitude of their language ſhews.

We muſt however own, that there are remains among all nations of the primogeneal language; but excepting the *Syriac*, *Chaldaic*, and *Arabic*, you will ſcarcely find ſo great an affinity with the *Hebrew*, as in the language of the *Finns*, *Laplanders*, and *Eſthonians*; for, here we may ſee the very roots and ſignifications of *Hebrew* words, their method of declining by tenſes and caſes both their verbs and nouns, many of which, in imitation of the *Hebrew*, anſwer to the four conjugations of the grammarians: To which I may add, that the *Laplanders* and *Finns* do ſtill to this day

uſe, beſides the *affixa*, as they are call'd, alſo the *ſuffixa*, things I know not, whether obſerv'd by others. *Cajanus*, in his *Academical* diſſertation *de convenientia linguæ Hebraicæ & Fennicæ*, rightly hints that their ſeparable and inſeparable pronouns are ſimilar to thoſe of the *Hebrew*, tho' he adduces but a few inſtances; that from feminines of the plural number ſubſtantives are form'd, as in the *Hebrew*, is plain. *Naar*, for inſtance, in *Hebrew* denotes an *infant*, *boy*, *youth*; *Nuor* to the *Laplanders*, *Nuori* to the *Finns*, denotes the ſame thing: Whence *Neuroth* in *Hebrew* ſignifies *childhood*, *youth*; *Nuoraewoth* to the *Laplanders*, and *Nuorus* to the *Finns*, denotes the ſame thing.

But in this diſſimilitude of the words you muſt not attend to the change of the vowels, but to the roots themſelves, which are conſtituted by the conſonants; and how inconſtant the vowels are, the *Swediſh* word *kung* ſhews: The *Danes* pronounce it *Kong*; the *Engliſh*, *King*; the *Germans*, *Konig*, &c. the conſonants are the ſame, the vowels different. *Naar* in *Hebrew* ſignifies he *agitated* or *ſhook*, &c. *Narthi* or *Nardi* denotes the ſame thing among the *Laplanders*. We have many other inſtances which I omit. No one of the Learned will be ſurpriz'd at thoſe leſſer variations of letters of the ſame organ, and of words in caſes and terminations; becauſe after letters and the art of writing, receiv'd from our anceſtors (which alone can put a ſtop to the deſtruction of languages) are loſt, it is no wonder that languages ſuffer.

I conjecture, that *Odin* I. as hiſtory informs, did not only exerciſe his power over the nation, but likewiſe on the language; and that he alter'd it.

From the names of towns in the north.

The opinion I above advanced, namely, that the *Iſraelites* came from *Perſia* and the *Eaſt* to the north, gains ſtrength, if we at the ſame time ſhew, that many names of towns and villages in theſe northern parts differ not from thoſe in *Aſia:* They have likewiſe the ſame ſound and ſignification; and among many others I ſhall adduce the few following: *Hallola*, the name of a town or village in *Perſia*, in 34° of latitude, is alſo the name of a village in *Tavaſtia*, in 62° of latitude, and alſo of a lake in the ſame country: *Jumalech* and *Jumalen*, a village in 38°: *Jumalai* in *Finland* of 61°: *Chaja*, a village in 40°: *Caja*, hence *Cajanſalmi*, that is, *the Streights of Caja* in *Cajania* 66°: *Ollau*, the name of a town near the river *Kurr* in 43°: *Oulou*, a town and river in *Oſtrobothnia* 66°: *Checmechu*, a village in *Perſia* near the mountains 34°: *Kekimechi*, a village of *Finland* 62°, as alſo *Sechmechi*, and according to others, *Sexmechi* in *Tavaſtia*, 62°: *Raſalain*, a lake in 36°: *Rozelain*, a lake of *Carelia* in 63°: *Vaſſa*, a town on the other ſide the *Euphrates* in 33°; *Vaſſa*, a town and river of *Finland* in 60°: Beſides a thouſand other names in the north anſwering to and like thoſe in *Aſia*.

From traces left by them between *Perſia* and *Finland*

Beſides, what rout theſe exil'd ten tribes took to the north, the traces left by them between *Perſia* and *Finland* do teſtify, as the appellations of lakes,

lakes, rivers, villages, *&c.* to be ſeen in maps or in travels: And I ſhould ſay, that theſe particulars were of the greateſt weight for diſcovering the origin of the *Finns* and *Laplanders*, nay, even of the *Eſthonians*, were not the following particulars of equal weight with the preceeding.

From their long commerce with the *Perſians*, there ſtill remain among theſe nations a great many *Perſian* words, which in numbering are us'd by the *Laplanders* alone, and their neighbours in *Europe*.

A *Laplander* is very brawny, ſtrong, and nimble: And as from the habit and bulk of their body you may diſtinguiſh an *Iſraelite* among the *Riphæan* mountains, he will own, when he comes down to *Helſingen* and the parts nearer to the *Goths*, what his anceſtors own'd, when they came to ſpy the land of *Canaan*, namely, in reſpect of the tallneſs of the inhabitants, that they were but *graſshoppers* to them, as ſome tranſlate it, or rather *partridges*, as I think[a]. From their bulk.

Beſides, the cuſtoms of the ancient *Hebrews* in entering upon an inheritance, in ſaluting, in embracing, in croſſing their legs in ſitting, and in other reſpects, ſwell the number of my arguments. They ſtill retain the *Hebrew* appellations for their cloaths, ſhoes, houſhold furniture, and animals; and, alſo in the manner of their anceſtors, the *Laplanders* worſhip the deity by ſacrifices, falling down on their faces, by anointing, by building temples, and by calling their Gods *Jumala*, *Thor*, &c. in all which, they imitated the *Hebrews*, and in thoſe early days they follow'd the *Hebrew* computation, beginning the year from *March*, and not from *January*, as with us, nor from *September*, which was the firſt month among the *Ruſſians*, and *Saturday* was their ſabbath. From the *Hebrew* cuſtoms, *&c.* among them.

I propoſe to proſecute theſe things in my *Theſaurus* of the *Aſiatic* and *European* languages, and in a peculiar work on the origin of the *Finns*, *Laplanders*, and *Eſthonians*.

[a] Numbers *c.* 13. *v.* 34.

The Anatomy of two Beavers; together with Obſervations on them. By Joh. Jacob. Wepferus. *From the* Miſcellanea Naturæ Curioſorum. An. II. Obſ. CCLI. p. 349.

Tranſlated from the LATIN.

IN this beaver (which was of a large ſize, weighing upwards of 30 *lb.*) the ſhape, colour, hair, head, teeth, both the inciſors and grinders, the fore and hinder feet, and, as it were, its ſcaly tail, were in all reſpects, as we find them deſcrib'd by *Geſner*, *Aldrovandus*, and *Johnſton*, only that the tail at its extremity was furniſh'd with very ſhort and roughiſh hair. This ſubject at firſt ſeem'd to be a female; for, in the *inguen* appear'd an oblong and rugous *rima*, at whoſe ſides internally on each hand a *ſinus* enter'd. The diſſection of the firſt beaver.

enter'd into a remarkable body, a palm broad, a palm and a half long, two inches thick, and upwards in ſome places. After ſtripping off the ſkin, which for the moſt part, as in a man and ſwine, adher'd cloſely to the ſubjacent muſcles and fat; and upon preſſing the parts in the *inguen*, there popp'd out of the upper part of the *rima* a bony *penis*, cover'd with a *præputium*; but there no where appear'd any thing like teſticles. Afterwards came to view thoſe large bodies, or protuberances, in which on each ſide the *ſinus* from the *rima* terminated: They were not an uniform body; for, the upper part of the protuberance appear'd both firmer and harder, and, as it were, a body conglomerated and compos'd of ſeveral hard glands, ſome of which were as big as a walnut: The lower part was an oval veſicle, of the length of a gooſe-egg, but flatter rather than exactly round. Upon preſſing the glandulous body there came out a waxy ſubſtance, as it were, ſmelling ſtrong of caſtor, and friable; but upon ſqueezing the veſicle, a whitiſh liquor run out, oily, viſcid and clammy, very fetid, and ſmelling like rotten cheeſe: Each follicle held about three ounces of this liquor; but both the conglomerate bodies ſcarce ſupplied an ounce of the waxy ſubſtance. Upon cutting lengthwiſe the veſicles, they were internally ſmooth, but ſeem'd furniſh'd with little eminencies and ſeveral minute holes, from which, upon compreſſing the veſicle externally, there ouzed out a liquor, in colour, odour and conſiſtence entirely like the contain'd liquor.

Upon opening the *abdomen*, the teſticles came to view, obſerv'd in no manner fixt to the ſpine, but anteriorly incumbent on the internal region of the *os pubis*, where was a ſuperficial *ſinus*, about the place of the *proceſſus peritonæi*; to wit, on each ſide half the teſticle with the *epididymis* lodg'd in the ſaid *ſinus*, and hence were eaſily taken out, as the teſticles were thought not to paſs the *peritonæum*, nor grow to the ſhallow *ſinus*'. The teſticles, in proportion to the bulk of the animal, were ſmall, ſcarce as big as pigeon-eggs; were white, ſmooth, and of an oval figure, but compreſs'd where they regarded the inteſtines, envelop'd in one thick, nervous coat; internally white as ſnow, and furniſh'd with a ſubſtance, as it were, of fibres, cloſely compacted, and impregnated with neither waxy nor oily ſubſtance, and without the ſharp ſmell of caſtor, nor form'd, as to admit of any cheat, or be adulterated by any art. The *vaſa præparantia*, encompaſs'd with a copious fat, deſcended to the teſticles in the common way; but from them and the *epididymides* the *vaſa ejaculatoria*, at firſt for ſome way winding, did afterwards proceed in a ſtreighter courſe towards the back part of the neck of the veſicle, and to the *proſtatæ*. Upon compreſſing the bladder the urine ſquirted out thro' the *urethra*, join'd to the *penis*. There did not appear the leaſt trace of an *uterus*, ſo that we could no longer have the leaſt doubt about the ſex of this beaver. The whole *abdomen*, which was greatly diſtended, was for the moſt part

fill'd

fill'd up with the ſtomach and inteſtines. The thin guts were upwards of nine *German* ells in length: The *colon* with the *rectum* made two ells: The *cæcum* came out from the left ſide, which I remember not to have obſerv'd in any other animal; where neareſt the *colon*, it was above an ell in length, and very large, and counterfeited the ſtomach full of meat; it was ſtuff'd with excrements and wind, but its extremity was ſlender, of the length and figure of a ſmall finger, in which was lodg'd a groſs, dry, and blackiſh excrement. The *colon* and *rectum* contain'd hard and dry *fæces*. The *pancreas* two ſpans long, thin and reddiſh, was faſten'd to the *duodenum* and *jejunum*, but what lay under the ſplenic veſſels ſeem'd more whitiſh and thick. The ſpleen was very ſlender, ſcarce a finger broad, a ſpan long, of the thickneſs of a gooſe-quill, pale and tender. Both the kidneys were flat, round about like a ſharp knife, and where thickeſt ſcarce a finger thick. The *caruncuiæ papillares*, in which long and ſtreight furrows were very conſpicuous, were large and long. The liver was divided into ſix lobes, from each of which the biliary ducts coming out were inſerted into a larger *ductus choledochus*. The gall-bladder was full of a liquid gall. The diaphragm appear'd ſtrong and very nervous. The lungs ſeem'd very light, whitiſh, with ſome red intermixt. The heart was nearly as big as that of a larger dog; its right ventricle was diſtended with a fluid and watry blood. The *cartilago enſiformis* was very broad, concave, like a child's ſpoon; round about, it was cartilaginous, in the middle, bony. The ſtructure of the ſtomach, which I very carefully examin'd, was quite ſurpriſing, it was very large, much like that of a ſow or dog, only that a ſomewhat deep furrow divided, as it were, its middle, as if it had had two ſtomachs: Again in the left lateral part near the ſtomach, or its left orifice, I obſerv'd a ruddy portion, fleſhy, upwards of a palm in length, a palm broad, and oval. I at firſt imagin'd, it was ſome diſeaſe or inflammation, becauſe this ruddy part was higher than the other coats; I cut at the top lengthwiſe from the *pylorus* to the ſtomach, and it was all of it full of pieces of barks and roots of trees, with which was mixt ſome pieces of the rinds of apples and pears, but there was not the leaſt appearance of fiſh or crabs, nor did the contents ſmell any thing fiſhy, as I have more than once found in diſſecting an otter: Upon removing the greateſt part of thoſe pieces, there was water found at the bottom of the ſtomach: Upon wiping the ſtomach, the internal *parietes* remain'd, notwithſtanding, beſmear'd with a certain *mucus*; where the furrow appear'd externally, there, internally was obſerv'd a certain nervous prominence, which, notwithſtanding, was not ſo high, nor did it divide the ſtomach in ſuch manner, that it muſt be reckon'd two: In that place, where the fleſhy, ruddy portion was ſeen externally, internally a great many holes or mouths came to view, moſtly round, and admitting a lentil; ſome of them like a half moon, eſpecially the upper holes and thoſe nearer the ſtomach: The internal coat

of

of the ſtomach being gently remov'd about theſe holes or mouths, or upon making an inciſion into one or two of the mouths, under each of them appear'd ſeveral ſmaller mouths opening into the outmoſt mouth that was cut. Upon preſſing externally the ruddy portion, a white, manifeſt, tough *mucus*, ſmelling of caſtor, ouz'd out of the mouths, and when pour'd to warm milk it curdl'd it a little. Upon blowing into one or two of the mouths, a ſmall portion of the ruddy ſubſtance ſwell'd externally; but upon thruſting in a probe, which was eaſily done after taking off the internal coat, its knob was touch'd by the external, and directly oppoſite part of the ruddy ſubſtance to the mouth. Upon removing the membrane, it ſoon appear'd, that this ruddy covering part was a muſcle, furniſh'd with ſtreight fibres, parallel to the external fibres of the gullet. Upon cutting lengthwiſe this membranous muſcle, as it were, ſmall convex bodies, or little glands appear'd; and after carefully removing the whole muſcle, we obſerv'd with ſurprize convex, oblong, reddiſh bodies, adorn'd with very minute blood-veſſels, and both broader and longer than a corn of wheat, and as arranged in order: Theſe we obſerv'd like the ſeeds of a peel'd pomgranate, or the ſeed of maiz or *Turkiſh* corn, faſten'd to its ſtalk, but arranged in a quite more beautiful order; for, no one ſtood higher than another, or ſwerv'd from a right line, or exceeded another in bulk, but they were placed, according to the ſtreightneſs of the fibres. Upon expreſſing the *mucus*, ſome of them ſubſided in the manner as ripe pox are depreſs'd and become rugous; but upon thruſting in a probe, or inflating them, they again became convex: So that thence we might eaſily gather, that theſe convex corpuſcles were nothing other than the extremities of canals, ducts, or channels, terminating from the internal mouths into this muſcular external portion; which afterwards appear'd more manifeſtly upon ſeparating theſe ſmall convex bodies; for, we ſaw they were ſmall, ſhort, membranous canals, join'd by means of fibrils, and in which the *mucus* was laid up in the manner as bees lay up their honey in combs; namely, as the food of the beaver is dry and very hard of digeſtion, the wiſe author of nature has ſupplied him with this beautiful and curious ſtructure, that the animal might never want a ferment proper to diſſolve it.

And of the ſecond.

In another beaver, which was thought to be ſcarce a year old, and not above 15*lb.* in weight, two foot long and one broad, the head was flat, the eyes ſmall and blackiſh, the ears ſmall and round, the noſe flat, the inciſors broad and prominent, the two ſuperior, yellow, the inferior, more red, the neck ſhort and thick, the fore feet furniſh'd with five toes, and arm'd with round but obtuſe claws; the toes of the hinder feet join'd by a thick black membrane, with blackiſh broad claws, like thoſe of monkeys; all the hair ſoft, but firmer, thicker, and dingy on the back, ſofter, ſhorter, and whitiſh on the breaſt and belly; the tail was upwards of two palms in length, three inches broad, of the thickneſs of a little finger, black and ſcaly,

ſcaly, as it were, but really not ſo; for, the black ſkin was indented, latticed, and as of a cartilaginous conſiſtence: With this tail in ſwimming they are ſaid to ſtrike the water ſtrongly in a very agreeable manner; it was thinner at the extremity, and not ſhaggy as in the former ſubject. Under the ſkin, eſpecially on the buttocks, loins, and *abdomen* lay the fat; whence it was taken off with difficulty; it came away more readily on the back, breaſt, and limbs; which, however, was oppos'd by portions of the *panniculus carnoſus*, faſten'd to it. Upon opening the breaſt, the heart was as big as that of an ordinary dog, the right ventricle quite rugous, as if it were ſew'd up, and blackiſh; the left ventricle fleſhy, thick, and ſmooth; both the auricles rugous; the *foramen ovale* was clos'd up; the diaphragm in the middle every where nervous and ſtrong; the *cartilago enſiformis* upwards of an inch broad, concave and cartilaginous round about; the ſtomach much ſmaller than in the former beaver, and alſo furniſh'd with a furrow in the middle, and, as it were, divided into two ſtomachs; the red eminence near the ſtomach was three inches and a half in length, two and a half broad, and one high: Upon removing its very thin covering, a muſcle or muſcular membrane appear'd, of the thickneſs of the back of an ordinary knife, furniſh'd with ſtreight fibres, which tended downwards from the end of the gullet; for, there it began; it encompaſs'd the ſuperior part of the ſtomach in ſuch manner as indeed to be extended towards its anterior part, yet declining more to the left, without encompaſſing the whole ſtomach; and tho' it appear'd continu'd with, or at leaſt contiguous to the gullet, yet upon gently ſeparating its extremity, both it and the ſubjacent parts were found to be a whole inch aſunder from the gullet, but continu'd with the middle coat of the ſtomach: Upon removing the muſcular membrane there ſoon appear'd the *apices*, or blind extremities of little canals like the ſeeds of maiz or pomgranates, and diſpos'd in a very beautiful order, whitiſh and ſoft. I gently ſeparated theſe extremities, and the ſmall canals themſelves, from each other; at their top and in their progreſs they were join'd by very tender and eaſily ſeparable fibrils. The ſmall canals were in length about half an inch; on the ſides, and at the bottom near their inſertion into the ſtomach, ſtain'd, as it were, and cover'd with minute blood-veſſels; ſome of the canals proceeded in a ſtreight line towards the coat of the ſtomach, and were obliquely inſerted into other intermediate ſmall canals, or near the bottom; whence ſome of them became there wider and larger, before they reach'd the coat of the ſtomach. Upon cutting the ſtomach from its top to the *pylorus*, I found it ſtuff'd with mere pieces of barks and wood, nor could we obſerve any trace or ſmell of fiſh or crabs; and a beaver-hunter inform'd me, that in the many beavers he had taken, he had never found any thing fiſhy in their ſtomachs. Upon clearing the ſtomach from its contents, the interior mucous coat came away with the gentleſt touch, probably, becauſe it had been

now three days after he had been taken; near the ſtomach in the left and anterior part internally I obſerv'd a vaſt many holes and mouths, and I reckon'd about 50 of them; ſome of them were round, ſome like a half moon, many of them furniſh'd at their extremity with a white ring or border, and ſome of them were inſerted obliquely: Whence, while entire, they with more difficulty admitted a probe, nor could any thing from the ſtomach enter theſe canals; for, upon preſſing externally the whole of them, only a whitiſh or grey and ſomewhat turbid *mucus*, ſmelling of caſtor, very plentifully ouzed out. Upon cutting one or two mouths internally in the ſtomach, there ſoon appear'd four, five, and more holes ending in that mouth; and thro' the mouth I could thruſt the probe without any reſiſtence, as far as the blind extremity of the canal: I cut lengthwiſe ſeveral of theſe canals to their extremities; internally they were full of *mucus*, diſpoſed like honey in combs, in wiping which off, a ſomewhat rough ſurface like velvet appear'd, and I alſo obſerv'd their internal ſurface ſpread over with capillary veſſels: The coat of the canals is, indeed, thin, but not ſo eaſily torn; a muſcular membrane externally involving the canals ſeems to compreſs them, and upon occaſion to force the *mucus*, generated in them, into the cavity of the ſtomach, and protrude it with ſome violence: The bottom, or part of the ſtomach to which they grew, and their roots reſembled a kind of muſhrooms, the ſmall holes no longer obſerving that exact order, which was to be ſeen in the blind extremities, on account of the various, and for the moſt part oblique inſertion of the canals into larger *tubuli*; and moſt of them ſtill plentifully diſcharg'd a turbid *mucus*, lightly tinged with the blood from the wounded capillary veſſels, tho' by repeated ſqueezing, all the juice, lodg'd in them, ſeem'd to be exhauſted. The gullet, as more fleſhy than the inteſtines, ſeem'd a fiſtulous muſcle, chiefly on account of its exterior coat; the internal coat, where it terminated in the ſtomach, jutted out, and conſtituted a border, from which hung round about ſmall white *apiculi*, like thoſe obſervable in a boil'd ox's tongue. In a part of the gullet, more remote from the border, I obſerv'd many ſuch hanging down from the internal coat, which ſeem'd to facilitate the ingreſs into the ſtomach, but to prevent a regreſs: I did not find this internal coat continu'd with the ſtomach, as I could ſeparate it without tearing the membranes of the ſtomach. In the *pylorus* the nervous coat of the ſtomach jutted out, and form'd a border, or ring, or circular valve, which ſeem'd to admit an egreſs, but to hinder a regreſs, or render it difficult; it was alſo thicker, denſer, rugous, and furniſh'd with ſtreight furrows, as if the *pylorus* alſo perform'd the office of a ſphincter: Before the *pylorus* in the *duodenum* I obſerv'd a *ſinus*, wherein, on account of the ring of the *pylorus*, the matter regurgitating upwards might have there ſtagnated. The thin guts were upwards of eight ells in length: The *colon* and *rectum* made two ells: The *cæcum* alſo in the left ſide adhering to the *colon*, was very large; nay,

nay, wider than it, terminating in a narrow point. The *colon* was beautifully divided into cells, ſtrengthen'd by a white nervous line; it contain'd ſofter *fæces*, but the *rectum*, harder. The excrements conſiſted of ſegments without any *fætor*; after taking out and waſhing a portion of the *ileum*, the *cæcum*, *colon* and *rectum*, I caus'd inflate them, and dry them in the ſhade: After cutting the *ileum*, as far as the middle of the *colon*; in the beginning of the *colon* I firſt cut thro' a valve, faſten'd to the *ileum*, nervous, circular and hindering a regreſs into the *ileum*; and then thro' a very large cavity or ſpace, in which not far from the mouth of the *ileum* in the left ſide was a very wide orifice opening into the *cæcum*, which had a remarkable nervous valve, externally regarding the cavity, and ſtopping the larger and impetuous ingreſs of the *fæces*; in its inferior part on the right ſide appear'd another aperture, terminating in the *colon*, in which was alſo ſituated a nervous circular valve, inclining downwards, and giving a deſcent to the *fæces*: And in fine, I obſerv'd as many nervous and membranous valves in the *colon*, as there were cells, and all of them ſemilunar; and generally the two oppoſite valves form'd a circle: Some, indeed, were not directly oppoſite, but not at ſo great a diſtance as to hinder their forming a circle; becauſe the inflation was made thro' the *rectum*, the valves of the *colon* were rais'd higher. The *rectum* in the *pelvis* was very large, to which externally on all hands adher'd a muſcle with ſtreight fibres, three inches in length, ariſing from the *os pubis*, on the ſides of the *os ilium* and *ſacrum*, ſtrong, as being the *levator ani*, which ought to be ſtrong, and quite encompaſs this inteſtine for retracting the *anus*, probably thruſt out farther in diſcharging very hard excrements: Under this muſcle, near the *anus*, was a *ſphincter* with muſcular fibres: The exterior coat of the *rectum* had very ſtrong, ſtreight fibres; ſo that equally with the gullet I may venture to call it a fiſtulous muſcle; but the internal coat was very rugous and plaitted; and by the gentleſt touch ſeparated from the next external coat, and it is that very coat, which in a *procidentia ani* ſeems to jut out, and when mortified may even in a man be cut away without danger; and when ſwell'd, it is often the cauſe of a more difficult and very painful diſcharge. The ſpleen was very ſmall, three inches in length, a ſmall finger in breadth, and very ſlender, ſcarcely of the thickneſs of the back of an ordinary knife, of a pale red, ſoft, and ſeem'd rather a fillet, ſew'd, as it were, to the ſtomach: The liver was ſoft, ruddy, large in proportion to the bulk of the animal, and divided, as in the former beaver, into lobes: The gall-bladder, not anſwering to the bulk of the liver, was ſmall, and half full of a liquid gall: The *ductus bilarius* extended an inch without the liver. In the ſkin of the *pubis* were obſerv'd two remarkable apertures; above, under the *os pubis* is the *rima*; below, under the tail the *anus*: Between theſe apertures on each ſide in the ſmooth ſkin appear'd two holes, which admitted a probe, but not deep, from which ſome ſtiff and blackiſh hairs grew

out an inch in length: In the upper part of the *rima* is lodg'd the *penis*; under it, the *rima* is by means of a partition-membrane divided into two parts, each of which terminates in the lateral *ſinus*. Upon removing the ſkin in the *inguen*, only leaving the lateral holes and the inferior part of the *rima*, where the membrane was divided, there came to view veſicles full of an unctuous liquor, the caſtor-bag, the teſticles and *penis* ſituated without the *abdomen*.

The veſicle or follicle, and the *caſtoreum* or caſtor-bag, properly and truly ſo call'd, were cover'd on each ſide with one common, fibrous, and, as it were, muſcular membrane; this membrane aroſe under the *os pubis*, and envelop'd both bodies, and was loſt under the veſicle or follicle; it was furniſh'd with ſtreight and oblique fibres; from its origin and inſertion it did not ſeem to be a portion of the *panniculus carnoſus*, but a peculiar membranous muſcle, ſerving not only as a cover for theſe parts, but alſo for compreſſing them. Upon removing on each ſide the fat, and this muſcular membrane, the teſticles, included in the proceſſes of the *peritonæum*, the caſtor-bag and the veſicle, to wit, three diſtinct parts on each ſide, came more diſtinctly to view. The veſicle and caſtor-bag were manifeſtly diſtinguiſh'd; for, each part was ſtill inveſted with a thin membrane, over which a great many capillary blood-veſſels were ſpread, proceeding from the neighbouring hypogaſtric and iliac veſſels. In figure the veſicle is like an almond, cover'd with a green rind, two inches long, one broad, and half an inch thick, of a whitiſh red, its external ſurface ſomewhat rough. Upon removing the thin membrane its whole ſurface was incruſted with ſeveral minute, conglomerate glands, cohering by very fine fibrils, upon ſeparating which, the whole ſurface ſeem'd poſſeſs'd, as it were, of whitiſh red warts: Theſe verrucal glands, as I may call them, adher'd very ſtrongly to the membrane of the bladder, as warts do to the ſkin; ſeveral capillary veſſels crept between theſe warts, each of which might alſo be divided, without tearing, into other very minute glands, with capillary veſſels alſo appearing in their interſtices. Near the neck of the veſicle or follicle, at its loweſt part was a gland, of the bigneſs of a kidney-bean, which at firſt ſight was globoſe; upon compreſſing it, there came out of the lower hole a white ſubſtance like a maggot, of the conſiſtence of new cheeſe, and of the thickneſs of a pigeon-quill, tho' the hole appear'd not much bigger than the *punctum lachrymale*, and it ſmell'd of caſtor: Upon ſqueezing the veſicle, there came out of an adjoining hole a yellow, oily liquor, of a ſtrong ſcent of caſtor, nay, of rotten cheeſe: Both theſe holes are ſituated in the intermediate ſpace between the *rima* and *anus*; each of theſe veſicles contain'd a drachm and a half of an oily liquor, with which ſomething cheeſy was mixt: The liquor, receiv'd in a veſſel, ſoon concreted like congeal'd oil; a paper, done over with it, and approach'd to the fire, made a crackling noiſe long before it flam'd, as if

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there had been much water or ſalt mingl'd with it; but after conſuming what was leſs inflammable, it burnt more clearly than bare paper does. Upon cutting a ſmall hole into the veſicle, and blowing it, it ſwell'd very much, without the wind eſcaping at the natural aperture: On the ſurface of the inflated veſicle, the verrucal glands became more ſeparated, yet not inflated by the wind, nor did there happen the leaſt change in the adjoining caſtor-bag. I afterwards cut the whole veſicle lengthwiſe, and after clearing it internally of its contain'd liquor, it was found encompaſs'd quite round with a thin membrane like an *amnion*, rugous and plaitted, which could not be owing to the inflation; for, I found the like membrane in the oppoſite veſicle, into which I had not blown; there alſo appear'd ſeveral very minute mouths, ſome of which admitted a millet ſeed; ſome a lentil, and a middling probe. Upon externally compreſſing the verrucal glands, from moſt of the mouths there burſt out into the cavity of the bladder a yellow oily liquor, and from ſome of them alſo a cheeſy ſubſtance; for, each gland had one mouth, and ſometimes two beneath; there alſo appear'd internally thro' the thin membrane a great many capillary blood-veſſels; beſides, the internal ſurface, on account of the roots of the glands, was very unequal: The neck of the veſicle internally was narrow and rugous, furniſh'd with ſtreight furrows, which externally for ſome way eaſily admitted a probe, but being internally ſtreight the paſſage was more difficult. The globoſe gland, adjoining to the neck of this veſicle, and of the bigneſs of a kidney-bean, after clearing it of its contents, appear'd alſo of the conglomerate kind. After viewing theſe things thoroughly, I took out the veſicle, without hurting the caſtor-bag, and this I could eaſily do, as they were diſtinguiſh'd by their proper membranes, and the neck of the veſicle had a peculiar egreſs, terminating in the ſmooth ſkin with an aperture half an inch diſtant from the *rima:* Upon inverting the veſicle, and ſtretching it upon my finger, there appear'd orifices like little cups, encompaſs'd with a membranous border, from which orifices, upon preſſing the verrucal glands, there ſtill came an oleaginous, and from ſome of them alſo a cheeſy liquor.

The *caſtoreum*, or caſtor-bag, lay on the ſuperior part of the veſicle; at firſt ſight it appear'd to be a glandulous body, of the conglomerate kind, three inches long, one and a half broad where broadeſt, at its extremities an inch broad, and where thickeſt ſcarce an inch thick; in figure it reſembled an oblong dry pear, round in its anterior, but flat in its poſterior part; its ſurface might be compar'd to the winding ſurface of the brain, its colour was grey, intermixt with red veins; a nervous membrane, furniſh'd with a great many capillary blood-veſſels, cover'd the ſurface of the *caſtoreum*; this membrane I could eaſily ſeparate in a freſh, but with more difficulty, in a dry *caſtoreum*, and that not before it was macerated in water: In ſeparating it I found, that it not only join'd together the windings on it

it by means of very tender fibres, but likewiſe cover'd thoſe windings every where even in the deepeſt furrows. Upon expanding and laying open theſe windings and *gyri* by breaking the fibres with my finger, I obſerv'd remarkable and numerous capillary veſſels creeping among the deeper furrows: After removing the nervous membrane, there appear'd another very beautiful one, furniſh'd with ſeveral very minute ſcales as it were, which oppos'd to the light, ſhone like ſilver, eſpecially when they were rais'd and ſeparated; but when they lay flat, appear'd livid, nay, according to the different incidence of the light, yielded different colours like a pigeon's neck. This membrane was every where moiſten'd by a very thin and limpid liquor. In the *rima* was an orifice into which one's finger might enter, opening into the cavity of the *caſtoreum*; upon putting in, therefore, my finger, I could expand all the windings or *rugæ*, and by blowing into it they were more expanded, and the whole *caſtoreum* in all reſpects reſembled a bladder: And thus I evidently learn'd, that the *caſtoreum*, which before I had taken for a glandulous body, was nothing other than a bladder, or a rugous and plaitted purſe, and form'd into various windings and *gyri* by its exterior nervous membrane: When expanded in this manner by inflation, it might hold four ounces, but otherwiſe, tho' indeed it had a cavity, ſcarce two or three drachms. Upon cutting it up, in its cavity was contain'd a waxy ſubſtance, as it were, yellowiſh, friable, of a ſtrong and ſharp odour, divided into little bits, ſome of which were as big as a pea, others bigger; its internal ſurface was beſet with the ſame ſubſtance, and its *paries* ſeem'd as if tinged with ochre; internally alſo the membrane was ſquamous, whence that yellowiſh ſubſtance ſtuck out, but it adher'd firmly to the ſcales or *villi*, ſo as not to be ſeparated without pulling away theſe *villi*: And upon pulling theſe out, there were punctures left in the membrane like the prick of a needle: It manifeſtly appear'd, that that waxy ſubſtance took its riſe and increaſe from atoms, or very minute particles incruſting the *paries*, and ſeparated by attrition. The ſame *phenomena*, as above, were obſervable in the other *caſtoreum*. I alſo found, that the veſicle and *caſtoreum* on each ſide may, on account of the ſkin, by means of which they cohere, be ſo ſeparated, as from one beginning to remain connected, the ſkin doing the office of a ligament or intermediate tie; but that the two follicles of both ſides could by no means be included in one membrane. The weight of the two *caſtorea* with the two veſicles was ſcarce four ounces.

I found the teſticles in this beaver, contrary to my expectation, under the *os pubis*, included in the *tunica vaginalis* near the *caſtoreum*; externally no ſigns of a *ſcrotum*, or teſticles in the *inguen* were diſcoverable either by the ſight or touch; and tho' the teſticles were near the *caſtoreum*, yet there was no communication between them and the *caſtoreum*, either mediate or immediate. The blood-veſſels, both the *deferentia* and the capillary veſſels in their ſurface, appear'd plainly thro' the *tunica vaginalis*, or the proceſs

proceſs of the *peritonæum*. The teſticles being gently preſs'd retir'd into he cavity of the *abdomen*, and lodg'd in a *ſinus* form'd internally in the eritonæum above the *os pubis*; above were inſerted into the teſticles the aſa *deferentia*, commonly call'd the *pyramidalia*, forming on all ſides with ach other ſurpriſing *anaſtomoſes*; on them lay the *epididymides* and *paraſ-atæ*: Into the external part of the teſticles, into the *paraſtatæ*, were in-erted, by means of a thin membrane, the *cremaſters*, in proportion to heir ſmall bulk, remarkable and half hollow, with a membrane envelop-ng their nervous tendons, as if theſe muſcles, which were pretty ſtrong, ere to ſerve for the retraction of the teſticles within the *abdomen*: The eſticles were very ſmall, very white, thick, oblong, and leſs than pigeon-ggs, and freſh they both weigh'd four ſcruples, but dry, exactly reſembl'd grape-ſtone, ſhrivell'd up and dingy, and then they weigh'd only twelve rains, and ſeem'd nothing other than a wrinkl'd ſkin; and neither freſh r dry did they ſmell of caſtor; nay, were inſipid and inodorous, and ould be adulterated by no art, becauſe the cheat might ſoon be diſcover'd y one who has once but tranſiently ſeen a beaver's teſticle. Upon care-lly looſening the ſmall branches of the *epididymides*, *paraſtatæ*, and *vaſa aculatoria*, I obſerv'd under the *os pubis* one continu'd duct, of an equal igneſs, ſtreight, round and nervous, and under that bone it proceeded to e neck of the bladder, but behind the bladder it became four times thick-, and as big as a gooſe-quill, but not ſo hard and ſolid: They were in-rted on each ſide laterally into the neck of the bladder. In order to view is more accurately, I caus'd inflate the bladder by the *urethra*; and the ladder became greatly ſwell'd and globoſe: A portion of the *urethra* for inch from the internal orifice, before it came under the *penis*, was diſ-nded as big as one's thumb; but the *urethra*, conjoin'd with the *penis*, as in no wiſe of this bulk; and that bigger portion we may call the neck: hey were, therefore, inſerted laterally into the neck, at an inch diſtance om the internal orifice. In the middle, between the inſertion of the *vaſa aculatoria*, were inſerted the *proſtatæ*, whoſe appearance was ſurpriſing; r, about their inſertion, half an inch in breadth, they are expanded into vo long horns towards the *vaſa ejaculatoria*, reſembling a cowl, white d ſoft; under the neck they are of the thickneſs of an ordinary quill, at e extremity more ſlender, to which on each ſide adher'd a pellucid gland, the bigneſs of a hemp-ſeed: Between the *cornua* of the *proſtatæ*, and e *vaſa ejaculatoria* was ſituated on each hand a plaitted body, compos'd veſicles and glands, whitiſh, and adorn'd with capillary blood-veſſels: I ok them for the *veſiculæ ſeminales*. Upon cutting this neck of the blad-r forwards, I obſerv'd internally in the poſterior inferior part a prominent runcle of the bigneſs of a pea, ſo as to have a *ſinus* beneath, into which catheter being thruſt may eaſily reach: In the middle of the caruncle ove, there appear'd an aperture, and two others laterally, to wit, one

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on each ſide. Upon preſſing the *vaſa ejaculatoria* from their lateral aperture, came out a white, thickiſh *ſemen*; but upon ſqueezing the *veſiculæ ſeminales* not ſo much as a drop. Upon ſqueezing the *proſtatæ*, either both or only one of the horns, from the middle aperture was diſcharged a thin, yellowiſh, turbid liquor. Upon cutting lengthwiſe the *vaſa ejaculatoria*, they were found hollow, containing ſtill a white concocted *ſemen*. Upon opening the *proſtatæ*, each horn had an oblong deep furrow, which united together before their inſertion, but upon cutting the *veſiculæ* lengthwiſe and a-croſs, I obſerv'd nothing beſides a thin *lympha*, at leaſt nothing like the *ſemen* of the *vaſa ejaculatoria*.

The kidneys were leſs convex than in other animals, flat and compreſs'd and ſharp at their borders, two inches and a half long, and one and a half broad, and where thickeſt ſcarce an inch thick. Upon opening the *pelvis* I obſerv'd its ſurface finely drawn over with capillary veſſels; the caruncles, of a dark red and large, jutted out from the canals. Upon compreſſing the *pelvis* towards the *ureters*, ſtreight long furrows were obſerv'd in them; the *ureters* were ſtrong and nervous. Between the duplicature of the bladder they proceeded above an inch before they opened into the bladder, and that obliquely. The bladder was almoſt empty, containing a little turbid urine, was thick, rugous, and furniſh'd with ſtreight plaitts, and of the bigneſs of an ordinary pear. Upon inflating it, it became remarkably big. The emulgent veſſels, ſuch as the veins and arteries, were large. In the *pelvis* at the ſides of the *rectum* and bladder I found two oval glands, of the bigneſs of a hazel-nut, pulpy and containing a viſcid *mucus*, in their circumference porous, as if they had been prick'd by a needle. Theſe glands probably impart this *mucus* to the *rectum*, of which it has always plenty. The *penis* was lodged in a peculiar and ſuperior *ſinus* of the *rima*; the whitiſh, rugous *glans* was cover'd with a white and rugous *præputium*, having below a *frænum*: From the *urethra* hung down two ſmall plaitted bodies, of a dark red, like the *nymphæ* in women; its bony anterior part for an inch in length is cover'd with a looſe, rugous ſkin, furniſh'd with ſtreight furrows, roughiſh and ſprinkled with ſeveral black ſpots, arranged in a certain order; its poſterior part was ſoft, compos'd of two ſpongy bodies and the *urethra*. Theſe bodies were cover'd with a hard, nervous membrane, aroſe from the *os pubis* in a broad nervous circle, internally of a dark red: Theſe bodies were in all reſpects as they are deſcrib'd by *Arantius*, to wit, like the pith of a reed; the one was diſtinguiſh'd from the other by a nervous partition. About the root of the *penis* I found remarkable blood-veſſels, which for ſome way extended towards its ſides and enter'd the ſpongy bodies; there alſo I found the *levatores penis*; the oſſicle of the *penis* was firm and hard, white, nowiſe cartilaginous, anteriorly globoſe.

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In the head were alſo obſerv'd ſome things worthy of remark: The temporal muſcle was thick and very ſtrong, and for that reaſon the *os jugale* was arch'd, a portion of it jutting out: The *ſinus* for receiving the *apophyſis* of the inferior *maxilla* was half an inch diſtant from the *occiput*, whence it might alſo yield backwards, otherwiſe than in a man. In the loweſt part of the orbit of the eye were three eminencies, in which the roots of the *molares* terminated, and near theſe eminencies the optic nerves proceeded: The *molares* were 16 in number; in each ſide of the upper and lower jaws four; the ſituation of the inferior *molares* inclin'd obliquely forwards; of the ſuperior, obliquely backwards: In the upper jaw the poſterior did not touch the two hinder inferior: In the inferior jaw the anterior did not touch the two ſuperior. Between the *inciſors* and *molares* I found a ſpace, of an inch in length, without teeth. The inciſors in the upper jaw are ſhorter, paler and of a yellow colour; the inferior are longer and red; both of them broad and equally ſharp: The inferior enter into the ſuperior, but do not touch each others points: Whence in the ſuperior *inciſors* is form'd a ſinus for receiving the inferior, which is alſo ſeen in ſome birds of prey, as the eagle, the hawk, and even the parrot. Hence the ſcull of the beaver, ſtript of its fleſh, did about the mouth reſemble, as it were, the beak of theſe birds. In the palate, not far from the *inciſors*, were two holes, of half an inch. The canal of the ears was directed upwards; where it ceas'd to be bony, the *tympanum* was ſeen. I obſerv'd a wonderful variety of ſutures; the ſagittal ſuture extended to the noſe, the coronal reach'd to thoſe two oblong holes of the *os palati* before the orbit of the eyes; and beſides theſe, many others were obſervable. The bones of the *cranium* were cloſe and ſtrong, and of an ordinary thickneſs; the tongue was very thick and fill'd the whole mouth. Each eye had ſeven muſcles.

Maximilianus Henricus Egermejerus inform'd me, that in a beaver he diſſected, after cutting away the *caſtoreum* and *follicle*, he obſerv'd about the ſtomach that ruddy eminence I obſerv'd above, and upon removing the thin nervous membrane and the thicker ruddy one, he ſaw the blind extremities of the *tubuli*, arranged in a beautiful order, like conglomerate glands; that upon opening the ſtomach thro' ſeveral both greater and ſmaller mouths, and after externally compreſſing it in that eminence, there was diſcharged a white and grey, clammy *mucus*, ſmelling of caſtor and pretty ſaltiſh; that the mouths ſcarcely admitted a probe internally, but externally upon making a wound on the top of the *tubuli*, the probe paſs'd without any obſtacle thro' the *tubuli* into the cavity of the ſtomach; and that he alſo obſerv'd a very large *cæcum*, ſtuff'd with excrements.

It is a groundleſs report, that the beaver, when purſu'd by the hunters, bites off his genital parts, as *Pliny*[a] relates the ſtory, and that according Obſervations.

[a] Hiſt. Nat. *lib.* 8. *c.* 30.

to *Solinus*[b], they ſwallow them; that this was a fabulous relation, the ancients, as *Dioſcorides*[c], to whom *Pliny* agrees[d], have long ago obſerv'd, and many alſo of the moderns have done the ſame thing, as *Phil. Jac. Sachs à Lewenheimb* in his *Gammarologia*[e]: But the hiſtory of the two beavers above does abundantly ſhow, that the cutting away theſe parts, if not impoſſible, would yet be always dangerous, and that thereby they would be ſo far from ſaving their lives, that they would haſten their death; as they muſt not only bite off the teſticles, but alſo the caſtor-bags with the follicles, which could not happen without a plentiful hemorrhage, on account of the wide baſe of thoſe parts and the remarkable blood-veſſels lodged in them; and which would be the more fatal, as the blood of beavers is very fluid. Tho' it is not to be denied, but that in brutes theſe parts may be cut away without hazard: And ſome of theſe operators, performing on men, oblige them to walk about ſoon after the operation, and that without any danger; and they affirm that they venture to do this from uſing a certain excellent, foreign balſam, which they, immediately after cûtting, pour into the freſh wound; and I very lately learn'd of a ſurgeon, who aſſiſted in theſe operations, that this balſam is nothing other than melted hogs-lard, which they plentifully pour into the freſh wound. The ſtory of the caſtor's biting away his teſticles, is probably owing to huntſmen themſelves, who firſt contriv'd this fable, either as they obſerv'd the beavers, tir'd with the chace, licking their groin, or as they themſelves privately ſtole the caſtor-bag, as a thing of value, and ſo put upon their maſters by this ridiculous tale.

Both the beavers above had the *teſtes* of a male, as well thoſe I found within the *abdomen* in the firſt, as thoſe I found externally under the *os pubis* in the ſecond, as appears fully from their deſcription.

The *caſtoreum* or caſtor-bag is falſely call'd the teſticles, and ſuch as aſſert it are deſervedly reprehended by *Charas*[f]; which alſo *Rondeletius in Geſner de caſtor.* has long ago affirm'd, becauſe there appear'd to him no paſſage to the *penis*; and beſides, the diſſection of both the beavers ſhews, that neither the caſtor-bag nor the follicles contribute any thing to generation; and therefore deſerve not that name. They are, indeed, both call'd *caſtorea* by *Dioſcorides l. c.* and *teſticuli* by other phyſicians, but abſurdly, according to *Melchior Sebizius*, in his treatiſe de *Aliment. facult.*[g] where there are more arguments to evince, that the *caſtoreum* deſerves not the name of teſticles; and of this opinion alſo is *Jan Saracen. in* Not. *ad* Dioſcoridem.

Our *caſtoreum* is the true *caſtoreum* of the ancients, which we may not only ſafely uſe for removing thoſe diſeaſes, in which they write it was of ſervice, but may mix it with the *theriaca*; becauſe, if we are to abide by the

[b] *cap.* 23. [c] *lib.* 2. *cap.* 23. [d] *lib.* 32. *cap.* 3. [e] *lib.* 1. *cap.* 2. § 3. *p.* 19
[f] *Hiſt.* Animal. plant. & mineral. *theriacam ingredientium in* Journ. des Sçav. *Tom.* IV *An.* 1668. verſ. Lat. *p.* 172. exc. *Frid. Nitzſchii.* [g] *lib.* 3. *cap.* 16. *p.* 1044.

the authority of the ancients, all the principal characters deliver'd by *Dioſcorides*, are found in our *caſtoreum*.

Of what ſervice the waxy ſubſtance, contain'd in the caſtor-bag, and the liquor in the follicle, may be of to the beaver, I own is obſcure and incertain. *Rondeletius in Geſner* relates, that beavers often lick and ſuck thoſe parts; a thing which is credible; for, the *mucus* in the *tubuli* of the ſtomach ſmells of caſtor, not that it enters the mouths of the *tubuli*, as it is taken down, but becauſe the *mucus* mixt with the chyle, infects the whole maſs of blood, from which it is again ſeparated in theſe *tubuli:* Whence *Geſner* and *Sebizius l. c.* write, that its fleſh is unſavory and hard, and that it muſt be temper'd by boiling before it can be taken as food.

That both beavers fed on nothing but bark, the contents of the ſtomach ſhow'd, nay, huntſmen agree in this. The illuſtrious Count *de Furſtenberg* at *Wirtemberg* lately caus'd bring up two young ones, but they rather choſe to die with hunger, than eat either fiſh or fleſh. The *tubuli* near the ſtomach opening into the ventricle, and bedewing it with that *mucus* above mentioned, deſerves further enquiry.

The virtues of caſtor are greatly, and often not without reaſon, cried up in cold affections of the brain, its *appendices* and nerves, to which Dr. *Willis* deſervedly reckons hyſteric fits; and probably this virtue of the caſtor in theſe diſorders is owing to a volatile ſalt; whence it can penetrate into the inmoſt parts, incide, diſſolve and diſſipate.

A Diſſertation on the Philoſopher's Stone, prefix'd by Henſing *to his* Demonſtrationes Chemicæ Publicæ, *at* Gieſſa, Nov. 1722. *From the* Opus Mago-Cabbaliſticum & Theoſophicum *of* Geo. von Melling. p. 517.

Tranſlated from the HIGH-DUTCH.

FROM time immemorial, indeed, a great deal has been writ on the *philoſopher's ſtone*, as appears from the writings of *Olaus Borrichius* againſt *Urſinus*, *Kircher* and *Conringius:* And a blind eagerneſs after it has prevail'd almoſt ſo univerſally, that within theſe few years between 8 and 10000 books have been wrote upon the ſubject. And if a man take but the leaſt ſurvey of ancient and modern times, he ſhall find, that many Emperors, Kings, Princes, Nobles, and others, both learned and unlearned, down to the meaneſt mechanic, have and ſtill do apply themſelves to the *ſtone*; nay, the thing is become ſo common that the meaneſt dabbler in chemiſtry can reaſon about it. On the contrary, there are many who regard the *ſtone* as a mere chimera and as a vain attempt, ſo as not only to oppoſe it by reaſoning, but to look on ſuch people as fools, who would only maintain the poſſibility thereof. Hence among others Cardinal

The philoſopher's ſtone attempted in all ages.

Porronius says; 'such are poor weak heads, indeed, who are employ'd 'about the quadrature of the circle, the *perpetuum mobile* and the *philoso-* 'pher's *stone.*'

And yet it is remarkable that there are not a few, who make scruple openly to allow of the *stone*, and on that account defame both the art and the artists; and this notwithstanding, apply themselves privately to the making of gold: A remarkable instance of this we have in the Lord *Bacon*, who up and down in his writings is very severe on chemistry; and yet in private he applied himself with great earnestness to this valuable art.

It is certain, that formerly in *France* alchemy was prohibited under severe penalties; and yet the present *Regent* insisted on it, that such members of the *Royal Academy*, as cultivated chemistry, should apply themselves to the discovery of the *philosopher's stone:* And no one is ignorant, that among *Roman* Catholics the art was forbid upon severe penalties; and yet no where were greater pains taken about it, than in the cloisters themselves.

The author's design.

In such circumstances it very easily happen'd, that men run into extremes; either they judged too favourably of the matter and became too credulous, or blindly despis'd the whole, and contrary to all reason expos'd it: Now as such a procedure ill becomes a man of understanding, I have thought proper on this occasion to say so much of this noted *stone* of the philosophers, that my readers may have a right conception thereof, and be able to avoid every disaster.

I shall on this occasion briefly illustrate the following particulars; 1. What the *philosopher's stone* is; whether the doing of it be possible, and whether the virtues ascrib'd to it be credible? 2. Why so few have attain'd thereto? 3. The absurd and injudicious *encheireses*, which those in pursuit of the *stone* commonly undertake. 4. Whether it be adviseable for any one to engage in this art?

Definition of the philosopher's stone.

That we may not reason like a blind man about colours, we must in the first place have a clear conception of what the *philosopher's stone* properly and truly is: And I define it, *a body composed by art from a highly purified, animated mercury and a living gold, and by means of a long continued fire so firmly knit together, as never after to be separated; in which form it can in an instant so ripen the other metals, purify and fix them, as to become exalted to the nature of the purest gold.* That the whole may be rightly understood, I shall take this definition to pieces, and explain in particular all the parts thereof.

Explanation.

In the first place I say, that the *philosopher's stone* is a *body compos'd by art:* This art, indeed, is now a days call'd *chrysopœia*, but abusively: 'for, we make no gold, says *Geber*, but we only supply nature with the 'preparation of her own proper materials, that she may compleat the 'design of the greatest purity'. Others call the art *alchemy*, but improperly too; for, this art is rather employ'd about the resolution of natural bodies

bodies, and has many views and many purpoſes: On the contrary, the principles or fundamental rules of our art are aptly call'd *philoſophia Hermetica*; the art itſelf, *Ars Hermetica*; and the artiſts themſelves, who have actually compleated the *ſtone*, are call'd *philoſophi adepti*, or only, and that by way of eminence, *philoſophi:* And ſuch have no further work on their hands, than to purify and unite; and they deal in nothing other than the centre or ſoul of mercury and gold: The production itſelf at laſt is a wonderful body, *a houſe of light, the moſt fixt and inconſumable, in fire the moſt fluxile ſulphur of nature*; and in fine, *the ſeed of gold, a medicine for men and metals.* Such as give out, that they have ſeen this ſtone, as *Frederic Gallus* in his journey to the deſart St. *Michael*, affirm, that in the night it is ſhining bright, but in the day time, a tranſparent, blood-red ſtone, or alſo a powder: Others aſſert, that it is alſo very heavy, and that it muſt be ſo, appears from the parts of which this ſtone is compos'd; for, I have ſaid, that its conſtituent parts are a highly purified, animated mercury, and a living gold. Theſe things we muſt conſider a little more exactly.

Firſt, there is mention made of a mercury: Here in general we are to obſerve, that it is a very ancient ſaying, *in mercury is all what the wiſe look for.* Now when we aſk in particular, what ſort of mercury it is, and wherein it is to be ſought, and proximately to be found? The philoſophers in their writings make ſuch ſurpriſing and round about deſcriptions, as entirely to confound the reader: But does a man enquire with indefatigable labour into the agreement of the philoſophers and follow nature, he finds the following truths, which to avoid prolixneſs, I ſhall couch in theſe ſhort axioms. 1. The only deſign and effect of the *philoſopher*'s *ſtone* is the increaſe and generation of gold. 2. All increaſe and generation of a ſpecies are brought about by a ſimilar ſpecies, that is, a like generates its like; thus a lion begets a lion, and not an elephant; a man, a man, and not a bear, *&c.* barley yields no wheat; nor does corn yield any rape-ſeed. 3. Every thing, that is capable of increaſe, muſt have its proper ſeed; and each ſeed requires its own proper fit matrix, if otherwiſe we deſign the ſeed ſhall not be ſpoil'd, nor, contrary to the nature of the thing, yield a falſe production. On this account no huſbandman is ſo abſurd, as to ſow his grain on marble, or throw his barley into a marſhy meer, but he carefully prepares his field, and commits the grain thereto; and who ſhall reckon that huſbandman prudent, who has ſown poppy-ſeed, and would reap wheat? 4. Every ſeed, ſhall it otherwiſe be fruitful, muſt above all other things be entire and ſound, as to its ſtructure and mixture; and then both its external and internal parts muſt be relax'd by a proper moiſture and be made fluid; beſides this, a proportional warmth muſt ſet the ſolution a going, that is, bring it to perfect action and move the whole: Beſides, the air muſt have acceſs to it in a due proportion, that the warmth may

may not be ſtifl'd, and the ſolution and circulation of the juices be not impeded. Upon theſe accounts corn grows not green upon a dry bottom; no barley blooms in winter; and under the earth or in an air-pump we are to expect no fruit. 5. The moiſture, which nouriſhes the ſeed, gives it no particular ſpecification, but it is ſpecificated in and by the ſeed; and this moiſture muſt have in itſelf the material principles, of which the ſeed conſiſts, namely a nitrous, fatty ſubſtance: Whence common ſalt water or vitriolic, aluminous water deſtroys the plant. 6. The ſeeds of the vegetable and animal kingdoms cannot yield the fruits, one of the other: As oats cannot produce a rabbit; and from the ſeed of a fox no pear-tree can be produced. Now as the vegetable and animal kingdoms have each of them their peculiar ſeeds, *matrix*'s, manner of generation, and life; and as out of its own ſpecies none of them ariſes and conſiſts, ſo is alſo the mineral kingdom very different: When, therefore, in this kingdom mention is made of ſeeds, life, death, growth, increaſe, *matrix*, moiſture, warmth, air and the like, we are to underſtand all theſe things according to the ſpecies and nature of minerals.

Now do the hermetic philoſophers ſecundarily ſeek for the increaſe of gold, they muſt 1. have a gold-ſeed; 2. a proper liquor, 3. fit *matrix*'s or ſoils. Now to diſcover theſe things we ſhall again run over theſe ſhort rules. 1. Gold according to its qualities is the moſt fixt, pure and heavy ſubſtance in the three kingdoms; according to its ſubſtance, a body coagulated together from the pureſt and moſt fixt mercury, ſulphur and ſalt; ſo that theſe its principles, except the third, cannot be ſeparated from each other, either by art or nature.

As according to the order of nature, the ſeed muſt be of a like ſubſtance with the fruit, as we have ſaid; ſo according to the opinion of the genuine philoſophers it is true, that the ſeed of gold muſt not be ſought for in conſumable, volatile, vegetable and animal ſubſtances, nor in ſulphureous, arſenical things, *&c.* but in gold itſelf. 2. But gold, ſo ſoon as it is ſmelted out of its ore, is dead, that is, can of itſelf yield no increaſe, in regard it only has ſo much moiſture in itſelf as is neceſſary to its eſſence, as we have ſaid above of corn. 3. To make it, therefore, into a living ſeed, its eſſential moiſture muſt be unlock'd and augmented with its like. 4. Now its eſſential moiſture is mercury, which is coagulated by its ſulphur, and is ſhut up in ſtony bands or receptacles, as appears from the firſt rule. 5. The ſolvent of gold muſt alſo be a mercury. 6. This mercury muſt be ſought for in the mineral kingdom, and, excluſive of the vegetable and animal kingdoms, nay all elements, muſt be found therein.

But that in this ſearch we may not go aſtray, I ſhall again draw ſome certain axioms from the true philoſophers. 1. Our ſolvent and our water, ſay they, is a metallic, ponderous, ſhining bright and dry liquor, that wets not the hand. 2. Further, our water has a near affinity with metals;

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it, therefore, mixes exactly with them and quits them not readily. 3. Our water, after its preparation, goes off entirely therefrom in the fire, as a volatile ſpirit, or remains entirely fixt therein. 4. Our water, united in a proper quantity with gold and ſilver, makes them volatile; and alſo with them abides the fire: And upon viewing all nature around we find no liquor, which has the above qualities for the moſt part and even in its crude ſtate, like quickſilver or common mercury: But now the confuſion continues, in regard all do reject the common mercury, and hence ſome would have a mercury of bodies, that is, of metals from gold and ſilver; but others from all the elements, by which means many millions have been ſquander'd away. But that this confuſion may be of no prejudice to us, I ſhall again cull out theſe ſhort axioms of the philoſophers. 1. The excellent author of the *arcanum philoſophiæ hermeticæ* confirms *Geber*'s opinion, when he ſays, 'he, who regards common mercury, as it exiſts in nature 'and in its entire ſubſtance, for the radical ſolvent of gold, deceives both 'himſelf and others: But he, who, on the contrary, entirely rejects the 'mercury of the vulgar, acts againſt the truth.' 2. He, who can draw from mercury its pureſt ſubſtance and free it from its leproſy and dropſy, is in the nigheſt road to find out our mercury. 3. He, who can increaſe in due weight the innate internal ſulphur of mercury, has then at length the true method to ſeparate the true water and *menſtruum*, the ſulphur and mercury of gold from the hard, cloſe, rocky ſhells, and to render it living or active.

This is that valuable water, which has ſo many names given it by the philoſophers for the inſnaring the imprudent; and which I have openly and without reſerve (ſo far as I could diſcover it from upwards of 400 books after indefatigable ſtudy and experiments) call'd above in the definition, *a highly purified, animated quickſilver*.

We ſhall now alſo conſider the *living gold*. Common gold, as was already ſaid, is entirely paſſive and dead, as it were; beſides, it has partly inherent foreign impurities, and partly different things are added to it by artiſts both in the mint and other works, which leſſen its natural worth and uncommon beauty: Hence the philoſophers reject, indeed, the common gold, tho' not gold itſelf; but they teach to purify and cleanſe it from all alloy by means of the corroding, mineral *wolf*, antimony, or by quartation, ſolutions and precipitations, cementations, *&c.* and then they look upon it as the proximate matter, from which the ſulphur of the philoſophers muſt previouſly be made, before the *ſtone* or the true gold-ſeed can be ſet at liberty; namely, with a drachm of the purified gold, made into a ſubtile powder, and with three drachms of the above philoſophical mercury, they make the ſofteſt amalgam, that is, a maſs, which like ſoft butter ſuffers itſelf to be treated by the hands. This they put into a proportionate glaſs-phial, call'd the external *philoſophical egg*; and even it is ſuch,

and

and effects, according to its nature, what the ſhell of an animal egg does; then they ſhut cloſe the phial above, that no more air may come in or go out than is needful; and then they give it in a ſpacious furnace the due degree of warmth, inceſſantly day and night for nine months together; and in that time the gold with the mercury is volatile, and as the philoſophers ſpeak, it is reduced to its *firſt matter*. In the mean time there appear from black to white, from white to red ſo many wonderful colours; conſequently, ſo many different circumſtances of the copulated mercury and gold, as the philoſophers cannot ſufficiently deſcribe; till at length the gold gets the upper hand, and thus unites the mercury with itſelf, ſo as never after to be ſeparated therefrom by any force of fire, water or air. Now this is the firſt rotation: But yet the ſtone is far from being made; but firſt the ſulphur of the philoſophers is form'd, which yet effects nothing other than that it farther quickens the dead gold, makes it rich in blood, nay, in ſeed; for, when this ſulphur is mix'd with gold, and then the mercury of the philoſophers is put to it, and as the firſt time it undergoes a coction of 7 to 9 months, ſo at length is obtain'd the ſo highly priz'd ſtone of the *wiſe* in the true ſeed of the gold, which ſuffers itſelf to multiply into ſeveral millions: And thus we ſee the ſoil wherein this ſeed is ſet.

A common ſoil for vegetables muſt have a ſufficient quantity of water, and a fat, ſaline, hollow earth, when it is to be fit for the purpoſe, and this water, fat and ſalt will be in the corn increas'd to corn, in wheat to wheat, *&c.* Theſe ſame principles ſmell well and agreeably in the roſe, clove-jelly-flower, lavender and *narciſſus*; in black currans they ſtink like buggs: In hen-bane, *opium* and *aſſa fœtida* they alſo ſmell diſagreeably: In a word, ſo many ſeeds as there are in nature, ſo many times is the undetermined water and earth determined and ſpecificated. The philoſophers alſo in this manner have their peculiar ſoils for their gold-ſeed; and theſe indeed are very different in goodneſs, as alſo uſually happens in other common ſoils; for, ſometimes one field wants water; another, fat and ſalt; another, is too ſandy; another, too ſtony, *&c.* But there are properly ſix ſoils of as many different natures and worth; the firſt and beſt is mercury; the ſecond, ſilver; the third, tin; the fourth, lead; the fifth, antimony; the ſixth, and the worſt, iron.

Each of theſe metals has its certain proportion of mineral humidity, that is, of mercury, of mineral fat, that is, of metallic ſulphur; and theſe are ſometimes mixt with more, ſometimes with leſs inflammable, earthy, ſtony, and glaſſy materials: And hence depends the worth of each metallic ſoil; and on that account ſome of them, as tin, lead, copper and iron, muſt be entirely and peculiarly prepar'd and purified, if you would otherwiſe expect the golden ſeed to bring forth a ſuitable crop in them.

Now

Now, as in the projection, as it is called, or properly in the ſowing, one grain of the fermented and multiplied philoſophical ſtone falls on a thouſand or ten thouſand parts of ſmelted metal, ſo the mercury and ſulphur of the metals nouriſh and increaſe the ſeed, and at the ſame time are by the ſeed ſpecificated to the nature of gold: But all this happens here inſtantaneouſly; as 1. This metallic ſeed is highly pure, active and penetrating; 2. As it has no organical ſtructure, but an union of homogeneous parts; 3. As the whole happens in the fire, whoſe actions and operations are much quicker than thoſe of air and water: And even in this manner a ſeed may be prepar'd from ſilver, which reduces the above-mention'd bodies to its own nature. Laſtly, we are to obſerve in all this, that the way hitherto explain'd is by the philoſophers call'd the *dry way*; they have, indeed, alſo a *humid way*, but it is kept ſo ſecret, that no one can be the wiſer by their writings, and therefore we ſhall not meddle with it. It is ſufficient, that from what we have ſaid the reader may clearly perceive not only what the *philoſopher's ſtone* is, but that both its preparation is poſſible and its effects credible.

Why ſo few have attain'd to the Philoſopher's Stone.

We, therefore, proceed to enquire into the reaſons, why ſo few have attain'd to the *ſtone*. To attain to a juſt knowledge in any ſcience, or art, ſeveral circumſtances are requiſite, 1. An experienced and faithful teacher; 2. A certain length of time; 3. A certain diſpoſition of the underſtanding and body; 4. Prudent and conſtant exerciſe; 5. Proper materials and inſtruments; 6. A proper place. Where one or other of theſe circumſtances are wanting, no art can be learn'd, at leaſt not to perfection.

Now let us apply all this to our art. If any art requires deep knowledge, or a peculiar knack or ſkill, it is certain the hermetic art does ſo; but where ſhall we find ſkilful and faithful teachers to aſſiſt us therein? We have books enow, but of what avail are they? Firſt, they are obſcure: And again it is rare, that an artiſt ſhall qualify himſelf for his profeſſion by books alone: But the reaſon, why we have none, or ſeldom any living maſter in the hermetic art is, that if any one ſets up for an *adept*, he is in danger of loſing both his freedom and life. Upon reading the fate of the renown'd *Philaletha* in his *diſplay'd palace*, one may indeed wonder at the wickedneſs of the world; nay, if a man in the courſe of his profeſſion venture to treat with underſtanding and due order of that innocent and noble art, chemiſtry, there is nothing but perſecution upon perſecution. But tho' there is no living teacher to be found, yet the ſtudious in the art apply themſelves to books, but with no great ſucceſs, as they bring not along with them the due meaſure of underſtanding; for, a diſciple of *Hermes* muſt firſt of all be a good divine, that he may know ſo to behave himſelf towards God and his neighbour, as that the curſe may not purſue him; again, he muſt be an exquiſite moraliſt, that he may in particular bring his affections under, and may not fall into blind deſires and inclinations:

And laſtly, he muſt be a compleat naturaliſt, and be maſter of phyſics in all the branches thereof, know the compoſition, ſpecies, and virtues of all bodies, that he may not be diſappointed in his labour; and then he muſt have a perfect underſtanding and practice in the whole compaſs of common chemiſtry: And from this character of an adept we ſee, that it is not every one that is qualified for chemiſtry.

Beſides, the diſciples in this art allow not themſelves the proper time in it; for, after running over one or two authors, they reckon themſelves ſufficiently qualified; and as they have learned the art in a hurry, with the ſame precipitancy they attempt on the *philoſopher's ſtone:* Whence one abſurdity follows upon the back of another. And ſuch people meaſure their own underſtandings too largely, ſo that they flatter themſelves from the dark riddles and contradictions of the philoſophers to have hit upon the true meaning, when yet it is not without difficulty, that one ſhall reach his end even from intelligible books. I ſhall, at preſent, mention nothing of the defect in knowledge as to the right matter, the true regimen, and alſo the proper place; only hint, that the principal cauſe is the will of God, who has been pleas'd to create gold and ſilver without corruption, and that in ſuch quantity, that all men, tho' they were ten times more in number, may to the world's end have enough, did not one time covetouſneſs wrap and rend all to one place; again, laviſhneſs waſte; and laſtly, pride deſtroy many millions. When I conſider this well, I imagine a ſpirit of giddineſs ſent abroad among gold-ſeekers, which perſuades them at one time to chuſe antimony; at another time nitre; and again ſomething elſe for the matter of this ſtone; that thus in their ſearch they always hope and when their hopes are at the higheſt, they are the moſt dangerously deceiv'd in, by and through their hopes: But this is the 3d thing we propoſe to handle. Such as treat the *Hermetic* art contrary to the doctrine of the true Philoſophers, were formerly call'd *Sophiſts*, but at this day *Alchemiſts*.

The ſeveral materials in which the Stone was ſought for.

Among theſe, ſome of them obſerv'd, that *mercury* is no ordinary water, but that ſomething extraordinary muſt be conceal'd therein: And hence they have alſo attempted on it; and indeed ſeveral have endeavour'd to fix it and inſtantaneouſly make it into gold and ſilver. But this ſcoffer has not only broke their glaſſes, but their ſtrong iron veſſels too, and flown away in fume; treated more gently, it indeed loſt its running form, and after a long time became into a powder; but upon the firſt occaſion it again reſum'd its form, and remain'd *mercury* as before.

Others indeed believ'd the ſaying of the philoſophers, that mercury in its crude and impure ſtate is of no avail: Hence they have thought to purify it with ſalt, vinegar, lee, and the like; and they have mix'd it with ſalt, nitre, *ſal ammoniac*, and ſulphur: Afterwards they have ſublim'd it for 10 or 20 times and upwards. But when they would revive it again, it was leprous, and remain'd ſo; and thus they loſt their labour.

It afterwards happen'd, that ſome more ſharp-ſighted, were appriz'd, that ſalts do not enter into the heart of metallic things, and ſo do not purify the mercury centrally; much leſs that they could not add the ſulphur that was ſtill wanting; they, therefore, fell upon metals and therewith they mix'd, amalgamated, diſtill'd, ſublim'd, boil'd, and roaſted the mercury; but the event prov'd vain. As now mercury was thus teaz'd without ſucceſs, it was dropt, and they applied themſelves to metals; and for a long time a mercurial ſubſtance, and a running mercury was ſought for from gold, ſilver, lead, tin, and iron; but partly in vain, and partly without any advantage.

After that the ſoul, or the ſulphur of gold in the other metals, was thought to anſwer, they then fell on cementation, calcination, and ſolution with *aqua fortis*, *aqua regia*, oil of vitriol, and on volatilization with acid, urinous ſpirits, and on extracting with *aceta radicata* and the like. They rack'd their brains ſo with the *purple mantle* of *Baſil Valentine*, as it is call'd, that many thouſands have been ſquander'd away and waſted into ſmoke. As if gold and ſilver could quit and lay aſide their eſſence, and the other metals yield what they had not! And from this folly aroſe the particular proceſſes, which have ſo often ruin'd the undertakers.

Farther, as the philoſophers ſay, that their gold and ſilver is living and not dead, that it has ſtill its ſpirit, that it was never in any ſmelting fire; ſo the ſophiſts go down into the mines, take out the ore thence, and would with a thouſand nets catch the bird of *Hermes*; when, notwithſtanding, a courſe of many dangerous proceſſes, they only obtain an arſenical ſublimate, or a ſulphureous water, or even a ſaline powder: And when bigeſt with hopes, lo! they are moſt diſappointed. And then, as they find that metals and their ores are cloſe ſhut up, they betake themſelves to minerals and ſalts; and there they ſuppoſe the ſulphur and mercury of gold lie open: And then we may with wonder obſerve, how arſenic, antimony, and mercury affect the operators, rewarding them with diſeaſes inſtead of gold. As common kitchen-ſalt does in men's bodies the office of an excellent balſam of life, they ſuppoſe it may be proper for the philoſopher's ſtone: And as nitre has an extraordinary force in ſulphureous mixtures, particularly in gun-powder, they ſuppoſe it may here burſt open the ſtrong bolted door of nature: And as vitriol is of ſervice in dying, they imagine it to abound with the ſulphur and mercury of gold; and all theſe things are treated with the greateſt application and zeal.

The fooleries we have hitherto related are ridiculous enough, but this is not all; there are others more ſo behind. Man, ſay they, is a little world in himſelf; and made up as the great world is, of four elements; and fancy they ſhall find the treaſure there. But as they doubt in what part of man it is to be found, they fall to work on the blood, hair, urine, excrements, bones, marrow, *&c.*

Hence *Hel Wigh* flatter'd himſelf, and would perſuade the world, that he found it in the eſſence of ſpittle, couch'd under *viſaliena teſtæ*, the anagram of *eſſentia ſalivæ*. Some affirm, that the earth is the *matrix* that receives the influences of heaven; therefore, that univerſal ſpirit, or the *anima mundi*, the *Archæus*, &c is coagulated therein, and found thus coagulated. They, therefore, dig up *bolus*'s, loamy earths out of fields that were never plough'd; theſe they expoſe for ſome months to the rays of the ſun, moon, and ſtars: At length they elixate theſe earths or diſtil them; and at laſt obtain either nitre or *Dutch* ſalt-petre.

Others with highly calcin'd ſalts ſearch for theſe coſtly things in the air; and for this they ranſack dew, hail, ſnow, rime, *March* rain-water, and ſun-beams to yield the *ſpiritus mundi:* Yet to no purpoſe. The artiſt forces from theſe things oils, ſalt, water, and earth; and is as far from his purpoſe as ever.

Theſe are the greater follies; and I could alſo mention a great deal about the leſſer ones, but that it is time to have done.

Some queries reſolv'd.

There are three queries remain to be clear'd up, *viz.* 1. Whether it is adviſeable for any one to engage in the hermetic art? 2. What the qualifications are which a happy diſciple of this art muſt have? 3. How one may know a perſon who pretends to be maſter of the art, or who would undertake to teach it? As to the firſt query; I roundly anſwer in the negative; for, tho' we are aſſur'd, that the true principles of the philoſopher's ſtone lie in mercury and gold, yet there are ſtill a great many locks to open: At the leaſt, the philoſophers aſſure us, that the true preparation of the mercury has not been openly, and in particular mention'd by any one; nay, they aſſure that this preparation cannot be diſcover'd in any writing under the ſanction of the moſt horrid curſe; and when any one arrives to this knowledge, it muſt either happen by immediate divine inſpiration, or by means of the oral tradition and manual demonſtration of an adept, under the ſeal of the greateſt ſecrecy. And after one has obtain'd this philoſophical mercury, there are in the after work, on account of the external furnace, the compoſition, the weight of fixt and volatile gold, ſo many difficulties remaining, that moſt people become doubtful, as they have not the patience of *Pontanus*, nor expect to arrive to the age of Count *Treviſan*.

The ſecond query we have reſolv'd above. As to the third, to wit, the diſcovering, whether any one be poſſeſs'd of this art, we may aſk him the following queſtions; whether he prepares the whole magiſtery from mercury alone, or whether he takes gold to it; whether it be neceſſary to take more than a drachm, or at moſt half an ounce? 2. Whether with a furnace in a cloſe glaſs, without opening or moving it, he can calcine, digeſt, ſublime, precipitate, diſſolve, and coagulate? Whether the matter in the glaſs be firſt black or white? And what is the meaning of this, *viz.* that one muſt firſt make ſilver before he can make gold: And if he can

do

o and clear up all this, you may believe him; if not, he is a deceiver. ut ſuppoſe one has learn'd from books to repeat all this, take heed whe- her he does not pretend poverty, and then he is no adept; but he will ither practiſe at the expence of your purſe, or inveigle you before you are ware. He who is wiſe will be on his guard!

)f Honey-Dews, or Mildews. From the Breſlaw Collection. April 1718. Claſs IV. Art. I. p. 956.

Tranſlated from the HIGH-DUTCH.

Mildew rever'd as a God among the *Romans*.

AMONG the diſeaſes, with which the fruits of the earth are affected, honey-dew has always been look'd upon as one of the worſt. The *Romans* formerly might be ſo plagu'd therewith, as to give it a eculiar Deity, call'd *Rubigus*, which indeed by ſome was call'd *Deus ru- icorum*, but was rever'd by the wiſeſt *Romans*, as among others the learned *'arro*[a] at the beginning of his book *de re ruſticâ* pays his devotion, firſt to *'upiter* and *Tellus*, then to *Sol* and *Luna*, again to *Bacchus* and *Ceres*, and aſtly alſo to the God *Rubigus* and *Flora*, which laſt being propitious, as is words run, ‘ neither does mildew affect corn and trees, and they bloſ- ſom in ſeaſon'. To which purpoſe alſo *Numa Pompilius* had in the 11th ear of his reign appointed a certain feaſt, called *Rubigalia*, in honour of his God; and which in *Pliny*'s days[b] was obſerv'd on the ſeventh of the *Calends* of *May*, that is on the 26. of *April*, as at that time plants are moſt obnoxious to mildew: And all this to the end, that this heathen Deity might avert from the fields ſo noxious a thing as mildew, as they were firmly perſuaded, that this diſaſter came from heaven. ‘ Mildew, ays *Pliny*[c], is a diſeaſe of corn and the vine, ſent from heaven'. This he *Greeks* hence called Αεροφολισμὸν, and the *Latins*, *Sideratio*; but in its ffects they conſider'd it as the greateſt plague of corn. *Pliny* in the above lace aſcribes its cauſe eſpecially to the noxious influence of the dog-ſtar: Hence they us'd to offer up a dog both to *Rubigus* and the *dog-ſtar*, as *Ovid* at the end of the 4th Book of *Faſti* ſhows.

Flamen in antiquæ lucum Rubiginis ibat,
Exta canis flammis, exta daturus ovis.

amely, the *Flamen Quirinalis* muſt perform this religious ceremony with- ut the city, and pour wine and incenſe on the entrails of the dog[d]. In-

[a] *Vid.* Varro *lib.* 7. *cap.* 1. *p. m.* 359. Ed. Zwingeri *de methodo ruſtic.*
[b] Hiſt. Nat. *l.* 18. *c.* 29. *p. m.* 338. [c] Id. *cap.* 17. *p.* 327. [d] Alex. ab Alex. Noct. eneal. *lib.* 3. *cap.* 12. *p. m.* 142. b.

ſtead

ſtead of which Chriſtians afterwards, and in different places, even at thi day, make their proceſſions round the corn fields.

Mildew what? And indeed this is a diſaſter very prejudicial to trees and corn, bu whoſe true nature is not hitherto known, as the importance of ſo commo a phenomenon requires, ſo far that one can learn but little even from ex perienc'd and knowing huſbandmen and gardeners, beſides what they hav learn'd, not ſo much from their own experience, as rather from commo tradition: And hence it is a difficult matter to give a circumſtantiate an true hiſtory thereof, on which we ourſelves have employ'd much pains yet could not in all things attain to the wiſh'd for ſatisfaction, eſpecially a we could not in perſon with ſufficient diſtinctneſs obſerve the true nature o this phenomenon abroad in the fields, unleſs we happen'd to be there b chance, as we were confin'd to a city life. What we could learn from th information of others, and alſo in part from our own obſervation, is princ pally as follows: Mildew chiefly happens in the ſpring, eſpecially abou the time of the ſhooting and blooming of the corn, and at the time of th budding and bloſſoming of the trees, both which it uſually affects, nay alſ beans and other pulſe, yet not promiſcuouſly, but often one garden befo another, nay ſometimes one tree or ſpecies before another, and often on ſide thereof. It is obſerv'd to be more or leſs plentiful one year than an other, and eſpecially when warmth, heat and ſun-ſhine enſue a preceedin wet: In this r. anner *Ramazzini* [c] remarks, that it appear'd in particular i great plenty about *Modena* in *Italy*, about the ſummer-ſolſtice of 1689 o trees, wheat, beans and other pulſe, after much ſpring-rain; as alſo i 1690, at the beginning of *June*, after preceeding rainy weather, and no only on low but alſo on high grounds: The like was alſo obſerv'd the in the following years[f]. The ſame was alſo obſerv'd by *Marc. Gerbeci* at *Labach* in *Carniola* in 1698[g]; as alſo by *Hoyer* in 1699 almoſt all ov *Thuringen*[h], and by many others. Generally it is obſerv'd in deep, moi or woody grounds, in which manner alſo *Pliny* ſays, 'it is very common i 'wet tracts and valleys, not expos'd to the wind: On the contrary, wind 'and high places are without it.'[i] It is conſtantly found after we and warm ſun-ſhine enſuing thereon; and it is generally aſſur'd, that it originally produc'd in a ſmall rain during ſun-ſhine, eſpecially in the mor ing. It ſettles upon the bloom and young ſhoots of trees, as alſo o the ears of corn, *&c.* like a clingy, yelloviſh, or even greeniſh matte often in great plenty, and paſtes together the heart-blades and bloom ſuch ſort, that they quite loſe the power of ſhooting; Whence they fad ſhrivel and fall off, at the leaſt it remains on the blades, that continue brow

[c] Diſſert. de conſtitut. *anni* 1690. in Miſ. Nat. Cur. Dec. II. An. 9. app.
[f] *Vid.* ejuſd. conſtit. An. 1690, 1692, 1693, 1694. in Miſc. Nat. Cur. Dec. III. An. app. p. 63, ſeq; [g] Chronol. Med. An. ſec. p. m. 183. [h] Miſc. Nat. Cur. Dec. II An. 9. & 10. Obſ. 93. p. 171, ſeq. [i] Plin. *lib.* 18. *cap.* 17. *p.* 327.

yello

yellow ſpots: The taſte of mildew is ſweet, yet ſomewhat piquant; and bees readily uſe it: Yet one ſpecies thereof is better for them than another. In this form it lies for many days on the trees and corn, eſpecially if the ſun does not timouſly dry it up, or the rain waſh it off: Yet we have not been diſtinctly inform'd, that alſo in this form it is found on graſs. In particular, we are to remark here, that in the honey-dew on trees almoſt always ſmall maggots and caterpillars are found, which by their gnawing of the minute *ſtamina* and pedicles of the blades and bloom promote their falling off: Yet in the honey-dew of corn the like is not obſervable; and among all trees the hazel alone remains free of honey-dew, as *Ramazzini*[k] and *Brunnerus*[l] remark.

The effect of honey-dew conſiſts principally herein, namely that trees much affected therewith loſt this year all their bloom and fruit. Corn remains barren or degenerates into what is call'd mildew'd corn[m]; nay it proves prejudicial to cattle, eſpecially ſheep, as alſo to men. As to our own obſervation in particular, which we had occaſion to make this month about this *phenomenon* in perſon, it conſiſted herein: Soon after *Eaſter* we obſerv'd in a woody ground near the *Oder* much honey-dew on fruit-trees, which had already fallen on *Good Friday*, namely the 15th of *April*; we remark'd that, for the moſt part, nay almoſt ſolely it affected the young apple-trees, namely on their flower-buds ſettled a tough, yellow matter like thin honey, ſomewhat ſweetiſh; the bloom, on which much of it ſettled, appear'd on the out-moſt blades as if ſinged, and when touch'd, the whole bloom and bud fell off; and the ground beneath was as much ſinged and appear'd as yellow as the blades: The leaves of the tree, which ſtood on the flower-buds, were partly fatty and clammy, and partly here and there beſet with yellow, browniſh ſpots, and partly appear'd ſomewhat ſhrivell'd; yet theſe fell not off like the flower-buds, but remain'd faſt. Upon enquiring, whether this honey-dew was ſuddenly and all at once obſerv'd, we were told, that at firſt only ſomething of it was obſerv'd; yet that it was moſt of all firſt perceiv'd in the like preceeding heat; and that it was probable, that the heat had either forced it out or collected it. Upon enquiring, why other trees were not in like manner affected with it, we were told that the then rain did not fall in one place, or that theſe muſt be the moſt ſenſible flowers: To this was added, that no bee would meddle with the yellow, but readily with the white ſort; that the yellow was very noxious. Its effect what.

As to the nature and generation of this honey-dew, the opinions of huſbandmen and naturaliſts are various: Some of which derive it from an evil conſtellation, as in particular the ancients, according to whoſe opinion, it is in *Pliny* call'd *ſaliva ſiderum*; but others, and thoſe the greateſt Opinions about mildew various.

k L. c. l Miſ. Nat. Cur. Dec. III. An. 2. p. 351. m *Vide* Miſ. Nat. Cur. Dec. III. *An.* 2. *Obſ.* 224. — *It. An.* 9. & 10. *Obſ.* 93.

greateſt number even at this day, from the earth and air; yet ſome alſo from the plants themſelves. The moſt common notion is, that honey-dew falls down from the air; and it is a common way of ſpeaking among huſbandmen and gardeners, that a poiſon, a noxious honey-dew or mildew is fallen; and in this manner all trees and plants indifferently and equally, nay men and beaſts in the ſame diſtrict, muſt be affected with it, which yet runs counter both to experience and hiſtory: Moſt people hold it for a ſort of corrupted dew, and that partly of a lixiviate, alcaline nature, partly and moſtly of a ſharp, ſour and corroſive nature as *Ramazzini* affirms[n]. As common dew is of a ſaline, volatile nature, from which may be prepar'd a ſpirit that reſolves metals, as for inſtance, *Cnoeffelius' menſtruum for preparing the tincture of corals*; to which if nitrous and acid corpuſcles are aſſociated, and which ferment together in the air and then fall down, honey-dew is produced; to which *Gerbezius*[o] and *Fromman*[p] add, that with theſe corroſive vapours, drawn up out of the earth and ſea, there are ſometimes arſenical *halitus'* complicated. *Jo. Borrellus*[q] holds it for real *aqua fortis*, and is of opinion, that mildew may be produced by art, eſpecially by means of lime and brick-kilns, glaſs and ſmelting-houſes, where they deal much in antimony and other minerals, whoſe fumes may by the wind be driven on trees and fields. Now ſuch vapours may be drawn up by the heat of the ſun out of the earth that is hitherto ſhut up, and at laſt fall down out of the air in form of a dew, or in rain; yet as this opinion has many and thoſe no ſmall difficulties, ſo in particular *Joh. Sam. Tromſdorff* has oppos'd this opinion in a diſputation at *Erford* in 1699 under the title of *Ros mellis non Ros nec mellis Ros*, &c. wherein he maintains that honey-dew is properly no dew, but an extract and exhalation of the plant, particularly of corn, not yet fully ripe: Hence it is not univerſally found in all plants, but ſuch as have an over-abundance of ſap; and he gives the following definition of it; 'it is an aqueous, hypoſtatic meteor, 'drawn by the heat of the ſun from the ſeed and leaves of plants, eſpe-'cially the long ſtalk'd ones, and from their ſuperfluous moiſture, which 'in ſome is conjoin'd with ſulphur, condens'd by a weak degree of cold, 'very noxious to the corn, firſt of a ruddy colour, but afterwards degene-'rating externally into blackneſs, deſign'd for the puniſhment of men, 'and the glory of God.' And certain it is, that this opinion in general, to wit, that honeydew has its true original from the plants themſelves, ſeems to come nigheſt the truth, as from this the *phenomena* thereof may be illuſtrated to the beſt advantage; for, it is well known, that corn, for inſtance, at bloom-time ſenſibly exhales, ſo that we may partly ſmell the vapour and partly ſee it with our eyes in form of a thick fog. The ſenſible and remarkable ſmell of fruit and foreſt-trees, as of oaks, pines, firrs

[n] Diſs. de conſtit. An. 1690. Miſc. Nat. Cur. Dec. II. An. 9. app. p. 37.
[o] Chronol. Med An. 2. p. m. 183. [p] Miſ. Nat. Cur. Dec. I. An. 6. & 7 Obſ. 186. p. 250.
[q] Obſ. Med Cent. 3. Obſ. 87. p 165.

firrs, wild-pines, willows, *&c.* at their firſt budding and blooming ſhows how great a quantity of exhalation they yield: But ſcarcely from other trees, eſpecially as it may be ſuppos'd to be of a more ſulphureo-volatile, fat and active nature; and one tree yields theſe vapours more plentifully than another, yet not always in equal quantity at one and the ſame time, but at different times, as the heat of the ſun, and the warmth of the air by day and by night are of any conſiderable degree, and of any continuance: And do theſe circumſtances follow upon the back of much preceeding wet, theſe vapours at one time or other being plentifully diſcharged from plants, are thus compleatly diſſipated in the air; but does there hereby ariſe a moiſt and cool air, that theſe exhalations cannot ſufficiently expand, and the ordinary dew be ſtill added thereto, or alſo thoſe ſun-rains, as they are call'd, with which theſe vapours combine, they ſoon again ſettle upon the plants, and in this mixture form ſuch a clammy ſubſtance; but which then in its nature does not neceſſarily, by virtue of any corroſiveneſs, but ſimply, on account of its glutinous and clingy nature, check the mounting juice in its circulation, and the growth of the plants in their tender expanſion; that hence the natural force of the plant in thoſe parts ceaſing to promote the farther mounting of the juice, it gives occaſion to the nouriſhment being diverted ſome other way, and deſtroys all the buds; and theſe our thoughts do for the moſt part, as to the effect of mildew, coincide with the opinion of Dr. *Hoffman* at *Hall*, who in a MS. phyſical college or lecture ſays; 'it is 'a vulgar opinion, that mildew is poiſonous and very corroſive, becauſe 'it is noxious to the fruits and a hindrance to their fecundity; whereas it 'uſually does harm by its ſweet viſcoſity alone, namely as it obſtructs and 'ſhuts up the pores, as of wheat and rye in bloom, or when the ſeeds 'begin to be elaborated; and hence the pores being block'd up, their 'further nutrition and augmentation is entirely impeded. But mildew 'acquires a corroſiveneſs, namely as by the heat of the ſun, the acid, 'ſaline *ſpicula*, of which all ſweet things conſiſt, are call'd forth and ex-'alted; which, beſides the preceeding obſtruction, alſo corrode and 'eat out the tender fibres of vegetables, *&c.*' And this final corroſiveneſs of a ſweet liquor, which in time becomes acrid or acid, is very probable, only that it is not thought to be in this form drawn out of the earth or plants. And this is our opinion as to the generation of mildew.

There remains behind to alledge another opinion, which is that of *Lewenhoeck*'s[r], who not only denies, that honey-dew falls down from the air, and has an affinity with dew; but by means of his microſcopical obſervations he averrs, that it is nothing elſe but an infinite number of the ſmalleſt maggots and their *ova:* And in this manner alſo *Chr. Frid. Garman*[s] holds

Lewenhoeck's opinion as to mildew.

[r] Continuat. arcan. Nat. detect. epiſt. 104.
[s] Oolog. curioſ. Dif. 2. § 256. p. 220.

holds, that mildew is nothing other than a vaſt number of ſmall winged inſects. Of mildew this is too clear to require any laborious proof; yet of honey-dew it does not hold with equal clearneſs, eſpecially as M. *Lewenhoeck*'s head was full of nothing but *animalcula*; and in this reſpect he has been oppos'd by *Joh. Georg. Hoyer* at *Muhlhauſen*[t], tho' this latter cannot deny, but that ſometimes all manner of maggots with their ſlaver and dirt uſually pollute and eat up the plants, and conſequently produce an effect like honey-dew: And he allows, that he once obſerv'd how from each drop of the honey-dew a ſingle maggot, and out of that, in a little time after, a green catterpillar was produced: In which manner alſo *Joh. Conr. Brunnerus*[v] alledges, that he found ſmall maggots on the leaves ſpoil'd by the honey-dew. Yet this notwithſtanding, the above-mentioned *Hoyer* denies, that honey-dew in its entire ſubſtance is any thing other than a congeries of ſmall maggots and eggs, as the eye often ſees thro' microſcopes ſomething different from what is actually found, eſpecially as by virtue of the alledged obſervation, no more than a ſingle worm was to be found in one drop of honey-dew: And if *Lewenhoeck*'s opinion were ſufficiently grounded, we muſt believe, that certain inſects lay their *ſperma* together with their ſlaver and other filth on plants, which then together appears like honey-dew: Whereas it rather ſeems probable, that this maggot-ſeed is laid in this clingy matter, as in a *matrix*, in which at length the above brood is produced. But to the demonſtration of the vermicular nature of honey-dew, more circumſpection and a greater number of obſervations are requiſite. Yet we muſt here alledge what we were told about the cauſe of honey-dew by an experienc'd huſbandman; he aſſures us from his own repeated experience, that honey-dew is produced on trees in the following manner: In harveſt, namely in *Auguſt* and *September*, a very ſmall worm eats into the flower-buds and lays an egg therein, which in ſpring creeps out a maggot and gnaws the heart of the flower-bud, out of which the ſap runs out, eſpecially in ſtrong ſun-ſhine, and, indeed, in ſuch plenty that the boughs are wet with it. He thinks this may be prov'd, if in winter one bring a ſprig, wherein ſuch egg is found, into a warm ſtove, the maggot becomes alive, and by its gnawing cauſes the ſap to run out: At laſt from this maggot is produced a larger one, which in a microſcope appears like a chafer, a little bigger than a large flea, of colour greyiſh, reddiſh, green, and yellow. How far this holds we cannot ſay; and whether the ſap that runs out be the ſame with what is call'd honey-dew; at the leaſt were it ſo, the honey-dew on trees muſt be quite different from that on corn; and perhaps there is a real difference in this caſe, according to the different ſorts of trees, which in general is the reaſon, that mention is made of different ſorts of honey-dews, as if at one time there fell a white,

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[t] Miſc. Nat. Cur. Dec. III. An. 9. & 10. Obſ. 93. p. 173. It. Cent. I. & II. Obſ. 117. p. 241. [v] Miſ. Nat. Cur. Dec. III. An. 2. Obſ. 224. p. 351.

at another a green or yellow ſort: Whereas notwithſtanding, it is barely different, according to the exhalations of the different ſpecies of plants.

An Obſervation on medicated Whey. *By* Georg. Frid. Gutermann. *From the* Commercium Literarium Norimbergenſe. An. 1732. Hebdomas IV. p. 30.

Tranſlated from the LATIN.

IT is, indeed, a very uſeful method of the illuſtrious Dr. *Hoffman* to preſcribe drinking *acidulæ*, mixt with milk; and of ſuch patients, as us'd my advice, there were ſome who drank the *Selteran* waters, mixt with milk, and that either cows or goats, as our country or neighbourhood affords no aſſes; that I might, therefore, preſcribe ſuch a quantity of the water as ſhould produce the deſired effect, and ſuch a due proportion of milk, that uſeful liquor both for ſupporting and refreſhing the human body, both in a ſound and unſound ſtate, as not to overcharge the drinkers with too much water and milk, and to free the milk from its cheeſy and uſeleſs *magma*, I propos'd, after the example of *Hoffman*, firſt to evaporate the milk in an earthen veſſel by a gentle fire, and till it is cool'd to pour to it the deſtin'd quantity of water; and by this means by ſtirring it I ſeparated that genuine ſugar of milk: Thus one pound of this milky water or of the *acidulæ*, impregnated with whey, conſiſted not only of an entire pound of water, but of an equal, or if you will, a greater proportion of good milk: And I cannot help mentioning the good effect, which above other things it had on a certain ſtudious young man, who had been very often troubled with hypocondriac and arthritic diſorders, and was brought very low, but is now in perfect health. At other times I was wont to procure ſweet genuine whey without evaporation or without any thing the leaſt acidulous, and that by an experiment borrowed from the kitchen. I took, for inſtance, 2 lb. of milk, which I put in a copper over a gentle fire, and when juſt ready to boil I order'd to put 6 or 8 eggs into it: Thus by the gentle heat the eggs unite with the cheeſy part of the milk; and all the pure whey ſeparates ſpontaneouſly, and is very ſweet. This very ſimple method, and, indeed, the beſt for obtaining whey, was formerly communicated to me by *Alex. Camerarius*, profeſſor at *Tubingen*. Medicated whey how made.

I ſhall here ſubjoin the manner of preparing the *lait coupè* of the *French*, as it is only known traditionally, differing a little from that which *Boecler*, profeſſor at *Straſburg*, gives in his *Cynoſura materiæ medicæ continuata*, p. 794. Take of oats and barley, waſh'd in ſpring-water, of each a handful; boil them over a gentle fire with 2 *lb.* of ſpring-water, till half be boil'd away: Thus alſo boil 2 *lb.* of milk, and while the milk gently boils, the ſkin appearing on its ſurface is to be taken off, till 1 *lb.* of milk remain, which Manner of preparing the *lait coupe*.

which is afterwards mixt with the decoction of the oats and barley; ſtrain'd thro' a linen cloth, and ſweeten'd with ſugar to your mind, it is fit for uſe.

Of the maturation of Amber, and the bringing of it to perfection, both by art and nature. From the Electrologia *of* Nathan. Sendelius. Ann. 1725.

Tranſlated from the LATIN.

Several ſorts of amber nam'd from their colour.

SUCH as have given us a deſcription of ambers expreſs, and with application have enquir'd into their nature, no ſooner began to know and handle them, than according to their different colours, which vary much among themſelves, they alſo nam'd various and diſtinct kinds thereof, and to this day offer'd them to us; ſo that if you would calculate their number, and advert to the whole train of white, milky, pearly, wavy, golden, yellow, dark, pale, dun, variegated, blue, green, black and the other ambers, and alſo conſider their greater or leſs difference, you might reckon upwards of 600 of them.

Reduced to two claſſes by *Hartmann.*

In this great ſtore and apparatus of ambers, tho' there be a pretty wide difference, yet there is no neceſſity for going in to the opinion of thoſe, who thence would make different ſpecies of them, as this has been ſufficiently confuted by *Hartmann* himſelf[a], calling that difference a difference of degree and not of ſpecies; and reducing their large and confus'd number to two claſſes, *viz.* the whitiſh and yellowiſh, and to theſe alone he contends, that the mixture of the other colours may and ought to be referr'd.

The author's diviſion.

But as with *Hartmann* I pronounce that ambers differ in degree, I ſhall undoubtedly be call'd upon, in the firſt place, to make out ſome higher degree, from whoſe perfection the qualities and affections either eſſential or accidental, of the other ambers, which are leſs in degree and leſs perfect, may appear: And this knowledge of perfect and imperfect ambers is, therefore, not only uſeful and neceſſary, that thoſe different degrees, in reſpect of the matter of amber and its other affections, may be known; but that alſo at the ſame time it may appear, whether nature continues to ripen ambers more and more; and moreover what helps ſhe uſes therein, that after changing their jejune and vicious nature, ſhe may produce perfect from imperfect ambers.

All which if we compare with *Hartmann*'s reſtriction and diviſion of ambers, *viz.* whitiſh and yellowiſh, it will eaſily appear of what little avail it is here; for, theſe mention'd claſſes do in general diſtinguiſh ambers only according to their colours, tho' it is evident, that neither all ſorts of colours, eſpecially the more rare, can be included and comprehended in theſe: But that neither the whitiſh nor yellowiſh can be reckon'd the capital

[a] Hiſt. Succin. *Præf. lib.* II. *cap.* 4. § 7.——11.

pital degrees or the more perfect ambers, appears even from the author himself, as he affirms, 'that these may be changed in a still higher degree 'into sparkling and pellucid, but those into white[b]:' But he still leaves us in the dark with respect to the highest degree of perfection.

Hartmann[c] affirms, that he has been shewn by workmen, that all the inferior colours may by the force of fire be exalted to a higher degree, and this effect, which he allows to art, he denies to nature. In the other kingdoms, as the vegetable and animal, we observe, that nature intends perfection, nor is this to be denied in the mineral kingdom; for, minerals are prepar'd and ripen'd in their veins, till they arrive to that perfection nature design'd them; and ambers, like other bodies of the earth, cherish'd by heat, and at length furnish'd with larger supplies of juices, are ripen'd and attain to their perfection.

Wherein the perfection of ambers consists according to *Hartmann*.

But in what the perfection of ambers consists is a hard matter to determine. *Hartmann*[d] reckons the white and milky ambers the most valuable; and he expresses his surprize, that the *Romans* formerly, as *Pliny* remarks, put no value on the white, as they are the most rare to be found. Next to these he classes the wavy, the sparkling and the yellow; and again in another place he makes the perfection of amber to consist in its hardness[e]; and again in another place he commends its purity and brightness[f]; but most commonly and in general he fixes the difference of ambers in their matter, colour, odour and effects, distinguish'd according to more or less[g]: I also consulted the artists that deal in amber, and they were all of *Hartmann*'s opinion, and that the rather as of the pearly kind several toys are made; so that thus I could find no satisfaction from either of them.

According to the author.

That I might at length find out and determine what those ambers are, that are so elaborated in the highest degree by nature, as to be capable of attaining to no higher, and in respect of which perfection all the others may be called imperfect, I have examin'd and collected various sorts of amber of different sizes; for this end, therefore, examining those neglected small pieces, with which the shore is sometimes strew'd all over, I found them all clear, transparent and sparkling, excepting only a very few obscure glebes, but which were chiefly furnish'd with acute angles, and which, therefore, seem'd to be torn off from the larger glebes.

The greatest part of those joints, as they are call'd, which are turn'd in the lathe, were clear and transparent, but the middle somewhat obscure, and inclining to clearness. In the larger common balls for the lathe, on the contrary, the darker parts were uppermost, with the clearer beneath, so that by estimation the latter made a sixth or seventh part, the other parts remaining either entirely, or in some measure at least, obscure; and of those, whose dark part was outmost, there were not a few, which seem'd inclining

[b] Ibid. § 11. [c] Ibid. § 12. [d] Ibid. *l.* 1. *c.* 7. § 6. [e] Ibid. *l.* 2. *c.* 2. § 8.
[f] Ibid. *c.* 4. § 7. [g] Ibid. § 7, 8, 9.

ing to clearneſs; as ſome of them were clear, not only for half their bulk, but likewiſe others, on their edges and externally, ſhow'd a degree of clearneſs the breadth of a gooſe-quill, ſo as by the ſaw to be ſeparated from the remaining darker part. In the largeſt glebes of all, which weigh from half to one nay two, but rarely three pounds, this clearneſs was ſo rare, that the larger theſe glebes were, they ſhew'd the more obſcure. And on the contrary, the greater tranſparency was obſerv'd, the ſmaller they were; and this brought a hint into my mind, whether all the obſcurer colours of amber are not chang'd by time, and made to put on a ſparkling brightneſs; and nature ſeems to have leſs trouble in perfecting and clarifying thoſe ſmaller glebes than the larger ones: And upon accurately examining not only ſuch as were half clear, but ſuch as were more ſuperficially ſo, in the confines of thoſe different colours I obſerv'd a darker cloud ſo diſperſed, that the bright and dark parts run into one another; and which I obſerv'd more evidently in other glebes, where the obſcurity being entirely diſcuſs'd, there only remain'd in the middle a kind of thin cloud ſcarcely hindering the tranſmiſſion of the light: And hence it ſeem'd agreeable to reaſon, that the portion, which became clear, was before very like the darker part, and that this darker part would arrive to the ſame tranſparency, had the glebe been ſuffer'd to lie longer in the earth or in its own veins; whence it appears, that nature attempts this change firſt from the external parts, and in this, art imitates nature, as we ſhall obſerve hereafter. And I myſelf have had an inſtance, by which it appear'd, that amber even by keeping undergoes this change; and this alſo has been obſerv'd by others. Tho' it is not to be denied, but that ſometimes one ſide, eſpecially in the larger and broader glebes, is obſerv'd clear and tranſparent, while in the mean time the other remains ſtill obſcure, tho' this alſo, in time, wears off; which change is brought about by its tranſpiring, by the rolling of the ſea, or by the cheriſhing heat of the ſun.

According to the author.

From theſe obſervations, therefore, I concluded, that nature attempts the perfection and maturation of ambers, and that this their perfection is their clearneſs and tranſparency, whereby they tranſmit light in the manner of glaſs; whether this tranſparency be of the diamond or wavy kind, which is the better and more perfect ſort, and happening in the pureſt, pearly ambers, or whether only it be a ruddy or golden tranſparency: And the more ambers recede from this tranſparency, the more they are claſs'd among the imperfect, commonly call'd baſtard, ambers; not that theſe are not genuine, but that they were not allow'd to arrive to their degree of perfection. The other properties of amber, as its hardneſs, odour and colour, are not to be compar'd with this property of tranſparency, as they do not ſtrictly involve any degree of perfection, and eſpecially as ſome of them may by art be corrected, as ſhall be ſhewn below.

Its perfection conſiſts in its tranſparency.

Hart-

Hartmann calls the hardneſs of amber its greateſt glory, and that it is the more perfect, the more ſolid it is[h]: Yet all hard ambers will not be perfect, as it may happen that they are not tranſparent, as is always the caſe in pearly ambers, nay and ſometimes in moſt others. Yet thoſe that are tranſparent are always hard, unleſs they ſhould happen to be ſpoil'd by ſome accident; for, all ambers expoſed to the ſun's heat, tho' they have a thinner and more friable coat, yet within they have a very hard and tranſparent body: And hence it is, that clarified by art, when before they were not hard, they afterwards become ſo, as we ſhall ſhew below more at large. And I know of none harder than the wavy ſort, which often blunt the edge of a knife, ſo as to require repeated whetting; and which is more, the clear part of the amber glebe is always the hardeſt.

According to *Hartmann* in its hardneſs.

Having thus eſtabliſh'd the preheminence of the tranſparent ambers as the moſt noble, the degrees of the others, as the more ignoble, may be diſtinguiſh'd from their more or leſs coarſe texture; namely as their matter and ſulphur are found more or leſs digeſted, as according to theſe, light finds now an eaſier, again a more difficult paſſage: The principal, therefore, will be the clear and tranſparent ambers, whether they be the wavy, which tranſmit the light very freely through their pores; and conſequently are the moſt to be regarded and the moſt valuable; or whether they be of a golden or ruddy tranſparency, in which indeed the light is with equal freedom tranſmitted, but along with ſome reflexion and refraction of the rays, that the light may the more ſtrongly ſhow the golden colour. From the tranſparent, all the other cloudy and opaque ambers ſhould be diſtinguiſh'd, among which the ſcaley challenge the firſt place, diſtinguiſh'd with very thin, obſcure interſtices, ſome of which are obſerv'd to be of the pearly kind, and more whitiſh; but others of the common obſcure kind, and yellow; In both theſe kinds the light is ſtill in ſome meaſure, but not perfectly and freely tranſmitted: However, ambers of this texture and conſiſtence ſtand in the firſt place for attaining to perfection: And I have often obſerved, that by their own proper motion and by bare tranſpiration in a little time only their thin clouds diminiſh and are at laſt diſſipated. Next to the ſcaley ſucceed the denſe pearly, and the others, more obſcure, as the waxy or pale yellow; in ſuch manner that as among the ſcaley the pale pearly are the beſt, ſo among theſe laſt the denſe or thick pearly are the principal; and that on account of the more rare and pure texture of their ſulphur, mixt with a very tender volatile ſalt, whereby they become fitter for attaining to their future clarification and perfection. Both theſe ambers do ſtill with greater difficulty admit the light, and that the more as the yellowneſs ſeems to run off into obſcurity. But both the pearly and pale yellow require no great time or labour to their clarification; nay, the former require leſs labour of art and nature than the latter,

The more ignoble ambers whereby diſtinguiſh'd from each other.

[h] Hiſt. Succin. *Pruſs. l.* 2. *c.* 2. § 8.

latter, eſpecially if no great degree of whiteneſs be mix'd with them; for, the more rare the whiteneſs appears, the more diſpos'd theſe glebes are to tranſparency, and *vice verſâ*. What judgment we are to form of the obſcure yellow, and other opaque ambers, as thoſe of a liver-colour, carnation, black and other mixt colours, is evident; the texture of which ambers, on account of the groſſer matter of which they conſiſt, as alſo on account of the admixture of many heterogeneous parts, tranſmits no light at all, nay entirely ſtifles it: Whence either with difficulty, or not at all, are theſe clarified. There remains the white, a peculiar kind of amber, which has united with its ſulphureous parts, white, ſaline, heterogeneous matters; and ſuch ambers both terminate the ſight, and on account of their poliſh'd ſurface again reflect the light as it fell.

The maturation, &c. of ambers, where perform'd.

The maturation and clarification of ambers is perform'd both in and out of their veins, but more frequently in their veins: And the reaſon, why both the perfect and imperfect ambers bear the ſame price is, that the imperfect and opaque may be eaſily and at a low expence made tranſparent: But what I have ſaid here is to be underſtood of the common and ordinary glebes, in regard that the larger tranſparent glebes, both for their uncommonneſs and price far exceed all the obſcure, nay, the pearly ambers themſelves. And the reaſon why theſe larger tranſparent glebes are more uncommon is, that they require a longer time for their maturation.

The operations of art on amber.

We ſhall now proceed to the ſeveral operations of art perform'd on amber, as the coction, digeſtion and maturation thereof, and whereby thoſe of nature may be illuſtrated. The art of poliſhing amber ſeems to have been known to the ancient *Romans*; and doubtleſs, being loſt in a length of years was afterwards recover'd in our days. *Archelaus*, king of *Cappadocia*, ſays *Pliny*,[a] relates, that amber is poliſh'd by boiling it in the lard of a ſucking pig; and by that politure *Pliny*[b] certainly means, that a clearneſs and tranſparency are conciliated to amber: And the ſame *Pliny*, tho' for another purpoſe, to wit, the tinging of amber, makes mention of the coction of amber in the fat of kids, ſo that the *Romans* muſt have known the true oily *menſtruum* for boiling amber; but that afterwards the art ſeems to have been loſt, as I find no traces of it for many ages; and the diſcovery of it by the Moderns ſcarcely exceeds half a century: Beſides, the moderns at firſt attempted that tranſmutation by digeſtion in ſand, induced, probably, from this reaſon, that they obſerv'd, that ambers become always tranſparent and clear, bak'd by the ſun's heat in the ſand. This art was firſt diſcover'd at *Dantzick*, from whence it ſpread into other parts: And as it is always eaſy to improve upon inventions, they devis'd another method, which was to boil and digeſt amber in rape-ſeed oil, which method, the former being laid aſide, ſtill continues to this day.

[a] Lib. 37. c. 3. [b] Id. ibid.

As

As to that firſt digeſtion in ſand, it was managed in the following manner: The workmen committed the amber, that was to be tranſmuted, to an iron pot, into which ſand was put, yet ſo that the amber ſhould not approach the pot too nearly and ſuffer by too much heat; and this they provided againſt in the following manner: After firſt wrapping up the amber-balls in paper, they ſo diſpos'd of the ſand on the bottom and ſides of the pot, that they ſhould every where poſſeſs the middle place, and be out of the reach of the fire; and putting coals at ſome diſtance to the pot, they at firſt made a gentle fire, which they afterwards heighten'd gradually, till they found the clarification accompliſh'd, which took up, as they ſay, the ſpace of 40 hours: And that they might not be deceiv'd or diſappointed in the event, they added to the other ambers certain proof-balls faſten'd to a thread, which they could take out and put into the ſand, ſo that as theſe were more or leſs pellucid, they might form a certain judgment about the reſt. Thus aſſur'd of the work being compleated, they again remitted the fire, and did not take out the ambers till the whole was cold, leſt, which eaſily happens, it ſhould crack by being expos'd to a ſudden and uncommon cold. The ancient method of clarifying amber.

Such was the ancient coction of amber, and not ſo long ago laid aſide, and which I may call the dry coction, and in our days ſucceeded by the humid, as all Artiſts in clarifiying amber do now boil it in rape-ſeed oil: The proceſs is, as follows: They build a quadrangular furnace, internally 2 foot and upwards over, and 1 foot high, according to the greater or leſſer capacity and bigneſs of the pot they deſign to uſe; then the pot is cover'd with a diſh, fill'd with oil and amber, and ſet in the middle of the furnace; a coal-fire at its four corners, carefully remov'd from the pot, is heighten'd by due degrees, 'till the amber is obſerv'd to boil, which they examine by removing the diſh: This boiling is continued more or leſs for twenty hours, as the ſize of the ambers is greater or ſmaller; and the proof-balls, which they here likewiſe faſten to a thread. and pull out at pleaſure, ſhow, whether the clarification be finiſh'd or no; then the fire is remitted; and all being ſuffer'd to cool, the ambers are taken out, and to be ſeparated by the workman's hand, that the perfectly clear may be wrought on the lathe, but the cloudy and the imperfectly tranſparent be committed a ſecond or a third time to the fire. The modern method.

Theſe are the two methods of clarifying ambers; and here it may not be improper to enquire, which of theſe is the better, or at leaſt in what reſpect the one excells the other; the former, indeed, is the more natural, having nature itſelf for its guide, and therefore not without its praiſe, in regard that it both reduces the ambers almoſt to a glaſſy tranſparency, which in the latter humid way ſeem to retain a caſt of yellow; and alſo that it makes them compleatly hard, a thing I myſelf have often obſerv'd with pleaſure, when in diſtilling any medicine from a ſand heat, I ſometimes committed Which the preferable method.

to it amber-cakes, and ſometimes ſmaller balls: Whence this is my favourite method, as in it you may in the mean time do any thing elſe; however the workmen complain of the longer time it takes up, in which there ſeems not to be much, and which notwithſtanding might doubtleſs be remedied, if, as in their boiling in oil, they repeated the work that was leſs perfect. But I imagine that the moderns principally have abſtain'd from the ancient method of clarifying, becauſe by a ſomewhat intenſer heat the amber-balls are oftner crack'd, which cracks made in ſand are obſerv'd red and unſeemly; but if they happen in boiling in oil, they are not ſo much ſeen on account of the greater paleneſs: Not to mention, that the external face of the amber is much burnt, and conſequently, that much of its weight is loſt by taking away and correcting that burnt cruſt: Beſides, that extraordinary hardneſs, which ambers acquire by digeſting in ſand, was not ſo agreeable to them, as it blunts the edge of their tools: Whereas, now, on the contrary, by boiling in oil they become much more tractable: And the better to promote this tractableneſs (becauſe ambers boil'd in oil acquire a greater degree of hardneſs) ſome workmen mix a tallow-candle or ſome tallow with the oil, and by this they obſerve, that a too great degree of hardneſs is prevented.

Whether ambers are ſoluble.

It is pretty much diſputed, whether ambers are ſoluble. And to ſpeak the truth I join with thoſe, who chuſe to call the ſolution of ambers with ſpirituous *menſtruum's*, eſpecially ſpirit of wine, a tincture rather than a central ſolution: In like manner alſo the thing is manifeſt as to oils; for, if with them you attempt a ſolution of amber, you can hence obtain nothing other than a ſlight emollition, a thing *Hartmann*[c] teſtifies of oil of pine, which is of great affinity with amber: Whence thoſe may look to it, who with *Bartholin*[d] ſcruple not to commend ſo very much the oil of lavender in this ſolution. What credit is alſo to be given to *Anſelmus de Boot*,[e] when he boaſts, that he is maſter of the art of diſſolving and coagulating amber again, I leave to the judgment of others; but I am certain this is an art we know nothing about. But to ſpeak what I myſelf have obſerv'd; tho' I take the ſolution of amber to be a very difficult thing, yet I am perſuaded, that it cannot be entirely deny'd, as I have often ſeen with my own eyes, that by only boiling ſome amber-balls in the common rape-ſeed oil, they were ſo diſſolv'd, as at leaſt to leave behind ſome thin caſes, almoſt like honey-combs, the whole body of the amber being almoſt diſſolv'd and deriv'd into the oil; and of theſe caſes I keep ſome by me: Yet I ſhould think, that ſuch diſſolv'd amber was not of the harder or indurated, but of the friable kind.

But this by the bye: And to return, there are not wanting many other *encheireſes*, by means of which you may perform with leſs labour, what

[c] Hiſt. Succin. Pruſſ. lib. II. cap. 2. § 5. [d] *Vide* Acta Germanica Vol. I. p. 266. 4. An. 1742. [e] Lib. II. cap. 162.

you

you have ſeen done more operoſely by the methods juſt mention'd. One compendious method is, as follows; put the amber you deſign to clarify into the tube of the heated furnace, covering it all over with ſand, ſo that it may not touch the furnace and ſuſtain too ſtrong a heat; for, thus as the heat riſes gradually to the higheſt degree, ſo it gradually remits; and in this eaſy experiment you ſhall not entirely be diſappointed. But the plates to be committed to the heat or fire muſt be ſomewhat more tender, and the balls not very large; for, otherwiſe they will ſcarcely anſwer in a ſhorter ſtay in the fire, without repeating the work over and over. I have, indeed, very often us'd this method in the winter time, but you are to obſerve, that all the ſucceſs depends upon the degree of heat; for, as it is moderate, or otherwiſe and too ſtrong, your amber will ſometimes be either very beautiful; or at other times on the contrary, marr'd with unſeemly cracks and fit for no one purpoſe.

A compendious method of clarifying Amber.

There is another method of ripening and perfecting amber (not irkſome, on this account indeed, as it requires but a very little time) and that is, to expoſe the amber-plates to the flame of a burning candle; and theſe plates muſt be ſuch, as are not totally obſcure, but have only thin clouds as the amber of the ſcaley kind; ſuch amber, cutting it into thinner plates (for, neither the time nor the degree of heat are proportion'd to the thicker ones) the workmen take up with a pair of tongs and often ſhift it over the flame; and in thus ſhifting it they alſo rub ſome ſuet or oil on the plate, the better to promote its clarification, and prevent its cracking in a naked fire: And thus as the heat gradually pervades the body of the amber, the clouds are in an agreeable manner ſeen to be diſpell'd; then they wrap up the amber-plate in ſome linen cloth or filtring paper, that it may gradually cool; which is a caution to be obſerv'd in this caſe: But what is no leſs remarkable, when the amber is cool'd otherwiſe, which is ſurpriſing, the cloud returns almoſt with the ſame degree of obſcurity.

Another method

This *encheireſis* has always been my favourite method, whence I have often us'd it: But as it is accompanied with a ſtench, caus'd by the ſuet or tallow, rubb'd on the amber, it is at the ſame time diſagreeable, unleſs performing the operation under a chimney may be thought a remedy: Whence as I was meditating on another method, inſtead of tallow I rubb'd on the plate diſtill'd or other oil of amber, with a view of greater ſucceſs; but, as it ſeem'd to me, the ſtench was but little corrected, and the operation, in point of diſpatch, by this method not remedied, only that the amber ſeem'd to become harder: Not to mention, that there is occaſion for often ſprinkling with this and the other diſtill'd oils, on account of the volatile parts, which viſibly fly off like a vapour: Whence in fine, whatever quantity of any oil is ſprinkled on ambers (and chiefly oil of almonds, nay plain wax producing the ſame effect, recommended themſelves to me) it only contributes to check the too great motion of the fire on the ambers,

Some diſadvantages in it.

and to prevent their cracking, as I not only now but formerly conjectur'd.

The clarifying of amber, owing to the fire by means of oil, &c.

From all the methods of clarifying amber you muſt conclude, that the whole of the effect is owing to heat alone, which promotes more ſtrongly their tranſpiration, otherwiſe too ſlow of itſelf; and if applied on any occaſion with caution and in a due degree, you ſhall promote the tranſpiration in many other ways, as was deſcrib'd above. A workman lately happen'd to let drop out of his hands into a boiling kettle of fiſh a glebe of amber, which remaining in the liquor till the fiſh was done, and being before ſomewhat more obſcure, now came out ſparkling and ſhining. That I might imitate this chance experiment, I took a thin and ſcaley plate of amber and threw it (which yet I ought not to have done) into hot boiling, ſaltiſh and partly fat water, wherein fiſh were boiling: After the boiling was over, I obſerv'd the plate, thro' my own fault, indeed, crack'd on its exterior cortical part, doubtleſs, owing to the ſudden heat; but after removing that coat and poliſhing the plate, it became ſhining and tranſparent. For brevity's ſake I omit the experiments I made for clarifying amber in boiling coleworts or beef. It is ſufficient at preſent to obſerve of all of them, that in whatever oily *menſtruum*, or which partakes of oil and fat, ambers are boil'd, provided there be a due proportion between the agent and patient, and a due regard be had to the degree of heat, to the manner of boiling, and to the time, they may be heighten'd to clearneſs and tranſparency.

A paſſage in *Pliny* corrected.

From all which, as you ſee, that amber may be clarified by ſo many oils and different fats, you will, no doubt more readily come into my opinion, hinted at above, namely, that they may be tranſmuted in the manner that was known and us'd among the ancient *Romans*, to wit, by boiling in the lard of a ſucking pig. But it may be matter of diſpute, whether there be not a miſtake in the paſſage of *Pliny*, in which *adeps ſuis lactentis*, the lard of a ſucking pig, may be put for *ſuis lactantis*, a ſuckling ſow, as ſuch a quantity of pig's lard could not be eaſily procur'd, as would be neceſſary in this operation. And this I am the more inclin'd to think from the word *lactantis* being ſet down in the margin of my copy of *Pliny*, as the ancient reading; and which is inſtead of all proofs, the experiment of boiling and clarifying ambers in the lard of a ſuckling ſow does anſwer.

The difference between ſeveral oils, with their effects on amber.

But it is a thing of greater importance to enquire, what may be the difference between the ſeveral oils and fats, or what qualities, as in point of hardneſs, and ſoftneſs, or other affections, amber may acquire in the different boilings; for, as it is certain, that boil'd ambers retain not the ſame degree of hardneſs, but according to the oils and fats made uſe of, it is ſometimes increas'd and ſometimes falls ſhort, we might hence probably judge, that on account of the greater efficacy which fats have to ſoften, ambers are in reſpect of hardneſs ſomewhat damag'd, an inſtance of which

I have given above from ſome who work in amber, and who in boiling add to the rape-ſeed oil a ſmall portion of beef-ſuet, that the amber may be more tractable, which is thought by them to become but little harder by boiling in oil alone: But this is to be left to their experience, as I cannot adduce any thing like it, or poſitively affirm it, as my ſmall way of boiling over the flame of a burning fire could not be compar'd with that larger way. Expreſs'd oils in this caſe differ very much among themſelves: and even lintſeed oil itſelf does, either on account of its greater power of emollition, or of its penetrating virtue, ſoften ambers, as that they ſeem entirely to have loſt their former hardneſs: Whence it is, that the workmen carefully avoid the adulteration of rape-ſeed oil with the leaſt part of lint-ſeed oil. As to the ſeveral circumſtances of time in which the ambers are boil'd, as alſo of colour and clearneſs, they hold, as far as I know, the ſame in all theſe oils and fats, unleſs that in a ſtronger and more penetrating oil, eſpecially if the regimen of the fire does not exactly anſwer thereto, the ambers are alſo more frequently crack'd: Beſides, we are not to omit, that one and the ſame portion of oil, in which ambers were once boil'd, may ſerve for a ſecond boiling, but not at all for a third.

In this manner I have ſufficiently ſhown the *encheireſes* both of nature and art in bringing amber to perfection; ſo that I think my hypotheſis greatly ſupported both by reaſons and experiments. But there remains a conſiderable difficulty behind; for, as I have ſhewn that all the other ambers may be clarified, yet the white alone ſeems refractory to the moſt careful operations both of nature and art: Whence they have always caus'd the greateſt difficulty both to Authors and Artiſts, but eſpecially to myſelf: Indeed, as to the more obſcure ambers and others charged with foreign contents, and exhibiting an unuſual colour, ſuch as are thoſe inclining to black or any duſky or liver-colour, as it is call'd, or ſuch as are blacker, like toaſted coffee-beans, I ſay, as to theſe and other colour'd ambers of this kind the reaſon would be obvious, on account of the admixture of many earthy and other heterogeneous parts, why their clarification could not be expected either by art or nature: But that white ſort, or only that furniſh'd with more ſolid white *ſtriæ* or veins, affords a matter of a higher enquiry: And if they are really incapable of clarification, they ſeem to throw a cloud on my hypotheſis.

White amber cannot be clarified.

But a little more accurately to relate the matter as it ſtands, it ſeem'd to me, while I was revolving this difficulty, that the clarification of the white ambers was not to be deſpaired of, in regard that the whole aſſertion was chiefly founded on the authority of the workmen, whoſe common method of proceeding, if exceeded by one more uncommon, and a longer time were allow'd this ſort to come to perfection, ſome ſucceſs might, probably, be expected; which as I revolv'd, I at the ſame time call'd to mind an experiment of *Schroeder*, commended by *Hartmann*[k]; or at the leaſt, 'he does

This farther conſider'd.

[k] L. c. lib. II. cap. 5. § 4. p. 273.

'does not think it unreaſonable, as he confirms, that yellow and clear ambers turn white by a continued boiling for 14 days and 14 nights in a lixivium of *ſal gem*, or ſea-ſalt in a ſtrong and earthen cucurbite with a blind ſtill-head:'[l] And this experiment and hypotheſis ſeems likewiſe to be approved by *Le Mort*[m], who after ſhowing the preparation of the tincture of amber with a highly rectified ſpirit, digeſted or diſtill'd on *ſal ammoniac*, he at length adds theſe words, 'that ſalts effect that, the boiling of yellow amber in common ſalt manifeſtly ſhows, in which the colour is entirely changed, inclining from yellow to white.' From theſe experiments I thus inferr'd, if we allow that by this *encheireſis* ſalts may be added to ambers; and thus conſequently, that white be produced from yellow ambers, what ſhould hinder me from expecting, that, by ſuch boiling, the ſalts may alſo be drawn out of the ambers, and on the contrary, yellow be produced from white ambers; whether that boiling be perform'd in the uſual oily *menſtruum*, or, which the ſaid experiments rather hint at, in an aqueous *menſtruum* and one more agreeing to ſalts.

But upon making the experiment I found myſelf diſappointed; and firſt I boil'd white amber in oil, and that repeatedly and for a pretty long time, but in the end I loſt all my labour; for, theſe white ambers remain'd in all reſpects unchang'd, but the vein'd and variegated, which I had added at the ſame time, ſhow'd only the obſcure duſky portion to be clear, the more ſolid white *ſtriæ* or veins being in no manner diſcharged, but the ſlighter veins a little; and in ſome of this kind, charg'd with obſcurity, intermixt with a ſlight caſt of white, a white cloud ſeem'd to be collected to the centre of the glebe, a manifeſt ſign that it was fixt there ſo as not to be diſcharg'd by any attempt.

Schroder and *Le Mort's* Experiments.

Thus the experiment in boiling the white glebes in oil proving unſucceſsful, we ſhall now conſider *Schroeder*'s and *Le Mort*'s experiments, that being firſt acquainted with theſe, it may previouſly appear, what we may expect from the coction of white ambers to be clarified in a watery *menſtruum*; and to deſcribe them accurately, I muſt own, that I have taken different ſorts of ambers, as clear, yellow and cloudy, that I might carefully obſerve the change they underwent; including all theſe in a thin linen rag I deſign'd them for a continued boiling, which was perform'd in common lee-aſhes, us'd with us for waſhing and ſcouring veſſels; for, it ſeem'd to me the ſame thing, or at leaſt that the operation was not different, whether the boiling was perform'd in this ſalt, which is equally fixt, or in ſea or common ſalt, eſpecially as after a few days new aſhes were thrown in, and thus the *lixivium* was never depriv'd of its ſalt. After that the amber had continued boiling for many days together, I ſometimes took it out at pleaſure, yet I always found it in its priſtine ſtate and in

[l] *Vid.* Pharm. Med. chem. lib. III. c. 30.
[m] In chem. Medico-phyſica, p. 150.

in no manner changed, only that in ſome obſcure glebes there appear'd thinner *nubeculæ*.

And thus ſtands that noted *encheireſis* of producing white from yellow ambers; and in whatever manner the proceſs may be ſet about, I am perſuaded the event will be unſucceſsful: Whence I ſcruple not to aſſert, that in the ſame manner that operation is to be tax'd, when from this antecedent experiment, as a foundation, after extracting by a watery *menſtruum* the ſalts out of ambers, I gave hopes of the change of the white into clear and tranſparent amber by means of a watery *menſtruum* alone; but tho' it were evident, that theſe white ambers do not ſhow more perfect, that is, not tranſparent, yet that does in no manner leſſen the authority of my hypotheſis, as I have inferr'd it from ſo many inſtances, that all ambers are chang'd into tranſparent, and made perfect both by nature and art; for, nature works inceſſantly, and art imitates her, unleſs as ſometimes happens, obſtacles intervene, that hinder their good deſign; for, I would have it known, that all other ambers are compos'd of the better part of ſulphur, tho' I would not deny them a ſlight admixture of ſalt: Whence theſe ambers alone more eaſily undergo this change to the better. But that theſe white ambers contain much foreign ſalt in their texture will be allow'd, eſpecially if we give credit to *Hartmann*, who affirms, and diſcovers large layers both of vitriolic and nitrous ſalt in the coaſt of *Sudau*:[a] Beſides, theſe white ambers taſte ſaltiſh by the gentleſt touch of the tongue; And all other ambers yield much oil in diſtillation, but very little ſalt; on the contrary, the white give a very ſmall portion of oil, but a larger portion of ſalt. All which things, as they manifeſtly ſhow, that this white glebe is not the genuine, certainly not the only product of the amber *matrix*, it will give you the leſs diſguſt, if you cannot ſhow all the requiſites, proper to pure ambers, in this impure ſort, which contains a great deal of adventitious fixt ſalt; unleſs therefore, you would expect, that I ſhould clarify earthy bodies, ſuch as theſe are, my hypotheſis muſt ſtand good; for, nature herſelf, whilſt ſhe is employ'd in clarifying and bringing ſuch ambers to perfection, can effect no more than to clarify the diſtinct obſcurer parts, if there are any ſuch, but leave the white untouch'd: yet from this her operation, or if you will, defect, there ariſe beautiful variegated ambers, ſo that the curious do with pleaſure obſerve (being aſſiſted herein chiefly by fancy) various kinds of animals, falls of rivers, a tempeſtuous ſea, high mountains, and in fine, plains full of cities and towns, *&c.* nay ſtrew'd with roſes and violets, and partly ſhaded by the leaves of wide-ſpreading trees.

Whether producing white from yellow ambers, &c. be practicable.

And thus now I have carefully ſhewn, that the deſign of art is the ſame with that of nature, to wit, the exerting all its force to promote the maturation and perfection of ambers, and this it only accompliſhes by procuring them

Whether a variegated white from a pale yellow.

[a] L. c. lib. I. cap. 2. § 4.

them a clearneſs and tranſparency; her other deſign is unknown to us, tho' it is notorious, that many changes of colours, by means of fire alone, are devis'd by ſome, and of this opinion is *Hartmann*, ° but they ſeem to have no foundation: And firſt as to the change of the pale yellow into a variegated white colour, expreſſing the grain of maple wood, I cannot think, that there was ever ſuch a change, at leaſt by means of fire alone; for, to ſpeak openly what I have learn'd from experiments, I only know this one thing, that the pale yellow ambers, if they be not expos'd to the higheſt degree of fire, but be rather remov'd before they attain to their total clearneſs, appear in ſome manner painted, leaving yellow interſtices behind, variouſly mixing and running into the diaphanous and clear parts; and this appearance is the more eaſily obtain'd, if you ſhift a broader plate of amber over the flame of a candle, in the manner above deſcrib'd, when in a very agreable manner the clouds of the amber being chang'd up and down, are ſeen to exhibit different figures; but whether this ſhifting colour may be deſervedly call'd variegated, and eſpecially a variegated white, and which expreſſes the grain of maple-wood, I do not ſee, as a white colour is by no means obtain'd from the pale yellow ambers, unleſs, previous to the operation of art, it was mixt with them.

Whether a bright white from a whitiſh.

Nor can we expect greater certainty about the change of the whitiſh into the bright white, providing we underſtand that the former are diſtinguiſh'd from the latter in this, to wit, that thoſe are white with paleneſs, but theſe boaſt of a greater degree of light and of the brightneſs of ſnow and marble. And now it ſufficiently appears, that ſalts, and by means of theſe, whiteneſs cannot be added to ambers.

Wavy amber producible from the pale clear.

What has a better foundation is, when *Hartmann* promiſes himſelf wavy ambers from the pale clear, providing we have a genuine conception of theſe laſt. It ſeems neceſſary to me to diſtinguiſh (a diſtinction that will be of uſe in a great many other places) between the paleneſs or *albeſcence* proper to pearly ambers and thoſe of affinity with them, and between the paleneſs preciſely peculiar to the white: The paleneſs in pearly ambers depends only on their ſulphur being well digeſted and depurated, tho' ſalts, but thoſe in ſmall quantity and volatile, be added thereto: But the latter paleneſs, on the contrary, ariſes from much fix'd ſalts. Now, therefore, as our author ſays, that the pale clear ambers are converted into the wavy, theſe former can be no other than the ſquamous pearly, that is, ſuch as are furniſh'd with ſlight whitiſh clouds and interſpers'd clear interſtices, which, from what was ſaid above, among all other obſcure ambers are underſtood to put on the greateſt degree of brightneſs.

If thus the author interpret the matter, it is well: But when, on the contrary, he ſuppoſes, that the whitiſh ambers may be made from the wavy, he again contradicts both himſelf and nature and art, whoſe efforts tend to perfection. But to incline to change the clear and pellucid ambers, and

° Loc. cit. L. II. c. 4. § 11.

and eſpecially the wavy, into the whitiſh and more obſcure, would be to bring them from the higheſt degree of perfection to a lower, and to make them loſe all their uſe, which conſiſts in their clearneſs.

Practical rules.

1. All ambers tend from a ſtate of imperfection to that of perfection. 2. Whence nature and art produce clear ambers from the obſcure; but there is no method of producing the obſcure from the clear. 3. Ambers with a ſlighter degree of obſcurity are more eaſily clarified. 4. In perfecting the ſmaller pieces of amber, the effort both of nature and art is the leſs. 5. Among the clear ambers the wavy are the principal; among the obſcure, the pearly. 6. Obſcure ambers, that excell in a greater degree of purity, do alſo acquire a more excellent degree of clearneſs, and *vice verſâ*. 7. Tho' the wavy colour be above all others the favourite, yet next to it the golden colour is not without its praiſe. 8. Ambers with a golden brightneſs, you may certainly believe, are the product of nature and not of art, which makes them paler. 9. Whence the wavy ambers, clarified by art, are ſcarcely diſtinguiſhable from thoſe produced by nature. 10. Ambers, boil'd by art, become always harder, nay the earthen pot itſelf, in which they are boil'd, acquires in time an irony hardneſs: Hence the fire is the beſt cure for friable ambers. 11. Ambers full of air-bubbles crack in boiling from the internal air being expanded and ſeeking an iſſue. 12. Ambers once committed to the fire, if they have remain'd ſound, may be ſafely recommitted thereto. 13. Ambers, not well freed from their external coat, acquire a coarſer after boiling; and even the poliſh'd, but not all, acquire ſuch a ſlight coat. 14. Whence crude ambers with a greater coat will be judg'd either clear or pearly, or deſtroy'd, on accouut of the greater length of digeſtion and tranſpiration allow'd them in the earth. 15. The fire is not always, but ſometimes the oil is in fault, that the operation does not ſo well ſucceed. 16. Neither is good oil, that has been employ'd twice, proper for a third boiling. 17. Such are deceiv'd, as from perfect ambers hope to obtain the alchemy of ambers; that is, the art of producing great from ſmall ambers.

A new ſort of Level. By N. Hartſoeker. *From the* Miſcellanea Berolinenſia. Tom. I. p. 320.

Tranſlated from the LATIN.

Plate V. Fig. 8. Deſcription of this Level.

LET the tube AB be ſo conſtructed, that the ſmall tubes C and D, the one furniſh'd with an eye, the other with an object-glaſs, may be put in and taken out of both the extremities of the tube AB: Let there be another tube EF ſomewhat leſs than the object-glaſs, ſuſpended in the tube AB in manner of a balance, ſo as not to touch the tube AB with its extremities; the weights L and M, approach'd to or

remov'd from the centre N of the croſs-piece GHIK, faſten'd to the tube EF, will adjuſt the balance or level: Let a very fine thread, parallel to the horizon, divide both the extremities of the tube EF; and let the tube EF be ſo exactly ſuſpended in the tube AB, that one thread, touching the centre of the common focus of the eye and object-glaſs, and running along the axis of both glaſſes, the other thread may interſect the ſame axis near the object-glaſs That the ſtrongeſt wind may not mar the uſe of this level, let it be included in the caſe OPQR, ſet on ſuch a baſe, as that it may be eaſily turn'd to any point.

The uſe thereof. The uſe of the level will be very eaſy, and evidently ſhew its exactneſs; for, viewing any object, and obſerving the point which the thread in the centre of the common focus of the eye and object-glaſs, covers, turn the inſtrument half round, and ſhift the places of the tubes CD, in which the glaſſes are included; and if you find, that the thread in the centre of the common focus of the eye and object-glaſſes, covers the ſame point of the object, you will be aſſur'd, that the tube EF is *in æquilibrio*; but if that thread does not cover the ſame point of the object, approach or remove either of the weights L or M, as the caſe requires, till the thread in the centre of the common focus of the eye and object-glaſſes covers the ſame point of the object, into whatever end of the tube AB you put the object or eye-glaſs.

A method of determining either the Quadrature, or the impoſſibility thereof, in a given figure, terminated by right lines and a geometrical curve. By D. T. *From the* Acta Eruditorum Lipſ. An. 1693. p. 433.

Tranſlated from the LATIN.

THAT I may briefly, and at the ſame time with perſpicuity, diſcloſe theſe things to the ſkilful in theſe matters, it is to be noted.

Plate V. Fig. 9. Conſtruction. I. Let the ſpace ACB be terminated by the geometrical curve AFB, by the axis AC, and by the ordinate BC: Let now the ſpace ACB be underſtood to be equal to the rectangle AEDC, as alſo the ſpace AGF to be equal to the rectangle AGHG: If now the ſame thing be every where ſuppos'd, there will hence ariſe a curve or ſome line AHD; but this will be either a geometrical or mechanical curve: If the former, the ſpace ACB will both in the whole, as in all its parts, be geometrically quadrable, and therefore I call ſuch a quadrature poſſible: But if it be any mechanical curve, the ſpace ACB, both as to the whole and all its parts, will be mechanically quadrable, or its quadrature cannot be found geometrically; and, therefore, I call ſuch a quadrature impoſſible.

II. Now

I.

PLATE V.

p. 354.

Fig. 1. p. 282.

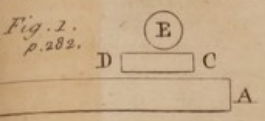


Fig. 2. p. 284.

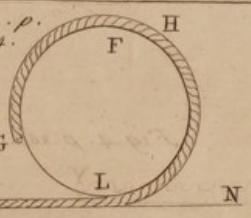
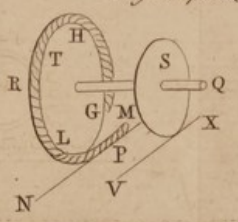


Fig. 3. p. 285.



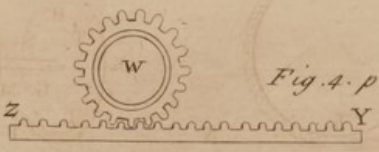


Fig. 4. p. 285.

Fig. 5. p. 286.

Fig. 6. p. 288.

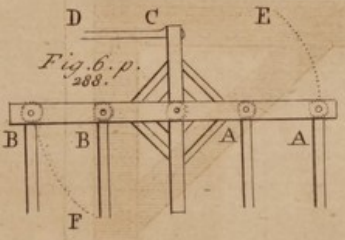


Fig. 7. p. 288.

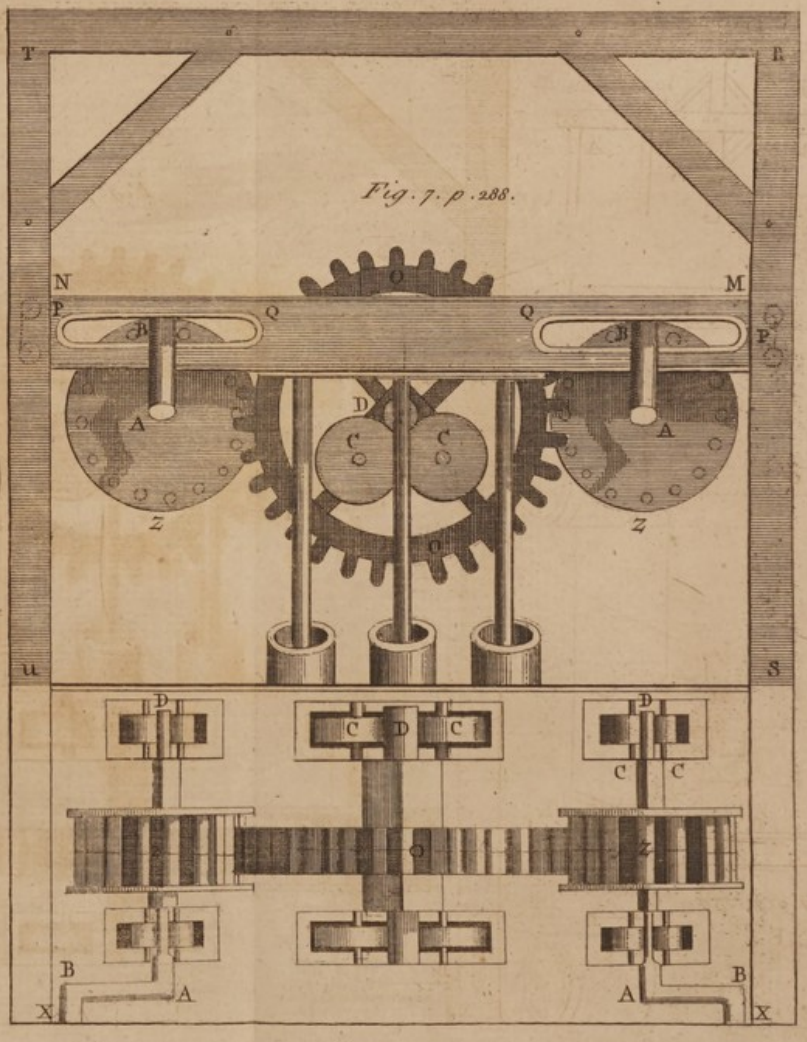


Fig. 8. p. 353.

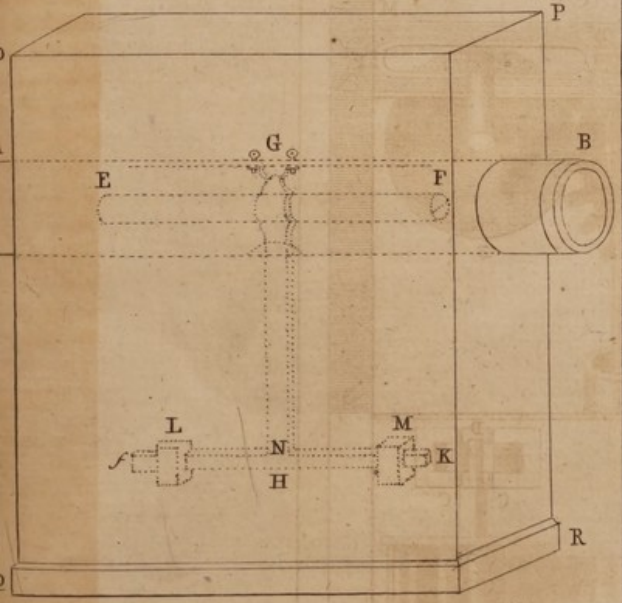
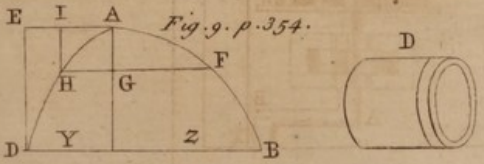
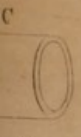


Fig. 9. p. 354.





ith del.

Hulett Sculp

II. Now let the following equations be form'd

$$by + ca = 0. \quad byy + cay + caa = 0. \quad by^3 + cay^2 + ca^2y + ba^3 = 0.$$
$$+dx \qquad +dxy + fax \qquad +dxy^2 + faxy + iax$$
$$+gxx \qquad +gx^2y + kax^2$$
$$+lx^3$$

Equations exhibiting all geometrical curves and all their possible relations to a right line.

and so on as far as you please.

But we are to observe of these equations, that they exhibit all geometrical curves AHD and all their possible relations to a right line; that x represents all the abscissa's AC, but y all the ordinates CD; b, c, d, e, f, g, &c. design the known quantities, prefix'd to these terms, with what signs soever they are affected; but the quantity a is instead of unit, in order to make the dimensions equal in all the terms of these equations. But that without a prolix calculus I may explain the following theorems, which demonstrate the quadrature of a given geometrical curve, or the impossibility thereof, let it moreover be

$$c = ca + dx \qquad i = ca + 2dx$$
$$d = ea + fax + gx^2 \text{ also} \qquad k = 2ea + 3fax + 4gxx$$
$$e = ba^3 + ia^2x + kax + lx^3. \qquad l = 3ba^3 + 4iax + 5kax^2 + 6lx^3$$

III. Farther let all the abscissa's AC of the geometrical curves AFB be $= x$; but their ordinates BC $= z$; then let it be put

Theorems deduced therefrom.

1. $B = bz + i$ and the first theorem will be $B = 0$

2. $\left.\begin{matrix} B = 2bz + i \\ C = cz + k \end{matrix}\right\}$ the second theor. will be $BBd - BCe + CCb = 0$.

3. $\left.\begin{matrix} B = 3bz + i \\ C = 2cz + k \\ D = dz + l \end{matrix}\right\}$ and the third theor. will be

$$B^3e^2 - B^2Cde + BC^2ce - C^3be + C^2Dbd - CD^2bc + D^3b^2 = 0$$
$$-2B^2Dce + 3BCDbe - 2BD^2bd$$
$$+B^2Dd^2 - BCDcd + BD^2c^2$$

These things I shall further enlarge on in their proper place, which now I am obliged to omit, in order to avoid prolixness,

IV. Now the use of these theorems is twofold. In the first place, we hence very expeditiously determine all the possible quadratures of geometrical curves; for, assuming any geometrical curve AHD, we immediately find, by means of the theorems just now exhibited, the quadrature of the space ACB, terminated by the geometrical curve: And as the equations in Remark II. exhibit all the curves and all their possible relations to a right line, even by these theorems all the possible spaces, terminated by a geometrical curve, are squar'd; which let it suffice to illustrate by one

Twofold use of these theorems.

First use.

Example. example: Let the curve A H D be a circle, whoſe nature is expreſs'd by this equation $yy = 2ax - xx$, or $yy - 2ax + xx = 0$; now in the equation, which is of the ſame degree in Remark II.

$$\begin{array}{l} by + cay + eaa = 0, \text{ it will } b = 1 \\ \quad + dxy + fax \qquad\qquad c, d, e, = 0 \\ \quad\quad + gxx \qquad\qquad f = -2 \\ \qquad\qquad\quad g = 1 \end{array}$$

Whence in the ſecond theorem $Bd - BCc + CCb = 0$ (which is to be choſen, becauſe the aſſum'd equation is of two dimenſions) it will be

$$\begin{array}{lll} c = 0 & i = 0 & B = 2x \\ d = -2ax + xx & k = -6ax + 4xx & C = -6ax + 4xx \end{array}$$

All which, if reſtor'd, there is obtain'd $zz = \frac{9aax - 12axx + 4x^3}{2a - x}$, explaining the nature of the curve A F B, all whoſe ſpaces are ſquar'd by means of the circle, in regard the ſpace A G F is always equal to the rectangle A I H G. In the ſame manner a different geometrical curve A H D being aſſum'd, a different geometrical curve is found, and quadrable: Hence thus it appears, in what manner theſe theorems include all poſſible quadratures.

Second uſe. V. The other uſe of theſe theorems is no leſs conſiderable, which is, that a geometrical curve being given, not the quadrature of any other may be found, as was juſt now explain'd, but either the quadrature of the given or propos'd curve itſelf be exhibited, or its impoſſibility demonſtrated; which we ſhall illuſtrate by two examples; for, in the firſt place let the nature of the given curve A F B be expreſs'd by this equation

$$zz = \frac{9aax - 12axx + 4x^3}{2a - x}$$

Example I. Now the queſtion is, whether its quadrature may be given or no? And, indeed, it is plain from Remark IV. that it is given: But ſuppoſe that this now is unknown, and obſerve the proceſs in determining what is ſought.

1. Becauſe the ordinate z riſes to two dimenſions, the third theorem is to be choſe (had it had three dimenſions, the third theorem was to have been aſſumed, and ſo on) but that theorem is as follows

$$BBd - BCc + CCb = 0.$$

2. In this theorem let the quantities B and C, as alſo b, c and d, be reſtor'd, and it will be

$$\begin{array}{ll} bzz + caz + eaa & \dfrac{dde + ccg + bff - cdf - 4beg \times aaxx}{4bea + 4bfax + 4bgxx} = 0 \\ \quad + 2dxz + 2fax + & \\ \quad + 4gxx & \quad - ccaa - 2cdax - ddxx \end{array}$$

3. Now

3. Now let all the terms of this theorem be compar'd with all thoſe (where x in each caſe has the ſame dimenſion) of the equation which explains the nature of the given curve; and hence there will ariſe ſome new equations, by help of which the quantities b, c, d, e, f, &c. will be found: And here b is found $= \frac{1}{2}$, c, d, $e = 0$ $f = -1$ $g = \frac{1}{2}$; all which as they involve no abſurdity, the quadrature of the given curve is given; had they included any impoſſibility, or were they all equal to nothing, the quadrature would be impoſſible.

4. If now from the equations of the ſecond remark that of two dimenſions be aſſum'd, ſuch as is $byy + cap + eaa = 0$ (becauſe the quantity $z + dxy + fax + gxx$ of the given curve alſo riſes to two dimenſions) and in this let the quantities b, c, d, e, f, juſt now found, be reſtor'd, it will be $\frac{yy}{2} - ax + \frac{xx}{2} = 0$, or $yy = 2ax - xx$, the property of the curve A H D, by help of which the given curve is ſquar'd; conſequently, it is now determin'd, that the propos'd curve admits of quadrature, and to what known ſpace it is equal. *Q. E. F.*

For a ſecond example, let the given geometrical curve A F B be a circle, whoſe property is $zz = 2ax - xx$; now the queſtion is, whether its quadrature be poſſible or no? To diſcover this, as the quantity z riſes to two dimenſions, we muſt here uſe the ſame theorem, as in the preceeding example: And if now all the terms of the given equation (which expreſſes the nature of the given curve) be compar'd with all the terms of that theorem, b, c, d, e, f will be found $= 0$; and conſequently, there is given no geometrical curve A H D, by means of which the circle may be ſquar'd; and therefore, the quadrature of the circle, in the ſenſe it is commonly ſought for by Mathematicians, is impoſſible. If the hyperbola be aſſum'd to be ſquar'd, the ſame thing entirely will be found, namely that its quadrature is impoſſible: But from theſe things it will abundantly appear, in what manner by help of the like theorems, ſome of which I have given in Remark IV. either the quadrature of a given figure, terminated by a geometrical curve, may be exhibited, or its impoſſibility demonſtrated (as the ſame proceſs may be perform'd in all geometrical curves in the manner I have explain'd in theſe examples) which was my deſign at this time to diſcloſe. But we are to obſerve

Example II.

VI. That what I have juſt now ſhown is in no manner contrary to the quadrature of the circle and hyperbola, which *Leibnitz* has exhibited * in the *Acta Eruditorum*, *An.* 1682; for, while the geometrical quadrature of any ſpace is not given, in that caſe the laſt reſource is to expreſs it by a ſeries

All this conſiſtent with *Leibnitz*'s quadrature of the circle and hyperbola.

* *Vide* ACTA GERMANICA, Vol. I. p. 59. *An.* 1742.

ſeries of numbers decreaſing *in infinitum:* And I am perſuaded, that there can be found no arithmetical expreſſion of the quadrature of the circle or hyperbola more ſimple, than that whch the illuſtrious *Leibnitz* has publiſh'd. But as to mechanical curves A H D, and which ſeem to be very ſimple in their nature, that by means thereof the circle and hyperbola, nay all curves, that admit not of a geometrical quadrature, may be mechanically ſquar'd, I ſhall exhibit on a proper occaſion the method of determining them, when it ſhall appear, how great an affinity they have with geometrical curves, as their ſpaces are always equal to the ſpace terminated by a geometrical curve.

Several Chemical Experiments and Obſervations. By Olaus Borrichius. *From the* Acta Haffnienſia, An. 1671, 1672. p. 128.

Tranſlated from the LATIN.

The true tincture of ſilver not blue. Obſ. 68.

NOTHING has for a long time been more common than the tincture of ſilver, but if the matter is rightly conſidered, nothing is more uncertain; for, that blue colour, which every where, and even in the ſhops, pleaſes the eye, is not the genuine offspring of ſilver, but of ſuch bodies as are mixt with it; for, the pureſt ſilver diſcovers no ſuch thing: The miſtake aroſe hence, namely that it has hitherto been thought by the generality, that ſilver after the act of fulmination, as it is call'd, or procuring to it in the cupel a ſplendor or ſhining brightneſs, retains no longer any thing foreign and excrementitious, which is a miſtake; for, there ſtill remain ſome minute feculencies (call'd by artiſts the *lead-ſack*) which after repeated fuſion and the blaſt of a hand bellows it ſcarcely lays aſide; but carefully freed of theſe it neither ſtrikes a blue or green colour in ſpirit of nitre, *ſal ammoniac*, diſtill'd urine, acids, or other ſalt liquors: And if it ſhould ſeem to impart any of theſe colours, it is a ſign of its imperfect purgation; for, a very few grains of copper, lying ſtill conceal'd in ſilver, tinge many ounces of a liquor and miſlead the careleſs obſervers: I uſually ſhow to the curious ſuch ſort of ſilver, purified by fulmination in a blaſt-heat, whereby neither acid nor ſalt ſpirits are tinged with any blue colour; But neither is that tincture of ſilver, which is prepar'd from plates of ſilver and flowers of ſulphur, genuine, both becauſe very often ſome copper lies conceal'd in thoſe plates, however apparently pure, as becauſe the flowers of ſulphur are not free from cupreous particles. *Zwelfer* in his *Mantiſſ. Spagyr.* has, indeed, cautiouſly hinted about ſilver, after one act of fulmination, that if the blue colour of the tincture of ſilver diſappears, there is to be added to the remaining abſtracted eſſence a little of a volatile animal ſalt, that the deſired colour may be reſtor'd: But no ſuch ſalt can effect, that, if ſilver be highly pure and free of all recrement,

it

it can put on that ſpurious colour, as appears from my defecated ſilver, as in other reſpects it has all the characters of the moſt perfect ſilver; nor does the tincture of the *lapis lazuli* ariſe from any thing other than from particles of copper floating up and down in its maſs, which the ſagacious experimentor cannot be ignorant of: Hence I remember the ſtomach to have been greatly diſorder'd from taking both theſe tinctures in a larger doſe, and ſuch as is very well known to be caus'd by copper and vitriol of copper.

To fuſe regulus of antimony without fire. Obſ. 70.

Take four ounces of the *regulus* of antimony, grind them in a glaſs or marble mortar to an impalpable powder, and on this depends the ſucceſs of the experiments; put this apart in a clean paper; then in the ſame mortar, after firſt cleaning it, grind into a very ſubtile powder, 12 ounces of ſublimate; then mix up both powders in a paper, with an oaken or beech ſtick, no matter which, that they may be well mix'd *per minima*. Put theſe powders thus mix'd into a ſmall common ſquare glaſs with a narrow mouth, and continually and ſtrongly compreſs the powders with the broader extremity of the cold ſtick, ſo that the ſurface of the powder may be every where cloſely preſs'd down; and ſtill the powder remains cold, tho' it be preſs'd for a quarter of an hour; but continue the preſſure for a quarter of an hour longer, and at length you will obſerve the ſtick, which before reached no deeper than the ſurface, ſuddenly ſink into the maſs and make its way to the bottom: After which groſs fumes immediatly ariſe, the glaſs is heated, the matter contain'd therein rolls over its brim, frothes and effervеſces, ſheds over, and fills the whole room with a nauſeous vapour; after which you are ſpeedily to convey the veſſel without the window, that you may the more ſecurely view the iſſue of the experiment.

To cauſe two ſpirits cold to the touch after mixing them to take flame. Obſ. 71.

Take four ounces of recent ſpirit of *Venice* turpentine, yet ſuffer'd to come to its native coolneſs, to which pour in a wide glaſs ſix ounces of recent and cold generous *aqua fortis*, and ſhaking the veſſel leave it in the open air, and in half an hour, upon removing the cover, the ſpirit of turpentine, ſet on by the acid particles of the *aqua fortis*, will begin to effervеſce, and amidſt thick volumes of ſmoke emitting a conſpicuous flame, and ſtrongly burſting out over the brims of the glaſs, it will burn: But it is not to be diſſembled, that this experiment ſucceeds better in the noon heat of a ſummers day, and that it is in vain attempted, unleſs the ſpirits be recent; ſo that hence we may probably not without grounds collect, that in all recent diſtill'd liquors ſome fiery and fiercer particles lie conceal'd, and that therefore it is proper to expect their mellowing by keeping ſome little time, before they are adminiſtred to the ſick, eſpecially if exhibited as refrigerants. And I doubt not, but that ſome ſubtiler ſubſtance of fire, or ſomething oily and ſaline in a vehement commotion (in which nearly the nature of fire is made to conſiſt) burſting out from the wood and coals, penetrates into moſt chemical veſſels, however cloſe,

and

and leaves ſome traces of itſelf behind in the things contain'd in the veſſels.

To make fire paſs through the pores of a glaſs-veſſel, ſo as to produce flame without hurting the Veſſel. Obſ. 72.

I very accurately mix'd 6 drachms of flowers of ſulphur with 1 ounce of *Eaſt-India* nitre; I put the mixture into a common glaſs retort, but of a longer neck, and looſly applying, for fear of burſting, a receiver, I gave it a ſand-heat, at firſt moderate, for ſix hours, afterwards gradually ſtronger; at length the ſand in the iron pot being ſtrongly heated, at firſt a ſmall flame of a blue colour appear'd in the retort, and immediatly a bright flame fill'd the whole glaſs; the flame at length going out of itſelf, I view'd the glaſs after it had cool'd, and it was without any crack, and much of a ſublim'd and inflammable ſulphur was ſtill obſervable in the glaſs, becauſe the flame impetuouſly ruſhing, there being only a ſmall hole at the extremity of the noſe, was extinguiſh'd before it had a ſufficient quantity of air to conſume the whole; nor need you be apprehenſive, that this experiment will prove without ſucceſs, as I never found it to fail, having often tried it in this manner. How far this may ſerve to illuſtrate the nature of glaſs and fire, I leave others to determine.

Of the ſoftneſs and various contents of Ambers. From the Electrologia *of* Nathan. Sendelius. An. 1726.

Tranſlated from the LATIN.

Very difficult to know the generation of ambers.

THE generation of ambers is a very difficult and arduous ſubject, of which the more you know, the more ſtill remains to be known. Few things are here diſcoverable by the ſenſes, as on one hand huge impending mountains, and on the other hand a raging and tempeſtuous ſea bar all acceſs. But to proceed from things certain and known to the knowledge of thoſe that are uncertain and dubious, I ſhall treat of a ſubject that comes near to that of the generation of ambers, namely their ſoftneſs, which, amidſt ſo great darkneſs, may yield ſome true and evident poſtulate, namely 'that the firſt matter of all ambers is ſoft and almoſt fluid', an aſſertion, tho' it may ſeem pretty undoubted and unſhaken from the many demonſtrations, hereafter to be alledged, yet it does not ſeem to every one ſo eaſy, or without exception, but that it may ſtill labour under ſome difficulties; for, the documents of ſoft, much leſs of fluid ambers, are not ſo obvious, eſpecially, as in our days, they are dug out of the bowels of the earth; on which very thing ſome reflecting with greater accuracy think they are not entirely without reaſon, when, being ſo uncertain about their generation, they affirm, that in the time of the univerſal deluge ambers were diſpers'd up and down: And tho' they do not openly deny their generation, yet they entirely doubt and are quite at a loſs how they are generated.

But

But as to this point we have no ſmall number of teſtimonies, both of the ancients and moderns; and particularly founded upon the authority of theſe three unexceptionable witneſſes, *Goebelius*[a], *Aurifaber*[b] and *Wigandus*, and laſt of all likewiſe upon that of *Hartmann*[c]: And to theſe we may add the teſtimony of the authors of *Illuſtrata Pruſſia*, *Tract.* 6. *Containing a relation of a ſoft piece of Amber, that was found.* And if, notwithſtanding all this, ſuch as oppoſe this opinion, ſhould ſtill continue doubtful, and alledge, either that that was the miſtake of theſe authors, or that they took other bitumens for amber, and if they are not convinc'd by arguments (to be treated of anon more at large) that confirm the original fluid ſtate of ambers, the bare viewing of theſe glebes, in which one *lamina* is obſerv'd to lie upon another, muſt convince them; and certainly ſuch a number of layers will not only argue the original ſoftneſs of ambers, but that they were form'd ſucceſſively and at different times; and conſequently their continued production and generation. Teſtimonies as to their ſoftneſs.

There is, therefore, no doubt as to the exiſtence of ſoft amber-glebes, unleſs the diſagreement of ſome authors ſhould cauſe a doubt, 'who ra-'ther claſs theſe ſoft ambers among roſins than ambers.'

According to *Hartmann* ſoft ambers differ from the true in colour, taſte and odour: "I have ſeen, *ſays he*,[d] ſome ſoft pieces rather like roſins 'than ambers, their colour the ſame, namely duſky, ſomewhat tranſpa-'rent, inclining to red;' without mentioning any thing of the taſte, which in other ambers he in ſome meaſure found ſaltiſh, with a dull ſweetneſs; and in fine, he makes two diſtinctions of odour, one produced by the attrition of the glebe, another by its deflagration: The former reſembled that of other roſins, and like that obſerv'd in the pieces of pine-roſin, found in ant-hills; but the latter alone was like that peculiar to ambers, as he calls it. The difference between ſoft and true ambers, according to *Hartmann*.

What I have obſerv'd myſelf on theſe heads, differs but little from *Hartmann*, except in ſome circumſtances: In theſe ſoft glebes I found no taſte, tho' I know not whether that found by *Hartmann* be obſerv'd in perfect ambers, excepting the white or thoſe inclining to whiteneſs; all which manifeſtly afford an acid, ſaltiſh taſte: nor did I perceive a different odour, all of them, both by attrition and deflagration breathing a reſinous exhalation, tho' more ſubtile and grateful in ſome glebes, in others more diſagreeable and groſs: From which diverſity I think it happen'd, that *Hartmann* has at one time pronounced this odour like that of ambers, at another time like that of roſins. In fine, as to the colours of the ſoft glebes, I have ſeen thoſe he deſcribes duſky and but little tranſparent; I have alſo The Author's obſervation about this difference.

[a] De Succin. cap. 4. *citante Hartmanno* Hiſtor. Succ. Pruſſ. lib. II. cap. 1. § 13.
[b] De Succin. cap. 3. *citante eod.* l. c. lib. II. cap. 1. § 15.
[c] L. c. Lib. I. cap. 4 § 2. & lib. II. cap. 2. § 6. It. lib. II. c. 5. § 4.
[d] Hiſt. Succ Pruſſ. Lib. I. cap. 5. § 1.

ſeen a clearer ſort, nay and ſometimes the wavy: And there lately fell into my hands a white ſoft glebe no harder than ſtiff wax; this I highly valu'd, as ſuch white ſoft glebes are the rarer, tho' authors do not entirely omit to mention them, as *Hartmann* ſhews[e]. Upon examining this glebe, it was externally white, with ſome ſmall ſpaces interſpers'd, that were at leaſt obſcurely whitiſh, and inclining to a bluſh of red: Whereas its internal ſubſtance, which I ſometimes ſcratch'd with my nails, and ſometimes cut like wax with a knife, was ſhining white without any defect; it was without any taſte, which I certainly expected to be ſaltiſh, on account of the admixture of ſalt in white ambers; and whence their white colour is uſually deriv'd, and the ſpittle acquir'd a white tincture: By attrition it had no odour, nor by a ſtrong friction againſt a piece of linen, to which it communicated a certain whiteneſs, but the glebe being ſet on fire, it both burn'd and breathed an odour, but diſagreeable and very noiſome, like that of ſtinking tallow; as was alſo that, which a piece of it thrown on burning coals yielded, which readily run and boil'd like other pieces of amber, till all its tough and tenaceous fat was conſum'd: And tho' all theſe different *phenomena* held me in ſuſpence, yet I ſcrupl'd not to claſs this glebe among the *bitumens*, gather'd with amber, much of which and chiefly of a different kind the Learned allow is found in *Pruſſia*.

Their different degrees of ſoftneſs and hardneſs.

I cannot help mentioning here, that from the frequent obſervation of theſe glebes, I met with different degrees of ſoftneſs and hardneſs: There was a ſmall one of them of a wavy colour; and therefore much differing from the colours deſcrib'd by *Hartmann*, which by the ſlighteſt heat of the hand or by the warm breath could be drawn out every way: And again upon the ceaſing of the heat, it recover'd its former rigidity. There were likewiſe others a little more ſtiff, that could not be affected by the above mention'd heat, but were comminuted by the teeth into a powder, and continuing the maſtication they were again coagulated like maſtic, ſo as to be manageable in the mouth like flexile wax: And there were again others, ſomewhat harder than thoſe juſt now mention'd, which when ground by the teeth conſtantly remain'd in the mouth like a powder without coaleſcing, tho' they were eaſily diſſolv'd by a ſlight coal-heat. The wavy ſort mention'd above is the moſt remarkable for its rarity, colour, ſhining brightneſs and greater ſoftneſs, on which, therefore, I made the impreſſion of my ſeal.

Leſs ſolid amber-glebes referable to the claſs of ſoft ambers.

To the claſs of ſoft ambers are to be reckon'd the leſs ſolid amber-glebes, and ſo friable, that they may be ſeparated by the leaſt ſcratch of the nails; and their coction in common ſeed-oil ſhews this, in which they are ſo diſſolv'd as to leave nothing ſolid behind, as I have hinted in another place*, beſides caſes like honey-combs; but yet if ſome of theſe, having a ſomewhat greater degree of hardneſs, do bear the fire, they are by means thereof

[e] Ibid. Lib. I. cap. 4. § 2. *Vide* ACTA GERMANICA Vol. I. p. 346 *ſupra*. An. 1742.

thereof brought to a more perfect hardneſs, and their parts looſely cohering, being united by the fire, they are, as it were, ripen'd.

Experiment on an amber-glebe in *Breynius's Muſeum.*

I had formerly ſeen in *Breynius' muſæum* a glebe of no ſmall ſize, of a dark red colour, exactly reſembling toaſted coffee-beans. At firſt, indeed, it yielded to the ſtrokes of the ſaw, juſt as other perfect and mature ambers do, and continuing them, and the glebe together with the ſaw being heated, the paſſage of the ſaw became difficult and entirely impeded, and that on account of the gummy ſubſtance of the amber being melted, as it were, and clogging the teeth of the ſaw. I ſometimes deſiſted from the work, and ſometimes to remedy it, I likewiſe ſprinkled cold water thereon, and the gummy parts recovering their rigidity, I proceeded; but I had not gone far, when its priſtine gummineſs return'd, which hinder'd my purpoſe and deſign. And from the colour of this glebe, as alſo from the greater diverſity of matter and conſiſtence, it muſt be one of the rarer ſort: And theſe are almoſt all the *phenomena* of ſoft ambers, as they are call'd, according to their different degrees of hardneſs and other properties, as far as I could diſcover them from viewing the glebes.

That the matter of all ambers is in its firſt generation fluid appears from ocular inſpection.

It, therefore, ſufficiently appears from ocular inſpection, that infallible evidence, that there are ſoft amber-glebes, and that the matter of all ambers is in its firſt generation fluid. And if the hardeſt ſtones were originally fluid, as *Boyle* affirms, that gems were ſometime liquid, and in that ſtate ting'd with different colours, we cannot well deny the ſame ſoftneſs and fluidity to bituminous and oily matters; but this will appear more from the contents of ambers, to which we now proceed.

From their contents.

The contents of amber are various according to the various kingdoms of nature: The animal affords the whole tribe of inſects; the vegetable affords its leaves, boughs, tops, ſeeds, barks and woods; the mineral, in fine, ſupplies its vitriolic ſalts, the very mineral wood or *matrix* of amber, metallic *ſcoriæ*, fragments of iron, earths, clays, ſtones and other things, to all which we muſt alſo add water.

Very difficult to determine how and where foreign bodies are included.

All theſe things afford a very beautiful proſpect; but it is a very hard matter to determine in what manner and in what place theſe foreign bodies are included; and indeed, the only firm bottom on which to proceed is the original liquid ſtate of ambers, by which as the ſole cauſe, we rightly conclude theſe bodies are included; but where the amber-veins are in a ſtate of fluidity, or where to be ſought for remains ſtill an inſurmountable difficulty: I know of no one who has been ſo lucky as to find the amber-glebe liquid in its vein; nay the moſt ancient diggers never met with any ſuch thing, nor, which is ſurpriſing, had any account of it from their predeceſſors.

Probable account thereof.

It ſeems very probable, that thoſe liquid and fluid ambers lie deeper in the mountains; and there ſeems to be no other way of accounting for their animal and vegetable contents than that thoſe parts of the mountains

are torn and broken off by the force of the ſea, whereby a paſſage is opened for inſects and vegetables, tho' the parts of vegetables are leſs rarely found in them than inſects; and that large pieces of mountains are broken off and fall into the ſea, is confirm'd by the neighbouring inhabitants, who averr, that a great part of the coaſt of *Sudau* is ſwallowed up by the ſea; and I can confirm the ſame thing by my own obſervation: And yet I have had an inſtance of a fly, included in a glebe of amber, dug out of the earth; nor do ambers lie ſo deep in the earth, as I myſelf have obſerv'd, but that inſects may make their way to them, as in the neighbourhood of the village *Groſsbubenic*, where the woody vein, together with the amber, lay only at the depth of an ell; and here I found a black beetle; nor is this woody vein more compact than other earths, eſpecially the claiey earth near *Klein Curen*, where a fly was found, but is rather much more ſoft, ſo that inſects may creep into it in the ſame manner, as they do into other earths, eſpecially if thoſe concuſſions of the mountains, mention'd above, ſhould make the paſſages more patent. That theſe inſects are included in amber within the earth we muſt infer, as they are of the winged kind, and therefore cannot plunge to the bottom of the ſea; nay a ſpider, upon the experiment loſt his life in water, and yet this animal is often found included alive; there would, therefore, remain ſome marine bodies; and what could be eaſier than to find ſea-weed and moſs, which yet are rarely included in ambers. And that theſe animals, included in amber, are real and genuine, cannot be queſtion'd, as appears from their accurate and perfect delineation, from the impreſſion of the ſeveral parts of their bodies, and even of the ſubtile fibres of their wings: And a ſingle glebe, which I had in my poſſeſſion, puts this out of all doubt; for, it ſhows a fly, whoſe poſterior parts only are included, its head with a part of its neck jutting out. Nay, the eggs of inſects are to be obſerv'd, as appear'd from a glebe which contain'd an oblong body, of the bigneſs of a muſtard-ſeed, and which view'd with the armed eye, ſhew'd a number of ſmall *animalcula*. That theſe inſects are not chang'd into the nature of amber appears from viewing the glebes, which after opening ſhow the aſhes or earthy parts of the animal: Whence it ſhould ſeem, that they have been included a long time before. And as to vegetables, tho' I allow that ſomething of the amber is deriv'd into their pores and interſtices, as they yield the odour of amber, upon throwing them into the fire, yet they ſtill retain their own nature. And as to minerals, that they are corroded by ambers is leaſt of all credible; as their conſerving, balſamic virtue ſeems to hint the contrary; yet, however, as minerals are ſometimes obſerv'd to be corroded, we are to conſider, as to their incluſion, that very often, if not always, fiſſures remain in the amber; nay, ſome of theſe irony contents jut out at their ſides, and then it is no wonder, if by the ſea-water, or other ſaltiſh and acrid liquor, or even from the air itſelf, the vitriol of the iron be diſſolv'd, and that corroſion and a natural *crocus* of iron be produced.

produced. And ſhould you ſuppoſe iron to be never ſo well included, and yet after taking it out, it be found to be corroded, there will remain no doubt but that it was ſo before incluſion.

There remains one queſtion about animals, included in ambers, namely, why inſects are only found in clear and tranſparent, but not in opaque and cloudy ambers? The anſwer might readily be, that they cannot be ſeen in cloudy and ſquamous ambers, on account of their obſcurity: And to this it may be anſwer'd, that there is yearly a twice, nay a thrice greater quantity of obſcure ambers clarified, than in that time is clarified by nature and falls into the hands of the workmen. Now if you ſhould aſk any of thoſe workmen, whether he ever found any inſect in ambers clarified by art? He will readily anſwer in the negative. When I had carefully applied myſelf to the ſolution of this phenomenon, it immediately came into my mind, that, probably, in ſuch a ſtrong boiling in ſeed-oil, the more tender traces of the animal are obliterated: And to put this opinion to the teſt, I committed a glebe with a fly in it to the uſual coction for other ambers, and for the uſual time and with the uſual degree of heat; and after the boiling was finiſh'd, the fly had undergone no change: But becauſe all obſcure ambers are not clarified by one boiling, I made the trial over again, yet ſtill the animal remain'd unalter'd, ſo that I found my hypotheſis not to anſwer. A queſtion as to animals included in ambers reſolv'd.

As I was caſting about for another method of ſolving this problem, I obſerv'd and that repeatedly, that the included inſects chiefly lodged between the amber-*laminæ* or plates: Theſe *laminæ* I, moreover, conſidered to be very frequent in the clear and tranſparent ambers, but very rarely, nay, ſcarcely occurring in the obſcure ambers. From all which obſervations, as I judged all clear ambers to be in their original ſoftneſs and fluidity highly fluid, as alſo the moſt perfect, as I have ſhown in another place,* but the obſcure ambers to be much more tenacious in their original ſtate; hence I thought I had found the reaſon, why inſects are intangled in clear ambers only, but not in the obſcure, whoſe fluidity is more viſcid: However, it is not to be entirely denied, that they are not at all, and without exception to be found in the obſcure ambers, as I have had two inſtances of this; one in a very obſcure glebe that ſhow'd a large ſort of inſect, which ſeem'd to be a beetle, and another in a ſquamous glebe, with ſlight *nebulæ*, exhibiting, as it were, in the ſhade, a fly; and therefore, I can give no other reaſon for the incluſion of inſects in clear ambers alone, than their greater degree of fluidity. Another method of ſolving this.

Beſides animals, vegetables and minerals, there ſtill remains behind to enquire into the incluſion of drops of water, a ſubject equally worthy of regard, eſpecially as the opinions of authors on this head are different: But to ſpeak my mind freely, the method of including water ſeems to me equally Drops of water how included in ambers.

* *Vid.* ACTA GERMANICA, Vol. I. p. 341. ſeq; An. 1742.

equally eaſy with that of the other contents; for, allowing the primogenial fluidity of ambers, which was juſt now prov'd, and obſerving their ſucceſſive rolling or flux, I eaſily conceive in what manner another particle of liquid amber may run into a ſoft amber-glebe, excavated in ſome part thereof, and include water in its cavity; but whether this water be ſalt or freſh, is not much to the purpoſe, in regard it is eaſy to give inſtances of both, tho' from my own obſervation, indeed, I always found it freſh.

An inſtance. But to conclude this matter; that theſe drops of water were included in the firſt concretion of ambers appears from a glebe which contain'd ſuch a drop; and after the exhalation of the water, ſome bits of wood (which were moveable, according as you mov'd and turn'd the glebe) remain'd behind: That it had had a drop of water, the appearance of the cavity itſelf ſhows, greatly reſembling cavities of this kind: And in fine, reaſon confirms this; for, if you ſuppoſe, that thoſe pieces of wood or earth were included in the firſt concretion of the amber without any water, as the matter of the amber was fluid and ſoft, they would have, doubtleſs, been faſtened to the glebe, as might plainly be ſeen in other pieces of this kind in the ſame glebe.

An Obſervation of the true Original of the Kermes-grains, of which the purple and ſcarlet Dyes are made. From the Breſlaw Collection, May, 1718. Claſs IV. Art. VIII. p. 1095.

Tranſlated from the HIGH-DUTCH.

Account of the purple-dye. PURple-dye was formerly the rareſt and the moſt coſtly dye of cloth, and us'd in particular by the *Roman* Senators and Emperors. It had its original from the ſhell-fiſh, *purpura*, which bore this purple liquor, included in a vein in its *fauces*; but which was taken out while the fiſh was alive, as after its death it was loſt: Yet this only happen'd in the larger ſort; whereas on the contrary, according to *Hier. Mercurialis*[a], the ſmall ſort were pounded, and the juice together with this liquor, was expreſs'd, and for the better preſerving of it, put into honey. This dye was firſt diſcover'd by means of *Hercules'* dog, who, as he bit a *purpura*, had the hair of his chops dyed with this liquor. The beſt was taken in *Phenicia*[b]: Whence the dye was call'd *color puniceus*; or it was found near *Tyre* and *Sidon*: Whence it was call'd *Tyrius*. Yet it was alſo found in other parts of *Aſia* and *Africa*, and in ſome parts of the coaſt of *Greece*. The ſmall ſhells were call'd *buccinum*, but the larger ones properly *purpuræ*; and they muſt in particular have been taken in ſpring. As to their nature, diverſity and preparation, *Pliny*[c], but in particular *Fabius Columna*[d], beſides ſeveral

[a] Variar. Lect. lib. 6. cap. 25. p. m. 482, 483. [b] Scalig. de Subtil. exercit. 325. 14. p. m. 1046. [c] Lib. IX. cap. 36, 37, 38. [d] Tr. de purpura cum not. Joh. Dan. Majoris, Kiliæ, 1675. quarto.

ſeveral others, may be conſulted. At firſt they dyed violet with it, a pound of which coſt 100 *denarii*. Upon this there aroſe at *Tarentum* the red, and at *Tyre* the moſt beautiful dye, where the cloth was not only once, as formerly, but twice dyed; and hence uſually call'd *dibapha*, a pound of which coſt 1000 *denarii*. *Lentulus Spinter*, the *Roman Ædilis Curulis*, began firſt to wear a *prætexta* thereof; but this was ill conſtru'd of him[e]: And this was then the red dye, which was got with great labour and in ſmall quantity (whence alſo its great coſtlineſs) from the animal kingdom and from ſhell-fiſh: But it was afterwards loſt, or it came into diſuſe, ſo that almoſt down to our time this purple-dye may be reckon'd among the *deperdita*, till at length in 1685 it was again diſcover'd in *England* by *Mr. Cole* on the ſea-coaſt of *Somerſetſhire* and the ſhore of ſouth *Wales* in a certain kind of ſea ſhell-fiſh[f]. Not long ago in *France*, *Reaumur* diſcover'd a like new kind of purple, which conſiſted of pure, ſmall, oval-round grains, fill'd with a yellowiſh liquor, and uſually hanging on certain ſtones, where otherwiſe the known purple-fiſh is found in *Poictou*. When theſe grains are laid on a linen-cloth in the open air, there appear purple, red ſpots thereon, and theſe grains are gather'd in harveſt, and taken by *Reaumur* for fiſh-eggs.[g]

A red dye found in the vegetable kingdom.

But whether this purple-dye has been ſince us'd, we know not; and poſſibly there will not be ſo much occaſion for it, ſince there was long ago, inſtead of this dye, found another beautiful, and alſo a very coſtly red dye in the vegetable kingdom, which the ſcarlet-oak yields, and which in former times was commonly made uſe of for this purpoſe, eſpecially in *Spain* and *Portugal*.[h] Moſt people at that time took it for a kind of fruit, by the *Greeks* call'd κοκκος, and which, *Dioſcorides*, on account of its dying quality, call'd κοκκος βαφικη, that is, the tinging *coccus*, and *Scaliger*[i] calls *Scarlatum*, and we uſually ſcarlet: Whence alſo the tree itſelf is called *ilex coccigera*. It was formerly found in *Crete* and in other parts of *Aſia*, and particularly in *Spain* and *France*, eſpecially in *Languedoc* and *Provence*, where it is ſtill found even at this day: Yet it does not produce univerſally theſe grains or *coccus*, but principally on the ſea-coaſt, where the tree is much expos'd to the heat of the ſun; neither is it alſo to be met with on all trees, but only on ſuch as bear no acorns. On which account the inhabitants every four years burn the ſhrubs, that the following year they may ſhoot out a-new: And hence they yearly produce on the ſmall ſhoots the *coccus* in form of ſmaller aſh-colour'd peas, which is gather'd by the children and women, and ſold to the merchants, by whom it is prepar'd for the market. By the *Arabs* it is call'd *chermes*, from the *Latin* word *vermis*, inſtead of which the *Arabs* pronounc'd *guermis*, and laſtly *kermes*[k]; by the *Spaniards* it was

[e] Plin. l. c. cap. 39. [f] Phil. Tranſ. N° 197. [g] *Vid.* Hiſt. de l'Acad. Roy. des Sciences, An. 1711. [h] Plin. lib. IX. cap. 41. p. 165, —— *and in particular in* lib. XVI. cap. 8. p. 269. [i] l. c. p. 1043. [k] Salmaſ. Exercit. Plin. p. 676.

call'd

call'd *grana de tintoretos*; and by the *French*, *vermillon* and *graine d'eſcarlate*[l]. Yet this grain is not of itſelf the true ſubſtance of the *chermes*, or crimſon-dye, but a ſmall worm lying conceal'd under it; but which is very nimble, in regard that as ſoon as it comes out of the ripe grain into the free air, it flies off immediately in form of a ſmall fly: Whence you muſt gather the grains before the inſect flies away, as its blood is the proper ſubſtance of this dye. The gathering of theſe grains or of the *coccus*, their nature and preparation are deſcrib'd by *Quiqueranus*,[m] *Bellonius*[n], *Eiſtachius*[o], as alſo by *Joh. Steph. Strobelbergerus*[p], the *Engliſh Philoſophical Tranſactions*[q], and laſtly by *Hyacinthus Ceſtonus* in his *Iſtoria della grana del kermes*, &c. to be ſeen in *Valliſnieri Iſtoria del Camaleonte*, and in an extract of it in Part XXIV. of the *Giornale de' Letterati d'Italia*.

Account thereof.

Now as M. *Garidel* in his *Hiſtory of the plants growing about* Aix *and in ſeveral parts of* Provence, publiſh'd at *Aix* in *Folio*, 1718, has given a more circumſtantiate deſcription of this ſcarlet-worm, than has hitherto been given, we ſuppoſe it will not be diſagreeable to the reader to give an extract here of the above-mentioned paſſage about the *chermes* worms[r]:

'In the beginning of *March* there creeps out a worm (which before liv'd 'in the fields, and is ſmaller than a millet-ſeed) into a ſmall tree or ſhrub, 'which *Baubin* calls *ilex aculeata cocciglandifera:* It lodges on the trunk, 'the branches, and oftenеſt on the eyes or buds of the tree; and after it 'becomes gradually ſtiff and motionleſs, it begins to grow thicker and 'thicker from the nouriſhment it draws from the tree; in that time it is 'obſerv'd, by means of a microſcope, to be of the moſt beautiful red, lying 'in a down, which like a fine wool, curls round about it, and ſerves it 'inſtead of a neſt; its figure is convex like half a plum, with ſeveral lines 'round about it: And where no hair or down is found, a great many 'points ſhining like gold are to be ſeen: In the place of the head nothing 'but a round proceſs is obſerved, on both ſides of which two arch'd, 'ſmooth horns, and cut ſhort, ſtand out, ſo that the head with its two horns 'reſembles a half-moon; and this may be call'd the firſt period of the 'kermes. In the ſecond period, which falls on the middle of *April*, and 'when this worm attains to its full dimenſion, it appears round like a pea, 'ſometimes bigger, ſometimes ſmaller; its ſkin then is much firmer, and 'the hair or down, which in the firſt period was only curly, does at this 'time encompaſs the whole ſkin, like a huſk or purſe, fill'd with a red-'diſh liquor, like a pale or watery blood. Towards the end of *May* there

[l] *Vid.* Car. Cluſius rar. Stirp. Hiſpan. l. I. c. 6. p. 33. ſeq. [m] Tr. de laudibus Provenciæ apud Car. Cluſium l. c p. 36. [n] Lib. I. Obſ. cap. 17. p. 43. [o] De confectione alkermes, p. 16, 17. ed. Stetini. Ann. 1635. 4to. [p] Tr. Nov. de cocco baphica & confectione alkermes. Jenæ, An. 1620. 4to. [q] N. 20. p. 302. N. 71. p. 2165. N. 72. p. 2177. N. 73. p. 2196. N. 76. p. 2294. N. 77. p. 3003. [r] Nouv. de la Republ. des Lettres, Art. ult. p. 385——393.

'is

‘ is obſerv'd on the under part of this huſk or purſe, or properly under the ‘ belly of this inſect, ſmall red and oval-round grains from 1000 to 2000 ‘ in number: Theſe are the eggs, which are hatch'd by the warmth of ‘ the ſeaſon, and from which a like worm is produced, which lodges in ‘ the fields, till the time when nature drives it to betake itſelf to the ‘ above-mentioned tree, and there propagate'. In this curious relation there are ſeveral particulars about the *chermes* worm, as alſo about the eggs, as that they are partly red, partly white, from which there is alſo produced a two-fold ſort of worms, exactly of the form of a moth.

From this obſervation we may plainly ſee, that the principal ſubſtance of the dye depends on the eggs, as being that red powder, which, according to the relation of *Verney* in the *Philoſophical Tranſactions*[f], is by means of a linen cloth, bolted or ſearced from the *cocci* or grains; conſequently, that they may not creep about or become alive, they are ſprinkled with vinegar, and made into balls; but the huſks of the grains muſt be moiſtened with wine, and ſet to dry in the ſun; and to 100 lb. of this laſt (which is rubb'd and made bright in a ſack) there is mixt from 10 to 12 lb of the above powder, and thus ſold: And according to this mixture the price of the *chermes* is higher or lower.

The principal ſubſtance of this dye what?

[f] N. 20. p. 302.

Reflections on Knowledge, Truth and Ideas. By G. G. L. *From the* Acta Eruditorum Lipſ. An. 1684. p. 537.

Tranſlated from the LATIN.

AS at this day there are diſputes among excellent perſons about true and falſe idea's; and as it is a matter of great moment to the knowledge of truth, in which neither *Des Cartes* himſelf has given entire ſatisfaction, I ſhall briefly explain what may ſeem to me to be determined about the diſtinctions and *criteria* of idea's and knowledge: Knowledge is, therefore, either obſcure or clear; and the clear is again either confus'd or diſtinct; and the diſtinct, either adequate or inadequate, as alſo either ſymbolical or intuitive: And, indeed, if it be at the ſame time both adequate and intuitive, it is the moſt perfect knowledge.

The difference and *criteria* of ideas and knowledge explain'd.

An obſcure notion is ſuch, as is not ſufficient to diſtinguiſh the thing repreſented, as if at any time I call to mind a flower or animal I formerly had ſeen, but yet not ſufficient, ſo as to know it again or diſtinguiſh it from any thing near it; or if I conſider any term not well explain'd in the *Schools*, as the *entelechia* of *Ariſtotle*, or the cauſe, as it is common to the material, formal, efficient and final cauſe, and ſuch like, of which we have no certain definition: Whence alſo the propoſition, into which ſuch a notion enters, becomes obſcure: *Clear knowledge*, therefore, is, when I have characteriſtics or marks whereby I may diſtinguiſh the thing repreſented, and that is again

An obſcure notion what?

Clear notion what?

Confus'd notion what?

again either *confus'd* or *diſtinct:* Confus'd notion is, when I cannot particularly enumerate ſufficient notes or marks for diſtinguiſhing one thing from another, tho' that thing has really ſuch marks and requiſites, into which its notion may be reſolv'd: Thus, indeed, we pretty clearly perceive colours, odours, taſtes, and the other peculiar objects of the ſenſes, and we diſtinguiſh them from each other, and that barely by our ſenſes, but not by enunciable notes or marks: We, therefore, cannot explain to a blind man what a red colour is; nor can we explain to others what we perceive by our ſenſes, but by bringing them to the thing preſent, and thereby cauſing them ſee, ſmell or taſte the ſame thing we do, or at leaſt, bringing to their mind ſome ſuch ſimilar paſt perception; tho' it be certain, that the notions of theſe qualities are compounded and may be reſolv'd, as they have their own proper cauſes. In like manner we ſee, that Painters and other Artiſts know very well the beauties and defects of any performance, yet oftentimes they cannot give the reaſon of their judgment, and they tell you, that there is ſomething they know not what wanting in what they diſlike. But a *diſtinct notion* is ſuch, as aſſayers have of gold, namely by means of ſufficient notes and trials they diſtinguiſh it from all other ſimilar bodies: Such we uſually have about the notions common to ſeveral of the ſenſes; as for inſtance, of number, magnitude, figure, as alſo about ſeveral affections of the mind, as hope, fear; in ſhort, about all the things of which we have a nominal definition, which is nothing other than the enumeration of ſufficient notes. Yet there is a diſtinct knowledge of an indefinible notion, when it is primitive or its own note, that is, when it cannot be reſolv'd, and can be known only of itſelf; and conſequently, has no requiſites. But in compound notions, as again each particular characteriſtic compounding it is ſometimes, indeed, clearly known, but yet confuſedly, as gravity, colour, *aqua fortis*, and other things of which the characteriſtics of gold conſiſt; hence tho' ſuch a knowledge of gold be diſtinct, yet it is inadequate. But when all that which enters into the compoſition of diſtinct knowledge, is again diſtinctly known, or when the analyſis is carried on to the laſt, the knowledge is adequate; of which I know not whether it be poſſible to give a perfect example; yet the knowledge of numbers comes very near it. And for the moſt part, eſpecially in a more prolix analyſis, we do not at once view the whole nature of the thing, but inſtead of the thing make uſe of ſigns, whoſe explication in any preſent thought we for brevity's ſake uſually omit, either knowing or believing, that we have it in our power: Thus, for inſtance, when I think of a polygon of a thouſand equal ſides, I do not always conſider the nature of a ſide, of equality and of a thouſand, or the cube of 10, but in my mind I uſe theſe terms (of whoſe meaning I have only an obſcure and imperfect idea) inſtead of the ideas I have of them, becauſe I remember, that I know the meaning of theſe terms, but do not now think the explication

A diſtinct notion what?

A blind or ſymbolical knowledge what?

cation of them neceſſary; and this knowledge I uſually call a *blind* or even a *ſymbolical* knowledge, which we uſe both in algebra and arithmetic, nay, almoſt every where. And indeed when a notion is very compounded, we cannot at the ſame time think of all the notions entering into its compoſition: But where we can do this, or at leaſt in ſo far as we can do it, I call that knowledge *intuitive*. We have no other knowledge of a diſtinct primitive notion than what is intuitive, as for the moſt part the notion of compounds is only ſymbolical.

Intuitive knowledge what?

Now from theſe things it appears, that we do not perceive the ideas of thoſe things, which we alſo diſtinctly know, but in ſo far as we uſe intuitive thought; and indeed it happens, that we often falſely believe, we have ideas of things in our mind, when we falſely ſuppoſe, that ſome terms we uſe have been already explain'd by us; nor does it hold true, or at leaſt, it is ſubject to ambiguity what ſome affirm; *viz.* that we cannot ſpeak of any thing intelligibly without having an idea of it; for, we often in ſome meaſure underſtand each term or we remember we underſtood them before, yet becauſe we are ſatisfied with this blind thought, and do not ſufficiently purſue the reſolution of the notions, it happens, that we loſe ſight of the contradiction, which probably the compound notion involves. What gave me a handle more diſtinctly to conſider thoſe things was an argument long famous among the Schoolmen, and reviv'd by *Des Cartes*, for the exiſtence of God, and which is as follows; what thing ſoever follows from the idea or definition of a thing, that thing may be predicated of it; exiſtence follows from the idea of God (or the moſt perfect being, or a being than whom no greater can be thought of; for, the moſt perfect being involves all perfections, among which exiſtence is one) exiſtence therefore may be predicated of God. But we are to know, that hence it only follows, if ſuch a being as God be poſſible, it follows that he exiſts; for, we cannot with ſafety uſe definitions for making inferences, before we know that they are real, or that they imply no contradiction; the reaſon of which is, that oppoſites may at the ſame time be concluded about notions involving a contradiction, which is abſurd: And to clear this I uſually employ the inſtance of the ſwifteſt motion, which implies an abſurdity; for, let us ſuppoſe any wheel to revolve with the ſwifteſt motion; any one ſees that any ſpoake thereof being produced will with its end move faſter than a nail in the circumference of the wheel; its motion, therefore, is not the ſwifteſt, contrary to the hypotheſis: It may however at firſt ſight appear, that we have an idea of the ſwifteſt motion; for, we in ſome meaſure underſtand what we ſay; and yet we have no idea of impoſſibilities: In the ſame manner, therefore, it is not enough to think of the moſt perfect being, that we can aſſert we have the idea of him; and in the demonſtration above alledged, the poſſibility of the moſt perfect being is to be either ſhown or ſuppos'd, that we may form a right concluſion: However,

The perception of the ideas of things we diſtinctly know, is only by intuitive thought.

nothing

nothing is truer than that we both have an idea of God, and that the moſt perfect being is poſſible, nay neceſſary; yet the argument is not ſufficiently concluſive, and has been rejected by *Aquinas*.

Diſtinction between nominal and real definitions, and thereby *Hobbes'* objection anſwer'd.

And thus we alſo have the diſtinction between nominal definitions, which contain only the notes of a thing, which is to be diſtinguiſh'd from others, and between real definitions, from which it appears, that the thing is poſſible: And in this reſpect we give an anſwer to *Hobbes*, who would have truths to be arbitrary, becauſe they depended on nominal definitions, not conſidering, that the reality of a definition is not arbitrary, nor that any notions at pleaſure can be conjoin'd; nor are nominal definitions ſufficient to a perfect knowledge, unleſs when it ſome other way appears, that the thing defin'd is poſſible. In fine, it is alſo manifeſt what a *true idea* and what a *falſe* one is; namely, an idea is true, when the notion is poſſible; falſe, when it implies a contradiction: But we know the poſſibility of a thing either *à priori* or *à poſteriori*; and indeed *à priori*, when we reſolve a notion into its requiſites, or into other notions of a known poſſibility, and in which we know there is nothing incompatible; and among other things this happens, when we underſtand the manner in which a thing may be produced: Whence above all others, *cauſal definitions* are of uſe; but *à poſteriori* when we experience the thing actually to exiſt; for, what actually exiſts or exiſted, that thing is poſſible: And indeed, whenever we have an adequate knowledge, we have alſo the knowledge of poſſibility *à priori*; for, after compleating the analyſis, if there appear no contradiction, the notion is poſſible: But whether a perfect analyſis of notions may ever be accompliſh'd by men; or whether they can reduce their thoughts to the firſt poſſibilities, or into irreſolvable notions, or (which comes to the ſame thing) into the abſolute attributes of God, namely the firſt cauſes and ultimate reaſon of things, I cannot now, indeed, venture to define; for the generality we are content to have learn'd by experience the reality of ſome notions, whence we afterwards compound others in imitation of nature.

A true and falſe idea what?

An appeal to ideas not always ſafe.

Hence, therefore, in fine, I think it may be underſtood that it is not always with ſafety we appeal to ideas, and that many abuſe this ſpecious title to eſtabliſh ſome of their own imaginations; for, we have not immediately an idea of a thing, of which we are conſcious we think, as I have ſhewn above from the inſtance of the greateſt velocity: And I no leſs obſerve that men in our days abuſe this boaſted principle, namely *that whatever I perceive clearly and diſtinctly about any thing, ſuch is true and enunciable of it*; for, often things ſeem clear and diſtinct to men, who judge raſhly, which are really obſcure and confus'd; the axiom, therefore, is of no uſe, unleſs the *criteria* of clear and diſtinct, which we have given, be employ'd, and unleſs the truth of the ideas be eſtabliſh'd. As to the reſt, the rules of common logics, and which Geometricians alſo uſe, are

no

no contemptible *criteria* of the truth of enunciations; namely, that nothing be admitted for certain, unleſs it be prov'd by accurate experience or firm demonſtration: But firm demonſtration is ſuch as keeps to the form preſcrib'd by Logicians, not that in the manner of the *Schools* there is always occaſion for formal ſyllogiſms (ſuch as *Chriſtianus Herlinus* and *Conradus Daſypodius* have employ'd on the firſt ſix books of *Euclid*) but that at leaſt the argumentation conclude by virtue of its form; and you may ſay, that any juſt calculus is an inſtance of ſuch an argumentation and form; and therefore, no one neceſſary premiſs is to be omitted, but all the premiſſes ſhould either be previouſly demonſtrated, or at leaſt aſſum'd as hypotheſes; in which caſe the concluſion is alſo hypothetical. Such, as ſhall diligently obſerve theſe things, will be eaſily on their guard as to deceitful ideas. And agreeably to this the ingenious *Paſcal*, in his excellent diſſertation *de ingenio geometrico* (a fragment of which is extant in *Arnaud*'s treatiſe *de arte bene cogitandi*) ſays, that it is the part of a geometrician to define all the terms that are *any thing* obſcure; and prove all the truths that are *any thing* doubtful: But I could wiſh he had ſettled the limits, beyond which any notion or enunciation is no longer *any thing* obſcure or doubtful. Yet what may be proper in this caſe, may be drawn from an attentive conſideration of what I have ſaid, as I now avoid prolixneſs.

Whether we ſee all things in God, or whether we have proper ideas explain'd.

As to that controverſy, namely whether we ſee all things in God (which is an ancient opinion, and if taken in a ſound ſenſe not entirely to be deſpis'd) or whether we have proper ideas, we are to obſerve, that tho' we ſaw all things in God, yet that it is neceſſary we have proper ideas, that is, not a ſort of images, as it were, but affections or modifications of our mind, anſwering to what we perceive in God; for, by our different ſucceſſive thoughts there is ſome change made in our minds; but the ideas of things not actually thought on by us are in our mind, as the figure of *Hercules* in a block of marble: But in God it is not only neceſſary, that there actually be the idea of abſolute and infinite extenſion, but of any figure, which is nothing other than a modification of abſolute extenſion. Beſides, when we perceive colours, or odours, we have no other perception than that of figure and motion, but ſo manifold and minute, that our mind in this its preſent ſtate is not ſufficient to conſider each diſtinctly; and therefore, does not advert, that its perception is compounded only of the perceptions of the minuteſt figures and motions; juſt as in perceiving a green colour, upon mixing together yellow and green powders, we perceive nothing but yellow and blue very minutely mixt, without adverting thereto, and rather framing to ourſelves ſome new being.

Of the Menſures or Laws of the Forces of Bodies. By M. I. Hermann. *From the* Commentarii Academiæ Scientiarum Imperialis Petropolitanæ Vol. I. Sept. Ann. 1725. p. 1.

Tranſlated from the LATIN.

The force of a body what.

1. THE force of any body, as all writers in mechanics are agreed, denotes *the power of effecting motion*, either in the very body itſelf, wherein this power is underſtood to exiſt, or in other bodies, different from it: For, no body really at reſt can have ſuch a moving power, but is only endued with a *vis inertiæ*, whereby it reſiſts the force acting upon it.

What is meant here by a body really at reſt.

2. We are here ſpeaking of a body really at reſt, and by this we underſtand not ſimply that which is only apparently at reſt, but rather that which is deſtitute of all *conatus* to motion: For, there are bodies, which tho' they do not actually move, yet have a *conatus* to motion; but this *conatus*, on account of interpoſing impediments, is ineffectual. Thus, a heavy body, inſiſting on any horizontal plane, is indeed apparently at reſt; becauſe the plane on which it is hinders its deſcent; but it is not, therefore, truly at reſt; ſeeing it has a *conatus* of deſcending, which will break out into an actual deſcent, as ſoon as the plane hindering the deſcent of the body, ſhall have been remov'd.

Dead and living force what.

3. There is, therefore, a wide difference between a power which produces an actual motion, and a power, which only terminates in a ſimple *conatus:* For, this laſt is only a *dead force*; but the other is call'd a *living force*; a body, therefore, hanging by a thread, or inſiſting on any plane has only a dead force; but if it actually moves, then it ſhall be ſaid to have a living force.

Mechanics entirely converſant in the invention of meaſures for eſtimating the dead and living forces.

The whole doctrine of mechanics is converſant in the invention of proper meaſures or laws, according to which both the dead forces of bodies and their living forces, may be rightly eſtimated: From which it appears that the true doctrine of forces is of ſome importance; and conſequently worthy to be carefully and cautiouſly cultivated. But tho' there are no diſputes about the *dead forces*, as about the *living forces*; yet I ſhall begin with the former.

The meaſure of dead forces what.

4. As to dead forces, therefore, and their meaſure; this meaſure is eaſily diſcovered: For, by a ſmall degree of attention it will be manifeſt that the weight of any body is the meaſure of its dead force; and in ſo far as this force flows from the principle of gravity: I have added this reſtriction, becauſe there is another ſpecies of a dead force in bodies, which flows not from the principle of gravity; and of this kind of dead force are the centrifugal forces of revolving bodies. For, as often as any body does, with an uniform or even with any degree of variable motion, deſcribe the periphe-

phery of a circle or other curve, in each moment of this motion it will endeavour to purſue its motion in the direction of the tangent of the circle, or curve, in that point wherein it is: In each moment, therefore, the body endeavours to recede from the circumference of the circle, or from the curve, in the direction of a perpendicular to the tangent, paſſing thro' the centre of gravity of the body, but as often as the body cannot really recede from the circumference of the circle, or curve, and has only a *conatus* of receding, this *conatus* is the dead force: For, the centrifugal *conatus*'s may be compar'd with gravity; the centrifugal forces, therefore, and gravity, are homogeneous quantities: Now the dead forces, of whatever ſpecies they are, are proportional to the maſſes of the bodies, *cæteris paribus*; that is, if the gravity in both bodies be the ſame, or if both bodies move with an equal celerity in equal circles: This is very eaſily prov'd; let two unequal bodies, the leſſer A, and the greater B, reſt upon any horizontal and immoveable plane; both will exert ſo much force upon the plane, as is proportionable to their weight; becauſe this plane is immoveable, and directly oppoſes the deſcent of both bodies; but the weight of the greater B is to that of the leſſer A, as the maſs of B, to the maſs of A; and this is generally allow'd; therefore, the dead force of the body A, is to the dead force of the other body B, as the maſs or quantity of matter of A, to the maſs of B: The caſe, therefore, holds thus with the dead forces depending on gravity; and the ſame may be eaſily ſhown as to thoſe which flow from the centrifugal forces: For, becauſe by the hypotheſis, both bodies A and B revolve with equal celerity in equal circles; if B have a greater centrifugal force than A, that is owing to the maſs; therefore, ſo many times as the centrifugal force of B is greater than that of A, ſo many times is the maſs of B greater than that of A; therefore, it is, as the dead force of B, flowing from its centrifugal force, to the force of A, ſo the maſs of B, to that of A.

In the like manner it may be ſhown, that if the intenſity of gravity in different bodies, or the intenſity of the centrifugal force of bodies, revolving in different circles, be different, the dead forces will be in the compound ratio of the maſſes of the bodies, and the intenſities of gravity, or the centrifugal forces of the bodies moving in circles. By the intenſity of gravity, or of the centrifugal force, I underſtand the gravity or weight which a body, whoſe maſs is as 1, has at different diſtances from the centre of gravity; or the centrifugal force, which the ſame body has in the different ſtates of its circular motion: So much for the dead forces.

5. But what ratio the dead force has to the living is a queſtion the moſt approved authors anſwer by affirming, that the living force is infinite in regard to the dead force: And what *Galilæo*, *Torricelli*, *Borelli* and others have ſaid of this matter, deſerves to be peruſed: Who all of them have endeavour'd to prove both by experiments and reaſonings, that the force

The ratio of the dead to the living force.

of

of percuſſion is infinite, if compar'd with the ſimple weight or gravity of bodies: I think it needleſs to tranſcribe their arguments, ſeeing they may be read in their works; and that there is no diſpute on this head among the intelligent: I ſhall, therefore, here only hint, that theſe excellent philoſophers would have expreſs'd themſelves more accurately, if they had ſaid, that the force of percuſſion and the gravitation of bodies were heterogeneous quantities; and conſequently, incapable of compariſon: As *Des Cartes** has ſpoke of thoſe ſorts of forces, in a letter to *Merſennus*, where he expreſsly writes, that the force which is ſufficient to raiſe a weight to any height *has always two dimenſions*; but that force, which is ſufficient to ſuſtain the weight in any point of this height, *has never more than one dimenſion*: So that theſe forces differ from each other as ſuperficies and line; and are therefore incapable of *ratio*. The ſame may be ſaid of the force of percuſſion, and the gravitation of bodies: For, the former is the living, but the latter is the dead force. What we have only briefly ſaid in this paragraph, will be more clearly prov'd in the following paragraphs, after that we ſhall have treated of the law of the living forces.

Diverſity of opinions about the ratio of the living forces to each other.

6. All are not agreed in opinion, as to the ratio of the living forces to each other: For, the generality own, that theſe forces follow the ratio of the impetus of bodies, or of their quantities of motion, that is, that the living forces of two bodies are in the compound ratio of the maſſes and celerities: And in this almoſt all the writers in mechanics ſeem to agree; but thoſe who fall in with the notion of the illuſtrious *Leibnitz* ſwerve a little from this, and hold, that the living forces are in the compound ratio of the maſſes, and the duplicate ratio of the velocities of the bodies: This propoſition M. *Leibnitz* firſt inſerted into the *Acta Eruditorum*†, and he deduced it from a twofold principle. 1. *That every heavy body*, abſtracting from every external impediment of motion, *does, by falling vertically, acquire a force of aſcending to the ſame height from which it fell.* 2. *That the force neceſſary to raiſe the body A, of one pound, to the height of four yards, is preciſely equal to that force, by which another body B, of four pounds, may be rais'd to the height of one yard.* From which it was eaſy for him to conclude, that the forces of bodies are as the products of their maſſes into the ſquares of their celerities: But the certainty of this concluſion depends on that of the principles; the firſt of which no one denies; and the ſecond alſo with this reſtriction, *if the times of aſcent be equal*, is univerſally admitted: In this ſenſe at leaſt the Abbè *Catelan*[a], who undertook to defend the *Carteſians* againſt M. *Leibnitz*, admits of the ſecond principle; yet pretending, that it was wrongly applied by M. *Leibnitz* to bodies, which abſolve their heights in unequal times: ſince it agrees only to iſochronal motions, when applied to the five mechanical powers: For M. *Catelan* and others would underſtand this *Carteſian* principle of iſochronal motions

*Epiſt. 74. part 1. † An. 1686. p. 161. [a] *Nouv. de la Rep. des Lett.* An. 1686. p. 577

motions, on the account only of converting the ſpaces deſcrib'd by the bodies into their celerities, and making the forces of the bodies proportional to their quantities of motion: For, in uniform and iſochronal motions, the celerities are as the ſpaces; but *Leibnitz* clearly ſhows,[b] that there is no neceſſity for conſidering the time in eſtimating the forces of bodies; and *Des Cartes* himſelf,[c] who makes uſe of this principle, ſays, *that neither a greater nor a leſs force is requiſite to raiſe any body to a certain height, than to raiſe another leſs heavy body to a height ſo much greater, as itſelf is leſs heavy; or to raiſe another heavier body to a height ſo much leſs.* He makes no mention of the time, tho' he has applied it to the mechanical powers, in which the motions are iſochronal: Nay, in the following letter he expreſly hints, *the firſt thing wherein one may be miſtaken in this affair is, that moſt people uſually confound the conſideration of the ſpace with that of the time or celerity:* Where he immediately ſubjoins; *Thus in the lever or balance, ſuppoſing that one arm is double the other, and the weight, hung to the ſhorter arm, is alſo double that ſuſpended to the longer arm; ſo that they may be* in æquilibrio: *Where we ſhould ſay, that the cauſe of this* æquilibrium *is, that if the greater weight ſhould raiſe the leſſer, or be rais'd by it, then that greater weight would only paſs over half the ſpace of that which the leſſer paſſes over; they affirm, that it would move twice* ſlower; *which error is of ſo much the worſe conſequence, as it is the harder to diſcover. Des Cartes*, therefore, would ſeclude the conſideration of the time or celerity from that of the ſpace in eſtimating the living forces; and in this very thing he pretends, he has ſhown more art than in any other part of his Statics: *Des Cartes*, therefore, agrees in ſome meaſure with M. *Leibnitz.*

Objection that the living forces are as the impetus of the quantities of motion.

7. The common opinion, that the living forces are as the *impetus* of the quantities of motion of bodies, ſeems to be founded in a principle, that cannot well be conteſted, but is ill applied; to wit, in this axiom, that effects are proportional to their adequate cauſes. Moſt people at leaſt deduce the common eſtimation of the forces from this axiom: For, if the force of any body be its power of effecting motion, this power will come to be conſider'd as a cauſe, and the motion produced, as an effect; wherefore, a double, triple, *&c.* power will produce a double, triple, *&c.* motion: By this means, therefore, the living forces of bodies would be as the quantities of motion, or the *impetus:* It does not then appear, why theſe very forces ſhould be as the products of the maſſes of the bodies, into the ſquares of the celerities, as M. *Leibnitz* has taught us.

Anſwer'd.

8. We allow that this argument is ſpecious; but not the truer for all that: We allow *that cauſes are proportional to their effects:* For, this rightly underſtood, and duly applied, cannot only not be denied, but even M. *Leibnitz* himſelf admits it in other words, when he ſays, *that there is*

[b] *Nouv. de la Rep. des Lett.* An. 1687. p. 131. [c] Epiſt. 73. Part 1.

an inviolable equality between the plenary cauſe and the entire effect: For, in reality, a cauſe is ſo far a cauſe as it produces its effect; ſo that the effect and cauſe which produced it, are equipollent; and if ſo, in what *ratio* the cauſe is augmented or diminiſh'd, in the ſame *ratio* will the effect be likewiſe increas'd or diminiſh'd: But we deny, that the motion of the body, or the *impetus*, in ſo far as it is expreſs'd by the products of the maſs into the celerities of the bodies, is an entire and adequate effect of the acting power; but rather that the heights, or ſpaces, thro' which bodies may aſcend, ſhould be aſſumed for the meaſure of the effects, which the powers, acting upon theſe bodies, can produce; nor according to *Des Cartes* himſelf are theſe ſpaces to be confounded with the celerities or times: For, the celerities are only modal and incomplete *entia*, otherways than the ſpaces which the bodies paſs over in their aſcent: Beſides, effects, expounded by the quantities of motion, are not capable of an accurate meaſure: For, the genuine law of meaſuring requires, that the meaſure be preciſely contain'd once or more times, or be repeated once or more times in the things to be meaſur'd; but this does not evidently hold in bodies moving with different celerities: For, tho' I own, to uſe M. *Leibnitz*'s example, that three equal bodies and with equal velocities have preciſely thrice more power than one of them; becauſe one and the ſame meaſure is repeated here three times (for, a body of a certain quantity, equal to each apart, is repeated thrice) yet it cannot, therefore, be immediately granted, that a body with three degrees of velocity contains three times a body equal to itſelf with one degree of velocity; becauſe in this latter caſe the common meaſure is not repeated in the ſame manner in the greater quantity, as it was repeated in the firſt caſe: For, in this, the ſubſtantial *ens*, that is, the body with one degree of velocity is repeared three times; but in the other inſtance, the celerity, which is a modal and incomplete *ens* of one and the ſame ſubſtantial thing, or body, is repeated three times: Wherefore, in theſe two examples, the leſs is not contain'd in the greater after one and the ſame manner.

A contradiction according to M. *Leibnitz* in eſtimating the living forces by the quantities of motion.

9. M. *Leibnitz*, moreover, in many places of the *Acta Eruditorum*[*] ſhows, that there is a plain contradiction, or abſurdity, in eſtimating the living forces by the quantities of the motion of bodies: For, he ſuppoſed any ball A to have fallen vertically from the height of one foot, and with the velocity acquir'd at the end of this height, continuing in equable motion in a horizontal plane to have impinged on the quieſcent ball B, $\frac{1}{4}$ thereof, or ſubquadruple thereof; and to have transfer'd all its motion and force to it: So that the ball B ſhall by this ſhock have acquired four degrees of velocity, and according to the common ſyſtem ſhall have obtain'd a force equal to that of the ball A in its fall from a height of one foot. M. *Leibnitz* next ſhews, that when the ball B, changing the motion, acquired

[*] *An.* 1690, *p.* 235. *An.* 1691, *p.* 439. *An.* 1695, *p.* 156, &c.

acquired from the ball A vertically upwards may riſe to the height of 16 foot; by means of a lever it may raiſe the ball A to a height upwards of three times greater than that to which the ſame ball A could have riſen with the force, which it had acquired by the fall from a height of one foot. Now the abſurdity and contradiction conſiſts in this, we have two bodies, of which A has the maſs as 4, the celerity as 1; the other B the maſs as 1, but the celerity as 4; which are made equal to the forces, when yet the ball B with its force can raiſe ſome body equal to the other A to a height greater than three feet; but the body A has only the force of raiſing itſelf to the ſimple height of one foot: Wherefore, the body B at one and the ſame time has a force greater than and a force equal to that of the body A.

M. *Papin*, againſt whom M. *Leibnitz* had urged this argument,* had no other anſwer to make than that it was naturally impoſſible that the motion of the ball A could be transfer'd to the other B at reſt: But when M. *Leibnitz* had afterwards ſhown how this could be done, and taken in the conſideration of the lever for that purpoſe; *Papin* excepted, *that there were no levers perfectly rigid and inflexible;* But the force of the argument is not ſo eaſily eluded; for, granting that the motion of any body cannot be transfer'd into another unequal body; and likewiſe allowing that there is no ſuch thing as a rigid and inflexible lever, the argument will loſe nothing of its force: For, it is poſſible, that the balls A and B, which in reſpect of their maſſes are in a quadruple *ratio*, may have equal quantities of motion; and that without the ſuppoſition of the motion of the one paſſing into the other, or that there are rigid and inflexible levers: It is, therefore, poſſible, that the leſſer ball B changing its motion upwards may riſe to the height of 16 foot; and if ſo, we muſt own, that the ball B may raiſe the ball A to the height of better than three foot, whether there be any ſuch thing as a perfectly rigid and inflexible lever, or no: M. *Leibnitz*'s argument therefore ſtands good, notwithſtanding M. *Papin*'s objections.

M. *Papin*'s anſwer.

From what has been ſaid I think it in ſome meaſure evident, how unſafe it is to eſtimate the forces of bodies by the quantities of motion; and that the more, that *Des Cartes* himſelf[d] has on this ſubject excluded the conſideration of the celerity, when among other things he ſays, *we can ſay nothing well and ſolidly on the celerity, before we have firſt rightly explain'd gravity, and at the ſame time the whole ſyſtem of the world.* But tho' the Moderns have now a ſomewhat different opinion about this propoſition; yet it is evident from it, that *Des Cartes* did not think it neceſſary in eſtimating the forces to attend to the celerities, but rather to the reſiſtences, which the bodies have to overcome, as it appears expreſsly in the ſame letter.

The forces of bodies not to be eſtimated by the celerity, but rather by the reſiſtences.

* loc. cit. [d] *Epiſt.* 74. *part.* 1.

The adequate and real effects of the living forces what?

10. Becauſe, therefore, the quantities of the motion of bodies are not entire and plenary effects of the powers acting on the bodies, we muſt not thence infer, becauſe cauſes are proportional to their adequate effects, that the living forces of bodies are proportional to the quantities of their motion, as is generally ſuppoſed; and for this reaſon it remains to be diſcover'd, what then are thoſe adequate and real effects of the living forces? Now *Des Cartes* himſelf has long ago in the above letter pointed at theſe real effects, when by the bye at leaſt he orders to attend to the reſiſtences to be overcome by the aſcenſional forces: For, by this means we have effects fit to meaſure the forces; for, this propoſition, *that all the impediments of motion, which taken together do extinguiſh any force are equal to that force*, ſeems to be as clear and certain as any axiom in geometry; and it comes to the ſame thing as ſaying, *that all the parts of any whole and that whole itſelf, are equal:* For, each impediment takes away ſo many parts from the force of the body; and together, the whole force. It, therefore, remains to be enquir'd, what theſe impediments are, which exhauſt the forces of bodies: Now gravity itſelf is ſuch an impediment; for, every one knows, that any body thrown vertically upwards with a given celerity does not continue its motion *in infinitum*, but reaches only to a certain height; but it ought to aſcend *in infinitum*, if it met with no reſiſtence and impediment to its motion; conſequently, from its reaching only to a limited height, which it cannot exceed, we muſt neceſſarily conclude, that that is owing to the reſiſtences it ought to overcome in its aſcent; but theſe reſiſtences ariſe not only from the air encompaſſing the aſcending body, but eſpecially from gravity; for, ſhould they ariſe from the air alone, that body ought to aſcend to any height at pleaſure in very rare air: which as it does not happen we muſt conclude, that the ſaid height is an undoubted proof of the reſiſtence the body finds from gravity; for, gravity is that force whereby bodies tend continually towards the earth; wherefore, this force, as being contrary to the aſcenſional force, comes now to be conſider'd as a reſiſtence: This, if I miſtake not, is ſo evident, that it ſeems to require no farther proof. But, perhaps, it will not appear ſo evident, how this reſiſtence ariſing from gravity ſhould be meaſur'd? Nevertheleſs any one who attends, that the aſcending body does in each point of the height it deſcribes equally gravitate towards the earth, cannot but ſee, that the ſum of the reſiſtences to be overcome by the aſcending body is very well expounded by the product of the height of the aſcent into the weight of the body; and as this ſum of the reſiſtences (by what has been ſaid above) is equal to the force of the body in the beginning of its aſcent, it is plain, that even this *living force* is to be meaſur'd by the product of the height to which the body aſcends into the weight of the ſame body. But ſhould this, notwithſtanding, ſeem to be not ſufficiently evident and undoubted to ſuch as give in to the contrary opinion,

Gravity an impediment, and how the reſiſtence acting therefrom is meaſur'd.

opinion, I ſhall give a fuller demonſtration of this matter below. But now I proceed to other things.

Springs another impediment, and how adapted to meaſure the forces.

Among a great many other impediments to motion, this likewiſe, which is taken from equal ſprings and equally bent, is adapted to meaſure the forces. *Joh. Bernouilli* has long ago ſhown, that any body A, having two degrees of celerity, exhauſts its force on four ſimilar and equal ſprings equally bent, while the ſame body A, having 1 degree of celerity, exhauſts its force on one ſpring only equally bent; but ſuch equal and equally bent ſprings are the adequate effects capable of an exact meaſure, which thoſe forces of the body A, having at one time 2 and at another time 1 degree of celerity, can produce; but becauſe the effect of a ſwifter body is to that of a ſlower, as 4 to 1, it is, therefore, manifeſt, that theſe effects are in a duplicate ratio of the celerities. *Bernouilli*'s own argument, which here for brevity's ſake I omit, may be ſeen in *Wolfius' Element. Mechanicæ* [e]. In a yet different manner *s'Graveſande* has in his *Element. phyſices*[f] deduced the ſame thing from the theory of ſprings.

The meaſure of forces obtain'd from the laws of motion in colliſion.

11. The ſame meaſure of forces may be had from the laws of motion obtaining in the colliſion of bodies, as I have already ſhown many years ago. Let the ball A having 2 degrees of celerity and moving in an horizontal plane, impinge upon another ball B = 3A but at reſt; it will, therefore give this a celerity as 1, and A will retrocede with the celerity 1; afterwards let this ball A impinge with its celerity 1 upon another ball C = A, that is alſo at reſt, it will likewiſe give it a celerity 1, and its motion will be ſtopp'd by this ſecond impulſe: And all this is very eaſily found from the known laws of the motion of elaſtic bodies. Here, therefore, we have the ball A, which, by two impulſes upon each of the balls at reſt, *viz.* B = 3A and C = A, transfuſing, ſo to ſpeak, the ſame celerity, is reduced to a ſtate of reſt and loſes its force; it, therefore, produced the ſame effect, as if it had communicated the celerity 1 to the ball D = 4A = A + 3A; and the ſame ball A with the celerity 1 will by one impulſe alſo communicate the velocity 1 to another equal ball, and be reduced to a ſtate of reſt; the effect, therefore of the ſwifter ball is to that of the ſlower as 4A to A, that is as 4 to 1. On this account the force of the ſwifter is to that of the ſlower, as the ſquare of the celerity of the greater to that of the celerity of the leſſer.

Farther conſider'd.

And the caſe is the ſame with the ſame ball A with 3 degrees of velocity; for, in the firſt place let it impinge on the quieſcent ball B = 5A; and after this impulſe it will recoil with a celerity as 2, but it will transfer into the patient B the celerity 1: In the ſecond place let the ball A impinge with the remaining velocity 2 upon the quieſcent ball C = 3A; and again by this ſecond impulſe it will loſe one degree of velocity; and the patient C will acquire one degree of celerity: In this manner there will remain

[e] T. II. §. 327. p. 61. Edit. Sec. Genevæ, 1733.

[f] T. I. p 112.

remain to the agent A the celerity 1, after the ſecond congreſs: And if in fine, it impinge with this celerity on the equal, but quieſcent ball D, it will after this third impulſe be at reſt, and the patient D will obtain that celerity 1, which the agent A had; wherefore, as the ball A has the velocity 3, it may transfer its motion, or rather its whole force into the balls $B = 5A$, $C = 3A$, and $D = A$, ſo as to give to each the ſame celerity 1: But the ſame ball A, with the celerity 1, can ſo transfer its force only to one ball equal to itſelf, as to communicate that celerity to the patient, which the agent had before conflict: Wherefore, the force of the ball A with the celerity 3 is to the force of the ſame ball with the celerity 1, as $5A + 3A + A = 9A$ to A, that is, as 9 to 1, and that is in the duplicate ratio of the celerities.

The ſame thing will always happen whatever be the ratio of the celerities; and indeed, a curious coincidence diſcovers itſelf here between bodies, which are thrown vertically upwards with given velocities, and between bodies which with the ſame velocities impel other quieſcent bodies; for, the altitudes, in each of whoſe higheſt points the initial celerity of the aſcending body decreaſes by 1 degree, are altogether in the ſame ratio of the odd numbers, as the maſſes of the bodies are; and on which being at reſt one degree of celerity is impreſs'd by ſucceſſive ſtrokes from a body with ſo many degrees of initial celerity, as the aſcending body had at the beginning of its aſcent, which entire celerity of the percutient body is at each ſtroke diminiſh'd 1 degree; for inſtance, the body A, which aſcends with the initial celerity 2, at the higheſt point of the height of 3 foot it will loſe 1 degree of celerity, and at the higheſt point of the height next above the laſt mention'd it will in like manner loſe another degree: for, we know, that a body with its celerity 2 may riſe to the height of 4 foot, abſtracting now from the reſiſtence of the air and from the other impediments to motion: In like manner the body A with the celerity 2 impinging on the quieſcent ball $B = 3A$, by this firſt ſtroke it will loſe 1 degree of celerity; and if with its remaining celerity 1 it moreover impinge on the quieſcent ball $C = A$, and by this ſecond impulſe it will loſe that velocity: And if the ſame body A aſcend with the initial celerity 3, ſo as it may reach to the height of 9 foot, at the higheſt point of the firſt height of 5 foot, it will loſe 1 degree of velocity; at the higheſt point of the ſecond height next after the firſt 3 foot, it will ſtill loſe 1 degree; and in fine, at the higheſt point of the third height of 1 foot next after the ſecond, it will loſe its third degree of celerity. Now what will be the caſe with the ſame body A, if 3 times ſucceſſively it impinge on the quieſcent balls $5A$, $3A$ and A; on the firſt with the celerity 3? It will happen, that by the firſt ſtroke it loſes 1 degree, and if with the remaining celerity 2 it impinge on the ball $3A$, it will loſe another degree of velocity; and impinging with that degree of velocity which remains on the

third

third body A, it will loſe the third and laſt degree of celerity. All theſe things ariſe of themſelves from the doctrine of the motion of heavy bodies, and from the rules of the communication of motion.

Rules of the communication of motion deduced from the meaſure of the living forces.

12. Nay, theſe rules of the communication of motion are elegantly deduced from the meaſure of the living forces of bodies, which we have here undertaken to prove, provided this one principle be admitted, *that the ſame quantity of forces be preſerv'd in the percuſſion of bodies, as was before conflict.* For, let there be balls whoſe maſſes are A and B, their velocities before conflict a and b; and after conflict x and y; that principle, therefore, affords the equation $Aaa + Bbb = Axx + Byy$, which I may call the fundamental equation; for, according to our eſtimation of forces, the forces of the balls A and B before concourſe are as Aaa and Bbb, and their forces after colliſion Axx and Byy: It, therefore, remains from the fundamental equation to find the values of x and y, but this is very eaſily done; for, ſuppoſe the motions of the balls A and B and their conflicts to be perform'd in a moveable ſpace, as in a ſhip, which ſpace ſuppoſe to move with the indefinitely ſmall velocity dv and tend towards the ſame part towards which the ball tends; in this manner the balls A and B will before congreſs be ſeen to move from an immoveable place (as from the bank of a river, in which the ſhip or moveable ſpace is carried) with the velocities $a + dv$ and $b + dv$, and after congreſs with the velocities $x + dv$ and $y + dv$: Wherefore, if inſtead of the celerities, a, b, x and y of the fundamental equation, the ſame celerities, increas'd by the adventitious velocity of the deferent ſpace, be ſubſtituted, the equality will ſtill remain; namely $Aaa + 2Aadv + Adv^2, + Bbb + 2Bbdv + Bdv^2 = Axx + 2Axdv + Adv^2 + Byy + 2Bydv + Bdv^2$; or cancelling the quantities that mutually deſtroy each other, $Aaa + Bbb + 2Aadv + 2Bbdv = Axx + Byy + 2Axdv + 2Bydv$: But if from it be taken the fundamental equation $Aaa + Bbb = Axx + Byy$, there will remain the equation $2Aadv + 2Bbdv = 2Axdv + 2Bydv$, which divided by $2dv$ gives $Aa + Bb = Ax + By$; or by tranſpoſition $Aa - Ax = By - Bb$. But the fundamental equation ſupplies this other, $Aaa - Axx = Byy - Bbb$, which farther applied to the preceeding equation gives for the reſulting equation $a + x = y + b$: We have, therefore, deduced from the fundamental equation $Aaa + Bbb = Axx + Byy$, theſe two equations $Aa + Bb = Ax + By$, and $a + x = y + b$: The former of which plainly ſhows, that the common centre of gravity of two balls A and B moves with equal celerity both before and after conflict; for, $\frac{Aa + Bb}{A + B}$ is the celerity of the centre of gravity before concourſe, and $\frac{Ax + By}{A + B}$ is its celerity after colliſion; and the other reſulting equation ſhows, that the reſpective velocity is the ſame in the acceding balls before impulſe, as in the receding balls after impulſe.

Now

Now from the equation $a+x=y+b$ is deduced $y=a-b+x$, which value ſubſtituted in $Aa+Bb=Ax+By$ gives $Aa+Bb=Ba-Bb+Bx+Ax$, from which is deduced $x=\frac{Aa-Ba+2Bb}{A+B}$; wherefore, $y=\frac{a-b+x}{A+B}=\frac{2Aa-Ab+Bb}{A+B}$, which celerities were to be deduced from that ſingle principle aſſum'd and from *Leibnitz*'s meaſure of forces.

The living forces are as the products of the maſſes into the ſquares of the velocities.

13. The equations, juſt now found, and determining the values of x and y, furniſh thoſe very rules of motion from percuſſion, which *Wren*, *Wallis*, *Huygens*, *Mariotte* and others have long ago given for elaſtic bodies, and eſtabliſh'd on other principles. What we have, therefore, diſcover'd in the preceeding § may very well ſerve to prove our theſis, namely *that the living forces of bodies are as the products of the maſſes into the ſquares of the velocities*, employing the concluſion as a premiſs, and from this afterwards deducing, that $Aaa+Bbb$ is $=Axx+Byy$; for, if m denote the vertical height, by which a deſcending body A with a motion naturally accelerated acquires at its lower extremity the velocity a; but n denote the height, in whoſe lower extremity B with a motion in like manner accelerated acquires its celerity b; in like manner p and q are the heights which the ſame balls A and B with their initial celerities x and y can paſs over with a motion naturally retarded, and m, n, p and q will be proportional to the ſquares of the celerities aa, bb, xx, and yy, taken in the ſame order; ſubſtituting, therefore, thoſe proportional heights inſtead of aa, bb, xx, and yy, in the preceeding equation, there will reſult the equation $Am+Bn=Ap+Bq$, or even this equation $\frac{Am+Bn}{A+B}=\frac{Ap+Bq}{A+B}$: But now the fraction to the left denotes the quantity of the deſcent of the common centre of gravity of the balls A and B, while they run down the heights m and n; and the fraction to the right denotes the quantity of the aſcent of the ſame common centre of gravity of the balls A and B, while they riſe thro' the heights p and q: Wherefore, we muſt conclude, that the quantity of the deſcent of the common centre of gravity of the balls A and B before conflict is the ſame with the quantity of its aſcent after conflict, ſuppoſing the balls A and B to change their motion, acquir'd in conflict vertically upwards, in the ſame manner as we ſuppos'd their velocities before congreſs to have been acquir'd by an accelerated deſcent through thoſe heights, which a little before we hinted at: But the quantities of the deſcent and aſcent of the common centre of gravity of the balls A and B, multiplied into the ſum of the bodies $A+B$, are the meaſure of the forces before and after their concourſe: In this manner at leaſt, the illuſtrious *Huygens* ſeem'd to have always eſtimated the forces of ſeveral bodies moving together, or acting mutually on each other, as appears from many places of the demonſtrations he has given in his poſthumous works about the rules of motion

from

from percuſſion, and more clearly ſtill from his theory of the centre of oſcillation, which he has exhibited in his *horologium oſcillatorium*. But if the ſum of the forces of the balls *A* and *B* ſhould be expounded by the product of the deſcent of their centre of gravity into the ſum of their weights, and the ſum of the ſame forces by the product of the aſcent of the ſame centre of gravity of the balls *A* and *B* into the ſum of their weights, why may I not, nay, why ought I not to expound their forces apart by *Am* and *Bn* before their congreſs, and after their congreſs by *Ap* and *Bq*? But there is no occaſion to dwell longer on this argument, as I have others of greater weight; and among theſe no one ſeems more evident to me than that, which ariſes from the conſideration of the manner, in which any living force may ariſe from a dead force.

The meaſure of the living force of a body obtain'd from its dead force when gravity is uniform.

14. In order to obtain the meaſure of the living force of any body from its dead force, I proceeded thus: I propos'd to myſelf the heavy body C, falling with a motion naturally accelerated in the vertical line *AH*, ſo as in *A* to begin its motion from a ſtate of reſt: In the beginning of its motion, therefore, I obſerv'd the body *C* deſtitute of all living force in *A*, becauſe there it has no motion, and a living force is aſcrib'd only to bodies actually in motion; yet it ought to have there a dead force, becauſe it is a heavy body, and has its determinate weight; this dead force I expounded by the right line *Aa*, perpendicular to the other *AH*, but after it was carried to *E*, there it now acquir'd ſome living force, becauſe there it acquir'd ſome determinate degree of celerity; but laying aſide for a little the conſideration of celerity, we are to enquire from what, in what manner and what quantity of living force it has gain'd in *E*, after its deſcent through the ſpace *AE*. But this living force could from nothing other have acceded to the body *C* than from its dead force; for, we have nothing other to conſider here beſides the body *C*, its gravity and the ſpace *AE* thro' which it fell; but this ſpace is merely paſſive, and contributes nothing to the motion; nor can the body *C*, conſider'd as extended, and furniſh'd with its own determinate maſs, produce any motion; and therefore, whatever degree of motion and force the body *C*, carried to *E*, has, may proceed from the dead force inceſſantly acting on the body, while it runs over the ſpace *AE*; but in what manner? As the body *C*, when it is in *A*, is urg'd by the dead force *Aa*, in *B* by the dead force *Bb*, in *C* by the dead force *Cc*, in *D* by the dead force *Dd*, and in *E* by the dead force *Ee*, ſo the ſame body *C* is urged, in each point of the ſpace run over, by ſome dead force, equal to *Aa*, if the gravity of bodies be uniform, ſo that the *locus* of all the dead forces urging the body *C* in the ſpace *AE* be the rectangle *AaeE*; on this account the living force acquir'd in *E* can neither be greater or ſmaller than the ſum of all the dead forces, which may be contain'd in the rectangle *Ae*, which ſum is expounded by this very rectangle: Wherefore, the living force, acquir'd in *E* by the deſcent thro' *AE*, is to the

living force, acquir'd in H by the deſcent thro' AH, as the rectangle Ae to the rectangle Ah (or becauſe theſe rectangles have the ſame common height Aa) as the ſpace AE to the ſpace AH. And theſe things hold thus, when the gravity in every diſtance from the earth is the ſame.

When gravity is different at different diſtances from the earth. Plate VI. Fig. 2. Demonſtration.

But what will be the caſe if, according to the Moderns, gravity be alſo different in different diſtances from the earth? Let us, therefore, ſuppoſe the moving body C to be urg'd in the points A, B, D, of the ſpace AH by the dead forces, which the ordinates Aa, Bb, Dd of any curve adh, and paſſing through the ſaid points, do repreſent. Now if the deſcent begins again in A from a ſtate of reſt, the living force, which the body deſcending thro' the ſpace AE has acquir'd in E, is nothing other than the aggregate of all the ordinates Aa, Bb, Dd, Ee, which are contain'd in the area $AaeE$; for, it ſolely ariſes from all theſe mutually ſucceeding each other; wherefore, the ſaid area $AaeE$ denotes the living force of the body in E, acquir'd by the deſcent thro' AE, and the area $AabH$ denotes the living force of the ſame body in H; wherefore, the living force in E is to that acquir'd in H, as the area $AaeE$ to the area $AabH$, as the ordinates of theſe area's expound the weights of the body C at different diſtances from the earth.

Fig. 2. Demonſtration.

And if the body C deſcend in any curve AEH, and its weights at different diſtances from the earth be expounded by the ordinates ap, bq, dr, &c. of the curve prt, the force of the body acquir'd in E by its deſcent in the arch AE, will be ſtill to the force, acquir'd in H by the deſcent in the arch AH, as the area $apse$ to the area $aptH$. Let the body come from A to D, and let us conſider with how great a dead force it is there urg'd along the tangent DG of the curve in D, when its gravity or weight in D is expounded by the ordinate dr; for that purpoſe, let us ſuppoſe the arch $AD = s$, the abſciſſa $ad = x$; the ordinate $dr = g$; the element of the arch, or $Dm = ds$, the element of the abſciſſa, that is, $nm = dx$; let DF parallel to Ha expound the gravity of the body C in D; and letting fall from F the perpendicular FG on the tangent to the curve DG, and the dead force DF will be reſolv'd into the lateral forces DG and GF; the latter of which is weaken'd by the curve along which the body proceeds; and therefore, deſerves no regard in this place; but the former, namely DG, is the tangential dead force, which has every where its effect, in regard nothing other reſiſts it than the air and the roughneſs of the curve: But we now lay aſide theſe external impediments to motion, as if they were not. Having now laid down all theſe things, the ſimilar triangles DFG and Dmn give $DG = \frac{g\,dx}{ds}$: Let us multiply this into the element of the curve $Dm = ds$, and the product $g\,dx$ will denote the increment of the living force, which acceded to the body, while it paſs'd from one extremity D of the element Dm to its other extremity m, and by

ſumma-

ſummation, the living force in D or m = the ſum of all $g\,dx$, contain'd in the area $aprd$: Wherefore, the living force in D is equal this area $aprd$, and the living force in H = the area $aptH$. Q. E. D.

In the preceeding article we for facility's ſake ſuppos'd the directions DF of the bodies to be parallel; and the argument is of equal force, if theſe directions converge to any centre; for, in that caſe the right lines Aa, Bb, Dd, &c. which are parallel to the horizon, will now run into circular, concentric arches, whoſe common centre is that point, towards which the directions of the bodies converge. The argument is of equal force, if the directions converge to any centre.

15. How evident ſoever the preceeding argument may be, or at leaſt may ſeem to me; yet we muſt remove an objection, which may cauſe a difficulty with ſome: And it was objected, when firſt I propos'd this argument in a meeting of the *Academy*, that in like manner the argument proves the living force of any body ſhould be expounded by the product of the time of deſcent into the dead force of gravity, if gravity be uniform, that is, be every where the ſame; and in that caſe, that the living forces of bodies become proportional to the times, in which they acquire theſe forces, if the bodies are of equal maſſes; but if of unequal maſſes, that then the living forces would be in the compound ratio of the times and maſſes. Let LM, LN, LO, LP and LQ (fig. 4.) be the times in which the ſpaces AB, AC, AD, AE and AH (fig. 1.) are run over. Now as in each moment of time apart L, M, N, O, &c. the gravity is uniform, ſo that it may be expounded by the equal, right lines Ll, Mm, Nn, Oo, &c. Why may not with equal truth the ſum of all the ordinates Ll, Mm, &c. contain'd in the rectangle $LlmM$, that is, this rectangle itſelf expound the living force, acquir'd by a body at the end of the time LP, as it was expounded by the rectangle $AEea$ above (fig. 1.) and that becauſe this rectangle is the *locus* and ſum of all the Aa, Bb, Cc, &c. contain'd therein; when yet LP (fig. 4.) is the duration of the action of gravity, juſt as AE (fig. 1.) is the ſpace of deſcent in the ſame time? I then made anſwer, that this latter way of arguing could not take place of the former, in regard that both the time and the celerity are only modal and incompleat *entia*, but that the ſpace run over by the deſcent is a real *ens*, indicating the number of dead forces collected together, as it were, into one ſum, which is the living force: I, moreover, added, that the deſcending body is in a different ſtate in different points of the time, and that not only the maſs of the body C, but likewiſe its ſtate, or motion, is to be taken into the conſideration along with the agent gravity and the ſmall time of action, which I ſhow'd as follows: Let $LO = t$, the time in which the living force V is acquir'd, $OP = dt$, the element of this time, as dV is the element of the acquir'd force, or its increment during the ſmall time dt. As that increment of the living force dV ariſes from the gravity g acting on the body C, which body may now have the celerity u, and

An objection anſwer'd.

Plate VI. Fig. 4

Demonſtration.

and the maſs M; and conſequently the quantity of motion Mu, a regard muſt neceſſarily be had to the quantity of this motion; for, in this ſtate in which it is a moving body, celerity is inſeparable from it; the increment, therefore, of the living force will be compounded of theſe 3, namely g, Mu, and dt; and therefore, dV will neceſſarily be equal to $gMudt$, and not, as is commonly ſuppos'd, $dV = gMdt$: But now $udt = ds$, if ds deſign the element of the ſpace, and gM will denote the gravity of the body C; if, therefore, we would adapt the *formula* $dV = gMudt$ to fig. 1. in which I put $AD = s$, $DE = ds$; and any ordinate Aa, Bb, &c. $= gM$, it will be $dV = DdeE$; and by ſummation, $V =$ the rectangle $AaeE$, as we found it § 14. from which it appears, that even the conſideration of the time and celerity conduces to the ſame meaſure of the living forces found above, providing we rightly take it

Fig. 4. Demonſtration.

16. But if the force of the body C, acquir'd in the time LP, were to be expounded by the rectangle $LPpl$, in which Ll or Mm, &c. would repreſent the ſimple gravitation or dead force of the body C, and the rectangle $PQqp$ the force acquir'd in the time PQ, theſe ſame rectangles Lp and Pq would likewiſe repreſent the reſiſtences the body C would have to ſurmount in its aſcent in the times PL and QP, in regard that the aſcent of the body is contrary to the continual action of gravity; and ſhould gradually be extinguiſh'd: Wherefore, if the times LP and PQ were equal, the rectangles $LPpl$ and $PQqp$ will be equal; and conſequently, the reſiſtences to be overcome in thoſe times. Let us now ſee, whether and how far theſe things agree with the rules of the motion of bodies falling by gravity? Let the body C fall with an accelerated motion begun in A from a ſtate of reſt through the ſpace AE (fig. 1.) in the time LP (fig. 4.) and through the ſpace AH in the time LQ; wherefore, if carried to E it change its motion acquir'd there vertically upwards, it will arrive by its aſcent to A, and no higher, on account of the reſiſtence of gravity: As, therefore, this reſiſtence (by *hypotheſis*) is expounded by the rectangle $LPpl$ (fig. 4.) and the reſiſtence of the ſame body, aſcending from H to A, is expounded by the rectangle $QLlq$, ſuppoſing LP and PQ equal, the reſiſtences, which the body aſcending from H to E, and afterwards from E to A undergoes, muſt be likewiſe equal: But if the time of aſcent through HA be double of that through EA, HA will be quadruple of EA; and conſequently, HE will be triple of EA: Wherefore, the times of aſcent; and conſequently, the reſiſtences in the height HE as 3, and in the height EA as 1, would be equal; but this cannot happen, but that gravity does not act uniformly in the whole length of both ſpaces, but by ſtarts and difformly, which is very abſurd and contrary to the receiv'd doctrine about the motion of heavy bodies: For, this doctrine ſuppoſes, that a body, in all the points of the ſpace it runs over, or in which it aſcends, is heavy; but, to be heavy denotes to be there urg'd by ſome force,

where

where the body is; and conſequently, in the common ſyſtem of gravity, the body is urg'd by gravity in every point of the ſpace it is found in; and that not only in the more common ſyſtem of uniform gravity, but likewiſe in all other ſyſtems that can be devis'd; for, the univerſal doctrine of central forces involves a continual action in all the points of the ſpace, without which action this doctrine, now univerſally approv'd of, cannot conſiſt.

17. It is, therefore, made out, that the living force, acquir'd by the body in *E* (fig. 1 and 2.) by an accelerated deſcent from *A* to *E*, is to its living force, acquir'd in *H* by the deſcent from *A* to *H*, as the area *AEea* to the area *AHha*, but not as the area *LPpl* (fig. 4.) to the area *LQql*, ſuppoſing that *LP* and *LQ* repreſent the times of deſcent in the ſpaces *AE* and *AH*, and the ordinates *Ll*, *Mm*, &c. repreſent the gravity of the bodies: From which it ſpontaneouſly flows, that the living forces of bodies are neceſſarily as the products of their maſſes into the ſquares of their celerities; which we have chiefly undertaken to deduce from the theory of the motion of heavy bodies, tho' the argument, borrow'd from the colliſion of bodies (§ 12, 13. *ſupra*) ſeems likewiſe to us very ſtrong and beyond all exception. [*To be continued.*]

The living forces of bodies as the maſſes into the ſquares of the velocity.

Of the family and various properties of Amber. From the Electrologia *of* Nathan. Sendelius, An. 1728.

Tranſlated from the LATIN.

IT may be doubted to what family or claſs, whether to that of ſtones or bitumens, ambers are to be refer'd, authors differ ſo much about it; for, you may find ſome among them, who claſs them with bitumens, and others who rather make them a kind of ſtone: Each have their own reaſons, and as they ſeem to be of ſome weight, they have given a handle to others to ſuſpend their judgment: And hence it happen'd, that ſome of theſe laſt authors have refer'd them both to ſtones and bitumens: Among theſe was *Magirus*, according to *Hartmann*[a], and *Anſelmus de Boot*[b] is in ſome meaſure charg'd with the ſame miſtake; not to mention many others, eſpecially of the ancient naturaliſts.

Different opinions about the genus of amber.

Among thoſe, who refer ambers to the genus of ſtones and particularly to that of gems, the moſt celebrated is *Hartmann*, who in this had many followers. As to his arguments, that ſulphurs and bitumens are ſoluble in oil, but amber not ſo, and that this latter exceeds the others in ſolidity, and that it does not run in a gentle heat, &c. they ſeem not to be of any great weight; for, as to the firſt, to wit the ſolution of ambers in oil, which they have not in common with other bitumens, nothing more can be

Hartmanni's arguments for referring ambers to the genus of ſtones conſider'd.

[a] Hiſt. Succin. Pruſſ. *lib.* II. *cap.* 2. § 9. *p. m.* 12. *It. cap.* 6. *p.* 21.

[b] *Vid.* Hiſt. lapid. & gemmar. *lib.* I. *cap.* 1.

be concluded from it than that ambers are of a ſomewhat firmer texture or coheſion than other bitumens: And who can deny, that ambers may be entirely diſſolv'd in oil? as I myſelf have ſeen it done by an ordinary heat in rape-ſeed oil, leaving only behind thin *capſulæ* not unlike honey-combs[c]. But ſhould I allow, that ſuch amber was more tender or friable, and not ſufficiently ripe, yet I have obſerv'd elſewhere, that more ſolid ambers have been affected by boiling[d]: And ſuch is the penetrating force of lintſeed oil, that if it does not conſume or entirely diſſolve ambers, at leaſt it ſo deſtroys them, that they retain nothing of their priſtine firmneſs: Whence amber-turners ſhould beware of the adulteration of rape-ſeed oil therewith,

The melting of ambers appears from experiment.

That the melting of amber cannot be entirely denied appears by experiment. Upon applying different degrees of heat, leſſer bits of amber being melted may be made to run into a larger maſs; and this is confirm'd to us by the teſtimonies of *Kerckringius*, *Morhoof*, *De Boot* and others, nay of *Hartmann* himſelf; and tho' the amber loſes ſome of its virtues, yet this operation may be rightly call'd the liquefaction of amber: Not to mention other operations deſcrib'd elſewhere,[e] I ſhall at preſent only name that eaſy *encheireſis*, by which a thin piece of amber being heated over the flame of a burning candle becomes ſo ſoft, as to be manageable at pleaſure; nay, may receive the impreſſion of a ſeal and that with a ſmall force. As to the ſolidity of ambers it is not ſo conſiderable, as that they may be refer'd to the claſs or family of ſtones, as they beſides, entirely want many other, either eſſential or accidental properties of the latter. I own there is a great difference obſerv'd between *bitumens*: From purer petrol amber and ambergris do concrete; from groſs and black petrol, the other more ignoble *bitumens:* But all theſe muſt be ſaid to differ rather in degree of mixture than nature, according to *Sturmius*[f]; which limitation will alſo hold of the greater or leſſer ſolidity and hardneſs of different *bitumens*; and the melting of ſtones and amber is different, as the former in fluxing yield a glaſs or *calx:* Whereas on the contrary, the liquefaction of amber does not entirely deſtroy, but only on account of the flying off of the ſalts, diſſipated by the fire, change their ſolidity and colour. That other ſtones burn as well as amber, as of that nature eſpecially is the pyrites (for, I except the agate and pit-coals, which are not referable to ſtones) the reaſon is, becauſe this ſtone has in its concretion a large admixture of ſulphur and inflammable matter, which after it is burnt out leaves the ſtone porous and exhauſted of its inflammable matter, and is commonly call'd a pumice-ſtone: But that the pyrites holds much ſulphur appears by ſtriking it with a ſteel, as alſo from chemiſtry, whereby true ſulphur may be

[c] *Vid.* Acta Germanica, Vol. I. p. 346. An. 1742. [d] L. c. p. 348. 349.
[e] L. c. p. 347. ſeqq. [f] *Vid.* Phyſic. conciliatrix part. Specialiſſ. *Sect.* I. *cap.* 1. § 3. *p.* 195.

be obtain'd from it, as *De Boot* remarks and ſhows the manner of the proceſs[g]. Whence it is, that modern Naturaliſts do not only conjecture, but ſolidly demonſtrate, that the pumice-ſtone itſelf is nothing elſe but a burnt ſtone, that has undergone the fire, and is thrown out of the cavities of mount *Ætna* and *Veſuvius*. And if all the *phenomena* of this burning ſtone be compar'd with amber, they will agree in no reſpect; as after exhauſting and burning out the ſulphur of the pyrites it may ſtill remain a ſtone: But amber on the contrary is entirely conſum'd in the burning, leaving behind no trace of its ſubſtance, not ſo much as earthy or ſtony particles: Wherefore, it appears, from what has been ſaid, how weak the arguments are for claſſing amber with ſtones; and that it is rather a bitumen appears from its origin. *Hartmann* himſelf allows, that amber is originally ſoft, and that the experience of people of credit teſtifies, that it has run in its veins like a limpid oil; and that the workmen in cutting it have ſometimes met with ſomething of a liquid or oily bitumen: And as amber is an oil, or liquid bitumen originally, after it is harden'd and has attain'd its due conſiſtence, it muſt ſtill remain a bitumen and not a ſtone, the materials of which laſt are different, as clayey, earthy, ſaline and rocky. Amber may be diſſolv'd, ſoften'd, bent, melted, ſet on fire, and in fine, be entirely deſtroy'd by burning, ſo that all of it ſhall evaporate: From all which *phenomena* one muſt conclude, that a ſtone is entirely different from a bitumen.

Amber a bitumen.

It ſhould ſeem ſurpriſing, what firſt gave riſe or occaſion to the claſſing amber among ſtones, and eſpecially gems: And I ſhould think, that it proceeded from the inconſiderate appellation of the ancients, whereby amber being abuſively, rather than truly and properly, called a gem, becauſe it counterfeited a ſpecies of gem, or was held of the ſame rank and value with gems, the error has been handed down to us. *Pliny*[h] ſeems to confirm this, when he ſays, that in his time amber was equally valu'd with gems; nay, employ'd in adulterating gems[i]; and *Martial* alſo calls it a gem[k]. And no otherwiſe did the ſucceeding authors of later times, not ſo much from any certain and true properties, but rather from ſome agreement in colour, call amber, a gem, as it ſeem'd to expreſs by its colour, a chryſolite, carbuncle, hyacinth, topaz and the other differences of gems[l].

The occaſion of amber being reckon'd among ſtones.

If I were allow'd to give a definition or deſcription of amber, it would be as follows; namely, *that amber is a* bitumen, *produced in* Pruſſia, *but eſpecially in the bituminous ſoil of the coaſt of* Sudau *and concreted to a proper degree of hardneſs, emulating a gem in its properties, as in brightneſs, colour, ſmell, its force of attracting light bodies or its electricity, and in its medical virtues exceeding all gems and bitumens, nay ambergris itſelf.*

Definition of amber.

Among

[g] *Vid.* hiſtor. lapid. & gemmar. *lib.* II. *cap.* 190. *p. m.* 520.
[h] Hiſt. Nat. 87. *cap.* 2.
[i] L. c. *cap.* 3.
[k] *Lib.* IV. epigr. 51. & *Lib.* VI. epigr. 15.
[l] *Vid.* Boetius de Boot, *lib.* II. *cap.* 1. *p. m.* 324.

Electricity a principal property.

Among the properties of amber, its electricity is the grand and capital one; and among all electrical bodies this is more peculiar to amber; a property not ſo well known and free of all doubts, as might, indeed, ſeem upon a tranſient view; for, in my opinion, there are difficulties therein, which I now deſign to note, and if poſſible, clear up and remove with all imaginable care; as I ſhall execute this taſk not ſo much by bare ſpeculalation, as rather by experiments I devis'd for that purpoſe.

The common theory of electricity.

I preſuppoſe (in order briefly to form a common conception of electricity) the powers of attrition and friction to be otherwiſe well known in phyſics; by means of which two ſolid bodies nimbly mov'd may be brought to heat, as is not only evident in rubbing two pieces of green wood, as alſo in waggons and other carriages, but eſpecially, which is a more ſurpriſing experiment, the ſame thing is ſhown in iron, which by the repeated blows of the ſmith is not only heated, but glows. I moreover preſuppoſe the well known effects of heat and cold, happening either from the rarefaction of the air or its condenſation; from which it ſpontaneouſly follows, in what manner amber may not only be heated by attrition againſt a ſtiff piece of cloth, or other the like body, but likewiſe in what manner this heat, produced in amber, makes the air in its atmoſphere more rare, and afterwards how by the preſſure of a heavier and denſer air light bodies in its way are at the ſame time attracted by it, which effect, according to the opinion of the greater number of authors ſhould be rather call'd a pulſion than attraction.[m]

Inſufficient to account for it, as appears from an experiment of Mr. *Boyle*'s.

This is the genuine and common theory of electricity, to which almoſt all, at leaſt moſt naturaliſts, give in: But that it is inſufficient, and that this *phenomenon* of electricity cannot be determin'd in this manner alone, more than one reaſon ſeems to perſuade; for, ſuppoſing this hypotheſis to ſtand good, doubtleſs, many, nay all heated bodies ſhould have this electric force; and other learned men, upon more accurately examining the matter, were alſo well appriz'd of this, and hence devis'd various reaſons of this *phenomenon*, which we ſhall note and produce up and down, after firſt premiſing the experiments I myſelf made: In the mean time, however, let this one experiment of Mr. *Boyle*'s ſuffice for overturning the above-mention'd theory; who, being about to examine, whether the motion of the excited air had any effect on the attractions produced by amber, ſet about with much apparatus a very difficult experiment by including an animated particle of amber, heated by friction, and for a long time retaining its electric virtue, into an exhauſted receiver, in ſo artful a manner, as to ſtand near a piece of ſtraw; and in the experiment he obſerv'd, that by the ſlighteſt touch the amber took up the light body, nay and repeating the experiment it rais'd it up without any contact, that is, attracted it[n]. But I proceed to my own experiments: I

[m] *Vid.* Sturm. phyſ. conciliat. Part. Specialiſſ. Sect. 1. *cap.* 1. § 7. *p.* 198.

[n] *Boyle*'s obſervations on the original of qualities.

I had at hand a vigorous and well poliſh'd glebe of amber, which I conſtantly us'd in all my experiments, leſt any unlook'd for effect, caus'd by different glebes, ſhould miſlead the experimentor; this glebe, when heated by attrition on the palm of my hand, I obſerv'd readily to attract ſlips of paper laid on the table: Pouring ſome drops of oil of almonds on my palm, I again rubb'd the glebe to the ſame degree of heat, but upon applying the glebe to the ſaid ſlips, its priſtine effect of attraction ceas'd; and again ſhifting the experiment, and drenching the ſlips in the oil and approaching the glebe when heated without oil, I obſerv'd all of them to be attracted. The Author's experiments. Experiment I.

I choſe another method, calling in to my aſſiſtance a coal-fire, becauſe the effect of electricity by any heat, even without attrition, is promoted; and therefore, approaching the glebe heated over the coals to the ſlips, more than once I obſerv'd it take them up, namely while the heat laſted, which in this manner is longer conſerv'd than by friction alone; and ſhifting the experiment, becauſe there ſtood a burning candle hard by, I caus'd heat the glebe over its flame: But my ſurpriſe was great, when I obſerv'd no attraction of the ſlips thereto: Whereas at the ſides of the glebe, where the ſmoke of the flame had not reach'd, they were taken up. As I was reflecting on this *phenomenon*, I by chance happen'd to wipe the glebe, after which it again readily attracted, tho' it was excited by no new heat than only what it had before. Experiment II.

It happen'd at the ſame time, as I was employ'd in making theſe experiments, that another *phenomenon*, hitherto new to me, offer'd itſelf, when I caus'd the ſmoke of an extinguiſh'd wax-candle, which I choſe on account of the leſs ſtench, to be attracted by the electrical glebe. This experiment was in ſome reſpect known to me, and was firſt hinted at, out of curioſity, as far as I know, by the ingenious Mr. *Boyle*[a]; but I find it obſerv'd neither by him nor by any other author, that that ſmoke is once only attracted, and that after that firſt attraction the virtue of the amber employ'd is loſt; an obſervation which was, doubleſs, omitted by theſe authors, or not attended to by them, becauſe probably they thought it enough, that they had ſeen the ſame effect once, and noted the force of electricity even in this attracted body. To be ſhort, any one will ſee, that the ſmoke, once attracted by the electrical glebe, is not farther attracted, but afterwards aſcends directly upwards, whether the electrical glebe be applied without intermiſſion to the aſcending ſmoke, or after ſome time be applied thereto again: But if the ſmoke, once deriv'd into the glebe of amber, be directly wip'd off, its priſtine electrical virtue will in an agreeable manner return, and continue for three or four times, if the glebe while ſtill hot be ſo often carefully wip'd: I ſay this muſt be done carefully, leſt inſtead of wiping you rub too hard, which alone might be a kind of friction: A new phenomenon obſerv'd. Experiment III.

[a] L. c.

tion: Beſides, whoever would accurately make the experiment, muſt firſt take care to heat the attracting glebe either over a burning candle, or even burning coals; for, thus the heat is both conſerv'd longer in the glebe and the reiteration of the electricity at different intervals is a curious *phenomenon.*

Experiment. IV. That any wet deriv'd to the glebe now excited by friction and diſpos'd to attraction, or that the bare breath hinders its attractive force, has, probably, been very well known and experienced by others; and, if I miſtake not, aſcrib'd to a falſe cauſe, as if by this adventitious wet the glebe remitted of its heat. Upon repeating this experiment, indeed, I ſeveral times obſerv'd, that breathing upon it did ſometimes no hurt to the attracting glebe, and ſometimes really check its attractive force; and in what this difference may conſiſt will be no difficult matter to divine, as it is to be ſought for both from the degree of heat in the attracting glebe; namely, as that heat can diſſipate or not the vapours of the moiſt breath, and from a longer or ſhorter time interpos'd between the act of attraction; for, it happen'd that a glebe, which this moment attracted not, as ſoon as it receiv'd the breath, would the next ſucceeding moment ſucceſsfully attract; namely, as that vapour was diſcuſs'd by the heat of the glebe, both the preſence and the going off of the vapour being manifeſt to the eye; to wit, as the glebe offer'd itſelf to my view, either overcaſt with obſcurity, or conſpicuous in its ſmoothneſs and politure.

Concluſions. What all theſe experiments may teach ſeems, probably, evident even without my hinting it; for, they very manifeſtly confirm, that *effluvia* proceed from the body of the amber: In regard, that even by a tranſient view we obſerve, that the pores of the amber, when obſtructed by any matter, reſtrain their electrical force, but that when unlock'd and open'd, they again exert their electricity.

The different *phenomena* and circumſtances of Experiment I. explained. Among all the matters that block up the pores of amber, and conſequently, reſtrain its electrical *effluvia*, oil is the groſſeſt: And as the *phenomena* of this experiment were not always the ſame, it will not be entirely diſagreeable nor perhaps uſeleſs to relate them here. I ſaid above, that I us'd oil of almonds in making the firſt experiment, but it was ſomewhat ſtale, ſo as to twinge my ear; and it gave me the hint, whether the ſame obſtruction of the pores of the amber would happen with other more fluid oils. I had at hand (I relate the proceſs in the ſame order I treated it) neat-foot oil almoſt a year old, and beſides, limpid and clear like thinner oil, by digeſting in a window in the ſun, and proceeding with this in the ſame manner, as with that of oil of almonds, the event was not entirely alike, in regard the anointing with this oil upon the amber-glebe or the rubbing it therewith, gave no check at all to the attraction: Surpris'd, therefore, at the event; and now more than ever making the viſcidity of the oil of almonds to be in fault, I employ'd other fats and oils in the experiment. The effect of pig's-lard was the ſame with that of oil of almonds,

which

which was not to be wonder'd at, as it was equally ſtale and viſcid: It, therefore, remain'd to apply the ſubtiler and diſtill'd oils in the proceſs; yet all of theſe, tho' very pure and freſh, as oil of mint, marjoram, thyme and lavender, when rubb'd on the amber, depriv'd it of its attraction, without any, nay not the leaſt act of electricity appearing: As, therefore, from theſe experiments it ſufficiently appears, that almoſt all oils and fats, communicated to amber in rubbing, reſtrain its electrical force, the reaſon remains to be diſcover'd, why neat-foot oil, applied for this purpoſe, preſerves its electricity entire? The ſolution of which will not at this time give me any anxiety; for, there are many other experiments that might and ought to be made; and there are alſo various circumſtances, which vary this experiment, in regard that that very neat-foot oil above-mention'd, when a year old, equally hinder'd the attracting force of the amber: Whereas on the contrary, the freſher ſort, prepar'd for this end, and rubb'd on a glebe, did in no manner reſtrain its attraction. Whence, whether the greater viſcidity and tenaciouſneſs of this oil, or its acrimony, be in fault, which promotes more the obſtruction of the pores of amber, I leave to the judgment of others.

Why ſmoke reſtrains attraction.

That the ſteam receiv'd from a burning candle and deriv'd into a glebe of amber, but eſpecially, that that fluid aggregate we call ſmoke, when it is once attracted, does reſtrain the farther attraction of the amber, is above all others a ſurpriſing *phenomenon*; for, the anointing a glebe with oil and the rubbing it therewith, ſeems evidently to change its former poliſh'd appearance; ſo that we may obſerve by the eye the outlets of the *effluvia* ſtopp'd and block'd up: But by the ſteam or ſmoke of a burning candle, receiv'd only once on the glebe, its appearance is in no manner chang'd; and yet we muſt neceſſarily conclude from the effect already mention'd, that the very ſubtile pores of the amber are block'd up by the matter of the no leſs ſubtile ſmoke.

The reaſon of the *phenomenon* in an amber-glebe rubbed to a heat and wetted.

We have in like manner remark'd, that wet alone or breathing on the glebe does, by the experiment above alledged, reſtrain electricity: Wherefore, we may ſee, that a watery matter, or at leaſt a very ſubtile watery vapour may obſtruct the *effluvia* proceeding from the amber. But it will here ſeem curious to the experimentor, that the glebe, rubb'd to a heat, and charg'd with the moiſt, nay the warm breath of the mouth, does not immediately attract, as ſoon as it is applied more nearly to the light bodies to be attracted, but in ſome ſmall time after ſnatches them to itſelf; the reaſon of which *phenomenon* is this, namely, that the internal heat of the glebe could not directly at firſt reſiſt the vapour flowing to it, but in ſome time after, this vapour being diſſipated, the amber exerts its power of attraction: Whence, whoever would ſet about this experiment with greater accuracy will chuſe the winter as the propereſt ſeaſon, in regard that then the vaporous humour deriv'd into the hot glebe is evidently condens'd and

collected by the external, ambient, cold air, and also soon after dissipated by the heat, the glebe, which was before seen as overcast with a watery vapour, in the mean time acquiring a certain politure and splendor: All which as I revolv'd with myself, there came into my mind a question formerly propos'd in the *Philosophical Transactions*[p]; *viz. whether the electrical virtue of amber, and the directive virtue of the magnet are subject to any alteration by an intense cold?* And *Kircher*, is of opinion, that electricity is diminish'd in thick, foggy weather. The apprehension of these authors, indeed, however groundless, even according to *Hartmann*[q], yet the circumstances just now mentioned and more accurately observ'd in this experiment, according as it is made in winter or summer, might in so far show some different effect; nay I doubt not, but am rather persuaded from experience, that the heat, amber acquires by friction, is sooner lost in winter by means of the cold, as is also the electricity, which I shall show below to be continued in the summer or in a warm stove in various manners.

Electricity how perform'd.

What firm and unshaken doctrine may be drawn from the above-mentioned experiments and their reasons is obvious; namely, that electricity is perform'd by substantial emanations from the attracting body, and in a mechanical manner; for, if it were the effect of a mere quality, and should it be call'd bare pulsion from a heavier to a rarified air, the rubbing of the bodies just now mentioned upon it, by which the heat of the amber glebe is neither lost nor impair'd, would be no impediment at all thereto: Not to mention the testimony of the senses and of the odour only, which amber yields upon friction. From the agreement of this with other reasons is inferr'd, that *effluvia* proceed from amber, and that by means thereof its electric virtue is exerted.

The manner how *effluvia* act in attraction, and the diversity of opinions about it.

Tho' we have shown that *effluvia* proceed from electric bodies, it remains to show whether and in what manner they act in attraction, and what that mechanical manner is, in demonstrating which almost all naturalists are greatly employed.

I have cited above the opinion of those who ascribe the pulsion of light bodies towards a heated electric body to a heavier air, and make this the bare cause of attraction; but as this is insufficient, for the reasons there alledged, to account for it, I shall next adduce the opinion of such as hold, that that effect is owing to the air, and yet at the same time admit of *effluvia* proceeding from amber, so that the said attraction is perform'd both by the air and the *effluvia* in conjunction.

But neither thus is every difficulty remov'd, as they also differ in describing that mechanical motion and the manner thereof, by means of which motion the *effluvia*, proceeding from the electric body, do by the pulsion of

[p] Num. 19. p. m. 284. [q] Hist. Succ. Prus. lib. II. c. 3. §. 4. *in fin.*

of the air return to the ſame body and carry back with them whatever they meet in their way; for, ſome imagine a *vortex* in the ſtruggle of the *effluvia* iſſuing out from the electric body, and returning again thereto by the preſſure or reſiſtence of the more remote air: Which opinion ſeems to give ſome ſatisfaction, indeed, in this inſenſible affection, becauſe the attraction of light bodies, put into commotion at the ſame time by that *vortex*, may in ſome meaſure be more eaſily conceiv'd.

Others would ſeek for that mechanical operation in the *effluvia* themſelves proceeding from the electric body, and with *Gaſſendi* conceive them as emitted in various directions, and interſecting each other, ſo as by this interſection more firmly to lay hold on, and carry back with them the lighter bodies. *Gaſſendi's* opinion.

Others conceive the *effluvia* more cloſely adhering to each other, as at the ſame time in their return to lay hold on the minute bodies they meet with in their way; and ſuch by a great many will be held to be unctuous bodies, which by their unctuoſity will inſinuate into other bodies and their pores, and being entangled with them, will likewiſe at the ſame time carry them back with themſelves: And this operation they explain in the manner, *Des Cartes'* opinion.

'we ſee drops of melted fat hanging by a ſtick; that by a gentle ſhake, 'one part thereof adhering to the ſtick, the other may recede ſome diſ-'tance from it and immediately return again, and carry along with it 'motes and other minute bodies it meets with[r].

Theſe are the words of the acute *Des Cartes*, who, as he denies not this cauſe of attraction, juſt now explain'd, to take place in ſome bodies, yet not in all, being principally induced by the example of glaſs, a body equally electrical; in which, indeed, he could not imagine to himſelf any *effluvia* from its nature as he deſcrib'd it: Aſſigning, therefore, a different cauſe of electricity in this body, and which he afterwards applies to many others, he thinks it happens by the intervention of ſome particles like figur'd *faſciolæ*, ariſing from the ſubtile matter lodging in the pores and fiſſures of the glaſs. That *Des Cartes*'s opinion may the more accurately appear from the nature and generation of glaſs, which he had deſcrib'd in another place[t], he gathers, that beſides the larger intervals every where pervious to the globules of the ſecond element, there are alſo found many oblong *rimulæ* between its particles, much more narrow and giving not ſo free a paſſage to theſe globules, as to the matter of the firſt element alone: Hence he imagines, that this matter of the firſt element, being accuſtom'd to put on the figures of all the *meatus'* into which it enters, by paſſing thro' thoſe *rimulæ*, is form'd into certain thin, broad and oblong *faſciolæ*, as it were; which lodge in them as they find not the like *rimulæ* in the circumjacent air, or at leaſt recede not much from the glaſs, but with a certain circular motion about its convoluted particles flow from one *rimula*

[r] Cart. Princip. Philoſoph. Part IX. Art. 183. [t] L. c. Art. 124.

rimula to another. Now, therefore, as the glaſs is pretty ſtrongly rubbed, ſo as to be heated a little, he fancies theſe *faſciolæ* to be forced out by this motion, and to be diſpers'd thro' the adjoining air, and to enter the *meatus*'s of the neighbouring bodies; but again return to the glaſs with minuter bodies carried along by them and entangled therein; becauſe they had not ſo eaſy a paſſage into theſe foreign *meatus*'s.

This opinion canvaſs'd.

This thought of *Des Cartes*' is curious; and as I view it more cloſely, I muſt repeat the words of *Du Hamel*[u], on *Des Cartes*' ingenious account of the ſtriated particles of the magnet; 'it ſeems to be equally arbitrary, did 'it not ſo well agree to the *phenomena* themſelves, that ſcarce any thing 'more to the purpoſe can be devis'd.' Yet there are ſome things to be oppos'd to this account; and firſt he ſeems to have devis'd this hypotheſis of electricity for this end, and which he himſelf owns, becauſe glaſs, which is otherwiſe an electrical body, was thought by him to be unfit for emitting *effluvia*. Again he himſelf is in doubt, whether this his hypotheſis ſhall take place in all electrical bodies or no: Nay, he admits, that the other cauſe of attraction, juſt now explained, may take place in ſome other bodies. In fine, he could learn nothing by his own experience with reſpect to amber, not having examin'd, as he ingenuouſly owns, its nature and other properties. Mr. *Boyle* obſerves, that *Des Cartes* is miſtaken in judging glaſs to be leſs fit for emitting *effluvia*, as glaſs mutually rubb'd together is not only obſerv'd to emit *effluvia*, but thoſe of a diſagreeable ſtench, with whom agree other authors of note and learning[w].

The difficulty of putting the manner of electricity beyond all doubt.

From theſe experiments and reaſons ſome light ſeems to be thrown on the mechanical manner of electricity; namely, that it happens by an undoubted emiſſion of *effluvia*, either oleous or ſpirituous. It is difficult, I own, to put it in ſuch a light, as that no doubt ſhall remain behind, tho' we are previouſly acquainted with the defects of the opinions of others. Nothing can be diſcover'd here by the eye, as this affection or quality, we are ſpeaking of, is by naturaliſts reckon'd among the inſenſible qualities of bodies, and not acting on our ſenſes, but cognoſcible only by reaſon from its effects.

Mr. *Boyle*'s notion the moſt ſatisfactory.

In the mean time he that is not ſatisfied with what has been juſt now ſaid, and who cannot conceive the *niſus* or virtue of the returning *effluvia*, and which has often been a difficulty with myſelf, ſuch a one, that I may be ſhort, may ſeek for the emiſſion and retraction of the *effluvia* in their very nature, namely, 'that they are hamous or hook'd, or of any other 'figure fit for coheſion; and that, therefore, they may be protracted and 'again contracted like thongs of leather.' Theſe are Mr. *Boyle*'s words and his method of explication[x]. An opinion, than which I have found none more ſatisfying and which I would more recommend to the reader. As to the opinion of the moderns it falls in with *Du Hamel's*, who proves, that

[u] *Vid.* Phyſ. Part II. Tract. 3. c. 6. [w] *Vid.* Ephem Germ. Decur. II. An. III. p. 507.
[x] L. c.

that electricity is perform'd by tenſion, and this ſeems to coincide with *Boyle*'s notion.

Now remains to enquire what bodies are attracted by amber, in regard that ſome maintain, that electricity is perform'd by a certain kind of ſympathy, and that, therefore, certain determinate bodies only are attracted, as iron is by the loadſtone? But it may be ſufficient to ſay, that all bodies promiſcuouſly are attracted by amber, provided there be a due proportion between the agent and patient, and the bodies ſo light, that they may be attracted by the weak attractive force of amber: Hence learned men have obſerv'd different bodies to be attracted, and their experiments I have with pleaſure repeated over and over again; for, beſides ſtraws and ſlips of paper (the common ſubjects of this attraction) any herbs, not only ſuch as are dry, but even the freſh, are attracted, tho' with a more or leſs ſtrong degree of attraction. The illuſtrious Mr. *Boyle* has obſerv'd ſand and mineral duſts, provided they are pretty light, to be rais'd thereby; ſpirit of wine is alſo attracted, and the ſmoke of an extinguiſh'd taper, firſt obſerv'd by Mr. *Boyle*, and of which we have treated above[y], is alſo attracted: Nor is the powder of amber itſelf, nor its tender *lamellæ*, without this attraction. As to bodies drench'd in oil, ſuch are alſo attracted, provided they are ſo diſpos'd, that a free ſpace be left for the electrical *effluvia* to encompaſs theſe bodies, and that theſe latter do not ſtick too cloſe to the table on which they are laid. In what manner a piece of amber, hung by a thread, upon applying another piece, approaches thereto, *Kircher* has formerly obſerv'd; and in what manner a drop of water at reſt is almoſt rais'd into a froth and deriv'd into the body of the amber, *Hartmann* has ſhown[z]. And I myſelf ſetting about this laſt experiment and ſprinkling with a fine duſt ſome drops of water on a table, I ſeveral times obſerv'd the water ſprinkled with the duſt approaching to the amber, and without this duſt the approach of the water alone could not, indeed, be ſo evidently obſerv'd, eſpecially if I had not a-new heated the amber. The ſame frequent attraction happen'd with expanded cob-webs, and only once rubbing the amber; nay, after the amber was cool'd, the approach of the cob-web thereto happen'd very frequently, and that in a ſurpriſing manner: And the ſame attraction was repeatedly obſerv'd in a hair of the head. All which experiments exactly agree with thoſe made by the illuſtrious Mr. *Boyle*[a], but eſpecially with one, namely, when with a piece of amber, ſcarce as big as a pea, but highly attractive, he mov'd up and down a pois'd ſteel needle, for about three minutes, after he had done rubbing the attracting body.

What bodies are attracted by amber

After theſe experiments I thought proper to enquire, whether living inſects are ſubject to this attraction or no? The firſt experiment I made was

Whether inſects are ſubject to the attraction of amber.

y *Vide* ACTA GERMANICA, Vol. I. p. 393. ſeq. *ſupra*, An. 1742. z *Vide* Succinct. Succ. Pr. Hiſt. Sect. 4. c. 2. § 3. p. 26. a L. c.

was on thoſe moths I often happen to meet with in books. It is an animal of the bigneſs of the ſmalleſt louſe, very nimble, and ſo tender as to be cruſh'd by the leaſt touch. Upon applying larger pieces of amber, I always obſerv'd, that the animal would fix and faſten itſelf, and begin again to run, when either the electrical force was ſpent, or the amber remov'd. Upon which I began to think with myſelf, that this animal faſten'd itſelf with its feet, and ſtuck its claws in the pores of the paper or table on which it was: But making a wound in its body, ſo that it could no longer run, nor ſtand on its feet, and then applying the amber, it was attracted by it. Upon cutting off the head of a common fly, tho' it continu'd alive, yet ſo as to walk ſlower, its wings only were attracted by the amber, the animal firmly faſtening with its feet on the paper on which I laid it: I, therefore, bethought myſelf to ſnip off all its feet with a pair of ſciſſars; upon which the animal was entirely attracted to the amber. I made the ſame experiments on ſmall beetles, as alſo on gnats, fleas and lice, and with the ſame ſucceſs: And I concluded, that the reaſon why others miſcarried in their experiments was, that they neglected the above precautions.

Some queries reſolv'd.

From what has been ſaid, we may be able to reſolve the following queries; why the attracting glebe ſhould be ſmooth and poliſh'd? Why impure ambers, and ſuch as are deſtitute of a proper degree of conſiſtence, cannot attract? As to the firſt, any one will eaſily allow, that the *effluvia* cannot penetrate thro' cortical or coated ambers, eſpecially ſuch as have a thick cruſt; and ſhould they be ſuppos'd to penetrate that cruſt, yet it will be granted, that their egreſs will not be in ſuch quantity, as to produce a due effect: And the ſame thing holds in the loadſtone, which by ruſt, nay by the very moiſture of the air, or by its ſituation, we obſerve has even its moſt vigorous virtue impeded, from the orifices of its *meatus'* being block'd up: Nor do crack'd ambers, tho' reſplendent and poliſh'd, always attract well, in regard that in the cracks they have acquir'd unequal ſides: Whence on this account neither can an equal attrition be conciliated to the glebe, nor a due egreſs of the *effluvia* be procur'd, as being hinder'd in their paſſage by the different angles of the glebe and depriv'd of their united force; nay, neither do glebes that are fil'd attract ſo well on the ſame account. It is, therefore, requiſite, that the ambers be poliſh'd, or at leaſt ſmooth'd; for, I have obſerv'd, that a ſmooth glebe has attracted, tho' it has not been poliſh'd, As to the impurer glebes, or ſuch as are deſtitute of a good and ſolid conſiſtence, we are not to wonder at their weak power of attraction, for, ambers of both theſe kinds are not properly ambers, but rather impurities intermixt with the amber-fluor, or, the recrements of amber; as in many of the pores of the former ſort (tho' I ſhould allow that they contain an equal admixture of earthy and amber matter) a foreign matter lodges, and the wide and frothy ſpaces of the latter are fill'd with air; both which cauſe that neither a due motion can be excited in friction,

iction, nor an egreſs of amber *effluvia* (of which there are but a few in his ſort) be effected.

We now proceed to the conſideration of the other qualities of amber, Other qualities of amber, and firſt of its colour. s its colour, odour and taſte. The colours of amber are various, which nay both delight and be of ſervice to workmen in ſeveral pieces of work-nanſhip. The moſt common, omitting their ſubdiſtinctions, are the vavy or thoſe clear as water, the golden, the milky, the pearly, the ſqua-nous or nebulous, the waxy or pale yellow, either more dilute or more bſcure, the variegated white, the azure, the green, and the black; be-des thoſe differently mix'd and compounded of the ſimple colours. Yet ho' there is reckon'd ſo great a number of them, nothing obliges us, hat according to the opinion of others we ſhould make thoſe various am-ers different ſpecies, as they are all of them rather of the ſame kind, as as been prov'd in another place more at large:[a] It will, therefore, remain, hat we ſay they differ in degree, providing in the firſt place we have ſome ertainty as to the moſt noble and excellent degree, that upon determin-ng this, we may afterwards rank the more ignoble; and this we have lready done[b].

As ſome ambers have an adventitious admixture of other matter, ſo they Some colours of ambers occaſion'd by adventitious admixtures. re tinged with different colours; of which kind are the white, the green, he azure, the black and the dingy, or thoſe expreſſing the colour of oaſted coffee-beans. Among thoſe mix'd ambers, the white are the prin-ipal, and they are of ſuch a nature, that the more they partake of white-neſs, the leſs they let go their interſpers'd opaque matter by any degree of heat whatever, either of nature or art, as I have ſhewn in another place[c]. That, therefore, a foreign and more earthy, and ſaline, fix'd matter is in too arge a proportion added to them in their firſt mixtion, appears by the boil-ng alone. The ſame aſſertion is evinced by their frequent decrepitations after their accenſion in a coal-fire, an evident teſtimony of the more co-pious preſence of ſalts therein; as alſo by the ſtronger and more agreeable odour breathing from them after accenſion. In fine, the ſame appears from their diſtillation, which forces from them a larger portion of that ſalt and a leſs portion of oil: Whereas on the contrary, a greater quantity of oil is drawn from the other, either diaphanous or obſcure ambers, but a very ſmall quantity of ſalt: Not to mention their taſte, which, according to the greater or leſſer degree of whiteneſs, is found to be acido-ſaline. Beſides, it is well known to the workmen, that the white ambers, on ac-count of their want of ſulphureous and oily parts, are not ſo fit for their works, as they cannot like the others bear being bent and brought to any form: And in fine, upon a general view of the ſhore, and a particular ſurvey of the veins, we find the ſhore laid up and down with large beds of nitre and vitriol.

[a] *Vid.* ACTA GERMANICA, Vol. I. p. 340, ſeq. An. 1742.
[b] Ibid. p. 341, ſeq.
[c] Ibid. p. 349, ſeq.

Origin of azure, &c. colours.

As to the cauſe of the azure-colour, and whether it ought to be aſcrib'd to copper or iron, may be diſputed. It is certain, indeed, from the principles of Naturaliſts and Chemiſts, that copper, diſſolv'd in ſpirit of *Sal ammoniac*, ſtrikes this ſame azure-colour; but it may be alſo excepted, that this colour depends on the condition of the concurring ſpirit, in regard that copper, expos'd to another acid liquor, rather exhibits a green colour: And in fine, that applied in glaſs-making it ſometimes yields a reddiſh, ſometimes a bluiſh, and ſometimes a dark colour. Nor could this be a ſtronger argument for iron, tho' yet I would rather aſcribe to it that azure tincture, as I have often ſeen azure-glebes, or ſuch as partake of an azure-colour, which had cloſely lodged in them bits of iron. But becauſe not all amber-glebes including iron have, therefore, this azure colour, hence it will be neceſſary to preſuppoſe a proper and adequate ſolvent or *menſtruum* of iron. I have ſometimes found very beautiful azure glebes, at leaſt one of their ſides was ſtill cover'd with a cruſt ſomewhat inclining to blackneſs, and conſiſting of martial, as I thought, or other metallic layers: But attempting to take off this cruſt in the lathe, I loſt both the glebe and this beautiful colour, which at length I underſtood had its origin from a certain modification of the light by means of this matter. As to the other glebes, which preſerve their blue colour, the matter is different. As to the green colour, it is, indeed, the more rare and was never ſeen by *Hartmann* himſelf [d], tho' confirmed to him by credible witneſſes: And I myſelf have ſeen a glebe with ſome caſt of green; but to ſpeak the truth, that colour was ſcarcely real, but ſeem'd to ariſe from the cruſt of the glebe, diſtinguiſh'd by ſome obſcure greenneſs between a black, produced by the reflexion of the light.

Black amber the rareſt colour.

As to the other particular colours, as the dingy, or that exhibiting the colour of toaſted coffee-beans; and as to the other colours analogous to this, and the different colours peculiar to the impure ambers, as they are call'd, we may judge they owe their origin to the various admixture of ſome foreign earthy matter or mineral juice: Yet among all other colours the black may be reckon'd the more rare; and whether any ſuch be really found, has hitherto been a queſtion; at leaſt, *Hartmann*, who himſelf had a conſiderable collection of ambers, and who beſides very carefully examined the different *Muſæums* of great men, ſeems to be in doubt, whether black amber is to be found or no; that is, ſuch as is light and ſolid, and very compact like jet; for, of the other impure, black ambers, which are often call'd by this name, we do not here ſpeak. And *Hartmann* ingenuouſly owns, that he never ſaw any ſuch; and upon viewing a glebe that was taken to be black, he found, that it was not black but a yellow maſs intermix'd with black. But to put this out of all queſtion, I formerly carried two unexceptionable black glebes to the *Royal Muſæum*; one of them

[d] Hiſt. Succ. Pr. *lib.* I. *cap.* 7. § 6. *p.* 145.

them was diaphanous, and about a third or fourth part of it black; and that black part was equally ſmooth and polite as the clearer part, and tranſmitted no light; the other glebe was all over tinged with black, and equally ſmooth and poliſh'd, without admitting any light; ſo that it was doubted, whether this glebe was amber or no: But upon accenſion it plainly appear'd to be ſuch, as its grateful odour ſufficiently ſhow'd, without that noiſome and ſulphureous ſtench of jet, ſuch as it was taken to be.

A method of tinging amber among the *Romans*, with obſervations thereon.

Whether the colours of ambers may be corrected and chang'd, would be no uſeleſs diſquiſition, both in the art and doctrine of ambers. But this I wave, as I have at large treated in another place[e] of the tranſmutation of ambers into clear and diaphanous; but I ſhall treat of a more curious change and of an unknown, if not loſt, method of tinging ambers, which as I have remark'd in another place[f] from *Pliny*, was done among the ancient *Romans*, with the root of *Anchuſa*, i. e. *a kind of bugloſs*, and with *conchylium* or the purple juice of a ſhell-fiſh: Yet we muſt obſerve, that that tincture was only ſuperficial, and in no manner entering deep into the internal ſubſtance of the amber. *Hartmann* hints[g], that ambers may be made black by art, at leaſt externally, and that by means of ſpirit of ſalt; but as to this encheireſis, if I may ſpeak what I have learn'd from experiment, I could never obſerve, that amber, either done over or ſprinkled with this ſpirit, became black; and I have ſometimes pour'd this ſpirit on pieces of amber of different colours, as the white, diaphanous and obſcure, but I never obſerv'd any change, much leſs any blackneſs in them for many weeks together. It was beſides, a matter of curioſity, that a few of thoſe pieces ſunk to the bottom, but moſt of them, eſpecially the white, floated on the ſpirit. One may probably imagine, that this ſpirit, applied to ambers, eſpecially when committed to a ſand heat, will give them a ſomewhat darker cruſt, but whether this is really owing to the ſpirit, as the fire alone produces this thin black cruſt, or which inclines to blackneſs, as I myſelf have experienced, may be deſervedly doubted.

The odour of ambers what?

As to the odour of amber, this is none of the leaſt qualities thereof, nay in its uſefulneſs by far the moſt noted and agreeable, as it recommends itſelf in refreſhing the ſpirits by diffuſing its divine ambroſial odour; nor were the ancient *Romans* wanting in their commendation thereof, as appears from *Martial*[h]. But what this odour of amber is, is a queſtion of no leſs moment? *Hartmann* affirms, that its odour approaches neither to that of myrrhe, camphire nor frankincenſe, but that it breathes a fragrancy, entirely peculiar and proper to itſelf[i]. Yet we are not to omit, that not all ambers promiſcuouſly after accenſion yield one and the ſame odour. The moſt ſubtile and grateful odour breathes from the pearly, the milky and the

[e] *Vide* ACTA GERMANICA Vol. I. p. 345. ſeqq. An. 1742. [f] Ibid. p. 344.
[g] Hiſt. Succ. Pruſs. cap VII. § 6. p. 146. [h] Lib. III. epigr. 65. —— et Lib. XI. epigr. 9. —— et Lib. V. epigr. 39. [i] Hiſt. Succ. Pruſs. Lib. II. c. 3. § 5.

*The Sequel of the Measures or Laws of Forces. From the Commentarii Acad. Imper. Petropol. Sept. 1725. p. 27.

Translated from the LATIN.

The controversy as to the measure of forces.

THE same position, *viz.* that the living forces of bodies are as the masses into the squares of the velocities, might have been prov'd by other arguments equally cogent: But as this has been distinctly perform'd by different members of this *Academy*, I shall now wave it, and proceed to the controversial part of the question about the measure of forces. For, the common opinion, which opposes that of *Leibnitz*, has, as it were, by a kind of prescription, found many excellent defendants, whose arguments deserve to be discuss'd.

An objection answer'd.

In the first place it has been often urg'd, that the idea of the living force of bodies does not imply that of gravity, in regard that every body with some determinate degree of celerity has its own determinate living force, whether that body be understood to have gravity, or to be entirely without it; and that for this reason it is in vain to have recourse to the theory of the motion of heavy bodies for obtaining the measure of their forces. Tho' indeed, we admit of the antecedent, yet the consequence will be nothing the firmer. Suppose that bodies may still be bodies, tho' they are not heavy, and that each of these bodies without gravity have their own degrees of living forces, what shall be the consequence? Indeed, nothing other than this, that these living forces are not the gravity of bodies, nor necessarily flow from gravity, which we no where have said, or ever concluded; but that from the descent of heavy bodies no measure of the living forces can be taken, does by no means follow from the preceeding proposition; for, let there be a body A without gravity, and with the celerity which I shall call u; and this body, therefore, will have some living force, which I shall make entirely independent of gravity; let there be another body B equal in mass to the first, but urg'd by gravity; and which falling from the height a, may acquire with an accelerated motion a celerity equal to the celerity u of the first body A without gravity: Now I ask, whether these equal bodies A and B, and having equal velocities have equal living forces or no? I think there will be no one who can say, that these forces are unequal; for, tho' the first body A is not (by the hypothesis) urg'd by gravity, but the other body B is urg'd thereby; and consequently, this diversity of circumstances seems at first view to induce some inequality of forces on both, yet really it does not; for, as soon as the body B is found in the lowest point of the height a, and has there acquir'd the celerity u, suppose the action of gravity to cease, the body B will there also be destitute of gravity, and with the acquir'd celerity u, it will equably continue its motion, as well as the body A; so that now we have equal bodies A and

Vide ACTA GERMANICA. p. 374. seqq. *supra*.

and B with equal velocities and without gravity: Whence it is neceſſary, that their forces be equal. But I grant that the living force of the body A without gravity does not depend on gravity; and yet, therefore, does not the living force of the other body B flow from gravity? Nay, it very much depends thereon, as in the beginning of the deſcent it had no force, and that which it at length acquir'd, it did ſo at the end of the ſpace A by the continued action of gravity: But as the forces of the bodies A and B were ſhown to be equal, cannot and ought not the one to be the meaſure of the other, tho' the force of the body B flowing from gravity is entirely independent of the force of the body A, which owes not its riſe to gravity? From all which it appears, that the above alledged objection can derogate nothing at all from our meaſure of the living forces.

18. But there were many other objections formerly publiſh'd by learned men, as by the Abbé *Catelan*, *Dionyſius Papin*, and others; and all theſe objections occur as to ſubſtance in what not many years ago Dr. *Samuel Clarke* urg'd againſt *Leibnitz* a little after his death, in a treatiſe publiſh'd in *Engliſh* and *French* at *London*, entitled, *a collection of papers, which paſs'd between the late learned Mr.* Leibnitz *and Dr.* Clarke *in the years* 1715 *and* 1716, London 1717, *in* 8*vo.* and which *Des Maizeaux* publiſh'd again in *French* with a large preface and other writings, under the title of *Recueil de diverſes pieces ſur la philoſophie, la religion naturelle, l'hiſtoire, les mathematiques, par Mrs. Leibnitz, Clarke, Newton, & autres Auteurs celebres, à Amſterdam in* 12*mo.* 1720. Now in the note to § 93—95, of the fifth anſwer to *Leibnitz*, Dr. *Clarke* not only endeavours to confute *Leibnitz*'s arguments for our meaſure of forces, but has alſo attack'd a certain paſſage of my *phoronomia* on the ſame head. But tho' I have in another place examin'd his principal arguments, yet as that is very briefly done in a writing which came into the hands of few, I ſhall, therefore, here adduce and refute Dr. *Clarke*'s principal objections, and that the more willingly as they afford us greater opportunity of illuſtrating better the theory of living forces. In the firſt place the Dr. charges *Leibnitz* with confuſion and contradictions in this argument on forces, that he holds, *that the ſame quantity of forces is conſerv'd in nature*, and yet owns, *that the ſame quantity of motion does not remain*; where by the term *force* or *active force* he ought neceſſarily in the preſent queſtion to underſtand *the impetus or the impulſive and relative force of moving bodies.* Here the Dr. aſſumes, that *Leibnitz* agrees with him, when he ſuppoſes, that *Leibnitz*, ſpeaking of forces in thoſe paſſages he quoted, underſtood by that term the impetus or quantity of motion, ſo that afterwards he might charge him with contradiction and confuſion, when *Leibnitz* differs from him. But the Dr. can adduce no paſſage, in which *Leibnitz* by the active force, which he holds to be conſerv'd in nature, meant the quantity of motion or the impetus; nay, the contrary appears plainly from himſelf, becauſe he endeavour'd to ſhow, that the

Objections, eſpecially by Dr. *Clarke*, anſwer'd.

the quantity of motion is mutable, but that the quantity of the forces always remains the same. In this matter, therefore, *Leibnitz* has not contradicted himself, but the Dr. hurried by a prejudicate opinion, has begg'd the queſtion. The Dr. afterwards proceeds; *what gave Leibnitz*, ſays he, *occaſion of contradicting himſelf was, that, thro' an error entirely unworthy of a philoſopher, he eſtimated the impulſive force*, as the Dr. ſpeaks, *by the quantity of matter and the ſpace which the body runs over in its aſcent, laying aſide the conſideration of the time wherein the aſcent is perform'd.* But if what I have demonſtrated in §§ 15, 16, 17, be true, namely, that the meaſures of the forces are the heights to which the bodies can arrive, multiplied into the force of gravity, *Leibnitz* has committed no error, much leſs ſuch as is unworthy of any philoſopher.

19. As to what the Dr. alledges, *that* Leibnitz *has committed no ſmall error in that he thinks, that this propoſition is granted by the* Carteſians *and other Philoſophers and Mathematicians:* That there is as great a force neceſſary to raiſe the body A of 1 *lb.* to the height of 4 ells, as to raiſe the body B of 4 *lb.* to the height of 1 ell, *as the times of theſe aſcents are not equal*, if it is an error, it is only an error of fact, which can derogate nothing from the principal thing: Beſides, that above in § 6. I have alledg'd a paſſage from *Des Cartes* himſelf, from which it appears, that that illuſtrious philoſopher admitted this controverted propoſition without any limitation of the equality of the time; nay, he reckons it erroneous to confound the conſideration of the ſpace in the buſineſs of the meaſure of forces with the conſideration of the time or celerity; and of this opinion we have given a ſolid demonſtration above in § § 15, 16. But the demonſtration in that place ſtanding good, all that the Dr. further adduces falls to the ground, as it conſiſts of bare aſſertions without any proof; for, he pretends, *that if any pendulum deſcribes a cycloid, the arch of the cycloid deſcrib'd by the aſcent will be proportional to the aſcenſional force in the loweſt point of the cycloid:* And of this propoſition he adduces no other proof than this; namely, that the times requiſite for the aſcent are equal. But how far the Dr. is wide of the truth will appear, after we have conſider'd a little more accurately the deſcent and aſcent of a body in the cycloid.

Plate VI. Fig. 5. The aſcent and deſcent of a body in a cycloid.

Let, therefore, the curve ADH be a ſemicycloid; its vertex H; and its axis aH; its ſemi-baſe, therefore, will be Aa; let the body C begin its deſcent in the point A, and with an accelerated motion run along the concave ſide of the cycloid, ſuppoſing gravity to be every where uniform; in the beginning of its deſcent, therefore, the body will be urg'd along the direction of the tangent to the cycloid in the point A with the force expounded by the arch AH, thus *Newton* firſt, and afterwards ſeveral other authors have demonſtrated; but which is well to be noted, this tangental force is not a living, but only a dead force; for, it is deriv'd from the force of gravity, which is a dead force only. The body afterwards carried from

A to

A to *B* will in this point be alſo urg'd in the direction of the tangent with the dead force, expounded by the arch of the cycloid *BH*, and ſo in every other point of the cycloid with a certain dead force, expounded by the arch of the cycloid between that point and the vertex *H:* Moreover, let there be ſuppos'd erected in the points *A*, *B*, *D*, &c. and in all the intermediate points, perpendiculars to the plane of the cycloid and reſpectively equal to the arches *AH*, *BH*, *DH*, &c. there will thence ariſe a cylindrical ſurface, whoſe baſe is the cycloid *ADH*; and I contend, that this whole ſurface and its parts are the meaſures of the forces, acquir'd by the deſcent of a body down *AH*, or the parts of this arch; for, the force, acquir'd in the loweſt point of the cycloid *H*, is the complex of all the dead forces, whereby the body is urg'd in the points *A*, *B*, *D*, *H*, and all the intermediate ones; for, whatever force it has in *H* it owes it to all theſe dead forces continually acting on the body; and therefore, the force acquir'd in *H* can neither be greater nor ſmaller than that complex of dead forces, from which it reſulted, and that cylindrical area comprehends all the lines repreſenting all the dead forces. For inſtance, if $AL = AH$, $BM = BH$, $DN = DH$, and ſo on in reſpect of all the other arches of the cycloid, and theſe *AL*, *BM*, *DN* be perpendicular to the plane of the cycloid, the cylindrical ſurface *ALMH* comprehends all the *AL*, *BM*, *DN*, &c. which expound the dead forces whereby the deſcending body is urg'd in *A*, *B*, *D*, &c. The ſaid cylindrical ſurface *HAL* does, therefore, expound the force acquir'd in *H* by the deſcent thro' the arch *AH*: For a like reaſon the ſurfaces *LABM*, *LADN* will expound the forces, acquir'd by the body in *B* and *D*, the beginning of the deſcent from a ſtate of reſt being in *A*. Plate VI. Fig. 5.

It remains to examine the quantity of the ſurface *ALH* and its parts. Let the arch *DH* be equal $DN = s$, and its element $= ds$; wherefore, the element of the ſurface *HDN*, which ariſes from multiplying the ordinate $DN = s$ into the element of the arch *HD*, becomes $= s\,ds$: Wherefore, by integration the area itſelf *HDN* becomes equal $\frac{1}{2}\,s\,s = \frac{1}{2}$ the ſquare of the arch *DH*: And therefore, the whole area $HAL = \frac{1}{2}$ the ſquare of *AH*, and the areas *ABML*, *ADNL* are equal $\frac{1}{2}AH^2 - \frac{1}{2}BH^2$, and $\frac{1}{2}AH^2 - \frac{1}{2}DH^2$. Now ſuppoſing theſe things it follows, that the force acquir'd in *H* by the deſcent down the arch *AH*, which is repreſented by the area *HAL*, is proportional not to the arch itſelf *AH*, as Dr. *Clarke* imagines, but to $\frac{1}{2}$ the ſquare of that arch *AH*; and ſo great alſo, at firſt is the force of the aſcending body in the cycloid from *H* to *A*; but if the deſcent begin from a ſtate of reſt in the point *D*, the force acquir'd in the loweſt point *H* will be proportional not to the arch *DH*, but to $\frac{1}{2}$ its ſquare, and to this is equal the force of the body aſcending in the arch *HD*.

When the Dr. farther ſays, *that if two equal bodies at different diſtances from the axis of any balance gravitate on its arms, the forces of theſe bodies will be as the arches they deſcribe, becauſe they run them over in equal times*, he does not touch on the true reaſon, why theſe forces are as the arches, deſcrib'd; for, theſe forces are as the arches, not becauſe the arches are deſcrib'd in equal times, but becauſe the action of gravity is continual, and becauſe in all the points of the arches theſe bodies are urg'd by a certain equal dead force.

But the Dr. proceeds, *if two equal balls be impell'd with unequal forces on a horizontal plane, in equal times they will deſcribe ſpaces proportional to the impelling forces*; or *if unequal balls be impell'd by equal forces, in equal times, they will deſcribe ſpaces reciprocally proportional to their maſſes.* Both theſe propoſitions are falſe; for, firſt let there be two equal quieſcent balls A, A; the former of which ſuppoſe to be impell'd by the ball B with the celerity b; but the other by the ball C with the celerity c; by the rules of the communication of motion, the former ball will acquire the celerity $\frac{2Bb}{B+A}$; and the other ball A will receive from the impelling ball C the celerity $\frac{2Cc}{A+C}$: The ſpace, therefore, to be deſcrib'd by the firſt ball A is to that to be run over by the other in an equal time, as the former fraction $\frac{2Bb}{A+B}$ to the latter $\frac{2Cc}{A+C}$; but theſe fractions are not as the impelling forces, which according to our author's hypotheſis are as Bb and Cc: Wherefore, his firſt propoſition is falſe.

Let us now ſee, whether his ſecond has any place or no? Now let the two unequal quieſcent balls A and B be both impell'd by the equal balls C, C with equal celerity a; by the ſame rules of the communication of motion the ball A will receive the celerity $\frac{2Ca}{A+C}$, and the ball B the celerity $\frac{2Ca}{B+C}$; and theſe celerities are as the ſpaces, which both the balls will after impulſe deſcribe in an equal time; but theſe ſpaces are not proportional to the maſſes of the balls A and B, as the Dr. affirms: Wherefore, his ſecond propoſition is alſo falſe. And, therefore, all the conſequences, which he draws from his premiſſes againſt *Leibnitz* fall to the ground; and I may venture to ſay, that in almoſt all that follows, he always begs the queſtion, becauſe he almoſt every where ſuppoſes, that the forces of bodies are as the quantities of motion, which notwithſtanding is deny'd by *Leibnitz*, and is the point in queſtion; he ought, therefore, to have advanc'd ſome proper demonſtration of his propoſition, before

before he ſhould object to *Leibnitz* and others of his opinion, I know not what contradictions and abſurdities. He will, probably, ſeem to have given a demonſtration of his propoſition in the following period, which runs thus; ‘ *Galilæo* in the ſuppoſition of uniform gravity has demonſtrated the motion of projects in non-reſiſting medium's; and all ‘ mathematicians, not excepting *Leibnitz* himſelf, aſſent to his propoſitions: But now if the time, wherein a body runs over its ſpace, be ‘ underſtood to be divided into equal parts; as gravity is uniform, and ‘ therefore, in equal parts of time acts equally, it muſt by its action impreſs upon and impart to a body equal forces, velocities and motions in ‘ equal times'. But this very conſequence, in ſo far as it regards the forces, is falſe, as it is true, that in equal times equal celerities and equal motions are generated by the continual action of uniform gravity; for, to the producing increments of velocity, gravity equally acts on bodies in motion, as on thoſe at reſt, ſo that in equal times equal increments of velocity may be added to the body, whether it be in motion or at reſt; but the caſe is different as to the increments of the forces; for, in computing theſe, the preſent celerity is to be taken into the account, nor can it be ſaid, that theſe increments of the forces are ſimply as the increments of the time, but rather in the compound ratio of the celerities, already acquir'd, and of the increments of the time; that is, as the increments of the ſpaces, namely if the maſſes of the bodies be equal, which we have prov'd at large above. After that the Dr. has deduced various other conſequences from that primary one, which I have juſt now refuted, he at laſt falls upon myſelf, as follows; ‘ but *Hermann* has fallen in with *Leibnitz* againſt ‘ thoſe, who hold, that the forces acquir'd by falling bodies are proportional to the times in which theſe deſcents are perform'd, or to the ‘ acquir'd velocities: *Hermann*, I ſay, aſſerts, that it is founded on a ‘ falſe ſuppoſition, namely that bodies thrown upwards do in equal times ‘ receive an equal number of impulſes from gravity, which is the ſame ‘ thing, as if *Hermann* had ſaid, that gravity is not uniform, which is ‘ entirely to overturn *Galilæo*'s theory, in which all geometricians agree. ‘ I imagine *Hermann* ſuppoſes, that the ſwifter the aſcenſional motion is, ‘ the greater number of impulſes the bodies receive, becauſe they meet ‘ with (*imaginary*) particles, which produce gravity; and thus the weight ‘ of bodies will be greater when they aſcend, and leſſer when they deſcend'. From theſe things the reader may ſee how ſagacious the Dr. is in deducing conſequences, and exploring the meaning of his adverſaries. I ſaid in my *Phoronomia*, that their opinion is founded on a falſe hypotheſis, who meaſure the forces of aſcending bodies by the times of aſcent, as they tacitly ſuppoſe that bodies, in equal times receive an equal number of impulſes: And as in the cited place I eſpecially diſputed againſt *Papin*, I made uſe of the term *impulſes*, as he himſelf firſt employ'd it, to deſign the

reſiſtences an aſcending body has to overcome, and from this the Dr. directly concludes, that it is the ſame thing, as if I had ſaid, that gravity is not uniform; and conſequently, that that was entirely overturning *Galilæo*'s theory. But if you look for the connection between this propoſition, *heavy bodies thrown vertically upwards not in equal times, but aſcending thro' equal heights, ſuffer equal reſiſtences from gravity*, and this other, *that gravity is not uniform:* This connection the Dr. has no where ſhown, and perhaps never can. But now he acts the critic, and explores my ſecret meaning not expreſs'd in words; for, he imagines that, according to my opinion, aſcending bodies receive the greater number of impulſes from gravity, the ſwifter the aſcenſional motion is, becauſe they meet with particles, which produce gravity, and which he calls *imaginary*, doubtleſs, for this reaſon, becauſe gravity, according to him, is an *occult quality*. But to be ſerious, and to give the Dr. a direct anſwer, he may ſee theſe two propoſitions geometrically demonſtrated in ſeveral paſſages of the preſent diſſertation. 1. From this, *viz.* that gravity is uniform, the meaſures of the forces of bodies are in the compound ratio of the maſſes and heights, which projects with thoſe initial velocities, which the bodies have, may run over. 2. But if theſe forces were in the compound ratio of the maſſes and of the times of aſcent, gravity would not act uniformly, but by ſtarts: And therefore, according to the Dr's hypotheſis, gravity is not uniform; and conſequently, *Galilæo*'s theory is deſtroy'd, which in our ſyſtem remains entire.

But we muſt examine a weighty argument the Dr. ſtill urges againſt us: 'If the force, *ſays he*, which a body by falling acquires, is as the ſpace 'deſcrib'd, let the time be divided into equal parts, and if in the firſt 'portion of time it acquire one portion of force, in the two firſt portions 'of time it will acquire four portions of force, and in the three firſt por-'tions of time, 9 portions of force, and ſo on: Wherefore, in the ſecond 'part of time it will acquire three parts of force; in the third part of time 'five parts of force, *&c.*' So far is very well. But the conſequences he draws from hence are but weak: 'If, therefore, *proceeds he*, the action of 'gravity producing theſe forces be ſuppos'd to be of one degree in the 'middle of the firſt part of the time, in the middle of the ſecond, third, 'fourth, *&c.* parts of the time it will have 3, 5, 7, *&c.* degrees'. But this is very falſe. For, the action of gravity in the middle of each time is the ſame, as in its beginning and end. We may judge of the ſtrength of this argument from this, namely, that in like manner it may be prov'd, that becauſe the ſpaces, deſcrib'd in equal times afterwards, are as the odd numbers 1, 3, 5, *&c.* that gravity alſo, which cauſes that theſe ſpaces are deſcrib'd by the bodies, is as the ſame odd numbers; for, if we ſuppoſe that the action of gravity, which cauſes theſe ſpaces to be run over in the middle of the firſt time is of one degree, the action of gravity in the middle

of

of the 2d, 3d, and 4th part of the time will have 3, 5, 7, *&c.* degrees: Wherefore, from this argument of the Dr's we have prov'd, that becauſe gravity *is uniform, it is not uniform.* But the Dr. ſeems to have argu'd thus, that he might conclude in theſe words, *that is, the action of gravity will be proportional to the time and to the velocity acquir'd.* But I would fain know in the middle of what time the action of gravity is proportional to the product of the time into the celerity? in regard this is not known from the premiſſes; for, in theſe he recited the order of the equal times, in the middle of which the action of gravity follows the ſeries of the odd numbers: But one muſt be very quick-ſighted, who can hence ſee, that the action of gravity is proportional to the product of the time into the celerity; and in fine, that at the beginning of the time gravity is none. Had the Dr. ſaid, that in the beginning of the firſt time the living force of the body is nothing, he had ſaid nothing wide of the truth, but that there ſhould be no gravity, will never be fairly deduced from our ſyſtem.

I at length come to the Dr's *Achillean* argument, which, according to him, ſeems entirely to overturn our eſtimation of the forces; for, he puts a period to this diſpute in the following words; ‘ that the preſent controverſy may be demonſtratively decided, let two ſteel-balls hang from two ‘ threads of equal length in ſuch manner, that when the balls remain ſuſpended and touch each other, the threads may be parallel; let either of ‘ theſe balls be always the ſame, and let it be drawn from the other to the ‘ ſame diſtance in all the experiments; let the other ball be of any bigneſs ‘ at pleaſure, and let it be drawn off to the oppoſite ſide to a diſtance reciprocally proportional to its weight: Let both theſe balls fall down in the ‘ ſame moment of time, in ſuch ſort that in the loweſt point of deſcent, at ‘ which they remain'd ſuſpended before they were ſeparated from each ‘ other, they may mutually touch. The firſt ball will reſile always in the ‘ ſame manner, that is, to the ſame height: Wherefore, the force of the ‘ one is always the ſame, as often as its celerity is reciprocally proportional ‘ to its weight; and conſequently, the weight remaining the ſame, its ‘ force will be proportional to the velocity. *Q. E. D.*

The better to take the force of this pretended demonſtration, I ſhall explain the whole matter by Fig. 6. Let the equal threads *D F*, *EG* be ſuſpended at *D* and *E*, at their loweſt extremity faſten ſteel-balls, namely to the thread *D F* the ball *A*, and to the thread *EG* the ball *B*; the diſtance of the points of ſuſpenſion *D*, *E*, muſt be equal the ſum of the ſemidiameters of the balls *A* and *B*; or if inſtead of the ball *B*, another bigger or ſmaller be employ'd, and which I ſhall call *C*, that the diſtance *D E* may be equal to the ſum of the ſemi-diameters of this ball and the ball *A*, for this purpoſe, that as often as the threads *D F* and *E G* are in a vertical poſition, the balls *A* and *B* or the balls *A* and *C* may mutually touch. Suppoſe the horizontal line *MN* to paſs thro' the centres of the balls, Fig. 6. Plate VI.

balls, and that the points, *F*, *G*, design these centres; from the centre *D* with the radius *DF* let the arch *FO* be describ'd; and from the centre *i* with the radius *EG* the arch *GP*; let the arch *FH* be to *Gi*, as the ball *B* to the ball *A*; and let the ball *A* be brought from *F* to *H*; and the ball *B* from *G* to *i*; and let both begin to descend together from *H* and *i* and in the same time they will arrive thro' the arches *HF* and *iG* in *F* and *G*, and there they will mutually impinge, so that both may recede in the same arch in which they fell, to wit, the ball *A* will after impulse recede from *F* to *H*; and the ball *B* from *G* to *i*, laying aside the consideration of the resistence of the air. After this experiment let the ball *B* be taken off from *G* and there let another ball *C* be fasten'd in such manner, that the distance *DE* may now be equal to the sum of their semi-diameters; and let *C* be to *A* as the greater arch *GK* to the smaller *Gi*. Now let us suppose the balls *A* and *C* to begin their descent together at *H* and *K*; and again in equal time with an accelerated motion they will describe the arches *HF* and *KG*; and in *F* and *G* they will mutually impinge with the celerities expounded by the arches *HF* and *KG*; but again after impulse the ball *A* will resile from *F* to *H*, and the ball *C* from *G* to *K*; and therefore the ball *A* in both experiments resiles to the same height *HL*: Whence the Dr. concludes, that the force of one of the balls, either *B* or *C*, is likewise always the same, as often as the final celerity of the ball *B* is to the final celerity of the ball *C*, as this latter ball to the former.

But I may say, that I could have no fitter medium to confute the Dr's measure of forces than this very experiment he adduces; for, first his conclusion, namely, that the forces of the balls *B* and *C* are equal, can be fetch'd from nothing other than from this supposition, that both the force of the ball *B* and that of the ball *C* is equal to the force of the ball *A* resiling always in the same manner. But this supposition is a mere begging of the question; but that I may not seem to have said this without proof, I shall in the second place show, that supposing all those things which are suppos'd in the experiment, the force of the swifter ball *C* is greater than that of the other *B*; but this will be demonstratively prov'd, after I shall have shown, that the common centre of gravity of the balls *A* and *C* ascending in the arches *FH* and *GK*, rises higher than the common centre of gravity of the balls *A* and *B* ascending in the arches *FH* and *Gi*; for, so, the forces of the balls *A* and *C* effect something more than the forces of the balls *A* and *B*, that is, the force of the ball *A* + the force of the ball *C* is greater than the force of the ball *A* + the force of the ball *B*; consequently, as (by the hypothesis) the force of the ball *A* is in both cases the same, there remains the force of the swifter ball *C* greater than the force of the slower ball *B*; and therefore, it only remains to prove, that the common centre of gravity of the balls *A* and *C* ascends higher than the common centre of gravity of the balls *A* and *B*. On the horizontal line

NL

NL let fall from the extremities H, i, K, of the arches the perpendiculars HL, iM and KN; and let HL be equal a; $iM=b$; $KN=c$, as alſo the arches $FH=l$; $Gi=m$ and $GK=n$: And in fine, the diameter of theſe arches or $2DF$ or $2EG=d$; ſuppoſing theſe things (by the hypotheſis) the arch GK (n) is greater than the arch Gi (m) and therefore, ln is greater than lm, that is, the fraction $\frac{lln+lnn}{dl+dn}$ is greater than the fraction $\frac{llm+lmm}{dl+dm}$; but as the arches FH, Gi, GK are very ſmall, they will coincide with their chords; and therefore, $ll=ad$; $mm=bd$, and $nn=cd$; which ſubſtituted in the preceeding fractions, it will be $\frac{an+cl}{l+n}$ greater than $\frac{am+bl}{l+m}$, or which comes to the ſame thing $\frac{anA+clA}{lA+nA}$ greater than $\frac{amA+blA}{lA+mA}$. But the conſtruction gives the equations $lA=mB$, and $lA=nC$: And therefore, in the firſt fraction ſubſtituting nC for lA, and mB for lA in the ſecond, it will be $\frac{Ana+Ccn}{nA+nC}$, or $\frac{Aa+Cc}{A+C}$ greater than $\frac{Aam+Bbm}{Am+Bm}$, or $\frac{Aa+Bb}{A+B}$. But from Centrobarics it appears, that the former fraction $\frac{Aa+Cc}{A+C}$ denotes the diſtance of the common centre of gravity of the balls A and C, when in A and K, from the horizontal line LN; and the other fraction $\frac{Aa+Bb}{A+B}$, the diſtance of the common centre of gravity of the balls A and B when in H and i: Wherefore, the centre of gravity of the balls A and C riſes higher than the centre of gravity of the balls A and B; and therefore, the force of the ball C is greater than that of the ball B. *Q. E. D.*

Let it cauſe no difficulty to any one, that in the preceeding demonſtration I have ſuppos'd the arches FH, Gi, GK to be indefinitely ſmall, ſo that they may be taken for their chords; for, the demonſtration even holds, when theſe arches are of a finite magnitude; but then the balls A, B, C, ſhould be reciprocally proportional, not to the arches FH, Gi, GK, but to the chords of theſe arches.

Aju-

A juridico-Mathematical Meditation on Rebate at ſimple Intereſt. *By* G. G. L. *From the* Acta Eruditorum Lipſ. An. 1683. p. 425.

Tranſlated from the LATIN.

Diſcount what.

REBATE or diſcount is *the difference between money due againſt a certain day, and its preſent worth*; or how much leſs it is juſt, one ſhould pay, who, not becoming indebted till ſome years after, makes preſent payment; the quantity thereof, which among lawyers is for the moſt part not ſufficiently, and among others not rightly enough explain'd, may be determined by an accurate *calculus*, aſſuming the two following ſuppoſitions from law.

Suppoſition Iſt.

1. The firſt ſuppoſition is, *that he, from whom money is demanded before it becomes due, may in his turn require, that upon that ſcore each enſuing year of mean time a legal intereſt be paid him*; as for inſtance, after 10 years you ſhall owe me 100 (on which, however, you owe no intereſt, otherwiſe you would now owe the principal) I who probably am to carry on ſome profitable buſineſs, but which requires ready money, aſk and obtain of you to pay me now down; you in your turn may require, that upon that account I pay you 5 at the end of each year of the ten, and it matters not whether the money, which is paid before the time be principal or intereſt.

Suppoſition II.

2. The ſecond ſuppoſition is taken from a well known principle in law, to wit, *that compenſation is a kind of payment*; and he, who allows a certain ſum to be deducted from the money he receives, is reckon'd to have paid that very ſum at that very time.

Poſtulate.

3. To theſe things I add this poſtulate, *that a creditor and debtor againſt a certain day to come, may preſently enter into an agreement about money not yet due, ſo that the whole buſineſs may be decided between themſelves, and that without detriment to either party*; the creditor, therefore, who now receives before hand 100 which are not due till 10 years after, ought on that account each year of the ſucceeding 10 to pay 5; and in order to free himſelf and the debtor from that trouble, and to conclude the whole buſineſs, he may allow that at preſent ſomething be deducted from the 100, on the ſcore of future intereſt, and that indeed not quite 50 or 10 times 5; for, they do not yet fall due, or their day is not yet come, but ſomewhat leſs: He will therefore, receive leſs than a 100, and the deduction he allows is the rebate itſelf, which is now to be determined.

Concluſion I.

4. From theſe things we ſhall now draw the firſt concluſion; to wit, *if the legal intereſt be the 20th part of the principal, the preſent worth of unity due a year after will be* $\frac{1}{1} - \frac{1}{20} + \frac{1}{400} - \frac{1}{8000} + \frac{1}{160000} - \frac{1}{3200000}$, &c. *in infinitum*, or more generally, aſſuming, inſtead of 20, any number

v to

v to expreſs the rate of intereſt, it will be $\frac{1}{1} - \frac{1}{v} + \frac{1}{v^2} - \frac{1}{v^3} + \frac{1}{v^4} - \frac{1}{v^5}$, &c.

Immediately at the end of the year you ſhall owe me unit or 1, as for inſtance, 1 pound, 10 or 100 pounds, *&c.* If you now pay me down this unity or principal, on account thereof I ſhall at the end of the year owe you intereſt, to wit, the 20th part of unity or $\frac{1}{20}$ (by *ſuppoſ. art.* 1.) but becauſe we agreed to decide the buſineſs immediately between ourſelves (by *Poſtulat. art.* 3.) you, therefore, in your turn demand, that I now pay you this ſum of $\frac{1}{20}$ by advance: But this payment may be made by compenſation, if I allow as much to be deducted from the ſum I was to have of you (by *ſuppoſ. art.* 2.) I, therefore, receive $\frac{1}{1} - \frac{1}{20}$. But as thus you alſo have now receiv'd the ſum $\frac{1}{20}$ not due till a year after; on that ſcore you ſhall at the year's end owe me intereſt (*art.* 1.) namely, the 20th part of $\frac{1}{20}$, that is $\frac{1}{400}$; and as we are immediately to decide the matter among ourſelves (*art.* 3.) beſides the preceeding ſum, which was $1 - \frac{1}{20}$, you ſhall give it me directly; you will, therefore, now give me $1 - \frac{1}{20} + \frac{1}{400}$; but thus you have now alſo given me the ſum $\frac{1}{400}$ not due till a year after; on that account, therefore, I in my turn ſhall at the year's end owe you intereſt (*art.* 1.) namely, the 20th part of $\frac{1}{400}$, that is, $\frac{1}{8000}$; and as we are immediately to decide the matter (*art.* 3.) I ſhall now directly pay you this intereſt before-hand, without again any detriment to the conſideration of anticipation: but I may pay it by compenſation (*art.* 2.) or I ſhall allow $\frac{1}{8000}$ to be directly deducted from the preceeding ſum, which you ſhould pay me, and which was $1 - \frac{1}{20} + \frac{1}{400}$; you ſhall, therefore, pay me $1 - \frac{1}{20} + \frac{1}{400} - \frac{1}{8000}$: And thus ſuppoſing the *calculus* to be continu'd *in infinitum*, and always by anticipation (that the matter may be directly decided) and neglecting no rebate (that neither of the parties be loſer) it is evident that you ought to pay me now the ſum of the above infinite ſeries, whoſe terms are in a ſubvigecuple geometrical progreſſion; for, the following term, is always the 20th part of the immediately preceeding one; and the ſigns + and − are alternate.

The demonſtration and explication.

5. *The fraction* $\frac{v}{v+1}$ *is* = *the whole infinite ſeries* $\frac{1}{1} - \frac{1}{v} + \frac{1}{v^2} - \frac{1}{v^3} + \frac{1}{v^4} - \frac{1}{v^5}$, &c.

Lemma.

Suppoſing v to be 20, we are to ſhow that the fraction $\frac{20}{21}$ is the ſame with the infinite ſeries $\frac{1}{1} - \frac{1}{20} + \frac{1}{400} - \frac{1}{8000} + \frac{1}{160000} - \frac{1}{3200000}$, &c. namely, the fraction $\frac{20}{21}$ multiplied by 21 gives 20, as is plain; and that infinite ſeries multiplied by 21 gives alſo 20, as ſhall be ſhown anon. Now ſuch quantities, whoſe equimultiples are equal, are themſelves equal; the fraction and ſeries, therefore, are equal: It remains only that we ſhow, that the ſeries, multiplied by 21 or 20 + 1, gives 20; the operation will ſtand thus.

Demonſtration and explication.

$+1-\frac{1}{20}+\frac{1}{400}-\frac{1}{8000}+\frac{1}{160000}-\frac{1}{3200000}$, &c. multiplied
By 20 ——————————————————————————
It will be ⊙, $20-1+\frac{1}{20}-\frac{1}{400}+\frac{1}{8000}-\frac{1}{160000}$, &c.
Let $+1-\frac{1}{20}+\frac{1}{400}-\frac{1}{8000}+\frac{1}{160000}$, &c. be multiplied
by 1 ——————————————————————————
It will be ☽, $+1-\frac{1}{20}+\frac{1}{400}-\frac{1}{8000}+\frac{1}{160000}$, &c.
Therefore ⊙ + ☽ = 20.

The second concluſion.

6. *The preſent worth of* 1, *or of the principal due a year after, is* $\frac{v}{v+1}$, ſuppoſing v to be a number expreſſing the rate of intereſt, or if v be 20, that is, if the intereſt be the 20th part of the principal, it will be $\frac{20}{21}$ of the principal, or $\frac{100}{105}$; for, that preſent worth is $1-\frac{1}{20}+\frac{1}{400}-\frac{1}{8000}$, &c. (*art.* 4.) that is (*art.* 5.) $\frac{20}{21}$ or $\frac{100}{105}$, which was to be prov'd: But if the intereſt was 6 in 100, then the number would be worth $\frac{100}{106}$, or $\frac{50}{53}$, and the preſent value of the principal would be $\frac{100}{106}$, or $\frac{50}{53}$ of the principal. The ſame concluſion may ſtill be found and demonſtrated in another manner, without an infinite ſeries, as follows; at the year's end you ſhall owe me the ſum of S, it is requir'd how much is juſtly to be paid me now, that the matter may come to the ſame thing. Suppoſe you ought to pay me now Y; the ſum Y, therefore, ſhould be ſuch, as at the year's end the intereſt with the principal may be equal to what you owe me; for, you have given me Y not now due; I, therefore, owe you Y, and at the year's end I ſhall owe you Y together with the 20th part of Y, or $Y+\frac{1}{20}Y$, which if equal to S, the ſum due me at the year's end, by making a compenſation, the debt will then in equity be mutually cancelled (*art.* 2.) and the buſineſs may be underſtood to be determined between us at firſt (according to *art.* 3.). Becauſe, therefore, $Y+\frac{1}{20}Y=S$, it will be $Y=\frac{S}{1+\frac{1}{20}}$, or $Y=\frac{20}{21}$ of S, as above; for, if you pay me now $\frac{20}{21}$ not due, at the year's end I ſhall owe the intereſt of $\frac{1}{21}$; therefore, at the year's end I ſhall owe you in the whole $\frac{20}{21}+\frac{1}{21}$, or $\frac{21}{21}$, or 1: But at the year's end you ſhall alſo owe me 1, to wit, unity or the principal; by making a compenſation, therefore, it appears, if for 1 then to be due, you now pay $\frac{20}{21}$, neither will owe the other any thing. But tho' this way be in this caſe more eaſy than the preceeding, yet I take the preceeding method to be of great moment, becauſe it gives us an inſtance of a remarkable analyſis different from algebra in this; namely, that algebra, as appears in the latter way, aſſumes an unknown quantity as known, and thence by regreſſion and an equation with known quantities it ſeeks its value: But the former analyſis, proceeding by mere known quantities, obtains directly the unknown value, a thing of great uſe, when it is impoſſible to obtain the rational value of the unknown quantity by algebra; for, then notwithſtanding, it may be obtain'd this way by an infinite ſeries.

7. Sup-

7. Suppoſing the ſame things, *the preſent worth of unity, or the principal due after two years is* $\frac{1}{1} - \frac{2}{v} + \frac{3}{v^2} - \frac{4}{v^3} + \frac{5}{v^4} - \frac{6}{v^5}$, &c. The third concluſion.

Two years hence you ſhall owe me 1, which if you now pay me before-hand, on the ſcore of intereſt I ſhall owe you after a year $\frac{1}{20}$; after two years, again $\frac{1}{20}$; in the whole $\frac{2}{20}$, which if you immediately abate (*art.* 5.) you will only give me $1 - \frac{1}{20}$: But becauſe in this manner you have alſo the former $\frac{1}{20}$ one year before-hand, to wit, the firſt; and the latter $\frac{1}{20}$ two years, to wit, the firſt and ſecond; you ſhall, therefore, owe me intereſt after the firſt year both for the former and latter $\frac{1}{20}$, received before-hand the firſt year, namely twice $\frac{1}{400}$, or $\frac{2}{400}$; and after the ſecond year, on account of the latter $\frac{1}{20}$, received the ſecond year by advance, you ſhall owe me $\frac{1}{400}$, the ſum, therefore, $\frac{3}{400}$, which if again you pay me by advance, you ſhall give me $\frac{1}{1} - \frac{2}{20} + \frac{3}{400}$, but thus now, I have again the former $\frac{2}{400}$ before-hand the firſt year; but the latter $\frac{1}{400}$ the firſt and ſecond years: Whence I ſhall owe you intereſt, which after the firſt year will be $\frac{2}{8000}$ of the former $\frac{2}{400}$, and $\frac{1}{8000}$ of the latter $\frac{1}{400}$, the ſum $\frac{3}{8000}$; but the ſecond year the intereſt will be $\frac{1}{8000}$ of the latter $\frac{1}{400}$; and the ſum of the intereſts of the firſt and ſecond years $\frac{4}{8000}$, which if again I allow to be abated by diſcount, you ſhall only give me $1 - \frac{2}{20} + \frac{3}{400} - \frac{4}{8000}$; but thus now you have again received the former $\frac{3}{8000}$ before-hand the firſt year, the latter $\frac{1}{8000}$ the firſt and ſecond years: Whence you will owe me intereſt, which the firſt year is $\frac{3}{160000}$ of the former $\frac{3}{8000}$; and $\frac{1}{160000}$ of the latter $\frac{1}{8000}$, the ſum $\frac{4}{160000}$; the ſecond year is again $\frac{1}{160000}$ of the latter $\frac{1}{8000}$; and the ſum of the intereſts of the firſt and ſecond years $\frac{5}{160000}$, which if you pay me directly by anticipation (regarding in the continuation of the *calculus* the rebate) you ſhall give me $1 - \frac{2}{20} + \frac{3}{400} - \frac{4}{8000} + \frac{5}{160000}$; and thus by ſuppoſing the *calculus* to be continu'd *in infinitum*, the infinite ſeries, which we laid down, will come out. Demonſtration.

8. *For three years, the ſame denominators and ſigns remaining, the numerators will be triangular numbers; for four years, pyramidal; for five years, triangulo-triangular*; and ſo on for more years, higher numbers, call'd *figurate*; and which I, for their uſe, am wont to call *combinatory*, in *infinitum*. As this may be ſhown in the ſame manner, as I have demonſtrated the preceeding concluſion, I wave the prolix deduction of it here, the numbers themſelves are as follows: The fourth concluſion.

Figurate or combinatory numbers.						The preſent value of a principal due		After Years
Unit	1	1	1	1	1	$\frac{1}{2}-\frac{1}{20}+\frac{1}{400}-\frac{1}{8000}+\frac{1}{160000}$, &c. =	$\frac{20}{21}$	1
Natural	1	2	3	4	5	$\frac{1}{1}-\frac{2}{20}+\frac{3}{400}-\frac{4}{8000}+\frac{5}{160000}$, &c. =	$\frac{400}{441}$	2
Triang.	1	3	6	10	15	$\frac{1}{1}-\frac{3}{20}+\frac{6}{400}-\frac{10}{8000}+\frac{15}{160000}$, &c. =	$\frac{8000}{9261}$	3
Pyramid.	1	4	10	20	35	$\frac{1}{1}-\frac{4}{20}+\frac{10}{400}-\frac{20}{8000}+\frac{35}{160000}$, &c. =	$\frac{160000}{194481}$	4
Triang. Trian.	1	5	15	35	70	$\frac{1}{1}-\frac{5}{20}+\frac{15}{400}-\frac{35}{8000}+\frac{70}{160000}$, &c. =	$\frac{3200000}{4084101}$	5
		&c.				&c. &c.		&c.

Lemma.

9. In order to find after another manner theſe preſent values, I aſſume this lemma: *The preſent worth of a future value is the preſent worth of that very ſum:* For inſtance, at the end of the year 1685, or after two years, you ſhall owe me a certain ſum: I would fain know what is now, at the end of 1683, the preſent worth of that ſum; I, therefore, firſt ſeek what ſhall be the value after a year of a ſum that falls due after two years, or at the end of 1685, and it will be $\frac{20}{21}$ of the ſum (*art.* 6.) becauſe there intervenes only one year: if, therefore, after two years you owe me unity, it is the ſame thing as to this *calculus*, as if after a year you ow'd me $\frac{20}{21}$; but again, if after a year you owe me $\frac{20}{21}$, it is the ſame thing (*art.* 6.) as if you ow'd me now $\frac{20}{21}$ of that ſum, or $\frac{20}{21}$ of $\frac{20}{21}$, that is $\frac{400}{441}$; if, therefore, after two years you owe me any thing, the preſent worth will be $\frac{400}{441}$ thereof, or the ſquare of $\frac{20}{21}$, receiv'd of that ſum as unity: And in the ſame manner it will appear, that the preſent worth of unity due after three years is $\frac{20}{21}$ of $\frac{20}{21}$ of $\frac{20}{21}$, or the cube of $\frac{20}{21}$, that is $\frac{8000}{9261}$, and ſo on: And this *Lemma* is nothing other than a ſubſumption from that well known axiom, *that things equal to a third thing are equal among themſelves*; for $\frac{400}{441}$ is now equal to $\frac{20}{21}$ due after a year, and this is equal to unity due after two years; and therefore, this unity is equal to $\frac{400}{441}$ due now: Thence now appears

The fifth concluſion.

10. If the rate of intereſt be v (that is, 20, ſuppoſing the intereſt one twentieth of the principal) *the preſent worth of a ſum due after ſome years will be to the ſum itſelf in the ratio of* v *to* $v+1$ (*or of* 20 *to* 21) *repeated according to the number of years*; that is, the preſent worth of a ſum due after a year will be ſimply $\frac{20}{21}$ of the ſum, or it will be to the ſum in the ratio of 20 to 21; but the preſent worth of a ſum due after two years will be $\frac{20}{21}$ of $\frac{20}{21}$, or $\frac{400}{441}$ of the ſum, or it will be to the ſum in the duplicate ratio of 20 to 21, or as 400, the ſquare of 20 to 441, the ſquare of 21. And the preſent worth of a ſum, due after three years, will be $\frac{20}{21}$ of $\frac{20}{21}$ of $\frac{20}{21}$ of the ſum, or $\frac{8000}{9261}$ of the ſum, or it will be to the ſum in the triplicate ratio of 20 to 21, or as the cube of 20 to the cube of 21, and ſo on. And by expreſſing this generally, let the preſent worth be Z, the

ſum

ım due S, the number of years *a*, and *v* the rate of intereſt; ſuppoſing hich, Z will be = S, multiplied by the *a* power of $\frac{v}{v+1}$; let *v* be 20 ıd S unit; the preſent value of unity due after one year will be $\frac{20}{21}$, the ɔot; after two years $\frac{400}{441}$, the ſquare; after three years $\frac{8000}{9261}$, the cube; ter four years $\frac{160000}{194481}$, the biquadrate; after five years $\frac{3200000}{4084101}$, the rſolid, *&c.* which numbers either by multiplication, or only by adding ieir logarithms, may be continu'd to any number of years; and it will uſeful to expreſs the fractions decimally. Of their uſe in ſome queſtions law, not ſufficiently well defin'd among excellent authors; and of eſtiıating annuities for life (where rebate is at compound intereſt) we ſhall eat on ſome other occaſion.

A Diſſertation on Metallic Salts, together with their Uſes in Phyſics, Chemiſtry, Medicine and Surgery. By Godfrey Rothens. *Publiſhed at* Leipſig, An. 1723.

Tranſlated from the HIGH DUTCH.

SUCH as labour to call in queſtion or entirely to invalidate the exiſtence and reality of metallic ſalts, principally build on theſe three things: 1. That the whole of what is uſually prepar'd from ietals under the name of a ſalt is no ſuch part as is ſeparated by the way extraction from their other remaining eſſential principles, as their ſulıur and mercury; but that it is rather the entire body of the metal, corded by the ſalts of the *menſtruum*'s uſed thereto. 2. Conſequently, that is only ſuch a combination, as conſiſts of a metallic calx, concreting with ſalt: Whence it is to be call'd a magiſtery, or by ſome other properer ame, rather than a ſalt. 3. On which account alſo theſe ſalts, extracted om metals, when treated with a candent fire, run not as other true ſalts ɔ, but become either a *calx* (which admits of no farther ſolution) or a laſſy *ſcoria*.

Objections againſt the exiſtence of metallic ſalts.

2. *Angelus Sala* in his *Chryſologia*[a] gives us, as it were, in a ſhort compaſs, l the oppoſite objections, when he ſays; 'tho' metallic aſhes were for a whole year together macerated in water, yet could not the leaſt particle of a true ſalt be obtain'd therefrom: I am not ignorant, that there were ſome who boaſted, that, by means of diſtill'd vinegar, or other the like liquor, they could extract ſuch a ſalt; but yet I alſo know, that they egregiouſly deceiv'd both themſelves and others; for, what they gave out for a ſalt is not really the ſalt of theſe bodies, but the ſpirit of the diſſolving liquors, which along with a part of the metallic aſhes ſhot into

Summ'd up by *Angelus Sala*.

'ſuch

[a] S. I. cap. II. p. 124.

'ſuch a ſaline maſs; as the fire ſhews, whereby the coagulated ſpirit ma
'again be ſeparated from the metallic aſhes: So that theſe aſhes, whe
'thus the ſpirit is abſtracted from them, return again to their firm co
'ſiſtence and form; and are no longer diſſolv'd in water.'

Refuted by the author.

3. But the whole of what is here advanced by *Sala* may certainly b very eaſily refuted; for, the firſt objection, namely, that the calcin' metals, tho' never ſo long macerated in water, yield not a grain of a tru genuine ſalt, may, probably, be granted, as to ſuch metallic *calx*'s, pr par'd by bare roaſting or calcining: Nevertheleſs, there are ſtill oth means behind, whereby metals may be reduced to ſuch aſhes, which witl out addition of any one ſaline or acid *menſtruum*, exhibit obſervab traces of a genuine ſalt, of which we ſhall treat below. The other arg ment, namely, that thoſe ſalts, which in the common method are b means of acid *menſtruum*'s prepar'd from calcin'd metals, may by the for of the fire be ſo ſeparated from each other, that when the ſpirit evap rates, which the metallic calx had imbib'd, they again reſume their form appearance of a calcarious earth: This argument, I ſay, may be alſo r futed by contrary and oppoſite experience; for, tho' moſt metallic ſalt which alſo for this reaſon are by ſome call'd vitriols, undergo ſuch a chang yet hence we are by no means to conclude, that they are all of the ſam nature: Beſides, the remaining calcarious body, to which theſe ſalts a chang'd by calcination, does remarkably and evidently differ from th firſt *calx*, from which they were drawn, as well in its tenderneſs, as its greater degree of ſolubility; nay, by repeated diſſolutions and ge tle calcinations (in which great care is to be taken that it does n vitrify) it may at laſt be exalted to a higher degree of purity and fixe neſs than thoſe *calx*'s of the more proper ſalts require: Beſides, the ſa alſo, which are unanimouſly ſo call'd (whence likewiſe our modern ſa borrow their names, as common ſalt, ſalt-petre and the lixivious ſalts plants) give out by the force of the fire a ſpirit; and there remains b hind another more fixt ſubſtance, which is diſtinguiſh'd from the forme and which is common enough; and in theſe laſt, namely, the lixivio ſalts, a ſpirit has likewiſe been ſought for with good ſucceſs by *Borrichiu* in regard that from ſix ounces of the ſalt from the aſhes of the cuttings the vine, mix'd with four parts of its own proper aſhes, out of which the ſalt was elixated, upon diſtilling it in an earthen retort for 24 hours, whole ounce of ſpirit was forced off, of a moderate ſharp taſte; upo pouring which on filings of copper, ſome veſicles like a rainbow were mad to float in the liquor[b]; nay, almoſt all ſalts, even the lixivious ſalts ther ſelves, peculiarly call'd *fix'd*, are at laſt, by repeated calcination and ſol tion, brought to an uſeleſs and inſipid earth, as *Borrichius* alſo teſtifies Nevertheleſs they are not on that account excluded from the genus an claſs of ſalts.

4.

[b] *Vid.* Tractat. de hermet. & Ægypt. Sapient. lib. II. c. V. § 8. p. 366.
[c] L. c. p. 253. & cap. VII. § 3. p. 404.

4. In fine, as to that objection, *viz.* that theſe ſalts are none of the rinciples, which conſtitute metals, and which are ſeparated from the thers, but are the entire body of the metal, which is only ſubtiliz'd and ttenuated into a ſaline form, I ſay, this objection does not properly affect s, but rather ſuch as attempt to maintain, that all mixts, and conſequently alſo metals conſiſt of ſalt, ſulphur and mercury; and may likewiſe gain be reſolv'd into theſe three principles. Tho' now our preſent purpoſe does not admit of our intermeddling with the famous diſpute about he principles of natural bodies, or of enquiring, whether the three elements of the Chemiſts, or thoſe of the *Carteſians*, are more eaſily demonrated; yet we hold this as a thing firm and certain, namely, that the enuine principles of mixt bodies are far more ſubtile than that they can be id down under the notion and form of a corporeal ſalt, as it is ſtill ſubject o a farther reſolution and ſeparation: However, the bare diſtillation of rtar ſhows, that a mixt, even without its ultimate diſſolution into its true nd primary principles, may be reſolv'd into ſuch parts, as are actually difrent from each other; as partly into a more acid ſpirit, a nauſeous oil, a x'd fluid ſalt, and laſtly into an aſhy, indiſſolvable earth; which, indeed, o ſo far as they may ſtill further be ſeparated into ſome other foreign parts, annot be held for the firſt and true principles; and yet certainly they deerve to be eſteem'd and denominated the *principiata*, which in their form, onſiſtence and effects are very unlike each other, and muſt thus be mually different: Now when thus the like happens with metals, namely, hat they can alſo be reſolv'd into ſuch different parts, what ſhould hinder s from giving different names to their different productions, to diſtinguiſh hem from each other, tho' the cloſe union of the principles be not eſentially ſever'd, and a compleat radical diſſolution of the mixt be not yet ccompliſh'd.

5. But in ſo far as any one is ſo minded as to clear up the whole of this ubject of the chemical principles of things, eſpecially of metals, according o the truth of the matter, he may in this view take *Beccher* for his guide, o whoſe opinion the famous *Stahl* uſually gives in; tho' his ſentiment in all eſpects is not according to the common notions, yet in my opinion he ands upon ſuch a bottom, that I am well aſſur'd, no one will repent the aking him for his guide much more in this: The ſaline principle in meals denotes not a perfect and proper ſalt, which actually conſiſts in a ſaline mixture (namely, that it is cloſely united with an humidity) in which orm it certainly belongs not to metallic mixtion, nay cannot conſiſt therewith: However, it is ſuch a ſubſtance, which in the quickeſt manner yields to ſalts, in the ſenſe they are commonly taken, before all other things, and eſpecially above all ſulphureous ſubjects, and unites with them, and if rightly underſtood, ſuffers itſelf, as it were, to be extracted from them. It is certain, that it forms with them ſuch a conſiſtence, as hence to become more

Beccher a proper guide in this matter

more proximately fitted to receive any new mixtion; I mean in other metals, that have a great poverty of this ſaline principle; and to enter more ſubtily and cloſely into them; in which reſpect the inſtance of an experiment of *Kunckel*'s, to be adduced below, is very remarkable; as alſo that excellent chemiſt at *Leipzig*, M. *Lincke*, may ſupply us with a ſample of this matter, namely ſilver made from common mercury, by means of a very ſmall quantity of a metallic ſalt; nay, if it were neceſſary, an experiment might be here adduced, where by means of a groſs, nay even a ſaline mixture, made from lead, copper, *&c.* ſuch a change is induced on common quickſilver, as eminently ſhows not only a compleat and genuine, but alſo the firmeſt degree of mixtion.

'Tis far from being made out that metallic ſalts are the body of the metal corroded.

6. Yet the matter is far from being made out, or ſufficiently prov'd, that theſe metallic ſalts are nothing other than the entire and perfect body of the metal, only corroded and diſſolv'd by an acid; and conſequently, by means of an alcali, again eaſily reduced to its former metal; for, tho' ſome among them may, by means of a particular *encheireſis* in reducing, ſhow ſomething of the former metallic body, yet one may ſtill doubt as to the compleat demonſtration of this attempt, even by this reduction itſelf, till one can be fully aſſur'd, that by this reduction the full weight of the metal taken thereto is again recover'd, and that a conſiderable quantity thereof does not change to a glaſs or *ſcoriæ*, or that this reduction may be perform'd without new addition of the more volatile part, which exhal'd in calcining: Tho' at preſent we incline not particularly to appeal to the manner mention'd by *Iſaac Hollandus*, or any other laborious method of reducing metals, with ſome ſeparation of other entirely different parts, into a ſalt; yet here we cannot omit adding, that the groſs ſolution of metals with acid *menſtruum*'s ſcarce happens without a manifeſt ſeparation of adventitious particles. Thus in the common preparation of martial vitriol, that is, in the ſolution of iron with oil of ſulphur, which is diluted with common water, and in filtring it, that it may be fit to ſhoot into cryſtals, a loamy, blackiſh matter at firſt uſually remains behind, which after drying becomes a greyiſh and very light powder, and by moſt people thrown away under the name of an uſeleſs earth [d]; but when examin'd more accurately it appears to be nothing other than the more ſulphureous part of the iron, which is left behind untouch'd by the acid of the vitriol, as it takes to itſelf more readily the ſaline and earthy parts, and this *Keſlerus* has remark'd [e]; nay, when the dried remainder is well ground or rubb'd with about an equal quantity of quickſilver and ſet to ſublime, the greateſt part of the mercury concretes with the ſulphur, and is rais'd a genuine cinnabar, which, probably, with the ſame juſtice as I call a cinnabar antimonial, may alſo be denominated a martial cinnabar. I have alſo remark'd, that even ſuch a ſediment ſeparates upon making the ſolution of iron with ſpirit of ſalt, yet I have had no

[d] *Vide* Glaſer's Traité de la Chymie, *lib.* II. *cap.* 5. *p.* 172. [e] Centur. II. n. 27. *p.* 173

no opportunity of enquiring into it and treating it in the ſame manner with quickſilver. Thus alſo does diſtill'd vinegar in the ſolution and cryſtallization of verdegris, leave behind many particles of copper undiſſolv'd, and which are again no otherwiſe diſſolv'd than by the addition of ſpirit of *ſal ammoniac*. *Glauber*'s hint, adduced up and down in his writings, is not entirely without foundation, namely, that ſuch ſediments, as ſettle ſometimes in the different ſolutions and digeſtions of metals, ſhould be examin'd ſomewhat more cloſely and carefully, as this labour may very often be of ſervice.

What may be denominated a ſalt.

7. Nay, I ſee not what ſhould hinder, that I may not aſcribe the denomination of a ſalt, even as it is commonly taken, to ſuch a production, as ſhows all the marks of a genuine ſalt, tho' prepar'd without the manifeſt ſeparation and collecting apart of the remaining principles, and tho' the entire body of the metal, or the greateſt part thereof be reduced to ſuch a ſaline ſubſtance. In the ſame manner that we deny not the name of an oil to that of wax or any other ſoft fat; tho' almoſt the entire ſubſtance of the wax or fat, ſubtiliz'd by the motion of the fire, does conſtitute the ſame.

The definition of a ſalt.

8. Yet the whole diſpute may be more eaſily decided after premiſing the definition of a ſalt, and with this the illuſtrious Dr. *Hoffman* ſupplies us in his Diſſertation *de Generatione ſalium* § 4. where he ſays; 'a ſalt is a ſapid 'ſubſtance, which ſuffers itſelf to be diſſolv'd in an aqueous liquid;' with whom alſo agrees *Geber*, when in his treatiſe, *Summa perfectio*,[f] he thus ſpeaks of ſolution; 'every thing that is diſſolv'd (namely in ſharp, bitter, 'auſtere and acid waters, ſuch as diſtill'd vinegar, unripe grapes and auſtere plums, *&c.* when they are previouſly diſtill'd) muſt neceſſarily poſſeſs 'the nature of ſalt, alum, or the like': And ſomewhat farther; 'we may 'from the works of nature ſhow, that barely ſuch things, whoſe ſalts partake of the nature of alum, and the like, do admit of ſolution.'

The principal ſecundary and accidental characteriſtics of ſalts what.

9. Thus it will not be improper to make the principal *criterion* of ſalts to conſiſt in this, namely, that they are eaſily diſſolv'd in an aqueous humidity. The other requiſites, namely, that on the tongue they yield a remarkable taſte, that after ſolution in watery *menſtruum*'s they may again be eaſily reduced to a dry conſiſtence, when duly evaporated, are rather its ſecundary and improper characteriſtics; their remaining properties, as their colour, fixedneſs or their abiding the fire, their purity and fluidity are only accidental diſtinctions, which may, indeed, alter the *ſpecies*, but in no manner, the *genus*; in which reſpect, ſugar, tartar and other ſalts, call'd the eſſential ſalts of plants, vitriol, alum and other ſuch like, are certainly to be reckon'd in the number of ſalts. In no other manner does *Baſil Valentine* uſually ſpeak, who, as *Helmont* and *Borrichius* teſtify, was almoſt the very firſt that introduced the appellation and diſtinction of the three principles, ſalt, ſulphur and mercury; for, thus he writes in his third book

[f] Lib. I. Part IV. c. 51.

of vitriol, p. 270. ‘ in the earth is a mineral ſalt, call'd vitriol, *&c.* this ‘ ſalt carries an inflammable ſulphur, which the others do not.’ Alſo in his *repetition of the ſtone of the wiſe*, p. 106. on tartar; ‘ this ſalt is not ‘ written in the book of minerals.’

Vitriolic ſalts or cryſtals how obtain'd from gold, ſilver, *&c.*

10. Thus if one could only obtain from metals a vitriol, it would be a ſufficient refutation of thoſe of an oppoſite opinion; for, they themſelves venture not to deny, that all metals, even the nobler ſort, which otherwiſe do without any waſte withſtand all force of fire, may by proper *menſtruum*'s be reduced to vitriols or ſaline cryſtals, tho' as to gold the matter is not ſo eaſy, upon expoſing plates of gold to the fumes of corroſive waters, as the generality do with this view recommend it: However, *Erbinæus von Brandau* in his *twelve fundamental pillars of nature and art*, p. 23. propoſes a ſpeedy and no improper method of reducing not only gold, but likewiſe ſilver and mercury to ſuch cryſtals or vitriolic ſalts; namely, the gold is diſſolv'd in *aqua regia*, but the ſilver and mercury in *aqua fortis*; then the *menſtruum*'s are drawn off to about the half, and to the remaining liquor ſome ſpirit of wine is dropp'd (for, without the addition of this latter, the ſolution of the gold made with *aqua regia*, does with difficulty ſhoot into cryſtals, as *Cramer* teſtifies[g]) upon which in a cool place it ſhoots into tranſparent cryſtals, which then may a-new be diſſolv'd in diſtill'd vinegar, afterwards in diſtill'd rain-water and ſpirit of wine: And by theſe repeated ſolutions and coagulations they may be brought to the greateſt purity[h].

From lead.

11. Such a vitriolic ſalt may more readily be obtain'd from lead, by means of diſtill'd vinegar, when pour'd on *minium*, litharge, ceruſs, or any other calx of lead, as being ſoon edulcorated thereby; and afterwards being duly evaporated it gives a ſalt, which on account of the peculiar ſweetneſs it yields in the taſte, is commonly wont to be call'd ſugar of lead; nay, it is ſtill more eaſily prepar'd, without any preceeding calcination, from filings of lead with ſmall *aqua fortis*, or ſuch as has been diluted with about three parts of common water; nay, even a ſomewhat ſtronger vinegar, when diſtill'd thro' a lead-alembic, or ſuch as is fill'd with ſheet-lead, carries along with it ſo much of the lead, that the vinegar becomes not only obſervably ſweet, but when it is alſo abſtracted or duly evaporated, it ſhoots into ſaccharine cryſtals[i]. In this manner *Zapata* prepares his *aqua Æſculapii*; for, that it is nothing other than a fluid ſugar of lead, may be eaſily ſhown from the circumſtances mention'd by the author himſelf, *ſee* his *Mirabilia Medico-chirurg.* publiſh'd by *Spleiſſius*[k].

From tin.

12. That from tin in the ſame manner as from lead, a ſalt may be extracted with diſtill'd vinegar, *Glaſer*, indeed, denies in his *Traité de la Chymie.*

g Colleg. Chym. p. 120. h Vid. *Keſler* Cent. 1. n. 4. and *Bar. Schroeder*'s thoughts on gold-making, p. 107. i Vid. *Kunckel*'s Remarks on *Neri*'s and *Merret*'s Art of Glaſs-making. k Cap. XIII. p. 220.

Chymie[l]. But upon taking good ſharp diſtill'd vinegar, to which in the diſtillation about a handful of common ſalt has been added, and pouring it upon *calx* of tin, prepar'd by bare ignition and a conſtant ſtirring it, and afterwards ſuffering them to digeſt duly together for ſome time, it indeed, takes ſo much to itſelf, that upon dropping ſome ſpirit of vitriol into the ſolution, it ſtrait becomes muddy and precipitates. In this manner *Mynſichtus* prepares his *ſal* or *magiſterium joviale*[m].

13. From copper, a vitriolic ſalt is very commodiouſly obtain'd, if it be cemented and calcin'd with common ſulphur; for, the ſpirit of vitriol lays weak hold on the copper, ſo that a pound of it ſcarcely takes to itſelf half an ounce of copper. From verdegris alſo with diſtill'd vinegar green cryſtals are uſually made, and ſold by druggiſts under the name of diſtill'd verdegris. The green precipitate of *Beguinus* and *Hartmann* for the clap, differs little from this. From copper.

14. In the ſame manner may from iron, as from copper, a vitriol be prepar'd by cementation and calcination with ſulphur; nay, as *Glauber* writes, it may alſo be eaſily obtain'd by barely conveying the fume of burning ſulphur to ſome iron-filings, put in a capacious alembic; nay, even by mixing iron-filings with pounded ſulphur, and barely ſprinkling it with water, it will in a few hours ſo heat as to burſt the glaſs, and yield a very thick fume, and laſtly become a brown powder, which by gentle roaſting in an open veſſel changes to a beautiful red *crocus*, from which afterwards with rain-water a vitriolic ſalt of no ungrateful taſte may be extracted[n]. Nevertheleſs, iron does eaſily and readily yield to the ſpirit or oil of vitriol, when diluted with about three parts of common water, which is alſo the moſt common way of preparing a martial vitriol or a vitriol of iron. Yet in this preparation there is this remarkable; namely the ſpirit, nay, even the oil of vitriol itſelf does often obtain partly, thro' the more immediate communication with the glowing matter in the diſtillation, partly by the addition of an inflammable, vinous ſpirit; nay, even barely by the abſtraction thereof from common mercury (which happens in the preparation of turpeth mineral) a peculiar volatility and ſuch a penetrating force, as that it can ſcarce in any manner be check'd from yielding thro' the junctures a very ſulphureous fume, which almoſt ſtifles the by-ſtanders; but which, upon only putting into the receiver ſome freſh iron-filings, that are not ruſty, is immediately entangled and concentrated into a beautiful vitriol. From iron.

15. But as for the moſt part theſe vitriolic ſalts, prepar'd from metals with acid *menſtruum*'s, have a very nauſeous and auſtere taſte; nay, ſome of them, a very ſtrong ſeptical or corroſive virtue, ſome have attempted to correct them in ſome meaſure, and render them fitter for medicinal uſe, partly by repeated ſolutions in diſtill'd vinegar and diſtill'd rain-water, These vitriolic ſalts how corrected.

[l] Lib. 2. cap. IV. p. 160. [m] Armamentar. Medic. chymic. p. 21. [n] Vid. *Heſſmanni* Notas in *Poterium*, p. 553.

and partly by the addition of ſpirit of wine, or a volatile, urinous ſalt; and indeed, as to ſpirit of wine, its effect in weakening, or, as it is commonly call'd, edulcorating or dulcifying the ſtrongeſt acids and corroſives, as for inſtance, oil of vitriol, concentrated ſpirit of nitre, *&c.* is well known. *Baſil Valentine* has mention'd of diſtill'd vinegar, that it is the beſt corrective of all mineral poiſons eſpecially; and he alſo adduces an evident experiment, that is well worth to be conſidered, whereby diſtill'd vinegar weakens, nay, entirely changes glaſs of antimony and other ſtrong antimonial emetics[o]; nay, the above-mentioned precipitate is uſually ſo prepar'd, that the mercury and copper are diſſolv'd in *aqua fortis*; afterwards the *aqua fortis* is abſtracted therefrom, but what remains behind is diſſolv'd in diſtill'd vinegar, and very ſeldom cauſes either vomiting or ſalivation: Whereas the former effect is otherwiſe very common to copper, and the latter, to quick-ſilver after ſolution and precipitation in *aqua fortis*; and certainly the peculiar and mutual changes, which diſtill'd vinegar both ſhews in and again ſuffers from metals, but eſpecially lead, copper and iron, deſerves mature conſideration, as appears in different manners in ſugar of lead, cryſtals of verdegris, different *crocus*'s and precipitates both of iron and copper. We muſt not diſregard the commendation *Iſaac Hollandus* beſtows on diſtill'd vinegar, when he aſſures, that above other *menſtruum*'s it is poſſeſs'd of an eminent virtue of penetrating metals, volatilizing, rectifying and again fixing them[p].

Whether ſpirits are fitted to correct theſe ſalts.

16. But that ſpirits, or volatile, urinous ſalts ſhould be fitted to correct theſe vitriolic ſalts, ſome might, probably, call in queſtion on this account, namely as it may be apprehended, that theſe ſalts may be deſtroy'd by the addition of an alcaline liquor, in regard the metalline particles, concreted with the acid *menſtruum*, are again torn and ſeparated from their union and combination. But this apprehenſion is groundleſs; for, copper, if only diſſolv'd with common *aqua fortis*, is not precipitated by ſpirit of urine or *ſal ammoniac*; or if at firſt any of it be precipitated, it is again ſtrait diſſolv'd, upon pouring in a larger quantity of the ſpirit, whereby the colour is then very beautifully exalted; ſo that the liquor, that was before entirely greeniſh, does now give the moſt beautiful, blue ſaphirine tincture. The only thing that ſeems to be ſtill wanting is, that this ſolution cannot eaſily be reduced to cryſtals of the like colour; for, upon evaporating it even in the gentleſt manner, or abſtracting it in cloſe veſſels, the beautiful blue colour ſoon vaniſhes, and there remains behind a greeniſh ſaline *magma*, that with great difficulty coagulates; but urged with a ſtronger fire, fulminates in the moſt violent manner, to the endangering the by-ſtanders. *Stiſſer* alſo owns[q], that he found no leſs difficulty in the ſolution of *Cyprian* vitriol, which in like manner, upon his dropping an urinous ſpirit thereon, inſtead of

[o] Vide Valentin. de magno lapide antiquorum Sapientium p. 107. *et* Currus triumphalis antimonii, p. 390. [p] Vid. *Stahl.* Specim. *Becher.* P. II. memb. 2. exper. 199. —— 209. [q] Act. labor. chym. ſpecim II. cap. XI.

of precipitating or becoming muddy, was exalted to a very beautiful colour, but could in no manner be brought to ſhoot into cryſtals; yet he mentions, that after ſeveral fruitleſs attempts, he at length accompliſh'd it by means of a liquor, neither acid and corroſive, nor alcaline and lixivious, which the author in the above-mentioned place does not, indeed, expreſsly mention, yet it has long ſince been conjectured by the experienced to be no other than a rectified ſpirit of wine. *Glauber*, in his *Philoſophical furnace*[r], as alſo in his *Proſperity of Germany*[s], ſhows very clearly, how vitriol of ſilver, prepar'd with oil of vitriol or *aqua fortis*, may by means of ſpirit of urine be corrected.

Whether vitriolic ſalts may be corrected by other ſalts.

17. I know not whether we may here refer the correction or exaltation of ſuch vitriolic ſalts, as ſome have attempted by the addition of other ſalts. Thus we find in *Digby*'s experiments p. 189. how to correct the cryſtals of ſilver by the addition of ſaltpetre, ſo that thereby their diuretic virtue may be the milder and more ſafe. *Febure* teaches, that from iron by means of *aqua fortis*, alter'd by a little ſalt-petre, may be obtain'd genuine cryſtals, which are alſo proper to be taken internally. *Caſſius* in his treatiſe *de auro* cap. x. p. 109. changes gold itſelf by means of the phlegm of *aqua fortis* and ſea-ſalt into very red cryſtals, which ſmell of violets and have no ungrateful taſte; and tho' in this manner they might with better ſucceſs be us'd in medicine, yet, probably, they will be the leſs receiv'd by others, as foreign ſalts are very evidently added to them.

Salts which approach nearer to genuine ſalts, obtain'd by calcination.

18. But to omit thoſe vitriolic ſalts and to proceed to ſuch as are generally held to approach nearer to genuine ſalts; *Geber*[t] plainly ſhows the method of obtaining them, when he ſays; 'we may from the works of 'nature ſhow, that barely ſuch things, as poſſeſs the nature of ſalts, alum 'and the like, ſuffer ſolution, *&c.* and ſuch as are thus diſſolv'd muſt 'neceſſarily be ſo by virtue of their nature. But as we ſee, that all ſuch 'things, as are duely calcin'd, are by the repetition of the calcination 'and ſolution diſſolv'd; it will hence be manifeſt, that all calcin'd matters 'approach neareſt to the nature of ſalts and alum'.

Calcination of metals what, and how perform'd.

19. And thus, as it were, calcination is the ſhorteſt and ſpeedieſt key for opening the firm locks and bolts of metals; but calcination, even as *Geber* deſcribes it[u], is a pulveriſation of a thing by means of fire, whereby the humidity, which held together or combin'd the parts, is diſſipated. But now this happens in a twofold manner, as he there alſo ſhows p. 100, either barely by the fire, or by the acrimony of the ſalt: Both methods are deſcrib'd by *Iſaac Hollandus* in a particular treatiſe he wrote on *the ſalts and oils of metals*; and he holds, that the former anſwers better in the harder, and the latter in the ſofter metals; namely gold, ſilver, tin and lead are diſſolv'd in their proper acid *menſtruum*'s, and afterwards precipitated;

[r] Lib. II. p. 19. [s] Part IV. p. 68. [t] Summ. perfect. lib. I. cap. LI.
[u] Cap. L. p. 98.

tated; the calx elixated from all its ſalt, is then put into cucurbites with flat bottoms, not exceeding a finger in thickneſs; and then it is kept for 20, 30, nay more days in ſuch a degree of warmth, as is neceſſary to make the lead run, yet without igniting it; after that, the fire is gently increas'd to ignition, and continued at that pitch above eight days; and the more volatile part, which he calls a mercury, riſes up in form of white flowers, and the *calx* remaining behind at the bottom ſwells or heaves like a ſponge; and when this happens, the ſalt is drawn off with diſtill'd vinegar; and what is brought over is purified by repeated ſolutions and coagulations; but the harder metals as copper and iron, are filed ſmall, and then reverberated by a bare ſlight ignition; but for a longer time, as 30, nay 90 days ſucceſſively, till they alſo heave and ſwell like the former; and then the ſalt is extracted with diſtill'd vinegar. But certainly this operation requires an uncommon degree of patience, and an entirely accurate regimen of the fire (and here the author very juſtly hints, that one muſt take particular care, that the metals do not vitrify) and hence he had ſo few followers; nay, it has hardly been believ'd by a great many. But yet, that this manner of opening and ſubtilizing metals by ſuch a continued reverberation does thus ſucceed, is confirm'd by *Kunckel*'s own experience, when he ſays, 'that iron-filings, when treated in this manner, become a ſubtile '*crocus*, which, as he hints, contains more in it than is proper to reveal[w]'.

Monte Snyder's method.

20. *Monte Snyder*'s method has been more generally receiv'd, (probably, as the proceſs is much eaſier and more compendious) wherein he mixes the metals with the *regulus* of antimony, and then reſolves them by means of ſalt-petre, tartar and ſulphur, mixt together in a due proportion; in ſuch manner, that after the ſalts which were added are elixated and the ſulphur ſeparated from the remaining *calx's*, after being firſt open'd by further calcination, the ſalt may at length be extracted; as this is more fully explain'd, partly by the author himſelf, tho' ſomewhat more darkly, and partly by his Commentator *Berlichius*, both in his remarks annex'd to *Monte Snyder*'s treatiſe, and alſo in his inaugural diſſertation *de Medicina univerſali*, An. 1679 at *Jene*. But as the illuſtrious *Stahl* hints in his obſervations for the month of *April*, ſcarcely can any other thing be obtain'd in this manner than beautiful clear cryſtals, and which alſo *Berlichius* himſelf does not entirely deny, only that he would maintain, that they are poſſeſs'd of a greater degree of fixedneſs and fluidity.

Inſtead of ſalts, &c. other minerals, nay metals themſelves might be employ'd.

21. Yet one might juſtly wonder, why the artiſts did not, inſtead of ſalts and common ſulphur, employ other minerals, or even metals themſelves for the purpoſe. It is well known, that tin and lead do in a gentle fire melt very well together and run into each other; but as ſoon as the heat becomes glowing, that the veſſels are ignited, they ſo heat each other, as to glow like a burning coal, aud preſently fall to aſhes. Thus it is alſo very

[w] *Vide* his Art of Glaſs-making, p. 69.

very remarkable of zink, that when laid in bits on any metal, as for inſtance hot running lead, it ſtrait breaks out into a very clear bright flame; and by a copious evaporation of very white flowers, it at laſt changes with the metal to a very light and highly tender white powder. And I remember not to have found any trace of this in any other author than in the latter part of *Beccher's Concordantia Chymica*, which he calls *roſetum chymicum*[x]; where he teaches, how to convert gold itſelf into a yellowiſh *calx*, without any luſtre or ſplendor, upon mixing about three parts of zink with it, and again ſubliming it from the gold with the ſtrongeſt degree of fire.

22. The following method is the more uſual and better known, for the more accurately attenuating and opening metals; namely, by often abſtracting and ſubliming mercury therefrom. Thus *Etmuller*[y] recommends, when one would further chemically edulcorate a calx of gold, made with *aqua regia*, and dulcified with common water, the *Mercurius dulcis* ſhould be added in equal quantity, and by a continu'd careful rubbing be well mix'd together, and afterwards again ſublim'd from the calx of gold, and the gold will remain behind like a wool; and it afterwards will become the fitter for the extraction of the tincture, and alſo, doubtleſs, of the ſalt. That corroſive ſublimate will be ſtill more powerful, ſo that without a previous ſolution of the metals in *aquæ fortes* it will be alone ſufficient, will be eaſily granted by ſuch as know the power of *ſal ammoniac*, or even arſenick itſelf in this caſe; tho' this method will be the leſs agreeable to ſuch as would have abſolutely no acid us'd therein, the more evidently the ſalts combin'd with the ſublimate do here operate.

The more uſual method of calcination what.

23. Thus moſt people have choſe to uſe running quickſilver, which method *Atremontius* alſo ſhews, as author of the *French* treatiſe, entitled the *Grave of poverty*, and which *Borrichius* (as the method is ſomewhat obſcure in the above-mention'd treatiſe) as it was communicated to him by the author himſelf, has plainly enough ſhown in his *Conſpect. Chymicor. illuſtr.* § 57. p. 38. and from which is not very different the proceſs deſcrib'd by *Beccher* in his *Tripod. hermet.* under the following title *Concord. mercur. Lunæ, lit.* Y. p. 170. And which, as he mentions, was communicated by *Keſlerus* and *Clauſius*, body-phyſician to the Emperor *Ferdinand* III. Yet it ſtands ſtill more clearly and evidently explain'd in the works of *Angelus Sala*, p. 290. under this title, *Spiritus ſolis Johannis Oſiandri*, Superintendant at *Murbach*; namely, the gold is beat into very thin plates, amalgamated with running mercury, and the ſuperfluous mercury ſtrained from it thro' leather; the maſs, remaining behind in the leather, is put into a glazed teſt on glowing coals under a glaſs-helm, to catch the mercury, as it flies off, and that it may again be ſeparated from the amalgam; the neceſſary *encheireſis* here, as *Beccher* remarks, conſiſts in this, that between the helm and the earthen veſſel, wherein the amalgam lies,

The method of calcination with running quickſilver how perform'd.

[x] N. 3. p. 792. [y] Colleg. pharmac. *Schroed.* S. III. c. X.

lies, a ſpace of a finger's breadth be left, that the mercury may fly off the quicker, and ſettle in the helm: But before the mercury is half or entirely evaporated, the maſs of gold muſt be taken from the fire, and again rubb'd, that it may not run or cake together, a thing that muſt be very carefully avoided. After that the mercury is entirely driven off, to the remaining *calx* muſt be again added freſh mercury, or even the former mercury, and be again ſeparated therefrom by the fire; and this muſt be ſo often repeated, till at laſt the *calx* will receive no more mercury. In the proceſs it is not even neceſſary, that the mercury, which in amalgamating was again added to the gold, be entirely ſeparated therefrom; for, it is no hinderance, tho' ſome of it ſtill remain behind along with the gold. Now, when the *calx* of gold receives the mercury, either with difficulty or not at all, then all the mercury is entirely ſeparated from it by the heat, only you muſt take care that the *calx* does not run; this *calx* is in ſome meaſure reddiſh; and on it is pour'd diſtill'd vinegar, which extracts from it what the mercury has prepar'd for ſolution; and then to the remaining *calx* either the former or even freſh mercury is again added, which it then (a thing to be wonder'd at) very quickly receives again; and then in the ſame order the firſt proceſs is repeated, till the entire *calx* of gold be in this manner reſolv'd, which yet can be no otherwiſe effected than by many and thoſe often repeated proceſſes. The vinegar, employ'd in the ſolution, and which was afterwards decanted off, is pour'd together, and then evaporated with a ſoft fire over the aſhes; and there remains behind at the bottom a ſalt, which may be diſſolv'd a-new and purified in diſtill'd rain-water. This ſalt, after drying and diſtilling it in a retort, yields a very penetrating ſpirit that ſmells like ſaffron; at the bottom there remains behind an aſh-colour'd *caput mortuum*, from which again a ſalt may be extracted, far exceeding the former in purity and fixedneſs.

Oſiander's method of reſolving gold and ſilver how perform'd.

24. That reſolution of gold and ſilver, ſought after by *Lucas Oſiander*, brother to the above-mention'd *Joh. Oſiander*, publiſh'd by *Joh. Ulric. Reſchius*, under the title of *Oſiander's Experiments*, and illuſtrated with many examples, is only in ſome circumſtances different from the former; namely, that author made an amalgam of one part of purified gold, and the ſuperfluous quickſilver he then ſtrained from it thro' leather, and put what remain'd into a glaſs-phial, coated externally with lute, and paſs'd it into a common pot, whoſe bottom was ſtruck out, and applied to it the flame of a lamp, whereby all the quickſilver, or the greateſt part thereof, was evaporated; ſo that the gold remain'd behind like an aſh-colour'd, or ſallow-browniſh ball. As this happen'd, he took out the ball, before the glaſs cool'd, and before it had cak'd too cloſe to the glaſs, he ground it and again added ſome quickſilver, as alſo common water, and rubb'd them ſo long, till the water pour'd on became black; and then decanting it off, he pour'd on freſh: And this he ſo often repeated, till in the rubbing no more

more blackneſs was to be ſeen. The amalgam thus waſh'd he treated again in the preceeding manner, till the whole ſubſtance of the gold was converted into ſuch a black powder; this black and very tender powder, when gently ignited, as he teſtifies, in a crucible, ſo that the common mercury ſtill adhering to it might evaporate (which may again be recover'd by ſetting about the ſeparation in a glaſs-retort) acquires a dark-yellow colour, but is depriv'd of all ſplendor, and can never again be reduced to gold, but changes to a green-colour'd glaſs like an emerald, when the reduction is attempted both with extemporaneous and common ſalt of tartar; but when often extracted with diſtill'd vinegar, it is at length entirely converted into a ſalt of ſome ſervice in medicine; and the ſame thing alſo happens with ſilver, if we only obſerve, that the water, with which the amalgam is elixated, and the powder itſelf, which is waſh'd from the amalgam, is not ſo very dark; but when attempted to be reduced, it becomes a yellowiſh glaſs, or of a hyacinthine colour.

Borrichius' method.

25. But however, as there are ſome of ſo delicate a taſte, as that they cannot well bear the leaſt acrimony, ſuch as diſtill'd vinegar is poſſeſs'd of, and which is uſually employ'd for the extraction of this ſalt; to give ſatisfaction to ſuch, and to cut off all further occaſion of exception, we ſhall only adduce the remark of the laborious *Borrichius*, whereby it has been found, that the very water, with which ſuch amalgams are waſh'd, after the blackiſh powder is ſeparated therefrom, and when the water is evaporated by a gentle warmth, yields forth ſome pure ſalt, which, upon taking pure diſtill'd water thereto, could proceed from nothing other than from the metal, which by this repeated grinding with the quick-ſilver is in ſome meaſure opened. *Borrichius* in his treatiſe *de Hermet. & Ægypt. Sapient.*[z] writes thus; 'I make an amalgam of four parts of highly purified quick-'ſilver, and one part of gold, previouſly well refin'd by means of anti-'mony; on which amalgam I pour diſtill'd water, and for a long time rub 'and grind it in a glaſs-mortar, ſo often as I have leiſure. In the mean 'time I daily, nay hourly obſerve, that ſomewhat of a darkiſh body does 'from the rubbing appear in the water; now when the water appears to 'be ſufficiently ſaturated with this blackneſs, I pour it off into a clean 'glaſs; and in a little time, when the black powder has ſettled to the 'bottom, I again pour upon the amalgam the clear water floating a-top; 'I rub it, as before, repeatedly: After ſome days, when the blackiſh 'powder no more appears ſo plentifully on the rubbing, I again put to it 'ſome very pure quick-ſilver, that the amalgam may become the ſofter, 'and the metallic powder adhering to the glaſs-peſtle may the more accu-'rately be divided: And thus continuing the proceſs for ſome weeks, I 'dry the black powder in the heat of the ſummer-ſun, and in different 'manners I attempt its reduction to gold; but I could not hitherto accom-'pliſh

[z] Lib. II. c. VII. § 5. p. 409.

'pliſh it, what *encheireſes* ſoever I employ'd. The diſtill'd water ſo often 'pour'd upon it, I caus'd gently to evaporate, and it left behind at the 'bottom ſome grains of a cryſtalline ſalt. The thing happen'd in the 'ſame manner with ſilver, and ſtill ſomewhat quicker; but the powders, 'forced from the ſilver, are not blackiſh, but rather of an aſh-grey colour: 'But ſo far as I know, they, like the former, ſuffer themſelves in no man-'ner to be again reduced to ſilver. White-lead, call'd now-a-days tin, 'does alſo yield by this rubbing ſuch a blackiſh powder, greatly reſem-'bling that from gold. Filings of copper, when rubb'd for two days, 'become a genuine amalgam; tho' this is hitherto unknown to moſt peo-'ple; and it leaves behind in the water at firſt, indeed, a blackiſh powder, 'which in continuing the rubbing becomes almoſt yellowiſh. Black-lead 'or lead ſeparates in the water white flakes, and that pretty copiouſly. The 'water, employ'd in the rubbing to each amalgam, when gently evapo-'rated, leaves behind at the bottom ſome genuine acrid ſalt. But that no 'one may imagine, that either the black powder or the ſalt proceeds from 'the quick-ſilver, employ'd in the operation, he muſt know, that I could 'never hitherto force any one of them from it, when it is well purified, 'tho' I have for a long time repeatedly rubb'd and ground it by itſelf in a 'mortar with diſtill'd water.'

Inſtead of Borrichius' method, digeſtion may be us'd.

26. Inſtead of this very operoſe and tedious rubbing, digeſtion may be employ'd; in which, notwithſtanding, ſuch a degree of warmth muſt be kept up, that the quick-ſilver may be ready to ſublime, but yet little of it actually be rais'd; and when continued a day and a night, or even for a longer time, the amalgam will be cover'd with a blackiſh ſkin; and then it is taken out, and rubb'd for a long time in a ſtrong mortar with diſtill'd water. And much of the blackiſh powder goes into the water, which is then decanted from the black powder, either as the powder ſettles of itſelf to the bottom, or it is filtred, and evaporated with a gentle fire; and it leaves alſo behind ſome genuine ſalt, tho' ſuch find themſelves much miſtaken, as expect a great quantity from it; yet if any one, as *Borrichius* hints, would inſtead of diſtill'd water make uſe of vinegar, or only the phlegm of vinegar in the rubbing, he will certainly obtain a greater quantity of ſalt: In like manner when the black powder, ſeparated by the waſhing, is dried and put into a glaſs-retort, to ſeparate the quick-ſilver that ſtill adheres to it, and if it be afterwards roaſted by a gentle ignition in an open veſſel and carefully ſtirr'd, and at laſt extracted with diſtill'd vinegar, it will alſo yield a larger quantity of ſalt, tho' we are not ignorant what either may or is uſually excepted to this method; yet it is certain, if I may venture to ſpeak the truth of the matter, that ſuch ſeek for and make difficulties where there are none, and loſe their labour beſides, as in the reſolution of metals not only reject, but entirely abhor all addition of any, nay the weakeſt acid.

27. But

27. But as we leave every one to his own judgment, ſo we now addreſs ourſelves to add ſomething as to the uſe of this ſalt; and this uſe regards partly phyſics and chemiſtry, partly medicine and ſurgery. As to the firſt, the great promiſes of ſome about it are well known; namely, that the ſalt of metals is the *philoſopher's ſtone:* Now, tho' *Iſaac Hollandus* expreſsly aſcribes to his metallic ſalts (and even to thoſe prepar'd from the ignobler metals) the power of tinging and of fixing mercury; to whom alſo among the moderns *Kunckel* with his own experience agrees, as he relates it in his chemical remarks[a], in theſe words; 'I know how to make a ſalt from 'metals, which is ſomewhat operoſe in a laboratory out of a glaſs-houſe, 'or the like conſtant fire. This ſalt, does like other ſalts, ſuffer itſelf at 'firſt to be diſſolv'd in vinegar or to be extracted with it, and it alſo paſſes 'along with it thro' the filtre; but after it once ſhoots like an *alumen plu-* 'moſum, neither vinegar or water any longer diſſolve it, nor will it melt 'in any fire, except in a very vehement one, where it becomes a milk-'colour'd glaſs: And this has much employ'd my thoughts. But as I 'brought about its ſolution in water, I pour'd it on highly purified and 'volatile mercury, till I forced the water from it in the warmth; and in 'the reduction I had a brittle maſs, which, after a number of fuſions 'and ſeparations, yielded about 2 ½ *loths* (or half ounces) of the fineſt and 'moſt beautiful ſilver'. Yet theſe authors ingenuouſly own, that theſe their ſalts ſtill want much to entitle them to that name. And thus it may be ſufficient, that we here advance what *Geber* in his *Summ. perfect.*[b] has ſaid of this matter both modeſtly and ſignificantly; 'but the reaſon 'that ſolution has been invented has been the ſubtilization of ſuch matters, 'as have no proper flux or ingreſs, on which account the great uſe of 'the ſpirits and of thoſe things which are of their nature is loſt; for, 'every thing that is diſſolv'd muſt neceſſarily be poſſeſs'd of the nature of 'ſalt, alum, or the like; but their nature is, that they give fuſion before 'their vitrification: And thus in like manner ſpirits diſſolv'd cauſe the 'like flux (fuſion) and now as, according to their nature, they greatly 'agree with bodies, and alſo mutually with each other, when they have 'acquired their flux, it is neceſſary that thereby they penetrate bodies, and 'in penetrating alſo tranſmute them'.

The uſe of this metallic ſalt what?

Its tinging and fixing mercury.

28. And even this ſubtilization of metals, adduced from *Geber* and recommended by him under this operation, affords no ſmall light to ſuch as enquire what advantage may be expected therefrom in medicine; for, this reduction of metals into ſalts may either ſo happen, that ſuch ſalts are extracted and ſeparated therefrom, or they may now be attenuated and tranſmuted; and it is evident, that in both manners they become more adapted for medicinal uſe; in regard that in this caſe both the ſpeedier ſolution, as alſo in the other caſe, the ſeparation of the too volatile parts and the earthy impurities

Metallic ſalts how beneficial in medicine.

[a] Part I. c. V. [b] Lib. I. c. LI.

purities, and the thence ariſing genuine agreement of the fixt and volatile, do both promiſe and cauſe a more ſucceſsful and beautiful effect.

A particular circumſtance adduced by *Claveus*.

29. It is certain *Claveus* in his book *de artificio produc. lap. philoſ.* adduces a particular circumſtance, which, at leaſt conditionally taken, in its kind deſerves to be well and accurately weigh'd; as he aſſures, that the metallic tincture, when brought to ſuch perfection, as duly and throughly to tinge metals, is far from being proper in medicine, ſo as to be ſalutary to the bodies of men; but for this end it ſtill requires, that the fifth degree of fire be continued many days longer, and at laſt it be thus calcin'd, and by this force of fire be ſo attenuated, as quickly to relent in any potable liquor; that is, be reduced to a genuine, compleat, ſaline nature and eſſence. However, here the matter reſts on the author's fidelity and credit: And to conclude, in that caſe the known ſaying might, without any ſtraining, hold good and true, and which *Claveus* often alledges, namely, that *the ſalt of metals is the ſtone of the wiſe.*

The principal effect of vitriols conſiſts in their contractile force.

30. However, as ſo ſmall a quantity of theſe ſalts is acquir'd, and their preparation is not particularly known and common, this has been the reaſon that they have not been employ'd for different medicinal purpoſes, and that their virtues, as they deſerve, could not be examin'd by repeated experiments. On the contrary, practical phyſicians have hitherto employ'd, and that not without ſucceſs, the other vitriolic ſalts; but the principal effect of almoſt all ſuch vitriols conſiſts in their contractile force, accompanied with a peculiar corroſive virtue, which is more or leſs evident; and this is ſtrongeſt of all to be found in cryſtals of ſilver and vitriol of copper; but in the vitriol of gold it is milder; and ſtill more ſo in the vitriol of iron, as being rather poſſeſs'd of a contractile earthy virtue, in which the ſugar of lead excells all others.

Their external uſe in ulcers.

31. They have alſo their uſe externally in all foul and running ulcers; a no contemptible thing, in regard they cleanſe them by their corroſive virtue, and by their corrugating hinder the flux of the humours; and thus they heal: Hence I alſo remember, that in all, nay in cancerous ulcers, the late Dr. *Petermann* of *Leipzig* particularly recommended the vitriol of gold, before all other cleanſing medicines. And this is alſo hence confirm'd, that M. *Belieur*, a ſurgeon of *Paris*, us'd an oil of gold, or rather a vitriolic liquor, prepar'd from gold with ſpirit of nitre and ſalt (as it is deſcrib'd in *Digby*'s experiments, publiſh'd by *Hartmann* and *Langius*[c]; and again in the *Medicina experimentalis Digbæana*, publiſh'd at *Offenbach*[d]) in all malignant, venereal, nay and cancerous ulcers; and thereby compleated a cure in a very ſhort time; which, as I myſelf know, is alſo found confirm'd by the proper experience of another; nay, I remember, that the bare and ſlight ſolution of iron, made with vinegar, has very ſpeedily cur'd ulcers in the throat, which are otherwiſe very obſtinate. However,

[c] P. 219. [d] P. I. p. 79.

one

one muſt previouſly well conſider, whether it be entirely of ſervice ſo quickly to repel and heal up old ulcers; for, there are many inſtances of pernicious, nay fatal conſequences from ſpeedily drying up old ulcers and ſores in the bones, as to both which a phyſician muſt uſe the greateſt precaution. And a like circumſpection is alſo neceſſary in inflammations, and eſpecially in thoſe of the eyes, which are commonly repell'd with ſugar of lead and other vitriolic matters; and ſuch cure is not to be undertaken without the preceeding, concomitant and ſubſequent internal uſe of deterging, laxative, and inciding medicines; or the regarding not ſo much the alleviating and removing the pain, as the diſſolving the ſtagnation of the blood. And we are alſo to remember, that in ſcars and films of the *cornea* of the eye, which are uſually remov'd with vitriol of copper, we do not undertake the cure without premiſing the *univerſals*, as they are call'd. And as the ſugar of lead is otherways not improper for obviating and allaying pain and the flux of humours, which otherways enſue on the uſe of corroſives, but cannot well be mix'd with the vitriol of copper without precipitation, ſo in this caſe you may firſt pour into the eyes ſome drops of the ſolution of vitriol of copper, and in ſome minutes after, ſome ſugar of lead, diſſolv'd in roſe-water.

Their internal uſe.

32. As to their internal uſe, the vitriol of gold has a purging, as alſo a ſtrengthening quality, as is expected from uſing it againſt the worms: And this virtue the vitriol of iron, tho' in a leſs degree, is poſſeſs'd of; whence it is not improperly added to aloetic laxative pills, cachectic powders and other medicines for promoting the *menſes*, and againſt the hypocondriac affection. The vitriol of ſilver is a ſtrong diuretic, ſo that many are of opinion that it cannot with ſafety be taken internally: But that it is alſo poſſeſs'd of a peculiar virtue in correcting a vitiated imagination, beſides the known commendation of the tinctures of ſilver, is confirm'd by the teſtimony of a famous phyſician in his ſucceſsful cure of ſome mad people; for, he aſſur'd Dr. *Stahl*, that in the curing of madneſs he depends on no one medicine ſo much, as on theſe vitriolic cryſtals of ſilver. The internal uſe of vitriol of copper is juſtly diſcharged, as it is a ſtrong corroſive and emetic. But what *Beguinus*, *Agricola*, and others aſcribe to it (when mix'd with quick-ſilver and a-freſh diſſolv'd and corrected with diſtill'd vinegar) for compleatly curing a contagious, nay even an inveterate clap may be ſeen in theſe authors: What *Stiſſer* promiſes of it in the cure of the epilepſy is alſo well known, when by means of ſpirit of wine and urine, it is converted into blue cryſtals, and again diſſolv'd in a proper diſtill'd water. Now tho' a proper and careful uſe thereof cannot be entirely rejected; and tho' in a ſmaller doſe it proves no emetic, nor cauſes any other hurt; yet practice ſhews, that when given in ſomewhat too ſtrong a doſe, it is not depriv'd of all its emetic virtue. *Mynſichtus'* ſalt

on

or magiſtery of tin is recommended by *Baglivi* in his *praxis* [c], as an approved ſpecific in hyſteric fits. The ſugar of lead is uſually, indeed, very much commended by ſeveral in madneſs, a virulent *gonorrhœa*, &c. for allaying inward heat. But upon conſidering the highly pernicious and almoſt fatal conſequences, caus'd by recovering ſour wines with litharge; nay, he who only conſiders the manifeſt vitiation and loſs of appetite, tho' otherways pretty ſtrong, uſually caus'd by a few doſes only of the vitriolic tincture of lead in a conſumption, will, doubtleſs, allow, that the ſugar of lead is rather to be us'd externally in ſurgery, than internally in medicine.

Concluſion. 33. But if any one inclines to have a regard to ſuch as promiſe ſomething ſtill higher, he may conſult the above-mentioned *Claveus*, who in the above cited place ſays; 'our gold-making ſalt, or the *ſtone of the wiſe*, 'is the true *aurum potabile*, which is ſolvable in any one liquor; and is, as 'they ſay, the moſt excellent and noble medicine for curing the moſt 'dangerous and mortal diſeaſes. I have always held, that one muſt par-'ticularly abide by this ſalt, *&c.*' As for the reſt, as I have not hitherto experienced the truth and certainty of this matter, ſo I will adviſe no one to apply himſelf to the purſuit of it, without the greateſt prudence and circumſpection.

[c] Lib. II. cap. IX. § 5. p. 209.

A very eaſy and cheap Remedy in a Gangrene; *by* Tho. Bartholin, *together with Obſervations thereon*; *by* Phil. Jac. Sachs à Lewenheimb. *From the* Miſcellanea Naturæ Curioſorum. An. II. Dec. I. Obſ. II. p. 2.

Tranſlated from the LATIN.

A remedy in a gangrene. FROM a ſort of malignant meaſles, which lately raged among us, a girl had her face ſo marred with a gangrene, that her lips were almoſt eaten away: I ſpeedily put a ſtop to this ſpreading evil by means of ſea-water, in which ſome wormwood was boiled; and this experiment I alſo repeated in other gangrenes with good ſucceſs.

Obſervations. No one can well doubt of the great variety there is of ſimple medicines; *Greece* had its own proper remedies; *Mauritania* ſupplied a great plenty of them: But as *Rombæus* affirms [a]; we ſtill ſee a great many more in uſe, of which they knew nothing at all; and with what ſtore of remedies do not both the *Indias* and their adjoining iſlands furniſh us at this day? Yet moſt people, and that not without reaſon, judge native remedies preferable to exotic, both on account of their affinity with our natural conſtitution, as that we in vain look for remedies abroad, of which we have ſuch plenty at home, according

[a] Epiſt. 28. p. 98.

PLATE VI. 1.

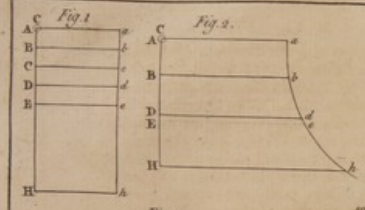


Fig. 1.

Fig. 2.

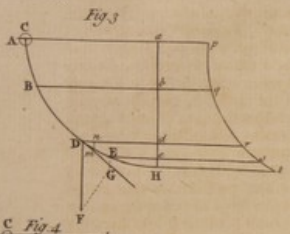
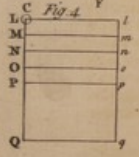


Fig. 3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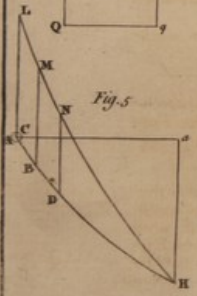


Fig. 5

Fig. 6.

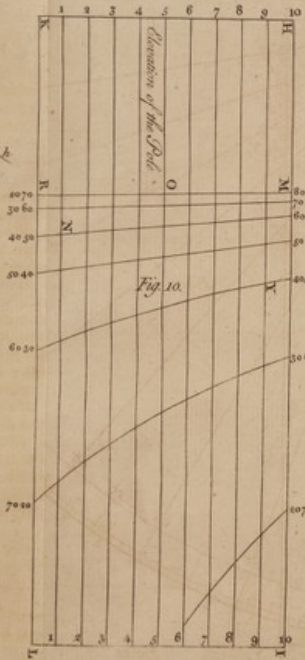


Fig. 10.

Fig. 11.

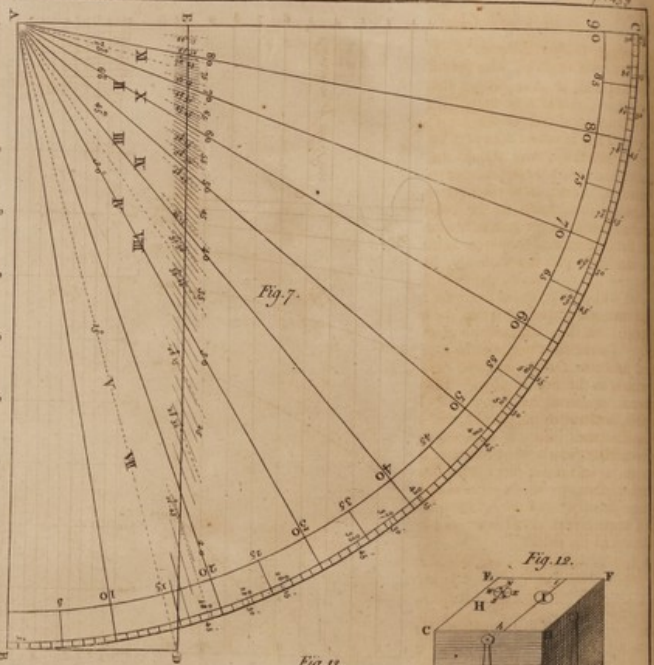


Fig. 7.

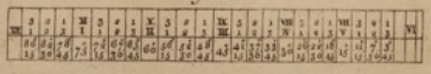


Fig. 8.

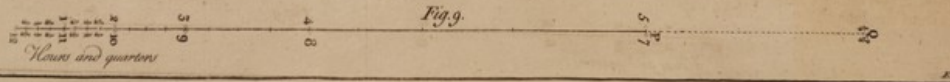


Fig. 9.
Hours and quarters

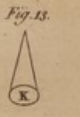


Fig. 13.

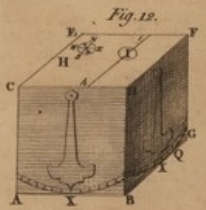


Fig. 12.

ccording to *Andr. Libavius*[b]. This, eſpecially *Beverovicius*, a phyſician f *Dort*, was aware of, who publiſh'd at *Leyden* in 1614 an elegant trea- iſe, entitled, *de* Αυταρκεια *Bataviæ* S. *Introductionem ad Medicinam ndigenam*; in which he ſhews, that every nation has all its neceſſaries in bundance, and that conſequently each malady has every where its own emedy; and as nature does nothing in vain, nor is deficient in any one thing hat is neceſſary, why ſhould ſhe be thought a laviſh parent to the *Eaſt* lone, and a froward ſtepmother to the reſt of the world beſides? Native emedies, indeed, as to their certainty, efficacy, purity and expenſe, have greater ſuitableneſs to the conſtitutions of the inhabitants[c], tho' far- etched medicines are generally more regarded. *Primeroſe*[d] took upon him he ſame defence of ſimple medicines: And *Pliny*[e] even in his time, tho' or the moſt part too violently, has prefer'd native to exotic remedies, when he ſays: 'Nature deſign'd ſuch remedies alone, as are commonly 'and with eaſe procured from the fruits of the earth; in proceſs of time 'avarice and impoſture ſet up the craft, wherein the lives of men are ex- 'poſed to ſale, and inexplicable compoſitions and mixtures cried up', *&c.* To the ſame purpoſe the excellent *Bartholin* had writ a book, enti- tled *Medicina Danica inquilinis remediis proprios morbos ſanans*, but which periſh'd in the fire of 1670. He writes of this performance thus in his treatiſe, *de Incend. Biblioth.* p. 69. 'I inclined to be of ſervice to the meaner 'ſort, and not to the learned, tho' I may expect but little thanks from the 'apothecaries: For the cure of native diſeaſes God has furniſhed native 'medicines, which every one may uſe without either apothecary, or phyſi- 'cian, or great expence: Thus I have cured a palſy of the left ſide with 'malt-ſpirits, in which primeroſes were boiled; epidemic pleuriſies with a 'bare decoction of barley; ſcorbutic patients I have purged with a decoction 'of water-creſſes in old beer, and hydropic patients with the more tender 'leaves of the elder'.

[b] Epiſt. ad Schnitz. 44. p. 135. in ciſtâ Hornung. [c] Benerovic. l. a. c. 2. p. 65.
[d] Error. in Medic. l. 4. c. 7. [e] L. 24. c. 7. It. L. 22. c. 24.

An inſtrument for deſcribing all manner of Sun-dials: And another inſtrument for exactly finding when it is noon. By Leutmann. *From the* Breſlaw Collection, Jan. 1718. Claſs V. Art. VIII. p. 599.

Tranſlated from the HIGH-DUTCH.

M. *Leutmann* in the firſt place gives the geometrical, and after that, the trigonometrical method: The geometrical conſtruction conſiſts in a quadrant ABC, divided into its 90 degrees, from whoſe centre A the radii, drawn through all the degrees, interſect the line ED; the line ED is from the point D (where the radius, produced thro' the 15th. Fig. 7. Plate VI. The geometrical conſtruction.

15th degree, interſects the perpendicular erected from B) drawn parallel to the line A B. On this line E D the radii cut off the proper diſtances for each hour, which are ſet off from the hour of XII. at equal diſtance both
Fig. 8. before and after noon. The table (fig. 8.) ſhows how many degrees and minutes the diſtance of each hour cuts off, and in this table the literal characters, and thoſe ſtanding neareſt over the line, repreſent the hours after noon, and the others the hours before noon: And the numeral characters 3, 2, 1, that ſtand between, the quarter-hours: The neareſt characters under the line and mark'd with (o) ſhow the degrees: The numbers beneath, mark'd with (′) the minutes correſponding to each hour. For inſtance, under XI. ſtands 75°; this ſhows, that the diſtance between E and where the line, drawn from the centre A through 75°, interſects the line E D, is the diſtance between XII and XI before noon; and between XII and I after noon. In like manner $\frac{78^{\circ}}{45'}$ ſhows that the diſtance between E and 78° and 45′ on the line E D is the diſtance of $\frac{1}{4}$ of XII and $\frac{3}{4}$ of I from the hour of XII, &c. To underſtand this the more
Fig. 7. eaſily, in fig. 7. the hours are annexed to the degrees, correſponding to them, with literal characters. But that we may alſo on the line E D have the minutes for the quarter-hours, we have again divided 90 degrees into 4 parts; and ſet down 1 part thereof to the degrees where 15 minutes,
Fig. 8. 2 parts where 30′, and 3 parts where 45′ are requir'd in the table of fig. 8. But we have repreſented the parts of the radii, where they interſect E D with dotted lines, and alſo added the numeral characters; for which purpoſe the quadrant is to be made pretty large. Upon ſetting off theſe diſtances of the line E D, where the point E is taken for the hour of XII,
Fig. 9. on the line P Q (fig. 9.) and marking upon it the hours, we thus obtain the proper *gnomonic ruler*: For inſtance, the diſtance between E
Fig. 7. (fig. 7.) and the interſection of the radius at 75° is taken with a pair of
Fig. 9. compaſſes and laid off on the line P Q (fig. 9.) namely from the point at the hour of XII till where ′, ſtands: This is the ſpace between 12 and
Fig. 7. 11, as alſo between the hour 12 and 1. The diſtance between E (fig. 7.) and where the firſt dotted line 15′ behind 86° ſhews the line E D, which is alſo ſet off on P Q; and thus we have the diſtance between 12 and $\frac{3}{4}$ of 12; as alſo between 12 and $\frac{1}{4}$ of 1 o'clock, &c. as plainly appears from
Fig. 9. . . 7. comparing the line P Q (fig. 9.) with the quadrant (fig. 7) and the table (fig. 8.) Now as for the delineating of a dial it is not only neceſſary to have the diſtance for each hour, but alſo the elevation of the pole, the
Fig 7. diſtance between the centre A (fig. 7.) and where each degree cuts the line E D, gives the elevation of the pole of each degree; as for inſtance, the part of the radius drawn thro' 80° from A to the line E D, is the elevation of the pole of 80°. A 75°, the elevation of 75°, *&c.* But now to obtain
Fig. 10. this in particular, there is made a parallelogram H I K L (fig. 10.) (the larger

larger it is the better) and its ſides H K and L I are divided into 10 equal parts, through which lines are drawn: On which again with a pair of compaſſes is taken in the quadrant (fig. 7.) the diſtance A 80°, and ſet off from H to M (fig. 10.) the diſtance between A and where 79° touches the line E D in the quadrant is laid off on the ſecond line 9, 9 (fig. 10) A, 78°, on the third line 8, 8, *&c.* that the diſtance in the quadrant A, 70°, may fall on the 10th line K L in R, through theſe points the line M O R is afterwards drawn; and then alſo this diſtance A, 70°, is again ſet off on the firſt line H I; the diſtance A, 69°, on the ſecond line 9, 9, and ſo on through all the degrees: And thus we have compleated the ſecond part of the *gnomonic ruler*, on which we may have the elevation of the pole of each place; as for inſtance, if we would have the elevation of the pole at *Breſlaw*, which is 51°, on the line K L we look for 50, and on the line H K, the line 1, 1; where this laſt is interſected in N by the tranſverſe line 50, 60, we have from I to N the elevation of the pole of 51°: In like manner S O is the elevation of the pole of 75°, H M for 80°, &c. The fig. ſhows, that on the outmoſt lines H I and K L the degrees from 10 to 10 are to be found: And from 70 to 20 on K L; and from 80 to 20 on H I, which is neceſſary in horizontal dials. In vertical dials the complement to 90 degrees is taken, On this account alſo the figures, namely to 80, are annexed on H I, 10; to 70, on K L, 20, *&c.* Now the manner of uſing theſe two parts of the *gnomonic ruler* ſhall be ſhown below, when we ſhall have firſt premis'd the trigonometrical conſtruction of this inſtrument. To find the diſtances for the hours on the line E D we need only obſerve, that the line A E is equal to the line B D, and this is the tangent of the angle of 15° B A D. It alſo appears from the fig. that E is a right angle. Farther, it is plain, that you may eaſily obtain the angle, which the radii form with the line E A at the centre A; namely, if you reckon above the degrees on the quadrant between the radius and the line A C, or which is the ſame thing, the angle at A is always the complement of the angles to 90°, which the radii ſhew; as for inſtance, the angle 80° A E is the complement of 80° to 90, namely 10°: Now from theſe *data*, the diſtances from E to the interſection of the *radii* may be eaſily found: And from theſe *data* alſo we may have the diſtances of the *radii* from the centre A to the interſections of the line E D, after ſubſtracting the angle at A from 90°, there remains the angle, which the radii form with the line E D; and thus we always have in the right-angled triangle the known leg A E and the oppoſite angle, together with the right angle, from which may be eaſily had, in the uſual manner, the hypothenuſe; and in this manner the diſtances for the elevation of the pole may be found. But for the benefit of thoſe, who are not converſant in theſe matters, but who take a pleaſure in drawing dials, we ſhall here add the following calculated tables.

Fig. 10.

I. *A table for the* gnomonic ruler *to set off the hours and quarter-hours from the scale.*

Hours a. m.	p. m	Parts	Hours a. m.	p. m.	Parts
XII		— —	IX	3	2680
3		176	3		3055
2		353	2		3492
1		538	1		4010
XI	1	718	VIII	4	4641
3		909	3		5433
2		1110	2		6469
1		1322	1		7894
X	2	1547	VII	5	10000
3		1790	3		13470
2		2056	2		20350
1		2350	1		40881

II. *A table for laying off the elevation of the pole from the scale.*

Deg.	Parts	Deg.	Parts	Deg.	Parts	Deg.	Parts	Deg.	Parts
10	15430	24	6588	38	4353	52	3401	66	2953
11	14043	25	6340	39	4258	53	3355	67	2911
12	12888	26	6113	40	4168	54	3312	68	2890
13	11911	27	5903	41	4084	55	3271	69	2870
14	11076	28	5707	42	4004	56	3292	70	2851
15	10353	29	5527	43	3929	57	3195	71	2833
16	9721	30	5359	44	3858	58	3160	72	2817
17	9165	31	5202	45	3790	59	3126	73	2802
18	8671	32	5056	46	3726	60	3094	74	2788
19	8231	33	4920	47	3664	61	3064	75	2774
20	7835	34	4792	48	3605	62	3035	76	2762
21	7477	35	4671	49	3549	63	3007	77	2750
22	7153	36	4559	50	3497	64	2981	78	2739
23	6858	37	4453	51	3448	65	2956	79	2730
								80	2722

Explanation. Pl. VI. Fig. 11.

In using these tables there is nothing other requisite than a scale (as represented fig. 11.) the construction of which may be easily learn'd from *Sturmius' Mathesis juvenilis*[a], or any other elements of geometry. We have divided

[a] Tom. I. Geometr. Sect. I. Art. I. qu. VII. p. m. 204.

Page 444.
PLATE VI.
n.s.
A
B
C
VIII
VII
VI
V
IV
III
Fig. 16.
a Wedge cut

PLATE VI.

Page 444
n. β.
n. α.
A
B
C
VIII
VII
VI
V
IV
III
II
I
North
South
Fig. 16.
a Meridian Line.

divided the radius of the quadrant into 10000 parts, that the coincidence of these tables with the quadrant may be perceiv'd. In other respects the thing may be perform'd according to any scale. The use of these tables entirely coincides with the quadrant; and in the following manner the hours may be delineated; draw the line AB (fig. 14.) in the middle from the point D erect the perpendicular DC; the use of tab. II. is to determine the length of this line D C, as it represents the elevation of the pole in a horizontal dial, such as this is design'd to be; as suppose we were to make a horizontal dial for the meridian of *Breslaw*, look for the elevation of the pole at *Breslaw*, namely 51°, in the column of degrees; just opposite thereto is found the number 3448 in the column of parts; and so many parts are to be taken from the scale (fig. 11.) and set off on this line CD. But as this scale is only divided into 1000 parts, but in the table the parts are reckon'd to 10000, the last figures, if below 5, may be omitted; but if above 5, the last but one may be increas'd with 1. And thus here instead of 3448, we take 345. In this manner one leg of the compasses is set in the cross line of the scale, where 300 stand; and the other leg is open'd to 40 on the line AB; and then both the legs of the compasses are advanced to the line where 5 stands above between AZ, and under BX; and thus it takes in the distance of the cross line 300 till where the diagonal 40 cuts the line 5; and thus you have 345 parts for the length of the line CD, the point D gives the hour of XII: To set off the remaining hours, the first table is made use of; for, in it we find in the first column the hours before and after noon; the former of which are mark'd with literal characters, but the latter with numeral characters; and in like manner the quarter-hours. But in the adjoining column the parts for each hour are to be taken from the scale (fig. 11.) namely for XI and I, 72, after that as was mention'd in the first table, the last figures are omitted; and the last but one is increas'd, when it exceeds 5, as in this case: Hence one leg of the compasses is set on the line TV, as the number is not 100, where the line 2 intersects it; and the other leg till where this line intersects the diagonal drawn from 70 to 80; this distance is set off from D on the line AB on both sides in XI and I: In like manner for X and XI, 155 parts (instead of 1547) are set off from D on the line AB from the scale, when the compasses are set with one foot on the cross line 100, where the line drawn from 5 to 5 intersects it; and afterwards to where this line cuts the diagonal drawn from 50 to 60. And thus you proceed till the hour of VII and V; for the hour of VI through the point C is drawn a parallel to AB, which is obtain'd, when from the points of VIII and IV or IX and III perpendiculars are erected; and on it is laid off the height DC, and thro' the points a line is drawn. And for the quarter-hours you proceed in the same manner, as with the whole hours; and they are all laid off from the

Fig. 14.

Fig. 11.

Fig. 11.

he ſhows, that he caus'd make for horizontal and vertical dials a right Fig. 15. angl'd triangle (as was ſhown fig. 15.) of firm wood; or which is ſtill better, of ſtone, and compleats only half the dials, on which he accurately fits the triangle, which he makes three fingers broad with one edge accurately applied to the line of the hour of 12, and makes it very faſt: And on the other edge of the triangle he draws the 12 hour-line, and from it ſets off the remaining hours; and the thickneſs of the ſtile is no hinderance, provided the ſides be made very ſharp: And one edge of the upper ſides ſhows the forenoon hours, but the other the afternoon hours entirely accu- Fig. 18. rate, as may in ſome meaſure be ſeen from fig. 18.

An inſtrument for exactly finding when it is noon.

As to the inſtrument, by which it may be exactly diſcover'd when it is noon, it is hop'd it may be acceptable to ſuch as carry watches; as by its means they may be accurately ſet, which cannot ſo well be done at the riſing or ſetting of the ſun. The inſtrument is repreſented fig. 12 and 13. Fig. 12 13. It conſiſts of a hollow cube, made of wood or braſs, on which above is fitted a compaſs at H, that it may be rightly ſet. At C is a circle, thro' whoſe centre a line *b i* is drawn, at an equal diſtance from the ſide D F, forwards and on the ſides are faſten'd plummets (as the fig. ſhows) that play eaſily and juſtly, by means of which when they ſtand exactly in X, or at 90°, the inſtrument may be ſet exactly horizontal. In fine, there is Fig. 13. turn'd a braſs or wooden cone (fig. 13.) whoſe baſe K is as big, as the circle I, about an inch in diameter; when the needle points exactly north, and the plummets ſtand accurately pois'd, the cone is ſet on the circle I: And as ſoon as the ſhadow of the point of the cone falls on the line *b i*, it is noon; and the watch may be ſet to 12.

An Obſervation on the Method of preſerving Anatomical Preparations in Liquors. *By* Chriſtoph. Jac. Trew. *From the* Commercium Literarium Norimbergenſe. An. 1731. Specimen IX. p. 68.

Tranſlated from the LATIN.

Requiſites in liquors for conſerving anatomical preparations.

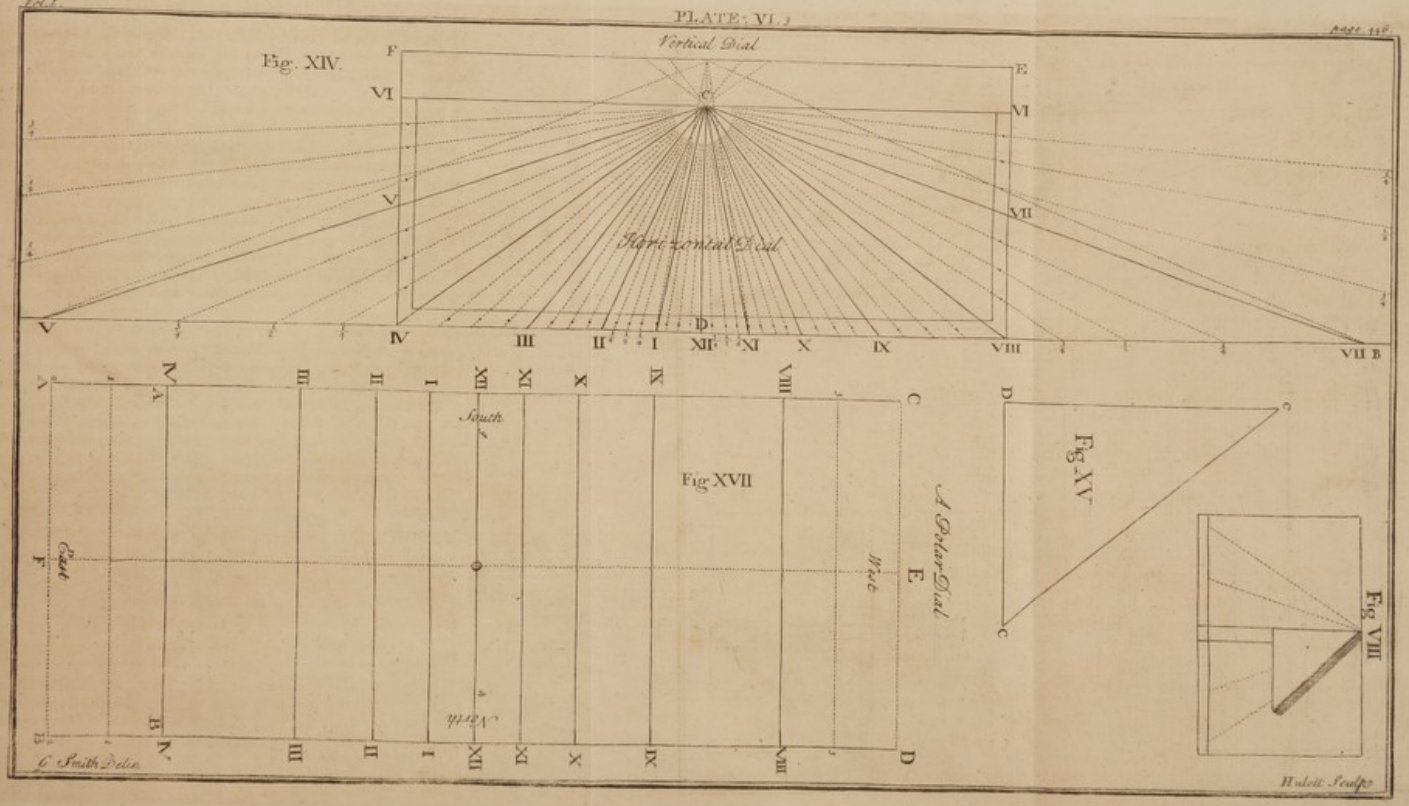
SUCH apply themſelves very uſefully to the buſineſs of anatomy, as are employ'd in preſerving the better or the more rare preparations therein, that upon any occaſion, they may be ſhow'd and view'd: And for this purpoſe almoſt every one has his own peculiar liquor, and which he generally keeps as a ſecret. But to the goodneſs of ſuch a liquor the three following conditions eſpecially are requiſite. 1. That it preſerve the preparation from corrupting and drying. 2. That it cauſe no change in the natural colour of the preparation. 3. That it be not too volatile; and that it ſtand not in need of freſh repeated ſupplies. Such liquors are generally prepar'd in the following manner; to three drachms

of

Vol. I.

PLATE VI.

Page 116.



of choice amber, one drachm and a half of camphire, and one ounce and an half of *Venice* turpentine, are put 2 *lb.* and a half of ſpirit of wine: After digeſting for ſome days, let the diſtillation be perform'd from a ſand-heat; or to white amber, put into a glaſs-cucurbite, pour as much rectified ſpirit of wine, as to riſe above it two fingers breadth; after digeſtion, let the diſtillation be made from a ſand-heat: And to each pound of ſpirit thus abſtracted add of camphire and *ſal ammoniac* two drachms each; and keep for uſe the ſpirit drawn off by a freſh diſtillation; for, experience has ſufficiently taught me, that the balſamic liquor, prepar'd both ways, is as volatile as bare ſpirit of wine; but that, beſides, it has this diſadvantage with it, *viz.* in a ſhort time it contracts a remarkable yellowneſs, with which it alſo tinges the preparations. And I am alſo well aſſur'd, that bare pure ſpirit of wine, highly dephlegm'd and limpid like the pureſt water, does in a ſhort time turn yellow; and that it turns the more ſo, if impregnated with oleous and reſinous particles: But this happens not to malt ſpirits. Wherefore, for many years back I am us'd to employ plain malt-ſpirits well dephlegm'd for preſerving my preparations; with this advantage, that ſuch as I put into it, are conſerv'd to my mind, and not tinged with any foreign colour whatever; beſides, it may be procur'd at a far leſs expence.

Their too great volatility how obviated.

But I ſhall briefly explain in what manner I obviate the diſadvantages of a too great volatility. I cover the mouth of the glaſs with a round glaſs-plate, exactly fitted to its bigneſs; I lay on a double moiſten'd bladder; and this I moreover cover with foils of tin: And all theſe I ſecure with proper threads, cloſely tied round, being well aſſur'd, that the ſpirit, which yet ſucceſſively diminiſhes by exhalation, rather eſcapes thro' the pores of the glaſs than the above covers. What is an argument with me is, that I have often obſerv'd, that round glaſs-plates, laid on in the manner mentioned, in ſuch glaſſes where a great deal had exhal'd, do by the preſſure of the incumbent air burſt into ſeveral pieces, and that with a great noiſe, which I think could not have happen'd, had the ſpirit eſcap'd thro' any chink left open, as I ſee not what ſhould hinder the air from entering thro' the ſame paſſages and filling up the empty ſpace.

Preparations how made to hang freely in the ſpirit.

If there are any preparations that we would fain have to hang freely in the ſpirit, I uſually tie them with a white horſe-hair, and then I fit two pieces of wood, laid a-croſs, in ſuch manner to the mouth of the glaſs, that the hair may be faſten'd to them; and yet ſo that neither the glaſs-plate may touch the pieces of wood, nor be hinder'd by them from cloſely covering it.

Saline liquors and their diſadvantages.

But if there are ſome preparations, which we foreſee are to be often taken out and ſhown, or larger than that we can find glaſſes capacious enough for keeping them; for preſerving ſuch ſome prefer liquors ſaturated with ſalts; as for inſtance, they diſſolve alum in ſimple water, as much.

much as the water will take; then add common ſalt; and if they will, nitre as much as it will receive; or they diſſolve *ſal ammoniac* and quick-lime in water; and after filtration the clear liquor is employ'd. But ſaline liquors have eſpecially this diſadvantage, that the preparations do not ſink but float in them. Wherefore, they muſt be depreſs'd by ſome weight and kept plunged. Beſides, ſalts eaſily ſhoot into cryſtals and adhere to the preparations, eſpecially if the veſſels be not often mov'd, and water carefully pour'd on for their ſolution.

Preparations how to be treated before they are put into the conſerving liquors.

Of all preparations, if we incline to keep them neat, we are to hold, that before they are put into the conſerving liquor, they ought for a pretty long time to ſoak in pure water, which is to be renew'd every day, till it extract no more redneſs; and then if you incline to put them into a ſpirit (for, there is no occaſion for this in a ſaline liquor) pouring on for ſome time malt-ſpirits, both the aqueous humidity and any remaining blood are extracted: And this you ſhould continue to do, till you are well aſſur'd, there remains nothing therein, which may either weaken or pollute the pureſt ſpirit.

Several Experiments. *By* Olaus Borrichius. *From the* Acta Haffnienſia. An. 1671, 1672. Obſ. LXII, *&c.* p. 138. ſeqq.

Tranſlated from the LATIN.

Water continuing without boiling in the heart of boiling water. Obſ. 62. p. 138.

THE following experiment may poſſibly ſerve to clear up the nature of fire. As often as a liquid is heated by a ſolid, the heat is propagated thro' all the body of the liquid, by means of bubbles ariſing from the bottom of the veſſel eſpecially, and at length collecting themſelves in great numbers on the ſurface; hence that ſcum which widely overſpreads the face of the liquor. This appears very evidently in glaſſes fill'd with water, and laid on the hot furnace of a copper: Beſides, if the heat proceeds from a liquid and ſoft heating body, the bubbles ariſe ſo ſparingly, that tho' the water within the glaſs, ſuſpended in the hot liquor, be greatly heated; yet I could by no means hitherto bring it to boil. This I often experience in water; namely I ſuſpend a narrow-mouth'd glaſs half full of water in the heart of an iron-pot fill'd with water too, and ſetting a fire under, both the waters heat, but while the external water very ſtrongly boils, that in the glaſs continues calm without boiling at all; and I often take out the glaſs-veſſel from that frothy water, and view it without any apprehenſion of its cracking, and again put it in; and no trace of any bubbles is ſeen on its ſurface, tho' the boiling liquor in the pot almoſt ſheds over the brim. I own, that ſome bubbles alſo ariſe from the bottom

bottom of the glaſs; but theſe very few in number; and which all vaniſh before they can reach the ſurface. It is probable, that if another glaſs were included in the former, it would happen, that not ſo much as one ſingle bubble would appear in the liquor contain'd therein; for, the bubbles obſerved in the firſt glaſs do almoſt all of them fall back again; and the ſame thing would happen the more certainly in the 2d glaſs. This experiment was, probably, not unknown to ſuch as firſt devis'd diſtillation by a *balneum Mariæ*, in which every thing obtained in this manner is milder for medicinal uſe and cauſes leſs diſorder in the body than thoſe procured either by a ſand-heat or by the hurry of a naked fire.

Congeal'd water receives nothing foreign into itſelf, neither increaſes nor decreaſes in weight. Obſ. 64. p. 140.

There are who imagine I know not what frigorific atoms deriv'd from the *hyades* to the earth, which in winter inſinuate into water, and by their acceſſion form that liquor into a ſolid maſs; a conceit rather more ingeniouſly devis'd than agreeable to nature, as I think I have diſcover'd in the following manner. In a very ſevere winter I took a narrow-mouth'd, but bellied, glaſs; and putting into it 5 *lb.* of common water, I clos'd it with three folds of bladder previouſly moiſten'd with oil, leſt any thing foreign ſhould inſinuate into it; I then accurately mark'd a line with a diamond on the place, where the water, ſtill liquid, ſtood in the veſſel. In this manner I ſet the glaſs on the flat roof of my houſe; and after half a quarter of an hour it ſhow'd ſome uncommon commotion within, accompanied with a remarkable noiſe. I quickly view'd it and I obſerv'd almoſt in a moment all of the water, the glaſs continuing entire, converted into ice; and that the ice roſe almoſt two inches above the line mark'd by the diamond. I began to think, that ſome foreign ſubſtance had, probably, with that noiſe enter'd the glaſs; but both the empty ſpaces up and down in the ice, and the weight remaining unchang'd, ſoon ſhow'd the contrary; for, the weight of the glaſs, after the water was frozen, was the ſame as before; ſo that it might juſtly be concluded, there was no new acceſſion of matter to it, but that the matter of the firſt element, putting the parts in commotion, and being ſcarce of any ſenſible weight in ſo ſmall a quantity of liquor, had however retir'd, theſe particles being otherways ſomewhat diſpos'd for ſuch a retreat; nor afterwards by the fire was there any thing obſerv'd in that ice than what we obſerve in common water: Whence, probably, one may give in to this opinion, namely, that all water when left to itſelf always congeals; but that in moſt places it is kept agitated in a certain violent ſtate by the aſtral rays and ſubterraneous fires, and that for the conveniencies of men and fiſhes; for, we obſerve it, when leſs diſturb'd and leſs mov'd by external cauſes, as in moſt ridges of the *Alps*, *Pyrenees* and *Norwegian* rocks, always to remain either ice or a ſnow emulating ice; and this I have obſerv'd on the maritime *Alps*, on the *Alpes Cottiæ*, which part *Dauphine* from *Piedmont*, at the magnificent monaſtery of the *Carthuſians*, in the valley *Pragelas* and in other parts in the extreme hot months of *July* and

and *Auguſt:* And when I liv'd at *Turin*, the illuſtrious Marquis *di Pianezza*, Prime Miniſter to the Duke of *Savoy*, carried me up to the upper part of that Prince's palace, from whence there was a wide proſpect of the *Alps*, and he ſhow'd me a mountain, the *Veſulus* of *Virgil*[a], now the *Monteviſo*, from whence the *Po* ariſes. 'On the lower brow of this mountain, *ſays the marquis* (for, it has two brows or points) is ſeen a pretty large lake, 'which even in the middle of ſummer is ſo cover'd with ice, that *Torrini*, 'firſt phyſician to the Duke, did in the middle of *July* advance 25 paces 'thereon; on the ſouth ſide there was then no ſnow, but a great deal on 'the north; upon cutting the ſnow he obſerv'd it to conſiſt, as it were, 'of numerous cruſts; for, it is probable, that each year a new cruſt of 'freſh ſnow is added. But the *Roche de Limon*, as it is call'd, is much 'higher than the *Veſulus*, and it, in my opinion, is the higheſt of all the 'mountains in *Europe*; on its top the cold is ſo intollerable, that no one 'has hitherto been able to bear it. Prince *Charles Emanuel* II. ſome years 'ago attempted to aſcend it on the 24th of *Auguſt*; but without accom-'pliſhing it, he was obliged to come down all ſhuddering with cold. I 'myſelf ſometimes in the advanced ſummer went up St. *Bernard*'s moun-'tain; and there entering into a monaſtery, which riſes amidſt heaps of 'ſnow, I have obſerv'd the water frozen in the very chappel; and the 'Religious had each of them their portion of reddiſh ice given them at 'dinner, which they drank after melting it at the fire and receiving it in 'a veſſel: *Muſt* carried thither continues ſtill *muſt* all the year round, and 'never changes to vinegar. Common *aquavitæ* is often condens'd into a 'maſs reſembling ſoap.'

I have been the larger in this quotation, that it might appear, that water, if left to itſelf, and free from the diſturbing particles of heat, always inclines to a ſtate of reſt and to become ice; and it is no obſtacle, that only a cruſt of ice was obſerv'd in the *Veſulus*, while the remaining liquor continued moveable; for, as there is not there a perfect degree of reſt, and as the ſubterraneous heat of the mountain ceaſes not to agitate the nearer particles of the water, it is no wonder, that the deeper parts of that lake ſtill remain liquid. Theſe things I adduce to relieve the reader, and not to obtrude them upon him. But to return: On another occaſion I committed ſome ounces of water to a glaſs-phial, which I hermetically ſeal'd, and ſetting it out in the open air, all the water turn'd to ice, the glaſs continuing entire; no acceſſion of weight was obſerv'd, tho' by the eye the liquor ſeem'd to increaſe in bulk; but that is to be aſcrib'd to the empty ſpaces of the ice: However, it was obſerv'd, that the ice in the middle of the glaſs heav'd into an eminence, and was ſmoother in the other parts. I would here willingly learn, why ſome veſſels burſt with the cold, and others that are weaker continue ſometimes entire. I remember, that the winter

[a] Æneid. X. v. 708.

winter of 1664 was ſo ſevere at *Paris*, that a tin-veſſel, ſtanding almoſt full of water on my table, was crack'd in three different places by the night-cold. On the contrary, in the month of *February* An. 1658 at *Copenhagen* in the keeneſt froſt in the memory of man, I have often kept glaſs-bottles with long necks, which together with the water weighed 3 *lb.* and upwards, cloſe ſtopp'd in the open air, till all the water was froze; and I obſerv'd no crack, tho' thoſe that were frozen within doors often burſt. I could not hitherto hit on the reaſon of it; unleſs, according to the ancient manner of philoſophizing, we ſuppoſe the cold in the open air on all hands equally to preſs the veſſel, and conſequently, cauſe no crack; but within doors all theſe circumſtances are different; becauſe one part ſtanding near the window or the wall receives a greater degree of cold, another part nearer a deſk, or floor, or ſtove, a leſs degree: Whence they eaſily burſt. Or, if you will, you may ſuppoſe, that the particles of the agitating heat, receding by the approach of the winter chill, do in the open air recede with an equal force and *impetus*; but in a houſe, for the reaſons alledged, with an unequal force. But becauſe my view here is principally to chemiſtry, I ſhall add what I have often obſerv'd; namely, that ſalt of tartar and any other *alcali* in the intenſeſt degree of cold reſolves no leſs into an oil or liquor on a glaſs plate than in the middle of ſummer: And then, that not only ſpirit of vinegar and the more ſluggiſh ſpirit of ſulphur, but the weaker liquor of ſalt of tartar, congeal; and that ſuch ice is entirely inſipid, no otherways than we yearly experience, that the ice of our ſeas, even a whole foot thick, is very inſipid, if you except its lower ſurface, which ſtill the ſalt water waſhes; and which if you waſh off in the ſlighteſt manner, the whole maſs of ice is inſipid to the taſte.

To diſſolve ſilver and mercury by a vegetable ſulphur into a liquor. Obſ. 65. p. 145.

Take eight ounces of generous *aqua fortis*, to which add two ounces of camphire well ground, and mixing them give a gentle ſand-heat in a glaſs-phial, till the camphire, diſſolv'd into an oil, floats upon the *aqua fortis*, like oil-olive. Let this oil, after the gentle heat of half an hour, by gently inclining the glaſs, be pour'd off into another glaſs-veſſel, without any the leaſt mixture of the *aqua fortis*; take now, therefore, one ounce of this oil of camphire, and add to it two drachms of purified and laminated ſilver; boil it for a quarter of an hour with a gentle aſh-heat; and the ſilver will be evidently diſſolv'd into a clear liquor. The ſame thing happens to mercury, two drachms of which do readily relent into a clear liquor in one ounce of oil of camphire. But however undoubted it may be, that camphire does not of itſelf principally effect this, but by receiving into itſelf the ſaline particles of the *aqua fortis:* Yet there are two things, pretty curious, obſervable here; one, that ſalts to produce the ſame effect equally move in oil, as in water; the other, that metals mix'd here with a little of a *menſtruum* ſtand diſſolv'd apart and at the bottom of the veſſel; and that the reſt of the *menſtruum* floats above them, diſtinguiſhable even

by the colour and, as it were, by a fine line, from the diſſolv'd ſilver and mercury, a thing hitherto unknown of *aqua fortis*.

An uncommon diſſolution of gold. Obſ. 66. p. 146.

It is a thing well known to Chemiſts, that ſilver is diſſolv'd by *aqua fortis*, as alſo by ſpirit of nitre; but that gold remains therein entire and untouch'd, and that there is no liquor fit to diſſolve the latter without the addition of common ſalt or *ſal ammoniac*; yet I have found, that gold alſo yields to *aqua fortis*, and is entirely diſſolv'd by it, if by two diſtillations it be previouſly forced off from an equal portion of nitre; to which degree the *aqua fortis* being advanced by means of nitre, it no longer can diſſolve ſilver, but yet tears it and throws it down a white powder; but very eaſily it diſſolves gold, changing it into a yellowiſh water. The caſe is this, in nitre there are ſaline, volatile and more fix'd parts; in common *aqua fortis* the volatile parts exert themſelves; in *aqua fortis* repeatedly diſtill'd from nitre, the fix'd parts do alſo diſcover themſelves, and attempt a ſolution of a new kind. Upon this I bethought myſelf to try, whether ſpirit of nitre, diſtill'd from nitre, would alſo diſſolve gold; but it did not anſwer. So that, probably, the cauſe of ſo great a diverſity is to be ſought for in vitriol; or we are to ſuppoſe, that *aqua fortis*, as being more violent, enters deeper into the fix'd parts of nitre, and carries off ſome of them (that produce a new operation) along with itſelf through the ſtill; a thing which happens not to ſpirit of nitre, unleſs, probably, the diſtillation be oftner repeated.

In purified mercury there lies conceal'd ſomething acid or ſaline. Obſ. 67. p. 147.

The nature of mercury may not only ſtrike the vulgar, but even the learned themſelves with ſurprize: Tho' it be very ſoft and open, as to appearance, yet no metal is found cloſer than it. Gold does in ſome meaſure ſuffer itſelf to be divided into parts of a different nature; ſilver more eaſily; but there has no one or ſcarce any been found who has divided mercury: Yet that there are different parts therein I think I have diſcover'd by the following experiment; I took ſome very clear plates of ſteel, and putting them into a new oblong glaſs, wherein well defecated mercury was kept, I left them plunged therein for three months, without applying any other heat than that of the ſun: Afterwards upon opening the veſſel, which had been ſtopp'd very cloſe, I found all my plates cover'd over with ruſt, tho' kept in the heart of ſo noble a liquor: Whence I was perſuaded, that ſomething acid or ſaline, the cauſe of this ruſt, was inherent in mercury; all of which might at length be, probably, extracted by repeating the ſame experiment with other different plates. The ſubtile *Geber*[b] acknowledges two ſuperfluous things in mercury; namely, an earthy dreg and a fugitive aqueous dreg: And if this be that watery dreg, let others look to it, how they may purge it of its earthy dreg: While I labour to diſcover how mercury, which is proper to be employ'd in the worms, may be diſtinguiſh'd; for, it is often adulterated, ſometimes with lead

[b] Summ. perfect. II. Part. I. c. 4.

lead and again with tin, ſometimes with biſmuth and at other times with zink, and that not without the detriment of ſuch as uſe it: And in this caſe it is not ſufficient to ſtrain mercury thro' leather, or to diſtill it; for, if the adulteration be more artfully made, ſomewhat of the mixture paſſes along with it, as was long ago obſerv'd by *Schroeder*; and by diſtillation, the whole mixture does oftentimes paſs not in a fume, but by fits; and renders the operation doubtful. To determine, therefore, the matter with more certainty, put one grain of the ſuſpected mercury on a burning coal and give it a gentle blaſt. If all of it go quietly off in fume, it is genuine mercury: If it make a noiſe upon the coal and attempt its flight by repeated ſkippings, you are to reckon it adulterate.

Diverſity of amalgams.

But we ſhall treat more at large of amalgams. And long ago *Vitruvius*[c], and *Pliny*[d] (nor were they, probably, the firſt) have deſcrib'd the union of gold and mercury; and others, following their example, have proſecuted the ſame thing in ſilver. Neither amalgam makes a noiſe in the fire, by reaſon of the abſence of the impure and noiſy ſulphur. Lead and tin are eaſily united with mercury: But their amalgams upon approaching the fire make a violent noiſe, as charg'd with an uſeleſs and fugitive ſulphur. Braſs too becomes into an amalgam and makes a noiſe. Antimony mixes not with mercury, nay, not its *regulus*, on account of its copious ſulphureous dregs. Of iron and copper *Geber* thus ſpeaks; 'mercury, 'ſays he, adheres not to iron, unleſs by the moſt ſubtile *encheireſis*; nor to 'copper, on account of the paucity of quickſilver in their commixture.' Yet I ſhall ſhow how it may adhere to iron: Take iron-filings, and pour thereto either *Hungarian* vitriol, or other vitriol of copper, diſſolv'd in common water; and ſhaking the veſſel up and down, you will immediately obſerve all the filings cover'd, as it were, with braſs-plates; upon obſerving which pour thrice the quantity of mercury, or better; ſhake it up and down, and you will obſerve produced almoſt in a moment a groſs, firm and apparent very good amalgam; but to ſpeak the truth, it is but a ſuperficial amalgam; for, neither are theſe two bodies united *per minima*: Whence by frequent triture in a ſtone-mortar, the union is again diſſolv'd: Yet braſs is eaſily, but in a ſomewhat longer time reduced to a genuine amalgam; and that it is ſuch appears from its pliableneſs, which is one argument of the moſt perfect amalgam. A freſh-made amalgam of copper makes ſome noiſe on burning coals, becauſe of the more impure ſulphur it holds, but yet ſparingly; and none at all, if it be for any time expos'd in a warm place: Nor, even did it make the moſt violent noiſe, would it affect the former experiment; as this kind of amalgam is unknown to the common perfumers and apothecaries; and as the copper immediately diſcovers itſelf on the coal, the mercury flying off; a thing which happens not in the other amalgams of zink, biſmuth, tin and lead, the whole

[c] Lib. VIII. c. 8. [d] Lib. XXXIII. c. 6.

whole of the metal flying off gradually with a noiſe. The amalgams of gold andſilver diſcover themſelves by no noiſe in the fire; yet is there no apprehenſion from theſe, that the infus'd water of ſuch an amalgam being us'd ſhould cauſe any detriment to the perſon that takes it.

A Deſcription of a burning and Medicinal Spring in Poland. *By* Conradus, *chief Phyſician to the Queen: Together with an Explication of the Phenomena thereof; by* M. Denis. *From the* Acta Eruditorum Lipſ. An. 1684. p. 326.

Tranſlated from the LATIN.

Burning ſprings.

AMONG the many ſurpriſing phenomena of ſprings, the flame which ſome of them emit, and from which they are call'd *burning ſprings*, is deſervedly reckon'd one: Such as is the ſpring of *Jupiter Dodonæus* in *Epire*, of which, beſides *Pliny*[a], *Lucretius*[b] makes mention: And ſuch we know that to be in *Dauphine* in *France*, near *Grenoble*, which flames in the night and in foggy weather; and, therefore, call'd *La Fontaine qui brule*. And in the *Engliſh Philoſophical Tranſactions* N° 172, there is an account of the like ſpring near *Wigan* in *Lancaſhire*.

Deſcription of a ſpring in a mountain of *Poland*.

In the Palatinate of *Cracow* of the Leſſer *Poland* there is a mountain, call'd the *wonderful*, cover'd both with aromatic plants and flowers, and aged oaks, reſinous pines and firrs, and abounding both in freſh and ſalt ſprings, and full of metals and minerals of different kinds. In its middle to the ſouth a ſpring of very clear water riſes with a remarkable noiſe and vibration; and its ebullition or ſwelling increaſes or decreaſes with the moon. The ſlime ſettling at the bottom is ſaid to be of ſervice in the itch, inveterate gout, palſey and the like more obſtinate diſorders. The odour of the water in the ſpring is obſerv'd to be very fragrant and highly balſamic; in taſte it reſembles the ſweetneſs of milk; and beſides its medicinal virtue, which was experienced in the different diſeaſes of horſes, it alſo purges men, ſometimes by ſtool, and ſometimes by urine: Yet ſo that ſuch as it does not thus immediately affect, do, notwithſtanding, perceive a chearfullneſs and peculiar vigour from it. Hence the neighbouring inhabitants ſcarcely ever have any fit of ſickneſs, but are very long liv'd; ſo as generally to arrive to 100 and 150 years of age. It may be carried a great way, and be kept for a pretty long while without ſpoiling. Upon evaporation it exhibits a ſort of blackiſh bitumen, very ſerviceable both in recent and inveterate ulcers. In the ſpring it freezes not by any degree of winter-cold; nay, which is ſurpriſing, by approaching a torch thereto, it flames like the ſubtileſt ſpirit of wine; ſo that the flame is agitated

[a] Hiſt. Nat. Lib. II. c. 3. [b] De rer. natur. lib. 6.

gitated and ſkips upon the ſurface of the water like bubbles: And there-
ore, this ſpring is call'd *ignis fatuus*. And this fire never goes out of
tſelf, unleſs it is bruſh'd with brooms; as about 35 years ago the inhabi-
ants neglecting to extinguiſh it, by gradually proceeding thro' ſubterra-
eous cataracts, it reduced both the roots of the trees, and thereby all the
eighbouring wood to aſhes, laſting almoſt for three years, before it could
e perfectly extinguiſhed; from which time public watchmen were appointed
o prevent ſuch burnings. But while the water burns but for a little time, it
oſes much of its force, which it ſcarcely recovers in 14 days: And tho'
his flame ſoon conſumes wood; yet it is ſo ſubtile, as not to heat the
ater: But when the water is drawn out, it is felt as cold as that mention'd
y *Lucretius*; nay, neither does it flame out of its ſpring, tho' kept in veſſels
loſely ſhut. The inflammability of this fountain, unknown to former ages,
s evidently ſhown by being ſet on fire in a ſtorm of thunder: Hence the
wood-hewers from the neighbouring wood cutting twigs from the trees
ave extinguiſh'd the fire by beating the ſurface of the water therewith:
rom which time being ſometimes afterwards, for experiment ſake, ſet on
ire by applying a torch, it was again extinguiſh'd by the motion of the
wigs.

M. *Denis* in the following manner explains the theory about the afore- Explication of the properties of this ſpring.
aid properties of this ſpring: And that its motion and agitation anſwers to
hat of the moon, he ſuppoſes to happen by its communication with the
ea, whoſe flux and reflux depends on the different phaſes of the moon, in
egard that a ſubterraneous cataract lying between the ſea and this ſpring
s to a certain height only fill'd with water; but the reſt of it, becauſe it
xceeds the *æquilibrium* of the ſea, with air: Hence when the greateſt eleva-
ion of the ſea about full moon ruſhes into this canal; and conſequently,
rges the included air and vapours towards the ſpring, the ſpring muſt
neceſſarily be fill'd with water. On the contrary, if the ſea does on the de-
creaſe of the moon, ſubſide, the ſea-water by retiring along with the air and
vapours condenſable into water, drains off much water from this ſpring.

He derives its medicinal virtues from a more copious ſulphur, as the Its medicinal virtues whence deriv'd.
grand *panacea* of diſeaſes; and with which the veins of this mountain
abound, whoſe vapours alſo being lighter than the particles of water do by
their *niſus* and tendency cauſe the noiſe and boiling of this ſpring; and at
the ſame time its fragrancy; while the groſſer particles unite into a ſlime,
which falls to the bottom: He ſays, that the bitumen, which remains
behind after the evaporation of this water, is, as it were, a natural balſam of
ſulphur, produced by the frequent agitation of the ſulphur and water on
each other. And in like manner he aſcribes its inflammability to ſulphur
and to its exhalations burſting out of the water; and that, therefore, the
flame floats upon the water, but is extinguiſh'd and ſtiffl'd by beating it
with the twigs; in regard that by this means theſe ſpirits or ſulphureous

miaſma's

miaſma's are a-new involv'd in the aqueous particles from which the endeavour to recede: So that, indeed, being conſum'd by the deflagration, the water loſes much of its medicinal virtue; and that, therefore, it takes not fire out of its ſpring, becauſe it contains few ſulphureous particles, and thoſe envelopp'd in water, and depriv'd of the *impetus* and impulſe of the ſpring; which, notwithſtanding, being preſent, the water within the ſpring eludes all force of cold in the manner as ſtronger ſpirit of wine does.

The Oil and Gall of Vipers, excellent Opthalmics, &c. *By* Georg Wolfgang. Wedelius. *From the* Miſcellanea Naturæ Curioſorum. An. II. *viz.* 1671. Obſ. CXXV, ſeqq. p. 206. ſeqq.

Tranſlated from the LATIN.

Oil of vipers a ſingular opthalmic and how us'd

AS oil of vipers ſurpriſingly pleaſes the eye with its ſparkling and purity, ſo, beſides its other uſes, it is a ſingular opthalmic. It is us'd two different ways; either the eye-lid is anointed therewith, and this is of ſervice in comforting the ſight and diſſipating humours; or which is a better and ſpeedier method, a drop or two of it is, with a clean-writing pen with a blunt point, deriv'd into the eye itſelf. It is a divine remedy and kept a grand ſecret in moſt affections of the eyes, but eſpecially in haws of the eyes, applied either ſimply, as was ſaid, or firſt gently warm'd: It ſooths acrimony; is a lenient, detergent and conſolidating medicine, ſo as not to be exceeded by any other: And with this oil alone I have very often in a ſhort time remov'd haws and tubercles, diſcuſs'd redneſs and remov'd other affections of the eyes. In wounds of the eyes it is a preſent remedy. It is the only medicine in ſpecks, clouds and haws remaining after the ſmall-pox. But what is chiefly remarkable is, that as often as it is dropp'd into the eye, in a ſmall time after there runs out a matter, like white butter or *pus*, and thus it deterges without any ſmarting. I might cite many experiments, whereby I found it of uſe in haws, in an opthalmia, in a ſuffuſion, and in ulcers of the eyes, eſpecially after the ſmall-pox; and in a particular inſtance, in reſtoring the aqueous humour in a wound of the eye, but without recovering the ſight, as the wound was too deep. I, moreover, gave it internally to two conſumptive patients with ſucceſs: And as ſome phthiſical perſons are recover'd by the fat or oil of dogs, why ſhould not the balſamic fat of vipers have the ſame effect? In this diſeaſe, when externally anointed on the ſpine, it proves of ſervice, and on that account ſtands commended by *Cardan*. It alſo conſolidates other wounds.

Vipers gall mix'd with ſugar, a ſucceſsful opthalmic

As the gall of the pike-fiſh, mix'd with a little ſugar (after premiſing the proper evacuations, and at the ſame time applying a veſicatory) does accord-

according to the experience of *Scultetus*;[a] ſucceſsfully remove beginning cataracts; ſo the ſame is far more ſpeedily effected by vipers-gall, by applying which in the ſame manner I have diſcuſs'd a beginning ſuffuſion; I have alſo often mix'd it with the eſſence of copper, made with *Malmſey* wine, and deſcrib'd by *Angelus Sala*[b]; and thus I have heightened an opthalmic of wonderful efficacy in itſelf with the acceſſional virtue of the viper; and I uſe it with ſucceſs in theſe diſorders of the eyes.

Vipers gall is charged with a diſcuſſing volatile ſalt; thus the very ſalt of vipers, diſſolv'd in pure water, and dropp'd thrice a day into the eye (the patient lying for ſome time on his back) ſtands recommended by *Severinus*. Sugar, partaking of the nature of ſalt, when added thereto, attempers the mucoſity of the gall, and by its own proper deterging virtue increaſes its efficacy. With this alone a certain woman about *Magdeburg*, ſome years ago, made conſiderably rich, by blowing into the eyes of patients, troubl'd with ſuffuſions, a very ſubtile powder of ſugar; and by repeating the medicine ſhe recover'd a great many. *Angelus Sala*[c] has ſufficiently enlarged on the praiſe of copper. But beſides theſe medicinal preſcriptions, there are alſo other things to be obſerv'd about a ſuffuſion; on which head there is an elegant paſſage in *Seneca*[d]. 1. 'There is, *ſays he*, 'a remedy neceſſary for purging and clearing the ſight. 2. The phy-'ſician does not only cure, but alſo caution; you are not, *ſays the phyſician*, 'to ruſh immediately into broad day-light; but you are firſt to proceed 'from a greater degree of darkneſs to a leſs, and gradually accuſtom your-'ſelf to bear the open light. You muſt not ſtudy after a meal, nor give 'your orders with paſſionate and ſwollen eyes; and you are to avoid the 'cold blowing directly into your face, and the like; and theſe precautions 'are of no leſs ſervice than the medicines themſelves'.

Vipers gall endu'd with a ſalt.

Sugar an excellent opthalmic.

Michaelis highly commends the liver of a viper, as a ſpecific in epidemic dyſenteries. I ſometimes made trial of it; and, indeed, without ſucceſs in ſome caſes, by reaſon of the violence of the diſtemper; namely in ſuch caſes where the urgent ſymptoms and copious ſtools requir'd ſome other method; yet a certain young woman, troubl'd with a dyſentery, after finding no relief from any other means, upon uſing the liver of a viper, mix'd with other things, found a ſenſible relief: But in this caſe the liver ſhould be ſeparated from the gall-bladder, as gall ſtimulates: But if you would incline to adminiſter it in hard labour, it is more adviſeable, that the liver be dried along with the gall and employ'd; for, as the gall of an eel by *Helmont*'s experiment promotes ſo ſucceſsfully the birth, we may with manifeſt advantage expect the ſame effect from the liver of a viper.

The liver of the viper an anti-dyſenteric and facilitating the birth Obſ. 127. p. 209.

[a] Armam. chirurg. Tab. XXXIII. p. 40. [b] Sept. plan. terreſtr. p. 211. [c] l. c.
[d] Epiſt. XCIV.

Experiments, wherein is plainly ſhewn, that the Pulvis Pyrophorus, *otherways call'd* Homberg's Phoſphorus, *takes Fire in the ſame manner as Quick-lime, when moiſten'd, beats. By* Joh. Godofr. Teſke. *From the* Commercium Literarium Norimbergenſe, Specim. XXVII. p. 213.

Tranſlated from the LATIN.

Various opinions about the manner of the burning of the *pulvis pyrophorus.*

IT is at this day a thing well known, that that grey powder (which *Homberg* firſt taught to prepare from a fecal matter, but *Lemery*, the younger, from meal, ſeeds, honey, the roots and leaves of trees, the yelks of eggs and a great many other matters) does when expos'd to the open air, take fire; and not only glows like a coal, but is cover'd with a ſulphureous flame obſervable in the dark: But the cauſe of this ſpontaneous burning is not hitherto ſo well known to philoſophers; for, ſome hold, that true fire is actually preſent in every ſenſible place, and they imagine, that its particles enter the pores of the ſpongy part of the powder; and that that part of the powder, being like a kind of fuel, very eaſily takes fire: But they fancy, that the burning is nouriſh'd by the ſulphur, of which the powder, eſpecially when glowing, ſtrongly ſmells: Whence it alſo happen'd, that they call'd this powder the *magnet of the aereal fire.* Others, on the contrary, are of opinion, that the *pulvis pyrophorus*, expos'd to the air, does not attract the particles of fire, but is impregnated by the vapours of the air, and thus its burning is promoted: And, indeed, the latter opinion ſeem'd always to me preferable to the former; and I have given in to it in a *Diſſertation* I publiſh'd in 1729, entitul'd *de igne ex chalybis Siliciſque colliſione naſcenti*, induced thereto from ſeveral reaſons, which I had read in the *Memoirs of the Royal Academy of Sciences*[a]; as alſo from the frequent obſervations I myſelf had made; for, 1. It takes fire more eaſily in a moiſt than in a clear air. 2. The grey powder, not being ſufficiently provided againſt the acceſs of the air, is chang'd into a darker powder, which gives a hint, that it has imbib'd ſome humidity. 3. It gradually loſes its virtue, (and, indeed, the ſooner, if you reſtrain not the approach of the air) and only recovers it again after calcination, *&c.* But tho' theſe arguments might determine one to either ſide, yet they were not ſufficient to convince him of the truth of the matter: Hence being about to enquire, whether any one had given a demonſtration of this *phenomenon*, I turn'd over the writings of ſeveral philoſophers, but without lighting on any thing to that purpoſe, till I myſelf had hit on the method of putting the matter beyond all doubt. I had about three months before, ſome toaſted and ground coffee by me, which I had already us'd; after I had kept it for three weeks

The author's experiments.

[a] An. 1715. p. 20. ſeq. p. 23. 41. —— An. 1711. p. 243. ſeq.

weeks at leaſt in a glaſs-veſſel with a glaſs-ſtopple, I expos'd it to the air in a ſtove, and it would no longer take fire; I, therefore, open'd the window, that the air, which was then rainy and moiſt, might inſinuate into the powder; but neither thus did I effect its taking fire, tho' it had been expos'd to the air for almoſt half a quarter of an hour: At length it came into my mind, that I had with ſome probability diſcover'd, that the powder was ſet on fire by moiſture; and I took the hint of moiſtening a part of the powder on a paper: Wherefore, ſpitting upon the paper, I ſo inclin'd it, that the ſpittle ſhould touch the powder, upon which I immediately obſerv'd the powder in an agreeable manner to take fire preciſely in that place, where the ſpittle touch'd it; yet I was ſtill uncertain, that the powder took fire on account of the approach of the ſpittle; nay, indeed, I ſuſpected that it was already heated before it was moiſten'd, becauſe, upon the approach of the ſpittle to the powder, I had not only heard a kind of hiſſing noiſe, like what is produced by water ſprinkled on live coals, but I had alſo obſerv'd ſparks burſting out therefrom; I, therefore, often repeated the ſame experiment, yet always with the ſame ſucceſs; and even then, when I immediately moiſten'd the powder juſt put upon the paper, this remov'd every doubt with me: And likewiſe by repeatedly communicating a vapour to the powder, I obſerv'd it at firſt to emit a very ſtrong ſulphureous ſtench, but at length altogether to take fire; which ſo much the more confirm'd me in the opinion, that the burning of the powder is promoted by moiſture, becauſe in this manner I found, that the whole of it is ſet on fire, if the whole of it be thus moiſten'd; and on the contrary, if only a part of it be wetted, it only takes fire in ſome part: Beſides, when the powder had now loſt almoſt all its virtue, and neither moiſten'd nor impregnated with vapour would it any longer take fire, yet upon moiſtening it with water, I obſerv'd it conceive ſo much heat, as to burn the finger laid thereon, juſt as quick-lime does when drench'd in water: My opinion, therefore, which had only hitherto been a probability, was now eſtabliſh'd beyond all doubt by a threefold experiment. But the reaſon, why I was not ſooner confirm'd about the manner of the burning in the *pulvis pyrophorus* is, that I was always apprehenſive, I ſhould have moiſten'd it too much; and I doubt not, but this has been the reaſon, why others have not hitherto experienc'd the ſame thing.

An Obſervation on the Integument, peculiar to the Membrane of the Tympanum *of* Fœtus's. *By* Chriſtoph. Jac. Trew. *From the* Commercium Literarium Norimbergenſe. An. 1731. Specim. II. p. 13.

Tranſlated from the LATIN.

A peculiar ſmall membrane obſerv'd ſtanding before that of the *tympanum*.

THAT a peculiar ſmall membrane, or a certain integument (ſtanding before the membrane of the *tympanum* of *fœtus*'s, not yet born, or but lately ſo, and always obſerv'd by the lateſt anatomiſts) is a real membrane and not ſpontaneouſly diſappearing after the birth, as thoſe famous anatomiſts, *Kerkringius*, *Ruyſch* and *Heiſter* ſuppoſe, I formerly aſſerted in the *Act. Phyſic. Medic. Acad. Nat. Cur*[a]. being convinced thereof by a fourfold obſervation on the bodies of adults. After this I alſo found, that the common opinion was maintain'd by *Waltherus* in his diſſertation *de Membrana tympani*[b], publiſh'd at *Leipſig* An. 1725; and that to this opinion too gave in *Jac. Valent. Hirſchelius* in his diſſertation *de præcipuis partium fœtus ab illis adultorum differentiis*[c], publiſh'd at *Straſburg* An. 1729. The reading of theſe things rais'd in me a deſire of more accurately enquiring into the condition of this integument in young ſubjects; and for this enquiry I allotted a *fœtus* of 6 months old: And upon laying bare the *meatus auditorius*, and very carefully looſening it all around from the bony ring, this integument appear'd in the manner, as it is commonly deſcrib'd. Now in order to be aſſur'd, whether this integument (which to others ſeem'd to conſtitute a membrane of a ſofter and laxer kind, and as it were, a temporary one) had the ſtructure of a real membrane, I caus'd blow by a pipe into the *meatus auditorius*, at that time greatly conſtricted: And thus more than once the ſaid integument was not only elegantly diſtended like a ſmall bag, but when thus diſtended ſuffer'd itſelf to be dried whole and entire; from which I think it appears, that there is no reaſon to doubt, but that this integument may and ought to be taken for a real membrane. But if any one will have it a peculiar ſort of membrane and not continued with the *tympanum*, he has readily my ſuffrage; for, thus indeed, it always appears in young ſubjects, but how it appears in a freſh ſtate in adults, I own I have not hitherto learn'd by experience; for, ſuch as I have ſeen and obſerv'd in theſe latter ſubjects had already undergone a long continu'd maceration.

[a] Vol. II. Obſ. 56. [b] § 10. ſeq. [c] § 7.

The End of the FIRST VOLUME.

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ACTA GERMANICA:

OR, THE

LITERARY MEMOIRS

OF

GERMANY, &c.

A new Invention of Hot-Beds, *receiving their Heat from the Steam of boiling Water. By* Martin Triewald, *F. R. S. Capt. of Mechanicks, and Milit. Architect to the King of* Sweden. *Taken from the* Stockholm Acts.

Translated from the SWEDISH.

THE conſideration, that to promote vegetation, a conſtant moiſture, as well as heat, is abſolutely neceſſary, has put me upon contriving hot-beds, which may enjoy both, as long as can be deſired, and that after the following manner.

In a room not far ſituated from my hot-beds, I have caus'd a round tower T, to be built of bricks, Plate I. Fig. 1. ſix foot high, and one foot in diameter a-top, and 18 inches below, near E. Fig. 2.

At top of the tower, there's a cover L, made of potter's clay, and burnt, which, beſides being well made to cloſe the top of the tower, is made to exclude the air, by being well daub'd with ſoft clay, every time the tower is fill'd with fuel.

Near the lower end of this tower there are two openings, the one juſt over the iron grate H, where the fire is kindled at *b*, and the other is the aſh-

aſh-hole *a*, where the aſhes are taken out; over againſt the opening *b*, is a hole *g*, thro' which the flame plays, under the bottom of the ſtill A, and ſo ſweeps about the ſides of the boiler or Still in the flews *r*, *r*, *r*, *r*, going in a ſpiral line, like a female ſcrew, about the boiler A, and laſtly into the chimney S. By which contrivance, very little fuel will keep the water boiling, and emitting ſteam in the aforeſaid Still.

An iron door is fix'd before the opening *b*, which is ſhut as ſoon as the fire is well kindled on the iron grates H.

Plate I. Fig. I. Near the boiler or Still A, ſtands a reſervoir for water, BDCE, of lead; near the bottom of the ſame there's a valve V, ſoder'd to the end of a leaden pipe RP, of half an inch bore, which pipe reaches from the valve V, to the boiler, and thro' its cover down to within one inch near to the bottom of the ſame, where this pipe is open, but well ſodder'd to the top of the ſtill near P.

On one edge DE of the reſervoir, is faſtened an upright ſtander, on which lies *in æquilibrio* a leaver, with a ſweep or ſegment of a circle KI at each end of it; and on each of theſe ſweeps are faſtened little braſs chains, with their hooks, and ſtrong braſs wires faſten'd to theſe hooks: At one end of theſe wires the cover of the valve V is faſtened; and at the other chain hanging from the ſweep I, is likewiſe faſten'd a ſtrong braſs wire, going thro' a ſmall hole in the Still: At the end of this wire in the boiler, is faſtened a piece of wood, turn'd like an anchor buoy *b*, or rather an hollow ball of thin copper, with a ſmall hole at top to let out the rarefy'd air; which buoy ſwims on the water, when the pan is fill'd to its proper height with water; but, as ſoon as the water begins to boil and diminiſh by the ſteam that is rais'd, this buoy ſinks with the ſurface of the water, and by its weight pulls down the end of the leaver I, and raiſes the other, and ſo by means of the wire, hanging from the ſweep K, opens the valve V at the bottom of the leaden reſervoir BDCE, and then the water runs thro' the valve V, and the pipe RP down into the boiler, till the water is riſen to its firſt height, when the buoy can no longer preſs on the arm I, of the leaver, or keep the valve any longer open, which immediately ſhuts by its own weight; by which contrivance the water in the boiler or Still is always ſupplied, and kept to an equal height, as long as there is any water left in the reſervoir, without the trouble of taking off the head, to look into the ſtill or boiler, which otherwiſe one would be oblig'd to do.

On the top of the boiler, there is a valve *v*, loaded with ſmall leaden weights, which are proportion'd to a leſſer force of ſteam, than what will make the head of the ſtill fly off: So that when ſervants are careleſs, and raiſe too ſtrong a fire; or if the pipes, which go from the head under the hot-beds, ſhould by any caſualty be ſtop'd, then the valve *v* gives notice, and the ſteam raiſes the top of the valve, ſtreams out, and is prevented from throwing off the head, or burſting the boiler.

From

From the head goes a leaden pipe, *r*, *r*, *r*, under, or above the ground, to the hot-bed *d*, *d*, *d*, *d*, and ſpreads itſelf near the ſame into three branches, which go thro' the ſide of the hot-bed, and join into three pipes, R, R, R, made of brick earth, and burnt in a potter's oven, from four to ſix inches diameter, the length as long as they can conveniently be made; *viz.* about three foot, with proper joints, to fit each length to its fellow: The half of theſe cylindrical pipes, or ſo much of their area as turns upwards, when laid in their places, are full of ſmall holes, thro' which the ſteam and heat riſe up into the incumbent earth. Next to theſe pipes, I have laid tanner's bark, which readily lets the ſteam and heat paſs up into the incumbent earth, and, at the ſame time, prevents the earth from falling thro' the holes, into the pipes.

When theſe pipes are laid the full length of your hot-beds, they are all to be join'd to, and terminate in a leaden croſs-pipe *t*, whoſe ſhort end *u*, goes thro' the ſide of the hot-bed; to which end I have fix'd a cock, through which the ſteam, that is condens'd to water again, in the earthen, or leaden pipes, may be diſcharg'd; for which reaſon, all the pipes are laid a little ſloping, towards that ſide where the cock is fix'd. This cock ſerves, however, chiefly to regulate the heat, according to a botanical thermometer; for when it opens more or leſs, the heat is increas'd or diminiſh'd. Plate I. Fig. 3.

The tower, which the profil T repreſents, ſerves to this purpoſe, that when the ſame is once fill'd with fuel or coals, you may have, for a day or two, according to the bigneſs of the tower, a conſtant and ſteady fire under the Still or boiler; for as the fire receives no air from the top of the tower, becauſe the cover L is very well ſecur'd, that no air can enter, nor get out that way; ſo it is impoſſible that more of the fuel can be kindled, than that is next to the grate H. The fire is, beſides, very eaſily regulated, to what degree one pleaſes, by means of the door at *h*, and by cloſing the aſh-hole, and is entirely put out, when both are clos'd up. Fig. 4.

The coals, with which the tower is fill'd, ſink down upon the grate, and maintain a conſtant fire under the boiler, as long as any are left; and when once the fire is regulated by a thermometer, placed under the windows of the hot-bed, the heat muſt always remain the ſame, as long as any coals are left in the tower.

The advantages this invention has, before all other hot-beds, hitherto invented, are as follows.

1. Here is not only warmth, or heat obtain'd, but likewiſe ſubtil warm vapours, which chiefly promote vegetation, according to the many curious experiments, which that learned and great philoſopher, Mr. *Stephen Hales*, has publiſh'd in his *Statical Eſſays*.

2. That the heat of theſe hot-beds, may be regulated according to pleaſure, and laſt as long as one pleaſes.

3. That this invention is ſuch, that it requires very little attendance.

4. Hence there is no neceſſity of watering the plants in theſe hot-beds, or of being oblig'd, for that purpoſe, to open the windows in cold weather, as the ſteam, which comes from the boiler, goes thro' the holes of the pipes, up the tanner's bark, into the roots, and puſhes forth their growth, to a ſurpriſing degree, without giving the plants any foreign taſte, as dung is ſuppoſed to do.

5. To raiſe exotick hard-ſhell'd ſeeds, nothing can be more proper, than theſe hot-beds; becauſe you may have heat and moiſture, to what degree you pleaſe, which that moſt ingenious gentleman, Mr. *Philip Miller*, has found to be neceſſary for raiſing *coco-nuts*, *bonda's*, &c. See *Philoſophical Tranſactions*, N° 403.

6. By this invention one may, in orangeries, and green-houſes for exotic plants, as *muſa*, *anana's*, &c. during winter, imitate the half year's warmth, and moiſt air, of the *Antilles* iſlands in *America*.

M. Caſſini's *new Method of obſerving the Parallax, and Diſtance of the* Planets *from the Earth, verified at* Rome, *by the Abbé* Francis Blanchini. *Taken from the* Acta Lipſienſia. An. 1685, p. 470.

Tranſlated from the LATIN.

The earth's ſemidiameter.

THE length of the earth's ſemi-diameter, ſmall, it is true, if compared with the vaſt extent of the heavens, yet ſufficiently large for perfecting aſtronomy, is the ſtandard by which we meaſure the diſtances of the planets. According to the quantity of the angle which the earth ſubtends, when view'd from different parts of the *æther*, we may, by trigonometry, find the diſtance of the point from which it is view'd: Conſequently, as the ſine of half the angle, under which, for inſtance, the earth, if view'd from the moon, would appear: is to the whole ſine:: ſo is the ſemi-diameter of the earth: to the diſtance of the moon, in ſemi-diameters of the earth too. The whole difficulty, therefore, of determining the diſtance lies here, namely, how an obſerver on the earth can meaſure the angle ſubtended by the earth's ſemi-diameter, were it view'd from that point, the diſtance of which, from the earth, we want to know.

The meaſure of the diſtance of the planets.

How this diſtance was formerly found.

Formerly aſtronomers found the quantity of this angle by means of two obſervers, who at the ſame time view'd the ſame ſtar from different and diſtant parts of the earth. Suppoſe, when *Mars* was at M, one of the obſervers ſtood at V, the other at Z, two points on the ſurface of the earth diſtant from each other, and both obſervers mark'd the point in the heavens, to which *Mars* ſeem'd to be referr'd. In this poſition, the obſerver *Z* would ſee *Mars* at the ſtar S, along the right

Plate I. Fig. 4.

line

line Z M S, and the other obſerver, being at V, would ſee it at the other ſtar R, along the right line V M R. Then by comparing both their obſervations together, they concluded from the difference R S, that the angle R M S (which, conſidering the vaſt diſtance of the fixt ſtars, is almoſt the ſame with the angle R Z S) is the ſame with the angle Z M V, at the vertex, namely the angle under which Z V, the portion of the earth, would be ſeen from *Mars*.

The celebrated M. *Jo. Caſſini* rightly obſerves, that the ſtars themſelves may ſerve inſtead of another obſerver. Wherefore, in his learned treatiſe on the comet of 1680, he ſhews a very accurate and conciſe method of performing it by one obſerver only, who by making ſeveral obſervations the ſame night, may view the ſtars thro' a teleſcope armed with a micrometer. It will be worth while to explain more fully this admirable contrivance. M. *Caſſini's* new method.

We are, therefore, to enquire, by what means a ſingle obſerver upon the earth, may find the quantity of the angle, which the earth's ſemi-diameter would ſubtend, were it view'd from any of the planets.

Suppoſe, I am placed in the axis of the world, and view the earth D. The point D will repreſent the pole of the earth's equator, which will be aptly repreſented by the circle A B C. Suppoſe the plane B A C indefinitely produced; it will then repreſent the plane of the æquinoctial in all the ſpheres of the planets it touches, even in the moſt diſtant ſtars, when ſo far produced. Let, therefore, *Mars* be in H, which let us ſuppoſe to be in the plane of the æquinoctial. In order to ſhew its diurnal revolution, we have nothing elſe to do, than on the centre D, with the diſtance D H, to draw the circle H M K E; which *Mars* will ſeem to deſcribe in 24 hours, if it be ſuppos'd not to proceed by its proper motion *in antecedentia*, or contrary to the order of the ſigns. Thus when we come to ſhew the diurnal motion of *Jupiter*, *Saturn*, and even of the ſtars, it will be ſufficient to deſcribe from the centre D, concentric circles, correſponding to their diſtance. And if we divide one of theſe circles into 24 equal parts, and thro' each of them draw planes perpendicular to the æquinoctial, and interſecting each other in the point D, we ſhall alſo have the hour-circles, which, with reſpect to places on the earth, will ſerve inſtead of meridians. Let one of theſe planes be L H A D, that is to ſay, the meridian of the place A under the *Equator*, where ſuppoſe an obſerver views *Mars* H and the ſtar L, both which ſuppoſe to be in the ſame plane of the *Equator*, with the obſerver, and let their limbs touch in ſuch manner, that the ſame line D H L may paſs thro' the limb of the planet, and of the ſtar, which for the eaſier conſtruction, it is beſt to ſuppoſe. If neither the ſtar or *Mars*, had any other motion, than what we call their diurnal revolution, they both would, in 24 hours, return to their former place, and if that diurnal motion were equable, they would both in ſix hours be in the plane Plate I. Fig. 5.

plane E D M, perpendicular to the meridian and paſſing thro' the pole D, namely in the circle of the ſixth aſtronomical hour. If an obſerver, therefore, were at the ſame time placed in the axis of that motion, and in the plane of the *Equator*, that is, in the centre of the earth, he might always ſee *Mars* and the ſtar, and both bodies to touch each others limb the ſame way, whether *Mars* and the ſtar be in the plane D H L or D M R. But it would not be the ſame caſe with the firſt obſerver, whom we ſuppoſed to be at A, who, it is true, will in his meridian ſee, in the ſame right line A H L, the limbs both of the ſtar and of *Mars*. But when they are in any other meridian D R, which in reſpect of the place A is the circle of the aſtronomical hour at ſix, the obſerver will ſee *Mars* in the plane A M, but the ſtar in the plane A R; conſequently *Mars* will appear to him to move *in antecedentia*, or the ſtar *in conſequentia*; tho', it is true, both will, according to the ſuppoſition, be equably affected by their diurnal motion.

Moreover, as the obſerver knows, that both move equably, he will find, that both are in the plane of the true aſtronomical hour at ſix: And he will alſo find, that *Mars* had paſſed the plane of the ſenſible hour of ſix, a little before the true hour of ſix, ſince the ſenſible hour of ſix, with reſpect to the place A, is not the plane E D R, but the plane A P N. For the difference of time between the tranſit of *Mars*, for inſtance, over two planes of ſix hours, namely A P, the ſenſible hour of ſix, and A M the rational or aſtronomical hour of ſix, will be known by the portion of the diurnal parallel P M deſcribed by *Mars*, which will be equal to the angle P A M, or the alternate angle in the parallels A M D, to wit, the angle under which the ſemi-diameter of the earth would be ſeen from *Mars* M: So that if that portion M P were one degree, for inſtance, *Mars* will be ſeen to paſs thro' the plane A P in four minutes of time, before ſix hours are elapſed from its tranſit over the meridian. For the farther *Mars* is diſtant from the earth, the latter will be ſeen from the former under a leſſer angle, as is plainly demonſtrated by optics: Conſequently, the leſſer will the difference be of the tranſit of *Mars*, over the plane of the ſenſible and rational hour of ſix. And if the greateſt elongation of that ſtar be ſuch as the diſtance of the fixt ſtars, the angle A R D, or its equal N A R, will be ſo ſmall, as quite to eſcape our ſenſes, and will be ſeen in the plane A N, in the ſame ſenſible time in which the ſtar comes to the plane D R.

And now we ſee, how the ſtar itſelf, or rather a pendulum clock together with the ſtar, may ſerve inſtead of an obſerver, who lives in C. For what elſe would the obſerver at C do, than aſcertain, that he ſaw the ſtar and *Mars* in the ſame plane of his meridian, or of our aſtronomical hour at ſix, while we viewing theſe ſtars, would obſerve their ſituation different. And this is chiefly perform'd by our clock, while it tells the hours

after

after the tranſit of *Mars*, over the meridian. For ſince it is evident, that the ſtar L will, ſix hours after its tranſit over the meridian, be in the plane of the ſixth hour D R, we are pretty ſure, that the ſtar is in that place, if it be ſix by the clock. For as with regard to the fixt ſtars, the plane of the ſenſible hour of ſix, agrees with that of the rational hour of ſix, if after ſix hours from the tranſit of the ſtar, over the meridian, ſome plane be diſpoſed ſo as to paſs thro' our eye and the ſtar, and be parallel to the axis of the world, it will be the plane of the ſenſible hour at ſix, in which the ſtar muſt neceſſarily be. And *Mars* will appear to differ from it ſo many minutes of its parallel as correſpond to its parallax. Let, therefore, the number of minutes, which paſs between the tranſit of *Mars* and the ſtar, be obſerved by means of a pendulum clock. For thus it will happen, that by taking each minute of a diurnal parallel of *Mars*, to be four ſeconds of time, we may find the angle M A R or M A N, which as to ſenſe, is the ſame with that we have explain'd, or with the alternate angle in the parallels A M D, that is, the angle under which the earth's ſemi-diameter is ſeen from *Mars*, Q. E. D.

Having found this angle, if in the rectangled triangle it be, as the ſine of A M D found by obſervation : to the whole ſine of the right angle D : : ſo the line A D : to its fourth part : we ſhall find the quantity of the line AM, or the diſtance of *Mars* from the place of the obſerver A in correſponding parts of the earth's ſemi-diameter.

The beſt way of obſerving this difference of time between the tranſit of *Mars*, and the ſtar, is ſhewn by *Caſſini* in the ſame treatiſe ; and that by means of a peculiar machine, armed with a teleſcope and micrometer. In the concourſe of the focil of the object and eye-glaſſes, are ſet four, or more threads, interſecting each other at right angles. The teleſcope thus furniſh'd, is turned ſo long till ſome of the ſtars which are near *Mars*, appear to move along ſome of the threads, while its image in the teleſcope moves parallel to the *Equator* ; and then it is plain, that even the threads are parallel to the *Equator*. And theſe threads which are placed at right angles with the firſt threads, do fitly anſwer to the circles of right aſcenſion in the ſmall ſpace of the heavens, which the teleſcope takes in ; eſpecially, when the ſtars, which are obſerv'd, are within the *Tropicks*, as in fig. 6. when the threads E C, B D, parallel to each other, are at right angles with the parallel lines E B, C D. Let the image of one of the ſtars which are near *Mars*, be in C, that moves ſtreight along the thread E B, while the ſtar carried round by its diurnal motion, deſcribes its way by its image in the *focus* of the glaſſes, it will appear, that the thread E B is parallel to the *Equator* ; conſequently, the threads E C, B D, which are at right angles with the former thread, will anſwer to the circles of right aſcenſion. Only wait till *Mars* F carried round by its diurnal motion, ſhall reach the thread A C in H ; then mind the clock, and reckon

Caſſini's peculiar machine.

Plate I. Fig. 6.

the

the vibrations that happen between the tranſit of *Mars* F, and of the ſtar G, which will appear to reach the ſame thread ſoon after *Mars* does. This time being reduced to the minutes of a circle, will give the minutes of *Mars*'s parallax; conſequently, we may, by trigonometry, find its diſtance from the earth.

Hitherto, for the eaſier conſtruction, we have ſuppoſed ſeveral things, to wit, that *Mars* has no proper motion, that the obſerver lives at the *Equator*, and that the difference is taken in the circle of ſix o'clock, (this laſt was only ſhewn as an inſtance; for really ſuch an obſervation cannot be made in that poſition of the ſphere, as the circle of ſix o'clock, with reſpect to a place under the *Equator*, is the horizon itſelf; and upon ſeveral accounts ſuch obſervations cannot be made in the horizon) what we have, therefore, hitherto conſidered as a poſſibility, in ſuppoſitions made on purpoſe, let us reduce to practice in thoſe caſes where there are no ſuch conditions ſuppoſed: As in our horizon, when we obſerv'd *Mars* in 1685.

Firſt, Let the obſerver be in any other parallel of the earth, a pretty way from the *Equator*, ſuppoſe the parallel of *Rome*, which is 41° 56′ diſtant from the *Equator*, the parallax of the right aſcenſion obſervable here, or the difference of the ſenſible hour of ſix, will be leſs than the true one: For the place of the obſerver will not be in A, but in ſome intermediate point between D and A, namely in I, thro' which ſince the plane of the ſenſible hour of ſix, I Q, ſhould be drawn, the difference of the planes of both hours at ſix will be leſs; conſequently, the parallax will be ſo too. For the greateſt parallax of the right aſcenſion obſervable here, will have the ſame proportion: to the greateſt parallax obſervable under the *Equator*:: as the line I D: to A D, namely:: as the co-ſine of the pole's elevation: to the whole ſine. Conſequently, if the greateſt parallax of right aſcenſion, correſponding to *Mars* when in the *Equator*, be obſerv'd in the parallel of *Rome*, in order to find the quantity of the parallax, which ſhall be obſerv'd by ſuch as live under the *Equator*, it muſt be as the co-ſine of the latitude of *Rome*: to the whole ſine:: ſo the parallax of right aſcenſion obſerv'd at *Rome*: to the parallax obſerved in St. *Thomas*'s iſland, or in any other place under the *Equator*.

Plate I. Fig. 4.

Scondly, Let us ſuppoſe, that the firſt obſervation is made, while *Mars* is in the meridian; but that the ſecond is not taken in the circle of ſix o'clock, but in the circle of three; for inſtance, here we muſt again ſuppoſe a two-fold hour, the one aſtronomical or rational, which paſſes thro the centre of the earth, the other ſenſible, which is parallel to the former and is to be drawn thro' the place of obſervation. In fig. 4. the firſt will be D O, and the other I T, which will not be diſtant from each other the whole length of the line I D, but only that of the line I S, which is to I D:: as the ſine of three o'clock or of the angle H D O of 45 degrees

to the whole ſine. Let the proportion be as before, as the ſine IS of the angle A D S: to the whole ſine I D of the right angle S:: ſo the parallax of *Mars* obſerv'd in the circle of three o'clock: to that which may be obſervable in the circle of ſix.

Thirdly, Let us ſuppoſe *Mars* to be out of the plane of the *Equator*. The proportion muſt be ſtated the converſe of the former; to wit, as the whole ſine: to the co-ſine of *Mars*'s declination:: ſo the parallax found in the parallel *Mars* deſcribes: to the greateſt parallax obſerved in any great circle; in the very ſame manner as we reduce the apparent diameter of the ſun to the minutes of a great circle, when we meaſure it by means of a pendulum clock, while the ſun paſſes thro' the *Tropics*, or thro' any circle out of the plane of the *Equator*.

Laſtly, Bating the ſuppoſition of *Mars* having a proper motion in the order of the ſigns or contrary thereto. Let us ſuppoſe that it moves equably, or at leaſt that it is uniformly and determinately accelerated or retarded, which is to be found out by means of ſeveral obſervations that are to be made the preceding and following days, while *Mars* moves over the meridian; conſequently, we ſhall find the true place of *Mars* at each time; and if we compare it with the apparent place by the parallax, it will be the ſame thing as if we had ſuppoſed, that *Mars* had no other than a diurnal motion. For I ſuppoſed *Mars* to be at reſt for this reaſon, that I might fix a determinate place for each minute. Thus ſince we can find this place, even if we ſuppoſe the motion of *Mars*, the clearneſs and the uſe of *Caſſini*'s rule will appear without it.

How much aſtronomy is indebted to the learned *Caſſini* for ſo admirable an invention, any one will readily own, who conſiders its conciſeneſs, and compares the difficulty of former methods with it: For he himſelf ſays, that by this method he found out the diſtance of *Mars*, when being in oppoſition to the ſun, it was neareſt to the earth. By treading in the ſteps of ſo great a man, I myſelf have endeavoured to find the parallax of *Mars* when acronical. I have ſelected ſome of theſe obſervations, which I made on the days immediately after *Mars*'s oppoſition with the ſun, and which ſeem'd to me to be the moſt accurate, and they are as follows. Excellence of *Caſſini*'s method.

Obſ.	Day	H.	′	″	N. S.	
	May					
I.	30	8	45	55	The preceding limb of *Mars* in its diurnal revolution at the thread E F.	Obſervations: Plate I. Fig. 4.
					After 106 vibrations of the pendulum (of which 92 are equivalent to one minute of time) the ſtar A comes to the ſame thread.	
					After 365 vibrations from the tranſit of *Mars*, the ſtar D comes to the ſame thread.	

Obſ.	Day	H.	′	″	N. S.
	May				
I.	30	8	45	55	After 375 vibrations from the tranſit of *Mars*, the ſtar C comes to the ſame.
II.		11	10	12	The preceding limb of *Mars* at the thread E F. The ſtar C at the ſame thread after 393 vibrations.
III.		12	20	12	The preceding limb of *Mars* at the thread E F. The ſtar C after 399 vibrations comes to the ſame thread.
IV.	31	11	23	55	The preceding limb of *Mars* at the thread E F.
	June				
V.	1	11	6	19	The weſtern limb of *Mars* at the thread E F. The ſtar C comes to the ſame thread after 670 vibrations.

Compariſon. By comparing Obſerv. II. and IV. it plainly appears, that *Mars* had in 24 hours 13 minutes of time changed ſo much of its right aſcenſion, as anſwer'd to the portion of the heavens run over during 142 vibrations. Conſequently, if in one hour it equably changes its right aſcenſion (which indeed it does almoſt equably, as plainly appears from Obſerv. II. IV. and V.) it is retrograde or elongated from theſe ſtars while $5\frac{1}{12}$ vibrations are performing. From Obſerv. I. to II. are 3 hours, [illegible] min. and $\frac{1}{4}$. Therefore if it was no ways retarded, it would accompliſh ſo much of its aſcenſion, as is equivalent to 20 and $\frac{1}{2}$ vibrations. But ſince at the time of Obſerv. I. it was retrograde with a greater degree of velocity, becauſe its retroceſſion is daily ſenſibly diminiſh'd about five or ſix vibrations, it ſhould in that time vary at leaſt 21 and $\frac{1}{4}$ vibrations. This change I compare with Obſerv. I. and III. according to which it plainly varied 24 vibrations. Conſequently, the greateſt difference that can poſſibly happen, does not exceed 2 and $\frac{3}{4}$ vibrations. Now to come nearer in order to find the parallax.

At the time of Obſ. I. *Mars* was diſtant from the meridian three hours, or 45 degrees, of which the one is 707. At the time of Obſ. II. *Mars* was diſtant from the meridian 3 and $\frac{1}{4}$ minutes or 8 and $\frac{1}{2}$ degrees, whoſe ſine is 148; the ſum 855.

As 855 : to the whole ſine 1000 :: ſo $2\frac{3}{4}$: to $3\frac{5}{48}$.

As 744, the co-ſine of the latitude of *Rome* : to 1000 the whole ſine :: ſo $3\frac{5}{48}$: to $4\frac{7}{48}$.

As 1000 : to 921 the co-ſine of the declination of *Mars* : : ſo $4\frac{7}{48}$: to $3\frac{41}{48}$ or in round numbers to 4.

And now if 92 vibrations of my pendulum give 60 ſeconds of time, how many will 4 vibrations give? I find $2\frac{56}{92}$ or $2'' 36''' 30''''$. But $2'' 36''' 30''''$ are minutes of the *Equator*, and conſequently $39'' 7''' 30''''$ of any

any great circle. Therefore, the greateſt horizontal parallax of *Mars* is 39″, and its diſtance from the earth is about 5250 of its ſemi-diameters. If you take its parallax in a round number, as 40″, its diſtance from the earth will be upwards of 5100 of its ſemi-diameters. I have not minded, you may ſee the ſmall fractions, in a matter where there is ſuch incertainty.

The Diſſection of a Maniac, *in whom one of the* Ovaries *was found hairy and ſteatomous. By Dr.* Auguſtine Buddeus. *Taken from the* Acta Berolinenſia.

Tranſlated from the LATIN.

A Woman, about 20 years of age, and of an emaciated habit, was confin'd, thro' a raging madneſs, of which ſhe finally dy'd. The corps being publickly diſſected laſt year, in the *Royal Anatomical Theatre*, the following appearances were obſerv'd.

Obſervations on the *dura mater* and *pia mater*.

1. As there was nothing unuſual externally, the muſcles and ſcalp being remov'd, and the ſkull ſaw'd off, I found the *dura mater* extremely moiſt, and, after an inciſion of it, I obſerv'd the *pia mater* abounding with many veſſels, which were turgid with a thin, dilute blood: This the rather ſurpriz'd me, as celebrated phyſicians have pronounc'd the blood of *maniacs* to be groſs, and even aduſt or parch'd; and which, by obſtructing the tender veſſels of the cortical ſubſtance of the brain, they have conſider'd as the cauſe of this diſeaſe: This I have no doubt, it ſometimes is, tho' experience has convinc'd me 'tis not the conſtant one. The *dura mater* being carefully remov'd from the ſubjacent, tender membrane, a large bag preſented itſelf, form'd by the *pia mater*, which contain'd a pound weight of a thin lymph, intermix'd with ſome bloody drops, and which occupy'd all the ſpace to the cortical ſubſtance of the brain. This *cyſtis* was diſcover'd in the left lobe of the brain, and the greateſt part of it was extended to the *baſis* and poſterior parts of the *cranium*. There was nothing farther remarkable, except, that the whole brain was very flaccid, moiſt, and of a mucous conſiſtence.

On the *thorax*.

2. There was little unuſual in the *thorax*, beſides a very ſtrong adheſion of the lungs, which were moſtly ſchirrous; tho' I obſerv'd further, that the right cavity was full of lymph, while the left was entirely free.

On the *abdomen*.

3. But I was infinitely ſurpriz'd on an apertion of the *abdomen*, which I effected with ſome circumſpection, leſt the ſituation of the parts might be confus'd. To which purpoſe, declining the common method of diſſection, I did not lay open the whole *abdomen* at once, but left the abdominal muſcles untouch'd for a palm's breadth from the *ſymphiſis*, or coherence of the *os pubis*, in a direct line to the navel; that, the lower parts of the

belly being tight and ſtreightened, the inteſtines ſhould be preſs'd a little upward, and reſiſt a procidence of the incumbent parts. But what enſu'd? To my great aſtoniſhment, on inſpecting this cavity, I could ſcarcely diſcern an inteſtine. The relax'd and flabby ventricle was drawn exceſſively downwards; and that part of the *colon*, which is call'd the *arcus* or bow, repreſented the figure of a *Roman* S, and entirely occupy'd the whole cavity of the belly to the *Iliac* region. The muſcles being diſſected to their coheſion with the *os pubis*, for an inſpection of the *pelvis* or baſon, here I found the miſplac'd inteſtines, ſomewhat dark and diſcolour'd, and ſurprizingly contorted and entangled together; while the meſentery, to which they were connected, was entirely ſcirrhous. The *omentum* or cawl, which was neceſſarily remov'd from its ſtation, by the dilapſe of the ſtomach and *colon*, was alſo found in this cavity, ſpread over the inteſtines, darkiſh, and filthily coloured. The liver, and other *viſcera* of the lower belly, ſeem'd tolerably perfect, or, at leaſt, had very little præternatural appearance.

On the womb. 4. The inteſtines being remov'd, I immediately diſcern'd the womb to be exceeding hard, tho' in its natural ſhape, and made an inciſion to diſcover if there might be any particular inhæſion, which there was not. From thence I proceeded to obſerve the *ovaria* and *fallopian* tubes, and found the right ovary of a remarkable magnitude, equal to a hen's egg. Surveying it attentively without, I obſerv'd it to hang by an inſertion or pedicle; the membranes involving it were tenſe, double, thick, and ſomewhat rigid, tho' lubricated with a clear fluid. It made no reſiſtance to the preſſure of my finger, but yielded, and retain'd the pit impreſs'd. From hence I conjectur'd that I ſhould diſcover ſome *hydatides*, or perhaps a dropſy of the ovary, which *Ruyſch* has formerly noted in his anatomical and chirurgical obſervations, and promis'd as much to my aſſiſtants and auditors the more readily, as I could not think of any diſorder, more congruous to the external appearances: But the event was different. For the Fig. 8. whole circumference being open'd, it was entirely fill'd with hairs, mix'd with a ſuetty or unctuous matter within. To prevent any deception in ſuch an unexpected caſe, I examined the hairs apart, waſhing them in water: They were about two inches in length, curl'd a little, and being apply'd to the flame of a candle, they burnt with a ſtink like that of nails, or other hair. Content with this, I conſidered the ſuetty matter they were intermix'd with, with much accuracy, which did not reſemble melted ſuet, but was in diſtinct, ſmall grains: This might probably be owing to ſome lymph in the ovary, which prevented the coalition of this unctuous matter into one entire maſs. This ovary, clear'd from the parts it had been connected with, weigh'd exactly an ounce.

Concluſion. Theſe are the moſt remarkable appearances I have obſerv'd in this wonderful ovary, which inſtance, ſuppoſing the like to have been already remark'd,

mark'd, may acquit ſuch obſervers from the charge of fiction; ſince it ſeems ſcarcely conceivable, how ſuch matter ſhould arrive at ſuch a ſituation. Moreover, we find *Ruyſch*, in different parts of his valuable collections, take notice of hairy tumours, and in his ſixteenth obſervation he deſcribes a ſimilar one of the *omentum*; as another example, nearly of the ſame nature, is recited in the Acts of the Academy of Sciences at *Paris*. Such *phænomena* cannot fail of furniſhing ample occaſion for ſpeculation and debate: As, whether theſe hairs always exiſted in their ovary, and in the condition we found them? or, if they grew and multiplied? As alſo, whether this morbid conſtruction of the ovary might haply be the cauſe of the patient's madneſs? It is however a ſenſible concern to me, that I could not arrive at an exact knowledge of the period, when the deceas'd was firſt attack'd with this diſeaſe.

A new Diſcovery of the real Cauſe of the Increaſe of Corn. *By Prof.* Wolf, *at* Hall. *Taken from the* Breſlaw Collection, Ann. 1718. p. 588.

Tranſlated from the HIGH-DUTCH.

The occaſion of the diſcovery.

MR. *Wolf* having reſolv'd on a farther examination of that new diſcovery, mention'd by the Abbot *de Vallemont*, (in his curioſities of nature and art in the proceſs of vegetation, printed in 1701,) where he obſerves, that a ſingle grain is productive of ſeveral ears, which effect the Abbot ſuppoſing to depend principally on ſoaking the grain before it is ſown; and it being manifeſt, that one grain, not ſoak'd, ſown in a fertile ground, produces ſeveral ears, Mr. *Wolf* was put upon examining into the real cauſe of this natural increaſe, eſpecially, when he found the modern hypotheſis to be very ill grounded, to wit, that the principal grain contained as many corns in miniature, as in a 1000 or more years, might ariſe from a large one; and that therefore, by means of ſoaking, one year would produce as many ſtalks and ears, as otherwiſe they would in three, which hypotheſis Mr. *Wolf* fundamentally contradicts: He firſt examines wherein the real cauſe of this wonderful increaſe conſiſts, and then ſhews how it was diſcovered. He made an experiment in his own garden, in a fertile ſoil, with two grains of oats, and found, that each grain came up like thoſe ſown in the fields, with one ſprout, which in time grew into a bunch, and at the time of harveſt, the ſtalks were longer, the ears full, large, and heavy, exceeding by far the common field-oats; and having parted one of the bunches, he found that each ſtalk had its particular root, which he could eaſily ſeparate; the other bunch he left remaining as it was, in the ground; and when it had rain'd after harveſt, there came up new ſtalks, which ſhot into ears by *Michaelmas*; nay,

upon

upon the rain which fell a little after *Michaelmas*, more green ſtalks ſhot up, ſo that both ſeed and harveſt appear'd together. Whence he perceived, that out of one ſingle grain, at firſt aroſe but one ſhoot, from which proceeded a ſtalk, therefore he concluded, that properly no more than one capital ſtalk was in the grain, and that the ſide-ſtalks had their derivation from another cauſe; and finding that the ſtalks neither proceeded from the grain nor the root, he ſearch'd and examin'd the ſtalk itſelf, and was ſoon ſatisfy'd that the ſide-ſtalks had their derivation from the main ſtalk, or from each other. This emergence, or extruſion of the ſide-ſtalks, he repreſented to himſelf preciſely, in the following manner. As on every ſtalk were found ſeveral knots full of marrow, while the ſtalks were quite empty, and obſerving no knot, but where a leaf ſprouted, this made him reflect, that not only the knots in trees, whence the branches proceed, are found where the leaf grows, but likewiſe in other vegetables, in which ſide-ſtalks and bloſſoms ſprout freſh out cloſe by the leaf, of which the ſun-flower is a plain inſtance, for when the flower has done blowing on the main ſtalk, new ſide-ſtalks and bloſſoms iſſue forth at every freſh remaining leaf. Whence he concludes, that a ſide-ſtalk could have ſprung from no part of the main ſtalk, where a leaf or blade had not put forth, and that ſuch a ſide-ſtalk had ſhot its own root into the ground: If then one or two leaves, which are neareſt the root, have their knots in or cloſe to the earth, then thoſe knots ſtrike, and grow into ſide-ſtalks from the matter, or marrow they contain; ſuch ſide-ſtalk, ſeparating itſelf in a little time from the original ſtalk, draws again one or two knots along with the earth, and thus each ſtalk may produce two new ſide-ſtalks, and ſo on to infinity, as long as it can receive proper nouriſhment: Theſe were Mr. *Wolf*'s fundamental reaſons, upon which afterwards he made the actual tryal.

Demonſtration. Mr. *Wolf* demonſtrates, in what manner the cauſe of the increaſe in this tryal is aſcertain'd: He propoſes, 1. To put ſome grains ſomewhat deep into the ground, ſo that at leaſt a pair of knots might lodge therein. 2. To ſink theſe knots that are above ground, into the earth, before they grow hard. 3. To divide a whole bunch, and to examine into the knots and roots thereof. 4. Whether after the harveſt a new ſeed may be raiſed? 5. Whether the ſeed may be winter'd? 6. To count the number of ears and grains. In the proſecution of this tryal he was for ſome time delay'd, but animated by M. *Leibnitz*, he made a ſecond attempt: In the ſpring, he had a little box fill'd with mould, in which he put one grain of barley, and one of oats, and found that both came up with a ſingle leaf; and after the growth of the ſecond leaf, a ſide-ſtalk ſhot out between both; the like happen'd between the ſecond and third leaf, ſo that even the ſide-ſtalks produced others. And having cover'd ſome of the new green ſtalks, above the lowermoſt knot, with earth, he found afterwards the ſame was burſt, and had ſtruck two roots, tho' there was as yet no appearance of

of a leaf; he left another knot longer in the ground, and found it ſhooting forth a new ſtalk: He had, at the ſame time, put ſome grains in his garden-ground, which had ſpread themſelves into much larger bunches; but they were inadvertently pull'd up before he made his obſervations, to one bunch of oats, which was full, both of good and blighted ears. The cauſe of this unequal growth he aſcrib'd to the pump water with which he had water'd thoſe in the box, when that in the garden was moiſten'd by the rain and dew. In examining the bunches, that had been pull'd up, he found that in the vaſt number of ſtalks, each was growing from the knot of another, above where its roots begin; yet ſo, that the root of one ſtalk had nothing depending on the root of another. He then enter'd upon a new experiment; he put both oats and barley, ſome in uncultivated ground, others in beds of aſparagus, which had been dung'd in the ſpring; in the former there grew handſome bunches, particularly in the ſtraw, but in the latter much larger and with fuller ears, but all of them with the beforementioned circumſtances: He once pull'd up in the field, a bunch of oats, divided it, and found 600 grains, altho', on account of the dry weather, many ſmall ſtalks, which had ſprouted ſlowly, were dry'd up: On one bunch of barley he found 68 ripe ears, and 21 not quite ripe, in the whole 1586 grains; to which adding the 504 dry'd grains there will be a product of 2090 grains from one ſingle corn in an uncultivated ground.

Remarks.

As to the goodneſs of theſe barley corns, Mr. *Wolf* remarks, that 28 grains, were equal in weight to 30 of common barley; the grain was more ſolid, and promis'd a better flower: He alſo found, that the ſide-ears had ſhot much higher than uſual in a common barley field. But principally he took notice, that ſome ſide-ſtalks had ſhot forth from the firſt knot above the root, a ſmall ſtalk of about two inches long, notwithſtanding it was an inch above ground, and incapable of ſtriking root; whence he concludes, that at leaſt a ſide-ear would thrive without a root, in caſe it had ſufficient nouriſhment.

Having left ſome of the roots and ſtubble of the oats ſtanding, he found them about the middle of *December* full of ſmall ſtalks, and green ſprouts; and he doubts not, but, had it been rye or wheat, the ſeed would have ſtood the winter out, and brought forth fruit the next year; he even ſuppoſes, that theſe young, and very late ſprouts, would bear to be divided and replanted; and if ſo, every ſprout would increaſe into a whole knot, or bunch. Thus much of Mr. *Wolf*'s fundamental experiments and reaſons concerning the increaſe of corn.

Uſe and benefit of this new diſcovery.

As to the uſe and benefit of this new diſcovery in agriculture, Mr. *Wolf* demonſtrates, that a field might be made 100 times more fruitful than it commonly is, when (1.) the ſeed is ſown above an inch deep in the ground, whereby two knots of the main ſtalks would remain in the earth. (2.) When the grains are ſown at leaſt three inches one from the other, ſo that

that the ſide-ſtalks may have room to ſpread, and not want ſufficient nouriſhment, without which the ſeed would be liable to the danger of being ſpoil'd or loſt. He believes there are many, who wiſh to ſee this put in practice; but as it is impracticable to do it by the uſual method, he hopes, that ſuch as are experienced in agriculture, and have a genius, join'd to ſome practice in mechanicks, will find out a method to accompliſh it; as in the mean time he himſelf did not doubt of diſcovering, at ſome leiſure hours, ſomething to anſwer this purpoſe.

Of uſe to explain natural philoſophy.

Laſtly, Mr. *Wolf* ſhews, that his new diſcovery may prove of general uſe in the explanation of natural philoſophy: He obſerves, that ſince he diſcover'd, that in each knot, where there is a leaf, there is alſo a ſprout with its root, he had different conceptions of ſeveral things, to what he had had before; and that in all the vegetables, where a leaf ſprouts, there will be found an eye, which can ſtrike root and ſhoot forth, if the ſtalk as well as the root touches the ground. This he has experienced in ſeveral vegetables, inſomuch that, by the help of the microſcope, he diſcover'd in every eye a root, by which it drew nouriſhment to itſelf, and therefore, if the eye or knot is to ſhoot forth, its root muſt remain unhurt; which obſervations were never made by either *Malpighius* or *Grew*, in their Anatomy of plants.

In planting of lemons, &c.

Hence Mr. *Wolf* learn'd the proper circumſtances in planting lemons, vines, carnations, *&c.* where the roots of the eyes ſhoot forth in the ground, in order to convey the more nouriſhment to the eye, that the miniature in the bud, may be able to grow; however, this cannot happen, where the knots are hardened, or where the root is obſtructed from making its way, but only to ſuch as are green and ſoft: This has been already obſerv'd in the knots of corn, which burſt at the ſhooting forth of the root: Hence Mr. *Wolf* modeſtly contradicts what has been advanc'd, that all vegetables were not fit to be propagated by planting. He believes, that, according to the notion of *Agricola*, nature forms the root from the united juices, at the inciſion, but that ſuch roots can be only the roots of the eyes, ſince nothing organical can be produced from an inorganical matter; and in this manner we are to account for the thriving of replanted twigs, which have a ſoft bark, and will not eaſily decay, of which the roſemary is a plain inſtance. On this occaſion Mr. *Wolf* inſpected the ſeed, and perceived that the ſame, as generally known, conſiſts of the matrix, which ſerves for the firſt nouriſhment, and of the bud; this bud has a ſmall root, two heart leaves, and one eye, from which he firſt diſcover'd the root; that part of the bud, which is lodg'd between the heart-leaves, contains not the whole tree, but only one ſingle eye, ſince ſo much is repreſented in ſmall, as what can grow from one eye. The heart-leaves ſerv'd to bring the eye to maturity, and to ſhoot forth. Having at laſt given his reaſons, which induc'd him to take the within

within the tree hidden part of the eye for a root; he explains, how from a kernel a tree is produced; namely, by the enlargement of a bud in the ſeed; alſo, how out of one leaf-eye is produced a tree, which is hid in the marrow of the knot the leaf proceeds from; namely, in the ſame way as in the ſeed: Alſo, how out of the roots there ſpring forth ſide-ſhoots, becauſe the roots are furniſh'd with marrow, and the marrow with eyes: Laſtly, how the bark ſhoots forth branches, becauſe thro' magnifying glaſſes it has been obſerv'd, that the inſide of old barks contains a great deal of matter, that has an affinity with marrow; hence it is poſſible, that a tree depriv'd of its marrow, may ſprout out branches from the bark. Since then this new diſcovery of the increaſe of corn, giveth ſo much light to the growth of trees and plants, Mr. *Wolf* has promis'd to neglect no opportunity of purſuing this enquiry; and for our part, we ſhall not be remiſs in giving what account we can, of the diſcoveries, made in agriculture, by other gentlemen here in *Sileſia*.

A ſpurious periodical Diabetes; *by* T. Bartholin. *Taken from the* Acta Haffn. Anno 1671, 1672. p. 19.

Tranſlated from the LATIN.

ALL the phyſicians in *Copenhagen* were call'd to a conſultation, on the caſe of Mr. *Bullich*, a Member of the Royal Council, and Preſident of the City; who, after a chronical *Diabetes*, fell into a *Diarrhæa*, which ſunk his ſtrength, and at length carry'd this elderly gentleman off, in ſpite of the exhibition of the moſt experienc'd remedies. For ſome years before this, he labour'd under an extraordinary, and monthly profuſion of urine, with pain, which was preceded by nephritic torments, and about the full-moon he diſcharg'd 24 pounds of urine, tho' he had not drank one pound of liquid: Nevertheleſs, this was attended with no viſible emaciation of the body, as he continu'd of a vegete and plump habit to the day of his death. In the paſſing of this urine, he was ſenſible of an augmentation of pain, if the fire in his chamber was larger than ordinary. He diſcharg'd gravel alſo by ſtool, that was viſible upon his linnen after this copious diſcharge, which induc'd us to conclude, that his blood was overſtock'd with tartarous particles. I advis'd chalybeated milk for his *Diabetes*, which is recommended by *Augenius*. Another preferr'd that in which heated gold had been quench'd. The cure had been alſo attempted by tranſplantation, but without effect.

Obſervations on the Matrix, *or Womb of* Amber. *Taken from the* Breſlaw Collection, July 1718, p. 1397.

Tranſlated from the HIGH-DUTCH.

Whether amber be a mineral or vegetable production.

IT has been long and warmly debated, whether Amber be a mineral or vegetable production. The ancient *Greeks*, *Latins* and *Arabs*, as well as *Olaus*, *Ruens*, *Scaliger*, *Baccius*, *Servius*, *Hermolaus*, *Barbarus*, and many more, ſuppoſe it a gum, iſſuing from trees; their arguments are ſtrictly examin'd, and fully repreſented from antiquity by *Andr. Libavius*. Others on the contrary, range it in the claſs of minerals, tho' in this they differ; for *Pytheas*, *Timæus*, *Theophraſtus*, *Xenocrates*, *Hector*, *Poethius*, *Theophraſtus Paracelſus*: and ſome others, aſcribe the birth of it to the ſea; while many others, as, *Agricola*, *Heſſus*, *Mathiolus*, *Jordanus*, *Aurifaber*, *Willichius*, *Goebelius*, *Cordus*, *Fuchſius*, *Libavius*, *Kircherus*, *Hartmannus*, and indeed the greater number agree, that it is a foſſile, and the fruit of *bitumen*, which opinion is maintain'd and defended from many arguments by *Libavius*: And this appears the more reaſonable, ſince in moſt places where amber is dug, there is generally found *bitumen*, *petroleum*, &c. and again, where *bitumen* and *petroleum* are found, they are frequently accompany'd with Amber. The obſervations of *Sylvius Bacconi* on this head, deſerve to be well conſider'd; he ſays, 'that here and there 'in *Italy*, the *petroleum* is found in plenty, and alſo *ſuccinum*; and that, 'particularly, on the ſtrands near *Agrigento*, *Catanea*, *Leocata*, &c. In 'Sicily, there is found amber, and likewiſe much *petroleum*, even in open 'ſprings, when yet in all thoſe Diſtricts, there are found no firs, nor any 'other reſinous trees: And wherever Amber is found, he makes no doubt 'but, upon further digging, we ſhall diſcover *bitumen*, ſea-coal, *naphta*, &c.' This foſſile Amber has been obſerv'd in *Bohemia* by *Balbin*; (*a*) in *Moravia* by *Hertodt*; (*b*) in the *Marck* and *Saxony*, particularly at *Wittenberg*, by the authors of the *Miſcel. Cur.* (*c*) and in many other diſtricts by *Hartman* (*d*). That *Sileſia* is ſtored with it, appears from the pieces of Amber frequently found, eſpecially on the *Venus mount* near *Riemberg*, and other places. On the *Kintzel-hill*, there was diſcover'd a few years ago, a matter, in colour, not unlike poliſh'd horn, encompaſs'd with a cruſt of a cinnamon colour, both of which, being flung on live coals, diffuſed a ſmell not to be diſtinguiſh'd from that of Amber.

The greateſt Magazine of amber in *Pruſſia*.

The moſt compleat and valuable magazines of Amber, are found in ſeveral parts of *Pruſſia*, particularly in *Samland*, where it is fiſh'd up in ſtormy weather with nets. The coaſt is ranged along with ſteep hills, out of which now, but not in ancient times, the amber is dug in full perfection, tho'

(*a*) Miſc. Regn. Boh. Dec. I. l. 1. c. 50. p. 115. (*b*) Tartaro-Maſt. P. I. c. 5. p. 30.
(*c*) Miſc. Nat. Cur. Dec. I. An. IX. & X. p. 102. & 223. (*d*) Hartman de Succino, c. 1. &c.

tho' with conſiderable danger to the workmen, as thoſe hills, conſiſting meerly of ſand, are very liable to fall in when undermined. The Amber veins are of three different ſorts, the one conſiſts of a blueiſh clay; the ſecond of ſand, and the third apparently of wood: The laſt deſerves well to be conſider'd, as not having the nature of a vegetable wood, but that of a foſſile *bitumen*, being turfy withal, and which, when ſet on fire, will not only ſmell of ſalt-peter, vitriol and brimſtone, but likewiſe of an agreeable gum or roſin, of all which however, the brimſtone is prevalent; for theſe wood-veins are throughout garniſh'd and blended with green tranſparent vitriol; the wood itſelf is of a dark brown colour, and, in other reſpects, much reſembles common wood, as well the grain as knobs, except that it is more brittle: It is of a vitriolic taſte, acid and aſtringent; being once ſet a fire, it will melt and conſume, leaving behind it a reddiſh powder or calx, which makes a bright brick-red colour; it has no taſte, except that it is ſtill ſomewhat aſtringent: This wood is of a bituminous or a turfy nature, and *Hartman* ſays, that the ſoil in *Pruſſia* is very bituminous: This *bitumen* is of various ſorts, but for the generality it is either hard or fluid: From the latter *Hartman* derives the origin of the *Succinum*, and with *Boccone* takes it to be nothing elſe than a *petroleum*, condens'd and indurated by ſea-water, which, in its fluid conſiſtence thro' the ſubterraneous veins, runs into the ſea, and is by the ſea-ſalt comping'd into hard pieces, tho' it cannot be denied, that between the foſſile Amber, and the marine or ſea-amber, there is ſome difference. *Hellwing*, concerning the *matrice ſuccini bituminoſa*, writes thus: 'When I viſited the promontories 'of the *Baltic* ocean, in order to ſearch as well for ſea-plants as foſſils, I 'enter'd the mines, where amber was dug, on purpoſe to ſee whether I 'might arrive at a more intimate knowledge of its nature, and the genera-'tion of it; and I found that it lay in certain *ſtrata*; firſt there is on the 'ſurface a yellow *ſtratum*, in the broken ſides of the mountains, next the 'ſea-ſhore, extended lengthwiſe, conſiſting of ſmall flints, and about an 'inch thick: Under this is a ſecond *ſtratum* externally black, and of a turfy 'ſubſtance, which abounds with a foſſile bituminous wood, to which vitriol 'either adheres, or is contain'd in it, and is often obſerv'd to ſpring or 'flower out of it, ſo that pieces of the pureſt vitriol are ſometimes obtain'd 'from it. Theſe *ſtrata* are alſo furniſh'd with nitrous and ſulphureous 'particles, which are likewiſe ſcatter'd over this bituminous wood, as is 'evident not only from its colour, taſte and ſmell, but from its ſudden 'inflammability, and evaporation by fire. 'Tis obſervable, that the *ſtrata* 'wherein amber is found, are blended more or leſs with a gravelly matter, 'ſo that a lump of it which may be found in the turfy *ſtratum*, and gene-'rally near this bituminous wood, as its matrix, is always involv'd in 'gravel, and a bituminous earth, and is ſo very moiſt and friable before 'it hardens in the air, that it muſt be tenderly handled. In ſhort, where-

Hellwing's enquiry into the nature of amber.

'ever amber is found, this foſſile wood, and bituminous earth, a gravelly 'matter, vitriol, nitre and ſulphur, are found alſo. But here I muſt be 'underſtood to ſpeak of the foſſile amber, ſuch as is taken from the moun- 'tains adjoining to the *Baltic* ſea: For that which is found on the beach, 'being thrown up by the waves, and harden'd in the ocean, is generally 'involv'd in ſea weed, and is never accompany'd with the bituminous 'wood, or any other appendage: So that it may be readily collected from 'this enquiry, that the matter of amber ſeems to be contain'd in a bitu- 'minous wood, which has been bury'd, as it were, in theſe mountains 'by the flood, or ſome ſubſequent inundation, and which, in progreſs of 'time, became impregnated with this *Pruſſian bitumen*. This may give 'ſome hint to the curious, how flies, and ſuch other bodies come to be 'involv'd in amber, eſpecially as the like inſects are frequently obſerv'd in 'theſe *ſtrata*. I alſo ſaw a piece of jet of the ſize of a fiſt, taken from the 'ſame veins.'

All this confirms what Mr. *Hartman* has propoſed in his *Hiſtoria Succini*, concerning the origin and growth of amber.

A cheap and new Hygroſcope; *by* M. D. Johrenius. *Taken from the* Acta Berolinenſia.

Tranſlated from the LATIN.

YOU will poſſibly be ſurpriz'd when I communicate my new Hygroſcope to you, as the cheapneſs and ſimplicity of it may render it liable to contempt at firſt; but you will not wonder at my commending a thing ſo ſeemingly trivial, when you are acquainted with its admirable uſe and properties. 'Tis, in ſhort, the ſeed of *Geranium* or Craneſbill, of which plant there are reckoned above fourſcore *ſpecies*, which all agree in this point, that they have a roſaceous flower, whoſe *piſtill* ends in a crooked or beak-formed ſeed-veſſel, divided lengthways into five creaſes, to which as many *capſulæ* adhære, terminating in a long tail; which *capſulæ*, being ſeparated by maturity from the ſtile or column to which they adhered, are wreathed, or ſpiral, from the *baſis* to the point. They generally contain an oblong ſeed. See *Tournefort*'s botanical inſtitutions, p. 266. But all the *ſpecies* of *Geranium* are not ſo proper to conſtruct a hygroſcope, tho' all their *capſulæ* are more or leſs affected by humidity. For in ſome of the kinds they are only ſimply curv'd from the *baſis* to the point, as in the 9th figure of Plate I. which are uſeleſs for the purpoſe: But others are ſo diſpoſed, that when they are ripe, they are wreath'd and controverted ſpirally, as we ſee in the ſecond figure, and thoſe are to be preſerved for hygroſcopes: tho' even of thoſe, ſome ought to be preferr'd

and

and ſelected. The ſeeds of the leſſer and trailing *Geranium*, with a hemlock leaf, (ſee *Caſper Bauhin*, *Pin* p. 319.) diſcover the quickeſt ſenſation of any alterations in the air; but they are too ſmall and ſlender, to have their wreathings or volutions very eaſily diſcovered by the eye. The broad-leaved *geranium* of *Caſpar Bauhin Pin*, p. 319. has large well-form'd *capſulæ* or Beaks, above a ſpan long, diſtinguiſhed with remarkable volutions; but from their ſize and groſſneſs, their ſenſation is more obtuſe than we could wiſh: we ſhould therefore prefer ſeeds of a middle ſize, provided with beaks or points, ſuch as are produced by the musked hemlock-leaved craneſbill of *Caſpar Bauhin Pin*, p. 319. which *Remb. Dodonæus Pemptad*, p. 63 calls the ſupine or trailing *Geranium*; and *Lobelius*, in his hiſtory of remarkable plants, p. 376, calls the *myrrhida* of *Pliny*, and the *craneſbill* or *muſked needle*.

The Geranium deſcribed.

It is a fair Plant, faſtened by a ſmall root, having purpliſh hairy ſtalks, and trailing on the ground, with many leaves on one ſtalk, diſpoſed on each ſide, after the manner of *tanſey*, thin, very much indented, ſomewhat hairy, which are ſpread on the ground, without their ſtalks, and ſmell of muſk, eſpecially if bruiſed between the fingers. There generally appear ſix or ſeven flowers about the top, on a long ſtalk, being ſmall, with fine leaves, either white or inclining to red, which are ſucceeded in their ſeaſon, by crooked or beak-form'd ſeed-veſſels, of two or three Inches in length, brown, and rough or hairy. It is cultivated in Gardens.

The manner of conſtructing this Hygroſcope.

To obtain then a very exquiſite Hygroſcope, you are only to graduate, as you pleaſe, a ſmall circle made of any convenient matter, or rather a convex body which is better, and fix within it a ſingle *capſula* or ſeed-caſe of our *Geranium*. A convex body is preferable, becauſe the beak of the ſeed-bag being extended from much humidity, does not continue parallel to the horizon, but as it ſtops might touch a plain ſurface, and be interrupted in its motion. This being done, you will obſerve this exquiſite Hygroſcope to wheel about ſo readily, with an augmentation of drought, as to effect nine or ten volutions, and to revolve and run back again ſo ſenſibly, at an increaſe of the moiſture, that upon the affuſion of a drop of water it will ſcarcely retain a volution or two. But no degree of dryneſs will ever contract it ſo far, as to make the extremity or beak wreathed like its lower part, which beak being always ſomewhat extended, performs the office of an *index*: ſo that the number of the wreaths, or ſpiral lines, in the lower part of the *capſula* or ſeed-caſe, will diſcover how many entire circles the *Index* has made: as the *index* will alſo demonſtrate that part of the graduated circle, which it has attained in its laſt motion. If, therefore, you will divide the circle into 24 degrees, and the hygroſcope recover only ſix wreaths or volutions, you will clearly perceive 144 degrees of humidity. It is in fact ſo exquiſitely ſenſible, that the *index* may be obſerved in continual motion, one while going round, and again revolving,

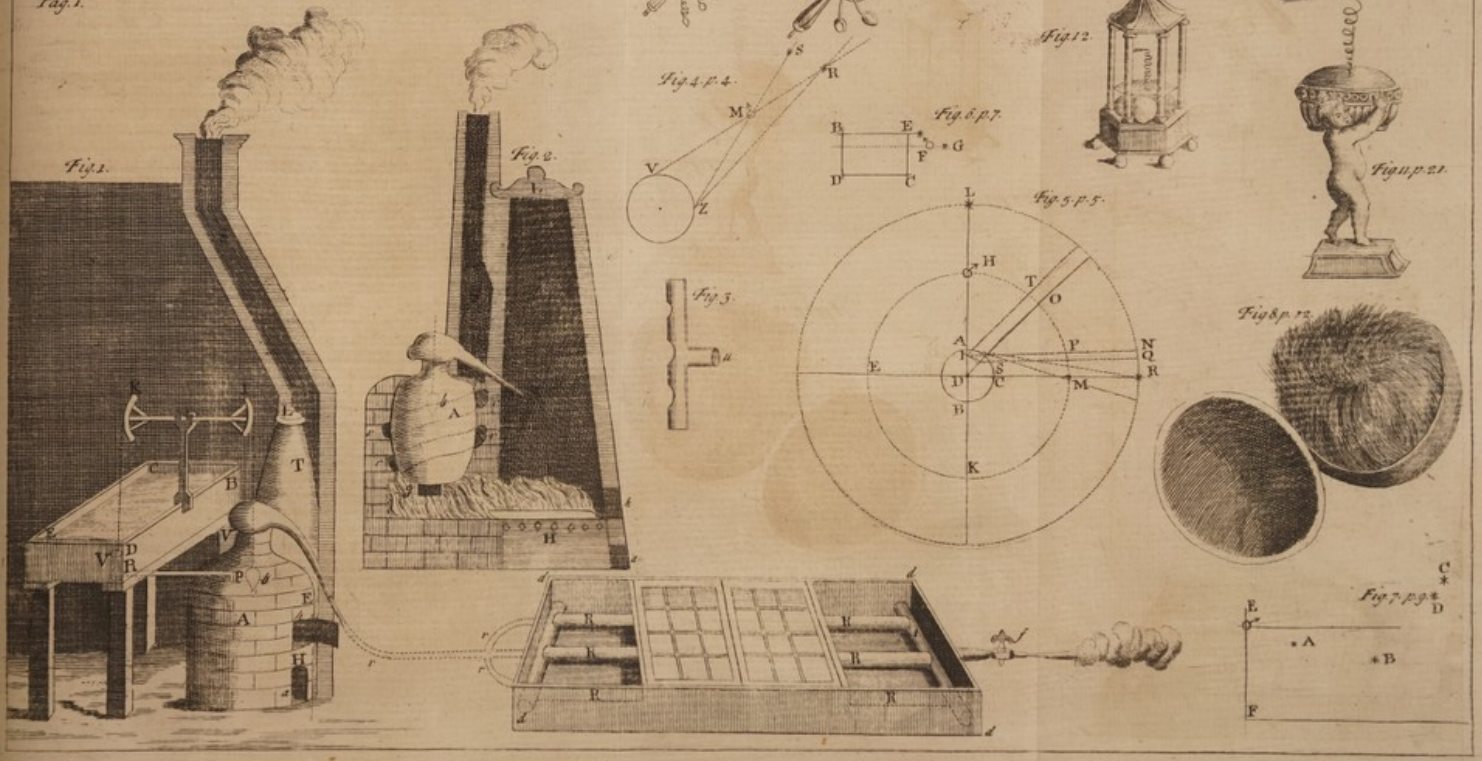
revolving, according to the action of the clouds in the atmoſphere, as the obſcurity of the ſun from an interpoſing one, immediately produces a revolution of the ſeed. Thus even the wind might be examined, whether it was introductive of moiſture, and of what degree. For as the Hygroſcope has not an artificial *Index*, there is no danger of its being blown down, and its ſurface is too minute to be torn, or to be diſturbed in its motion, by the moſt violent wind: but it rather ſometimes, againſt the courſe of it, contracts or unfolds itſelf. A gentle breathing of the mouth affects the Hygroſcope ſome degrees, and the different temperament of chambers may be evidently aſcertained by its motion; nay, which entirely elucidates its acute ſenſation, the very vapours tranſpiring from a human body are ſufficient to affect it, if the *Index* be apply'd near enough: from which the juſt preference of this Hygroſcope to all former ones is ſelf manifeſt. And if we regard its ſimplicity, 'tis impoſſible to think of any *apparatus* ſo plain and eaſily attainable, as the herb, producing this ſeed, is of no difficult culture, but, when once planted, continues ſpontaneouſly from deciduous ſeeds. It has the farther advantage of being portable, without which quality, one of the greateſt and moſt general uſes of a Hygroſcope, which is to aſcertain the temperament of different places, muſt be wanting. The rays of the ſun do it no injury, nor have we any occaſion to preſerve it very curiouſly from duſt, ſtraws or the like, ſince it may be ſecurely expoſed to the open air. Beſides, we are not troubled with the laborious conſtructions we ſee in other Hygroſcopes, to determine how many circles they have accompliſhed in their motion; but as the ſpires it affects, may be always reckoned, our information is continual, and without defect.

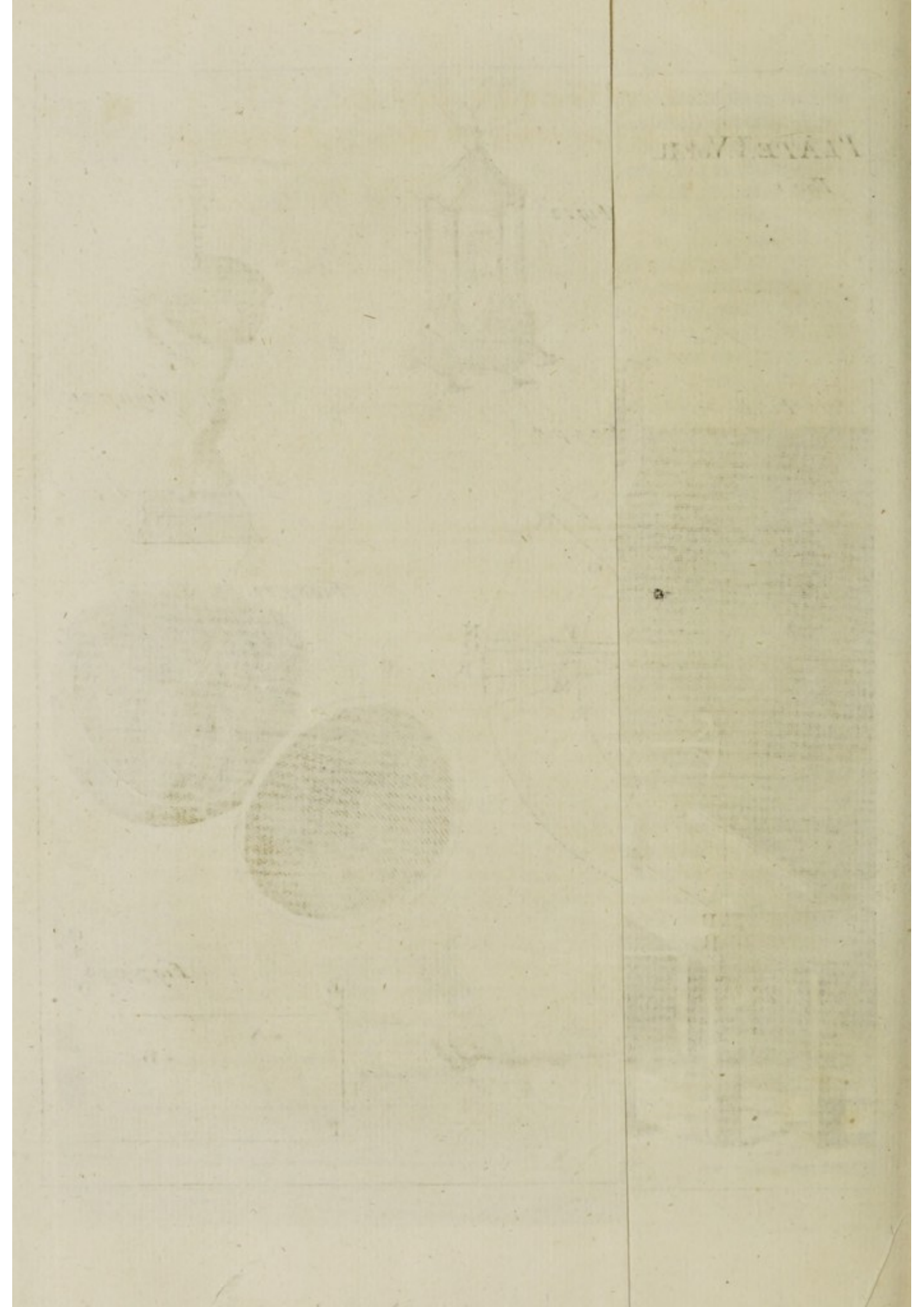
Liable to ſome defects.

Yet, to diſſemble nothing, I muſt acknowledge, that the perfection of our machine is impaired by its ſmall durability, ſince it ſeldom laſts more than one, or at the moſt two years. And yet this defect is common to other Hygroſcopes, which in a little time looſe the faculty of diſcovering the dryneſs or humidity of the air. If, therefore, one or two of the former Hygroſcopes be preferable to this for duration, that difference is rather inconſiderable than much; eſpecially when we conſider, that we have annually a ſufficient quantity of theſe ſeeds, and there is but little difficulty in fixing a freſh one in the place of the other. I would adviſe you however, for the longer preſervation of the ſeeds you ſhall ſelect, to keep them in a cellar or ſome moiſt place. It muſt be allowed too, that we can ſay but little of the ſtrength of our machine, ſince it cannot ſuſtain the leaſt colliſion with a hard body, but is immediately deſtroyed by it. Therefore, if a Phyſician or any other curious perſon, ſhould incline to carry one in his pocket, let him provide a caſe like a watch-caſe, whoſe bottom may be diſtinguiſhed into degrees; it may be defended a-top with a glaſs, as that is, but the rim ſhould be artificially perforated, that there may be a free

PLATE. I. Vol. II.

Pag. 1.





a free afflux of air. And this method will ſufficiently guard againſt the ſlender texture of it.

A third, and the laſt objection I know of, may ariſe from thoſe who are dim thro' age, or whoſe eyes are ſo conformed, as to diſcern ſmall objects, not without ſome trouble, and by the mediation of ſpectacles. For the benefit of ſuch I have drawn the figure of a Hygroſcope, which may ſerve as a model, and by which means an optic *lens* may be commodiouſly apply'd, to aſſiſt the ſight. Thus in fig. 12. you may ſee a repreſentation of a hexagonal body, with a ſurface ſomewhat convex, on which a graduated circle is deſcribed, containing in the centre a ſeed-veſſel of the *Geranium*. At the corners of the *hexagon*, pillars are erected, which ſupport its top: two of them have grooves, that the board inſerted between them may be raiſed or depreſſed, for the convenience of ſight, and as other occaſions may require. This board has a hole, covered with an optic *lens*, of a convenient convexity, by the help of which the ſpiral lines or volutions may be eaſily reckoned. See fig. 9, 10, 11, and 12.

The great increaſe of the Norway Pea. *From* T. Bartholin. Act. Hafn. p. 66.

Tranſlated from the LATIN.

THE extraordinary fæcundity of the little ſoil among the rocks in the northern countries, aſſiſted by the climate, is manifeſt, to the great ſatisfaction of the huſbandmen. In the iſles of *Feröe* one grain of barley produces fifty ſtalks and ears, full, and of a plump grain, nature making amends for the ſcarcity of ſoil, by its exuberant produce. The thing is fact, I have ſeen and experienced it. I ſhall inſtance the *Norway* pea as a proof of it. A ſmall pea, called the *pea of grace*, which was imported into *Europe* from *America*, is affirmed to produce near a hundred fold. But we have it atteſted by *Simon Paulus* a perſon of noted reputation and experience, in his Botanics, that in the garden of the noble *Klingenberg*, near *Hamburg*, one of theſe peas was productive of three hundred and twenty-four. This induced Mr. *Jac. Joach Kirſebohm*, paſtor of *Sognedahl* in *Norway*, to procure ſome of theſe peas from *Holland*, each of which produced, together, ſix hundred and ten, as he inform'd his father in a letter of *June* 2. 1672. The reaſon of fæcundity in theſe places is probably owing to the great quantity of ſnow with which the earth is impregnated, and to the rays of the ſun which may be collected with particular force and action among the rocks. And though the ſoil has little depth above the rocks, yet it appears ſufficient for the reception and increaſe of the grain; for as *Theophraſtus* ſays, in his firſt book of planting, chap.

chap. XXII. 'Corn indeed emits many roots of fibres, but they are ſu-
'perficial, rather than deep and perpendicular.'

A diſſertation on the Anodyne Sulphur *of* Vitriol. *By Dr.* Godfrey Roater. *Publiſhed at* Leipſic. Ann. 1723.

Tranſlated from the HIGH-DUTCH.

INTRODUCTION.

Neceſſary means for improving Chymiſtry.

IF there be any one thing, which is highly neceſſary for the farther improving and promoting the art of chymiſty, it is certainly, the accurately weighing, and circumſpectly imitating the diſcoveries, which thoſe, who have gone before us, have made in the art: For, the bounds of this noble ſcience being ſo extenſive and wide, it is ſcarce poſſible for any perſon in his own experience and obſervation to examine every thing by himſelf. Whence it is of no ſmall help in our inquiries to adapt the care and application of others upon the ſame ſubject: and for this end it were to be wiſhed, that the elder writers, in communicating their diſcoveries to poſterity, had thought fit to uſe a greater degree of plainneſs and openneſs, than they are generally found to have done: but in regard, they pretended ſuch a procedure not allowable, or rather, not falling in with their inclination, they have ſcarce left us any thing more than the bare names of their diſcoveries: and yet even theſe ſhould not be entirely neglected, in regard the title of the diſcovery does ſometimes contain more under it, than the diſcovery itſelf: and certainly might help to throw a greater degree of light on the art; but for jealouſy and a fond deſire in the moderns of rivalling the ancients; as that ſome, diſcouraged by the tediouſneſs of proceſſes, have neglected or overlooked circumſtances, that were notwithſtanding to be regarded, as the authors themſelves have hinted; and rather taking into conſideration the colour, taſte, or ſome other trifling circumſtances only, it has generally happened, that they have embraced the ſhadow inſtead of the ſubſtance. Others, not to appear ignorant of any one thing, obtrude upon us, with great care, the fictions, inſtead of the real productions, handed down from venerable antiquity: whereby it might neceſſarily happen, that the promiſed and wiſhed for effect coming to fail, there unavoidably a doubt ariſes; whether the ancient chymiſts have not ſometimes publiſhed falſhoods for truths, or bare empty ſpeculations, inſtead of genuine and certain experiments: or whether, their ſucceſſors have faithfully trod in their ſteps, or rather, over-eager in ſhortning the road, have ſwerved into the by-paths

of

of error; as *Stahl* in his Zymotechny or art of fermentation, not without reaſon, ſuſpects, when he ſpeaks to this purpoſe: 'We, ſays he, are 'hindred in our moſt ſucceſsful progreſs in chymiſtry thro' our impatience; 'not being able to bear the tediouſneſs of a long digeſtion, a long trituration, a repeated cohobation, repeated imbibition, and a ſtill oftener 'repeated deliquation, or running *per deliquium* in a moiſt air.' And to our purpoſe, the name of an *anodyne ſulphur of vitriol*, was a thing in great repute amongſt the elder chymiſts, particularly *Paracelſus*; but amongſt the moderns, ſcarce any thing to be found, deſerving the commendations given this Sulphur by that author: ſo that many have ranged it amongſt the dreams and chimeras of chymiſts. We have therefore thought it of ſervice, to examine, whether ſuch an anodyne Sulphur be procurable from vitriol; by what method it may be procured, and what the virtues that are to be expected from it.

CHAP. I.

Whether there really be an anodyne Sulphur in vitriol?

1. THIS query might ſeem unneceſſary and ſuperfluous, ſo were but the regard paid to the authority of others ſufficient to eſtabliſh the truth of any propoſition. For, we might here bring in the teſtimony of *Paracelſus* (*a*), the grand monarch in chymiſtry, as he is pleaſed to ſtile himſelf; who not only expreſly maintains the exiſtence of ſuch a Sulphur in vitriol, but extols its virtue in a very high degree. As this is the principal paſſage, and the very firſt that makes mention of this matter, it deſerves to be here alledged, tho' ſomewhat with the longeſt; it runs thus: 'Now know, from the embryonated Sulphur in vitriol and the like, what 'ſpecies of vitriol there be; as the ſalts, that give a highly ſurpriſing Sul'phur, if the animated bodies are ſeparated from the embryonated ones, 'as from ſalt, ſal-gem, the ſeveral ſpecies of alum, from vitriol, *&c.* 'But now I ſhall give you a ſhort rule in general; *viz.* That all Sulphurs 'from vitriolated ſalts, are narcotic, anodyne, and ſoporiferous; yet ſo 'mild as to go off without producing any of the bad effects of opiates from 'poppies, mandrakes, henbane: and know of this ſulphur, that amongſt all 'thoſe from vitriol, it is in itſelf fix'd.' We might here alſo advance the teſtimony of *Sylvius* (*b*) in his praxis, who thus ſpeaks of the matter: 'what ſeveral people relate about the anodyne, or rather alleviating 'ſulphur of vitriol, ſufficiently ſhews, that this Sulphur is a thing un'known to moſt people; tho' never enough to be commended on ac'count of its ſurpriſing effects, which I myſelf have experienced.' And

(*a*) De Reb. Nat. T. I. L. 1. c. 7. p. 1045. (*b*) L. II. c. 25. §. 17.

§. 32. he adviſes, the ſeeking after this anodyne Sulphur of vitriol, and when found, the holding it for the greateſt arcanum. We might even adduce all the chymical phyſicians of the latter ages, were thus a lover of truth to be ſatisfied, or one of a contrary opinion, thereby to be convinced. But authorities are ſo far from determining this diſpute, that on the contrary, it is eaſy to adduce a *Detharding*, a *Ludovici*, a *Jüngken*, a *Barkhuſen*, and many others, who either entirely deny ſuch anodyne ſulphur in vitriol, or depreciate much its virtues and effects: And thus authority would ſtand oppoſed to authority.

2. This diſpute can ſcarcely be determined without a previous knowledge of the nature of vitriol, and an examination of its eſſential parts: and by a chymical analyſis it appears, to be compounded of four parts, *viz.* (1.) An inſipid phlegm or water. (2.) An acid ſpirit. (3.) Metallic, coppery and irony particles. (4.) A mineral earth, which hitherto has acquired no metallic nature; as *George Detharding* (*a*) has ſhewn at large.

3. Now from this it eaſily appears of itſelf, that a vitriol is an acid ſpirit, entirely ſimilar to the acid of Sulphur; but of the inflammable principle or reſinous ſubſtance, that eaſily takes fire, and conſtitutes the other portion of what is properly called Sulphur, is with difficulty any trace found in vitriol. To this add, that ſulphurs, if not very accurately combined with alcali ſalts, are not ſo much as once affected by aqueous menſtruums, not to mention, quite diſſolved; in which notwithſtanding the entire ſubſtance of vitriol comes to be diſſolved; nay, wherewith vitriol itſelf is extracted out of its ore.

4. On which account, if any one would undertake to prepare from vitriol a genuine inflammable Sulphur, he attempts a bootleſs labour, and ſhall by no art or ſkill procure from it what it really has not; unleſs inſtead of the vitriol he take its ore, which we readily allow generally to abound with inflammable ſulphur; eſpecially if it has not hitherto undergone the action of the fire, or been long expoſed to the air. And poſſibly hither refer the words of *Paracelſus*; whereby he aſſures, that ſuch embryonated ſulphurs, as he calls them, are not to be looked for in the animated body or kernel itſelf, but in the ſhell, enveloping this kernel: but his mentioning, that this anodyne Sulphur of vitriol is in its nature fixed or can abide the fire, deſtroys any ſuch conjecture; as no ſuch fixedneſs can with certainty be aſcribed to any inflammable ſulphur.

5. However 'tis no unuſual thing with chymiſts to call the more ſubtile and moſt tinged particles of metals or minerals, tho' not inflammable, Sulphur; as in this ſenſe mention is often made of the ſulphur of iron, copper or antimony: but vitriol greatly abounds with ſuch particles, that not only

(*a*) Chymiſche probier-ofen. p. 228.

only affect the ſight with the moſt beautiful variety of colours, but beſides, are ſo ſubtile as to communicate their tint to the hardeſt glaſs, as experience confirms, and *Chr. Langius* ſhews (*a*).

6. Finally, as to the anodyne virtue; *Paracelſus* himſelf diſtinguiſhes the virtue of this ſulphur from the effects of opium, henbane, mandkrake, and other narcotic vegetables: whence it would be doing our author an injuſtice, to make him confound theſe virtues together; 'tis enough, we can ſhew ſomething in vitriol, which is capable, by a gentle force, to ſtill the motion of the irritated nerves; though poſſibly it may operate in a different manner from opium, and not ſo quick, and in ſo ſmall a doſe.

7. And thus, if one was to chuſe among the above-mentioned parts of ſulphur; the two firſt, namely, the phlegm and ſpirit muſt without heſitation be excluded: for it is evident, that to theſe the name of a ſulphur cannot agree, as being what rather manifeſts a firm, cloſe, and not a volatile, a tinged and not a tranſparent ſubſtance. That we alſo exclude the metallic particles, tho' poſſeſſed of very beautiful tints or colours, is owing to the anodyne effect we look for here; as theſe, eſpecially the particles of copper, have a ſtimulating and emetic, rather than an anodyne and calming virtue: and therefore, there only remains the mineral earth. Now that ſuch is capable by a gentle force to cauſe ſoft, eaſy contractions, and lay the tumult of over-ſtimulated nerves and feveriſh motions, the bare inſtance of the ſweet or balſamic earth of vitriol, as it is called by ſome, is a proof. 'Tis certain, this laſt is of eminent ſervice in aſſwaging vomitings, looſeneſs, hypercatharſes and other preternatural fluxes, when properly prepared, and freed from the adhering acid, coppery particles, though ſtill overſtocked with many groſs earthy impurities, and far from being exalted to a proper degree of ſubtilty.

CHAP. II.

The method of preparing the anodyne Sulphur from vitriol.

1. AS *Paracelſus* himſelf, who, ſo far as we know, firſt made mention of this Sulphur, has concealed its preparation; it muſt neceſſarily have happened that his followers ſhould have entertained different opinions on that head: ſo that I am apt to believe, there are ſcarce more ways of preparing the *aurum potabile*, than there are of preparing this anodyne Sulphur of vitriol: yet they may be principally reduced to three claſſes, ſome proceeding by way of precipitation; others of ſublimation; and others again of extraction and diſtillation.

2. The moſt uſual method, and of which *Baſil Valentine* makes mention, is that of precipitation: namely, the vitriol is diſſolved in com-

(*a*) Miſcel. p. 86.

mon water, into which is then dropped oil of tartar *per deliquium*, or a ſolution of potaſh, or any lixivium, or even an urinous ſpirit; and there falls to the bottom a powder, which indeed at firſt ſhews greeniſh, but afterwards, when edulcorated and dried, of a brown colour, and uſually ſtiled, tho' undeſervedly, an Anodyne Sulphur. In this operation 'tis remarkable, that the parts thus thrown down, differ in kind; as that thoſe precipitated at firſt are of a far darker green than thoſe at laſt, as having a much brighter colour, till at laſt they become quite whitiſh: and this difference of the precipitated parts not only in colour, but alſo in effect, is alſo obſervable in the precipitation of Sulphur from antimony (*a*). Next remains to be obſerved, that when this precipitation is performed with the ſpirit of urine, the buſineſs ſucceeds with difficulty in a vitriol of a coppery nature, as is the cyprian. For ſo far is this ſolution of vitriol, by dropping in an urinous ſpirit, from becoming turbid, that rather is its colour generally heightened, nay become ſapphirine (*b*). But common vitriol, as that of *Geyerſberg*, which generally holds both iron and copper, takes precipitation with eaſe: but when the precipitated magma together with the liquor floating a-top, is expoſed to a gentle heat or the ſun's rays, the liquor hitherto pale, does thence gain, in the courſe of a few weeks, a deep blue colour; plainly to ſhew, that copper has a peculiar ſympathy with the urinous ſalts; ſo that the coppery particles, though once let go, are again attacked and diſſolved by it.

3. Some people, in order to heighten the virtue of this vitriolic precipitate, are wont to employ, inſtead of the ſimple alcali, an alcali impregnated with the ſulphur of antimony, or the lixivium of the ſcoriæ of the regulus of antimony; the precipitating powder is edulcorated, dried and calcined in the ſtrongeſt reverberating fire for 12 hours, in order to diſſipate the volatile, emetic, antimonial parts, and only retain the more fixed and diaphoretic ones, together with the anodyne ſulphur of the vitriol.

4. Others again endeavour to enrich it, by means of ſublimation, diſtillation and a ſecond precipitation, with a nobler ſet of virtues. The method is laid down by *Keſler* (*c*), *Hartman* (*d*), and *König* (*e*): namely, the ſuppoſed Anodyne Sulphur of the vitriol, precipitated as above, and freed from all its ſalt by means of common water, is ſublimed; the ſublimate mixt with half tartar, or according to *Hartman*, an equal quantity of ſalt of vitriol, and by means of a retort diſtilled into a red oil, which is a-new precipitated by pouring vinegar thereon, and then extracted with ſpirit of wine.

5. *Baſil*

(*a*) Etmul. in Colleg. Pharm. in Schroder. S. III. c. 19. p. 889. (*b*) Stiffer in Act. Chym. Specim. II. (*c*) Cent. 3. n. 66. (*d*) Prax. Chymiatr. p. 75. (*e*) Regn. Miner. Sect. IV. c. V. n. 7. p. 149.

5. *Baſil Valentine*'s *Encheiriſis* muſt not here be omitted; which conſiſts in precipitating this Sulphur with alcali; extracting with juniper oil, and laſtly with ſpirit of wine (*a*). With this coincides *Robelius*'s method, which, without the addition of oil, ſhews how to extract with ſpirit of wine the ſulphur of the vitriol, precipitated by an alcali; and is recommended by *Etmüller* (*b*).

6. The precipitation may alſo happen without addition of an alcali ſalt; in the ſame manner as the metallic ſolutions made by means of aqua fortis, upon throwing in a body, that they more readily diſſolve; ſuch in particular are iron and zink; when the metallic particles, they had before drank up, come directly again to fall out of their pores: in this manner *Pharam. Rhumelius* (*c*) prepares his anodyne Sulphur from vitriol; namely, ſuffering the ſolution of the vitriol to boil gently over the fire, he throws into it tender iron plates, therein to continue for about an hour. And thus as he ſuppoſes, will the anodyne Sulphur be extracted out of the iron plates, which is then to be ſcrap'd off, waſh'd with hot water, dried, and kept for uſe. Yet to ſpeak the truth, inſtead of an anodyne Sulphur, we rather thus procure bare coppery, emetic particles.

7. But thoſe who hope by means of ſublimation to reach their end, have, beſides *Baſil Valentine*, *Helmont* himſelf for their guide: and ſuch take either vitriol, which is gently calcined in the ſun, or even the ſulphur of vitriol, which is precipitated with the ſpirit of ſal-armoniac; or they employ the edulcorated caput mortuum of vitriol, which they mix with an equal quantity or with two parts of ſal-armoniac, and ſublime it with a ſtrong fire; the ſublimate they again free from all its ſal-armoniac with common water, and afterwards extract it with diſtilled vinegar, and laſtly with ſpirit of wine: Or they mix it, without ſeparating the ſal-ammoniac, with the ſea-ſalt extracted out of the caput mortuum, remaining after diſtilling the ſpirit of ſalt.

8. Thoſe, who would by a kind of extraction or diſtillation, perform the thing, go in queſt of ſeveral menſtruums; amongſt which common water offers the firſt; in regard vitriol is thereby boiled out of its ore; and the ſolution beginning to grow thick, there uſually ariſes upon the liquor a pellicle or fat cremor, that muſt be removed with a broad ladle, or by filtration; this *Agricola* (*d*) calls the ſoul of vitriol; and afterwards made by him, by means of the ſweet ſpirit of mercury, into an eſſence or tincture. But *Mimmerus*, a celebrated chymiſt of *Sileſia*, has a-new ſeparated therefrom, by pouring on water, a fatty ſubſtance, which in a few grains he adminiſtred to patients, as the mildeſt and moſt efficacious anodyne,

9. In

(*a*) Schluſs-reden. c. 8. p. 373. (*b*) Col'. Pharmac. in Schrod. Sect. III. c. 27. p. 923. (*c*) Baſil. chym. n. 20. p. 178. (*d*) Comment. in Popp. p. 338. and p. 443.

9. In the next place, we are to mention diſtilled vinegar, peculiarly employ'd by *Quercetanus*, *Hartman*, and *Keſler*: Take and mix Hungary vitriol with half the quantity of the pureſt iron-filings; when well mixed and worked up together by a continued rubbing, there is ſome diſtilled vinegar poured thereon, to the heighth of a finger's breadth above it; then it is boiled in to dryneſs, after which the fire is ſo heightened, till the whole in ſome meaſure become red. (But the better way would be to calcine the vitriol *per ſe*, in an hermatically ſealed vial, to the higheſt degree of redneſs, after the method of *Kunckel*, *Agricola*, *Geiſler* and others.) Then the maſs is taken out, well rubb'd, and freſh vinegar poured thereon, to the height of 3 or 4 inches above it; after which by means of digeſtion the tincture is extracted, the tinged vinegar decanted and filtrated, and oil of tartar per deliquium dropped thereon: and there falls down a narcotic ſulphur, as they call it, which being well edulcorated, dried, and along with ſome aromatic extracts mixed with the magiſtery of pearls and other things, is *Hartman*'s laudanum without opium (*a*).

10. Next to vinegar, we juſtly rank ſpirit of wine, which being a number of times abſtracted from vitriol, thence acquires a notable flavour, like malveſy or *Spaniſh* wine, and is alſo impregnated with an anodyne virtue: whence it appeared to *Angelus Sala*, the moſt adapted for this purpoſe; who frankly owns, that he could not obſerve the anodyne virtue, he in vain looked for in ſeveral things prepared from vitriol, in any one thing, in a more obſervable and certain manner, than in this extract, prepared with ſpirit of wine. Take vitriol, which has gently calcined in the ſun, or is well dried in a warm room, and put it into a glaſs veſſel, wherein there is no wet: to two pounds of vitriol pour on 30 ounces of highly rectified ſpirit of wine, (for he ingenuouſly hints that the leaſt phlegm in the ſpirit, or wet in the glaſs, wherein the vitriol is put, will diſſolve, and not extract it, whereby a nauſeous flavour is communicated to the medicine) and then the veſſel, after ſtopping it well, is for a month together to ſtand in horſe-dung: after which the ſpirit of wine, which now has gained a peculiar, elegant and ſtrong flavour, by gently tilting the veſſel, is parted from the feces, and abſtracted in balneo mariæ, till only an oleaginous liquor remain behind (*b*).

11. On this very bottom ſeems to reſt the cephalic ſpirit of the late *Chr. Langius*, which M. *Waitz*, Burgomaſter and phyſician at *Gotha*, in his epiſtles, entitled, *reflections on alchymy* (*b*), ſhews, how to make in a compendious, neat and elegant manner: namely, the caput mortuum of vitriol is put into a ſtone body, having a ſmall tube, and urged with a ſtrong fire, till all be of a thorough glow; then a little ſpirit of wine is dropped

(*a*) Hartman. Prax. Chymiatr. p. 13. Keſleri Centur. III. p. 67. (*b*) Vid. Angel. Salæ Anatom. Vitriol. Tr. I. c. 11. p. 272. (*c*) Bedencken von der Alchymie, p. 42.

dropped in, which comes over the helm in form of a highly oleaginous ſpirit, and forces over along with it ſome of the more ſubtile mineral earth. Now that this laſt, and not any genuine ſulphur is in this manner by means of ſpirit of wine extracted from vitriol, appears from the ruddy powder, that of itſelf ſettles in the ſpirit of wine, abſtracted from calcined vitriol.

12. Farther, urinous ſpirits are here too not unſerviceable: and thus was *Hartman* wont, out of vitriol, moiſtned with children's urine, to prepare his antepileptic ſpirit; which *Etmuller* (*a*) avers to be no mean preparation, and that the late Dr. *Michaelis* greatly uſed it; nay, makes mention of ſome epileptic patients, that by taking it have been freed from inveterate epilepſies; and this alſo *Agricola* (*b*) confirms by his teſtimony.

13. To wave theſe, and come to the phlegm and ſpirit of vitriol: In diſtilling vitriol, there at the very firſt comes off with the greateſt degree of heat and force, a volatile ſpirit; ſo greatly eſteem'd by *Paracelſus*, as generally to aſcribe thereto the cure of the epilepſy; aſſuring, that what is commonly thrown away under the name of an uſeleſs ſpirit, is the nobleſt part; and that we are not to look for the cure of the falling-ſickneſs in the fix'd oil of vitriol, but in its volatile parts: but that this volatile ſpirit of vitriol is no other than a part of the phlegm, impregnated with a few particles of the ſubtile mineral earth, appears from *Glauber*'s remark (*c*); for he has obſerved, that after a red powder ſettles to the bottom, it turns to an inſipid phlegm; an obſervation confirmed alſo by *Ludovici*'s experience (*d*).

14. Nay *Glauber* promiſes himſelf a large quantity of this volatile ſpirit, upon mixing vitriol and iron-filings in equal quantity with half the quantity of ſalt-petre, and diſtilling with a ſtrong fire in a retort (*e*). But it may eaſily be conjectured, that this large quantity of volatile ſpirit ariſes not ſo much from the vitriol as from the iron, which is laid hold on and diſſolved by the ſpirit of nitre, forced out of the ſalt-petre by the vitriolic acid; for upon diſſolving iron with ſpirit of nitre, or with aqua fortis, copious ſulpheurous fumes ſtrike the noſe: Nay another experiment of *Glauber* confirms the ſame thing; namely, when iron-filings, by means of his ſecret ferment (which conſiſts of common ſalt diſſolved in water, and half the quantity of oil of vitriol) is diſſolved, there alſo goes over a volatile, ſulphureous, and highly penetrating ſpirit, which in like manner by means of rectification is changed into an inſipid phlegm, and a reddiſh, highly fixed powder. (*f*).

15. But

(*a*) Colleg. Phar. in Schrod. p. 921. (*b*) Comment. in Pop. P. I. p. 320. (*c*) Philoſ. Offen. P. II. p. 13. (*d*) Pharmac. Mod. Sec. applic. p. 439. (*e*) Pharmac. Spag. P. II. p. 93. (*f*) Pharm. Spagyr. P. VI. c. 13.

15. But *Glauber* aſſures, the quantity, that in this manner is brought over along with the phlegm, is ſo ſmall, that out of 10 pound of this ſpirit, tho' ſo penetrating, ſcarce a ſcruple of this red powder could be collected: whence here is needful repeated cohobation, were this phlegm any thing worth the while, as being the method employed by *Helmont* the ſon to ennoble it; M. *Marci* (*a*) teſtifies, that in a deſperate conſumption, from a vomica in the lungs, it manifeſted an extraordinary ſtrengthing virtue. Certain it is, the effects of repeated cohobation appear from the inſtance of common-water, which being diſtilled a number of times from vitriol, gains therefrom a penetrating, aſtringent, yet no diſagreeable taſte.

16. Yet herein ſhew the ſpirit andoil of vitriol (which laſt is no other than a more concentrated portion of the ſpirit) a far quicker and better effect; eſpecially when this latter is urged with a violent and continued fire, and the other only cohobated a number of times over its own ſalt, or only over the caput mortuum. This method *Agricola* employ'd; namely, he takes the ſpirit, which as uſual, is forced out of a well purified vitriol, and pours it on its own ſalt, extracted with common water out of the caput mortuum, and by repeated calcination, ſolution and coagulation, purified in the beſt manner poſſible; and therein diſſolves it by means of a long continued digeſtion; the ſolution he ſeparates from the impurities by decanting it off, and brings over again the ſpirit by diſtillation in a retort, pouring it back again on what remains behind, and this he repeats ſeven times, till it becomes a fatty well-flavour'd liquor. Finally, he pours again the abſtracted ſpirit on the remainder in the retort, which, after a ſhort courſe of digeſtion extracts a very beautiful red tincture; the tinged ſpirit he again diſtills to dryneſs; and from the remaining powder extracts the tincture with highly rectified ſpirit of wine, and again abſtracts it by diſtillation (*b*).

17. That *Paracelſus* himſelf had alſo employ'd this method, and forced the ſulphur out of the vitriol by means of its own ſpirit and repeated cohobation with the ſtrongeſt degree of fire, appears from what he mentions of the preparation of the antepileptic ſpirit of vitriol (*c*).

18. But for the ſpirit and oil of vitriol, without ſo many tedious cohobations to bring over along with them in diſtillation ſomething of the ſubtle mineral earth, and hold it included in their pores, chymiſts have deviſed ſeveral methods; as alſo to ſet at liberty the Sulphur from the acid, which is not a little unfriendly to the nerves: And thus the firſt trials were made with ſpirit of wine, which they mixed with the ſpirit or oil of vitriol, and digeſted together for a long time, at laſt abſtracted it again; that in this manner the ſulphur might ſettle to the bottom in digeſtion, or in diſtillation

(*a*) Phil. Vet. Reſt. P. V. c. 9. (*b*) Agricol. Comment. in Popp. P. I. p. 497. (*c*) T. 1. p. 789.

diſtillation come over along with the ſpirit of wine. Whence were procured the diſtilled ætherial oils, far more adapted to blunt the ſharp points of acids; and hence alſo *Bartholine*, as *Etmuller* teſtifies, attempts to do the buſineſs without wormwood-oil, *Maetſius* and *Margraff* with oil of turpentine: namely, taking half an ounce of oil of vitriol, and the ſame quantity of ætherial oil of turpentine; or, as *König* (*b*) will have it, ſix times that quantity; *viz.* ſix half ounces, mixing the whole together in a pretty tall body, and often ſhaking the glaſs, till at laſt, after a violent efferveſcence and incaleſcence, the whole turns to a red liquor, ſmelling like opium. This liquor is diluted with pure water, and boiled a little; and the turpentine in part along with the water evaporates, and in part floats thereon, a thick balſam, like pitch, ſettling to the bottom; which may be extracted with ſpirit of wine, and after abſtraction evaporated to the conſiſtence of pills (*c*). In this proceſs 'tis worth obſerving, that by its means a genuine inflammable ſulphur is procured; which yet, as *Barchuyſen* (*d*) truly hints, takes its riſe, not ſo much from the vitriol as from the oil of turpentine, which unites with the vitriolic acid, and is coagulated thereby. Beſides, it muſt needs happen, that the more ſubtile parts of our Sulphur, which is what is principally to be regarded, partly evaporates in the boiling, and partly remains behind in the maſs of floating liquor.

19. Whence *Keſler*'s method (*e*) is far better and more commodious, tho' not perfect in all points; wherefore we think it worth while to attempt the improving it. Namely, the vitriol is calcined yellow at firſt with a gentle fire, kept at the ſame pitch for a whole day together, ſo as not to exceed the heat of a ſummer's ſun; afterwards the fire is gradually heightened and raiſed till the red oil come over, and thus the ſpirit be forced off. From the caput mortuum is extracted the ſalt, which is carefully purified, and thereon the ſpirit again poured, and ſet in horſe-dung for fourteen days: After which, the ſpirit is again brought over with a ſtrong fire in a retort, then in a cucurbit freed of its phlegm, till a dark brown liquor remain behind; which is ſet to cryſtallize in a cold place; and this ſo often repeated, till all the liquor ſhoot to tranſparent cryſtals. On theſe cryſtals the ſpirit or ætherial oil of turpentine is gradually dropped in a wide phial (not the ſpirit of vitriol as *Keſler* has it) till after a violent efferveſcence, the cryſtals are diſſolved by the oil of turpentine, and changed to a highly red liquor. Then three times the quantity of highly rectified ſpirit of wine is added, and again abſtracted by a gentle diſtillation; and the ſpirit that comes over carries along therewith the ſubtileſt ſulphur in form of a blood-red tincture; which may either be ſtill repeatedly

(*a*) Colleg. Pharm. p. 923. (*b*) Reg. Min. p. 149. (*c*) Vid. Morley Collect Chym. Leyd. n. 532. p. 484. & Konig l. c. (*d*) Pyrof. L. III. S. IV. c. 3. p. 306. (*e*) Cent. III. n. 65.

rectified with freſh ſpirit of wine, or circulated with raſped genuine unicorn, and thus be uſed as the greateſt cephalic, antepileptic, antipodagric, *&c.*

20. Yet there remains a more ſecret method, without adding any one thing foreign or adventitious, of ſeparating from the ſpirit of vitriol the nobleſt ſulphur; of which we find obſervable traces in *Baſil Valentine*; but as this method is known to a few, and beſides, beſet with many difficulties, we ſhall no farther inſiſt thereon.

21. As the limits we have ſet ourſelves will not ſuffer us to conſider at large which of the above methods is beſt, it may ſuffice here to alledge, that the anodyne virtue to be expected from vitriol, is to be ſought for in its mineral earth, but in its more ſubtle parts; and conſequently muſt be, with care, freed not only from the adhering acid, but alſo the coarſe, earthy, eſpecially the coppery metallic particles. For ſo long as it is entangled with acid particles, it proves prejudicial to the nerves; and when loaded with coarſe earthy particles, cannot be ſufficiently penetrating, or commodiouſly diſtributed in the body; and if ſtill mixed with copper, there is hazard of its cauſing vomitings. When this is duely weighed, it will be no difficult matter to conjecture, which method of preparation is to be prefer'd. The method by precipitation with a lixivium or an urinous ſpirit; or that by ſublimation, by means of ſal ammoniac; or by extraction with diſtilled vinegar, to procure the anodyne ſulphur of vitriol, will difficultly give it pure and ſubtle enough, and quite free of all copper, and all emetic virtue. Thoſe adviſe beſt both for themſelves and patients, who know how to ſeparate it with common water or ſpirit of wine; or by its own phlegm and ſpirit bring it over by means of diſtillation, and again aptly ſet it at liberty from the acid.

CHAP. III.

Of the virtue and utility of the anodyne Sulphur of vitriol.

1. AS the life and health of our body ſolely conſiſt in, are preſerved and again recovered by motion; and as alſo by motion, namely, an unordinate and irregular ſort, they are greatly annoyed, nay quite deſtroyed; 'tis certainly neceſſary, that the phyſician be furniſhed with two ſorts of means, whereby not only to rouſe up the low, weakly, and quite depreſſed motions, but alſo to lay, and to calm the more exceſſive or over-violent ones. For the former purpoſe, ſuch active medicines, as ſtimulate the nerves; for the latter, ſuch as aſſuage and ſtill the irritations; in a word, ſuch as are anodyne.

2. But

2. But in what manner theſe produce their effects, is not hitherto ſufficiently known; though they ſeem to do it in a two-fold way; namely, by either gently relaxing or contracting the nerves and muſcular fibres; for in both ways is their motion maintained; as appears evidently from the fibres of the muſcles and the nerves that ſerve for voluntary motion; their effects directly ceaſing, when either preternaturally relaxed, as in the palſy, or extraordinarily contracted, as in convulſions.

3. The former effect is produced by opiates; which theſe may accompliſh, in regard they thin the blood and diſtend the arteries of the brain, and thus compreſs the beginning of the nerves, and intercept their motion; an opinion that of late is generally received: or they may produce the ſame effect, by diſſipating the fluids and emptying the veſſels; or in any other way to us hitherto unknown; yet ſeveral circumſtances, obſervable in the operation of opiates, ſhew that they relax the nerves and muſcular fibres; for inſtance, that peculiar laſſitude, enſuing upon ſleep, cauſed by opiates, as *Etmuller* (*a*) teſtifies; in like manner, that liſtleſſneſs and drowſineſs, common to thoſe that exceed in the uſe of opium; farther, the manifeſt damage, cauſed by opiates in thoſe that labour under a dropſy, cachexy, or flaccidity of the parts, or in perſons quite weakened and exhauſted by old age: as do alſo the anodyne effects, produced by mucilaginous and moderately oily matters, as milk, luke-warm water, and each warm moiſture, that ſoftens ſtiff and rigid parts.

4. The latter effect is to be expected from matters, that, with a mild force are capable of producing a gentle contraction, and ſtrengthen the nerves and muſcular fibres; thereby hindering their being eaſily incited to unordinate motions, by every ſlight ſtimulus; or the motions, after the removal of the irritating cauſe, being cauſleſsly continued.

5. And in this number may alſo be ranked the Sulphur of vitriol: for we have above not only adduced the teſtimony of *Paracelſus*, that it manifeſts its anodyne virtue in a quite different manner from opiates; but alſo that of the celebrated *Sylvius*, who was not unacquainted therewith; affirming (*b*), that the narcotic effect of opium, and the calming virtue of the anodyne Sulphur of vitriol widely differ from each other; tho' he explains this difference ſomewhat otherwiſe.

6. But that this our opinion is not quite groundleſs; namely, the aſcribing the virtues of this anodyne Sulphur of vitriol to its contractile force, will eaſily be granted by any one, that comes to examine by the taſte barely, either the whole concrete of vitriol, or all its parts, or even all the preparations thereof; or if he but a little accurately conſider the effects of the flowers of the hæmatites, which by *Etmuller*'s teſtimony (*c*), is anodyne; or even the virtues of the other more moderate martial preparations, in hy-

(*a*) Coll. Pharmac. in Schrod. p. 712. (*b*) Prax. L. III. c. 26. §. 31. l. c. p. 804.

pochondriac, hyſteric, and the like caſes. It alſo appears, that from no other ground can the virtue of this ſpirit of vitriol, when tolerably impregnated with its Sulphur, againſt the epilepſy be derived; when we remark that a like efficacy in the like diſtemper may alſo be found in other gentle ſtimulants, as the *cortex chinæ*, *ſemen lycopedii*, and the prepared hard parts of beaſts.

7. At leaſt, it hence appears, that this vitriolic anodye, in certain caſes, is preferable to opiates; namely in ſuch, where it appears, that opiates, either on the ſcore of their force of reſolving or in ſome meaſure weakening the nerves, are unadapted thereto; or on account of their tranſient effects prove inſufficient for the purpoſe; for inſtance, in a flaccidity and weakneſs of the parts, in a dropſy and cachexy; as alſo in habitual diſtempers, as epilepſy, vertigo's, and the other chronical convulſions. For our mineral anodyne not only ſtrengthens the nerves, far from weakening them, but beſides conſiſts of more fixed particles, that are not ſo eaſily diſſipated and ſcattered about in the air: and therefore the encomiums *Langius* (*a*) makes on his cephalic ſpirit, are not to be regarded as extravagant; when he aſſures, that it moſt effectually cures the apoplexy, head-ach, vertigo, and other cephalic diſorders; ſtrengthens all the bowels, and happily roots out cachexy and dropſy.

8. But to haſten to a concluſion; opium may retain its commendation; and we not inconſiderately deprive it of the great eſteem it is held in by the unanimous conſent of modern phyſicians. Yet at leaſt our Sulphur may claim the next place, and may either be taken ſometimes inſtead of opium, or uſed along with it, that the reſolving force of opium may be tempered by its contracting virtue; as the mixture of opiates and anodynes with aromatic and volatile ſalts is otherwiſe not unſucceſsfully employed, and greatly cried up.

COROLLARIES.

1. FROM antimony may a genuine, inflammable Sulphur be procured; and not firſt produced therefrom by the addition of acids, but extracted by a ſimple ſeparation.

2. Tho' this Sulphur of antimony differ little in inflammability and external appearance from the common ſort; yet we may conclude, that in internal texture and the mixtion of its particles, and conſequently in its virtues, it is really different from it; as we ſometimes obſerve, that, when diſſolved in oil of turpentine, and after cooling ſettled to the bottom, it then concretes into the form of long *Antimonial ſtriæ*.

3. A vitriol may be produced from all metals, and from every thing having an affinity with metals; yet with more difficulty from gold, and moſt

(*a*) Miſcell. p. 85. Id. Pathol. Anim. p. 106, and 404.

moſt of all from antimony. Yet this laſt, may, by means of a peculiar encheireſis be brought to tranſparent cryſtals, reſembling nitre.

4. There are alſo volatile metallic ſalts.

5. Every ſpirit of vitriol is not acid; but there is a vitriol that yields no acid ſpirit.

6. That there are alſo inſipid menſtruums of metals, at leaſt, not acid, the inſtance of common water ſhews.

7. The waters wherein glowing metals are repeatedly quenched, or wherein they have boiled for ſome time, or have been but barely plung'd, do thence acquire obſervable virtues, not aſcribable to bare irradiation, but to ſome certain particles imparted.

8. Mercury does peculiarly and with eaſe communicate itſelf thereto; water receiving into its pores, no ſmall portion thereof, nay carrying it along with it ſelf over the helm.

9. Mercury ſeems to be nothing other than an inſpiſſated mineral water; whence it may alſo, by means of a peculiar encheireſis, be re-converted into a bright clear water.

10. That there is in Mercury an anodyne virtue, not only does reaſon, but experience itſelf, demonſtrate.

The ſceleton of a Swan. By Dr. Geo. Wolfgang Wedel. Miſc. Curioſ. Ann. 2. Obſ. 12.

WE are ſufficiently apt to admire the ſporting and variety of nature in animal and vegetable bodies, even where her productions ſeem erroneous, though we are ignorant of many of her curious, continual, and œconomical elaborations. The *Sternum* or breaſt-bone of a Swan is no bad inſtance of this; being hollowed, in the upper part, like an arch, for the reception of the wind-pipe, which, after its admiſſion, within it, recurves upwards, and terminates within the *thorax*. There is no doubt, but many other creatures, which have ſeldom been diſſected, muſt furniſh us with many inſtances of ſingular contrivance and mechaniſm, diſtinct from the ordinary appearances of others. Thus we ſee the lower jaw-bone of the badger ſo firmly and accurately inſerted within the upper, that 'tis impoſſible it can be diſlocated, being ſecured like a door on its hinges; ſo that after death it remains equally faſt, without the connexion of any Ligament, and is moveable upwards and downwards. The better to demonſtrate the contrivance of the *ſternum* of the Swan, I have ſent the Sceleton of one, which has been engraved ſince by order of the academy, to manifeſt their acceptance and approbation of our good intentions. See fig. 1. Plate II.

EXPLI-

EXPLICATION of the FIGURE.

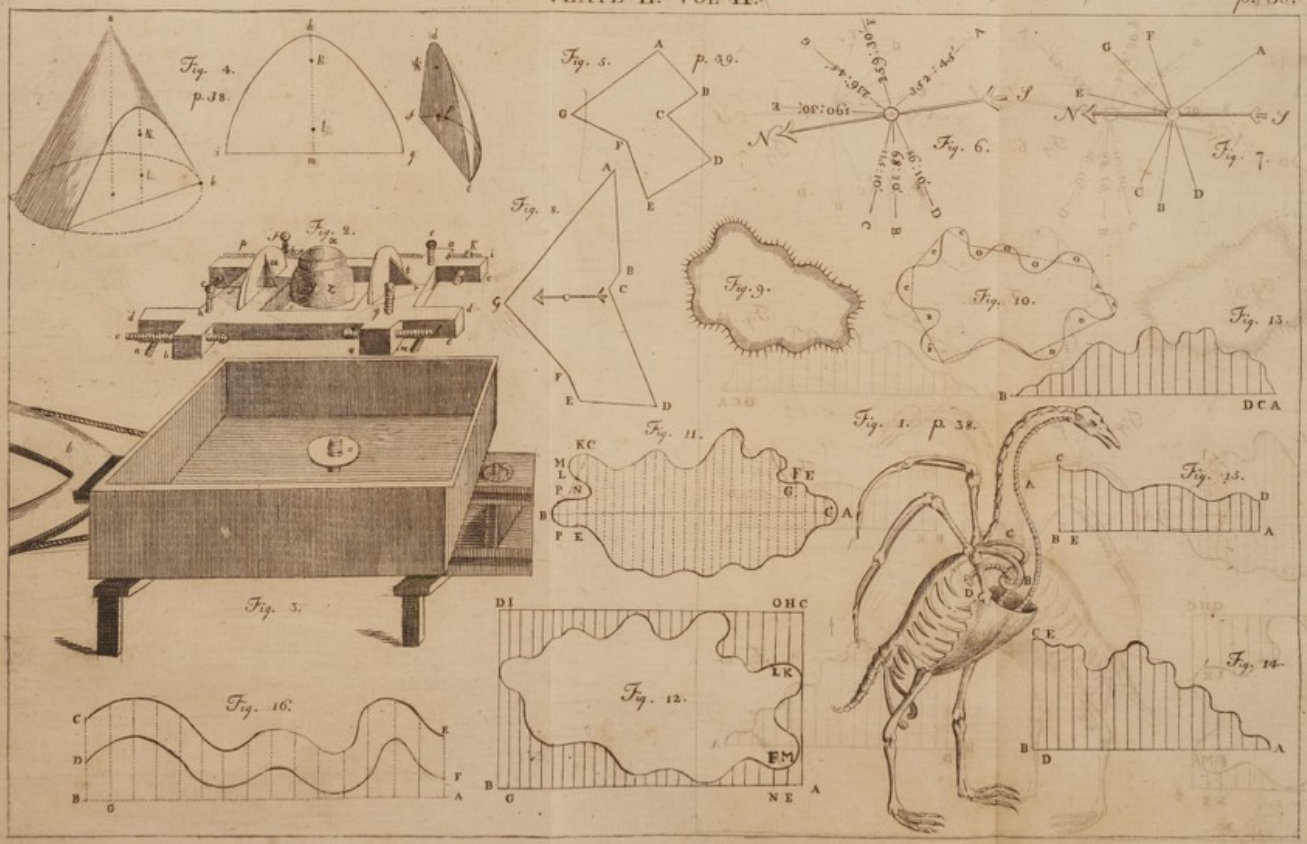
a The Swan's wind-pipe. b The reception of it within the cavity of the *ſternum*. c The triangular *ſternum*. d The part of the wind-pipe that enters the lungs.

An eaſy method of grinding and poliſhing Parabolic, hyperbolic and elliptic Lens's. *By* C. G. Hertelius. *From the* Miſcellanea Berolinenſia; Continuatio ſecunda, pars ſecunda, p. 146.

Tranſlated from the LATIN.

JOIN ſquare-wiſe, ſo as to project their ends beyond each other, four pieces of timber, aa, bb, c c, dd, (Fig. 2. Plate II.) that ſhall exactly fit the cavity or opening of the lathe (Fig. 3.) Into the ends of the timbers inſert, by means of ſcrew-holes, 12 ſcrews; four of which *e*, *f*, *g*, *h*, to ſtand upright, and eight, *i*, *k*, *l*, *m*. *n*, *o*, *p*, *q*, to be directed in a horizontal poſition, towards the four ſides of tne opening of the lathe, either for raiſing, lowering, moving to any hand, or faſtening down the above ſquare frame. Then let a cone be turned of a hard and well-ſeaſoned piece of wood, afterwards to be ſaw'd out into an elliptic, parabolic or hyperbolic ſection, according to the figure, deſigned the glaſs. Fig. 4. repreſents the cone, *abc*, of which, *def* is a ſection: On the ſection apply a ſteel plate, *g h i*, equally ſmoothed on each ſide, and of a thickneſs to anſwer to what was waſted in the ſawing; leſt upon coming to join the ſections, the cone ſhould fall any thing ſhort of its accurate rotundity: The plate ſhould every way project, in a manner, beyond the ſurface of the cone, and the two parts be tied down firm by means of ſcrews or nails paſſing through the correſponding holes, *k l*. After which, the projecting edge of the plate is to be carefully filed down, till every where become level with the ſurface of the cone, it has acquired the perfect ſection deſigned, whether parabolic, elliptic, or hyperbolic; and you procure an exquiſite model of grinding your Glaſs by: In like manner cauſe to make another model, by means of the ſame cone, in every reſpect like the former: as alſo ſeveral pairs of models, yet of different ſections and ſizes, for forming divers Lens's by, and all of them to be marked with a right line, *h m*, tending from the vertex to the middle of the baſe: After this too, let the oppoſite pair of timbers, *aa*, *bb*, (Fig. 2.) be marked in the middle with tranſverſe lines, *r* and *s*, and upon each of the timbers, let each of the models be placed with its axis perpendicular *h m*, that both may touch the tranſverſe lines *r* and *s*, and be parallel to each other. Let both models be ſupported by the props *t* and *u*, and made

PLATE II. VOL II.



made firm by means of ſmall ſcrews: then let any Glaſs be ground in a ſpherical diſh, that approaches neareſt to the ſection wanted, yet ſomewhat wider; or if one diſh happen not to be ſufficient for one Glaſs, a number of them, ſo as to be gradually narrower the one than the other, to be employed in the grinding: by which the Glaſs will come in ſome ſort to be of the deſtined figure, and be a kind of ſketch of it. Let the Glaſs *x*, after grinding be, by means of cement, faſtened to the block *y z*, and duely applied to the arbor *a*, ſo as not to project on one ſide or other, nor totter by the gyration of the wheel *b*. The Glaſs being in this manner applied, the machine (Fig. 2.) is to be lodged in the box or cavity of the lathe, and by means of the upright and inclined ſcrews to be ſo ordered, that the vertical points may coincide in a right line with the centre of the ſurface of the Lens; which may be known by the extenſion of a fine thread or hair; and by ſcrewing or unſcrewing may the matter be adjuſted: which being done, faſten firmly down the machine, by equal turns of the inclining ſcrews.

There now only remains to explain the act of reducing Glaſſes to the moſt perfect conic ſection: for which purpoſe have at hand a pretty ſtrong, level, iron-plate, both ways exceeding the diſtance between the models; which being laid in a horizontal poſition on the models and Glaſs, ſhall touch any one of theſe parts in one point at leaſt. Let this plate be moved up and down with the left hand along the limbs of the models on each ſide, after firſt ſprinkling common ſand, paſſed through a middling ſieve and wetted; at the ſame time turning round the wheel *b*, with the right hand, till the Glaſs be brought to the due figure; which, I am perſuaded, it cannot fail of, as the motion of the plate is directed along the edges of the models. After levigation, which is done by means of a finer ſand, or of emery, its poliſure may be given by means of a level piece of lime-tree wood, whoſe motion is directed by the models, and from the firſt done over with ſome putty, and at laſt with tripoli. In this manner too may concave Glaſſes of ſimilar ſections be ground, only changing the models and the grinding plate.

Some

Some practices in Geometry rendered more easy; by Philip Naudè, *the Elder. From the* Miscellanea Berolinensia. Continuatio secunda, Pars secunda, p. 235.

Translated from the LATIN.

Surveying, the principal thing therein.

AMongst the more frequent, and at the same time, most necessary and useful problems of practical Geometry, is that of laying down or plotting an Area taken in the field: and of all the methods of executing this, that undoubtedly has the preference, wherein we apply the mariner's compass, or magnetic needle.

Magnetic Needle, its use in Surveying.

This use of the magnetic needle in these operations, I formerly neglected, nay despised, as supposing the needle easily made to swerve from its natural direction by the approach of the least iron, or nearness of the subterraneous veins of that metal; but was at length undeceived by a frequent and successful practice.

'Tis however possible, on some occasions, that the Magnetic Needle shall be swiftly whirled about, and its magnetic virtue there suddenly vanish, which yet is very rarely the case. But to obviate any such inconvenience, it is proper to be furnished with two or more Magnetic Needles, if whole countries are to be laid down; that if one needle happen to lose its virtue, another may be ready to receive it: nay, it will be of service to have the load-stone itself carried about.

Construction of a compass to be used in Surveying.

The box or compass has its limb internally divided into 360 degrees; on its bottom are drawn 8 radii, denoting the 8 cardinal points, one of which has the flower de luce to signify the north, and at the opposite end S. to denote the south; to the right E, and to the left W, to denote east and west. In the middle of the bottom is erected and made firm a perpendicular needle, on which plays horizontally a Magnetic Needle: externally towards south and north are made fast perpendicularly brass plates, with slits in the middle for directing the sight or visual ray from south to north. Two other similar plates are fastened perpendicularly on the limb of a moveable circle, and diametrically opposite; in such sort that these four plates do occasionally the office of the sights of a graphometer.

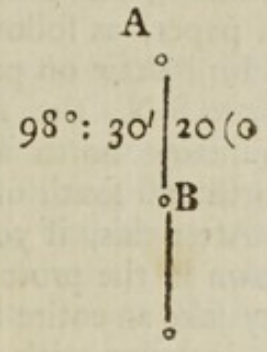
Compass how used?

To perform the operations; these plates are to be turned in such a manner, that the one shall look east and the other west. Below, the box has a joint, fastened in such sort, that it may be mounted on a staff before the sight of the operator. And this instrument may be commodiously used, as an astrolabe, graphometer, or mariner's compass.

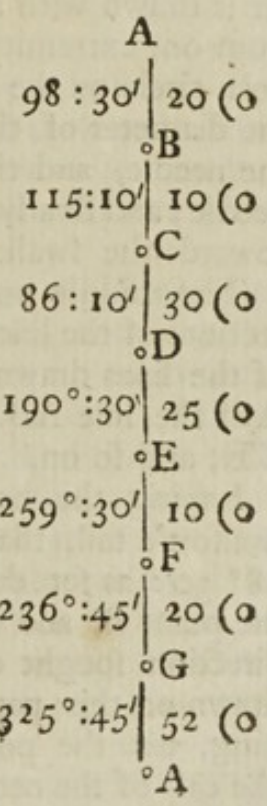
Let

Let the Area in the field be the figure z (Fig. 5. Pl. II.) to be geometrically laid down on paper. Suppoſe I begin from the point A through the line A B, proceeding from A towards B: Then I order the aſſiſtants to go towards A, there to ſet up perpendicularly a ſtaff, and carry along with them the chain, whilſt I at B mount before me the box with the Magnetic Needle. But 'ere we proceed, we are to lay this down as a fixed rule, *viz.* always to look in the ſame manner thro' the ſights: That is, that if at the firſt I lay my eye to the ſouth ſight & look to the north, I never omit doing the ſame for each angle. I therefore preſcribe this rule to myſelf, to look always from ſouth to north, as drawn at the bottom of the box. Plate II Fig. 5. The praxis of this method.

At B therefore I begin, and direct thro' the ſights the viſual ray from the angle B towards the ſtaff A, looking thro' the ſights from ſouth to north of the box. Then I order the aſſiſtants to quit the ſtaff A, if the figure be ſuch, that it ſhould be cloſed. Moreover I order them to come to me at B, along the line A B, meaſuring it in their way: but I at B wait 'till the magnetic needle come to ſtand quite ſtill: and then I obſerve what degree of the limb the north point of the needle ſtands over: And here in B it pointed to 98° 30′; this I ſet down in my book, near any line at pleaſure, A B on the other ſide ſetting down the diſtance A B, meaſured by the aſſiſtants; *viz.* 20 (o.



Then I quit the ſtaff, erected perpendicularly at B, and convey along with me the inſtrument to C, where I again look thro' the ſame ſights from C towards the ſtaff B; and there I ſtop, till the magnetic needle ſtop too. Its point ſhews 115° 10′; which I write down near the line BC: The aſſiſtants coming from B to C, carry with them the ſtaff, left by me at B, and meaſure the diſtance BC; which is 10 (o; which I write down as before. I proceed to ſhift my inſtrument from C to D, whilſt the aſſiſtants fix the ſtaff upright at C: I again look thro' the ſame ſights from D to C, and obſerve the degrees pointed out by the needle; *viz.* 86° 10′. The aſſiſtants meaſure C D, bringing with them the ſtaff, which they fix up at D; the diſtance C D was 30 (o which I write down by the ſide of the line CD: and ſo on, till I come to A again: and from this figure and operation has ariſen the prototype here denoted.



In the ſame manner might the prototype of a figure of fifty angles, of what length ſoever the ſides were, be ſet down. A commodious practice this, all Surveyers muſt own.

We may moreover here obſerve the diſpatch of the Operation: The aſſiſtants are always meaſuring, almoſt as faſt as they can run; all the ſtay being, till the needle come to ſtand ſtill, and point out the degrees to be writ down.

What has been hitherto advanced is notorious, and there are ſeveral Surveyers who often employ this inſtrument. But to theſe things I now add a new method of forming the geometrical figure from the prototype; which prototype has no manner of reſemblance with the figure itſelf. The method uſually employ'd for conſtructing this figure is ſo prolix and intricate, as to have near diſguſted me from ſo expeditious an uſe of this inſtrument, had I not hit on a method of laying down with eaſe the figure on paper, as follows:

Fig. 6. Firſt draw on paper with a lead-pencil a line, on which deſcribe the figure S N, the magnetic needle, with its point and ſwallow's tail, to denote north and ſouth: This needle will immediately determine the north and ſouth of the figure ſought.

After this, if you want the ſituation of the firſt line AB, (*fig.* 12.) ſet down in the prototype, with the degrees 98° 30′. employ for greater facility ſake an entire horn-circle, divided into 360 deg. on which one diameter is drawn with a ſteel point; the 360 degrees beginning to be reckoned from one extremity of this diameter, quite to 360: apply therefore your horn circle on the line repreſenting the magnetic needle, in ſuch ſort, that the diameter of this horn circle ſhall coincide with this repreſentation of the needle, and the centre of the circle, with the middle point O of the needle; and finally, that the beginning of the numbers on the horn circle be towards the ſwallow's tail, that is, the ſouth point of the needle.

The middle point O of the needle will denote the origin of all the directions of the lines to be ſet down; or better, the beginning of each one of the lines drawn in the prototype. That is O will repreſent the point A of the line AB; the point B, of the line BC; the point C of the line CE, and ſo on.

Laying the horn circle as was before ſaid, begin to reckon from the ſwallow's tail, that is, from the ſouth, and proceed to the eaſt quite to 98° 30′: as ſet down in the prototype near the line AB, and there make the point B, and with a lead pencil draw the line OB, which will give the direction ſought of the line AB: Then wherever the line AB ſhall be drawn on this paper, it ſhould be parallel to this line OB, and its beginning, *viz.* the point A, be towards O, and its point B proceed towards the eaſt of the needle, delineated on the paper.

Now do as much for each line ſet down in the prototype, as you have already done for the line AB: For inſtance, I obſerve near the line BC, 115° 10′

115° 10′. I therefore place the horn circle, as before, upon the needle SN, and I begin in S to reckon eaſtward 115° 10′, and there I make the point C, and draw OC, denoting the direction of the line BC; and ſo on to the end. Whence ariſes the above figure, which I call the *Preparatory Rotula.*

I would now hint, that this *rotula* might be formed by one only application of the horn circle: For, the circle being duely and accurately applied, and on it a piece of lead placed, for it to remain immoveable, all the points, deſigned in the prototype, may be marked round with the laſt letters of each line, as here the letters, D, B, C, E, G, F, A. Then removing the circle, we may draw all the true lines of direction, as here the lines, OB, OC, OD, OF, OG, OA; which is therefore very accurately and readily done. In this *rotula* we immediately ſee that the line OB repreſents the line AB of the prototype; but the line OA, the line GA, on the ſcore of the different origin of theſe lines.

It may poſſibly be objected, that this would prove very difficult, were the number of the angles of the figure great; becauſe in that caſe the points would come to be too near each other, nay ſometimes perhaps coincide: In which caſe there would be no room for inſcribing the letters to denote the extremity of each line by. My anſwer is, that room may always be found, tho' ſeveral lines ſhould fall upon each other, or coincide, provided inſtead of the capital, the ſmaller letters be uſed: Becauſe the points denoting each line, may be put unequally diſtant from the center O; and in this manner nothing ſhall hinder, but that all the lines may be drawn, or at leaſt diſtinctly denoted by their proper letters.

If the preparation above deſcribed could be readily and accurately done, the geometrical figure would be formed with ſtill greater diſpatch, provided a fit place were rightly taken for the firſt angle A; to find which we ſhall ſhew hereafter.

Now ſuppoſing this fit place to be in A, Fig. 7, 8, thro' A, I draw with a lead pencil a line, parallel to the radius OB of the *rotula*, and I take in a given ſcale between the legs of the compaſſes the opening 20 (o, becauſe in the prototype at AB, the length is thus marked: This done, I compleat the line AB with ink. Again, thro' the point B, I draw with a lead pencil, a line parallel to the radius OC of the *rotula*, making it 10 (o in length, as marked down for BC; this done, I draw BC in ink. Again, thro' the point C with the lead pencil I draw a line parallel to the radius OD of the *rotula*, making it 30 (o in length, as is CD in the prototype: And thus proceeding, I accurately and very readily compleat the figure; eſpecially if we employ a rectangle-triangle of wood or ivory for drawing the parallels: And then the buſineſs is perform'd almoſt with equal diſpatch, as if each angular point of the figure were given in poſition. Such then is my method of forming the geometrical figure from Fig. 7 and 8.

the given prototype. We are now to find the proper place on the paper, for the beginning A of the figure.

The ſite of the figure to be conſtructed on the propoſed paper, depends on two things; *viz.* on the ſituation we there give the needle S N of the preparatory *rotula*, and on the poſition A, the beginning of the figure. To proceed therefore ſurely, it is expedient immediately to compleat this preparatory *rotula* on ſome ſmall piece of paper: and being done, lay it on a level table, faſtening it there with a ſoft wax or otherwiſe: Then take in the ſcale, deſigned the figure, with a compaſſes, the diſtance AB, *viz.* 20(0 ſet down in the prototype; and place the one leg of the compaſſes in the point you at random deſign for the beginning A; the other leg apply in ſuch manner on the table, that its poſition may with the firſt point of the compaſſes make a line parallel, at leaſt to the eye, to the radius OB of the *rotula*; and with chalk mark the two points, ſetting alſo down the letters A and B.

Then again take in the propoſed ſcale the opening BC, *viz.* 10 (0, and ſetting one point of the compaſſes in B, already marked, ſet the other on the table in ſuch ſort, that its poſition may form with the point B, a line parallel by ſight to the radius of the *rotula* O C; and with chalk mark the point and letter C.

Further take in the propoſed ſcale the aperture CD, *viz.* 30 (0; and ſetting one point of the compaſſes in C, ſet the other on the table in ſuch ſort, that its poſition may with the point C, form a line parallel to the eye, to the radius of the *rotula* O D, and with chalk mark the point and letter D. In the ſame manner mark all the other points E, F, G, and by this means you ſhall have the geometrical figure depicted nearly on the table, in ſuch manner that the diſtinction and ſituation of its greateſt length and breadth may be ſeen.

Then apply the paper deſtined for the geometrical figure upon this table, by ſhifting it this way and that, till it exactly cover the figure marked with chalk; and thence take the ſite of the needle S N of the *rotula*, and the place A, deſtined for the beginning of the figure to be conſtructed on the paper; which being done, every thing will be plain.

But if you ſet down the lines, marked out by the compaſſes, not only to the eye, but geometrically parallel to the radius of the *rotula*, then all the figure on the table will be geometrically drawn.

Finally, if the firſt application of the preparatory *rotula*, on the table, to the radius of the *rotula* ſhould cauſe the figure to project without the table, the remedy is eaſy; either by ſhifting the place A of the beginning of the figure, or diverting a little, if needful, the preparatory *rotula* from its firſt ſituation, aſſigned on the table. For, if by the ſcale the figure may be ſet off on the table, its not anſwering ſo well, and its projecting beyond the table, will be owing to one or other of theſe defects; either, to the undue ſite at firſt given to the needle of the *rotula* S N (for it might

might happen that the ſcale might bear the figure being conſtructed on the table, as alſo the poſition of the beginning A, and yet not, the undue ſite given the needle SN) or to the undue poſition of the beginning A, tho' the ſcale or given ſite of the *rotula* might bear it.

I here add another prototype, which ſhall cloſe another figure, if any one ſhould have a mind to try it.

But if we would know the number of degrees of any angle, ſet down in the prototype; 'tis now well known to be done by two ſubſtractions: The degrees ſet down both above and below the ſought angle are to be taken, and the leſſer to be ſubſtracted from the greater number; if the remainder be leſs than 180, then it is to be ſubſtracted from 180; but if exceeding 180, then 180 to be ſubſtracted from the firſt remainder, and the ſecond remainder will give the number of degrees of the angle ſought: For inſtance: If we want the number of degrees of the angle C, ſet down in this laſt prototype; I ſubſtract 7° from 112° 15′; the remainder is 105° 15′, which is leſs than 180; I therefore ſubſtract 105° 15′ from 180; the remainder is 74° 45′, the number of degrees of the ſought angle C. But if I want the number of degrees of the angle D, I then ſubſtract 7° from 309° 15′, the remainder is 302° 15′, which exceeds 180; from this remainder therefore I ſubſtract 180, the reſidue is 122° 15′, the number of degrees of the angle ſought D.

A	
207°:50′	227(1
°B	
112°:15′	607(1
°C	
7°	311(1
°D	
309°:15′	289(1
°E	
226°	167(1
°F	
309°	159(1
°A	

It may often happen that an area irregularly curvilinear ſhall offer to be meaſured and geometrically conſtructed; ſuch as are the two repreſented Fig. 9.10. and the area ſhall both from without and within be every where acceſſible, or only inacceſſible from within; yet we muſt always work by Approximation, and that in a twofold manner: Either we conſider the figure as a rectilinear of many angles, and its circumference conſiſting of ſeveral very ſhort rectilinear ſides, which thus almoſt quite deſtroy the curvity, as may be ſeen (Fig. 9.) Its area is afterwards to be divided like a rectilinear figure into a number of triangles, whoſe ſum exhibit that of the figure. Or we give it a new rectilinear circumference, as (Fig. 10.) ſo formed, that what the true figure loſes in one part, may be compenſated in another nearly, as is done (Fig. 10.) where the two ſpaces *a* compenſate each other, as alſo the two ſpaces *b*, the two *d*, and the two ſpaces *c*. Then the area is found too by means of triangles, whoſe ſum is put equal to the curvilinear area given. Fig. 9 and 10.

But this laſt approximation is extreme rude, and cannot ſerve geometrically to conſtruct the figure, or tolerably repreſent it. But if the figure be anyhow to be laid down on paper, the firſt method hinted for Fig. 9. is the more preferable: In which caſe the above mentioned uſe of the magnetic needle is highly conducive, and better than all the common ways.

But

But when ſuch a figure of many ſmall ſides, already conſtructed on paper, is to be calculated or caſt up; it is to be divided into ſeveral rectangles and triangles, which will cauſe no ſmall trouble: I therefore bethought me of another way of laying down on paper ſuch an irregular curvilinear figure, and then caſting it up, and that by one only multiplication; a way approaching the accurate truth as near as any other, and is as follows.

Fig. 11. Thro' the greateſt dimenſion of the figure draw the line AB, Fig. 11. which divide into any number of equal parts, and the more numerous the parts, the nearer you approach the true area; thro' all the points of diviſion of the line AB draw perpendiculars, reaching to each ſide of the figure: Meaſure all the perpendiculars and one of the equal parts AC: Add all the perpendiculars together, and multiply their ſum by AC, one of the equal parts of the line AB; and the product will give the area of the figure nearly: There is here no other error beſides that ariſing from the figure not being included in ſmall right lines, to be drawn thro' all the extremities of the perpendiculars; a very inconſiderable error, that: For were theſe ſmall lines drawn, there would thence often ariſe a neceſſary compenſation, pretty exact, as may be ſeen by the line GH. But if any perpendicular happen to cut the curve three or four times, as IK, not all IK is to be ſet down in the addition, but only IL; ſuppoſing L to be in the middle of MN; for in this manner there will be had a pretty accurate compenſation, as may be ſeen by the line CLP.

By the ſame method may be form'd geometrically on paper any ſuch given figure, without any other inſtrument than that we want for drawing right lines and perpendiculars in the field: For if you ſet down in your book, the lengths of all theſe lines, you will compleat the figure, by drawing a curve thro' the extremities of all the perpendiculars.

Here poſſibly it may be objected, that we require the figure to be every way acceſſible within ſide, but that is not needful; this method may be uſed, tho' the figure were a lake, or any other place quite inacceſſible, provided it were acceſſible without ſide.

In this caſe the propoſed figure is only to be included in a rectangle,
Fig. 12. whoſe four ſides touch the figure, as is to be ſeen by Fig. 12. AB and CD will be the greater dimenſion of this figure, which I may divide into any number of equal parts; drawing perpendiculars to the diviſions, and meaſuring them, I ſet down their lengths in my book; and thus I may eaſily conſtruct the figure at home, and caſt up as above. To find the ſum of the perpendiculars contained within the figure, you need only multiply the length AC or BD by the number of perpendiculars betwixt theſe two: beginning here from EH, and ending at GI. Then add all the perpendiculars betwixt the limb of the given figure, and the lines AB, CD; as here the lines HK, OL, ME, FN, *&c.* Let this ſum be ſubſtracted from the above product, the remainder will be the ſum of the perpendiculars, which multiplied by AE, or EN, the product will give the area ſought.

By

By the ſame method too, may the area's of any mixt irregular figures be obtain'd by only one multiplication: For inſtance, ſuppoſe a figure bounded by a right line, and an irregular curve, as here Fig. 13. The right line AB is to be divided into a number of equal parts, the more the better: Then from the points of diviſion are perpendiculars to be erected; which added together, and that ſum multiplied by one of the equal parts AC. we have the area. Fig. 13.

If any other figure were included betwixt two right lines perpendicular to each other, and an irregular curve, as Fig. 14. the longer right line AB is to be divided into equal parts, and thro' the points of diviſion, parallels drawn to BC: But in ſumming up the perpendiculars, only half BC is to be ſet down; then that ſum multiplied by one of the equal parts, as DB, gives the area. Fig. 14.

If any other mixt irregular figure be included within two parallel right lines, perpendicular to a third, and an irregular curve, as Fig. 15, This third AB is to be divided into equal parts, and perpendiculars erected to the points of diviſion; and in ſumming, half only of the two extremes, AD, BC to be added: And multplying this ſum by one of the equal parts, as BE, you have the area ſoughti Fig. 15.

Finally, if any irregular mixt figure be included betwixt two right parallel lines, and two irregular curves, as Fig. 16, Then to theſe two parallels draw the perpendicular AB, which divide into equal parts; and at the points of diviſion erect perpendiculars to AB, or parallels to CD, EF: Sum up all theſe parallels, and only half of the two extreme parallels CD, EF. Then multiply this ſum into one of the equal parts, as BG, and you have the area of figure 16. Thus far of regular figures. Fig. 16.

There are alſo ſome compendiums for regular figures. For inſtance, all regular polygons of the ſame denomination, that is, having a like number of angles, are mutually ſimilar: All circles, all ſectors of a circle, whoſe ſubtended angles are mutually equal, are alſo mutually ſimilar figures. This being well obſerved, and if beſides, we duely underſtand the uſefulneſs of decimal arithmetic, which in geometry is extraordinary, we ſhall thence procure very elegant compendiums.

For in this caſe, if we once take the trouble to caſt up the area of a figure in each kind, whoſe ſide, or diameter, or radius is 1 (o, there will thence ariſe an excellent compendium.

Decimal Arithmetic, what?

But in the firſt place I call that Decimal Arithmetic, in which the integer or firſt linear meaſure, as a rod, perch, fathom, *&c.* is divided into ten equal parts, called *primes*; a *prime* again divided into ten equal parts, called *ſeconds*; a *ſecond* divided into ten equal parts, called *thirds*, and ſo on.

In planes the integer ſquare meaſure is divided into 100 *ſquare primes*; a *ſquare prime* into 100 *ſquare ſeconds*; a *ſquare ſecond* into 100 *ſquare thirds*, &c.

In

In cubes, the integer cubic meaſure is divided into 1000 *cubic primes*; a *cubic prime* into 1000 *cubic ſeconds*, &c.

Moreover, in this Algorithm, after the integral parts, is ſet down, ſeparated by a crotchet, the value of the laſt numeral character; and the dimenſion, in its proper character, as *q* for plane, *c* for cube, excepting the linear, which need not be expreſſed.

If in lines I would write down 43 integers, I ſet them down thus; 43(0: But if I would write down four integers, and three primes, I do it thus; 43(1. If I would ſet down four primes, and nine thirds, I do it ſo; 409(3. And ſo on.

In planes; if I would write down 54 ſquare integers, I write 54(0*q*. If I would expreſs five integers and nine ſquare primes, I do it ſo, 509(2*q*. If I would write down 40 ſquare primes, 76 ſquare ſeconds, I write 4076(4*q*. To expreſs nine ſquare primes, and eight ſquare ſeconds, I do it thus; 908(4*q*, *&c.*

In cubes: 76(0*c* denotes 76 cubic integers: 9573(3*c* ſignifies nine cubic integers, and 573 cubic primes; 7009(3*c* ſtand for ſeven cubic integers, and nine cubic primes: 8076(6*c* expreſſes eight cubic primes, and 76 cubic ſeconds.

Hence may be ſeen that in lines, to each denomination is allotted one ſingle place; as to primes one, to ſeconds one, to thirds one, *&c.* Becauſe beyond nine, the denomination changes to a higher.

In planes, to each denomination are reſerved two places; as two to primes, two to ſeconds, *&c.* becauſe as far as 99 the ſame denomination ſubſiſts.

In cubes, to each denomination are three places allotted; three to primes, three to ſeconds, *&c.* becauſe as high up as 999 the ſame denomination is continued.

Hence it is, that for the greater clearneſs, it matters not in lines, what number is put after the crotchet, which is the fractional index or character. But in planes, it ſhould be an even number, and in cubes, a ternary: And where it is not ſo ſet down, it is ſo underſtood to be, by virtue of the poſition of the laſt figure: For 46(1*q* and 460(2*q* are equal; as are 49(1*c* and 4900(3*c*. On which account it is proper to complete the fractional index, which is an even number in planes, and a ternary in cubes, by a due appoſition or removal of cyphers; ſo that inſtead of 42(1*q*, we write 420(2*q*; or in lieu of 49540(4*c*, 4954(3*c*, and yet their value remain unaltered.

The method of operation remains the ſame, as if all the parts were integers; only obſerving that in addition and ſubſtraction, the fractional index and the dimenſion of the numbers remain the ſame, that they were in the given numbers.

But

But in multiplication, both the fractional character and dimenſion are changed by addition: for here the ſum of the fractional characters will give the character or index of the product, and the ſum of the producing dimenſions, the dimenſion of the product: as if 4(1 be multiplied by 4(1, the product will be 16(2: and 16(2q multiplied by 4(1 gives 64(3c, *&c.*

In diviſion the fractional index and dimenſion are changed by ſubſtraction, becauſe diviſion is contrary to multiplication. The fractional character therefore of the diviſor is to be ſubſtracted from that of the dividend, and the remainder is the fractional index of the quotient. Moreover, the dimenſion of the diviſor is to be ſubſtracted from the dimenſion of the dividend, and the remainder is the dimenſion of the quotient: As if I divide 64(3c by 16(2q, the quotient will be 4(1; but if I divide 64(3c by 16(1, the quotient will be 4(2q, which ſtands for 4 ſquare primes. For a line has one dimenſion; a plane, two; a body, three.

Theſe things being well obſerved and underſtood; for calculating the areas of regular polygons, uſe only the following table, in which I exhibit the areas of 10 ſuch, the length of each of whoſe ſides I ſuppoſe 1(0.

AREA		AREA	
Of a Triangle	43(2q	Of an Octagon	481(2q
Square	1(0q	Enneagon	617(2q
Pentagon	172(2q	Decagon	765(2q
Hexagon	260(2q	Endecagon	935(2q
Heptagon	361(2q	Dodecagon	1116(2q

For inſtance, let it be required to find the Area of any regular decagon, whoſe ſide is 32(1, I only ſquare 32(1, which makes 1024(2q, and multiplying it by 765(2q, the product is 783360(4q, for the area of the decagon ſought, yet retaining the plane or ſquare dimenſion; becauſe after this multiplication, there is underſtood a diviſion made by 1(0q, which in the product changes nothing but the dimenſion: for it is well known, that ſimilar polygons, are to each other as the ſquares of their homologous ſides, In the ſame manner may all regular polygons be calculated by help of the preceeding table.

The ſurface of a circle being ſought, either its diameter, circumference, or both, are to be given; if any one of the two, the other is ſought by means of the ratio of the diameter to the circumference, which is commonly put as 7 to 22; but for the ſake of a more expeditious calculus, and becauſe alſo we employ decimal arithmetic, let the ratio be put as 100 to 314, which is much nearer the truth than the former.

Now it is evident, that the peripheries of circles are as their diameters.

Let the firſt compendium then, ſuppoſing the diameter given, and the periphery ſought, be as follows; namely, multiply this diameter only by 314(2, the product will give the circumference ſought: always keeping the linear dimenſion, on the ſcore of a diviſion here underſtood, and hinted at once for all.

The ſecond compendium, ſuppoſing the periphery given, and the diameter ſought, will be to multiply this periphery by 318(3, the product giving the diameter.

The third compendium, ſuppoſing given the diameter, and ſought the area of the circle, will be to multiply the ſquare of the diameter by 785(3, and the product is the area ſought.

For the fourth compendium; given the circumference and ſought the area: multiply the ſquare of the circumference by 794(4 and the product will give the area ſought.

Fifth compendium for the ſector of a circle, whoſe radius and the number of degrees of the angle are given, and its area ſought: multiply the ſquare of the radius by the number of the given degrees, which product is always to be multiplied by 872(5, and this laſt will give the area ſought.

Sixth compendium, if the given angle of the ſector contain degrees and minutes: The degrees are firſt to be converted into minutes; then the ſquare of the radius to be multiplied by the number of the minutes of the angle, and this product by 14533(8, which will give the area ſought.

Seventh: If in the ellipſis the two axes be given, and the ſurface be ſought: I ſay, the product of the axes is to be multiplied by 785(3, which gives the area ſought. This rectangle, or product of the two axes we uſe in the ellipſis, as we did the ſquare of the diameter for the circle.

Eight: If the diameter of the ſphere be given, and ſought its ſurface: I ſay, the ſquare of the diameter is to be multiplied by 314(2, and this gives the ſurface ſought.

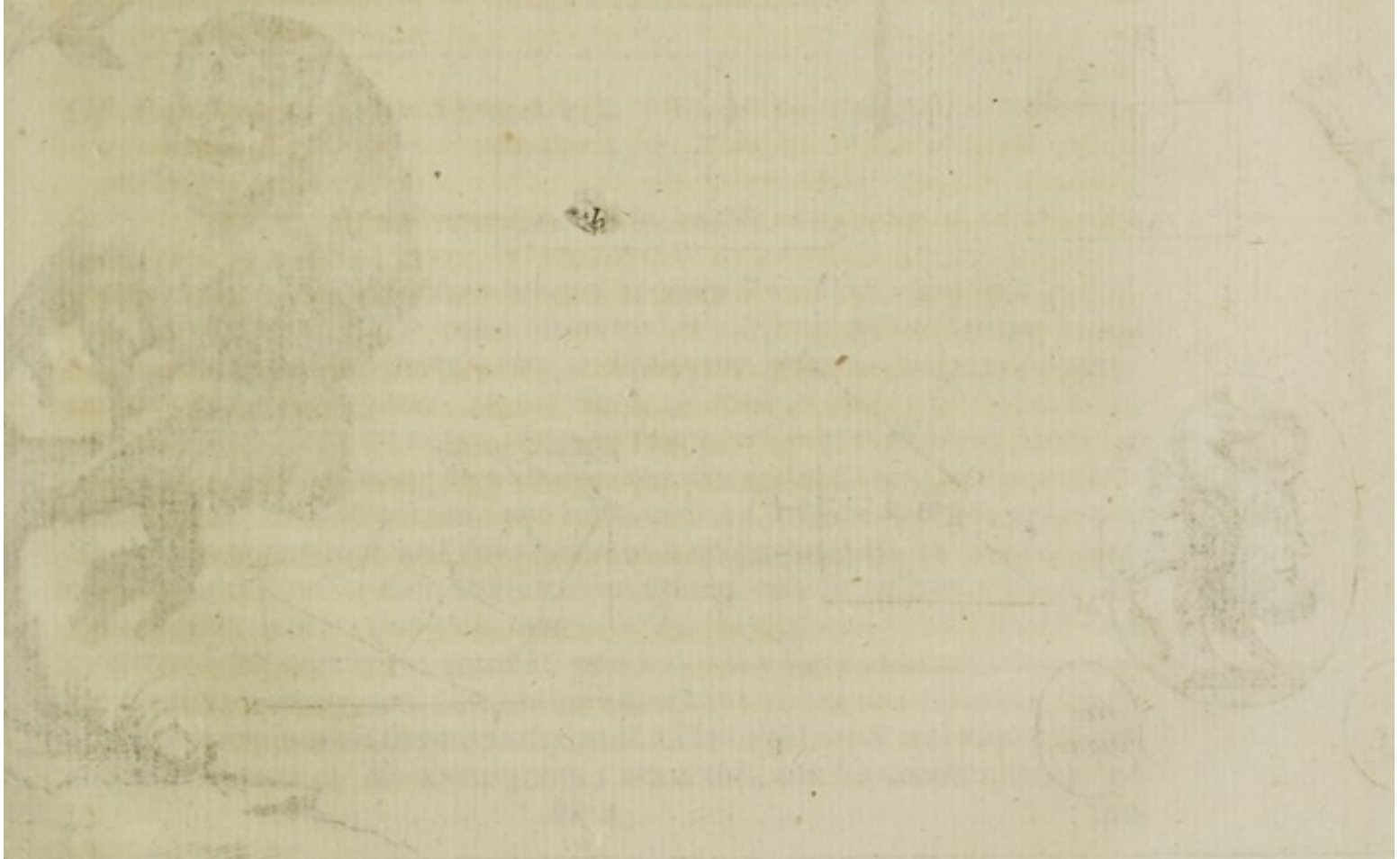
For the ninth and laſt compendium: If the periphery of a great circle of the ſphere be given, and its ſurface ſought; the ſquare of the periphery, multiplied by 318(3, will give the ſurface.

If you want the ſolidity of any regular polyhedron, uſe the following table, exhibiting their ſolidities, the ſide of each of which is 1(0: The hexahedron or cube I except, as admitting of no compendium.

The SOLIDITY of the

Tetrahedron	1178(4c
Octohedron	471357(6c
Dodecahedron	768496(5c
Icoſahedron	20898(4c

Now,



The Cow-Dance.

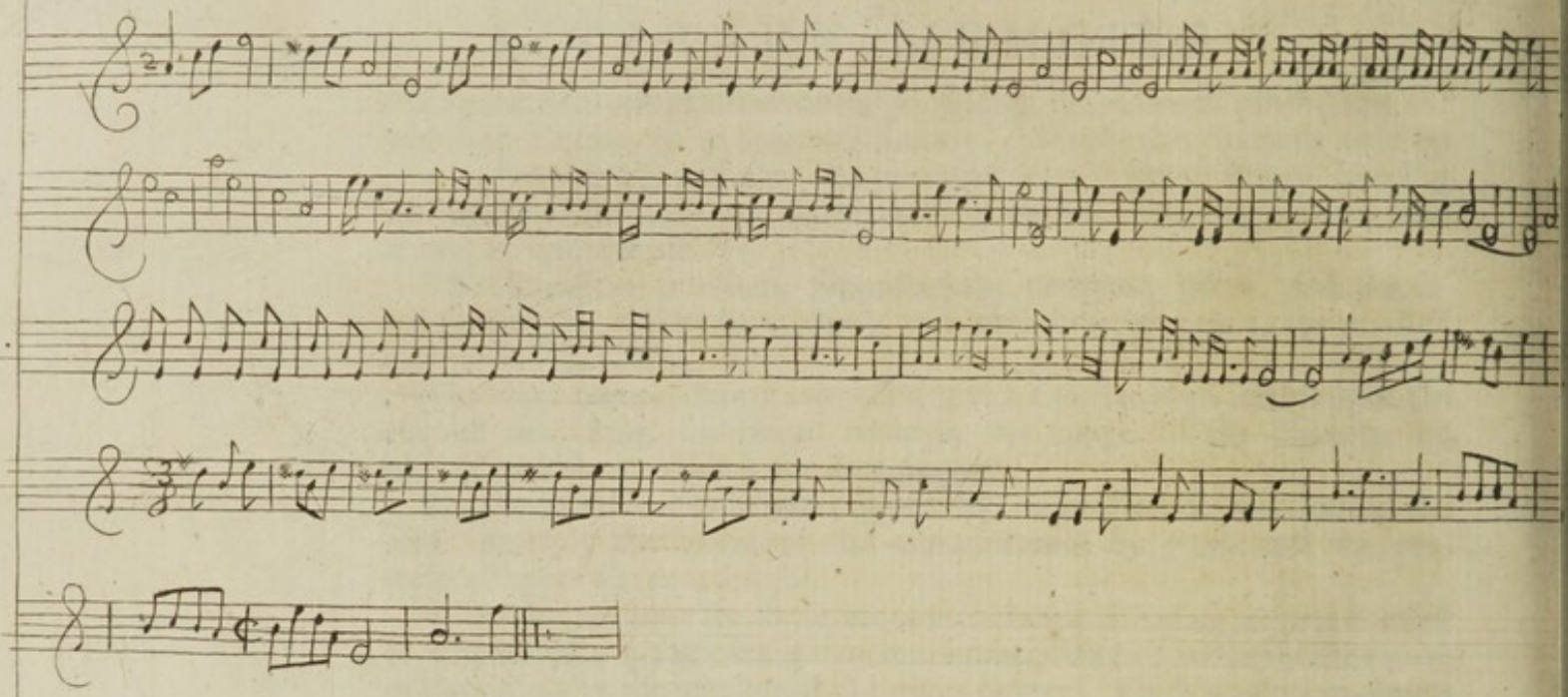


Fig. 2. p. 54.

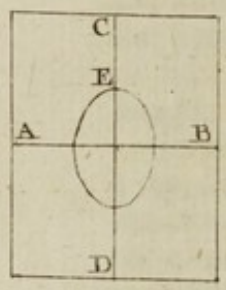


Fig. 3. p. 58.

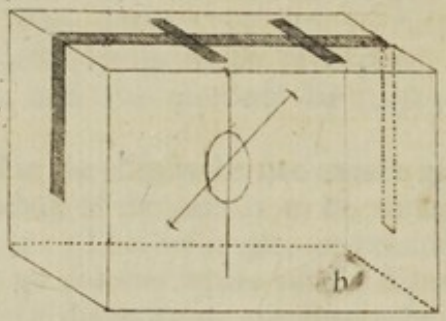


Fig. 4. p. 62.

Fig. 5. p. 63.

The size of the Stone.

Fig. 6. p. 72.

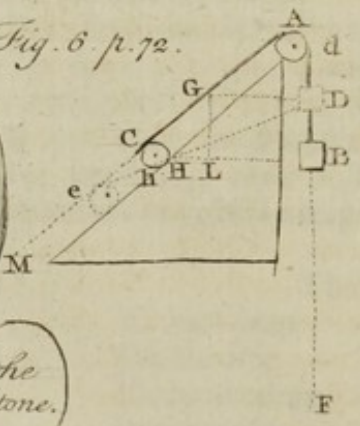
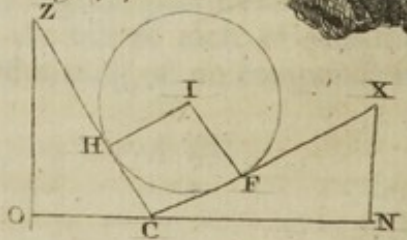


Fig. 7. p. 73.



Now, ſuppoſe given the ſide of any regular polyhedron; for inſtance, the tetrahedron, its ſolidity is to be found. The given ſide is to be cubed, and this cube to be again multiplied by the ſolidity above given of the polyhedron of the ſame denomination, as here by 1178(4c; and this laſt product will give the ſolidity ſought: For, ſimilar bodies are as the cubes of their homologous ſides.

(2.) For the ſphere: If the diameter of any ſphere be given and you would find its ſolidity; cube the given diameter, and that cube multiply by 523562(6c, this laſt product is the ſolidity ſought.

(3.) If the circumference of a great circle of the ſphere be given, and you would find the ſolidity of the ſphere: The circumference is to be cubed, and that cube to be always multiplied by 168858(7, which product gives the ſolidity ſought.

We now come to the ſpheroid; which is a ſolid, generated by the revolution of the ellipſis about its axis; if about the greater, the body is oblong, almoſt like an egg; but if about the leſs, it is depreſſed or flatted, like a pocket-watch nearly. In the ſpheroid may always be drawn thro' the centre three axes mutually perpendicular. If the two leaſt are equal it is an oblong ſpheroid; but if the two greateſt, an oblate one; and were all the three equal, the body would be the ſphere itſelf: But be they in any of the above proportions, the product of the three axes multiplied by 523562(6 gives the ſolidity of the propoſed ſpheroid.

Of the Noſtalgia, *or* Home-Ach. *From the* Breſlaw Collection, 1718. p. 832.

Tranſlated from the HIGH-DUTCH.

THE *Noſtalgia* or *Home-ach*, as it may be called, is a kind of Ailment, which has been hitherto but little regarded by our Phyſicians, few of them, except *Harderus*, in his *Diſſert. de Noſtalgia*, and *Theodorus Zwingerus*, in his *Diſp. de Pathopadridalgia*, taking any notice of it. This however is not ſo much to be wondered at, ſince the diſeaſe from its natural appearance is ſo very obvious, and very ſeldom requires the aſſiſtance of a Phyſician, nor ſubmits to his judgment or preſcriptions: So that an annotation and deſcription of it might perhaps be ranged in the claſs of rarities rather than conſidered as a thing very neceſſary or uſual. This malady either affects the brain or the belly, but generally the former, and diſcovers itſelf chiefly in youthful perſons, who have been accuſtomed to their native country, and the mother's kitchen; ſuch a one reflecting on the loſs of a parent's table, the converſation of all his old friends and acquaintance, and the manners of his countrymen; from this, and his contemplation on

the grief of his family about his abſence, and whatever elſe may concur to his continual diſquietude and perplexity, he feels the activity of his body and mind abated; he delights in nothing; his former good appetite is ſucceeded by an averſion to food, and what he takes, being poorly digeſted, is of little or no nutriment, but his fleſh begins to fall and decay, his face turns wan and pale, his limbs feeble, the whole body looſes its vigour and activity, and ſometimes he ſuffers ſuch a failure of all the functions of the bowels, from diſcontent, ſtrange air and food, that it is attended with many troubleſome conſequences, as anxiety, palpitation of the heart, and other heavy ſymptoms; eſpecially, as it frequently happens, that the diet and the air differ very conſiderably from what he has been accuſtomed to, and he finds his whole ſituation contrary to what a mother's indulgence had long allowed him. In this caſe the medicinal help is generally very inſignificant, and the cure, while abroad, is not accompliſhed but by a long inurance to the alteration; but the beſt remedy is a return into his native country, which commonly is effectual to diſpel the malady inſtantly without the help of phyſick.

This ſickneſs is more prevalent among the *Swiſs* than any other nation, on which account it is called there, *La maladie du pais*, and ſome will aſſert, that it is hereditary and peculiar to the natives of the canton of *Bern*, tho' at the ſame time, it is not denied, but that the reſt of the *Swiſs* ſubjects are not wholly exempted from it. *Hoferus (a)*, relates ſome particular caſes which the *Swiſs* officers have obſerved among their troops in *France* and *Flanders*, and particularly informs us, that new recruits, who, upon hearing the old *Swiſs* ſoldiers either ſing or play a certain tune, frequently ſung by the peaſants that inhabit the *Alps* of *Switzerland*, and called the *cow-dance*, are inſtantly taken with that malady, and at the ſame time with a burning fever, inſomuch, that the officers were obliged to prohibit the whiſtling or playing that tune upon any inſtrument, under a ſevere penalty. Some of our Readers, perhaps will be pleaſed to ſee the notes of that bewitching tune, wherefore we ſhall ſet them down here, as they are inſerted in that diſſertation. See Plate III. Fig. 1.

Plate III. Fig. 1.

But however, we muſt not wholly aſcribe this diſeaſe among the *Swiſs* to the diſquietude of the mind, but in a great meaſure to the change of air and diet, eſpecially as their native air is more pure and rarified than what they meet with in foreign countries, which to them is generally very thick and heavy. The learned phyſician *S. J. Scheuchzer*, in his natural hiſtory of *Switzerland*, has made the following remarks on this malady, when he ſays: "Whoſoever accurately compares the nature of the *Swiſs* "air with that of other countries, will find ſome very uſeful and obvious "hints for reſolving a multitude of other remarkable events, an example "of

(a) Diſp. de Pathopatrialgia ſub. Præſ. Theod. Zwingeri, §. 12.

" of which we find in a treatiſe entitled, *the natural occurrences of Switzer-*
" *land (b)*, where the author derives the Home-ach, as a ſtrange and dan-
" gerous malady, in foreign countries, principally from the nature of the air
" in *Switzerland*, and the changing of it. Dr. *Detharding*, in his diſſer-
" tation on the healthful air of *Roſtock*, ſeems to be an entire ſtranger
" to the air of *Switzerland*, when p. 32. he ſays, that the Home-ach of
" a *Switzer* ariſes from the unwholeſome air incloſed among the moun-
" tains he was accuſtomed to. This reaſoning might indeed appear
" good to a native of *Roſtock* or *Holland*, when out of a cloſe and impure
" ſea-air he ſhould remove into the *Switzer* mountains, and there take
" in, without doubt, the cleareſt air in *Europe*; on which account the
" *Swiſs* are looked upon to be unhappy, as their ever ſerene and clear
" air ſubjects them to moſt dangerous fevers and ailments, whenever
" they come to be oppreſſed in foreign countries with a groſs, heavy,
" thick and ſtrong preſſing medium, particularly, with a *Netherland* ſea-
" air." This learned author, under that head, aſcribes the Home-ach principally to the change of air and diet; tho' he does not deny, but that the natural inclination or hankering after home, contributes in a great meaſure towards it, eſpecially, when from a mild and tender indulgence, they meet with rough and ſevere diſcipline, and other ill treatment from their officers.

But we ſhall dwell no longer on this ſubject, than juſt to obſerve, that other nations are not exempted from the like indiſpoſition, tho' it does not always or exactly correſpond with the Home-ach of the *Swiſs*, which is generally attended with a fever; of this a learned friend in *Upper Hungary* communicated to us the following relation, as a true ſpecimen of the Home-ach, (which diſeaſe is called by *Harder* Noſtalgio *.) " I have ex-
" perienced it the latter end of *February* and the beginning of *March*, in
" *B*—— my brother, who, after we had continued for fourteen days at a
" place ſome diſtance from home, was always ſad, giving himſelf up to
" melancholy: This was attended with a palpitation of the heart, his ap-
" petite was gone, and he was troubled with ſuch anxiety in his mind, as
" prevented his reſting the whole night; I bled him, and gave him ſome
" antivertiginous mixtures and the like, but all in vain, till at laſt we re-
" turned home, when his malady entirely left him, and he enjoyed his
" former health.

(*b*) C. 1. §. 11. Tom. I. p. 57, &c. * In Diſſert. de Noſtalgia Th. II. p. 4.

Of

Of Worms *in* Fiſh; *from the* Miſcell. Berolin. p. 43. *By* J. L. Friſch.

Tranſlated from the LATIN.

I Formerly ſuppoſed it a bold aſſertion of Dr. *Andry*'s, in his treatiſe of Worms in human bodies, where he ſays, p. 39. edition *Anno* 1700, that 'with regard to animals, there are ſcarce any, in which worms 'are not found.' For ſo many inſtances and ſo much experience are required to eſtabliſh this, as human induſtry can ſcarcely attain. However I begun, and made ſome progreſs in enquiries on this occaſion; and upon examination, I muſt confeſs, that I found worms in beaſts, birds, reptiles, in canker-worms, in flies, and ſuch like; inſects in inſects. And as the ſame author affirms in his 50th chapter, that 'Worms are found in moſt 'Fiſh,' I reſolved to examine ſeveral river fiſh, which I imagined to be the more liable to them in our river *Sprea*, as it is muddy and ſlow, and ſtagnates in many places, by reaſon of the ſluices and mills. Neither was I miſtaken, for I did not only diſcover different worms infeſting the ſkin and ſurface of fiſh, ſuch as leeches, lice, and ſome of the *Scarabæus* or beetle kind, but I found them alſo in their guts and head. Among other fiſh of this river, there is a ſort of whiting, which abounds remarkably with worms. The laſt I diſſected was ſcarce four inches long, yet had three worms, of which one was a foot, another 8 inches, and a third 5 inches long; ſo that the firſt was three times the length of the fiſh. They were not contained in the guts, but were concealed in the head, between the gills, adhering to thoſe red fibres, which many conſider as the lungs of fiſh. This very narrow cavity in ſo ſmall a head had obliged theſe worms, whoſe length together was 25 inches, to knot themſelves up. See plate III. fig. 2. The largeſt had the moſt, the ſhorteſt the feweſt knots; every knot rendering the body 3 inches ſhorter. They were meaſured after being unknotted. I obſerved an artery along the back, from their head to their tail, ſufficiently conſpicuous, by the blood it contained, and diſtinguiſhed, as often as they extended themſelves from the whiteneſs of their other parts; but which, upon their contraction, became more obſcure. The breadth of the body was gradually leſſened towards the tail, and terminated in a very acute angle. The head, or fore-part was ſomewhat obſcure, which it could retract in ſuch a manner, as tho' it had been cut off. I found the ſame ſort of worms too in the fiſh called bleak, which many authors call the Bream or *Ballerus*, and others the *Pleſtya*.

Pl. III. fig. 2.

The

The Mildew *in* Corn *accounted for. From the* Breſlaw Collection, An. 1718, p. 594.

Tranſlated from the HIGH-DUTCH.

THIS is the diſcovery of the celebrated profeſſor *Wolf*, in ſome meaſure indeed claſhing with what is commonly advanced on this head*. But his happier genius enables him to reduce to a degree of ſcientifical knowledge the moſt common, but neceſſary and uſeful facts in agriculture and gardening.

Wheat has been frequently obſerved to be mildewed; barley ſometimes, oats more rarely, to which we add millet, from our own experience. The remedies hitherto propoſed againſt it, have, he remarks, proved ineffectual, from the not rightly underſtanding the nature of the mildew; by ſome aſcribed to dews; by others to the ſeed itſelf: Entirely rejecting the fatty and oily dews, advanced by *Chomel*, *Becher*, and *Florini*; he propoſes his own notion of it, from ocular inſpection and obſervation: namely, that one grain of barley lodged in the box under the window of his chamber, and ſecured from dew and rain, became mildewed equally with what had been ſown in the open fields. The principal ear, as alſo one of the ſide-ears proved good, and again produced good ſound ears; but another ſide-ear was mildewed and yielded others mildewed too: The beards of the mildewed ears were neither long, ſtreight nor green, but twiſted and whitiſh; the grain fuller than that of the ſound ear, but moſtly black, ſprinkled up and down with green: Towards the point the grain divided into three parts, ſo as that on each ſide other grains ſeemed to ſhoot out, or three corns to grow into one: And by the microſcope, the mildewed barly corn appeared a monſtruous production with three bodies; as did an oat-corn, monſtruous, and ſpotted black.

From which he concluded, (1.) That mildewed corn is nothing other than a monſtruous production. (2.) That the motion of the juice in ſuch miſhapen figures was impeded. (3.) That the juice comes to ſtagnate, and conſequently, (4.) To corrupt.

The cauſe of ſuch monſtruous productions, our author could not hitherto diſcover; and to this he aſcribes the miſcarriages in the cure.

* Vid. Act. Germ. Vol. I. p. 132.

On

On the Uſefulneſs of Aſhes *in* Agriculture. *From the* Breſlaw Collection, An. 1718. p. 1388 & 1409.

Tranſlated from the HIGH-DUTCH.

FOR the improvement of land, and particularly for the increaſe of corn, many have had recourſe to ſalt, eſpecially nitre; after having obſerved, that ſoils, much impregnated therewith, manifeſt a greater degree of fruitfulneſs than others; as for inſtance, the province of *Xantung* in *China*; where the earth is as ſalt as ſea-water, yet producing the fineſt corn, beſt grapes, *&c.* of any part in the world, not only for quality, but in conſiderable quantity too (*a*). And the *Chineſe Denys Kao* teſtifies, that any one year's crop is ſufficient to ſupport the inhabitants for ten years running (*b*). In the ſame manner is the fertility of the *Ukrain* to be accounted for; tho' here more owing to art than nature; in regard that every ſpring they there burn down the graſs, that has been withering all the winter over, and which, when green, could have reached above a horſe's belly; and the reſulting aſhes, as an alcali ſalt, may greatly ſerve to improve land.

But in what manner ſalts, eſpecially the nitrous and alcaline ſort, exert their virtues; whether by a material influx upon the mixtion of plants, or by keeping the ſoil moiſt? as alcali's eſpecially attract the moiſture of the air and earth, thereby ſupplying abundant nouriſhment for the increaſe of vegetables; or whether in any other manner; is ſtill a queſtion?

Potaſh or ſoap-boiler's aſhes have, after elixation, been found greatly to improve lean, ſandy and dry grounds: And upon making an experiment with theſe aſhes and common dung, on two diſtinct parcels of land, ſowed with four buſhels of corn each; from the aſhes there were reaped 11½ ſhocks, and from the dung, not quite 7: The ſtanding corn from the former was upwards of 4 foot high; and each ſhock yielded from 5 to 6½ buſhels: The other from the dung was ſcarce half ſo high, giving only about 3 buſhels the ſhock.

I take aſhes to be the quinteſſence of all dungs, in regard that they not only make the ſeed fruitful, and promote its increaſe and ſhooting greatly, but ſerve alſo to root out all manner of weeds; nay, greatly cleanſe paſture-grounds, tho' all over moſſy, rendering them in a ſhort time a fruitful clover-bottom: Whereas dung, on the contrary, eſpecially the freſh ſort, does, on the ſcore of its crudity, promote the growth of weeds.

Aſhes

(*a*) Paliſſy. Tr. Moyens pour devenir riche p. 221 ſeq.
(*b*) Vid. Iſbrand Ydes Voyag. p. 270.

Aſhes mixed amongſt good clean wheat, and daily ſtirred in with it (the wheat thereby turning ſo hard as ſcarce to be bit) are obſerved to prevent its mildewing little or any: The ſame thing holds of old corn, as that of one or two years old, and for the ſame reaſon, namely, its becoming hard: Lime alſo has the ſame effect.

A particular account of the manner of preparing the Blue Aſhes *in* Pruſſia. *From the* Breſlaw Collection, An. 1718. p. 1391.

Tranſlated from the HIGH DUTCH.

TO the preceding account we think it not improper to add the method of preparing the Blue-aſhes, a ſpecies of Potaſh, as it was communicated to us by Mr. *George Hellving*, miniſter at *Angerburg*, as follows.

The Blue-aſhes are prepared from the common aſhes, procured from the burnt wood of lime, beech, willow, hazel trees, *&c.* the turpentine kind, as the fir, pine, *&c.* being unfit for the purpoſe. The wood is firſt burnt to aſhes in the open air, then the aſhes are preſerved under a ſhed, to ſcreen them from the wet: After procuring a ſufficient quantity of theſe aſhes, you run or melt them thus: Firſt ſeparating the beſt aſhes from the worſt, you throw the former into a furnace, prepared for the purpoſe, in which they are burnt or calcined, till they come to run or melt: The melting is promoted by a lye made of the worſt of the aſhes, and with this lye the beſt are continually watered, then mixed and ſtirred together, till the matter become of a thick conſiſtence, after which they proceed to the melting them: The lye, to be fit for the purpoſe, is boiled till it turns thick, and has a ſkim a finger thick upon it. After the aſhes are fully calcined and run together, they ſhew blueiſh; and then they are packed up hard in caſks of ſeveral ſizes, and prove a conſiderable branch of trade, which is carried on at *Konigſberg*, *Elbing*, *Thorn*, and *Dantzick*, and from thence to *Holland* and *England*. The aſhes, when burnt from a ſoft kind of wood, ſhew of a light blue, but from a hard, of a dark blue. This ſort of blue aſhes is employed in dying, ſoap-boiling, *&c.* and is inferior in goodneſs to the potaſh, as this laſt requires a better ſort of wood, and a larger quantity of aſhes; yet preferable to the weed-aſhes, as theſe are thrown into a furnace and burnt without any lye. In other reſpects the Blue aſhes are very ſharp, affect the tongue, and hold much ſalt; they muſt always be kept dry, as on the acceſs of moiſture, they turn like a lime or meal, and muſt be worked over again. The workmen muſt avoid uſing roots of trees, or any oak wood, as the former are full of earth, and ſpoil the aſhes, and the latter yield no good aſhes. The apparatus for this proceſs are 6 large

and 6 ſmall troughs to each houſe, theſe laſt being for holding the lye; two coppers of $1\frac{1}{2}$ ton built up with maſonry; a ſmelting furnace, and a good ſecure ſhed for the aſhes.

From Olaus Roemerus *to* G. G. Leibnitz, *concerning an Inſtrument of his own invention, for aſtronomical Obſervations. From the* Miſcel. Berolin. Pars. II. p. 276.

Tranſlated from the LATIN.

OUT of a number of thoughts, I ſhall at preſent collect one concerning an inſtrument, for which I have longed to ſee a proper chamber or building theſe twenty-five years, but never met with one compleatly to my wiſhes.

The inſtrument is a meridional axis ſix feet long, revolving round the poles A B, ſupported by ſolid walls, and carrying in its middle, the meridional circle E, of 4 or 5 feet diameter, with the tube C D of 6 or 8 feet, which revolving in the axis A B, purſues the whole meridian to its very horizons, within 4 or 5 degrees. The inſtrument muſt be fixed in a covered apartment, 6 feet broad, which is the diſtance of the Walls. Its length, accordiug to the meridian, ſhould be 30, or at leaſt 25 feet, and its heighth not leſs than 20. And that the whole meridian may appear on the circumvolution of the tube, the top of the walls ſhould have a continued fiſſure or chink 4 inches wide, the walls of this nearly biſſected apartment being bound together by the intervention of a few iron bars.

Pl. III. fig. 3.

The inſtrument itſelf being eaſily contrived, the chief difficulty lies in procuring a building of proper ſtrength and ſituation for the admiſſion of it, which muſt be conſidered as its neceſſary appendage and accompliſhment. It can be no ways neceſſary to make either the inſtrument or its receptacle any larger. Beſides three clocks of the ſame ſize and fabric, there is no occaſion of any other inſtrument; all our care ſhould be confined to the firm ſtructure and conſtant motion of it.

Its uſe conſiſts in determining the right aſcenſion and declination of all viſible points in the heavens, the former by the clocks, the latter by the circle adhering to the tube and axis. If it were not over tedious, I could annex ſeveral uſeful mechanical obſervations, in managing the parts of this inſtrument, having experienced it for eight years, during which time I have made uſe of ſuch an axis (tho' very imperfectly fixed) with no contemptible ſucceſs, which, God willing, I may hereafter demonſtrate, by publiſhing my obſervations.

Copenhagen, Decem. 15, 1700.

A Re-

A Remedy for the Scurvy in Greenland. *From the* Acta Haff. P. 35.

Tranſlated from the LATIN.

HERman *Nicolai*, who had been twice at *Greenland*, informs us of their common remedy for the Scurvy, which rages ſo vehemently among them, as to take away the uſe of their limbs. He obſerved ſuch great abundance of ſcurvy-graſs and ſorrel to grow in a mountain in *Bear-Iſland*, as to embarraſs foot-paſſengers, which, it was alſo remarkable, never grew a-part, but cloſe together; as if it were a natural indication for compounding them medicinally, as each by itſelf might be prejudicial, one abounding with an acrid volatile ſalt, the other being ſenſibly replete with an acid; the reſult of which combination and mixture is of an intermediate quality and nature. The common method of uſing them in *Greenland*, is to make a broth of the freſh fleſh of birds or rain-deer, with a decoction of oats or barley, and to impregnate this ſoup with theſe anti-ſcorbutic herbs, which proves an extraordinary medicinal diet, that keeps the body open, evacuating the corrupt humours as readily as a purging potion, and ſo thoroughly purifying the juices, that the patient ſeems to attain a new conſtitution.

Birch Beer. *From* T. Bartholin. Act. Haff. p. 49.

Tranſlated from the LATIN.

THE juice of birch is ſerviceable to perſons afflicted with the ſtone, as well as the dropſy, being plentifully furniſhed with a vegetable ſalt. Dr. *Payngk*, the king's chief phyſician, frequently compounded it into a nephritic draught, with a water diſtilled from wild thyme and mulberries. A beer is made from the juice of this plant of ſingular flavour and ſervice, which the noble *Peter Reſen* preſident of *Copenhagen* uſes as a precaution againſt the ſtone. If malt-liquor brewed with oatmeal is ſubſtituted in the room of that brewed with barley, it becomes more efficacious, of which the *Engliſh* have experienced the advantage in nephritic patients. To which if our common carrot-ſeed were added, or ſuffered to infuſe in it during fermentation, it would bid fair for a very efficacious beer in ſuch diſorders.

A Dripping or Stillation of Urine; *by* T. Bartholin. *From the* Acta Haff. p. 52.

Tranſlated from the LATIN.

A Colonel, who was troubled with a continual dripping of his urine, could not reſtrain or ſtop it, without a manual compreſſion of the *perinæum*. Being conſulted about this diſorder, I imagined there was a reſolution of the *ſphincter* of the bladder from the acrimony of the urine: To ſoften which acrimony, and to relieve and reſtore the *ſphincter*, I preſcribed an emulſion of almonds, with the cold ſeeds in barley-water, which effectually repreſſed this complaint.

Of the Elk, *and the reaſon of its being ſubject to the Falling-ſickneſs. From the* Breſlaw Collection, An. 1718. p. 1524.

Tranſlated from the HIGH-DUTCH.

THE Elk, an animal very common in *Pruſſia*, *Courland*, *Livonia*, *Norway*, and the other northern countries, is as high as a large horſe; his body of the deer-make, but much thicker and longer; the legs high, the feet broad and cloven; the horns large, rough and broad, like a wild-goat's; yet not furniſhed with ſo many ſmall horns as the deer; its fleſh fit to eat, and ſerved up at the tables of the greateſt perſons.

This animal is ever and anon ſubject to the falling-ſickneſs; a circumſtance that favours its being taken, which would otherwiſe prove a very difficult matter. Upon diſſecting one, there were found in its head ſome large flies, with its brains almoſt eaten away. It is an obſervation ſufficiently atteſted, that in the large woods and wilderneſs of the north, this poor animal is attacked, towards winter chiefly, by a larger ſort of flies, that thro' its ears attempt taking up their winter-quarters in its head: Whence it is no difficult matter to conceive how the humming and buzzing of theſe inſects, with their devouring its brains, muſt needs ſubject it to ſuch a diſtemper. *Hellving*, a divine of *Angerburg* in *Pruſſia* informs us, he has ſeveral times obſerved a brood of flies diſcharged from the Elke's noſtrils; and the head internally ſtuffed with them: The nearer they lie to the noſtrils, the more perfect, and the deeper in the head, the more imperfect they were obſerved; ſome of theſe laſt being ſtill in their maggot-ſtate: And which is ſurpriſing, they alſo bred in the

the ſkin of this animal, and particularly about the ſpine; and being come to perfection eat their way thro' it.

A method of entirely removing and renewing the Bark *of* Trees. *By* J. L. Friſch. *From the* Miſcell. Berolin. Contin. II. p. 26.

Tranſlated from the LATIN.

THE lord of *Carpzow*, a generous promoter of all uſeful ſtudies, communicated to me his method of recovering the bark of fruit-trees, of which he has great numbers, in his fine orchard at *Carpzow*. If he ſees an apple or pear-tree with an unſightly rough coat, a cherry with a reſinous ſtock, or deformed with excreſcences, or any other defect in the Bark, that might poſſibly either impair the future fæcundity of the tree, or which viſibly leſſens the handſome appearance of it, he is not content with the common methods of redreſſing them: He does not ſhave away the roughneſs; he does not remove any particular piece of the outward bark, nor cut away knots and plaiſter them over, nor wound the grain of the tree; but, what may appear more ſurpriſing, he ſtrips off the bark entirely from the loweſt boughs to the earth; and indeed does not only remove the hard, external bark, but the thin, interior one; ſo that the naked wood appears, without the leaſt fibre of its cover adhering to it. When this nobleman firſt aſſured me of the innocence, and even efficacy of this method of curing the diſeaſes of trees, I could not diſſemble my doubts, as it ſeemed contrary to common experience: For 'tis well known that ſuch trees die, as have been deprived only of a ſmall part of the bark, if the ſeparation has been circular, and quite round the body of the ſtock. But as this nobleman afterwards favoured me with the ſight of a great number of trees, which had been treated after this manner, and contracted freſh barks, experience has convinced me of what I muſt think was, before this experiment, unknown to us; or, if it was known, it does not appear that any other ever ventured to practiſe it. Wherefore with the approbation of the author of this method, and for the benefit of botany, and phyſics, I ſhall communicate what I thought remarkable and neceſſary in this operation.

Firſt, let the ſeaſon for it be the ſummer ſolſtice, at which time the juices flow more liquid and copious; not overlooking the ſituation of the garden or orchard, as they flow more readily in trees that enjoy a ſouthern expoſure, than in others.

Secondly, let the whole body of the ſtock be entirely ſtripped of its Bark, as any remaining inequality would deform the tree, that is to reſume a new, entire and ſhapely covering.

Thirdly,

Thirdly, let the moiſture that exſudes from the ſtock be ſpread ſmoothly and equally, with a quill or feather, wherever it ſhould ſtagnate; and let it be diſpoſed and derived to ſuch parts, as are not ſpontaneouſly covered with it.

Fourthly, leſt the violent heat of the ſun ſhould diſſipate the efflux of the juices, let the ſtock be ſhaded; more eſpecially on the ſouthern quarter. This alſo defends it from being diſturbed by any kind of duſt the winds might force upon it.

Laſtly, let there be a particular care to avoid any external impreſſi on on the tender renaſcent bark, as the leaſt friction muſt injure it in that ſtate.

This diſcovery cannot fail of being very uſeful to thoſe trades, that the bark of any trees are employed in, and muſt be eſpecially profitable to the proprietors of ſuch trees.

The Anatomy of a Monkey, *called a* Mamonet; *by* T. Bartholin. *From the* Act. Haff. p. 67.

Tranſlated from the LATIN.

Pl. III. fig. 4 THERE was diſſected in the houſe of *Henry Jacob Scriverius* the king's chirurgeon, a Monkey from *India*, of an unuſual figure, called a *Mamonet*, which died in *Fort Royal*. He had a hog-like head, was bare-buttocked, and of a colour ſomewhat like *minium*, or red lead. We meet with no draught among the writers on animals, that reſembles this. *Johnſton*'s Monkey, deſcribed in the 59th table had a long tail, but this was without any. *Geſner* tells us of one, p. 862, not very different, excepting that its head rather reſembled a Dog's. *Albertus Magnus* calls one ſpecies of Apes with tails *Mamonet*. *Geſner* further ſays, p. 856, that the *Mamonet* is an animal leſs than an Ape: But ours is larger, and has no tail, ſo that we may ſuſpect, as this creature is delineated by none, and has a very horrible countenance, it is either a monſtrous production, or one not hitherto ſeen or depicted. But however that may be, we were, many of us, invited by *Scriverius*, to the diſſection of this *Mamonet*, where we obſerved the following appearances, which I do not remember to have ſeen in other animals.

1. There was not the leaſt trace or reſemblance of a navel.

2. The teſticles were pretty large, and placed about the middle of the *os pubis* above the *penis*, which was conſiderably long, and provided towards the middle with two round muſcles, which ſerved to erect it. The greater *proſtatæ* were properly diſpoſed on each ſide, to which the ſmaller orbicular ones were annected. The *Veſiculæ ſeminales* were minute glands

glands, and without any contained humour, tho' the animal is extremely ſalacious, never looking at girls, without evident deſire and laſciviouſneſs.

The liver, conſiſting of three lobes, is furniſhed with the ſame number of lymphatic bladders, as large as a fiſt, ſtrictly joined about the middle of their convexity to the *parenchyma* or membrane of the liver, tho' ſeparable without much difficulty; and being contained within the concavity of the lobes, they are accompanied with leſſer *veſicles*, not unlike the manner obſerved in the *ovaria* of animals. The coat of theſe bladders was pretty thick, and diviſible into farther membranes: They contained a pure lymph, which being expoſed to the fire remained thin or ſimple like water, the glutinous parts of it very probably concreting into membranes. This water was ſecreted from the liver by ſome inviſible paſſages.

4. A *veſica* or bladder of the ſame kind was alſo found in the lungs.

5. A grumous maſs of blood, adhering by certain fibres, was found in the ventricles of the heart, which, obſtructing the circulation, kill'd the creature.

6. A great quantity of water was collected between the ſkin and the muſcles of the head, which might be conſidered as a dropſy, and be induced by the difference of air and diet, and the drinking of beer.

7. His ſpine was manifeſtly bowed and tortuous, but whether naturally, or otherwiſe, I am ignorant.

8. The ſpleen was very ſmall, being ſcarcely as long as the breath of three fingers.

9. The *ſeptum cordis* ſeemed to be very perviouſly porous, which circumſtance may be worth enquiring into in other Animals.

Extract of a Diſſertation, firſt publiſhed in High-Dutch, An. 1717; *by* J. C. Schott. *From the* Miſcell. Barolin. Vol. III. p. 336.

Tranſlated from the LATIN.

THERE is a ſtone, of very elegant workmanſhip, in the royal jewel- Pl. III. fig. 5
chamber at *Berlin*, and of no little ſingularity, with regard to the emblem or device of the ſculpture, under which the deſigner undoubtedly propoſed to couch ſome latent ſenſe, and profound meaning; and in the enucleation of which antiquaries have not ſweated and differed a little. Many of them conclude the human face in the jewel to refer to *Socrates*, and the other figures, to his accuſers, which they endeavour to evince by ſuch arguments, as, in ſo obſcure a matter, are not without ſome probability, tho' they afford little demonſtration. Neither is their opinion much better ſupported, who endeavour to interpret it of the rural god *Pan*.

Pan. Other perſons ſuppoſe it pregnant with a divine or myſtical purpoſe, while ſome imagine it to refer to an hiſtorical event, to romance, prodigy, magic, or finally to be only a meer exerciſe of the wit and imagination. But to me, I confeſs, this ſymbol ſeems truly to deſignate the merit of ſome extraordinary prince, both in war and peace, and his aſſiduous culture both of the religious and civil rights of his ſubjects.

The venerable head of an old man is the ſymbol of ſage advice: Age ſeems qualified to deliberate; youth to execute. Thus *Florus* in his account of *Romulus* ſays, lib. 1. chap. 1. 'The youth, divided into tribes, 'were always prepared for any ſudden action; the care of the common-'wealth was committed to people of mature underſtanding, who were 'named *Fathers* from their authority, and the *ſenate* from their age.' The rays or points, prominent from the bald head, deſigure an extraordinary meaſure of ſupernatural light in the underſtanding. They reſemble thoſe which are circumfixed in old coins, to the face of the ſun, after which the *Romans* faſhioned the *radiated crown*, they uſually adorned the heads of their deified emperors with. It is altogether probable they intended to ſignify ſomething divine and celeſtial by theſe rays, which ſuppoſition may be very naturally referred alſo to this radiated head: To which purpoſe *Seneca* ſays, epiſt. 41. 'The rays of the ſun are con-'tinued to the earth indeed, but exiſt peculiarly in the place from 'whence they are emitted: Thus a great and exalted ſoul may be ſent to 'furniſh us with a juſter reliſh of divine things. It converſes indeed with 'men, but adheres to its perfect origin.'

The excluſion of youth from the cabinet is not a neceſſary conſequence of this; it only follows, that our counſels ſhould not be precipitate, but more agreeable to the pace of age, conforming to that device of *Auguſtus*, *Feſtina lente*, which *Suetonius* informs us, he applied to military conduct, affirming a cautious general to be preferrable to a bold and forward one.

War is to be commenced after mature deliberation: War is repreſented by the head of a fierce horſe. Their continual uſe in war made them a ſymbol of it, and *Anchiſes* prognoſticates war from the ſight of thoſe noble animals, upon his firſt arrival in *Italy*.

——— *bellum O terra hoſpita portas,*
Bello armantur equi, bellum hæc armenta minantur. Virg.

Steeds on theſe ſeats our future wars proclaim,
For ſteeds, employ'd in war, denounce the ſame.

This creature was alſo ſacred to *Mars*, and thoſe harnaſſed to his war-chariot were named *Pavor* and *Terror*. *Natal. Com. Myth*, *L.* ii.

The

The laurel he holds in his mouth, denotes victory, and was always dedicated to triumphs and conquerors. *Apollo* thus addreſſes his beloved *Daphne* at the inſtant of her transformation:

Tu ducibus lætis aderis, cum læta triumphum
Vox canet, & longas viſent capitolia pompas. Ovid. Met.

Crowning the chiefs whom ecchoing triumphs raiſe,
Thy leaves ſhall publiſh conqueſt, joy and praiſe,
While the long pomp the capitol ſurveys.

The laurel was alſo a ſymbol of immortality.

Peace ſucceeds the glory of conqueſt, which is expreſſed by the *Caduceus* or Wand, engraved on the jewel behind the horſe: The ſerpents wound about the wand are a ſymbol of the force of prudence and eloquence, by which peace is procured and concord effected between the moſt violent natures; whence thoſe who were ſent to treat of, and conciliate a peace, were termed *Caduceatores*.

The improvement of agriculture and farming enſues on peace, whence follows a general plenty. This is repreſented in the ſtone by the head of a weather, with an ear of corn in his mouth. This creature was ſacred to *Mercury* the god of trade, and is the ſymbol of traffick, from its extenſive uſe, and the variety of commodities produced from it; and as *Mercury* is alſo deemed the author of manufacturing it.

Tertullian, talking of the ancient *Pallium* or cloak ſays, 'that *Mercury* 'is ſuppoſed, on his being delighted with the ſoft wool of a ram, to 'have ſlead a ſheep, and after forming the wool into yarn, to have 'wove it into the ſhape of that ancient garment, which he wound about 'with the tender bark of *Philyra*.' This opinion is ſupported by a ſtone mentioned by *Leon*: *Auguſtin* in the edition of *Gronovius*, *L.* 2. *N.* 2. where *Mercury* is repreſented leaning on a ram, with his rod in his left hand, and a purſe behind his head; as he was eſpecially credited with the care and increaſe of herds and cattle, in which the riches of the firſt ages chiefly conſiſted. *Cælius Rhodiginus* remarks, *lib.* 16. *cap.* 19. 'Some 'have called *Mercury*, *Kerdous* or lucrative, as preſiding over traffick 'and gain, for which reaſon they have added a purſe to his other *in-* '*ſignia*.'

The ear of corn repreſents plenty, as one of the bleſſings of Peace. Thus *Tibullus* ſays, Book 1. Elegy 10.

At nobis pax alma veni, ſpicamque teneto.

——— Sweet peace draw near,
Approaching gently with thy foſt'ring ear.

And in old coins, not the ear only, but the very grain denoted its own abundance. This is obſervable in a coin of *Auguſtus* in the royal treaſury of *Berlin*, on the reverſe of which a woman holds a *Caduceus* or wand in her right hand, and in her left, ears of corn intermixed with poppies, with the inſcription PAX; the poppy being alſo deemed a ſymbol of great fæcundity.

The upper figures of this ſculpture are ſupported by the legs of a cock, which are eaſily diſtinguiſhed by the ſpurs. The ancients aſcribed alacrity, vigilance, and prognoſtication to this bird, and therefore ſuppoſed it ſacred to *Mercury* the alert, *Minerva* the vigilant, and prophetic *Phœbus*. In the preſent emblem its vigilance is chiefly referred to, as the hieroglyphic of a cock may deſigure an induſtrious perſon,' effecting 'all things thro' great attention and aſſiduity, as all pious magiſtrates, 'and perſons preſiding in religious matters ſhould,' as *Pier. Vallerius* obſerves *Hieroglyphics*, Book II. Wherefore the cock is alſo a ſymbol of that piety, that ſtimulates a good prince to the care of religion, for the glory of God, and benefit of his ſubjects. *Pliny* mentions one reaſon for this in his natural hiſtory, Book X. Chap. 21. 'Of all birds, ſays he, the cock 'alone frequently eyes the firmament.' And he adds, that he is a terror to the lion and even to the baſiliſk. This preſaging bird farther reminds us of that prudence, which diſpoſes a provident prince, as it were by divine admonition, to be ever prepared againſt future events. That cocks have foretold a victory by their crowing is evinced by by two inſtances. One is antique, which *Tully* records. 'At the ſame time, while *Trophonius* was 'ſacrificing at *Lebadia*, the cocks there crowed without the leaſt intermiſ-'ſion; upon which the *Bœotian Augurs* ſaid, the *Thebans* had obtained a 'victory, becauſe that bird when conquered was ſilent, but crowed, when 'victorious.' The event proved the verity of this prediction, the *Lacedæmonians* being deſtroyed by them, under *Epaminondas*, with great ſlaughter. *Cernitius*, a grave author, furniſhes us with another example, in the hiſtory of the electors of *Brandenburg*, where talking of *Joachimus* (at that time prince, and afterwards the ſecond elector) he ſays, 'On the 10th of *Auguſt*, '1532, the baggage being ſent before with 2000 horſe, the Marquis *Jo-'achimus* ſet out on his march againſt the *Turks*, when there happened an 'extraordinary and unuſual thing at *Berlin*; for chickens that had not 'been hatched above 2 or 3 Days, cackled and crowed ſo inceſſantly, that 'it ſeemed evidently ominous; and the omen was thought good, as crow-'ing was ſuppoſed to preſage victory. And the event was truly proſper-'ous; for *Joachimus* was not only preſent at the bloody battle of *Leopold-'ſtadt*, but *Coſſon* the *Turkiſh* general being ſlain, he deſtroyed the remains 'of the fugitive army.' To which we might add *Pliny*'s obſervation, 'That theſe fowls preſerve a rule in their families, and exerciſe a govern-'ment wherever they are kept.' In this point, he is no ill reſemblance

of

of a magnanimous prince, who is capable at, all times and places, to defend and adorn the dignity and excellence his maker has diſtinguiſhed him with. Thus have we proved the cock to be an acknowledged ſymbol of induſtry, vigilance, religion, magnanimity and preſcience, virtues that conſtitute the accompliſhment of the greateſt princes; which being conſidered with our explication of the other figures, ſtrengthen our concluſion, that the device of this ſtone was intended to repreſent ſome monarch, accompliſhed with all the arts of peace and war, and a conſummate knowledge of adminiſtring the religious and civil duties of his empire; from whence I muſt conclude, that this ancient jewel was ſet in a ring of one of the *Cæſars*, or ſome other extraordinary prince, and worn and uſed as a ſignet. The ſimplicity and ſingularity of the figures greatly countenance this opinion, as it was the old cuſtom to couch the precepts of wiſdom and morality under ſuch. The price and uſe of this kind of ſtone makes this farther probable, if we may credit *Pliny*, who ſays, it was more frequently uſed for this purpoſe, as it was engraved with leſs difficulty than other jewels, which were alſo very apt to cohere with the wax, which the *Sardian* or *Cornelian* ſtone was leſs ſubject to, as *Pliny* obſerves.

Luſibus ingenii ſimiles opponere luſus
Quid vet at ?

THE firſt figure is not a human head as the former interpreter imagines, (for it is without a neck) but a theatrical vizor, which mimicks one. Three points or rays emerge from this vizor, which cannot be ſuppoſed ſo many parts of a radiated crown, ſince they are fewer than requiſite, and are deſtitute of a common ring or connexion. Let theſe *Apices* amuſe ſuch, as hunt for great matters in every trifle: But the maſk or vizor is univerſally allowed to be the ſymbol of hypocriſy. Hence *Petronius* calls it a falſe and diſſembled face.

A different explication of this device; by *J.G. Wachterus*.

Mox ubi ridendas implevit pagina partes,
Vera redit facies, diſſimulata perit.

Actors, their parts abſolv'd, their vizors leave,
To wear the countenance that nature gave.

And *Pinicelli*'s inſcription on it was: *Vera latent*; the true one is concealed.

Now diſſimulation is the principal artifice of tyrants: For tho' all men behave with ſuch reſerve and concealment, that our common nature may ſeem, in ſome degree, to uſe a vizor; yet in the life of a tyrant there is an univerſal hypocriſy and diſguiſe, in as much as they are more wicked than other men, and judge of the diſpoſition of all by their own. *Dion*

gives us ſuch a picture of *Tiberius* P. 57 — 'He never profeſſed what he 'deſired, but conſtantly uttered ſentiments very different from what he 'thought, oppoſing what he coveted, and aſſenting to what he abhorred. 'He pretended wrath when he was leaſt diſpleaſed, and æquanimity in 'the depth of indignation. He profeſſed pity, where he determined to 'puniſh, and diſſembled a prejudice to ſuch as he deſigned to pardon. 'He received thoſe he conſidered as his worſt enemies with the moſt be-'nevolent aſpect, and his friends with a very ſtrange and forbidding one. 'He uſed to ſay, the real intention of a prince ſhould be acceſſible to 'no man: That the knowledge of it produced many and great evils, 'and its concealment more and greater benefits: And if this had been 'his only ill quality, it would certainly have been ſufficient to defeat the 'caution of thoſe perſons, who had any tranſactions with him; when tak-'ing all things contrary to his real ſentiments, they muſt ſuppoſe him to 'deſire what he was averſe to, and be diſguſted with what he chiefly co-'veted. At one time he was ſo enraged, if any one acted in conſe-'quence of his declared opinion, that many were put to death for no 'other reaſon: So that it was dangerous not to penetrate into his very 'ſoul, as many experienced, who aſſented rather to his expreſſions, than 'his will; and yet there was ſtill greater peril in being acquainted with it: 'For theſe were conſidered as prying into his intentions, which engaged 'his ſuſpicion and hatred. Finally, he was commonly the ſafeſt (if ſuch 'a ſituation could occurr) who was neither ignorant of his diſpoſition, nor 'ever contradicted it: For ſuch a man was neither led into a miſtake by 'believing him, nor did he incurr his hatred, by diſcovering that he was 'acquainted with his deſigns.' With ſuch a diſpoſition, and ſuch arts, *Tiberius* obtained and held a crown, not ſo truly a man as a viſor or maſk, as we have demonſtrated.

The ſecond figure is the head of a horſe with a crown of laurel in his mouth. The horſe is acknowledged to be a type of war and warriors: the laurel in his gaping mouth denotes that paſſion for glory and empire, which ſtimulates a tyrant in the proſecution of an unjuſt war: For tyrants do not enter upon hoſtilities to repel invaſion, or enjoy peace, the only juſtifiable motives of arms, but for the ſake of fame and conqueſt: Nay, even conqueſt itſelf is not purſued by them for the ſake of glory alone, but as it enriches them alſo with the ſpoils and treaſures of the nations they ſubdue or plunder. The *Romans* were of this diſpoſition, as *Mithridates* atteſts, in his letter to *Arſaces*. 'The perpetual and only motives of 'the *Romans* warring with all kings and nations, were, (ſays he) 'their inſatiable ambition of wealth and dominion.' This paſſion tyrants eſteem as the peculiar and prime ornament of regal inſolence. *Tiridates*, king of *Armenia*, and *Solyman* the ſecond, emperor of the *Turks* are ſufficient inſtances of this; the firſt of whom commonly ſaid, that it was the glory of a monarch to hold faſt his own property, and

endeavour

endeavour to poſſeſs himſelf of other people's: And the latter, on the capture of *Rhodes*, *A. D.* 1522, made this anſwer to his grand maſter of the horſe: 'That it was the prerogative of a monarch, deſcended from 'ſuch, to invade and plunder others, not indeed from the ſtimulations 'of avarice, but the glorious paſſion of empire; and that he conſidered 'the oppoſition of any neighbour as a ſufficient reaſon for deſtroying him!'

With regard to the *Caduceus* or Rod, nothing is a more certain indication of tyranny: But leſt this ſhould appear ſurpriſing, we muſt reflect, that in the decyphering of emblems, the ſame thing frequently admits of various, and even oppoſite ſignifications, of which indeed ſome may be more common and familiar, and others more abſtruſe, and abſtracted from the conceptions of the vulgar: Such we find the *Caduceus* was eſteemed by the poets, being alike the enſign of peace, and of ſuch violence alſo, as terminated in death itſelf. Whence it is called the *Caduceus*, from *cado*, as not only determining and putting an end to the contentions of men, but to the parties alſo; which mortal efficacy of the *Caduceus* is maintain'd by *Virgil:*

——*animas ſub triſtia tartara mittit.*

It drives the anxious ſouls to dreadful ſhades.

The very ſame things are effected by a tyrant's rioting in the blood of his ſubjects, while he puniſhes the guiltleſs, and deſtroys multitudes, before their time, by the ravage and licentiouſneſs of war: So that if we were to ſtudy a proper device for a tyrant, it would be difficult to diſcover any ſo compleat and well-adapted as the *Caduceus*, with the aforeſaid motto from *Virgil*. The *Virga* or Rod of it, ſo called, a *vi regendo*, from governing by force, denounces in its very appellation, the violent ſway of one over all: While the ſnakes, with their reciprocal morſures, pourtray that ſolicitude and internal anxiety, which continually gnaw the tyrant.

——— —— *diri conſcia facti*
Mens habet attonitos, & ſurdo verbere cædit,
Occultum quatiente animo tortore flagellum. Juv. Sat. 13.

To conſcious minds interior horror ſprings,
And guilty ſpirits ſmart with inborn ſtings.

This is what the poets ſeem to have intended under the notion of the furies, whoſe whips terminate in ſerpents; as it is a received opinion, that deeds of wickedneſs are ſcourged by ſtings of conſcience. *Socrates* has excellently depictured theſe interior viper-like gnawings, which *Tacitus* has copied: 'Could the minds of tyrants be diſſected, ſays he, there

'would

'would be many viſible ſtabs and lacerations: ſince, as the body is af-
'fected with external violence, cruelty, luſt and and impious devices rend
'the ſoul itſelf.'

It is further obſervable, that the cruelty of tyrants is generally blended with riot, and that they have been bloody in ſome proportion to their intemperance and luſt. This vice the ancients repreſented under the figure of a ram, wich is devoted to *Venus*, and ſignifies a perſon abandoned to luſt. *Venus* was worſhipped by the *Eleans*, ſitting on a ram. And at *Corinth* upon the tomb of that celebrated courtezan *Lais*, a ram was engraven, as couching under the ſeizure of a lioneſs; the meaning of which emblem is thus expreſſed by *Alciatus*.

Quid ſcalptus ſibi vult aries, quem parte leæna
Unguibus apprenſum poſteriore tenet?
Non aliter captas quod & ipſe teneret amantes;
Vir gregis eſt aries; clune tenetur amans.

What, wou'd the ram be claw'd, whoſe hinder veins
With bloodleſs gripes a lioneſs conſtrains?
Such to the fav'rite ewes his ardour deal,
Head of the flock, but govern'd by the tail.

This expoſition is confirmed by *Erizzus* and *Pierius Valerianus*: And *Artemidorus* affrms, that to dream of a ram's throwing a man off his back, ſortells the approach of an adulterer, who ſhall cuckold the huſband. Some of the moſt libidinous princes have ſtamped their coins with the figure of this animal, and there have been flatterers of ſuch abandoned impudence, as to uſe the ſame device on a medal of *Antinous*, in alluſion to the unnatural paſſion of *Hadrian* for him.

The figures, thus explained, are ſupported by the legs of a cock, as columns to the whole. This bird, it is confeſſed, from his frequent aſpect to the heavens, and his riſing before the ſun, has been often uſed as the hieroglyphic of piety and vigilance. But as theſe virtues reſide in the head, and not in the legs, which alone are repreſenred in the ſtone, it would be ridiculous to apply them to the ſhanks of the bird. But when we conſider, what theſe parts may properly refer to, the very reverſe quality, impiety itſelf occurrs, the ordinary employment of tyrants, and peculiar to the cock, who ſeldom heſitates to exerciſe thoſe parts in treading his mother, and wounding his father too. For which reaſon the wiſeſt legiſlators directed a cock, a viper, and a dog to be encloſed in the ſame bag with the condemned parricide, as aſſociates in the ſame impiety. And *Ariſtophanes* introduces a wretch, who had beat his father, defending his wickedneſs by the example of the cock.

As

As this interpretation ſtrictly coheres with the other figures, we find it correſpond with experience alſo. For ſome tyrants have been inceſtuous with their ſiſters, mothers, and daughters too: Others have dethroned their fathers: And tho' all of them have not arrived at the ſame fullneſs of impiety, yet moſt of them teſtify very little reſpect for their parents or progenitors, like *Alexander*, who, as *Salluſt* tells us, attempted a new path to glory, from a hatred to his father's qualities. In ſhort, I can diſcern nothing wanting in this device, to furniſh us with a compleat idea of a tyrant: Nevertheleſs, I ſhall not abſolutely conclude, that the artiſt really intended by this odd jumble of heads and feet, to deſigure the diſpoſition of any prince, good or bad; For we meet with no inſtance of this ſort either among old or modern writers. It ſeems more probable, that he had little farther intention, than to indulge and proſecute the abſurdities of his own raving and whimſical imagination, which ſort of drawings the moderns term *Groteſque*. But if we muſt needs diſcover profundity in emptineſs, and, infatuated with our imaginary penetration, muſt conceive extraordinary ſenſe and meaning under abſurd repreſentations, I muſt rather conclude, that if there is any meaning or deſign in this figure it muſt have been intended to deſigure no good prince, but ſome virulent tyrant.

SCHOLIUM *by the* TRANSLATOR.

WE might very well ſubmit this debate, wherein each party has ingeniouſly and learnedly ſupported his oppoſite explication, to the deciſion of antiquaries and medalliſts, ſaying very juſtly of ourſelves: — *non noſtrum eſt tantas componere lites*. It ſeems difficult however, not to obſerve, that the laſt decypherer of this figure has taken no notice of the ear of corn, which is undoubtedly entitled to ſome ſhare of whatever meaning the device may have. Indeed it would have been very difficult, if not impoſſible, to have made it ſymbolize properly with any ill quality of a tyrant; tho' it has a very natural application to the conduct of a good prince, which tends to eſtabliſh his ſubjects in peace and plenty. The head of a goat muſt have repreſented the luſt of a tyrant leſs ambiguouſly than a weather's, or even a ram's, which may very obviouſly refer to the increaſe of flocks, and the advantages ariſing from it. It may well be ſuppoſed alſo, that all ſuch devices are oftener intended to deſigure the good, than to record the tyrant. He would ſcarcely have been the inventor of an emblem, that might be readily applied to his own demerit and wickedneſs. No ſubject, or rather ſlave, would have dared to preſent him with ſuch; and probably none could think his actions either worthy the ſtone, or the workmanſhip.

The Momenta *of heavy bodies upon inclined planes determined; as alſo the quantity of preſſure ſuſtained by two planes joined together at right angles from an incumbent ſpherical body; by* G. G. L. *From the* Acta Eruditorum Ann. 1685. p. 501.

Tranſlated from the LATIN.

The determination of the *Momenta* of heavy bodies on inclin'd planes.

LET in fig. 6. plate III. the plane ADB be vertical, and the plane ACE inclined; in that let the body B have its tendency of deſcent, in this the body C, both which I deſign by the points in which their centers do exiſt. Let the bodies be connected by the ſtring BAC, and be in equilibrium, and the angle ABC a right one. I ſay, that the body B will be to the body C as the right line AB to the right line AC; which I thus prove. Laying hold on the ſtring, which I ſuppoſe to be without gravity, with the hand at C, and pulling downwards the body C to E and conſequently raiſing upwards the body B to D (after which, CE and BD will be equal) 'tis plain the equilibrium that exiſted between the bodies, does ſtill remain, and that the hand is neither aided nor impeded by them, and conſequently, that neither is their common centre of gravity (or the centre of the whole, compoſed of theſe bodies, or the centre of equilibrium) raiſed or depreſſed: And ſhould the common centre of gravity of the bodies in the poſition B, C, be in the right line BC parallel to the horizon, their centre, when in the ſituation DE, will remain in the line BC, otherwiſe it would be raiſed or depreſſed: But it is alſo in the right line DE, as being what joins their centre of gravity B and C, it will therefore be in H the common point of the right lines BC and DE.

Now from geometry a lemma, neither difficult nor unpleaſant may be demonſtrated; namely, that if CE and BD be equal, DH will be to HE, as AC to AB; of which anon. But the body E or C is alſo to the body D or B, as DH to HE, becauſe H is the centre of equilibrium; therefore the body C will be to the body B, as AC to AB, which was the thing affirmed.

The ſame thing may alſo be demonſtrated in a different manner, without aſſuming the geometrical lemma hinted at; if the body B be raiſed up as high as A, or if *d* fall in the point A, in that caſe C*e* or B*d* will be equal to BA, and *b* will fall in C, and *bd*, coincide, with CA; and C will be the centre of equilibrium of the bodies, transferred from B and C to A and *e*, and conſeqnently the body in *e*, that is the body C, will be to the body in A, that is the body B, as AC to C*e* or AB, as before. We here ſubjoin the demonſtration of the lemma.

Lemma.

Lemma. The baſes of all the triangles, having a coinciding angle and the ſum of the ſides about that angle equal, are cut by the baſe of one of the triangles in the ſame ratio ; *viz.* the ratio of the ſides of this triangle, placed about the common angle. Lemma.

Demonſtration. Let the common angle be FAM fig. 6. and let there be any number of triangles, as ABC, ADE, having the coinciding angle BAC DAE, and the ſum of the ſides BA + AC or DA + AE always equal (whence BD will be equal to CE) and let one of theſe triangles, as ABC, be aſſumed ; I ſay, that by its baſe BC is cut the baſe DE of any other triangle ADE, having the above conditions, into the parts DH and HE, which are in the ratio of AC to AB : From D to AC let DG be drawn parallel to BC, and from G to BC, GL parallel to AB. Now becauſe the triangles ABC and GLC are ſimilar, AC is to AB, as GC to GL, or to DB or to CE. Again, becauſe the triangles EGD and ECH are ſimilar, GC is to CE, as DH to HE ; therefore AC will be to AB, as DH to HE. Q. E. D. Demonſtration.

From the demonſtration it appears, that it matters not whether the the angle B be a right one, and therefore too DE the baſe of the triangle ADE cuts the baſe BC of the other triangle ABC, having the ſame ſum of the ſides about the common angle, ſo that the ſegments CH and HB are proportional to DA and AE, the ſides of the triangle ADE about the angle A, common to the triangles. The quantity of preſſure ſuſtained by two planes at right angles, from an incumbent ſpherical body

We now proceed to the ſolution of the caſe about the ſpherical body I (fig. 7.) incumbent at the ſame time on the two planes XC, and ZC, on the one in F, on the other in H, inclined to the horizon NO, but making with each other a right angle ; in order to determine the quantity of the *momentum*, wherewith each plane is preſſed. Demonſtration.

It appears on firſt ſight, that the body exerts a two-fold *momentum* on any one of the inclined planes ; one by which it tends to deſcend declinedly, the other by which it preſſes the declining plane, both which together conſtitute the abſolute or total *momentum* of the body. Therefore in our caſe, from two cauſes, either plane as XFC, is underſtood to be preſſed by the ſpherical body I : The firſt, that the body I tending to deſcend in the line FC of the plane XFC, with a *momentum* which is to the total one, as XN to XC, it will act with the remaining *momentum*, which will be to the total one, as XC − XN to XC, on the declining plane itſelf XFC, by which it is ſuſtained. But that action, tho' true and real, is notwithſtanding alternative, and weakened by the preſence of the other plane, which alſo ſuſtains it, as ſhall be afterwards explained : The ſecond cauſe of preſſure on the plane XFC is, that the ſpherical body deſcending in the other plane ZHC with a *momentum*, which is to the total one as ZO to ZC, preſſes with that very *momentum* the plane XFC, directly oppoſing its declining deſcent in the line HC, and thus receiving this force of

deſcent: And the ſame way of reaſoning may be uſed for the other plane ZHC, and that from thoſe two cauſes of preſſure; and from the firſt, the plane ZHC is preſſed with a *momentum*, which is to the total *momentum*, as ZC − ZO to ZC; but from the ſecond, the plane ZHC is preſſed with a *momentum*, which is to the total as XN to XC. And indeed the firſt cauſe of preſſure on the plane XFC, and the ſecond on the plane ZHC, which are diſſimilar, do together conſtitute the whole *momentum* of the ſpherical body; for the ſpherical body preſſes on the plane XFC, as it is ſuſtained thereby, and on the plane ZHC, as it is not ſuſtained by the former. In like manner, the firſt cauſe of preſſure on the plane ZHC, and the ſecond on the plane XFC, tho' diſſimular, conſtitute the whole *momentum* of the body. But ſimular cauſes conjoined, as two preſſions on account of ſuſtaining, or two preſſions on account of receiving, do not, taken from different partitions of the total *momentum*, integrate or compleat the total *momentum*. But when by four cauſes of preſſion taken together, the total *momentum* is twice integrated; 'tis plain, that taken abſolutely they are incompatible, nor to be compounded *cumulatively*, but only *electively* or *alternatively*; otherwiſe the effect of the ſpherical body upon the planes would be greater than the abſolute *momentum* of the whole body. But as it is manifeſt, that two cauſes in any one plane ought equally to be taken into conſideration, and yet cannot be retained entire, the rule of *alternatives* is to be employed, which takes place in eſtimating the expectancy of gameſters, and other caſes; that is, the half of both *momenta* is to be taken, or which comes to the ſame thing, an arithmetical mean between them, or half the ſum of both. If therefore the *momentum* of the ſpherical body be put unity, ſince the two *momenta* of preſſion on the plane XFC are $\frac{XC-XN}{XC}$ and $\frac{ZO}{XC}$ (if XC and ZC be put equal) it follows that the *momentum*, wherewith in this ſituation the plane XFC is really preſſed, will be half $\frac{XC-XN}{XC}$ + half $\frac{ZO}{XC}$, or $\frac{XC-XN+ZO}{2XC}$; and in like manner, the *momentum*, wherewith the plane ZHC is really preſſed, will be half $\frac{ZC-ZO}{ZC}$ (or half $\frac{XC-ZO}{XC}$) + half $\frac{XN}{XC}$; that is, $\frac{XC-ZO+XN}{2XC}$, the ſum of which 2 *momenta*, really preſſing on the 2 planes, compoſes the total *momentum* of the ſpherical body, or unity. In order to try the goodneſs of our rule, it will be of ſervice to conſider and compare therewith the ſolutions of particular caſes, otherwiſe known: As if NX be put equal to nothing, the plane XFC will be horizontal, and ZHC vertical, and the right lines XC and ZO equal; where alſo according to the rule the total *momentum* will come out for the preſſion on the plane

plane X F C, and nothing for the preſſion on the plane Z H C. But if the right lines X N and Z O be taken equal, and conſequently the angles X C N, and Z C O equal, 'tis then evident that both planes are preſſed in the ſame manner by the ſpherical body, and therefore that half the total *momentum* is ſpent on each, which alſo comes out by our rule. The method, which we have uſed, by the rule of *alternatives*, may be very uſeful in reſolving other perplexed and complicated caſes, tho' it be not purely geometrical, but in ſome meaſure metaphyſical too; whence it may be looked on as proviſional, till the ſame thing can be demonſtrated in another way, more geometrical and rigorous, according to the common notions. 'Tis to be obſerved, that what we have determined about the preſſion of each plane, only takes place, when each of them is ſufficiently firm, ſo as to be able to reſiſt each one of the *alternative conatus*'s apart, whereby it is preſſed: But if one of the planes be capable of reſiſting the leſſer *conatus*, urging it, or half the ſum of both, but not the greater; but the other plane ſo firm, as to be able to reſiſt each one of the two preſſions, on that very account will then one of the *alternative* caſes abſolutely take place in preference to the others, and conſequently the rule of the *alternatives*, which equally take place, ceaſing, the former or the weaker plane would be overcome by the force of the *conatus*, to which it is unequal. This indeed is a ſingular obſervation, and may ſerve to diſtinguiſh each *alternative conatus* of nature from the *conatus*, on account of the fruitleſs effort either way, reſulting from the *alternatives* reſiſting each other; nor therefore is, for inſtance, the plane X F C to be thought to be abſolutely preſſed by the *momentum* $\frac{ZO}{XC}$, becauſe it is preſſed conditionally by that very *momentum*; ſo as to be broken, if uncapable of reſiſting it. For in the caſe of its being able to reſiſt, reacting as it does, by its elaſtic force on the preſſing body, it endeavours to throw off the load on the other plane, which if ſufficiently firm, there will from the conflict, that equal diſtribution ariſe, which we have explained; where not the four *momenta* themſelves, but *momenta* proportional to them are uſed, into which the total *momentum* is diſtributed or ſhared. Theſe ſpeculations, as at firſt ſight they may ſeem paradoxalic (namely, that any plane can be ſaid to be alternatively or conditionally preſſed by ſome certain *momentum* or *conatus*) ſo they afford pleaſure in the reflection, and are fitted to illuſtrate not only the mathematical, but in ſome meaſure the metaphyſical proceſs of nature.

Some anatomical obſervations on the Lumbrici, *or* Maw-worms *in the bowels, tending to demonſtrate, that theſe are the* Maſques *or* Nymphæ *of the* Tænia *or* Tape-worm; *by* J. L. Friſch. *From the* Miſcell. Berolin. Pars I. p. 46.

Tranſlated from the LATIN.

THE whole body of the Worm conſiſts of three parts, the ſkin externally, and two guts, one of which is longer than the other.

The ſkin is thick, and without any aperture, that I could diſcover, except the mouth, which is more diſtinct in the ſmaller ones, where the lips may be obſerved, by which it clings, like a Leech, to the guts. In the larger Worms the mouth is provided with a certain curve or hook, which is ſhaped like an obtuſe wedge, and is very hard, by which they adhere, in ſuch a manner, to the inner membrane of the guts, and lower orifice of the ſtomach, as to produce a bump, or *Callus*. The nearer the Worm is to the ſtomach, the larger I found the *Callus*, eſpecially in Sows, in the midſt of which the head of the Worm is faſtened by its hook, leſt it ſhould be extruded from the ſtomach, with the frequent and copious dejections. The tail or lower part of the *Lumbricus* is ſolid, the cavity of the belly is not continued to the extremity of the body. There is either no fundament, or it is ſo ſtrictly cloſed, that no excrmeents are to be ſqueez'd from it by a compreſſion of the body. But by a ſlight compreſſion a watery humour proceeds from the mouth, which fills the empty ſpace unoccupied by the two guts, particularly, between the navel and the mouth. I call a certain ligament the navel, which is a ſixth part of the length of the body diſtant from the mouth, and has the long gut ſuſpended about the middle and the wideſt part, leſt it ſhould fall out of the watery humour it is ſurrounded with, into the lower ſpace of the belly, that is leſs replete with moiſture, and hurt its tender parts, when the Worm ſhould be in a perpendicular ſituation. The long inteſtine is nouriſhed, by the mediation of this navel, from the ſhorter one, as a kind of ſtomach, with the purer white juice or chyle.

I call the ſhorteſt gut a ſtomach, as it contains a ſtercoraceous fluid, and particles that ſavour of human excrement. It is of a black appearance, and lies ſmooth, without any fold or curvature.

But the long gut is more eſpecially remarkable, and,

Firſt, It contains a white and thicker juice.

Secondly, It adheres to the navel by its middle, where it is more full and diſtended.

Thirdly, each portion hanging from the navel is much longer than the cavity of the belly, and the whole Worm, wherefore it lies folded and curved

curved, like the inteſtines in the bodies of animals; and from the quantity of its contained fluids, it appears thinner towards the extremities, tho' without any evident aperture or orifice.

Hence ſuch Worms as have attained near a proper maturity for a change or *metamorphoſis*, are more replete with this white juice, which appears thro' their cuticle, and exhibits more external whiteneſs: But the ſmaller are more red, the natural colour of the ſkin prevailing.

This white gut, or principal interior part of the Worm, appears to me to be the *Tænia* or Tape-worm, which, under the diſguiſe, and in the huſk of the *Lumbricus* purſues its nutriment in an animal body, till it attains a certain accretion; when, caſting its ſlough, it appears in its true ſhape, as a Butterfly emerges from the relicks of a Caterpillar or *Chryſalis*, which ſeems reaſonable, if we conſider,

Firſt, The length of it, which is as three to one to the *Lumbricus* or Worm, when its folds and volutions are extended.

Secondly, The white colour, which is inſeparable from the *Tænia*.

Thirdly, The ſmoothneſs and homogeneity of the chyle or juice.

Fourthly, The ſkin of the Worm, or the texture of the Huſk or *exuviæ*, for it ſprings or cleaves open, like the ſkin of an *Aurelia*, on the prorepſion of the Moth or Butterfly. I have obſerved many Worms deſtroyed by *mercury*, voided in the ſame manner, with a burſt or lacerated ſurface.

Fifthly, And which moſt of all confirms our *hypotheſis*, the ſkin of the Fiſh-worm; for if after they are ſeparated from the fiſh, the inſects are thrown into cold water, they ſplit open in the ſame manner, and upon the rupture of the external ſkin, we diſcover the exact form of the *Tænia*.

Sixthly, We may reflect on the defective bowels and members of the *Lumbricus*, which are never wanting in a compleat animal, as the organs of generation, womb, ovary, *&c.* with which, eſpecially the genital, we ſee the common Earth-worms are provided.

To all which may be added the reſemblance of its ſituation with that of a *Fœtus* in the womb, which is nouriſhed through the navel, and ejects no excrement after digeſtion.

A new Antiepileptic *and* compoſing Medicine. *From the* Breſlaw Collection, An. 1713, p. 561.

Tranſlated from the HIGH-DUTCH.

IF the following ſpecific ſhall be found, upon further experience, to produce the ſalutary effects, which have generally attended the exhibition of it, it may undoubtedly be conſidered as one of the moſt valuable phyſical

phyſical diſcoveries of the preſent age, ſince it effectually removes the moſt ſtubborn obſtructions, and convulſions, reſtoring the regular motions of nature, and a due exerciſe of the animal œconomy.

The worthy diſcoverer and publiſher of it is Mr. *Deppelius*, who in his treatiſe, entitled: *The Diſeaſes and cure of the animal ſenſual life*, c. 2. p. 67. introduces it in the following manner:

'I cannot neglect, ſays he, communicating and recommending to my 'fellow-creatures, from repeated trials of my own, a medicine, which, at 'once taking, removes all *epileptic* diſtempers, with a ſurpriſing and eaſy 'operation: For the patient being readily compoſed by it into a kindly 'refreſhing ſleep, after a repoſe of fifteen hours or more, awakes 'chearful and free from a diſtemper, attended with ſuch fatal conſe-'quences.'

'The virtue of this medicine was firſt diſcovered by an experiment 'tried upon one, who for a long time was afflicted with terrible convulſive 'fitts, which had nearly deprived him of his ſenſes: Upon taking a doſe 'of this medicine, he ſlept for 30 hours together, and then awaked very 'chearful, having recovered his ſpeech and ſenſe, to the great admiration 'of the Phyſicians, and all who had formerly known him.

'This ſure, ſafe and pleaſant medicine is an oil, diſtilled from any 'part of an animal, in a *retort*, till it leaves no ſediment, which is not ef-'fected without repeating the proceſs 15 times ſucceſſively. Of this oil 'the patient is to take 30 drops before the paroxyſm faſting; which pro-'ducing a ſound ſleep of ſeveral hours, removes the diſtemper, from which 'he awakes with chearfulneſs and eaſe.

The diſcoverer of this extraordinary medicine being already famous for the communication of ſeveral other phyſical *arcana*, Dr. *Joh. Junkerus*, Phyſician to the Orphan-houſe at *Hall*, and Dr. *Elias Cramerus* reſolved to make the experiment, and were ſo ſucceſsful as to bring this medicinal oil to perfection in 16 weeks.

They made choice for this proceſs of Deer's blood, which they ſlowly dried, and then diſtilled in a retort; whereby they obtained a phlegm, a ſpirit and volatile ſalt, which they preſerved a-part. The reſt was diſtilled over for twenty times, when there remained no ſediment or aduſt *fæces* at the bottom of the retort: In each operation they made uſe of a new glaſs. The firſt oil was thick, and of a diſagreeable ſmell, and taſte, but the oftener the diſtillation was repeated the ſcent was leſs offenſive, and the taſte became more agreeable and balſamick, till at laſt it was brought to its utmoſt perfection: Whereupon it was conſulted how to make trial of this famous medicine, which was ſuſpected however, on account of its ſleepy operation. The firſt opportunity, that preſented to make the experiment, was upon a Soldier, 40 years of age, who, for 6 years together, was, three days before every new and full moon, ſeized with an epilepſy, which had brought

brought him very low, and almoſt deprived him of his ſenſes: They gave him, a little before the ſecond paroxyſm, 30 drops of the oil, which preſently cauſed him to fall into a ſound ſleep, wherein he frequently ſneezed, and turning himſelf once about, he juſt uttered theſe words: *O this is moſt delightful*! and having ſlept for 26 hours together, he awoke with a chearful countenance, a ſerene mind, and with an unuſual good appetite; when before his countenance was pale, his fleſh looſe and flabby, his mind dull and melancholy, attended with a total loſs of appetite. From which time he was entirely freed from that or any other diſtemper, and his ſtrength and agility increaſed to admiration. This was the firſt trial, and the effect of one ſingle doſe.

It was tried the ſecond time on a girl of ſeventeen years of age, who was attacked with hyſteric ſymptoms, from a retention of the *Menſes*, and which at laſt degenerated into convulſions that returned every day. After the exhibition of many remedies, generally uſed in ſuch caſes, they gave her, at laſt, a little before the paroxyſm, 25 drops of this oil: She preſently fell into a ſleep, in which ſhe likewiſe ſneezed, and awoke in 24 hours after, briſk, and chearful in mind and countenance; ſhe had a good appetite, and was free from her diſtemper for ſix months together, but neglecting the advice of being careful to procure a diſcharge of the *Menſes*, ſhe was ſeized with the ſame diſeaſe about the *vernal equinox*, from which ſhe was a ſecond time delivered by taking 25 drops of this oil: Six months after this ſecond cure, ſhe was attacked again through negligence, but entirely recovered by the ſame medicine.

They made a third experiment on a young woman of 21 years of age: She had ſuffered much from obſtructions of the *Menſes*, and had ſeveral ſpaſmodic twitches, as well as convulſions; but by taking one doſe of 30 drops, which was attended with ſome ſleep, ſneezing, a moderate ſweat and diſcharge of urine, ſhe was entirely freed from the *epilepſy*, and had the *Menſes* come regularly down the next day.

The fourth ſubject of this medicine, was a maid of 40 years old; ſhe had been troubled with the *epilepſy* every month for 15 years together: The cure in this caſe was effected with this difference, that the firſt doſe of 30 drops did occaſion no ſleep, and ſhe had the return of the *epilepſy* once more in the ſame month, but upon taking the ſecond doſe, and ſleeping four hours after it, ſhe was perfectly cured of the diſtemper.

The fifth caſe was an *idiopathic epilepſy* in a young man of 24 years of age; bleeding and gentle purging being firſt premiſed, he was compleatly cured by a doſe of 30 drops, for after he had ſlept for 14 hours, he awoke, and roſe briſk and lively.

The ſixth experiment was made on a young man of 20 years old, who by a doſe of 30 drops was cured of a melancholy *delirium*, after eight hours

hours ſleep. Many others, in ſimilar caſes, have alſo taken the ſame medicine, with the like ſucceſs.

Yet to be ingenuous, ſuch is the imperfection of human knowledge, that it is certain the very ſame medicine has ſometimes been found ineffectual, which was inſtanced in a man of 46 years old, whoſe furious madneſs and epilepſy could not be removed with two doſes of this oil, though this very caſe firſt prompted the above gentlemen to prepare it.

This medicine being exhibited to a youth of 14 years of age, who was troubled with epileptic fits, and ſuſpected to have worms, the diſtemper continued upon him for a month after taking it, but then left him.

There was alſo a trial made on a young man of 28 years, who had been troubled with the epilepſy, from the age of ſeven: Having taken ten doſes of this oil for ten days together, it did not cauſe him to ſleep, tho' all that time he was free from the epilepſy: On the eleventh day, neglecting to take the remaining doſes, and going about his buſineſs in the fields, the diſtemper returned upon him, and his father forebore to proſecute the cure, becauſe the patient had once, when in a fit, fallen into the fire; from which time they had given over all hopes of his recovery.

In arthritic complaints this medicine has not hitherto been tried: In intermitting fevers it has been found of no benefit: It is remarkable, that when Mr. *Deppelius* had put ſome aniſeeds into the retort, with an intent to take off the nauſeous ſmell, the patients who took it, were, for two hours together, deprived of their ſight.

The ſame humane and laudable motives, that incited the authors of the *Breſlaw* collection, to tranſlate the account of this medicine into *German*, have determined us to tranſlate it into *Engliſh*, that every curious and humane perſon may have an opportunity of enquiring into the virtues of ſo ſimple and efficacious a medicine, as this ſeems to be, by the account of theſe learned Phyſicians. And it is not the leaſt happy circumſtance of it, that it is not attended with any ill conſequences, altho' a judicious circumſpection in the uſe of it ought not to be neglected: As, (1) To conſider attentively, whether the epilepſy be *idiopathic* or ſymptomatic, as this oil is of leſs efficacy in the ſecond than the firſt. (2.) That the material cauſe of the diſeaſe be firſt removed. (3.) That to make a ſure prognoſtic of the cure, the operation of the medicine, as ſleeping, ſneezing, *&c.* be well obſerved. (4.) To remark the real cauſe that may obſtruct the operation in a patient, the better to remove it, but not haſtily to reject or condemn the medicine. And in caſe it ſhould anſwer the end, we are bound in gratitude to Mr. *Deppelius*, as well as to the abovementioned Phyſicians, for their generous communication of it to the publick, rather than conſulting their private lucre in it. It only remains to be obſerved

* *Joh. Junckeri* Diſp. in aug. ſiſtentis obſervationes practicas de medicina qnadam efficaci in motibus naturæ exacerbatis habit. Menſe. *Jan.* 1718.

ſerved, that this oil cauſes none of the ſymptoms above-mentioned, as ſleep, ſneezing, *&c.* in people that are in health, nor has it any ill conſequences attending it.

Of the Oſſifrage, *or* Bone-breaking-graſs. *By* T. Bartholin. *From the* Acta Haff. Vol. II. p. 126, 232. Vol. IV. p. 48.

THIS ſurpriſing plant grows in *Norway*, where it is called *Stur*, in moiſt places, amongſt other ſhrubs, and about farm-houſes. It has a flag leaf, with a hard ſtalk, and ſmall elegant yellow or reddiſh flowers, like the leſſer *centaury*, which the whole plant conſiderably reſembles. 'Tis the firſt graſs which appears in the ſpring, and ſeems chiefly for that reaſon to be coveted by the cattle; for as ſoon as other graſs appears, they leave this, probably by reaſon of the hardneſs of the ſtalk. Creatures that feed on it grow very lean and ſick, their ſpine becomes gibboſe, which the Peaſants call Back-broken, and their feet and bones become ſo weak, that they walk with the utmoſt difficulty. The farmers always keep a quantity of dry bones by them, which proves a certain antidote. They are given, broken into ſmall bits, to the affected animals, who give them a farther comminution, with evident eagerneſs, and appetite. This is followed by a ſalivation, which diſcharges a great quantity of water, whence the creatures are preſently relieved, and finally recovered. Pl. IV. fig. 1

Dr. *Truebler* of *Bergen* ſuppoſes this morbid effect might proceed meerly from the extreme humidity of the plant, which riſes early in the ſpring in thoſe cold climates, and grows in moiſt ſituations. And it appears indeed, that the dry plant had no ſuch effect on ſome cattle it was given to in *Denmark*, which ſome have ſuppoſed to happen from the exhalation of its volatile ſalt. He informs us alſo, that two Chirurgeons had miſtaken and uſed it for *Centaury*, without any ill conſequence. But Dr. *Sim. Paulus* attributes its poiſonous effects to ſome particles of lead and mercury blended thro' the plant, and propoſes, that it may be enquired, whether ſuch minerals are not diſcoverable in thoſe ſoils, where it ſpontaneouſly vegetates. Such particles muſt certainly be acknowledged more adequate to ſuch diſſolving, colliquative effects. The ſame graſs growing in *Juitland*, and in ſuch moiſt ſoils too, was eat liberally by cattle, without the leaſt ill conſequence. So that 'tis very reaſonable to conclude, that the qualities of this plant, as well as of ſome others, muſt be varied by the ſoil, the laſt country having few or no minerals: And thoſe plants which the Surgeons uſed innoxiouſly for *Centaury*, might be nouriſhed by a very ſimple ſoil. Beſides, the hardneſs and aridity of the ſtalks of the graſs are not the great- Scholium by the Tranſlator.

eſt indication of extreme humidity in it, if meer humidity could be productive of ſuch violent effects: On the other hand, 'tis a little difficult to account for the neceſſity of chewing and ſwallowing dry bones, in order to bring on a ſalivation, which is attributed to mineral particles ingeſted. The extraordinary degree of maſtication neceſſary to prepare them for deglutition, *&c.* may be ſuppoſed indeed to open the ſalival glands ſufficiently, and, as it were, to invite a diſcharge of ſuch a preternatural fuſion of the humours by thoſe channells. But their jaw-bones and grinders ought to be priviledged from the tender ſtate of the other bones, to qualify them for ſuch ſevere duty. Perhaps, upon the whole, we may be allowed to ſuppoſe, that this graſs, upon ſome particular ſoils, is impregnated with ſuch particles as muſt produce a conſiderable alteration in the blood, and make its *Serum* ſuch a peculiar *Menſtruum*, as to ſoften and affect the oſticular ſyſtem particularly: That the humours are highly fuſed, and that the great degree of maſtication theſe bones require, may ſerve to derive the preternatural liquidity and expanſion of the humours, with the particles occaſioning it, to the ſalivary glands, where they will be diſcharged: For this action, which is not found neceſſary, in erect animals, to invite the natural aſcent of the mineral vapours, may be ſo in quadrupeds, from their horizontal conformation and extent. As for the effects, as ſuch, of the bones themſelves, which are ground and ſwallowed, if they ſhould be concocted (which I can ſcarcely conceive them to be, by the organs of graminivorous animals, in a natural ſtate) they may be fuſed to a balmy or gelatinous *Serum*, to attemper the remaining tenuity and ſharpneſs of the reſt: Or, if they are diſcharged through the bowels, they may then, as abſorbents, imbibe and carry off ſome of the acrimony, in the firſt paſſages, along with them.

An Experiment of Congelation; *by Dr.* S. Reiſel. *From the* Miſc. Cur. An. 2d. Obſ. 177.

Isaac Heræus, Apothecary to the Elector of *Hanover*, and a very expert Chymiſt, diſtilled the blood of a perſon beheaded 1669, by an alembic, and put the diſtilled water into two phials, containing 4 ounces each, covering them over, and expoſing them to the air in an open ſhop, and never obſerved them to freeze, throughout the very ſevere winter that enſued, the water continuing clear and limpid. Being ſurpriſed at this, he took one of the phials in his hand, about the middle of *January* 1670, and after handling it a while, and laying it down again, he found it ſuddenly froze, the contents of the phial he had not touched remaining ſtill unfroze. The reaſon of this is ſubmitted to the curious. Was it owing to a previous intervention of heat, or to a commotion of the different atoms of the water?

The

The Peſtilence cur'd by Venery. *From* Vincentius Fabricius. *Taken from the* Miſc. Cur. Ann. II. Obſ. 188.

Tranſlated from the LATIN.

THE following poem contains a ſurpriſing caſe that happen'd in *Holland*, when the plague rag'd there in 1636. A *Dutch* ſervant maid, who was then ſeiz'd with it, had three carbuncles, and was remov'd into a garden, where ſhe lay with very little ſuccour or attendance: Under which circumſtances ſhe was viſited and aſſiſted by her ſweet-heart, who lay with her every night, and enjoy'd the laſt * intimacies, the woman recovering, and her lover remaining uninfected. *Fabricius*, highly affected with ſuch an extraordinary occurrence, inſcrib'd a relation of it, in *Latin* verſe, to the famous *Salmaſius*, which, for the elegance of the poem, and the ſurprizing ſubject of it, was judg'd worthy of a place in the *Miſcellanea Curioſa*. And as *Boerhaave* has inſerted at length the poem of *Fracaſtorius*, entitled *Syphilis*, in his collection of the writers on the venereal diſeaſe, we thought ſuch authorities ſufficient to countenance the following abridgment, and free tranſlation of the only poem we have met with among the *Acta Germanica*.

THE blaſting Plague thro' wretched *Belgia* flew,
And wrathful Heav'n her Guardian Pow'r withdrew:
The flagrant Air infuſing cauſtic Breath,
Her Marts were Hoſpitals, their Trade was Death.
Unbury'd Heaps the thin Survivors ſee,
No Place exempt, nor Conſtitution free;
Ev'n Art expires, and Hope's among the ſlain,
While Horror riots with her hideous Train:
Yet while the waſteful Tyrant gluts his Rage
On either Sex, and ev'ry Rank and Age,
Immortal Love aſſerts her Pow'r alone,
And ſplits his ſhatter'd Arrows with her own.
Hapleſs or happy ſhall we term the Maid,
Whoſe artleſs Beauty, all her cordial Aid,
Inſpir'd a dauntleſs Youth, with am'rous Force,
To breath his Vows to one almoſt a Corſe;
By dread Infection, nor by Death diſmay'd,
To woo, to win, and ſave the ſinking Maid:
While Horror ſhock'd, and Spectres ſcream'd around,
She ow'd her Safety to her Lover's Wound.

* Such Intercourſes being not unuſual in *Holland*, after their *betrothing*, without any Reflection on the Parties.

Then leſt untaught Poſterity accuſe
The ſhort Hiſtorian, or incurious Muſe;
A generous Poet to the World ſhall prove
The healing Pow'r of death-repelling Love.

The beauteous *Ægle*, of *Batavian* Race,
(Her Manners correſponding with her Face)
Vy'd with the faireſt Nymphs that wont to ſhine,
Thro' the flat Plains, or near the flow'ry *Rhine*.
Fortun'd indeed to ſpring from humbler Earth,
And ſtrange to all the Inſolence of Birth,
The Maiden on her dow'rleſs Charms rely'd,
And liv'd by ſerving others helpleſs Pride;
But Poverty's unequal to diſguiſe
The ſparkling Luſtre of effuſive Eyes;
Tho', of the different Hearts her Beauty won,
The *moral Charmer* wiſh'd to warm but one.
Few haughty Nymphs might boaſt ſo true a Breaſt,
Tho', all inflate, of Wealth and Pride poſſeſt,
Beneath the coſtlieſt Silks and Gems they ſhine,
As thro' the Dance the flowing Wantons twine.

Thyrſis and *Corydon* their Loves profeſs,
With equal Fervour, but unlike Succeſs;
She lov'd the firſt —— his youthful Down began,
And all his vivid Bloom to promiſe Man.
His comely Cheeks were ting'd with ruddy Dies,
And ſportful Spirits danc'd amidſt his Eyes.
Plain as her own his Birth and Fortunes prove,
Ægle's Ambition was Exceſs of Love:
Nor poorly grateful to the Youth ſhe fir'd,
The generous Beauty glow'd as ſhe inſpir'd.
What Looks and Kiſſes! Smiles and Vows enſu'd!
The Sponſal, ne're revok'd, was oft renew'd.
Yet that themſelves and After-times might prove
The matchleſs Pow'r of perſevering Love;
Severeſt Tryal! Peſtilence invades,
And blends with deadlier Fires the ſick'ning Maid's.
The cauſtic Atoms, with corroding Pains,
Sting thro' her Nerves, and pierce her inmoſt Veins;
Potent to fuſe, and curdle, as they paſs,
Scorch the ſmooth Lymph, and tear the cruent Maſs.

Her

Her Lips, where fragrant Graces lov'd to dwell,
Parch'd to the Sight, were horrid to the Smell.
Her once fair damaſk'd Cheeks deep-purpled Hue
Portends, from acrid Salts, a deadly Blue.
Ardours, that ſpeed to Death, her Vitals rend,
And to her Brain the virous Fumes aſcend.
Horrors like theſe invok'd, and yet diſmay'd,
Accus'd, but half abſolv'd the Want of Aid.
'Midſt a wide Garden from the Houſe ſhe lay,
Dreaded by Night, nor viſited by Day.
She prays (ſhe thinks) in vain, in vain ſhe calls,
Her Screams redoubled by the ecchoing Walls;
Her Fellows only ſhudder at her Cries,
And dread the Courſe of *Æther* whence they riſe.

Thyrſis alone, her ſoul-felt Horrors heard,
Ruſh'd to prefer the Peſtilence they fear'd.
Heav'n he accoſts with almoſt impious Pray'r,
'Attack a Man, he cries, a Virgin ſpare;
'And if with perfect Juſtice you decree,
'Remit her Pangs, her Life, and finiſh me.
His Rage of Woe the ſinking Virgin grieves,
And chides the Wiſh, the Paſſion that ſhe b'lieves:
As vainly ſhe implores his quick Retreat,
Unprays his Pray'rs, and trembles for his Fate;
Round her pale Neck his cloſing Arms he ſtrains,
And graſps the Limbs where ſcarcely Life remains:
He courts Contagion, he devours her Breath,
And ſwallows Kiſſes from the Caves of Death;
Which ſtrange Phylacteries and Cordials prove,
The Rage of Poyſon feels the Balm of Love.
From the dear Air his fragrant Breath exhales,
She feels new Spirits mount in cordial Gales;
Which brace the Heart afreſh, her Fears remand,
And whiſp'ring ſay, her total Cure's at hand.
The Youth's intenſe Affection next explores
Her burning Boils, and peſtilential Sores;
He chaffes them gently, while he wails them much,
And ſooths them with his ſofteſt, ſmootheſt Touch;
(Love and Neceſſity had baniſh'd Form,
And much he ſaw to dread, and more to warm)
When *Venus* inſtantly the Maid inſpires,
And blends her genial with the peſtal Fires;

Her

Her humid Eyes with ſofter Languors melt,
A ſweet Infection *Thyrſis* ſaw and felt.
Acted by thoughtleſs Ardour to improve
The total Extaſy of deſperate Love,
All throbbing with delirious Joy he lies,
Deeming Poſſeſſion, tho' with Death, a Prize.
Leſs warm and daring ſeems the vent'rous Boy,
Who ſwam a nightly Ocean to his Joy.
Leſs if his Flame, his Fate was more deplor'd,
The Plague relented, but the Ocean roar'd.
While melting Damſels genial Joys approve,
And grateful Force excuſes baſhful Love;
While Beauties ſigh to kindle equal Fires,
Where fell Diſeaſe may yield to fierce Deſires;
The *Cyprian* Annals *Thyrſis* ſhall proclaim,
His potent Med'cine, and ſtupendous Flame.

A Maid no more, but Woman all compleat,
Ægle concocts the peſtilential Heat:
Her Bloom returns, her native Warmth revives,
Nor long, nor vainly, with the Fever ſtrives.
The dear Phyſician doubly now ſhe loves,
And conns the Method that her Health improves;
Smiling, ſhe ails, and, willing to be ſure,
Repeats her Phyſick, to confirm her Cure.
At length her Health and Knowledge more compleat,
The vanquiſh'd Hypocrite reveals the Cheat,
And in her Lover's cordial Arms agrees,
Girls ſhou'd be heal'd by Remedies like theſe.
Thus, what might try ev'n M—D's or P—M—'s Skill;
Where crouding Pharmacy muſt ſurely kill,
The Plague itſelf was cur'd without a Groat,
By a Preſcription Love and Nature wrote.

Sacred and free from peſtilential Stains,
Thyrſis, the Wonder of his Sex, remains.
Their Story *Belgian* Chronicles may tell,
And challenge ev'ry Clime to paralell.
Well might the Pow'rs defend a generous Youth
Of matchleſs Love, and death-deſpiſing Truth:
The Sequel prov'd his dreadful, dear Delight,
No tranſient Guſt of ſhort-liv'd Appetite:
Soon to confirm his plighted Vow he flew,
And fix'd, with Tranſport, to the Charms he knew.

A ſuc-

A ſuccinct account of a prodigious appearance of Blood. *From the* Miſcell. Berolin. Cent. II. p. 60.

Tranſlated from the LATIN.

THERE is a pool near the village of *Sarow* by *Stargard*, called by the inhabitants, *Keſſel Pfuel*, ſixty feet wide, and 140 in length. In the beginning of *Auguſt* 1724, there appeared a thick, red matter on the ſurface, which might be ſeparated by hand, and brought off, like cream or gelly: But ſome time afterwards, upon a ſucceſſion of rain and thunder, the ſurface became more thin and limpid, tho' it appeared as dilutely tinctured with blood. At the ſame time the matter that was more ſaturately red, was drove among the adjacent ruſhes, and tended more to the bottom, as the moſs and herbs, that germinated under water, were ſpread over with a reddiſh matter, which appeared granulous, upon diſſolution, and imparted its colour to paper. After ſome time this redneſs both in the plants and in the bottom, was changed into a greeniſh ſlime, diſtinguiſhed by ruſty ſpecks, which exhibited much the ſame appearance, as if turpentine had floated on the ſurface. This ſlime contained a multitude of ſmall green eggs, and little broad flies of the ſame colour adhered to the ſpecks, with which the ruſhes every where abounded. When the water ſunk from the borders of the pool, the matter might be found here and there, in ſpots of the breadth of a hand, and two or three fingers thick, which on the ſurface was coloured like congealed blood, but of a duſky red beneath, and ſmelt like rotten fiſh. We ſhould not omit, that a great number of Worms, Leeches, and ſmall fiſh were in the pond.

This red matter, being rubbed on the hands, adhered ſo very tenaciouſly, as not to be ſcoured off with ſoap, tho' it diſappeared ſpontaneouſly in three or four days. White and brown paper, and linnen dipped in this water, were ſtained with the ſame colour.

On reſerving ſome of this water in a phial, within three days a granulous red matter ſubſided to the bottom, as tough as glew; yet the water itſelf preſerved its redneſs for fourteen days, after which it became perfectly limpid and diaphanous, but let fall a duſky reddiſh ſediment. The water, a month after it had been drawn, exhibited a greeniſh froth on the ſurface.

In like manner, at *Stargard*, about *Whitſuntide*, the water of a fiſh-pond in a garden, which was covered over with duck-weed, was tinctured with a manifeſt redneſs. Some little fiſh which had been put into it, all died as ſoon as the water was tinged. The ruſhes on the borders were ſprinkled with ſpots, which lodged a kind of flies or *cantharides* of a light green; and even at the diſtance of ten or 12 paces from the pond, the graſs was

here

here and there infected with red ſpots, undoubtedly from the drawing and ſcattering the water about. Whatever plants were ſprinkled with this water, withered and turned black. And about the ſame time, above a hundred and ſixty cabbages were eaten up with a kind of ruſtineſs, and ſcattered all over with black ſpots.

Reflections on this ſtrange appearance.

FRom all the relations we have received of the waters of the pond, called *Keſſel Pfuel*, being converted into blood, we ſhall, without pretending to obtrude our ſentiments to the prejudice of any others, infer the following obſervations.

1. That it contracted this colour by the laws of nature, as thoſe ſhowers, called *Bloody* do, and as well as other ponds, ditches, wells and ſtanding waters have done: So that we may conclude very little new or extraordinary, and much leſs any thing miraculous in it: or (as the ages of ignorance and ſuperſtition readily might) ſuppoſe it to be portentous and prenunciatory of War, or other dreadful calamities.

2. This appearance has never been obſerved in winter, or in the cold months, but is demonſtrated by all ſuch obſervations to occur in the ſummer ſeaſon, and hotteſt months, as it did in the preſent caſe.

3. Though this alteration of the water might be effected in different ways, by the admixture of ſimple or compound bodies, animal and vegetable, Toads, Frogs, Butterflies, and other inſects; from the excrements of birds and beaſts in the adjacent grounds, from the infuſion of putrid leaves, graſs and ruſhes, as well as from dew diffuſed thro', and infected by the air, and deſcending again to the ſurface of the earth: I ſay, though this effect might have been produced from ſuch a variety of cauſes, yet 'tis my opinion, in the preſent caſe, that we ſhould particularly attend to the effect of Butterflies, which are to be eſteemed the principal cauſe; theſe particularly, which we obſerved to abound with a red liquor, which they void by drops, and in which their eggs, that produce Catterpillers, are frequently contained: If any of theſe drops light on trees, leaves or fruit, we commonly call it a ruſt, or mill-dew; and from ſuch as were emitted with eggs, ſmall Caterpillers quickly proceed, if not prevented by cold. When any quantity therefore of theſe drops is received into ſtanding water, it is often found to communicate a blood-like redneſs to it. And that this was the circumſtance affecting the before-mentioned pool, is ſufficiently confirmed from the circumſtantial relation of it in the *Pomeranian* acts.

And firſt (to omit other particulars) as it was obſervable, that in ſome neighbouring gardens, above a hundred and ſixty cabbages were deſtroyed by Caterpillers. Next, as both on the graſs and ruſhes of the pond, and on the bank of the fiſh-pond, near *Stargard*, where they were produced, a great number of red ſpecks or blemiſhes were diſcovered: And farther, as all the fiſhes in the pond, near *Stargard*, were killed with this redneſs of the water.

water. From which it ſeems evident, that this Alteration was owing to the Butterflies, and that the imaginary converſion of the water into blood was neither new nor miraculous, but depended on natural cauſes. Finally, as that redneſs was not of a long continuance, but is wont to go off by degrees, and ſubſide towards the bottom, it happened exactly ſo in this caſe, which was effected, the ſooner too, by the intervention of cold.

Yet ſhould we by no means infer from this, that all ſuch blood-like alterations of water muſt depend on theſe Butterflies. And even with regard to the preſent caſe, unleſs we were well apprized of the ſituation of the pond, and other circumſtances, or had been preſent when this change occurred, and while the redneſs was at its height, ſhould we venture to decide poſitively, upon vulgar rumour, that ſuch an alteration depended ſolely on theſe butterflies: Since undoubtedly the like effect ought frequently to be attributed to different cauſes, as to a variety of matter indued with, and communicative of that colour, as we formerly ſpecified; or to a commonly ſubſequent putrefaction, which is readily effected in the ſummer months, in ſtagnant waters; eſpecially, if expoſed to a commixture of any filth, which greatly promotes it: From whence it alſo happens that waters, contaminated with ſuch a redneſs, contract a ſudden and exceſſive ſtink. Neither can we be certain that ſummer exhalations, deſcending again with dew and rain, may not conduce to the production of ſuch a *Phænomenon*; which, nevertheleſs, it muſt be difficult to aſcertain with much accuracy; and which cannot be clearly known from the appearance itſelf. The ſtrict inveſtigation of ſuch points requires a pretty intenſe engagement of the underſtanding, an accurate examination of the particular quality of the water, before it was changed, and of the different circumſtances that accompanied this change, and were conſequent of it; beſides, there may be neceſſity too for ſome phyſico-chymical experiments on the occaſion; tho' poſſibly the concurrence of all theſe may at laſt prove unequal to an exact and compleat knowledge of the ſubject.

But tho' we may not always be capable of fixing the particular cauſes of ſuch mutations, we may certainly conclude they depend on natural ones: Which opinion, tho' we readily allow every perſon to indulge his own, we might eaſily ſupport from hiſtory, and, among other proofs, if it were neceſſary, from a variety of obſervations contained in the *Wratiſlaw* collections.

We can reaſon but little from the ruſhes, leather, paper, or any materials that were infected with this colour of the waters; but an enquiry ſhould be built upon regular experiments on the water, the day it is drawn, and which ſhould be commenced the very day the alteration begins: Since, as we have ſaid, putrefaction enſues on this appearance, and is ſenſibly increaſed in the ſummer ſeaſon; in the progreſs of which putrefaction, the coheſion of the parts is not only deſtroyed, but a new tranſpoſition, and

connection of them are produced; ſo that when this putrid fermentation is finiſhed, which has been continued for ſome months by the ſolar heat, the water, with its contents, appearing ſimple and unchanged, is not diſpoſed for ſuch experiments, as may diſcover the true cauſe and mode of the alteration of it, which has been vulgarly thought a converſion of it into blood.

Of the Wall on Mount Caucaſus; *by* T. S. Bayer. *From the* Commentarii Academiæ Imperialis Petropolitanæ, p. 425.

Tranſlated from the LATIN.

IN the expedition undertaken by the Czar, *Peter the Great*, againſt *Perſia*, (in which *Derbent* and the country round it ſubmitted to him) he partly by himſelf, and partly by other proper perſons, obſerved whatever was remarkable therein: Of which the principal thing that preſented itſelf to view, was the inacceſſible ridge of mount *Caucaſus* fortified with towers, and ſeemingly, with a very ſtrong wall; which laſt, as thoſe acquainted with the country affirmed, reaches a vaſt way between the *Caſpian* and *Euxine* Seas. From that part of the wall which was ſeen, one might form a judgment of the reſt. This prodigious work, eſpecially as it was built in a deſert, upon the tops of ſuch high mountains; and beſides, by the accounts of the people of the country, and even from the ſtones it was made of, plainly appeared to be very ancient. All which ſo far excited the curioſity of Prince *Demetrius Cantimir* of *Moravia*, as to go himſelf and view its ſituation.

The town, from which he ſet out, was *Derbent*, the capital of *Schiruan* (which province extends from the river *Cyr*, to the territory of the town, from which *Dageſtan*, that is a mountainous country, reaches towards *Circaſſia*) ſituated in a declivity near the ſea. From thence towards the weſt, riſes a mountain into a craggy Peak, on which is built a Caſtle. The way from the town to it is through the gate *Kyrclar*, and in the middle of the road, is, cut through a very hard rock, a ditch, forty fathoms long, four broad, and three deep. A hundred fathoms from the caſtle, lies the village *Piridmiſky*, that is to ſay, the *Demon* or genius of *Damaſcenus*: For there ſtands a monument of one *Piridmiſky*, who, they ſay, was the ſon of *Damaſcenus*. Prince *Cantimir* could not read the inſcription which was cut in a huge ſtone, as the characters were coptic, and as he had no interpreter with him. In the town ſtands a tower to the north, built of a rougher ſort of ſtone than any of the reſt, very ancient; and the inhabitants affirmed, that here *Alexander the Great* began to lay the foundation of a city. Going down from the caſtle to the ſea, in the north wall are the following gates; the firſt

firſt is called *Driardizi Capuſi*; the ſecond, *Kyrclar Capuſi*; the third, *Babulbab* or the *Gate of Gates*, a magnificent piece of workmanſhip, which ſtill retains the ancient name of the city, and is two fathoms broad, and one fathom high; the upper part of this gate does not ſtrike off into an arch, but huge ſtones are placed at right angles on poſts, and are not faſtened with iron bands: On the gate under-ground (called *Babulkyiamar*, *i. e.* the gate of the *Laſt Judgment*) are ſome figures, but it is uncertain whether they are hieroglyphics or not. There is a tradition among the people, that this gate having been built of equal height with the other gates, had gradually ſunk, and whenever it will entirely do ſo, then ſhall come the general judgment. Seven *Ruſſian** *ſtadia* or furlongs from the city, Prince *Cantimir* meaſured the wall the length of 3285 fathoms, equivalent to ſix furlongs, and 285 fathoms; and he adds, that it is certain that the wall reaches to the ſpring-heads of the river *Irhan*, in the borders of *Georgia* 450 furlongs. M. *Bayer* did not find the name of any ſuch river in the borders of *Georgia*; therefore from the meaſure taken by Prince *Cantimir*, and even from the ſituation of the river itſelf, he takes it to be the river *Yori* in M. *De l'Iſle's* tables, which is in 63 degrees of longitude, and 44½ degrees of latitude. At *Derbent*, the mountains are of different heights; the higheſt Peak is *Schadagy*, the *Royal Mountain*, as it were, becauſe *Nuſrivanus*, ſon of *Kieicubat*, built a houſe on its top, where he ſometimes retired for his pleaſure. With a quadrant, Prince *Cantimir* found its height to be 18 *Stadia*; it is reckoned the next higheſt mountain to *Ariarat*, and is more than half covered with ſnow. The greateſt part of the range of the mountains of *Caucaſus* are ſteep, craggy and buſhy, and ſometimes there is a plain a-top In the valleys grow vines: And in one of the villages live *Jews*, who ſpeak *Perſic* and *Hebrew*. The wall, which is continued along the tops of the mountains and over the valleys, lies now in ruins, ſome towers, eſpecially thoſe in the valleys, (not unlike the towers in *Muſcow*) together with their gates, are entire. The wall is but a *Ruſſian* fathom thick; the ſtones in that country are three *Ruſſian* ells long, and an ell thick; here are no bricks; the ſtones are not faſtened with iron bands or with cement, only laid over each other, but ſo nicely cut, that hardly any joining is perceivable. Prince *Cantimir* was told by the Interpreter belonging to a Prince of *Georgia*, who lived for ſome time in this town, that this laſt prince being, by reaſon of a conſpiracy formed againſt him, obliged to withdraw, ſet out from *Taflifius* northwards for *Oſſetus*; and from thence he turned to *Tuchetuo*, at the foot of mount *Caucaſus*, and then to *Tianetus* and *Eretus*, till after paſſing the craggy mountains, he came to a plain in the confines of

* A *Ruſſian* furlong is called a *verſt*, and contains 500 *Ruſſian* fathoms, one of which is equal to three *Ruſſian* Ells, and one of theſe is equal to 28$\frac{8}{100}$ *London* inches.

the city *Schamachia*; then he went to *Bacua*, and from thence he paſſed over to *Derbent* by water. Eight days journey from *Oſſetus*, may be ſeen *Caucaſus* on the left, as alſo the ruins of the wall. In M. *De l'Iſle's* tables *, on the *Euxine Sea*, under 44 degrees of latitude, and 58½ degrees of longitude, not far from the town of *Dandarus*, are marked the traces of a wall, which run along the river *Cudurus*, from ſouth to north, and at laſt turn a little to the eaſt, 75 *Ruſſian ſtadia*. Whether M. *De l'Iſle* had his information of this Wall from *Soſcamus Sadda*, a Prince of *Georgia*, or from *Cruſius* or *Zurabecus*, it is indeed, no mean proof that this Wall reaches to both ſeas. *F. Archangelus Lambertus*, in his † *Iter. Ibericum*, deſcribes the Wall (of which he gives a figure) nearly in the following manner: 'That it is a vaſt tract, and that the Wall is upwards of 600 miles 'in length; that here and there it is fortified with towers, in which are 'Soldiers to guard them; that the principal inhabitants of *Odiſcus* ſend 'men thither every month to relieve them; that from the ſea the land 'riſes gradually up to the higheſt Peak of *Caucaſus*; that the lower part of 'the country is partly fortified by nature and moraſſes, and partly by art 'and with wooden towers, in order to hinder any perſon paſſing that way 'without the Soldiers leave.'

Now from this Wall to the river (to which Prince *Cantimir* certainly found it reached from the eaſt) is but a little way, in which the veſtiges of the Wall are either quite effaced, or have not hitherto been traced. Thus far Prince *Cantimir*.

Some curious perſons may be deſirous to know how much of this noble monument of antiquity was diſcovered before *Peter the Great* went upon this expedition; moſt people may complain that every particular as to the ſituation and courſe of the Wall is not entirely aſcertained. As to all which, *M. Bayer* endeavours to give all the ſatisfaction he can.

It was latterly that the *Greeks* knew any thing of mount *Caucaſus* (called by the *Scythians Graucaſus*, from the ſnow upon it, it being a kind of *Alps*, as it were) and that by means of the colonies ſent thither from *Pontus*. As they therefore ſuppoſed, that this mountain was ſituated in a diſtant country, as it was then reckoned, and conſequently liable to fabulous relations, they believed that *Prometheus*'s puniſhment would be the more ſevere, were he, according to the command of *Jupiter*, tied down to mount *Caucaſus*, whither none would have ventured to come to releaſe him, but ſome *Hercules* or other. *Heſiod* had only tied him down to a pillar; but *Æſchylus* was the firſt, as appears, who had tied him down to that mount *Caucaſus*, which riſes between the *Pontus* and the *Caſpian* ſhore. *Herodotus*, as he was a native of *Halicarnaſſus*, and very much converſant with the King's Lieutenants in *Aſia*, knew better than any other

* Regionum vicinarum Maris Caſpii, Ann. 1723 ed.
† Dans le Recueil de Voyages au Nord. T. VII. p. 176.

other, the ſtate of thoſe countries, which were under the *Perſian* dominion: For, in his *Euterpe*, he ſays, that the *Caſpian* ſea is 15 days journey in length and 8 in breadth, to the weſt of which lies mount *Caucaſus*, of a vaſt extant and height, and inhabited by people of different nations, who paint their cloaths, but in ſuch manner, that the figures appear interwoven, as it were, in the ſtuff, which is owing to the deep dye given it in the wool. This mountain (as he ſays in his *Thalia*) bounded the *Perſian* empire, and every fifth year its inhabitants paid the King a tribute of a hundred boys and as many girls. At this time there was no part to the north of *Caucaſus* under the dominion of *Perſia*; and to the eaſt of the *Caſpian* ſea, is a vaſt plain, which is known to be the ſeat of the *Maſſagetæ*. And likewiſe in his *Clio*, he obſcurely hints at two paſſes through which the *Cimmerians* and *Scythians*, from different countries, and by different ways, iſſued out, in great numbers, into the *Greater* and *Leſſer Aſia*. *Caucaſus* is no better known by the Expeditions of *Alexander*, the dynaſty of *Lyſimachus*, or of the Kings of *Aſia* and *Syria*, as their affairs are likewiſe involved in obſcurity. *L. Lucullus*, in his expedition againſt *Mithridates*, was not far from that mountain. *Cn. Pompey* was the firſt of the *Romans*, who ſat down near the paſſes of *Caucaſus*. *Lucian*, in his *Pharſalia*, introduces *Pompey*, ſpeaking thus:

Si vos, O Parthi, peterem cum Caſpia Clauſtra,
Et ſequerer duros æterni Martis Alanos,
Paſſus Achæmeniis late decurrere campis. Lib. viii. v. 222.

From that time were known two paſſes of *Caucaſus*, the one the paſs of the *Caſpian* ſea to the eaſt (called *Caſpia*, if we may credit *Eratoſthenes*, from which likewiſe ariſes a large mountain to the eaſt) the other, the paſs * of *Caucaſus*, both which paſſes have been confounded together, as *Pliny* obſerves in more than one place. Thus *Lucan* wrongly calls it *Caſpia*, as *Pompey* or no *Roman* General had ever penetrated ſo far: For, *Pompey*, as is plain from *Appian* and *Plutarch*, after coming up with *Mithridates* at the river *Euphrates*, defeated him in a great battle in the night-time, and in the purſuit after him, he firſt turned to *Armenia*, and then advancing into *Albania* (ſituated between mount *Caucaſus* and *Armenia*) he came among the *Iberi* to ſeek him. But *Mithridates*, as he wintered in the mean time at *Dioſcurias*, after taking a compaſs to view the coaſt of the *Pontus*, fled to the coaſt of *Boſphorus*, and *Scythia*; this way the *Romans* muſt have followed him. Therefore, as is evident † from *Appian*, *Pompey* ſat down in the paſſes of *Scythia*, thro' which no one had penetrated before; and in his return making War on the *Albani*, on account of their revolt, he afterwards turned againſt the *Armenians*. When he marched

* Ap. Strab. f. 568. Ed. Henr. Petri. † P. 400. ed. Tol.

marched to the *Caſpian* ſea, he was told, according to *Plutarch* *, ſeveral frightful ſtories, particularly of great numbers of Serpents in the way: However he ſent ſome of his people to know the certainty of this report; and upon their bringing him ſome of the water of the *Caſpian* ſea, he found it ſweet, as *Alexander the Great* had done before him, and as lately the *Ruſſian* army found it ſo too. For the Waters are ſweet without loſing their ſapor, near the ſhore, where the rivers diſembogue. *Pliny* ‖ likewiſe charges the Writers of the exploits of *Corbulo* in *Armenia*, under *Nero*, with the ſame error of confounding the paſſes of the *Caſpian* ſea and thoſe of mount *Caucaſus*. And next he adds, that the table of thoſe countries, ſent by *Corbulo* to *Rome*, places the paſſes of the *Caſpian* ſea where thoſe of *Caucaſus* are. *Cornelius Tacitus* † was thereby miſled. *Claudius Ptolemæus* calls the paſſes of mount *Caucaſus*, *Sarmatica*, and thoſe of the *Caſpian* ſea, *Albania*; and he places them too far from the *Caſpian* ſea, unleſs perhaps he would mean the paſs where the ridges of *Caucaſus* firſt part and form a valley.

What ſort of paſſes theſe were, we might learn from *Varro* (or from the Author which *Pliny* borrowed from, whether it be *M. Terentius* or *P. Atticinus*, who were both intimate friends of *Pompey*, even in his laſt misfortunes) I ſay, from *Varro*, and *M. Agrippa*, had not their commentaries been loſt. Now it is uncertain how much *Pliny* borrowed from either, and how much he borrowed from *Corbulo*'s commentaries: For *Corbulo* having been very ſucceſsful in *Armenia*, the *Romans* were ſo filled with the fame of the paſſes of mount *Caucaſus*, that *Nero*, who was always vain-glorious, intended himſelf to undertake an expedition againſt the *Sarmata* through theſe paſſes, wrongly called *Caſpian*, though as *Pliny* ‡ affirms, there was ſcarcely any communication open between the paſſes of *Caucaſus* and thoſe of the *Caſpian* ſea; he therefore gives an account, whether he had it from thoſe who had been in *Pompey*'s expedition, or from ſome of *Corbulo*'s Soldiers; 'that § the *Caſpian* paſſes were a narrow way, between 'ſteep rocks, eight miles long, cut out by art; ſo that ſcarce a waggon 'could paſs; and that on the right and left ſtood rocks reſembling buſhes; 'and that there was no water for 38 miles (in ſome copies it is only 28) 'and that the narrowneſs of the way hindered the flowing of a ſaltiſh 'liquor from the rocks, as alſo the paſſage of great numbers of Serpents, 'but in the winter.' As to the paſſes of *Caucaſus*, he ſays, 'that a 'great many are very much miſtaken, who call it *Caſpian*, it is a pro-'digious work of nature, where ſtand ſteep rocks and gates ſecured 'with iron bars; underneath in the middle runs a rivulet of a ſtrong 'ſtench, on this ſide, fortified with a caſtle, called *Cumana*, to hinder the 'excurſions of a great many nations that way, which is ſhut up with a 'gate

* F. 638. ‖ Plinius e Varrone. † Annal. L. vi. c. 33. ‡ L. vi. 13. § L. vi. 14.

'gate over againſt *Harmaſtis*, the chief city of *Iberia*, which *Ptolomey* 'calls *Harmacticus.*'

After that time there is nothing conſiderable related of the gates of *Caucaſus*, and thoſe of the *Caſpian* ſea, down to the time that *Conſtantinople* became the ſeat of the *Roman* empire in the eaſt; to which *Caucaſus* was nigher, and there followed frequent incurſions of the barbarous nations into *Armenia*, *Aſia*, and *Syria*, according to the *Greek* and *Syrian* Writers. *Claudian*, therefore, under the Emperor *Arcadius*, a little before the death of *Stilico*, ſpeaking of the *Gothic* war, ſays,

Nonne videbantur quamvis adamante rigentes,
Turribus invalidis fragiles procumbere Mari,
Ferratæque Getis ultro ſe pandere Poſtæ?
Nec Vallum denſæque Sudes arcere volantes,
Cornipedum Saltus, jamjam conſcendere Puppes
Sardonioſque habitare ſinus & inhoſpita Cypri,
Saxa parant, Vitamque Freto ſpumante tueri.

According to him, *Procopius* of *Cæſaria*, in the tranſactions in the eaſt, mentions in the *Gothic** war, two gates of *Caucaſus*, *Tzur*, and the gate of *Caucaſus*. And in the *Perſian* war, he gives a very full deſcription of the gates of *Caucaſus*; for he ſays, that *Taurus* of *Cilicia* runs out into *Armenia*, *Perſarmenia*, *Albania* and *Iberia*, and the farther it does ſo, the higher it is; that beyond the confines of *Iberia*, is a very narrow path or paſs 50 *ſtadia* long, which ends in a ſteep and inacceſſable rock, only that nature had made a way through it, as if it had been cut by art. He affirms that that gate was called *Caſpia* from time immemorial. That after going through this gate, there opens a vaſt plain, very well watered, and fit for feeding Horſes, and that in it live the *Hunni*, as far as the *Mæotis*, and that horſemen can go this way as far as *Iberia*; but there is no going any other way without the greateſt trouble, and without leaving one's Horſe behind, on account of the precipices and windings of the mountains; that *Alexander the Great*, conſidering all this, had made a gate and built a caſtle over it, in order to hinder the excurſions of the northern nations; where *Procopius* calls the gate of the *Caſpian* ſea, the gate of the *Caucaſus*; this is a miſtake of a great many of the ancients, as has been ſhewn above from *Pliny*. And this error prevailed ſo much among hiſtorians, that with the name, even the memory of the gates of *Caucaſus* was gradually loſt. But *Euſtathius*† of *Theſſalonica* gave the following deſcription of the *Caſpian* Gates: That the *Medes* lay to the eaſt as far as the *Caſpian* gates, which are in *Media*, and are called the key of *Aſia*: And that there are mountains, or rather ſteep rocks like gates, which

* L. iv. c. 3. † In parecbolis Dionyſianis, ad. v. 1034.

which take their name either from the *Caſpian* ſea, or from the *Caſpii*: That thro' theſe is the way from the north into *Hircania*, and *Perſia*; and that the northern nations are hindered thereby from making excurſions.

It is almoſt in this manner that our Authors mention the paſſes of *Caucaſus* and thoſe of the *Caſpian* ſea: But no *Latin* or *Greek* Writer of all antiquity has made mention of the Wall which was drawn along mount *Caucaſus*. But the *Arabians* and *Perſians* mention it in their writings, as if it were a barrier made againſt *Gog* and *Magog*. Mr. *Hyde*, in his letter about the meaſures and weights of the *Chineſe*, believes he had found that Wall in *China*; but in this he is miſtaken. *Abulgaſus Bagadur Chan*, in his *Schagjare Turki*, or genealogy of the *Turks*, ſpeaks of the Wall of *China*: In *Arabic* it is called *Sed*, which in *Perſic* is *Dir* or Gate, and in the old *Turkiſh*, *Chataic* or *Chineſe* languages, *Unguli*. Thus erroneouſly did *Abulgaſus* write, and more erroneouſly has he been tranſlated and publiſhed in the *Ruſſian* language, from that in *High-Dutch*, and laſtly in *French*. For that * *Ungu li* is *Van li*, which ſignifies 10000 *Stadia*, by which name the *Chineſe* call, as it were, the Walls of their kingdom: But *Abulgaſus* diſtinguiſhes this Wall from that which *Alexander the Great* built to hinder the excurſions of the *Jagjugi* and *Magjugi*, who †, the *Tartars* ſay, have noſes like dogs, and have not yet touched the Brazen-Wall, but that immediately before the day of judgment they ſhall, according to them, break thro' it with their noſes. In fine, he diſtinguiſhes this wall from that which *Nuſchiruan* built over againſt *Schamachus* § round his kingdom.

This is the ſame Wall which we ſtill find lying in ruins. The other Wall does not differ from it, only that the *Mahometans* have perplexed it by a fabulous name, and other idle inventions: For when *Mahomet* in the eighteenth *Surat*, ſays, that *Alexander* built a Wall between two mountains, his followers have wanted to find out in what part of the world it lies. *Eledriſus* tells us a great many idle ſtories from the authority of *Abſalemus Alterajeman*, or the Interpreter; which laſt affirms, that he was ſent by a certain Caliph, who in a dream had ſeen the Wall of *Alexander*, extending, as it were, between his own dominions and between *Gog* and *Magog*, and carefully to find out what Wall this was: That the Caliph had given him a convoy of fifty Horſe, as alſo 5000 *Denarii*, beſides a preſent of 10000 Drachms, and to each horſeman 50000 Drachms for his pay and proviſion for a year; and in fine, 100 Mules to carry water and other neceſſaries. Who this Caliph was, neither *Abdalla Ebn Chordaba*, nor *Eledriſus*, who tells this ſtory out of *Alſalemus*, ſay any thing.

* P. 118, 119. † In the *High Dutch* and *French* Tranſlations *Jadſutz madzutz*. l. c. § From which the Tranſlators without any foundation from *Abulgaſus*, have made it *Neu-Schiruanadill Sultanum Sazaartem Schamathiæ*.

thing. But as *Alſalemus* relates, that he ſet out from *Sermanraia*, M. *Bayer* does from hence judge of the time. For *Motalemus*, the eighth Caliph of the *Abbaſidæ*, about the beginning of his reign, which was *An. C.* 834, tranſlated the ſeat of the empire from *Bagdat* to *Sermenraia*, not far from *Bagdat* upon the *Tygris*; and the ſucceeding Caliphs down to *Motadedus* reſided in the ſame city. *Motadedus An. C.* 893, tranſlated it again to *Bagdat:* Therefore ſix Caliphs, in almoſt 60 years, reſided at *Sermenraia*; and we learn from *Albulpharagius*, that at that time reſided among the *Arabians*, moſt of the *Greek* Commentators, among whom this *Alſalemus Altargjeman* is reckoned one, who ſet out from *Sermenraia* to *Tephliſius* with the Caliph's letters for *Iſaac Eben Iſhmael*, Governor of *Armenia*, from whom he had recommendatory letters to the Prince of *Alſarir*, and afterwards he came to the Prince of *Lan* and *Philaſchae*, from this laſt having got five guides, he in twenty-ſeven days came into the extreme parts of the *Beſegert*. M. *Bayer* explains theſe obſcure names in the edition publiſhed at *Rome*, in which *Eledriſus* is ſadly handled and maimed of the better part. From *Tephliſius* he came to *Alſarer*, a country ſituated on the *Caſpian* ſea, and which is called *Alſerir Aldeheb* (i. e. *the golden throne*) where *Derbent* is reckoned to be. *Lan* ſeems to be a corruption of *Lahgjan*, which town is in the country of *Gilan*, called *Laginum* by *Europeans*, four days journey from *Caſbin*. What *Philaſchah* is, M. *Bayer* could not conjecture: But *Beſegert* is the country *Beſa*, or as the *Arabians* pronounce it, *Phaſa*, that is, a *northerly country*, as it lies to the north eaſt of *Perſepolis*. Hence, he ſays, he found in the dark country (the ſilly man had never heard of *Cimmerian* darkneſs) for ten days journey, the air to ſtink ſo intolerably, that perfumes were hardly of any uſe. After a month's journey, through the places laid waſte by *Gog* and *Magog*, he at length, after ſix days more, came to *Chacanus Otcos*, which lies adjoining to this mountain, in the opening of which is a ditch or mound. Here he viewed the Wall, which is almoſt two *ſtadia* from the town; and hence it follows that he purſued his journey thro' *Perſia* and ſome part of *India:* For in his return he alſo affirms that by theſe towers he was led towards *Choraſanus* into *Samarcandia*. And ſince, according to *Abulfeda*, even the veſtiges of the Wall are found at *Gihon* or *Orxanthus*, in the country of *Ilak*, from *Schalbaleg*, as far as the out-let of the valley *Alſchaſch*; hence *Alſalemus* ſeems to have borrowed the whole of this fabulous relation. Now let us with *Alſalemus* view the Wall.

The mountain lay in the valley 150 *Savada* cubits; there was an iron gate 50 cubits high, fortified with two butreſſes, each of which was 25 cubits broad, projecting from the gate 10 cubits; the gate was entirely made of iron plates, covered with braſs; the butreſſes being 50 cubits high, were covered with a roof 120 cubits: Over this roof was another building up to the very top of the mountain, on which were two iron

wings, and on the top of each two horns over againſt each other; the leaves were ſhut, being 50 cubits broad each, and 5 cubits thick; the bolt was 7 cubits long and one cubit round; this bolt was 25 cubits from the ground, and the lock was 5 cubits higher than the bolt; the key was a cubit and a half long, with 12 handles hanging to a chain; the lower threſhold of the gate was ten cubits broad, and 100 cubits long: The governor of theſe towers, with ten horſemen, uſually make their rounds about the gate and ſtrike the bolt with hammers, ſo that not only thoſe without the gate may hear that the guards are at hand, but likewiſe, that they themſelves may know what is a doing: It is reported that upon clapping the ear here, one perceives the buzzing, as it were of a mighty people, who live beyond it: He affirms that a little way from this, he obſerved a camp that took up 10 *ſtadia* of ground, and two towers, near the gate, 200 cubits high, and as many cubits broad; and that between them runs a river: That in one of them are kept tools for building a fort; and that here are iron caldrons and other utenſils, where the iron plates are made. *Alſalemus* likewiſe ſaw ſome of theſe plates upwards of a cubit in length, and a hand in heighth. And in fine, to conclude his ridiculous fable, he affirms that ſometimes were ſeen on the wings of the Wall vaſt numbers of the nations of *Gog* and *Magog*, of whom they were ſo much afraid and to oppoſe whom, they had built ſo many forts, caſtles and towers, all of iron and braſs, and had ſtrengthened with a Wall a mountain, that by nature was inacceſſible. Would one think that theſe people were ſtout warriors? They were no other than pigmies, two hands and a half high.

Thus the fable that took its riſe from the Caliph's dream, ended in *Aljalemus*'s.

Gregory of *Malatia*, the nearer he was to mount *Caucaſus*, the more probable is the account he gives of the ſituation of the Wall, than that of *Eledriſus* the *African:* And yet his account is not without ſome fiction: For he relates *, that *Alexander* being entreated to build the mound of *Jagjug*, made a Wall of ſtones, iron and braſs, which by putting fire under them became one ſolid ſtone, 12 cubits long and 8 cubits broad; and after finiſhing this, came to the mound of *Babulabuad*, in the valley of *Kaphgjak*, and having dug the foundation, extended it over the mountains as far as the ſea of *Conſtantinople*. *Kaphgjak*, is by the *Arabians*, *Perſians* and even *Armenians* called *Daſcht* (which *Antonius Giggæus* interprets a *Deſert*, but *Golius* a *deſert plain*) and is called *Daſchte Kaphgjak*. In the hiſtory of *Timurus*, *Arabſides* deſcribes its ſituation in the following manner; 'On the ſouth of *Daſcht* lies the ſea *Colzum*, or the ſea of *Conſtan-* 'tinople, which is ſtormy and noted for ſhipwrecks; as alſo the ſea *Mezri*, 'extending from hence to *Conſtantinople*. Theſe two ſeas would join, did 'not

* P. 108.

‘ not the mountains of *Circaſſia* intervene: To the eaſt lye the confines of
‘ the kingdoms of *Chouareſmia*, *Otrard* and *Sagnak*, and after paſſing over
‘ other countries, it borders on *Turceſtania*, the country of the *Getæ*, and
‘ extends to the confines of *China*, in the kingdoms of *Mogul* and *Chatai*.
‘ But to the north lies *Emirus* of *Siberia*, *Berar*, *Kephar*, a ſandy deſert
‘ and mountains: And after that, it is ſurrounded with a deſert, where
‘ are wild beaſts and fowl, which ſerve as game for the great: None
‘ have reached its extreme parts: To the weſt, border upon it, *Ruſſia*,
‘ *Bulgaria*, and the provinces inhabited by Chriſtians.

M. *Bayer* explains ſome unknown names of places, that render this deſcription obſcure. And firſt, to the South lies the ſea *Colzum*; *Mohammed*, *Alfraganus* (*a*) and others call it the *Arabic Gulph*, from a town on the coaſt of *Egypt*, which is the *Cly ſma* of *Ptolomey*; but *Arapſiades* calls it the *Caſpian* ſea; for it is common with this *Arabian* to uſe the moſt far fetched and uncommon expreſſion. *Bernardus da Parigi*, *Angelus* (*b*) *a S. Joſepho*, and *Meninſkius* affirm that the *Perſians* and *Turks* call the *Calſun* or *Colzum*, the *Caſpian* ſea: But Mr. *Hyde* (*c*) adduces the teſtimony of a certain *Perſian*, who finds fault with his countrymen for improperly uſing this name. *Gregory* of *Malatia* calls the *Euxine* ſea, *Colzum*: But either *Gregory* was miſtaken, or this was inſerted by an unſkilful Tranſcriber. *Mezri* is not the ſea of *Egypt*, but the name of a great town or city, for ſo they call *Mezr*. The *Circaſſian* mountains are *Caucaſus*: It is bounded to the eaſt by known countries, *Chouareſmia* and *Turceſtania*. *Kata* is the country of the *Getæ*, as *Arabſiades* and ſome others call it, but moſt part, *Chata*, on which the Author of *Logat Meſnavi* cavilling ſays, that ſuch as write it ſo are miſtaken. That *Cataia* the ancient name of the *Getæ* lies beyond *China*. *Arabſiades* does ſomewhat obſcurely compriſe this *Cataia* and the *Mogul*'s country, as far as *China*, within *Kaphgjak*: But *Tagj Altauarich Saadi Effendi* in the *Ottoman* annals, and from him the Author of *Nimetullah* or the *Perſic* lexicon, ſay, upon the word *Turc*, that the *Catæi* and *Choteni* inhabit *Deſti Kaphgjak*. *Abulgaſus Bagadur Chan* in *Schagjare Turki* deſcribes this country as being within the rivers *Tin*, *Atil* and *Jaik*. He calls it *Tanais* and *Volga*, which is called *Etel* by the Writers of *Conſtantinople*, and is known by the name *Jaicum*. Beſides, he writes that the *Uruſſi*, *Olaci*, *Magjari*, and *Baſkiri* dwelt in *Kaphgjak*, but that they were defeated by *Kaphgjakus*, who was ſon to a certain General in the army of *Oguſus Chun*: As he was poſthumous and brought up in a hollow tree he had his name from thence; for in the *Turkiſh* language, *Capſchack* ſignifies a hollow tree: This country, as he ſays, was ſo called, becauſe he and his poſterity down to *Gangiſcanus* poſſeſſed it four thouſand years. Here are ſome fictions, particularly that

(*a*) P. 36. (*b*) Vocabular. *Ital. Turcheſc.* p. 1321. (*c*) Commentar. R. Abraham. Peritſol. p. 65.

this calculation of *Abulgaſus* runs higher than the deluge. Yet this name of the country is very ancient and was not unknown to the *Greeks*; for when *Polybius* makes mention of the *Aſpaciacæ Nomadæ* between the *Tanais* and *Oxus* (*a*) Ασπασιακαι is evident a corruption of *Kaphgjak*, and even the plain was known to *Herodotus* and *Procopius*, and *R. Abraham Peritſol.* calls it the *deſerts of the continent belonging to* Gomer *and* Magog; and *Pliny* (*b*), *a vaſt plain*, and like *Egypt*.

This digreſſion to ſhew the ſituation of this country, may not be unacceptable, as both that part of geography which is very dark, is explained, to throw a light upon hiſtory, and as at the ſame time is aſcertained in what valleys *Gregory* places the Wall of *Gog* and *Magog*, and we are the more confirmed herein as he writes that it reached from *Babolabuab* to the *Euxine* ſea: For *Derbent* is the modern name given it by the *Perſians*, and, almoſt in *High-Dutch*, *Derbent* ſignifies *the bar of a door or gate*. The *Turks* call an iron gate, *demir capi*. And *Haytho* of *Armenia* ſays, 'that '(*c*) *Miralis* is called the iron-gate, which *Alexander the Great* fortified on 'account of the different nations that dwell in the utmoſt parts of *Aſia*, 'whom he would not have to paſs into the *Greater Aſia* without his leave, 'And that city lies on ſome part of the *Caſpian* ſea, and touches the great 'mountain *Cocas*.' *Cocas* is mount *Caucaſus*; but the *Arabians* call this city for the moſt part no otherwiſe than by the old name, *Babolabuab*, *i. e.* the *gate of gates*, to which *Naſſireddinus Tuſæus* and *Ulugbegus* of *Tartary* aſſign the ſame length and breadth, as they themſelves in their tables give to *Derbent*.

As we have determined the extent and ſituation of this very much celebrated Wall or Mound, let us enquire into the common opinion received among the eaſtern nations, that *Alexander the Great* was the founder of it. We need not be ſurpriſed at the teſtimony of ſo many *Arabians*, *Perſians*, and *Tartars*, who cannot but relate fictions, when they follow *Mahomet*, that barefaced Impoſtor. *Gregory* of *Malatia*, it is true, was one of the ſect of the *Jacobites*, but even he takes all opportunities ſhamefully to flatter the *Mahometans*, and he betrays great want of judgment. *Mahomet*, in the XVIII Surat, thus repreſents the caſe; that *Dulkarnain* had, by the command of God, gone to the eaſt, and travelling from thence, came between two mountains, where I know not what people entreated him to build a Wall to defend them againſt *Gog* and *Magog*; and that he, with their Aſſiſtance, made uſe of caſt iron to build it; that he, beſides, propheſied, that the time would come, whenever *Gog* and *Magog* paſſed this Wall, this iron bulwark ſhould be reduced to aſhes. In the mean time his followers believed all his fables: Yet here interpreters do ſomewhat differ. Some contend that this *Dulkarnain* was King of *Arabia Felix*, ſon of King *Hareth*, father of *K. Abraham*, from whom *Balcais* Queen

(*a*) P. 862. Ed. Gron. (*b*) L. vi. c. 17. (*c*) P. 9.

Queen of *Sheba*, who came to see *Solomon*, is said to be descended. But the greater (*a*) and better part of them think, that here *Mahomet* points at *Alexander the Great*, and there are various opinions among the learned for his being called *Dulkarnain* or *two-horned*: Yet *Mahomet* did not invent all this about *Alexander*, but foisted in several idle notions of the schools and sects of the *Jews*, *Arabians*, and *Greeks* as the chiefest things in his book. *Josephus* is the first among the *Jews*, who in three words says, that *Alexander* fortified the passes with iron-gates, whose veracity (*b*), how great it is in this matter, appears, M. *Bayer* thinks, from hence, that he writes, that a passage was opened to *Alexander* thro' the *Pamphilian* sea, as was the case with the *Jews* under *Moses* their leader, through the gulph of *Arabia*: 'In (*c*) this, says he, 'agree all who have writ of the exploits of *Alexander*.' What assurance! All the eastern nations relate the same thing of *Alexander*, as having built the Wall and subdued the people of *Caucasus*; and to the same purpose is what *Musladinus Sadus Schiracensis* writes in the *Gulistan*, that *Alexander* with infinite labour entered the *Cimmerian* darkness: But the *Samaritan* (*d*) edition of the book of *Joshua*, or chronicle of the *Jews*, published about the beginning of the eastern empire, mentions that *Alexander* subdued *India*, *Persia*, and *Biladilrum*, that is, the *Lesser Asia*, and whatever was subject to the *Roman* empire, at that time, in *Syria* and *Mesopotamia*, and likewise the other provinces; and that at that time being desirous to see the land of *Seir*, he entered into the land of darkness: 'And the *Macedo-* 'nians, says he, entered for three days journey into darkness, and after- 'wards became masters of the country beyond this, which they had in- 'vaded and viewed in the light.' Then it was that they saw the mountains of precious stones and of gold: For what did not they seem to see upon their sudden emerging out of darkness? Yet the *Samaritans* say nothing of that Wall. And *Hegesippus* (not the ancient) but he who borrowed a great many idle stories from the *Jews*, relates the whole matter thus: 'That the *Albani*, with the other nations, were restrained by the iron- 'gate which *Alexander* had built on the steep ridge of mount *Taurus*, and 'that they dwelt on the *Tanais*, in *Scythia*, its neighbouring parts, and 'the *Paulus Mæotis*, and by his contrivance were confined in a prison, as 'it were, so as to be hindred from making any excursions.' This was so currently received in the east, that it came to *Procopius*'s ears. And (*e*) *Gervasius Tilberiensis* relates that in *India* is *Mons Caspius* (from which the *Caspian* sea takes its name) between which and the sea, *Gog* and *Magog*, very fierce nations, that eat both human and animal flesh raw, were shut up by *Alexander the Great*.

Now

(*a*) Abrahamus Ecchellen. in Chronico Orient. f. 254. (*b*) De Bel. Jud. L. vii. c. 29. (*c*) In Archæol. L. ii. c. 7. (*d*) M. *Bayer*'s Edition was *Golius*'s. (*e*) T. J. Script. Brunsuic. f. 911.

Now from the authentic records of the *Greeks*, it is evident that *Alexander* never undertook any expedition to this *Caucaſus*. For early in the ſpring of Olymp. CXI. 2. he ſailed from *Eleus*, and arrived at *Sigeum*, fought the battle of *Granicum* on the ſixth of *Thargelion*, or the twenty-ſecond of *May*, O. S. From thence, marching thro' *Caria*, *Phrygia*, *Lycia* and *Pamphilia*, and thro' the paſſes of *Cilicia* and *Taurus* in *Syria*, in the month *Maemacterion*, the ſame with our *October*, he fought another battle. Hence it is plain, that he had no time to undertake any expedition to *Caucaſus*. After this he beſieged *Tyre* for ſeven months and took it by ſtorm, Olymp. CXII. 1. on the twentieth of *Hecatombæon* or *Auguſt*. After which he marched to *Egypt*, and having ſettled affairs on the eaſt of the *Helleſpont*, as far as this country, he returned to *Thepſacus*, Olymp. CXII. 2. in the month *Hecatombæon* or *July*. He fought a battle with the *Perſian* army at *Arbela* or *Gaugamala*, in the month *Pyanepſione*, or *November*. *Darius*, after his defeat in that battle, ſent his wives and the reſt of his family into *Caſpian Pylæ*: But *Alexander* haſted by long marches to *Perſepolis*, and followed *Darius*, who was encamped in *Media*, where when *Alexander* was informed by *Ecbatana*, that neither the *Scythians* nor *Caduſii* had ſent *Darius* aſſiſtance, he purſued him with a few horſe in his flight into *Parthia*. Here, it is true, *Arrian* (*a*) writes, that *Alexander* marched from *Media* thro' the *Caſpian Pylæ* into *Parthia*; but whatever thoſe paſſes within *Parthia* and *Media* be, they are not the *Caſpian* paſſes we are in ſearch of. And this *Plutarch* (*b*) ſaw, who from thence draws an argument, that the *Iberi* could not have ſubmitted to the *Macedonians*, as *Alexander* ſuddenly left *Hyrcania*. From thence he marched againſt the *Bactrians* and *Indians*, and after his return he died at *Babylon*. M. *Bayer* not only confutes the fable, but traces its origen. *Alexander* had ſent *Zopyrion* to *Pontus* to carry on the war, who marched againſt the *Scythians* (*c*), that is, as far as the paſſes of *Caucaſus*, and if we credit *Macrobius* (*d*), even againſt the *Boryſthenit*. But he and 30000 men were cut to pieces. Now here we have a remakable inſtance of the readineſs of conjecture in former days: For according to them, the *Scythians*, *Sarmatians* and *Poles* are one and the ſame people: And therefore the victory obtained by the *Scythians* is aſcribed to the *Poles*. The *Macedonians*, according to *Vincentius Cadlubecus*, were defeated in a great battle by the *Poles*, nay, and what is more unlikely, *Alexander* himſelf. And thus we loſe the truth! It is not probable that of 30000 men all ſhould be cut off, but that ſome few might have eſcaped: And whither do we think they betook themſelves? They were ſurrounded by a diſmal country and inhoſpitable people, and there was no hopes of returning by land through ſuch potent nations: They therefore betook themſelves to the *Caſpian* ſea, and

(*a*) Arrian. p. 205. Ed. Blanc. (4) p. 208. (*b*) In Pompeio, f. 637. (*c*) Juſtinus L. xii. 2. (*d*) P. 238.

and where did this carry? Into the eaſtern and northern oceans. Now they rode in the harbour, when from the northern ſea they came to the *Baltic*, the way was open into *Franconia*, *Saxony* and *Pruſſia*. For *Scandinavia*, according to the ancients, is an iſland. M. *Bayer* adduces one teſtimony from *Ravennas* the Geographer (*a*), who borrowed it from the *Greeks*. 'The 'world, ſays he, is bounded on the north by the above-mentioned ocean, 'which comes from *India*, and the *Caſpian* paſſes, it waſhes the deſerts of '*Scythia*; then the country where we read the *Amazons* dwelt, after they 'came out from the mountains of *Caucaſus*, afterwards the country of the '*Roxolani*, *Sarmatæ*, *Scythæ*, *Rerefeni*, and *Sidefenni* (and probably there 'too the *Germans* dwell) the *Danes*, *Saxons* and *Triſi*.' He places the (*b*) *Amazons*, after coming from the mountain of *Caucaſus*, near *Colchis*, and makes *Scanzia* or *Scandinavia* to be no other than an iſland.

But what can be groſſer than ſuch conjectures? Yet thus Authors invented hiſtory in thoſe times, when they unhappily made uſe of the monuments of antiquity: Therefore *Otfridus* the Monk derives the origin of the *Franconians* and *Gotofredus Viterbienſis*, that of the *Saxons*, and *Albertus Stradenſis*, even that of the *Pruſſians*, *Rugiani* and *Holſati* from the *Macedonians*. 'There it is found, ſays he, that the remains of the *Macedonians*, 'after the death of *Alexander*, were diſperſed over all the world: For as '*Alexander* had, by their bravery, conquered *Aſia*, after his death, they 'durſt no longer truſt themſelves to that country, but withdrew with 300 'ſhips, which were all loſt, excep 54, of which 18 landed and took poſ-'ſeſſion of *Prucia*, 12 arrived in *Rugia*, 24 in *Albia*; the people in one of 'which ſhips landed and cut down a wood beyond *Albia*, where they ſet-'tled, and were afterwards found, and therefore called *Holſati*. As an improvement upon this fable, *Gobilinus* adds, that a *Demon* opened to the fugitive *Macedonians*, all the ways into *Pruſſia*: 'Thoſe of them, ſays he, 'whom *Alexander* left in the *Caſpian* mountains, and whom he could truſt 'to guard that country, upon hearing that he was dead, were very much 'troubled, and conſidering the hatred of the inhabitants to them, deſpaired 'of returning into *Macedonia* by land: Wherefore getting ready 300 'ſail, they ſet out on the *Caſpian* ſea, and were long upon the Ocean in 'queſt of ſettlements; but at laſt a ſtorm ariſing, all their ſhips were loſt 'except 54, of which 17 arrived at *Pruzia*, and 12 in *Rugen* and on 'the adjoining ſea coaſts.' Thus readily are fables invented and propogated!

Beſides, there is another fable, from which the two abovementioned fables are derived: The *Arabians* borrowed it from the *Greek* Writers, that *Alexander* had penetrated as far as *Caucaſus*; amongſt theſe is *Dexippus* (*c*), who relates, that after gaining ſeveral victories at mount *Caucaſus*, and

(*a*) P. 293. Ed. Porcheronis. (*b*) P. 140. (*c*) Excerpta Euſebii Græca f. 57. & Cedrenus.

and the *Mæotis*, *Alexander* returned to *India*. *Diodorus Siculus* (*a*), as may be gathered from his fragments, has followed *Dexippus*. Other Writers only mention *Caucaſus*, without taking any notice of *Mæotis*: For they call *Caucaſus*, not this that M. *Bayer* has found out, but *Paropamiſus*, beyond *India* and *Bactria*. The origin of this error has been ſhewn by *Strabo* (*b*), *Plutarch* (*c*), and *Arrian* (*d*), tho' the laſt is inaccurate in his account of the life of *Alexander*, having been miſled by the authority of *Ariſtobulus*, who betrayed ſuch ſillyneſs in his hiſtory, that when he recited it to *Alexander* in *Hydaſpis*, he was ſo enraged, as to throw the book into the river, and could hardly forbear flinging the Author after it. When *Alexander* after conquering the *Bactrians*, had turned to *Sogdiana* and *Paropamiſus*, the *Macedonians* bethought themſelves of the *Caucaſus*, they had heard mentioned on the ſtage at *Athens*, ſo as to be celebrated all over *Greece*, and in order to add to *Alexander*'s glory, they called *Paropamiſus*, *Caucaſus*; and according to *Plutarch* took the river *Orxantus* to be *Tanais*, famous for the exploits of the *Scythians*. Now they heard, that the *Amazons* dwelt of old upon the *Tanais* and *Mæotis*: And therefore they were confounded with the exploits of *Alexander*. That a Queen of the *Amazons* came with a great retinue, in order to have children by him, and after finding herſelf with child, returned to *Tanais*. In *Plutarch* are ſeveral things to refute this: For what authority may be better depended upon than that of *Alexander* himſelf? From whoſe preciſe orders to *Antipater*, it is plain, that the King of *Scythia* offered him his daughter in marriage: And when *Oneſicritus* had mentioned this of the *Amazons*, in his hiſtory, King *Lyſimachus*, who accompanied him in his expedition to *Paropamiſus*, checked *Oneſicritus* in his recital, with the following remarkable ſaying; *But where was I when this happened.* Thro' the unacquaintedneſs of the *Macedonians* with theſe countries, they were led into this miſtake about *Caucaſus*: For the *Greeks*, after *Herodotus*'s time, as is evident, eſpecially from the *Argonautic* Writers, *Dionyſius Periegetes*, on the *Parecbolæ Dionyſianæ* of *Euſtathius*, placed *Aſia* to the north, within narrow bounds, in order to have the *Euxine* ſea next to the *Caſpian*, and ſomewhat more northerly, joining together the *Paulus Mæotis*, and the *Caſpian* ſea, by a channel of communication. Thus they drew *Tanais* from the eaſt, and extended mount *Caucaſus* under *Tanais* to the utmoſt parts thereof: Thus confounding the ſituation of the world, they placed the *Choraſmii* near the *Colchi* and *Scythiæ*, and gave out, that *Pharæſmenes* King of the *Choraſmii*, according to *Arrian*, offered himſelf, as knowing the roads on account of the nearneſs of that country to his own, to conduct *Alexander* in his *Pontic* and *Scythian* expeditions. *Diodorus* (*e*), in his deſcription of *Aſia*, reckons *Sogdia* and *Bactria*, as the laſt provinces to the eaſt

(*a*) L. xviii. 83. (*b*) P. 787. (*c*) In Alexandro, f. 690, 691. (*d*) In Indicis, p. 511. (*e*) L. xviii. 5.

eaſt and north not far from *Tanais*, and he bounds *India* with *Caucaſus*. He alſo writes (*a*), that *Alexander*, having in ſixteen days paſſed *Paropamiſus*, built *Alexandria* in *Caucaſus*, by which a communication is opened into *Media:* He therefore had in view the *Caſpian* paſſes, and the city of *Derbent*. From this *Caucaſus* to the eaſt, *Polybius* (*b*) likewiſe writes, that the river *Oxus* runs. Beſides ſo great a confuſion in geography, another thing, according to *Strabo*, miſled the *Macedonians*; for in *Paropamiſus* they found a ſolemn ghaſtly cave, which they compared with the account given of it in their *Tragedies*, and where they ſaid *Prometheus* was tied down and releaſed by *Hercules*; ſuch a miſtake is not to be wondered at, for in the life of *Alexander* a great many incredible things are told; ſo that upon the authority of their Writers, the exploits of *Hiero*, *Gelo* or *Clearchus*, are more famous, according to *Arrian*, than thoſe of ſo great a Hero as *Alexander*.

Hence it evidently appears, from what this opinion took its riſe; and at the ſame time, how it came to be reported, that *Derbent* was built by *Alexander*; for according to *Arrian* (*c*), in *Paropamiſus Alexandria* was built by him. *Pliny* (*d*) places that town beyond *India*, the memory of which is preſerved by different nations, who claim the honour of it: For the Subjects of the *Mogul* contend, that *Alexander* performed his greateſt exploits and built towns in the country which they inhabit; and they inſtance in thoſe places which, it is true, are now deſolate, and lye in ruins: And a certain perſon told (*e*) *Nicholas Vitſenius*, that he ſaw eight ſuch places in his way to *China*, through *Seleng*, not only houſes cut out of the rock, but the roads ſtrewed with rubbiſh. Not far from the Wall of *China* are ruins of pillars and ſtone-towers. The Subjects of the *Mogul* affirm that *Alexander* deſtroyed theſe towns, but in another part of the deſerts of the *Mogul*'s Country is the town, *Iki Burchan Koton* or *Trimingzing*, by the *Ruſſians* called *Bogatiri*, that is, the *City of Heroes*, which they ſuppoſe to have been built by *Alexander*, and called by his name: Not that M. *Bayer* takes this to have been really the caſe, but that either his name being famous all over *Aſia*, has been given to towns built even in latter times, or that other Princes of the ſame name would have the towns which they built called ſo.

As to the builder of this Wall, M. *Bayer* ſeems rather in a matter of ſuch obſcurity to deſtroy the common opinion, than to give his own. Should any one contend, that the *Medes* laid the firſt foundation of theſe barriers, M. *Bayer* will not be againſt it: For they yielded to no people in ſumptuous and magnificent buildings.

Near *Babylon* was the *Wall of Media*, 20 foot thick, 100 foot high and 20 *Paraſanga* long, which was all of bricks. The ruins of *Lariſſa* (*a*) and *Meſpili*, the former 100 foot high, and the latter 50; it appeared that the foundation was made of a foreign red ſort of ſtone, the ſame with

(*a*) L. xviii. 5. (*b*) P. 863. (*c*) P. 230. (*d*) L. vi 23. (*e*) Nic. Vitſenius in Tartariæ Deſcriptione. *Noord en Ooſt Tartarye, tweede druk*, t'Amſterdam 1705. Parte II. p. 28.
(*f*) Xenophon in Expedit. Cyri L. II. c. 4.

that in the Wall of *Caucaſus*, upon which was built a brick Wall. Probably too (*a*) the paſſes of *Cilicia* and *Syria* were fortified by the *Medes*, as far as the ſea; from the *Medes*, the poſſeſſion of theſe paſſes fell to the *Perſians*: the *Perſians* being ſubdued, theſe paſſes fell to the *Macedonians*; and their dominions extended as far as *India*, and were compriſed between the *Adriatic*, the *Pontus*, and mount *Caucaſus*, which formerly bounded the *Perſian* empire: But there was no Wall built over mount *Caucaſus* before *Seleucus Nicator*'s time. If therefore the Wall was firſt begun by *Antiochus Soter* or *Antiochus Theus*, no wonder it is called the Wall of *Alexander*, as ſome things performed by his ſucceſſors are aſcribed to him. Under *Seleucus Callinicus* great-grand-child of *Nicator*, the power of the *Seleucidæ* was broken, and then both the *Armenians* and *Hyrcanians* raiſed their heads. *Joſephus* (*b*) relates that King *Hyrcanus* commanded the *Caſpian* paſſes under the reign of *Veſpaſian*; the paſſes of *Caucaſus* were in the hands of the Kings of *Pontus*, and after *Mithridates* was ſubdued, were reckoned to be under the dominion of the *Romans*, yet the *Iberi* guarded them: And probably the Wall was quite broken down at that time; as no mention is made of it by thoſe, who could not be ignorant of the paſſes of *Caucaſus*.

When the *Mahometans*, under *Gjerai Chan*, became maſters of *Derbent* and *Anderum*, *Muhamed Anabi Akraſſi*, was ordered to ſearch the writings of the *Arabians* and *Perſians*, and to write in *Turkiſh* the antiquities of *Dageſtan*. He ſays, that the Wall of *Caucaſus*, built by *Alexander*, was at length ſo effaced, that ſcarce any veſtige of it remained. That *Cubades*, father of *Nuſreuanus*, King of *Perſia*, made war upon *Hacanus* King of the *Turks*, and *Hirri*, who had the kingdom of *Nucratum*, and all *Ruſſia* under his dominion, and an army of 40000 men; that, at length, after concluding a peace, he gave his daughter in marriage to *Cubades*, and that the allied Kings agreed to build a Wall to part their dominions; but that *Cubades* being told by the angel *Gabriel* of *Alexander*'s Wall, had, after clearing away the ſand that covered it, built upon its foundations the ſouth part of the Wall, and 7 years after carried on the remainder from the ſea to the further parts of the city *Tibriſeran*, near 500 *Ruſſian ſtadia* diſtant from *Derbent*, and fortified it with iron gates, ſo that 100 men could defend themſelves againſt 100000; that *Cabades*, after planting Guards at the gates of both Walls, ſent *Hacanus*'s daughter home to her father, having kept her only one night, and returned into *Aberbeidriana* or *Media* and *Arak* or *Parthia*. Here are ſome things that come near the truth. As to *Acraſius*; after touching upon the wars of the *Ephthalite Hunns*, with *Perozes*, father of *Cubades*, &c. mentions the paſſes of *Caucaſus*, which he confounds with the *Caſpian* paſſes. Even this is plain from *Procopius*, who writes, that (*c*) the paſſes of *Caucaſus*, had ſucceſſively fallen into ſeveral hands, till *Abuzucus* the *Hunn*, a very great friend to *Anaſtaſius* and the *Romans*, poſſeſſed them, who ſent an ambaſſy to *Anaſtaſius* to deſire a certain ſum of money for delivering up to the *Romans* the gates and the caſtle

(*a*) Ib. L. III. 4. (*b*) De Bel. Jud. L. VII. c. 29. (*c*) F. 28.

caſtle. *Cubades*, after *Abuzucus*'s death, turned out his ſons and put in a *Perſian* garriſon. Afterwards in the reign of *Juſtinian*, *Rufinus* was ſent to *Cubades* to treat of a peace, who made a grievous complaint to *Rufinus* of *Juſtinian*, and the *Romans*, telling him that, for the mutual advantage of himſelf and the *Romans*, he had taken poſſeſſion of the paſſes of *Caucaſus* (when *Anaſtaſius* refuſed to buy them to ſave the expence of maintaining a garriſon there) leſt the barbarous nations ſhould make incurſions into the provinces belonging to the *Romans* and to himſelf, that he kept a very numerous army to guard theſe paſſes, and maintained them at his own expence without any trouble to the *Romans*. That, whilſt with the one army he oppoſed the barbarous nations, from carrying every thing before them, in his own provinces, and in thoſe of the *Romans*, it was unjuſt that the *Romans* did not cauſe, as there was occaſion, another army to oppoſe them, which he would defend againſt any open attacks. That he had for ſome time deſired, that the *Romans* would evacuate the *Perſian* dominions, namely, all *Meſopotamia*, or if they made his provinces the ſeat of war, that they ſhould eaſe him of the burden of maintaining another army, or at leaſt ſhould ſend an equal number of men and be at half the expenee with him, to defend the paſſes of *Caucaſus*; that a peace could not be ſettled, unleſs the *Romans* did either of the two. This *Cubades* demanded of *Rufinus*, in the fourth year of *Juſtinian*'s reign. A war enſued upon the *Romans* refuſing to accept either conditions, and it had quite ruined the *Roman* provinces, had not *Cubades* died, and *Choſroes* been harraſſed with the incurſions of the *Huns*, when *Juſtinian* ſent Ambaſſadors (*a*) to him, he agreed to a peace, one of the conditions of which was, that unleſs the *Romans* thought fit to guard the paſſes of *Caucaſus*, they ſhould pay the *Perſians* 110 *Centnars*, that is 110000 pound of gold. But the peace did not laſt long: For *Choſroes* (*b*) ſoon after invaded *Syria*, and took *Antioch*, where a treaty of peace was concluded with *Choſroes*, by which the *Romans* were to pay the *Perſians* down a tribute of 500 *Centnars* of gold, and every year 5 *Centnars* for the maintenance of the gariſon of *Caucaſus*. This *Choſroes* is the ſame the *Perſians* call *Nuſriuan*, by the ſirname of *Choſres*; conſidering his power, it is not unlikely but he built this Wall; beſides he reigned long to finiſh ſuch a work: For, according to *Geo. Syncellus* (*c*), he reigned 48 years. Laſtly, *Gregory Malatienſis*, after relating that the Wall was built by *Alexander*, ſpeaks thus, that the Kings of *Perſia* did not give over looking out for the Wall, till *Jazdegerdus*, ſon of *Pabram Juri*, grandſon of *Jezdegerdi*, and great grandſon of *Sapor* found it; and that he began to build it with ſtones made of braſs and lead, and yet did not finiſh it. In fine, that *Coſraes Nauſriuanus* carried it on over the tops of the mountains, and a mile into the ſea, and ſecured it with iron gates, ſo that the country might be defended by 100 men, which could hardly be done before by 100000.

 Whether

(*a*) F. 64. (*b*) F. 112. (*c*) F. 360.

Whether the appearance of Plants *may be raiſed from their* Salts. *Extracted by* T. Bartholin. *From* Olaus Borrichius, Acta Haff. p. 78, 79.

IN a publick promotion of Batchelors, the firſt candidate propoſed three queſtions for the ſolution of *Olaus Borrichius*. 1. Whether the Salts of Plants were known to the Ancients? 2. Whether all Salts are of the ſame efficacy? 3. Whether Plants might be reſuſcitated from their Salts? To all which *Borrichius* anſwered learnedly and to ſatisfaction. He evinced the Ancients knowledge of Salts by citations from themſelves: He denied that they were all endowed with the ſame virtues; and he demonſtrated, from different inſtances, that the figure of Plants were reviviſcible from their Salts, which inſtances I will attempt ſuch a compendious relation of, as my memory has retained.

Quercetan obſerved, in a congealed *lixivium* of nettles, the repreſentation of numbers of the like plant, with roots, leaves and ſtalks, ſo exactly delineated, that it were difficult to procure a Painter that ſhould expreſs them as truly.

Hannibal Barlet, a *Pariſian* Chymiſt, ſhewed *P. Borellus*, and many others, a beautiful plant he raiſed from tartar of vitriol, as he aſſures us in his hiſtory of medicines.

Le Febure, formerly chief Phyſician to his *Britannic* Majeſty, digeſted the lixivial Salt of tartar, firſt with ſpirit of vinegar, and afterwards with the higheſt rectified ſpirits of wine, for the ſpace of ſixteen months and upwards; when, upon ſubliming in a glaſs cucurbit, it roſe ſurpriſingly into the exact and natural reſemblance of a vine, the colour excepted. *Sachſius*, in his *Ampelographia*, or account of the vine, has recorded the ſame appearances from tartar, to occur in the *Holſtein* Laboratory.

Daniel Horſtius ſaw the like picture of wormwood, from the Salt of the plant.

Petrus Servius, a *Roman* Phyſician, ſaw a roſe-tree ſpring up, and produce, in twenty-four hours from the aſhes, which had been previouſly prepared with great ingenuity and diligence.

Borrichius himſelf burnt to aſhes the tender ſprouts of cypreſs, from which he extracted Salt, which he put into a glaſs veſſel, and to which after ſome months, he added a little phlegm of vitriol, that he might diſcover the form of the ſalt of cypreſs, which are ſooneſt extracted by an acid. About the end of the month, upon inſpecting the veſſel more attentively, he obſerved the ſides of it to be adorned internally, with a multitude of figures repreſenting the dwarf cypreſs; and one little tree in particular, about the middle of the glaſs, of the height of a little finger, which was white indeed, but in all other reſpects, reſembled the ſanders tree, which being pretty tough was very tractable, and ſhewn continually to the Curious at *Paris*.

The

The ſame *Borrichius*, an excellent inveſtigator of nature, obliged me with the ſight of a very elegant ſhrub in the neck of a retort, which he had reſuſcitated from the Salt of thyme and antimony, and which reſembled the ſtalks of that plant.

The peculiar Methods the Sieur Santerre *employed in his* Paintings. *From the* Breſlaw Collection. Ann. 1718. p. 730.

Tranſlated from the HIGH-DUTCH.

1. THE *Sieur Santerre* was ſo great a maſter in anatomy, and painted ſo much after nature, as to be able to correct ſeveral capital pieces of the moſt eminent *Italian* maſters. 2. He could give his works ſuch an air of freſhneſs, that after 30 or 40 years, they ſhould look as if but newly finiſhed. 3. For this purpoſe he employed only four or five earth, or mineral colours; by mixing which he could, though not without ſome trouble, produce all the variety of colours. 4. He laid his colours on for three or four times, and, 5. Uſed no lake, or other colours, ſubject to fade and decay.

As to the procuring a laſting freſhneſs to a piece of painting; it is the opinion of ſkilful Artiſts, whom we conſulted on this occaſion, that a picture in oil-colours, as in time theſe colours grow faint and dull, cannot long maintain its primitive beauty and freſhneſs; gum, ſize, and milk-colours hold out longer, yet theſe at length fade too, as there is nothing but gives way to the air's impreſſion. Nay, it may be affirmed, that a picture in oil-colours, ſhall, in the courſe of three or four days, fall ſhort of its firſt beauty: Tho' it muſt be owned, there are others, that improve by time; for grown old, their harſhneſs wears off, and the carnation or fleſh-colour eſpecially, looks ſofter and more natural than at firſt: Flowers on the contrary, and the like, appear more ſplendid and gaudy. However, much depends on the apartment where pictures are kept, and on the manner of cleaning them: For, by an apartment's being over-heated or filled with ſmoke, a painting ſuffers much, growing gradually darker, till at laſt quite black, as we frequently ſee in old pieces: Whereas a clean neat room conduces greatly to preſerve a picture: When a piece of painting turns foul, the better way is to clean it often, rather than let it continue long in its dirt; as by too much rubbing, the ſoft and tender teints are apt to be hurt and wore off. Beſides, a Painter, to have his colours laſting, ſhould avoid painting on new painted canvas, and grinding or mixing his colours with new oil.

As to the beſt ſort of colours: It may be affirmed, that earth-colours prove in no manner ſo beautiful as the ſap-colours; eſpecially in oil-paintings: Though the former having a much greater body, when ground with oil, exhale not, nor change; as ſap-colours, eſpecially indigo, do.

As

As to the principal colours in painting; white, black, red, yellow and blue, to which ſome add green, are held ſuch; though a blue may be made by a due mixture of a black and white; and a green, by a yellow black and white.

White, eſpecially white lead prepared, or flake white, is the principal colour: But care is to be taken that it be not adulterated with lime or other things, which in time turn the white quite yellow. For black, we uſe ſea-coal or *Cologne*-earth, chiefly in oil-colours. For red, cinnabar, common *Engliſh* brown-red and copper-red; with which may be claſſed burnt-oaker. For yellow, light and dark-oaker, as alſo umbre, being the moſt proper in oil. For blue, ultra-marine and verditer, which laſt turns of a greeniſh caſt in oil, but ſtands in water-colours. For green, *terre verte* or green earth, flake-green and verditer; which anſwer well in oil, only the laſt is apt to darken in time.

As to ſap-colours, ſuch are not fit to be uſed in oil, as they not only work foul, but prove evanid in ſunſhine or the air; whereas mineral colours will ſtand both; however, of theſe latter, ſome laſt longer than others; as, for inſtance, red than yellow; vermillion or brown-red, ground with oil, ſerves to impart an indelible ſtain to linen, preferable to the marking it with ſilk, which may be eaſily picked out. So that lake, being a ſap-colour, muſt prove prejudicial in a picture.

How, laying on the colours ſeveral times over, may conduce to a picture's duration, is eaſy to account for; as the ſtronger and fuller a colour is laid on with the pencil, the more laſting will be the painting: For which end, ſeveral Maſters have laid on their colours to a great thickneſs, eſpecially in ſuch as require being viewed at a diſtance. Some of the original pieces of *Rembrand* are done in this manner, with great judgment.

As to the diſtinguiſhing the *Italian*, *French*, *Dutch* and *Flemiſh* paintings from each other, this ſeems to be no difficult matter. If we obſerve that the *Italians* have ſomething noble in their deſigns, and ſtrong in their colouring. The *French*, a beautiful, ſweet and eaſy invention and colouring: And the *Dutch* and *Flemiſh*, a plodding, laborious imitation of nature.

Whether and in what manner may the faults of a painting be diſcovered? We are here to make a diſtinction; namely, that the Artiſt may fail either in not duly imitating nature; or, again, in not being fully Maſter of the rules of his art.

From all that has been ſaid may be ſeen, that the aſſertion, as to the duration of *Santerre*'s paintings, is not without exception. Time indeed may improve, nay frequently add more beauty to a picture than the Artiſt himſelf could: Hence the beſt Maſters have ſo blended their colours as that time ſhould produce that intended effect.

However,

However, to prepare the colours for duration, and make them leſs liable to change, the grinding and mixing them up with clean and ſweet nut-oil, inſtead of lintſeed-oil, will contribute greatly; eſpecially, if mineral colours be employed: Beſides the advantage of varniſhing a picture with a varniſh, prepared with gum copal and ſpirit of wine; which, like the common varniſh of the ſhops, is not liable to change. The painting in mineral colours has been practiſed amongſt the moſt ancient Painters; and the celebrated *Venetian* Painter *Gioggio*, who died in 1511 in the thirty-ſecond year of his age, and had brought colouring to the higheſt perfection in his time, uſed for his carnations no more than 4 capital colours; by judiciouſly mixing which, he diſtinguiſhed all ſorts of complexions, ages and ſexes; and he alſo knew how to heighten his colours that they ſhould for a long time retain their beauty; particularly his green, which was not ſubject to fade, as it generally is. From *Pliny*(*a*) it appears, that the moſt famous Painters, as *Apelles*, *Echion*, *Melanthus*, and *Nicomachus* made uſe only of 4 earths; as the *terra melina* for white; *Sil atticum*, for blue; *ſinops pontica*, for red; and *atrementum*, for black.

In the more early times, when Painting was yet in its infancy, the figures were not made out or ſhaded, but only the out-lines drawn with one ſingle colour, which ſcarce deſerved the name of colour; and when they drew or painted, they were wont to write underneath the name of the thing; ſuch paintings were called *picturæ lineares* or line pictures. The firſt in this way was either *Philocles* or *Cleanthes*. In proceſs of time, the art came to improve, and ſeveral colours to be employed; however, each figure in one colour only: Such pieces were called *monochromata*. *Eumarus* of *Athens* practiſed the painting all ſorts of figures; and *Simon Cleones* invented the profile way; imitating alſo the veins and arteries, the folds in the drapery, and he began to give his figures above one colour: And from this time the art grew to be in great eſteem. *Ariſtides* the *Theban*, was the firſt who taught to expreſs the paſſions (*b*).

In thoſe days the greateſt performances were in water-colours, laid on high and glaring: *Apelles* ſoftened them with covering his pieces with a thin *atramentum*, that made the picture be viewed with a more attentive eye: By this method he alſo preſerved his Paintings from ſoil. And *Protogenes*, to make his colours laſting, was wont to lay them on fourfold; that if by accident or injury of time, one layer ſhould drop off, another might preſent itſelf in its room. This was the ſtate of the ancient Painting; what improvements have been made in it ſince, would carry us too far to mention: We ſhall only obſerve, that the *Flemiſh* Painter *John Van Eyck*, was the firſt who diſcovered, in the beginning of the 14th

(*a*) Vid. Plin. Hiſt. Nat. L. 34. c. 12, 13. p. 594, 595. L. 35. c. 7. p. 617, 618. c. 6. p. 616, 617. Jonſton. Not. regn. Min. p. 11, 12. Polymath. p. 28.

(*b*) Plin. Lib. 34. c. 13. Lib. 35. c. 3, 7, 8, &c.

14th Century, the way of painting in oil; whereby Pictures come to retain their beauty for many ages together.

A practical Obſervation of an Inflammation of the Eye, *with a* Caries *of the* Orbit; *by* Con. Holtzendorf. *From the* Miſcell. Berol. Vol. II. p. 65.

Tranſlated from the LATIN.

A Robuſt, tall youth of 24 years of age, of a choleric ſanguineous temperament, and addicted to pleaſure, was ſeized in the ſpring with a ſudden and moſt violent pain in the fore-part of the head, and eſpecially raging about the *Sinus Frontales*. The blood veſſels, viſibly overturgid, indicated depletion, which being complied with, the ſeverity of the pain remitted indeed; but the third day after, the whole bulb of the Eye became unexpectedly inflam'd, and prominent, to the ſize of a pidgeon's egg. The *tunica adnata*, or outer coat ſeemed in a manner ſeparated from the ſubjacent membranes, and of a reddiſh colour, which diſeaſe the Oculiſts term a *Chemoſis*. The ſcarification recommended by *Hippocrates*, with the uſe of internal and external reſolvents was applied for three days to no purpoſe; for in the greater *canthus*, or angle of the Eye, towards, or beneath the juncture of the eyelids, we diſcovered a ſoft tumour, of the ſize of a large pea, from which, upon inciſion, a great quantity of well concocted matter was diſcharged. The wound being dreſt as uſual, the ſuppuration continued, and even encreaſed to the one and twentieth day, after which time, the *pus* was ſucceeded by a ſanious *ichor*, which indicated a corruption of the adjoining bones; and in fact, upon ſearching, we found the *Os unguis* entirely carious; when reſolving to perforate it, as in the caſe of a *Fiſtula lachrymalis* it appeared, on a more accurate inquiry, before the propoſed operation, that not only that part of the *coronal* bone that is joined to the *Os unguis*, but even the *Os ethmoides*, and the circular *Apophyſis* of the upper jaw-bone, that forms the *maxillary ſinus*, and conſtitutes the lower part of the orbit, proved to be corrupt, or carious. Theſe circumſtances being conſidered, I reflected that the pertuſion of the *Os unguis*, in this caſe, would not only prove inſufficient, but uſeleſs; as the whole lateral, internal, and lower part of the orbit was currupted; ſo that after all, I determined to commit this difficult work to the ſagacious operations of nature, only aſſiſting the patient with regular care, and due regimen: Within a few days after we arrived at the defective and ſeparable bones, and making an inciſion in the rim of the orbit, three pieces of them were ſucceſſively extracted

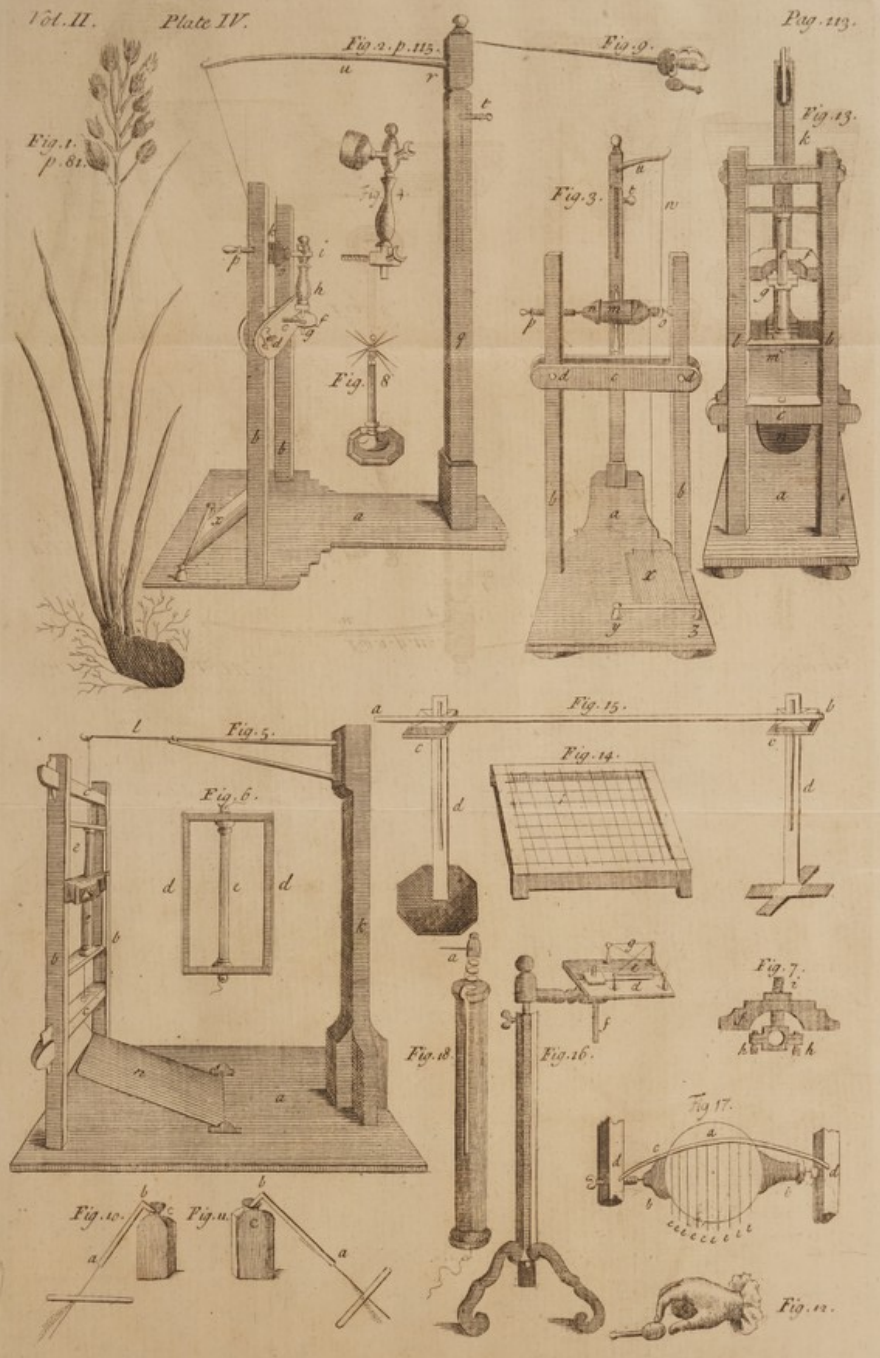


Fig. 1. p. 81.
Fig. 2. p. 115.
Fig. 9.
Fig. 13.
Fig. 3.
Fig. 8
Fig. 5.
Fig. 6.
Fig. 15.
Fig. 14.
Fig. 7.
Fig. 18
Fig. 16.
Fig. 17.
Fig. 10.
Fig. 11.
Fig. 12.

extracted of the ſize of a large lentil. After this ſeparation, the ulcer diſcharged a laudable *pus*, as at firſt, which was not only diſcharged by the inciſion, but through the channel of the noſe on the ſame ſide: We had recourſe to deterſive vulnerary inſpections, and after an interval of ſome weeks, the patient was entirely recover'd, the Eye being no ways impair'd in its uſe and function.

I cannot heſitate to communicate this caſe to the literary world, which my vanity does by no means ſtimulate me to do, ſince the cure of this diſeaſe was altogether inartificial. But I publiſh it to the intent, that young practicioners may not abide too abundantly in their own ſkill, in ſuch deſperate caſes: That they may not meddle over raſhly, but obſerving their due limits, let them reflect on the extenſive operations of nature, and pay a juſt reverence to her laws, who ſo wiſely ſuperintends and directs the Operations of our bodily machines.

New Experiments in Electricity, *publiſhed in* 1744; *by* John Henry Winkler, *Profeſſor of* Greek *and* Latin, *at* Leipſick.

Tranſlated from the HIGH-DUTCH.

An Explication of the terms.

1. WHEN a piece of *Electrum* or amber is rubbed, there is a virtue excited therein, which operates on light bodies, lying near it, as chaff, ſand, threads, feathers, leaf-gold, *&c.* in ſuch a manner as to cauſe them to ruſh on the amber, as if forcibly pulled towards it.

2. This virtue, excited in amber by rubbing, not only cauſes light bodies to fly towards it, but alſo repels them.

3. In like manner do ſulphur, pitch, ſealing-wax, glaſs and many other bodies manifeſt the ſame effect upon friction.

4. Yet the experiments on ſulphur and glaſs are of a later date than thoſe on amber, *Otho Guerick* (*a*) of *Magdeburg*, being the firſt who obſerved an electric virtue excited in a ball of ſulphur by friction: After this diſcovery, many excellent perſons, as *Gilbert*, *Boyle*, *Hawkſbee*, *Gray*, *Du Fay*, 's*Graveſande*, *Muſſchenbroeck*, and others applyed themſelves with great care to make experiments on glaſs, by means of which they greatly enriched natural Philoſophy.

5. Now in regard that glaſs and many other bodies agree with *Electrum* in this, that by friction they manifeſt a virtue, whereby light bodies are both attracted to, and repelled from, them, this virtue came to be called

(*a*) Experimenta nova Magdeburgica de vacuo ſpatio. c. 15.

called *Electricity*, and the body itſelf was ſaid, *to be electriciſed or impregnated with Electricity.*

The Deſcription of two new Machines employed for exciting Electricity.

6. For making the electrical experiments with glaſs, there has generally been employed a hollow glaſs-tube, which rubbed either with leather, a cloth or paper, by interpoſing theſe between one hand and the glaſs, and moving the glaſs up and down with the other.

7. But as this proves extremely tireſome, and the body thereby not in ſo uninterrupted a manner impregnated with Electricity, the late *Chriſtian Auguſtus Hauſen*, Profeſſor of Mathematics at *Leipſick*, deviſed a more compendious way, providing himſelf with a globe which he turned round in a horizontal poſition, by means of a wheel. The whole apparatus is to be ſeen in his treatiſe, publiſhed in 1743, by Profeſſor *Gottſched*, under the title of *Novi profectus in hiſtoria Electricitatis.* The globe of this machine is the very ſame with that otherwiſe employed for producing the electrical light, as M. *Hauſen* himſelf teſtifies. Profeſſor *Wolf** relates, how *Hawkſbee*, from the conſideration of the light which the mercury in vacuo, exhibited upon rubbing the glaſs, was led to other experiments, where by means of friction on glaſs he produced light. The machine contrived by *Hawkſbee* for this purpoſe, Profeſſor *Wolf* cauſed to be imitated by the famous Mechanic M. *Leupold* of *Leipſick*, but with ſome alterations, as he ſhews in the above place. The conſtruction and nature of the machine, as it was contrived by *Hawkſbee* may be ſeen in 's*Graveſande*†. And after the ſame manner is *Hauſen*'s machine conſtructed. In *Hawkſbee*'s machine, as altered by *Leupold*, the globe ſtands vertical and the wheel horizontal; but in 's*Graveſande*'s and *Hauſen*'s on the contrary, the globe lies horizontal, and the wheel hangs vertical.

8. Profeſſor *Hauſen* in his phyſical colleges, which he read in 1742 and 1743, had by means of his horizontal globe, not only ſhewn the moſt remarkable experiments, which in 1716 and the following years, he had ſeen in *England* and *France*, but had alſo diſcovered many new effects of Electricity, which he recounts in the above-cited treatiſe.

9. But there are ſome things in *Hauſen*'s machine, which have given occaſion to make improvements therein. For in the firſt place, the virtue ſucceeds not, if the hand, which is laid on the electrical globe, happens not to be dry: In the ſecond place, the globe, for want of ſo quick a rotation, as were neceſſary, cannot be ſtrongly enough rubbed: And in the laſt place, it proves extremely tireſome to turn round the wheel, by which the globe is moved; eſpecially if the virtue is to be heightened, ſtrengthened and propagated.

10. I therefore bethought me how to obviate theſe inconveniences; but my principal aim was to procure a machine, whereby Electricity might be excited

* Nützliche verſuche der Natur und Kunſt, Andere Theil §. 173. † Pars II. Tab. I. fig. 2. & 3. & Tab. II. fig. 1.

excited with all the poſſible diſpatch, and the leaſt trouble imaginable: Upon diſcloſing theſe my thoughts about *Hauſen*'s machine, as that it worked too ſlow and laborious, to *John Fredrick Gieſſing* an ingenious mechanic of *Leipſic*, he began to tell me he had for ſome time hit on a new ſort of machine, by means of which, with the greateſt eaſe, and a peculiar degree of diſpatch, an exceeding ſtrong Electricity might be excited. This machine is very ſimple, and requires no great art to imitate it.

11. It conſiſts of three pillars or poſts *bo*, *bp*, *qr*, (Plate IV. fig. 2 and 3.) which are mortiſed into a heavy pedeſtal *a*, reſting on three balls; of an iron ſpring *ru*, and of a glaſs *lmn*, cemented in wood: The iron ſpring is made faſt in a piece of wood *r*, moveable in the hindermoſt pillar *qr*, in regard it ſticks therein by means of a gudgeon, which may be faſtened by the ſcrew *t*: The two foremoſt pillars *bo* and *bp* are made firm with two cheeks *d* and *d*: On the pillar internally there is a pan *o*: Thro' the pillar *bp* there goes a ſcrew, on which there is likewiſe an iron pan: On both the ends of the wooden frame, wherein the glaſs is cemented, there are two iron points, by means of which the glaſs is hung on the two pans: The glaſs itſelf is a common beer-glaſs; or any other glaſs, which is compleatly cylindrical, may be uſed for the purpoſe, the effect proving the ſame. His excellency the Count of *Manteufel* had for ſome time entertained a ſurmiſe, whether Porcelane or China might not, inſtead of glaſs, be uſed for exciting Electricity; and upon trial it was found to manifeſt a far ſtronger virtue than glaſs. To the iron ſpring there is faſtened a ſtring *ww*, ſlung a number of times round the long arm of the frame in *l*, and below made faſt to the treadle *x*, moveable upwards and downwards on the pedeſtal *yz*. Behind the glaſs (fig. 4.) there is a ſmall pillar *hi*, with two ſcrews *e* and *g*, which below, by means of a ſcrew *f*, is made firm to the internal cheek. Above, on this pillar there is a ſmall cuſhion *k*, done over with leather or linen, and ſtuffed with wool or other ſoft matter, and ſo ordered by means of the ſcrew *e*, as to apply cloſe to the glaſs.

12. The ſpace, thro' which the treadle is ſtamped down by the foot, and raiſed up again by means of the ſtring, is ſo large, that the glaſs, in ſtamping down, turns round one and a half time; and the iron ſpring pulls ſo ſtrong, that the treadle, upon raiſing the foot from it, comes in a moment to its former height; ſo that each point of the glaſs is in the time, in which the treadle is pulled down once and raiſed up again, rubbed four times againſt correſponding points of the cuſhion; which is a very ſmall ſpace of time; and in a minute the treadle may be puſhed down 170 times, and thus each point of the glaſs applied to the cuſhion, be rubbed 680 times; the remaining points on the contrary, which touch not the cuſhion, before the glaſs is moved, are in this ſpace of time

rubbed 340 times: As the cuſhion has a certain breadth, each point will be ſo much the oftener rubbed, the more points in the cuſhion apply ſucceſſively to the glaſs in turning.

13. The iron ſpring is ſo elaſtic, as to pull back the glaſs again even tho' the cuſhion be pretty tightly applied thereto: And thus the rubbing may be heightened or ſtrengthened to any degree at pleaſure; and in particular it is ſo, upon ſtrewing ſome fine ſcraped chalk between the glaſs and cuſhion.

14. From hence it is eaſy to perceive, that this machine which is formed in the manner of a Turner's lathe, is greatly preferable to *Hauſen*'s or 's*Graveſande*'s: As here we need never apprehend that the glaſs will become moiſt, upon ſcrewing the cuſhion to it, or the ſtamping down the treadle prove ſo tireſome and laborious as the turning round the wheel; beſides that the velocity in turning the glaſs backwards and forwards is far greater than in turning round the globe: And laſtly, as each point, with which the glaſs applies, is in a minute rubbed 680 times and another in the very ſame time 340, the effect is indiſputably quicker and more violent, eſpecially if the cuſhion be ſcrewed on tight, and ſome chalk ſtrewed between.

15. And if we would try to turn round the points of a globe, by means of a wheel, the ſame number of times in a minute, we ſhould find it a very laborious taſk; and to eaſe the labour a number of wheels muſt be employed, which would render the apparatus too coſtly and take up too much room.

16. The machine with the treadle would then at length arrive at its full perfection, could another machine be contrived, which either by help of a ſpring or a weight, ſhould replace the action of the man, who ſtamps down the treadle with his foot.

17. As I have long obſerved, that thin glaſs tubes do, by pulling backwards and forwards in the hand, acquire an uncommon degree of Electricity, I contrived a machine, by which the ſame thing might be done in a more commodious and eaſy manner: The motion is the ſame, as in the foregoing, as fig. 5. ſhews. Under the ſpring of the hindmoſt pillar *k* I cauſed to fix another, as a prop or ſtay, which helps to puſh up the firſt after being pulled down by the motion of the foot. The glaſs tube (fig. 6.) is 2 *Leipſic* foot and 4 inches long; tho' it may be taken of any length at diſcretion: It is $1\frac{1}{4}$ inch in diameter, and put into a wooden frame, which is 1 foot and $5\frac{1}{2}$ inches broad; on both ſides *d* and *d* it has externally iron ſlips, which pull up and down in a groove in both the fore-pillars *bb*, fig. 7. On the upper and under ſides of the frame there are iron rings fixed *m* and *m*, to which two ſtrings are tied, one of which is made faſt to the treadle, the other to the ſpring. To both the fore-pillars there is faſtened a wooden

wooden croſs-arch *f*, fig. 6. and in the middle thereof a ſcrew *i*, with a half round nut, to which another may be ſcrewed by means of two ſcrews *bb*: Both the nuts are lined with leather and wool, and ſo firmly applied as the glaſs can bear. When the croſs-arch with the two half-round nuts are fixed in their proper places, the frame with the glaſs tube is faſtened in ſuch a manner to both the ſtrings, as that the treadle comes to be compleatly pulled upwards by the ſpring, but the frame not to run againſt the upper croſs bar *c* (fig. 5 and 7.) of both the pullies *bb*, that the glaſs may not be ſhivered by the jogging: After giving the frame this poſition, the croſs-arch is ſcrewed on the pillars almoſt to the end of the frame. The length of the tube from this place muſt thus be ſomewhat greater than the length of the ſpace, in which the treadle is ſtamped down, that the upper ſide of the frame may not run againſt the nuts. It alſo hence appears how large the ſpace muſt be, both above and below the tube, quite to the croſs-bar of the pillars.

18. This machine is in like manner well fitted to rub a tube with eaſe, quickneſs and ſtrength: Yet the firſt has the preference; for in the time that the treadle is ſtamped down, and again pulled upwards, no point of the lining on which the glaſs lies, before the motion is begun, rubs above twice. Whereas in the firſt machine, the points of the glaſs, reſting on thoſe of the cuſhion, before the motion is begun, are in the abovementioned time, rubbed 4 times. Beſides, that in this laſt machine the Electricity is alſo leſſened, becauſe the lining encompaſſes the whole tube: For I found by the firſt machine, that the Electricity is by far not ſo ſtrong, when the cuſhion covers half the glaſs, as when it is ſmaller, a cuſhion touching the glaſs in a narrow width producing the beſt effect.

19. The Electricity, that takes its riſe from no other thing, is called the *original Electricity*. The Original Electricity.

20. This Electricity is generally excited by rubbing; which, as was already mentioned, is fitly done by means of leather, nay cloth, linen, paper, wood, cork, chalk, lead, iron and other metals.

21. The thinner the glaſs, the ſooner is it excited to electricity.

22. Upon warming the glaſs and then rubbing it, the effect proves the quicker and ſtronger.

23. With bare warmth alone I could never excite any Electricity, whether the glaſs-tube were warmed over glowing coals or in the ſun: And thoſe, who tell us that by bare warmth they have impregnated bodies with Electricity, at the ſame time aſſure us, that the effect or virtue proved extreme weak.

24. On

24. On the contrary, I have often found that ſticks of ſulphur have for months together, after they were caſt, manifeſted a remarkable Electricity on leaf-gold, tho' I never warmed nor rubbed the ſticks.

25. Among the bodies, which bear rubbing, I have by friction on wood, leather, hempen ropes, metals, and my own ſkin, been ſometimes unable to excite any Electricity.

26. I have at times obſerved, that the original Electricity has become weaker, when the glaſs has, by the long rubbing on the machine, been over-heated: Yet I would not from hence conclude, that an over-vehement heating always leſſens the Electricity. 'Tis neceſſary that this be often tried.

27. 's*Graveſande* * pretends, when the glaſs-tube happens to be rubbed the contrary way to what it was begun to be rubbed at firſt, the Electricity ceaſes to be ſenſible, but I have found the Electricity the ſame, which way ſoever, by ſhifting hands, the tube was rubbed.

The Circumſtances wherein the propagated Electricity becomes obſervable

28. Electricity bears being propagated from an excited body to another without mutual contact.

29. But there are certain matters, on which the body muſt reſt, to make the propagated Electricity obſervable. In particular, I have experienced, that the propagated Electricity has a ſtrong effect, when the bodies, to which it is communicated, lie upon pitch and blue-died ſilks; as alſo, when the bodies lie upon ſealing-wax, ſulphur, black cloth, white linen, porcelane, and raw-ſilk.

30. The communicated Electricity ceaſes inſtantaneouſly to be ſenſible, upon touching the impregnated body with the hand, with wood, iron or hemp, either in the middle or end of the body.

31. And thus to render the propagated Electricity inſtantaneouſly perceptible, I place the body on blue ſilk ſtrings; if the body prove long, on blue ſilk ſtrings extended over the two frames *c c* (fig. 9.) placed on the ſtands *dd*, to be raiſed and lowered, as occaſion ſhall require: And I cauſe a man tread on the ſilken ſtrings, wherewith the ſquare frame repreſented fig. 8. is ſtrung, and which are covered with boards, but theſe not to touch the wooden ſides of the ſquare frame.

32. After that the glaſs is ſufficiently done on the machine, the communicated Electricity however proves effectual, even though a tin-rod reſts on wood and metal, or is touched by men. M. *Hollweg* was the firſt who tried this with the new machine, at *Gotha*, when the Electricity was excited ſo ſtrong, as to manifeſt its force, in whatever part the excited rod were laid on. In an eſpecial manner the communicated Electricity ſhows itſelf in a wooden pole, done over with pitch, and reſting on wood.

33. The

* Phyſices Element. Mathemat. §. 555.

33. The leaf-gold, the pieces of paper, the file-chips, or ſand-corns, which we would have put into motion, either by the original or the propagated Electricity, are laid on ſmooth and dry bodies; for if the ſurface proves wet and rough, theſe light bodies adhere thereto in ſuch a manner as not to be eaſily propelled by the Electricity.

34. Some, who have writ on Electricity, pretend, that to ſucceed in electrical experiments, there is neceſſary a certain ſort of weather; as that the heavens be clear, the air dry, the warmth moderate, and the wind northerly; a moiſt air, a keen cold and great heat being ſuppoſed contrary to the electric effects; whence theſe ſucceed not equally at all ſeaſons: and therefore in winter a room moderately warm; in ſummer, a cool place, is to be choſe for the purpoſe. In particular, that the electrical experiments anſwered but indifferently, when the room happened to be full of people, that perſpired much, and whoſe cloaths ſmelt ſtrong of tobacco.

35. But by my machine, not any one of theſe things proved any impediment; the trials equally ſucceeding, whether made in a dry or moiſt air, in heat or cold, morning or evening, in a northerly or ſoutherly wind, or even in a ſtorm, or in rooms full of tobacco-ſmoke: Only I have obſerved that in a cold room, a longer time is required to warm the glaſs by rubbing, than in a warm room; but once warmed, it fails neither in ſtrength nor velocity of electric virtue. 'Tis true indeed, the air muſt not be ſo moiſt as to wet the glaſs: In too great a degree of heat, the virtue begins only to be weak, when the glaſs is long rubbed; being over-heated on account of the warmth in the air.

36. Upon ſuſpending a hollow glaſs globe *bab* (fig. 11) by its gudgeons in the pans between the two pillars *dd* of the electric machine, and fixing to the ſides of the pillars an arch *dcd*, from which hang perpendicularly downwards ſeveral threads *eeee*, at a certain diſtance from the globe; the threads, ſo ſoon as excited to Electricity, move towards it and become horizontal; and this happens, even though the globe be quite exhauſted of air: This trial I have, with care, repeatedly made, becauſe 's*Graveſande* * denies any ſuch effect in the laſt caſe. The exhauſted globe does alſo communicate its Electricity to other bodies, with the ſame ſtrength and velocity, as when full of air.

The Bodies wherein Electricity bears being propagated.

37. In ſome bodies, which being excited by rubbing, we obſerve, that it is only in a very ſmall degree, an Electicity is communicated to them: Of this ſort is raw-ſilk, but eſpecially among the dreſſed, the blue: A ſtring of that ſort being rubbed, the Electricity proves very ſenſible: Whereas I could never obſerve, that the Electricity had any effect on it, were the glaſs, on which the blue ſilk ſtring was laid, never ſo violently excited.

38. Among

* Phyſic. Elemen. §. 559.

38. Among the bodies, wherein Electricity is excited both with and without rubbing, we reckon pitch, glaſs, ſealing-wax, ſulphur.

39. The firm bodies (§. 25.) which I could not excite to Electricity by friction, bear the having it very eaſily communicated; as do alſo animals, whether living or dead; metals, cold or warm and glowing; alſo herbs or trees, green or dry.

40. Not only does the excited glaſs communicate Electricity to certain bodies, lying at a certain diſtance therefrom; but among theſe ſome propagate the communicated Electricity to others.

Of all it cannot abſolutely be ſaid: For I could never yet propagate from a ſtick of wax, into a wooden and metallic rod faſtened thereto, the Electricity it acquired from an excited glaſs.

41. Fluid matters bear being excited in ſuch a manner, as to propagate the communicated Electricity to other bodies.

Bind, for inſtance, a hempen rope over the blue ſilk ſtrings of the ſtand (fig. 10.) and ſet it againſt the glaſs on the machine, the remaining rope is in like manner laid over the blue ſilk ſtrings of another ſtand, in a veſſel either full of water, milk, beer, quick-ſilver, or brandy, but the rope not to touch the ſides of the veſſel; and the veſſel to ſtand on the blue ſilk ſtrings over the ſquare frame, fig. 8. or on pitch. At a wide diſtance from this rope, there is another, hung in the water, and in like manner laid over blue ſilk ſtrings on a ſtand, ſo that its end no where touches the wood. Inſtead of this other rope may a wooden ſtaff be taken, and bound on blue ſilk ſtrings, ſo as with its end to touch the ſurface of the water: Or a man may ſtep upon a ſquare frame fitted with blue ſilk threads, and hold either his hand or foot, or a ſtaff in the water: So ſoon as the glaſs on the machine is excited, the end of the other rope, or wooden pole, or the other hand of the man, or his cloaths, manifeſt Electricity on the leaf-gold.

42. As water bears being excited to Electricity, which it propagates to other bodies, ſo this Electricity comes to be propagated in a wet blue ſilk ſtring in a very remarkable degree, tho' otherwiſe not very obſervable when the ſtring is dry (§. 37.)

When therefore the ſilken ſtrings, which are ſtretched over the frame, fig. 8. become wet, there is obſervable in the man, who ſtands thereon, either no Electricity at all, or a very ſmall degree thereof, tho' the glaſs copiouſly imparts Electricity to the man

43. Glowing coals, the flame of a candle, and burning ſpirits have in like manner Electricity communicated to, and propagated by, them.

With the flame of a candle I have made the trial two ways: There is ſet to burn in a long veſſel, between two iron-bars, one of which lies in the confines of the excited glaſs on ſilken ſtrings, as does the other alſo on the like ſtrings, ſome lighted ſpirits of wine: The bars

muſt

The bars muſt neither be ſo near each other, nor the metalline veſſel, as that either the Electricity can go from the one to the other bar, or from the one bar to the veſſel, and from this to the other bar: This you try, before the ſpirit of wine is kindled: and as one bar is excited, without the other's being ſo in the leaſt, the ſpirit of wine is lighted; and in an inſtant the Electricity becomes obſervable on the extreme end of the other. But the veſſel with the ſpirit of wine muſt alſo reſt on blew ſilk ſtrings: If it ſtands on wood, which lies not on pitch, or blue ſilk ſtrings, or other matters, which may be uſed inſtead of ſtrings, the effect ſucceeds not.

The flame of a candle, whether of tallow or wax in a candle-ſtick, ſtanding on the blew ſilk ſtrings of the ſtand fig. 16 near the excited glaſs is ſo ſtrongly impregnated with Electricity, as to communicate it to a tin tube, reſting on the blew ſilk ſtrings of the ſtand fig. 15. and above an ell diſtant from the flame.

44. I have obſerv'd no Electricity in the ſun-beams falling thro' a hole in a darkened room upon an excited tin tube, and from this laſt upon a man, ſtanding on blew ſilk ſtrings: neither do the rays, falling from the excited bar, move or affect the leaf gold; nor does the man, who is enlightened by theſe beams, excite in the leaf-gold an electric motion.

45. Whether the rays in the *focus* of an excited burning-glaſs manifeſt an Electricity, is what I have not been able to examine, as not having had a glaſs, that throws its *focus* to ſuch a diſtance from it, as not to give ſuſpicion, that the Electricity of the burning-glaſs, reached quite thereto, when an iron bar is laid on blew ſilk ſtrings therein.

46. Even ſnow and ice may have Electricity imparted to them, and then they excite it in other bodies.

47. Sand, leaf-gold and other light bodies, which lie on metals, on glaſs and ſmooth wood, are raiſed upwards with a great degree of velocity and repelled ſideways, ſo ſoon as the metals, the glaſs and the ſmooth wood are excited. The motion ariſing by means of Electricity.

48. The motes in a ſun-beam, paſſing into a darkened room over an excited bar, lying on blew ſilk ſtrings, come into a variety of motions; ſome, which touch the bar either above, below, or on the ſides being repelled; others again, which either move over it or to the ſides, ſwiftly ruſhing towards it, are again repelled; whereby, amidſt the various motions of theſe motes, there are varieties of curves produced.

49. A needle, hanging perpendicularly at reſt by a thread near a tin tube, lying on blew ſilk ſtrings, at the diſtance of one or more inches, comes inſtantly out of its ſtate of reſt, when the tube is excited; goes towards the tube, but returns back again, ſo ſoon as it touches it. Both motions are uniform, like the vibrations of the pendulum of a clock.

50. Upon counterpoiſing in a ballance two equal weights; the weight lying at no great diſtance from the excited tin tube, comes to be moved: if one of the weights be hung over the tube, the weight is made to

deſcend and again aſcend; if under the tube, to mount up and come down again: In both caſes the riſing and falling laſts ſo long as the tube is excited: and the intermediate times are conſtantly one and the ſame.

51. We have the following Phænomena from drops of water, dropt on the *Semen Lycopodii* or ſeed of wolfs-claw. This ſeed is diſpoſed of on a ſmooth board or wooden ruler: the drop is ſo let fall on the ſeed, as only underneath to unite therewith: ſo ſoon as the ruler is, by means of the glaſs, excited to Electricity, the ſeeds come to fly off gradually, ſome of them to the ſides of the water-drop; others having aſcended almoſt perpendicularly upwards, to fall back again on the water-drop, ſo as to cover it quite round; and the drop being now of a full round, and excited, and a finger or firm body held over it; by the approach of the body or finger, it comes to loſe its roundneſs and acquire an oval form, whoſe point is turned towards the finger or body. If you divide it into two drops, covered equally thick with the ſeed, and touching each other, in the act of exciting to Electricity, they remove from each other, without holding any thing againſt them, and come together again, upon the Electricity of the ruler ceaſing. If the divided drops happen to be very ſmall, they are by means of the Electricity, communicated to the ruler, driven away from it in the air, in like manner as the ſeeds.

52. A drop of water on a wooden or metalline pin, which tapers ſomewhat, is changed to a compleat cone, whoſe baſe is on the pin, when this laſt is by its length directed towards the earth, and has been excited to Electricity. On the contrary, a drop on a tin tube, becomes not conical, 'till a finger or other body is held againſt it.

53. A flaſh of water, iſſuing out of a glaſs ſiphon or crane, in a right line, is by the Electricity of a ſecond body bent or incurvated.

The experiment is as follows: The ſiphon *a b c*, fig. 10. 11. is bent, and a line in diameter: the ſhort end *b c* is dipt in a veſſel with water *c d e*, on an elevated part, near the tin tube *f g*, which is to be excited to Electricity. The veſſel is placed and raiſed in a twofold manner: (1) ſo as that the flaſh, iſſuing out by the long part *a b* of the ſiphon, ſlips over the tube fig. 11. (2) paſſes underneath it fig. 10. Upon which the tube is excited to Electricity, and inſtantly the flaſh of water loſes its right-line direction; and paſſing under the tube fig. 10. it now becomes bent upwards towards *i*; but over the tube fig. 11. it bends downwards towards *i*. In both caſes it divides into ſmaller flaſhes, which are puſhed quite to the tube. If the tube be touched, the flaſh aſſumes its former courſe: If you put oil into a teaſpoon, and hold it under the croſs bar of the bow of the ſword, fig. 4, it will be at times driven upwards in one continued curve line, againſt the veſſel.

54. On the contrary a ſun-beam, paſſing thro' a ſmall hole into a darkened room, either over or under a tin tube, after being excited, will not ſwerve by that Electricity from its right-line courſe.

55. When

55. When the glaſs or glaſs-globe is full of air, and rubbed on the cuſhion of the machine, there appears in the place, where the cuſhion applies, on the external ſurface of the globe, a light. If inſtead of the cuſhion you lay the hand on the glaſs or globe, the light in like manner ſhews itſelf in the part, where the glaſs or globe is touched. The light of bodies, excited to Electricity.

56. On the corners and points of bodies, as for inſtance, a ſword, a cruſt of bread, there iſſue out in the time they are excited, ſhining beams in right lines, removing ſtill wider from one another the farther they are produced.

If a ſtar, fig. 8. with eight metalline and pointed rays be by means of a ſtalk put into the hollow tube of a metalline candleſtick, and the ſtar be turned round, ſo as to continue its circular motion, there appears in the dark a ſhining Wheel, ſo long as the ſtar moves in the candleſtick on the excited glaſs.

57. The rays iſſuing out at the points, all the time they are excited, are produced ſo quick one after another, as not to be interrupted by any motion of the air, or blowing with the mouth.

58. When the points of the ſtar are too near each other, they cannot by the exciting be brought to ſhine forth all at once: Thus alſo on an excited ſaw, very few teeth do ſhine together.

59. From this light, which ariſes of itſelf on the corners and points of an excited body, we are to diſtinguiſh that which ariſes, upon holding an unexcited body againſt one excited: This laſt light appears between both bodies and touches both: 'Tis perceived, upon holding, in the dark, a finger at a certain diſtance, againſt the excited glaſs on the machine, or againſt excited wood, or excited ice and excited ſnow.

60. In particular the cloaths of an excited man ſhine ſtrong in the dark, upon paſſing over them with a finger or with the whole hand, yet without touching them: If one continue in the due diſtance, at which the light was once found to be the ſtrongeſt, he may with the finger for a conſiderable length draw a ſtreak of light, almoſt as broad as the finger: And if the whole hand be nimbly moved on the cloaths, there will one field, as it were, after another come to be enlightened: Could ſuch a light be produced at once on the whole ſurface of the man, his appearance would be uncommonly agreable to the beholders eyes.

61. Upon holding an unexcited body againſt a ſhining point, the iſſuing ray becomes longer and more compleat.

62. As the ſtar, turned round, repreſents with the rays of its excited points a circle of light, ſo a ſingle point moved lengthwiſe forwards, deſcribes a ſhining right line.

This is performed with the inſtrument, repreſented fig. 18. In the tube there is a wire-ſpring, which by the two ends *a* and *b* is included in wood: On the end *b* there is a thread, whereby it may be drawn together;

and on the end *a* fixt a ſharp pin. This inſtrument is held parallel to an excited tin tube, at the diſtance of about two or three inches, and the ſpring drawn together with the thread: ſo ſoon as you obſerve on the point of the pin a light, the thread is dropt: as you paſs along, the light on the point deſcribes a right line.

This inſtrument and the ſtar were in like manner contrived by the above mentioned *Gieſſing*,

The Electrical ſparks.

63. From ſome excited bodies there proceeds for a certain diſtance to others unexcited, a light, which is reflected from the latter to the former, and in the reflexion ſnaps; and which upon touching the ſkin of a man or beaſt is felt with a ſmarting: This ſnapping light is call'd the *electrical Sparks*.

64. Upon holding againſt excited wood, porcelane, ſealing-wax, cloth, ice, and againſt excited ſulphur, hemp and ſnow, a finger, or other body, I have, 'tis true, perceived a light, but could obſerve no ſparks.

65. So, that we have two ſorts of electrical lights: the one conſiſting in a bare ſhining; the other, in ſparks. The former is produced in a twofold manner; either of itſelf, or by the approach of a body: The ſparks on the contrary never make their appearance of themſelves: the light of the firſt ſpecies cauſes in ſome bodies, as glaſs, porcelane, wood, both a ruſhing noiſe and a crackling.

66. Among the bodies, on which the electrical ſparks may be excited, we are to reckon metals, the ſkin and fleſh of men and of living and dead beaſts, flint-ſtones, chalk, diamonds, quickſilver, ſpirit of wine, water, vinegar, milk, cheeſe, butter: Yet the ſparks vary in ſtrength: The moſt vehement are produced of metals and men: The electrical ſparks of a flint-ſtone are not ſtronger than thoſe of butter, or milk, or water.

67. The electrical ſparks only ariſe, when both bodies, between which they are produced, are of a nature, capable of giving forth ſuch ſparks. Thus may, for inſtance, either an excited man move up to one unexcited, or this to that; and in both caſes there ariſe ſparks. Should on the contrary an excited man move his fingers towards unexcited wood, or an unexcited man towards excited wood, no ſparks ariſe.

68. The electric ſparks produce in both bodies, between which they ariſe, a ſtrong motion.

This at firſt comes to be obſervable on the threads, which hang on bodies, that in the act of exciting give forth ſparks. For ſo ſoon as the ſparks of an excited tin tube proceed to another body and are reflected, the thread on the tube is moved, whether it be nigh to, or far from, the part, where the ſparks ariſe. Again, both the perſons, between whom the electric ſparks ariſe, feel at the ſame time a ſmarting in the ſkin.

69. When two bodies, which are capable of giving forth electric ſparks, are excited equally ſtrong, they give none at all.

70. But

70. But if excited unequally ſtrong, there are then ſparks produced.

For inſtance, if you lay two iron rods in a right line on blew ſilk ſtrings, at ſuch a diſtance from one another, as is neceſſary for producing ſparks, between them: no ſooner is the one excited, on the glaſs of the machine, than between it and the other there are ſparks produced: The other rod is not only thereby excited, but obtains alſo, as it lies on blew ſilk, the communicated Electricity. But the ſparks grow gradually weaker and weaker, the more the Electricity encreaſes, in the other rod: At length they quite ceaſe, when the Electricity is therein as ſtrong as in the firſt. And would you inſtantly experience the truth of this, lay at the ſame time with the firſt rod a rope on the glaſs, and ſling it, by means of a ſilk ſtring on a ſtand in ſuch a curve manner, as to be quite diſtant from the firſt rod, and with its end to touch the other. For thus the ſecond will after two or three approaches be as ſtrongly excited as the firſt: And hence the ſparks, which were at firſt produced, come to ceaſe inſtantaneouſly; but to manifeſt themſelves on a ſudden, upon touching the other rod with the finger.

71. Alſo from the glowing iron, that lies on two cold iron rods, which laſt are excited, and reſt on blew ſilk ſtrings, there iſſue electrical ſparks.

This experiment is mentioned by Profeſſor *Hauſen*, in the above-mentioned *Latin* treatiſe (*a*).

72. In like manner there ariſe ſparks on excited and melted lead, upon holding a metal againſt it.

73. Whereas in melted and excited ſealing-wax we only hear a ruſhing noiſe, upon bringing a metal to it, the wax heaving in the part, where the metal is held, like a pointed drop.

74. The ſpirit of wine in the thermometer begins to riſe, after hanging it for ſome time by a ſtand, on or over a tin tube, excited at once, and at no great diſtance therefrom.

This muſt be tried in a room, that in the courſe of the experiment has an uniform degree of warmth: And therefore the thermometer to ſtand in this room till it have an equal pitch of warmth therewith; as alſo the perſons, who are to perform the experiment. The thermometer alſo to be ſo diſtant from the perſon, who excites the glaſs on the machine, as to receive no degree of warmth from him. In a quarter of an hour, that the tin tube is excited by the glaſs, the height, thro' which the ſpirit of wine diffuſes itſelf, becomes very obſervable.

If the thermometer be held againſt the excited glaſs, the ſpirit of wine riſes in an inſtant viſibly upwards.

The tin tube, all the time it is excited, acquires no degree of warmth, that may be felt with the hand on its cloſe ſurface; But in the time of exciting, if you either move the finger, or the mouth towards it, ſo as to remain at a certain diſtance therefrom, there is felt a ſoft motion, which produces on the finger or mouth a gentle warmth.

75. The

(*a*) §. 6. n. 2. p. 11.

75. The electrical ſparks from metals, as iron and ſilver, kindle fluid matters, which are otherwiſe capable of being kindled by means of a flame. In particular this experiment eaſily ſucceeds upon holding a vegetable quinteſſence in a tea-ſpoon under the hilt of an excited ſword, whoſe point is turned towards the exciting glaſs, fig. 9. This fine ſpirit is alſo very eaſily kindled by the ſparks of an excited tin tube.

This experiment, with the ſparks of excited metals, was made by Dr. *Ludolph*, Field-Phyſician to the King of *Pruſſia*, in the beginning of 1744; when by the friction of a glaſs tube, he, in the preſence of ſeveral hundred perſons, kindled the ætherial liquor of *Frobenius*.

76. A glowing iron cauſes no flame in any ſpirit, whether the iron be held quite cloſe to, or at the diſtance of a few lines from it; but if excited, its electrical ſparks inſtantaneouſly kindle any fine ſpirit (§. 71.)

77. The ſparks, which iſſue from an excited Man, ſet on fire a ſpirit, even as quick as the ſparks of an excited metal, whether the Man be excited either immediately by the glaſs of the machine, or by means of a tin tube.

This experiment I made on myſelf, on occaſion of ſhewing ſome Electrical Experiments to the celebrated Profeſſor *Wolf* of *Hall*: For at that time, neither any one in the company, nor I myſelf knew, that the ſparks, which ariſe from an excited Man, were capable of kindling, or ſetting ſpirits on fire. But in regard the ſparks of an iron tube, which was full of ruſt, had ſet on fire the vegetable quinteſſence with an extraordinary quickneſs; one of the company took occaſion thence, to aſk, whether the ſparks of an excited Man would not have the ſame effect? I therefore ſtepped directly upon a ſquare frame, ſtrung with blue ſilk ſtrings, and laying hold with one hand on the ruſty tube, I held the fingers of the other hand over the quinteſſence. The ſparks of the finger fell ſo plentifully into the ſilver ſpoon, that the eſſence was in an inſtant ſet on fire. The more unexpected this appearance, the greater matter of ſurpriſe and ſatisfaction it yielded the company. (fig. 12.)

78. Dead pullets, pork, raw and boiled veal may be excited in ſuch a manner on a tin tube, or in the hand of a Man, that the ſparks proceeding from the fleſh ſhall alſo kindle the vegetable quinteſſence.

79. When the liquors, which bear being kindled by the flame, happen not to be quite fine, you need only warm either the ſpoon, wherein you put them, or previouſly kindle the liquor, and again extinguiſh it, before you approach it to the excited body.

Thus I have with electrical ſparks ſet on fire camphorated ſpirit of wine, ſpirit of wine tinged with ſaffron, the common vegetable eſſence, dulcified ſpirit of nitre, nay *French* brandy and corn ſpirits, after being previouſly warmed a little.

If you would kindle oil, pitch and ſealing-wax by means of the electrical ſparks; theſe ſubſtances muſt be heated to a degree, nearly approaching accenſion.

80. One ſort of glaſs bears the being excited by rubbing, in a quicker and ſtronger manner than another. Among thoſe made in *Germany*, I have found the white ſtreaky ſort, peculiarly proper for the purpoſe. Of two glaſſes, which in ſubſtance are of equal goodneſs, but which differ in thickneſs and ſize, the thinner and ſmaller is ſooner and more ſtrongly excited than the other. But above all things, the glaſs, intended to be excited, is to be dry, and the cuſhion neither to have any wet.

81. It was mentioned above (§. 42.) how electricity may be remarkably propagated in wet ſilk; and tho' but moderately wet, the electricity of a body reſting thereon proves weaker than otherwiſe it would.

82. And thus the air, abounding in moiſt vapours, ſo as to wet either the blue ſilk ſtrings, on which the bodies lie or ſtand; or the glaſs, which is rubbed; or the leather, wherewith it is rubbed, will make the electricity not to be of its uſual ſtrength: And in theſe circumſtances it may be ſaid, that at times the weather proves an impediment to Electricity.

83. When an excited body reſts upon blue ſilk ſtrings, its electricity extends all around it to a good diſtance: But upon ſo near an approach of other bodies, which propagate electricity, as to be within its ſphere, the body comes to ſhare ſomething of its force to theſe other bodies.

84. Neither the original nor propagated Electricity is interrupted by the motion of the air, whether the excited body be expoſed to the wind, or to the blaſt of a pair of bellows or of the mouth. I have ſometimes cauſed four or more perſons blow with their mouths againſt an excited rod, and even with bellows, without ever obſerving that the electricity was weakened thereby.

But ſhould a moiſt wind, or the breath of the mouth, wet the blew ſilk ſtrings, on which the rod or other body reſts, the Electritity becomes thereby diminiſhed, ſo, as to propagate itſelf in the ſtand, and from that, farther.

85. I could never, by means of the glaſs on the machine, communicate any Electricity, to the iron, wherewith a magnet had been long armed or capp'd, tho' laid on blew ſilk ſtrings, ſo as to excite ſparks, which are otherwiſe no uncommon thing in iron.

86. But if this magnetic iron be held againſt an excited tube of iron plate, which is impregnated with no magnetic virtue, there ariſe ſparks of no inconſiderable force.

87. Nay the naked magnet becomes but ſlightly excited, if the glaſs immediately communicate the Electricity thereto.

88. But if either a naked magnet, its capping alone, or a capped magnet, be ſuſpended by a tube of iron plate, ſo as to be in immediate contact there-

with, theſe bodies acquire ſo ſtrong a degree of Electricity, as that the iſſuing ſparks ſhall viſibly ſet on fire the vegetable quinteſſence.

89. There would ſtill remain various experiments to be made; as whether the electricity of the glaſs on the machine would be weakened upon exciting a magnet upon it for ſome hours together. This I have tried twice, and each time obſerved a certain degree of weakneſs; which I not only ſenſibly perceiv'd in the act of exciting, but alſo ſome time after I had begun a new to excite the tin tube with the foregoing glaſs. In order to diſcover to what this might be owing, I made the experiment with the globe, which Profeſſor *Hauſen* otherwiſe employed for exciting Electricity; and the Electricity immediately ſhewed itſelf in its greateſt ſtrength: I therefore directly put another glaſs to my machine, and being rubbed a number of times, we came to perceive a great degree of Electricity. I at length removed the blue ſilk ſtrings, on which the excited magnet had lain, and ſtretched others over the ſtand, which had lain in the ſame room, wherein thoſe removed had ſtood. In an inſtant, upon moving the glaſs, the Electricity manifeſted itſelf in its due degree of ſtrength, and the ſparks iſſuing out of the tin tube, ſet ſpirits on fire.

With this new glaſs I excited the day following the magnet again for ſome hours ſucceſſively; and again I obſerved a decreaſe of Electricity: After this I let the glaſs reſt, that it might fully cool: In ſome hours after I begin anew to excite the tin tube and the ſword therewith: But the effect was ſo weak, that the ſparks were quite unfit to kindle any ſpirit. Upon this I left the glaſs to ſtand for 24 hours; but afterwards attempting to excite therewith, the Electricity it communicated to the ſword and tin tube, was ſtill unable to kindle the quinteſſence; ſo that I took a ſecond time a new glaſs, and ſtrung the ſtand again with a ſet of new ſtrings, when immediately the deſired effect enſued.

But after ſuffering both theſe glaſſes to ſtand a few days, they again come to be capable of ſufficiently communicating Electricity to bodies, which lie ſufficiently near them.

Yet from both theſe remarks I would not have a general propoſition drawn, as if the magnetic virtue impeded or weakened the communication of the Electricity.

90. The Electricity excited by the glaſs immediately in the fleſh is by much weaker than that, which the fleſh receives from an excited tube of iron plate, or from an excited man.

By the former I have not been able to kindle the vegetable quinteſſence. I will not ſay, that it is abſolutely impoſſible, only the making the experiment would take up too much time: On the contrary, the other Electricity, which the fleſh acquired from an excited man, or tube, ſet the quinteſſence in an inſtant on fire by its ſparks.

91. The

91. Whereas men, ſwords, and tubes of iron plate acquire from the excited glaſs ſo ſtrong a degree of Electricity, as to ſet on fire all manner of ſpirits indiſcriminately.

92. But if thoſe bodies happen to be excited by help of a rope, which is immediatly excited by the glaſs, the ſparks prove very weak; and ſometimes I have not been able therewith to kindle the vegetable quinteſſence.

93. But if the rope be excited by the tin tube, which lies near the excited glaſs, it communicates to a ſword ſuch a degree of electricity, as that the ſparks in an inſtant light up the vegetable quinteſſence.

94. A dry ſpunge, at an excited ſword, or an excited tube of iron plate, gives forth no ſparks: but drenched with water, gives ſparks, which are often pretty ſtrong; tho' ſometimes I have not been able to kindle with them.

95. In like manner, the Electricity, which is propagated from the flame of an excited candle, into a tin tube, is not of a degree of ſtrength, to yield kindling ſparks.

96. Upon cementing with wax a piece of wooden board on a beer-glaſs, wherein are leaf-gold or ſand-corns, on a ſmall ſtand; or upon doing over a glaſs cylinder, in which alſo the like light bodies lie on a ſtand, either with dry paper, or with white and dry linen, or black and dry gawze, and holding an excited glaſs tube over it, the ſubjacent ſmall bodies are in an inſtant made to ſkip and friſk about. But if the wood, paper, linen, gawze, be thoroughly wetted, 'tis impoſſible with the glaſs tube, never ſo ſtrongly excited, to cauſe ſuch friſking motions in theſe ſmall bodies: whereas, if the glaſs cylinder, on which the wet wood is cemented, or other wet thing lies, be placed on a blue ſilk net, ſtrung over a ſquare frame; and the ſtand, whereon the leaf-gold lies, be ſet on the table, under the frame, ſo as to paſs quite thro' the net, and in the cylinder be at ſuch a diſtance from its ſides, as to have little or none of its electricity communicated; the leaf-gold begins to friſk and ſkip about, each time the excited glaſs tube is paſſed over the wet wood, the wet paper, the wet linen and the wet gawze.

97. When a tube of iron-plate, or a ſword, is excited at both ends at once by two glaſſes; the communicated electricity operates ſtronger, than if it only aroſe from one excited glaſs: The encreaſed degree of ſtrength manifeſts itſelf both by the electrical ſparks, and by the bending of the water-flaſh, paſſing out of a ſiphon or crane over the tube: For the ſparks prove longer, ſtrike more violently, and ſooner kindle: And the water-flaſh is, at ſome diſtance from the tube, bent towards it; which otherwiſe happens not, if only one glaſs be employ'd to excite electricity.

98. The propagation of electricity is ſo quick, as not only by far to exceed the flaſh of kindled powder, but alſo the motion of a bullet, which in a ſecond paſſes thro' a length of 600 foot.

The experiments, whereby I diſcovered this, are as follows. I laid on the blue ſilk ſtrings on the ſtand, Fig. 14. an iron rod, ſeven ells long,

and to one end thereof ſuſpended a thread. Near the other end I planted myſelf on the blue ſilk net of a ſquare frame, exciting one hand at the glaſs of the machine: Upon this, I held a finger of the other hand towards the iron rod; and no ſooner did the ſparks burſt out between the finger and the rod, than the thread at the other end was moved.

Upon this, I trailed along a hempen rope of 60 ells in length out of the room, where the machine was, thro' a hall, and out of this, into another room, and back again to the firſt room: The rope moved along blue ſilk ſtrings ſuſpended atop the doors: Both the ends of the rope were in the room removed ſome ells aſunder. On the one end I cauſed a perſon ſtand with a glaſs roundle, on which there lay leaf-gold: Near the other end I myſelf ſtood upon the blue ſilk net of a ſquare frame, holding one hand towards the glaſs of the machine: After I was excited, I with the other hand laid faſt hold on the rope; no ſooner was this done, than the leaf-gold on the glaſs roundle at the other end of the rope began to ſkip and friſk; and ſcarce was there any ſpace of time obſervable betwixt the touching the rope, and the leaf-gold's beginning thus to ſkip.

99. The electrical ſparks are with as great velocity propagated to bodies, as electricity in general; and prove as ſtrong in the part, where they ceaſe, as where they begin.

This appears by ſeveral experiments: If, for inſtance, you preſs the finger againſt the end of an iron rod, that reſts on blue ſilk ſtrings; ſo ſoon as an excited man either holds his finger, or an excited piece of metal againſt the other end of the rod, ſo that ſparks ſhall ariſe, a violent pricking is felt in the preſſed hand: If the rod be preſſed againſt the cloaths, ſo as theſe ſhall be made to lie cloſe to the body, the pricking will be felt each time very violent and quick, on each part, on which the rod preſſes.

This ſenſation is felt more violent ſtill on the head: I have ſometimes taken up an iron hammer with the wooden handle, and preſſing hard its flat part againſt the forehead, have held its narrow or ſharp ſide againſt an excited tube of iron-plate, at the diſtance, that ſparks are produced at: When ſuch ſparks ariſe, one imagines, they paſs thro' the middle of the hammer, and that the ſtroke of the ſparks goes in a ſtreight line through the hammer and the whole head; and this ſtroke is alſo ſo violent as to make the head quake; ſo that I was apprehenſive, the often repeating this experiment might poſſibly hurt the brain: If you apply the hammer to the teeth or gums, the ſtroke does in like manner prove ſo twingiug, as that one would not chuſe to feel it often.

100. Electricity may be propagated thro' glaſs, and put into motion light bodies in vacuo, equally as in the free air.

If you lay on a ſmall ſtand on the plate of an air-pump a glaſs roundle with leaf-gold, and a glaſs bell or receiver over all; after the air is quite exhauſted, let a glaſs tube be rubbed and held on, or over the bell; at

at each ſtroke of rubbing the tube, the leaf-gold under the bell is put into electrical motions.

If the glaſs of the bell happen to be ſomething thick, it may be previouſly warmed with a warm cloth.

101. I have put into balls, ſuch as thoſe on Thermometers, ſome grains of ſand, and hermetically ſealed the ſhort tube of the ball, after the air has been forced out by the heat. Now, whether I hold thoſe balls either againſt an excited glaſs tube, or an excited metal, the ſand-corns remain ſtill motionleſs therein.

They alſo remain without motion, tho' the balls are open at the points and conſequently full of air.

102. If you rub a narrow and exhauſted glaſs-tube between the fingers; or if you lay the hand on an exhauſted glaſs globe, turned round with a wheel, or rub the globe on a lerther cuſhion on the lathe, there is within-ſide produced a light, almoſt filling the whole glaſs tube, and diffuſing itſelf out in various parts of the globe.

103. But there is alſo produced without-ſide the exhauſted globe a light, upon holding a body, as for inſtance, a finger or piece of metal againſt it.

104. If an exhauſted glaſs cylinder, which is ſome inches in diameter, be brought towards an excited tube of iron plate, there ariſes on its inward ſurface a number of rays, flaſhing up and down like lightening, and diffuſing themſelves internally about the whole cylinder.

If this experiment be made with a ſmall globe or ball, having a narrow tube, hermetically ſealed over the fire, after the air is expelled by the heat; the whole ball will be internally enlightened, and its tube ſo filled with light, that when held to the excited tin tube, the light ſhall ſeem to flow like a ſtream.

This ſtream becomes ſtill more ſenſible, if there is ſome quickſilver in the exhauſted ball

I have cauſed to bend a narrow glaſs tube in ſuch a manner, as that the figure has repreſented the firſt letters of ones name; I alſo put ſome quick-ſilver into it, and expelled the air by means of fire, and then ſealed the tube with a view, by thus producing the electrical light in the bent tube, of repreſenting the letters in the dark: Yet I could not then ſucceed, as probably the air was not quite expelled, or the tube was too narrow; and my affairs have not hitherto allowed me to repeat the experiment.

105. 's*Graveſand* deſcribes a machine, by means of which, a glaſs globe may be rubbed in vacuo with a cloth; and if this rubbing be performed in the dark, there is a light obſerved on the globe. A machine ſhould alſo be deviſed where all the experiments, which are now done in the open air, might be performed in vacuo.

The Reader is deſired to correct the Miſtakes in the Sheet Q. Pag. 116. l. 40. read fig. 13. p. 117. l. 1. r. f. 7. l. 8. r. f. 5 and 13. p. 118. l. 29. r. f. 15. l. 32. r. f. 14. p. 119. l. 26. r. f. 17. p. 120. l. 16. r. f. 16. l. 20. r. f. 14.

An Account of a Whirlwind *that happened in* Möklinta, *a Pariſh in* Weſtmannia, *on the 27th of* September, 1725. *By M.* Eric Kalſenius. *From the* Acta Literaria Sueciæ Trimeſtre 4. Ann. 1725. p. 106.

Tranſlated from the LATIN.

ON the 27th of *September* laſt paſt, near two in the afternoon, as M. *Kalſenius* had, after dinner, got upon the top of a ſandy riſing ground near the Biſhop of *Möklinta*'s houſe, and the clouds, which were ſcattered here and there over the face of the heavens (for a rain which had laſted, without intermiſſion, for ſome time, ceaſed a little before noon) ſeemed at length to gather together in order to a ſhower: At firſt a kind of indiſtinct noiſe or murmuring was heard as it were, at a diſtance; which, tho' it ſeemed to him to be ſomething uncommon, as a gentle wind blew from the weſt; yet ſuſpecting that nothing more remarkable would ariſe from ſo trivial a matter, he returned home and went in to his own chamber. But upon his comming out again immediately, a great rumbling noiſe, like that of a very rapid river, filled the whole air. Upon looking about for the cauſe of this phenomenon, he obſerved, that ſomething like ſmoke came from the weſt, that was divided into ſeveral balls, which moved round very ſwiftly, and poured down into his area, a great quantity of water, not like drops of rain, but whole pailfuls as it were.

At which being not a little ſurpriſed, and not being ſure what the matter was, he went in again; but had ſcarce been gone ſo far as to look thro' the window, when he ſaw the thatch of a certain granary, all of a ſudden, raiſed aloft, as if torn off with hands, and the wooden ſpars for keeping on the thatch, tho' pretty large and heavy, on account of the continual rain, carried like feathers thro' the air. A large gate newly put up, with its roof and thick ſtrong poſts of firr, and ſome of the roofing next the gate was broken in pieces, and, what will ſeem remarkable thrown to the part oppoſite to that from which the wind blew. A ſtrong chimney was thrown down, and the tiles ſcattered about; the boards and laths upon the ſmaller houſes were torn off and broken; moreover, the whole air was all of a ſudden filled with thatch, laths, and every thing elſe that could not withſtand the violence of the ſtorm.

As ſoon as the tempeſt abated, M. *Kalſenius* went out, in order to view more accurately this ſudden deſolation, when he met one of his ſervant-maids, who happened to be abroad about ſome buſineſs without the village, who, as ſhe wanted to go thro' the gate that was thrown down, as has been ſaid, was ſuddenly ſeized by the Whirlwind, which carrying her up into the air ſo as not to touch the ground, the diſtance of 15 or 20 fathoms,

fathoms, laid her down on the top of a riſing ground, where tho' ſhe catched hold of the rock, ſhe had much ado to withſtand the violence of the ſtorm. Then we found that all the hedges, thro' which the Whirlwind had taken its courſe, for the ſpace of 40 or 50 fathoms in breadth, were broken and ſtrewed here and there over the fields; and we obſerved, that the new and ſtrong laths were not only carried two ſtones throw, but ſplit as with an ax, and broken in ſeveral places, nay, and driven into the top of the riſing ground a foot deep.

Next M. *Kalſenius* carefully enquired, where, and in what manner this Whirlwind firſt appeared; of which he had different accounts from different perſons, yet almoſt all agreed in this, that a thick ſmoke was obſerved to ariſe from the neck of land which ſtretches out into the neighbouring lake, and is about the eighth part of a mile from where M. *Kalſenius* lived, and that preſently the Whirlwind was carried thither with ſo much impetuoſity along one arm of the lake, as to carry up into the air ſuch a great quantity of water, and the lake ſeemed to riſe up in walls, as it were, as is evident from Scripture was the caſe with the river *Jordan*; and hence doubtleſs did theſe waters riſe, which did ſo plentifully overflow the village.

To the eaſt, this Whirlwind did no leſs damage; for a wood, which ſtood in its way, was for the moſt part pulled up by the roots, and levelled to the ground. In the mean time, the Whirlwind gradually mounted up in the air; ſo that about half a mile from the village, it was obſerved to carry along with it boards, laths, beech-bark, with which the houſes are thatched, beſides other ſubſtances, which ſoon after fell into the neighbouring lake. But what ſeems moſt remarkable is, that the thick cloud or ſmoke, which had ſpread a diſagreeable ſtench, immediately ſettled over the lake.

After all this, it began again to rain plentifully, and continued ſo next day.

The eating of Spiders *without any ill effect. From Sir* Sim. Scholzius, *Miſc. Curios. Ann 2d. Obſ.* X.

I Knew a young *Scotchman*, a Student at *Leyden*, who eat ſpiders continually, without any ill conſequence: he hunted them out in every corner of the houſe, and affirm'd they were very delicious food. He had a pale countenance indeed, and ſeemed a little bloated under the eyes, but was otherwiſe healthy.

Borelli takes notice of the inoxious comeſtion of ſpiders (*a*). An idiot

at

(*a*) Cent. 3. Obſ. 19.

at *Padua* eat both them and ſcorpions without damage, and *Offredus* ſaw a beggar at *Orleans* devouring ſpiders, and other filthy ill-looking animals without detriment (*b*).

Strange Idioſyn craſies. *From Dr.* Sim. Scholzius, Miſc. Curios Ann. 2d. Obſ. XI.

A *German* ſtudent, who was my fellow-boarder at *Leyden*, eat apples and eggs familiarly, raw or dreſſed; he cou'd handle and ſee them lie on a table, without the leaſt diſturbance: but if any one ſtirred them, it was wholly inſupportable to him, he could not look at them, but was ſeized with a total fainting and ſwoon, which the famous Dr. *Witte*, of *Riga* in *Livonia*, and my countryman *Scholzius*, who were alſo my fellow-boarders then, as well as my landlady and her ſon, with others, were witneſſes of, and of the entire reality both of this and the preceding hiſtory. I obſerved ſomething like this at *Elbing* in a clergyman, an intimate friend of mine, who cou'd not eat, nor even behold a pig ſtuffed and roaſted with the head and feet on, as they dreſs it in *Pruſſia*, without ſwooning, but after the head was removed, he could even eat of the pig without difficulty.

Short Reflections on the Plague; and particularly on its riſe and cure. By *Dr.* John Kanold. *From the* Breſlaw *Collection.*

Tranſlated from the HIGH-DUTCH.

THE Plague ſeems to ariſe not ſo much from any inbred defect or corruption of the air, or from a bad diet, as ſolely from contagion, or the communication of the peſtilential matter; in the ſame manner as the venereal diſeaſe; tho' it is not to be denied, but that the weather may greatly influence its raging and ſpread. For from undoubted teſtimonies it is evident. (1) That the Plague in moſt parts of *Chriſtendom*, is conſtantly wont to take its riſe from the eaſt, and particularly *Turkey*. (2) That this calamity is peculiar to the eaſt, eſpecially *Turkey*. (3) That it is communicated thence, partly by infected perſons, and partly by infected goods, eſpecially thoſe tainted with the miaſmata and recrements of infected perſons; by land, to *Hungary* and *Poland*; and by water, to *Italy*, *France*, *Spain*, *Holland*, *England*, (as was the caſe in 1663, by means of cotton from *Turkey*) and other maritime places, by the way of an actual, material ferment. Yet (4) that all this happens by a particular direction of the divine providence, at one time preferably to another; partly the various

(*b*) *Joh. Rhod* Cent. 3. Obſ. 19.

various co-operation and prediſpoſition of the ſeaſons of the year; and partly, negligence, ſelf-intereſt, malice and other circumſtances, now at this, anon at another time, bringing forth this contagion from its native ſoil into foreign countries: Whence thoſe conſtantly engaged in commerce with *Turky*, eſpecially the *Venetians*, have come to this ſalutary reſolution, not only to conſtitute a ſtanding Council of health, but order all ſhips from the *Levant* to perform a ſhorter or longer Quarantine, before ever they ſhall venture a-ſhore. However (5.) this holds true, that the Plague in its original muſt needs have a ſpontaneous, material cauſe, even without any derived Contagion; poſſibly exerting itſelf as little, as among us does the cauſe of Petechial fevers; which not every year, but after a ſhorter or longer period, thro' the means of a peculiar diſpoſition of our bodies, and the weather, originally take their firſt riſe amongſt us. What *Helmont** remarks; namely, that the plague recurs oftener now than formerly it did, holds very true; and that not only in *Chriſtendom*, but in the Eaſt itſelf; here, on the ſcore of the Mahometan doctrine of fate; there, by means of the frequent intercourſe at this day maintained with the *Turkiſh* Provinces: Two circumſtances that formerly did not take place; whence then the plague could not produce ſuch repeated and wide-deſolating ravage, as it uſually does at this day. But where and whence this peſtilential material Cauſe had formerly firſt derived, and ſtill at this day derives its original, remains ſtill a queſtion; eſpecially as little attention has been beſtowed on ſuch Origination, the univerſal or common cauſes barely, yet, without grounds, being regarded and ſtuck to; tho' at preſent ſeveral learned Phyſicians have been forced in general to own, that the plague is by contagion communicated from the Eaſt to *Europe*. To me it ſeems highly probable, that the Plague principally takes its material riſe in *Egypt*, and other, either neighbouring or diſtant countries, alike diſpoſed therewith, by means of a peculiar action of the climate, air and weather, on vitiated and corrupted bodies: And indeed either it uſually takes birth from that native diſtemper, proper to the *Egyptians*, called *Dem el muya*, which in a few hours carries off ſeveral perſons, and is accompanied with vomitings, anxiety, exceſſive heat, violent thirſt, phrenſy, diſquietude, corrupted ſtools, and other ſymptoms common to the plague, eſpecially tumours, and thoſe ſubſiding again: Or it is bred of itſelf immediately from the exceſſive drying heat of the climate, and from the *Nile* water corrupting in pits and ciſterns, and the naſty manner of living of the poorer ſort near canals, full of ſtinking water.

The grand miſtake in the ſeveral Methods of cure hitherto uſed for this calamity, is the neglecting to ſecond and promote the efforts of nature: Her uſual way is to expel, with the ſooneſt, any noxious recrements, received into the body by outlets proportioned thereto; as by ſweat, urine, ſtool, *&c.* The ſame procedure of nature we alſo obſerve in the plague, whilſt

* Tract. de Peſte. c. 4.

whilſt commonly ſhe attempts the diſcharging the unknown and highly deleterious ferment or poiſon by buboes in the groin, armpits, and behind the ears; or failing in this, by carbuncles; that is, gangren'd, nay ſphacelated abſceſſes. Of ſuch peſtilential excretions we find innumerable inſtances in the ſeveral caſes and obſervations that are handed down to us; but which thro' the prejudice of Syſtem and Authority have not been conſidered in that light evidence would ſeem to claim.

The hiſtory of all ages ſhews, 1. That the plague has been always accompanied with tumours and carbuncles. 2. That ſuch excretions prove the ſureſt and beſt relief; almoſt all thoſe, who have had ſuch excretions, having recovered. 3. That the miſcarriage of other Patients was owing to ſuch excretions either happening too late, being inſufficient, or appearing not at all, or being accompanied with other diſorderly motions and excretions.

Notwithſtanding theſe evident truths, ſuch excretions have barely been conſidered as ſymptomatical; and conſequently their treatment thrown over on manual Operations; and the internal and capital cure directed to promote and excite ſweating, and by no means the excretions, pointed at by nature.

Tho' an appropriated ſpecific for promoting ſuch excretions be not hitherto known; yet from diligently conſidering the nature of the humours, to be excreted, the organ and the medicines, it may not be a thing impoſſible to light on ſome one, that ſhall ſerve to promote the expulſion of peſtilential abſceſſes; as we are not without ſpecifics in other diſeaſes with eruptions.

F I N I S.

[ii]+viii+460+[xii]:

136.

appar. lacks
par. ginden
anvi. Tpodin
gvanii