Soulsby no. 638*, p. 652-688

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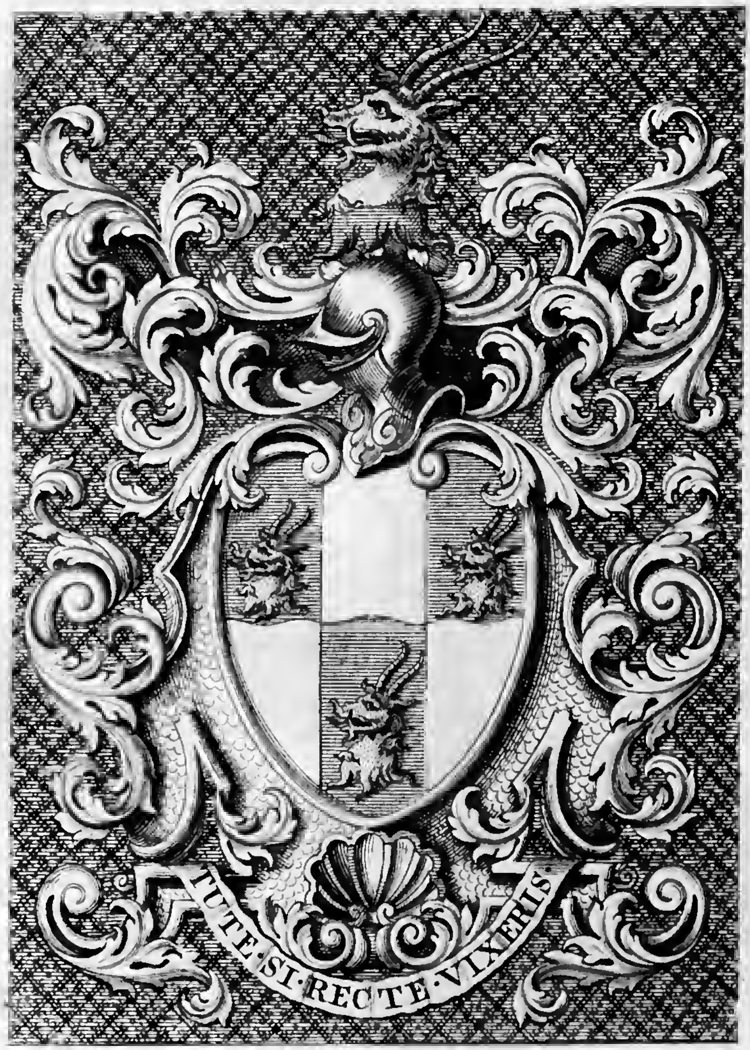
TUTE·SI·RECTE·VIXERIS

PHILOSOPHICAL TRANSACTIONS,

GIVING SOME

ACCOUNT

OF THE

Present Undertakings, Studies, *and* Labours,

OF THE

INGENIOUS,

IN MANY

Considerable Parts of the WORLD.

VOL. L. PART II. For the Year 1758.

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LIX. *An Account of the Effects of Electricity in paralytic Cases. In a Letter to* John Pringle, *M. D. F. R. S. from* Benjamin Franklin, *Esq; F. R. S.*

S I R,

Read Jan. 12, 1758.

THE following is what I can at present recollect, relating to the effects of electricity in paralytic cases, which have fallen under my observation.

Some years since, when the news-papers made mention of great cures performed in Italy or Germany, by means of electricity, a number of paralytics were brought to me from different parts of Pensylvania, and the neighbouring provinces, to be electrised; which I did for them at their request. My method was, to place the patient first in a chair, on an electric stool, and draw a number of large strong sparks from all parts of the affected limb or side. Then I fully charged two six-gallon glass jars, each of which had about three square feet of surface coated; and I sent the united shock of these thro' the affected limb or limbs; repeating the stroke commonly three times each day. The first thing observed was an immediate greater sensible warmth in the lame limbs, that had received the stroke, than in the others: and the next morning the patients usually related, that they had in the night felt a pricking sensation in the flesh of the paralytic limbs; and would sometimes shew a number of small red spots, which they ſuppoſed were occaſioned by thoſe prickings. The limbs too were found more capable of voluntary motion, and ſeemed to receive ſtrength. A man, for inſtance, who could not the firſt day lift the lame hand from off his knee, would the next day raiſe it four or five inches, the third day higher; and on the fifth day was able, but with a feeble languid motion, to take off his hat. Theſe appearances gave great ſpirits to the patients, and made them hope a perfect cure; but I do not remember, that I ever ſaw any amendment after the fifth day: which the patients perceiving, and finding the ſhocks pretty ſevere, they became diſcouraged, went home, and in a ſhort time relapſed; ſo that I never knew any advantage from electricity in palſies, that was permanent. And how far the apparent temporary advantage might ariſe from the exerciſe in the patients journey, and coming daily to my houſe, or from the ſpirits given by the hope of ſucceſs, enabling them to exert more ſtrength in moving their limbs, I will not pretend to ſay.

Perhaps ſome permanent advantage might have been obtained, if the electric ſhocks had been accompanied with proper medicine and regimen, under the direction of a ſkilful phyſician. It may be, too, that a few great ſtrokes, as given in my method, may not be ſo proper as many ſmall ones; ſince, by the account from Scotland of a caſe, in which two hundred ſhocks from a phial were given daily, it ſeems, that a perfect cure has been made. As to any uncommon ſtrength ſuppoſed to be in the machine uſed in that caſe, I imagine it could have no ſhare in the effect produced; ſince the ſtrength

of

of the ſhock from charged glaſs is in proportion to the quantity of ſurface of the glaſs coated; ſo that my ſhocks from thoſe large jars muſt have been much greater than any, that could be received from a phial held in the hand.

I am, with great reſpect,

SIR,

Your moſt obedient Servant,

London, Dec. 21, 1757.

R. Franklin.

LX. *Obſervations on the late Comet in* September *and* October 1757; *made at the* Hague *by Mr.* D. Klinkenberg: *In a Letter to the Rev.* James Bradley, *D. D. Aſtronomer Royal, and F.R.S, and Member of the Royal Academy of Sciences at* Paris. *Tranſlated from the* Low Dutch.

SIR,

Read Jan. 12, 1758.

I Hope you will be pleaſed to excuſe the liberty, which I take, of troubling you with my obſervations on the comet, which made its appearance here, and in other parts of Europe, in the months of September and October laſt; and which, according to the news-papers, was firſt obſerved the 11th September by Mr. Gartner, at Dorlkeurtz near Dreſden; then by me, on the 16th of the ſaid Month, here in the Hague; and afterwards in different places. As I find, that you have obſerved the comet, I doubt not but that you have done it in the moſt accurate manner; and my great love for this ſcience induces me to beg, that I may have the happineſs of knowing ſome of your obſervations. My good friend Mr. Struyk at Amſterdam wrote me ſome time ago, that he intended to aſk the ſame favour of you; but I have not ſince heard any further from him. I obſerved this comet from Septemb. 16th in the morning, until Octob. the 11th in the morning; and found its ſituations, according to my method, as follows:

1757.				*Longit.* °	′		*Latit.* °	′	
Sept. 16.	at 4 h. ante mer.	The comet in	♋	10	15	with	10	10	North.
17	— 3	— — — — —	♋	14	7	—	9	38	
18	— $3\frac{3}{4}$	— — — — —	♋	18	10	—	8	57	
19	— 4	— — — — —	♋	22	1	—	8	17	
22	— $2\frac{3}{4}$	— — — — —	♌	3	46	—	6	15	
23	— 4	— — — — —	♌	7	36	—	5	24	
25	— $4\frac{1}{4}$	— — — — —	♌	14	50	—	4	6	
28	— 4	— — — — —	♌	24	22	—	1	41	
Oct. 1	— $4\frac{3}{4}$	— — — — —	♍	2	46	—	0	12	South.
4	— $4\frac{1}{2}$	— — — — —	♍	9	45	—	1	30	
9	— $4\frac{1}{2}$	— — — — —	♍	20	20	—	2	40	
11	— 5	— — — — —	♍	24	46	—	3	9	

But the two laſt obſervations will, in my opinion, differ the moſt; becauſe, when I made them, I was in ſome doubt about the adjuſtment of my inſtruments; and the comet was then far advanced into the morning rays. I have, ſince the month of February laſt to the end of May, made ſundry obſervations on fixed ſtars, with a teleſcope of 16 inches, made by Mr. Short; and with a pendulum clock, made after the manner of Mr. Graham, by Mr. Vryhthoff of this

this place. In the months of February and March, by a medium of eight obſervations, I found, that by the clock, the ſtar Rigel, in every daily revolution, paſſed 4 min. $2\frac{4}{9}$ ſeconds of time earlier, in the teleſcope; and in the latter end of May I found, by ſix obſervations, (the clock not in the leaſt changed or altered) on the ſtar Spica Virginis, that that ſtar, in every revolution, paſſed 4 min. $5\frac{1}{20}$ ſec. earlier, in the ſame teleſcope; which intervals differ pretty nearly $2\frac{3}{7}$ ſeconds of time from one another. Whether this difference ariſes from any defect in the clock, or whether it proceeds from any ſmall difference of velocity of the earth's motion round its axis, I would have been very glad to have endeavoured to find out by farther inquiry, had not the death of Mr. S. Koenig intervened, and I thereby hindered from continuing my obſervations. The above obſervations were taken in the obſervatory of his illuſtrious Highneſs the minor Prince of Orange and Naſſau, *&c. &c.* under the direction, and with the approbation of the aforeſaid Mr. Koenig. After the death of that gentleman, I petitioned her Royal Highneſs the Princeſs Governeſs of theſe Provinces, *&c.* that I might have leave to continue my aſtronomical obſervations; but as yet I have not been able to obtain her Royal Highneſs's permiſſion: otherwiſe I would have obſerved this laſt comet with more exactneſs. Had I been able to purſue the above-mentioned obſervations, I would, for the greater certainty in regard to the pendulum, have made uſe of a farther precaution. By means of a ſtove, with the help of a thermometer, I would have endeavoured to have kept the room (in which the clock ſtood) in the winter, and

at

at all times, in the ſame degree of heat it had at the time I made the obſervations in the ſummer. I would alſo have daily obſerved and noted the moon's place, at the time of the obſervations. Tho' this is but a ſlight obſervation of mine; yet I make no doubt, but that in caſe, by the different diſtances of the earth from the ſun, and the different diſtances and ſituations of the moon with reſpect to the earth, and the reſpective effects produced by theſe cauſes, any inequality ariſes in the velocity of the diurnal motion of the earth on its axis, you (who have made the moſt ſublime obſervations on the aberration of the fixed ſtars, and more than any mortal ever did before) muſt have diſcovered, and are well acquainted, with the ſame.

As my above-mentioned obſervations on the comet appeared too incorrect to undertake a calculation for the aſcertaining of its path from the theory, I contented myſelf with effecting it by a conſtruction. By this means I found, on a figure, whoſe globular or ſpherical diameter was 13 $\frac{1}{2}$ Rhineland inches, as follows:

That the comet was in its perihelion the 21ſt of October, at two of the clock in the afternoon: the place of the perihelion 3 degrees in Leo. The comet's diſtance in the perihelion from the ſun was about 34 parts, whereof 100 make the mean diſtance between the ſun and the earth. The inclination of the comet's orbit with the ecliptic 13 degrees; and the ſouthern latitude of the perihelion alſo 13 degrees: the aſcending or north node ☊ $4\frac{1}{3}$ degrees in Scorpio; and the comet's motion direct, or according to the order of the ſigns of the zodiac. On this ſuppoſition

tion I have, for ſome of the times of obſervations, eſtimated the apparent places of the comet, and found them as follows:

			Long.	Latit.
Sept.	18, at $3\frac{3}{4}$ ante merid.	In	♋ $18\frac{1}{12}$	and 9 deg. North.
	19 — 4	— — —	♋ 22	— $8\frac{2}{5}$
	22 — $2\frac{3}{4}$	— — —	♌ $3\frac{5}{8}$	— $6\frac{1}{4}$
	23 — 4	— — —	♌ $7\frac{3}{5}$	— $5\frac{1}{2}$
	25 — $4\frac{1}{4}$	— — —	♌ $14\frac{2}{3}$	— 4
	28 — 4	— — —	♌ $24\frac{1}{3}$	— $1\frac{3}{4}$
Oct.	4 — $4\frac{1}{2}$	— — —	♍ $9\frac{1}{3}$	— 2 — South.
	9 — $4\frac{3}{4}$	— — —	♍ $19\frac{2}{3}$	— $3\frac{2}{5}$
	11 — 5	— — —	♍ $23\frac{1}{8}$	— $3\frac{4}{5}$

The obſervations, which I have taken, to ground the meaſurement on, are thoſe of the 16th and 23d of September, and of the 1ſt of October. It appears very evident, not only from this rough calculation, but every other circumſtance of this comet, that it is not the ſame with that in the year 1682: which, on certain accounts, is very deſirable to be known; for both here, and in other parts of the Netherlands, there have been ſome people, who have publiſhed mere conjectures; and have ventured (very minutely and exactly, as they pretended) about the time that this comet firſt made its appearance, to predict the return of the comet of the year 1682. But by the above, the weakneſs of their pretenſions is very evident to all the world: whereas, if this had proved to be the expected comet, they would have aſſumed to themſelves much undue praiſe, and have pretended to knowlege even ſuperior to the every-where much celebrated Newton and Halley.

It appears alſo probable to me, that this comet is none of thoſe already calculated, or brought upon a liſt, by Meſſieurs Halley and Struyk. It is ſomewhat remarkable,

remarkable, that the line of the nodes is almoſt at right angles with the long axis of the ellipſis; which correſponds nearly with the comets of the years 1580, 1683, and 1686: but thoſe had their perihelions northward of the ecliptic; whereas the perihelion of the laſt, which we have lately ſeen, was to the ſouthward of the ecliptic.

I have the honour to ſubſcribe myſelf, with the moſt perfect eſteem for you, and your ſublime ſtudies, very reſpectfully,

SIR,

Your very humble and obedient Servant,

Hague, 13th Dec. 1757.

D. Klinkenberg.

LXI. *Remarks on the different Temperature of the Air at* Edyſtone, *from that obſerved at* Plymouth, *between the 7th and 14th of* July 1757. *By Mr.* John Smeaton, *F. R. S.*

SIR,

Read Jan. 12, 1758.

ON the reading of Dr. Huxham's letter at the laſt meeting, ſome obſervations occurred to me, concerning the different temperature of the air, which I had obſerved at the Edyſtone, from what had been obſerved by the Doctor at Plymouth, between the 7th and 14th of

July

July laſt: which having been deſired by ſome members to be put into writing, I beg leave to trouble you with the following.

Edyſtone is diſtant from Plymouth about 16 miles, and without the head-lands of the Sound about 11.

The 7th and 8th were not remarkable at Edyſtone for heat or cold: the weather was very moderate, with a light breeze at eaſt; which allowed us to work upon the rock both days, when the tide ſerved.

About midnight, between the 8th and 9th, the wind being then freſh at eaſt, it was remarkably cold for the ſeaſon, as I had more particular occaſion to obſerve, on account of a ſhip that was caſt away upon the rocks. The wind continued cold the 9th all day; which was complained of by ſome of the ſhipwrecked ſeamen, who had not time to ſave their cloaths; and ſo freſh at eaſt, as prevented our going near the rocks, or the wreck; and ſo continued till Sunday the 10th; when, ſeeing no proſpect of a ſudden alteration of weather, I returned to Plymouth in a ſailing boat, wrapped up in my thick coat. As ſoon as we got within the headlands, I could perceive the wind to blow conſiderably warmer; but not ſo warm as to make my great coat uneaſy. Having had a quick paſſage, in this manner I went home, to the great aſtoniſhment of the family to ſee me ſo wrapped up, when they were complaining of the exceſſive heat: and indeed, it was not long before I had reaſon to join in their opinion.

This heat I experienced till Tueſday the 12th, when I again went off to ſea, where I found the air very temperate, rather cool than warm; and ſo continued till Thurſday the 14th.

In my journal for Wedneſday the 13th I find the following remarks, *viz.* " This evening's tide" (from 6 A. till 12 A.) " the wind at eaſt, but moderate, " with frequent flaſhes of lightning to the ſouth- " ward. Soon after we got on board the ſtore- " veſſel, a ſquall of wind aroſe from the ſouth-weſt " on a ſudden, and continued for about a minute; " part of which time it blew ſo hard, we expected " the maſts to go by the board: after which it was " perfectly calm, and preſently after a breeze re- " turned from the eaſt."

And in the journal of the 14th is entered, " This " morning's tide" (*viz.* from 1 M. to 1 A.) " the " air and ſea quite calm."

Hence it appears, how different the temper of the air may be in a ſmall diſtance; and to what ſmall ſpaces ſqualls of wind are ſometimes confined.

It may not be amiſs further to obſerve upon this head, that once, in returning from Edyſtone, having got within about two miles of the Ramhead, we were becalmed; and here we rolled about for at leaſt four hours; and yet at the ſame time ſaw veſſels, not above a league from us, going out of Plymouth Sound with a freſh of wind, whoſe direction was towards us, as we could obſerve from the trim of their ſails; and as we ourſelves experienced, after we got into it by tacking and rowing.

I am, Sir,

Your moſt humble Servant,

Furnival's-Inn Court,
12th Jan. 1758.

J. Smeaton.

LXII.

LXII. *An Account of the Earthquake felt in the Island of* Sumatra, *in the* East-Indies, *in* November *and* December 1756. *In a Letter from Mr.* Perry *to the Rev. Dr.* Stukeley, *dated at* Fort Marlborough, *in the Island of* Sumatra, Feb. 20. 1757. *Communicated by the Rev.* Wm. Stukeley, *M. D. F. R. S.*

Read Jan. 12, 1758.

THE earthquake at Lisbon, which you gave me an account of, was certainly the most awful tremendous calamity, that has ever happened in the world. Its effects are extremely wonderful and amazing; and it seems, as you observe, to have been felt in all parts of the globe. On the 3d day of the same month the earthquake of Lisbon happened, I felt at Manna (1) a violent shock myself; and from that time to the 3d of December following I felt no less than twelve different shocks, all which I took an exact account of in my pocket-bock. Since which we have had two very severe earthquakes, felt, we believe, throughout this island (2). The walls of (3) Cumberland-house * were greatly damaged by them. Salop-house *, my own (formerly Mr. Massey's), the houses

(1) Manna lies about 50 miles to the southward of Marlborough.

(2) The island of Sumatra is between 7 and 800 miles long from north to south.

(3) Cumberland-house is a new well-built house for the governor of the place.

* *N. B. Both these are contiguous to the fort.*

of Laye (4) and Manna, were all cracked by them; and the works at the ſugar-plantation (5) received conſiderable damage. The ground opened near the *qualloe* (6) at Bencoolen, and up the River in ſeveral places; and there iſſued therefrom ſulphureous earth, and large quantities of water, ſending forth a moſt intolerable ſtench. Poblo Point (7) was much cracked at the ſame time; and ſome *dooſoons* (8) in-land at Manna were deſtroyed, and many people in them.

Theſe are all the ill effects, that have come to our knowlege; but, it is reaſonable to ſuppoſe, not all the damage, that has happened upon the iſland.

LXIII. *Concerning the Fall of Water under Bridges. By Mr.* J. Robertſon, *F. R. S.*

Read Jan. 19, 1758.

SOME time before the year 1740, the problem about the fall of water, occaſioned by the piers of bridges built acroſs a river, was much talked of at London, on account of the fall that it was ſuppoſed would be at the new bridge to be built at Weſtminſter. In Mr. Hawkſmore's and Mr. Labelye's pamphlets, the former publiſhed in 1736,

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(4) Laye houſe or factory is about 30 miles to the northward of Marlborough, and Manna houſe or factory fifty miles to the ſouthward.

(5) The ſugar-plantation is five or ſix miles from Marlborough.

(6) The *qualloe* is the country word for a river's mouth.

(7) Poblo Point lies about three leagues to the ſouthward of Marlborough.

(8) *Dooſoons* are villages.

1736, and the latter in 1739; the reſult of Mr. Labelye's computations was given: but neither the inveſtigation of the problem, nor any rules, were at that time exhibited to the public.

In the year 1742 was publiſhed Gardiner's edition of Vlacq's Tables; in which, among the examples there prefixed to ſhew ſome of the uſes of thoſe tables drawn up by the late William Jones, Eſq; there are two examples, one ſhewing how to compute the fall of water at London-bridge, and the other applied to Weſtminſter-bridge: but that excellent mathematician's inveſtigation of the rule, by which thoſe examples were wrought, was not printed, altho' he communicated to ſeveral of his friends copies thereof. Since that time, it ſeems as if the problem had in general been forgot, as it has not made its appearance, to my knowlege, in any of the ſubſequent publications. As it is a problem ſomewhat curious, tho' not difficult, and its ſolution not generally known (having ſeen four different ſolutions, one of them very imperfect, extracted from the private books of an office in one of the departments of engineering in a neighbouring nation), I thought it might give ſome entertainment to the curious in theſe matters, if the whole proceſs were publiſhed. In the following inveſtigation, much the ſame with Mr. Jones's, as the demonſtrations of the principles therein uſed appeared to be wanting, they are here attempted to be ſupplied.

PRINCIPLES.

I. *A heavy body, that in the firſt ſecond of time has fallen the height of a feet, has acquired ſuch a velocity,*

locity, that, moving uniformly therewith, will in the next ſecond of time move the length of 2 a *feet.*

II. *The ſpaces run thro' by falling bodies are proportional to one another as the ſquares of their laſt or acquired velocities.*

These two principles are demonſtrated by the writers on mechanics.

III. *Water forced out of a larger chanel thro' one or more ſmaller paſſages, will have the ſtreams thro' thoſe paſſages contracted in the ratio of* 25 *to* 21.

This is ſhewn in the 36th prop. of the 2d book of Newton's Principia.

IV. *In any ſtream of water, the velocity is ſuch, as would be acquired by the fall of a body from a height above the ſurface of that ſtream.*

This is evident from the nature of motion.

V. *The velocities of water thro' different paſſages of the ſame height, are reciprocally proportional to their breadths.*

For, at ſome time, the water muſt be delivered as faſt as it comes; otherwiſe the bounds would be overflowed.

At that time, the ſame quantity, which in any time flows thro' a ſection in the open chanel, is delivered in equal time thro' the narrower paſſages; or the momentum in the narrow paſſages muſt be equal to the momentum in the open chanel; or the rectangle under the ſection of the narrow paſſages, by their mean velocity, muſt be equal to the rectangle under the ſection of the open chanel by its mean velocity.

Therefore

Therefore the velocity in the open chanel is to the velocity in the narrower paſſages, as the ſection of thoſe paſſages is to the ſection of the open chanel.

But the heights in both ſections being equal, the ſections are directly as the breadths;

Conſequently the velocities are reciprocally as the breadths.

VI. *In a running ſtream, the water above any obſtacles put therein will riſe to ſuch a height, that by its fall the ſtream may be diſcharged as faſt as it comes.*

For the ſame body of water, which flowed in the open chanel, muſt paſs thro' the paſſages made by the obſtacles:

And the narrower the paſſages, the ſwifter will be the velocity of the water:

But the ſwifter the velocity of the water, the greater is the height, from whence it has deſcended:

Conſequently the obſtacles, which contract the chanel, cauſe the water to riſe againſt them.

But the riſe will ceaſe, when the water can run off as faſt as it comes:

And this muſt happen, when, by the fall between the obſtacles, the water will acquire a velocity in a reciprocal proportion to that in the open chanel as the breadth of the open chanel is to the breadth of the narrow paſſages.

VII. *The quantity of the fall cauſed by an obſtacle in a running ſtream is meaſured by the difference be-*

tween

tween the heights fallen from to acquire the velocities in the narrow paſſages and open chanel.

For juſt above the fall, the velocity of the ſtream is ſuch, as would be acquired by a body falling from a height higher than the ſurface of the water:

And at the fall, the velocity of the ſtream is ſuch, as would be acquired by the fall of a body from a height more elevated than the top of the falling ſtream; and conſequently the real fall is leſs than this height.

Now as the ſtream comes to the fall with a velocity belonging to a fall above its ſurface;

Conſequently the height belonging to the velocity at the fall muſt be diminiſhed by the height belonging to the velocity, with which the ſtream arrives at the fall.

PROBLEM.

In a chanel of running water, whoſe breadth is contracted by one or more obſtacles; the breadth of the chanel, the mean velocity of the whole ſtream, and the breadth of the water-way between the obſtacles being given; To find the quantity of the fall occaſioned by thoſe obſtacles.

Let b = breadth of the chanel in feet.

v = mean velocity of the water in feet per ſec.

c = breadth of the water-way between the obſtacles.

Now $25 : 21 :: c : \frac{21}{25} c$ the water-way contracted. . . . . *Principle* III.

And

And $\frac{21}{25}c : b :: v : \frac{25b}{21c}v$ the veloc. *per* ſec. in the water-way between the obſtacles. . . *Princip.* V.

Alſo $\overline{2a}^2 : vv :: a : \frac{vv}{4a}$ the height fallen to acquire the vel. v. . . . . I. & II.

And $\overline{2a}^2 : \overline{\frac{25b}{21c}}\big|^2 \times vv :: a : \overline{\frac{25b}{21c}}\big|^2 \times \frac{vv}{4a}$ the height fallen to acquire the vel. $\frac{25b}{21c}v$. . . . . . I. & II.

Then $\overline{\frac{25b}{21c}}\big|^2 \times \frac{vv}{4a} - \frac{vv}{4a}$ is the meaſure of the fall required. . . . . VII.

Or $\overline{\overline{\frac{25b}{21c}}\big|^2 - 1} \times \frac{vv}{4a}$ is a rule, by which the fall may be readily computed.

Here $a = 16,0899$ feet and $4a = 64,3596$.

EXAMPLE I. *For London-Bridge.*

By the obſervations made by Mr. Labelye in 1746,

The breadth of the Thames at London-bridge is 926 feet;

The ſum of the water-ways at the time of the greateſt fall is 236 feet;

The mean velocity of the ſtream taken at its ſurface juſt above bridge is $3\frac{1}{6}$ feet *per* ſecond.

Under almoſt all the arches there are great numbers of drip-ſhot piles, or piles driven into the bed of the water-way, to prevent it from being waſhed away by the fall. Theſe drip-ſhot piles conſiderably contract the water-ways, at leaſt $\frac{1}{6}$ of their meaſured breadth, or about $39\frac{1}{3}$ feet in the whole.

So that the water-way will be reduced to $196\frac{2}{3}$ feet.

Now $b = 926$; $c = 196\frac{2}{3}$; $v = 3\frac{1}{6}$; $4a = 64{,}3596$.

Then $\frac{25b}{21c} = \frac{23150}{4130} = 5{,}60532$

And $\overline{5{,}60532}|^2 = 31{,}4196$; and $31{,}4196 - 1 = 30{,}4196 = \overline{\frac{25b}{21c}}|^2 - 1$.

Alſo $vv = \overline{\frac{19}{6}}|^2 = \frac{361}{36}$; And $\frac{vv}{4a} = \frac{361}{36 \times 64{,}3596} = 0{,}15581$.

Then $30{,}4196 \times 0{,}15581 = 4{,}739$ feet, the fall ſought after.

By the moſt exact obſervations made about the year 1736, the meaſure of the fall was 4 feet 9 inches.

EXAMPLE II. *For Weſtminſter-Bridge.*

Altho' the breadth of the river at Weſtminſter-bridge is 1220 feet; yet, at the time of the greateſt fall, there is water thro' only the thirteen large arches, which amount to 820 feet: to which adding the breadth of the twelve intermediate piers, equal to 174 feet, gives 994 for the breadth of the river at that time: and the velocity of the water juſt above bridge (from many experiments) is not greater than $2\frac{1}{4}$ feet *per* ſecond.

Here $b = 994$; $c = 820$; $v = 2\frac{1}{4}$; $4a = 64{,}3596$.

Now $\frac{25b}{21c} = \frac{24850}{17220} = 1{,}443$.

And

And $\overline{1{,}443}|^2 = 2{,}082$; And $2{,}082 - 1 = 1{,}082$ $= \overline{\frac{25\,b}{21\,c}}|^2 - 1$.

Alſo $v\,v = \overline{\frac{9}{4}}|^2 = \frac{81}{16}$; And $\frac{v\,v}{48} = \frac{81}{16 \times 64{,}3596} =$ $0{,}0786$.

Then $1{,}082 \times 0{,}0786 = 0{,}084$ feet, the fall ſought.

Which is about 1 inch; and is about half an inch more than the greateſt fall obſerved by Mr. Labelye.

LXIV. *An Account of the Earthquake in the Weſt Parts of* Cornwall, July 15*th* 1757. *By the Rev.* William Borlaſe, *M. A. F. R. S. Communicated by the Rev.* Charles Lyttelton, *LL. D. Dean of* Exeter, *F. R. S.*

Read Jan. 26. 1758.

ON Friday the 15th of July, 1757. a violent ſhock of an earthquake was felt in the weſtern parts of Cornwall.

The thermometer had been higher than uſual, and the weather hot, or calm, or both, for eight days before; wind eaſt and north-eaſt. On the 14th in the morning, the wind ſhifting to the ſouth-weſt, the weather calm and hazy, there was a ſhower. The afternoon hazy and fair, wind north-weſt. The barometer moderately high, but the mercury remarkably variable.

On the 15th in the morning, the wind fresh at north-west, the atmosphere hazy. Being on the sands, half a mile east of Penzance, at 10 A. M. near low water, I perceived on the surface of the sands a very unusual inequality: for whereas there are seldom any unevennesses there, but what are made by the rippling of the water, I found the sands, for above 100 yards square, all full of little tubercles (each as large as a moderate mole-hill), and in the middle a black speck on the top, as if something had issued thence. Between these convexities were hollow basons of an equal diameter. From one of these hollows there issued a strong rush of water, about the bigness of a man's wrist, never observed there before nor since.

About a quarter after six, P. M. the sky dusky, the wind being at west north-west, it fell quite calm. At half past six, being then in the summer-house at Keneggy, the seat of the Hon. J. Harris, Esq; near Penzance, with some company, we were suddenly alarmed with a rumbling noise, as if a coach or waggon had passed near us over an uneven pavement; but the noise was as loud in the beginning and at the end, as in the middle; which neither the sound of thunder, or of carriages, ever is. The sash-casements jarred: one gentleman thought his chair moved under him; and the gardener, then in the dwelling house (about an hundred yards distant from us) felt the stone pavement of the room he was in move very sensibly.

In what place the shock began, and whether progressive or instantaneous in the several places where it was felt, is uncertain, for want of accurately determining the precise point of time in distant places.

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The ſhock was not equally loud or violent. Its extent was from the iſles of Scilly eaſtward as far as Liſkerd, and towards the north as far as Camelford; thro' which diſtrict I ſhall trace it, according to the beſt informations I could procure.

In the iſland of St. Mary, Scilly, the ſhock was violent. On the ſhores of Cornwall, oppoſite to Scilly (in the pariſh of Senan, near the Land's-end) the noiſe was heard like that of a ſpinning-wheel on a chamber-floor. Below ſtairs there was a cry, that the houſe was ſhaking; and the braſs pans and pewter rattled one againſt another in ſeveral houſes in the ſame pariſh. In the adjoining pariſh of St. Juſt, two young men being then ſwimming, felt a ſtrong and very unuſual agitation of the ſea. In the town of Penzance, in one houſe the chamber-bell rung; in another the pewter plates, placed edgeways on a ſhelf, ſhifted, and ſlid to one end of the ſhelf: and it was every-where perceived more or leſs, according as people's attention was engaged.

At Trevailer, the ſeat of William Veale, Eſquire, about two miles from Penzance, the noiſe was heard, and thought at firſt to be thunder: the windows ſhook, and the walls of the parlour, where Mr. Veale ſat, viſibly moved. The jarring of the windows continued near half a minute; but the motion of the walls not quite ſo long: and ſome maſons, being at work on a contiguous new building, the upright poles of the ſcaffolds ſhook ſo violently, that, for fear of falling, they laid hold on the walls, which, to their ſtill greater ſurprize, they found agitated in the ſame manner. And a perſon preſent, who was at London at the time of the two ſhocks in

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the year 1751, thought this ſhock to reſemble the ſecond, both in degree and duration (1).

At Marazion, the next market-town eaſt of Penzance, the houſes of ſeveral perſons ſhook to that degree, that people ran out into the ſtreet, leſt the houſes ſhould fall upon them.

In the borough of St. Ives, on the north ſea, ſix miles north of Penzance, the ſhock was ſo violent, that a gentleman, who had been at Liſbon during ſeveral ſhocks, ſaid, that this exceeded all he had met with, except that on the 1ſt of November 1755, ſo fatal to that city.

At Tehidy, the ſeat of Francis Baſſet, Eſq; the rooms ſhook, and the grounds without doors were obſerved to move. The ſhock was felt ſenſibly at Redruth, St. Columb, Bodman, *&c.* along to Camelford, which is about 90 miles from the iſle of Scilly. From Marazion eaſtward it was felt at ſeveral places in like manner, as far as Loſtwythyel; but at Liſkerd, about ten miles eaſt of Loſtwythyel, it was but faintly perceived, and that by a few perſons. It was ſtill leſs ſenſible at Loo and Plymouth, "ſcarcely ſufficient to excite curioſity or fear" (2).

The times of its duration were various. At Keneggy we thought the noiſe could not have laſted above ſix ſeconds; at Trevailer, not two miles diſtant to the weſt, it was thought to have laſted near half a minute; in the pariſh of Gwynier half a minute; at Ludgvan, three miles eaſt of Penzance, the noiſe was rather longer than half a minute; but

(1) Letter from William Veale, Eſq;
(2) Letter from John Trehawk, Eſq;

the

the ſhaking felt in the garden, and obſerved in the houſes, ſhort and momentary. In Germo great Pin-work, ſeven miles eaſt of Penzance, it laſted only a few ſeconds; but in the iſles of Scilly it was computed at 40 ſeconds.

Thus was this earthquake felt in towns, houſes, and grounds adjacent; but ſtill more particularly alarming in our mines, where there is leſs refuge, and conſequently a greater dread from the tremors of the earth.

In Carnorth adit, in the pariſh of St. Juſt, the ſhock was ſenſibly felt 18 fathom deep; in the mine called Boſcadzhill-downs, more than 30 fathom.

At Huel-rith mine, in the pariſh of Lannant, people ſaw the earth move under them, firſt quick, then in a ſlower wavy tremor; and the ſtage-boards of the little winds or ſhafts 20 fathom deep were perceived to move.

In Herland mine, commonly called the Manor, in the pariſh of Gwynier, the noiſe was heard 55 and 60 fathom deep, as if a ſtuddle (3) had broke, and the deads (4) were ſet a running. It was nothing like the noiſe of thunder.

In Chace-water mine the ſame noiſe was heard, at leaſt 70 fathom under the ſurface.

At Huel-rith mine, near Godolphin, the noiſe was ſeemingly underneath. I felt (ſays the director of the mine) the earth move under me with a prodigious ſwift, and apparently horizontal tremor: its continuance was but for a few ſeconds of time,

(3) A timber ſupport of the deads.
(4) Looſe rubbiſh and broken ſtones of the mine.

not

not like thunder, but rather a dull rumbling even ſound, like deads running under ground. In the ſmith's ſhop the window-leaves ſhook, and the ſlating of the houſe cracked. The whim-houſe ſhook ſo terribly, that a man there at work ran out of it, concluding it to be falling. Several perſons then in the mine, working 60 fathom deep, thought they found the earth about them to move, and heard an uncommon noiſe: ſome heard the noiſe, and felt no tremor; others, working in a mine adjoining called Huel-breag, were ſo frightened, that they called to their companions above to be drawn up from the bottoms. Their moor-houſe was ſhaken, and the padlock of their candle-cheſt was heard to ſtrike againſt the ſtaples. To ſhew, that this noiſe proceeded from below, and not from any concuſſion in the atmoſphere above, this very intelligent captain of the mine (5) obſerves, from his own experience, that thunder was never known to affect the air at 60 fathoms deep, even in a ſingle ſhaft pierced into the hardeſt ſtone; much leſs could it continue the ſound thro' ſuch workings as there are in this mine, impeded in all parts with deads, great quantities of timber, various noiſes, ſuch as the rattling of chains, friction of wheels and ropes, and daſhing of waters; all which muſt contribute to break the vibrations of the air as they deſcend: and I intirely agree with this gentleman's concluſion, that thunder, or any other noiſes from above in the atmoſphere, could not be heard at half the depth of this mine. This therefore could be no other than a real tremor of the earth,

(5) Mr. J. Nantcarrow.

attended

attended with a noiſe, owing to a current of air and vapour proceeding upwards from the earth.

I do not hear of any perſon in thoſe parts, who was ſo fortunate as to be near any pool or lake, and had recollection enough to attend to the motion of the waters; but it may be taken for granted, that during the tremors of the earth the fluids muſt be more affected than the ſolids: nay, the waters will apparently be agitated, when there is no motion of the earth perceptible, as was the caſe of our ponds and lake-waters in moſt parts of Britain on the 1ſt of November 1755. Whence this happens is difficult to ſay: whether the earth's boſom undergoes at ſuch times a kind of reſpiration, and alternately emits and withdraws a vapour thro' its moſt porous parts ſufficient to agitate the waters, yet not ſufficient to ſhake the earth; or whether the earth, during the agitation of the waters, does rock and vacillate, tho' not ſo as to be ſenſible to man; is what I ſhall leave to future inquiry.

Earthquakes are very rare in Cornwall. This was but of ſhort duration, and did no harm any-where, as far as I can learn; and it is to be hoped not the ſooner forgotten for that reaſon; but rather remembered with all the impreſſions of gratitude ſuitable to an incident ſo alarming and dangerous, and yet ſo inoffenſive.

LXV. *Some Obſervations upon the Sleep of Plants; and an Account of that Faculty, which* Linnæus *calls* Vigiliæ Florum; *with an Enumeration of ſeveral Plants, which are ſubject to that Law. Communicated to* Wm. Watſon, *M. D. F. R. S. by Mr.* Richard Pultney *of* Leiceſter.

kref

Read Jan. 26. 1758.

A Coſta and Proſper Alpinus, who both wrote near the concluſion of the XVIth century, are, I believe, the firſt, who recorded that nocturnal change in the leaves of plants, which has ſince been called *ſomnus*. It is an obſervation indeed as old as Pliny's time, that the leaves of trefoil aſſume an erect ſituation (1) upon the coming of ſtorms. The ſame is obſervable of our wood-ſorrel; and Linnæus adds, of almoſt all plants with declinated ſtamina (2). In the *Trifolium pratenſe album C. B.* or common white-flowered meadow trefoil, it is ſo obvious, that the common people in Sweden remark, and prognoſticate the coming of tempeſts and rain from it.

The examples of ſleeping plants inſtanced by Alpinus are but few. That author ſays, it was common to ſeveral Egyptian ſpecies (3); but ſpecifies only the Acaciæ, Abrus, Abſus, Séſban, and the Tamarind-

(1) Trifolium quoque inhorreſcere et folia contra tempeſtatem ſubrigere certum eſt. Hiſt. Nat. lib. xviii. cap. 35.

(2) Flor. Lappon. p. 222.

(3) Proſp. Alpin. de plantis Ægypti, cap. 10.

tree.

tree. Cornutus ſome time afterwards remarked this property in the Pſeudo-acacia Americana. From that time it has remained almoſt unnoticed, till Linnæus, ever attentive to nature's works, diſcovered that the ſame affair was tranſacted in many other plants; and his obſervations have furniſhed us with numerous and obvious examples thereof. Mr. Miller mentions it in the *Medicago arborea Lin. Sp. Pl.* 778. and we may add to the liſt two other common plants not mentioned by Linnæus: theſe are the *Phaſeolus vulgaris*, common kidney-bean; and the *Trifolium pratenſe purpureum majus*, or clover-graſs: in both which this nocturnal change is remarkably diſplayed. Doubtleſs the ſame property exiſts in numberleſs other ſpecies; and future obſervation will very probably confirm Dr. Hill's ſentiment, that no "plant or tree "is wholly unaffected by it."

It is now more than twenty years ſince Linnæus firſt attended to this quality in plants. In his *Flora Lapponica*, when ſpeaking of the *Trifolium pratenſe album*, as above-mentioned, he remarks, that the leaves of the Mimoſa, Caſſia, Bauhinia, Parkinſonia, Guilandina, and others in affinity with them, were ſubject to this change in the night time: and he had then carried his obſervations ſo far, as to find, that heat and cold were not the cauſe of this quality; ſince they were alike influenced by it when placed in ſtoves, where the temperature of the air was always the ſame.

The merit of reviving this ſubject is therefore due to the illuſtrious Swede; and the naturaliſt is greatly indebted to him for ſo far extending his obſervations thereon.

The subject of the *somnus plantarum* cannot but be highly entertaining to the lovers of natural knowlege: and such, I apprehend, cannot be less entertained with that faculty, which Linnæus calls *vigiliæ florum*; of which we shall give a brief account.

Previous to our explanation of this affair it is proper to observe, that the flowers of most plants, after they are once opened, continue so night and day, until they drop off, or die away. Several others, which shut in the night-time, open in the morning either sooner or later, according to their respective situation in the sun or shade, or as they are influenced by the manifest changes of the atmosphere. There are however another class of flowers, which make the subject of these observations, which observe a more constant and uniform law in this particular. These open and shut duly and constantly at certain and determinate hours, exclusive of any manifest changes in the atmosphere; and this with so little variation in point of time, as to render the phænomenon well worth the observation of all, whose taste leads them this way.

This faculty in the flowers of plants is not altogether a new discovery; but we are indebted to the same hand for additional observations upon this head likewise. It is so manifest in one of our common English plants, the *Tragopogon luteum*, that our country people long since called it *John-go-to-bed-at-noon*. Linnæus's observations have extended to near fifty species, which are subject to this law. What we find principally upon this subject is in the *Philosophia Botanica*, p. 273. We will enumerate these plants, and mention the time when the flowers open and shut,

ſhut, that thoſe, who have opportunity and inclination, may gratify themſelves, and probably at the ſame time extend this branch of botanic knowlege ſtill farther.

It is proper to obſerve, that as theſe obſervations were made by Linnæus in the academical garden at Upſal, whoever repeats them in this country will very probably find, that the difference of climate will occaſion a variation in point of time: at leaſt this will obtain in ſome ſpecies, as our own obſervations have taught us; in others the time has correſponded very exactly with the account he has given us.

Whether this faculty hath any connexion with the great article of fecundation in the oeconomy of flowers, I cannot determine: in the mean time it is not improbable. Future and repeated obſervations, and well-adapted experiments, will tend to illuſtrate this matter, and it may be lead the way to a full explanation of the cauſe.

1. Anagallis flore phœniceo C. B. pin. 252. Raii Syn. p. 282. Anagallis arvenſis Lin. Spec. plant. p. 148. *The Male Pimpernel.* The flowers of this plant open about eight o'clock in the morning, and never cloſe till paſt noon. This plant is common in kitchen-gardens and in corn-fields, and flowers in June, and continues in flower three months.

2. The Anagallis cærulea foliis binis terniſve ex adverſo naſcentibus C. B. pin. p. 252. Raii Hiſt. Plant. p. 1024. Anagallis Monelli Sp. plant. 148. *Blue-flowered Pimpernel with narrow leaves.* The flowers of this plant obſerve nearly the ſame time in opening and ſhutting as the foregoing.

3. Con-

3. Convolvulus peregrinus cæruleus folio oblongo C. B. pin. 295. Convolvulus tricolor Sp. plant. 158. *Little blue Convolvulus, or Bindweed.* This opens its flowers between the hours of five and ſix in the morning, and ſhuts them in the afternoon.

4. Phalangium parvo flore ramoſum C. B. pin. 29. Raii Hiſt. Pl. 1193. *Branched Spiderwort with a ſmall flower.* Theſe open about ſeven in the morning, and cloſe between the hours of three and four in the afternoon.

5. Lilium rubrum Aſphodeli radice C. B. pin. 80. Hemerocallis fulvus Sp. pl. 324. *The Day Lily.* The flowers open about five in the morning, and ſhut at ſeven or eight in the evening.

6. Plantago aquatica minor. Park. 1245. Raii Syn. 257. Aliſma ranunculoides Sp. pl. 343. Fl. Suec. 2. N°. 325. *The leſſer Water-Plantain,* during its flowering-time, only opens its flowers each day about noon.

7. Caryophyllus ſylveſtris prolifer C. B. pin. 209. Raii Syn. 337. Dianthus prolifer Sp. pl. 410. *Proliferous Pink.* The flowers expand about eight in the morning, and cloſe again about one in the afternoon.

8. Spergula purpurea J. B. III. 722. Raii Syn. p. 351. Arenaria rubra. Sp. pl. 423. *Purple Spurrey.* Theſe expand between nine and ten in the morning, and cloſe between two and three in the afternoon. This little plant is common among the corn in ſandy ſoils, and flowers in June.

9. Portulaca latifolia ſativa C. B. pin. 288. Portulaca oleracea Sp. pl. p. 445. *Common Purſlain,* opens its flowers about nine or ten in the morning, and cloſes them again in about an hour's time.

10. Fi-

10. Ficoides Africana, folio plantaginis undulato micis argenteis adſperſo Boerh. Ludg. I. p. 291. Meſembryanthemum chryſtallinum Sp. pl. 480. *Diamond Ficoides.* The flowers of this plant open at nine or ten, and cloſe at three or four in the afternoon.

11. Ficoides Africana folio tereti in villos radiatos abeunte. Tourn. Meſembryanthemum barbatum Sp. pl. 482. The flowers of this ſpecies expand at ſeven or eight in the morning, and cloſe about two in the afternoon.

12. Ficoides folio tereti Neapolitana flore candido Herm. Ludg. 252. Kali Craſſulæ minoris foliis C. B. pin. 289. Meſembryanthemum nodiflorum Sp. pl. 480. The flowers of this plant open at ten or eleven in the morning, and cloſe at three in the afternoon.

13. Meſembryanthemum folio linguiformi latiore Dillen. Hort. Elth. Meſembryanthemum linguiforme Sp. pl. 488. *Ficoides with a tongue-ſhaped leaf.* Theſe open at ſeven or eight in the morning, and are cloſed about three in the afternoon.

14. Nymphæa alba J. B. III. 770. Raii Syn. 368. Nymphæa alba Sp. pl. 510. Fl. Suec. 2. N°. 470. *White Water Lily.* This plant grows in rivers, ponds, and ditches, and the flowers lie upon the ſurface of the water. At their time of expanſion, which is about ſeven in the morning, the ſtalk is erected, and the flower more elevated above the ſurface. In this ſituation it continues till about four in the afternoon, when the flower ſinks to the ſurface of the water, and cloſes again.

15. Papaver erraticum nudicaule flore flavo odorato Dillen. Hort. Elth. 302. Papaver nudicaule Sp.

pl.

pl. p. 507. *Wild Poppy with a naked ſtalk and a yellow ſweet-ſmelling flower.* The flower of this plant opens at five in the morning, and cloſes at ſeven in the evening.

16. Alyſſoides incanum, foliis ſinuatis Tourn. Inſt. 213. Alyſſum ſinuatum Sp. pl. 651. *Hoary Madwort with ſinuated leaves.* The flowers of this plant expand between the hours of ſix and eight in the morning, and cloſe at four in the afternoon.

17. Abutilon repens alceæ foliis, flore helvolo Dillen. Hort. Elth. 5. Malva Caroliniana Sp. pl. 688. *Creeping Indian Mallow with leaves like Vervain Mallow, and a fleſh-coloured flower.* Theſe open at nine or ten in the morning, and cloſe at one in the afternoon.

18. Tragopogon luteum Ger. 595. Raii Syn. 171. Tragopogon pratenſe Sp. pl. 789. *Yellow Goats Beard,* or *Go-to-bed-at-noon.* The latter of theſe names was given to this plant long ſince, on account of this remarkable property. The flowers open in general about three or four o'clock, and cloſe again about nine or ten, in the morning. Theſe flowers will perform their *vigiliæ,* if ſet in a phial of water, within doors for ſeveral mornings ſucceſſively; and I have ſometimes obſerved them to be quite cloſed, from their utmoſt ſtate of expanſion, in leſs than a quarter of an hour. It flowers in June.

19. Tragopogon gramineis foliis, hirſutis. C. B. pin. 275. Raii. Hiſt. Plant. 253. *Roſe-coloured Goats Beard.* Theſe open between five and ſix in the morning, and cloſe about eleven. Tragopog. hybridum Sp. plant. 789.

20. Tragopogon, calycibus corolla brevioribus inermibus,

ermibus, foliis lyrato-ſinuatis. Hort. Upſ. 244. Sp. pl. 790. Hall. Hort. Gotting. 2. p. 419. The flowers of this plant open at ſix or ſeven in the morning, and ſhut between the hours of twelve and four in the afternoon.

21. Sonchus Tingitanus papaveris folio. Tourn. Raii Suppl. 137. Scorzonera Tingitana Sp. pl. 791. *African Sowthiſtle with a poppy leaf.* This plant opens its flowers between four and ſix in the morning, and cloſes them in about three hours.

22. Sonchus repens, multis hieracium majus J. B. II. 1017. Raii Syn. 163. Sonchus arvenſis Sp. pl. 793. *Tree Sowthiſtle.* Theſe flowers expand about ſix or ſeven, and cloſe between eleven and twelve in the forenoon. This is common in corn-fields, and flowers in June, July, and Auguſt.

23. Sonchus lævis Ger. Raii Syn. 162. Sonchus oleraceus Sp. pl. 794. *Smooth or unprickly Sowthiſtle, Hares Lettuce.* Theſe open about five in the morning, and cloſe again at eleven or twelve.

24. Sonchus lævis laciniatus cæruleus C. B. pin. 124. Raii Hiſt. pl. 225. Sonchus alpinus Sp. pl. 794. *Blue-flowered Mountain Sowthiſtle.* Theſe open about ſeven, and cloſe about noon.

25. Sonchus tricubitalis, folio cuſpidato Merr. pin. Raii Syn. 163. Sonchus aſper arboreſcens C. B. pin. 124. Sonchus paluſtris Sp. pl. 793. *The greateſt Marſh tree Sowthiſtle.* It expands its flowers about ſix or ſeven, and cloſes them about two in the afternoon.

26. Lactuca ſativa C. B. pin. 122. Sp. pl. 795. *Garden Lettuce*, opens its flowers about ſeven, and cloſes them about ten, in the forenoon.

27. Dens leonis Ger. 228. Raii Syn. 170. Leontodon Taraxacum Sp. pl. 798. *Dandelion.* It expands at five or ſix, and cloſes at eight or nine, in the forenoon. This flowers early in the ſpring, and again in the autumn.

28. Dens leonis hirſutus leptocaulos, Hieracium dictus. Raii Syn. 171. Leontodon hiſpidum Sp. pl. 799. *Rough Dandelion*, or *Dandelion Hawkweed.* This plant opens its flower about four in the morning, and keeps it expanded till three in the afternoon. In May.

29. Hieracium minus præmorſa radice. Park. 794. Raii Syn. 164. Leontodon autumnale. Sp. pl. 799. *Hawkweed with bitten roots*, or *Yellow Devil's-bit.* The flowers open about ſeven, and keep in an expanded ſtate till about three in the afternoon. It flowers in July and Auguſt.

30. Piloſella repens Ger. 573. Raii Syn. 170. Hieracium Piloſella Sp. pl. 800. *Common creeping Mouſe-ear.* It opens about eight in the morning, and cloſes about two in the afternoon. Very common on dry paſtures, flowering in June and July.

31. Hieracium murorum folio piloſiſſimo C. B. pin. 129. Raii Syn. 168. Hieracium murorum Sp. pl. 802. The flowers of this plant expand about ſix or ſeven, and cloſe about two in the afternoon. Upon old walls, flowering in June and July. This is called in Engliſh, *French* or *Golden Lungwort.*

32. Hieracium fruticoſum anguſtifolium majus. C. B. pin. 129. Hieracium umbellatum Sp. pl. 804. *Narrow-leaved buſhy Hawkweed.* The flowers of this ſpecies expand about ſix in the morning, and remain open till five in the afternoon.

33. Hiera-

33. Hieracium fruticoſum latifolium hirſutum C. B. pin. 129. Raii Syn. p. 167. Hieracium ſabaudum Sp. pl. 804. *Buſhy Hawkweed with broad rough leaves.* Theſe flowers are in their expanded ſtate from about ſeven in the morning till one or two in the afternoon. In woods, flowering in June and July.

34. Hieracium montanum cichorii folio. Raii. Syn. p. 166. Hieracium paludoſum Sp. pl. 638. Fl. Suec. 2. N°. 702. *Succory-leaved Mountain Hawkweed.* The flowers expand about ſix in the morning, and cloſe about five in the afternoon.

35. Hieracium hortenſe floribus atro-purpuraſcentibus C. B. pin. 128. Hieracium aurantiacum Sp. pl. 801. *Garden Hawkweed with deep purple flowers,* or *Sweet Indian Mouſe-ear.* The flowers are in their expanded ſtate from ſix or ſeven in the morning till three or four in the afternoon.

36. Hieracium luteum glabrum, ſive minus hirſutum. J. B. Raii Syn. 165. Crepis tectorum Sp. pl. 807. *Smooth Succory Hawkweed.* The flowers of this plant expand about four in the morning, and cloſe about noon.

37. Hieracium Alpinum Scorzoneræ folio Tourn. Inſt. 472. Crepis Alpina Sp. pl. 806. *Mountain Hawkweed with a vipers-graſs leaf.* Theſe open about five or ſix, and cloſe at eleven in the forenoon.

38. Hieracium dentis leonis folio, flore ſuave-rubente, C. B. pin. 127. Raii hiſt. pl. 231. Crepis rubra Sp. pl. 806. *Hawkweed of Apulia with a fleſh-coloured flower.* The flowers remain in their expanded ſtate from ſix or ſeven in the morning till one or two in the afternoon.

39. Hieracium echioides, capitulis cardui benedicti C. B. pin. 128. Raii Syn. 166. Picris echioides Sp. pl. 792. *Lang de bœuf.* On banks about hedges, and about the borders of fields, flowering in Auguſt. Theſe expand about four or five in the morning, and never cloſe before noon: ſometimes they remain open till nine at night.

40. Hieracium Alpinum latifolium hirſutie incanum flore magno. C. B. pin. 128. Raii Syn. p. 167. Hypochæris maculata Sp. pl. 810. *Broad-leaved Hungarian Hawkweed.* Theſe flowers are in their vigilating ſtate from ſix in the morning till four in the afternoon.

41. Hieracium ramoſum, floribus amplis, calycibus valde hirſutis, foliis oblongis obtuſis: dentibus majoribus inæqualibus inciſis Raii Suppl. 144. 76. Hypochæris Achyrophorus Sp. pl. 810. This plant opens its flowers about ſeven or eight in the morning, and cloſes them about two in the afternoon.

42. Hieracium minus dentis leonis folio, oblongo glabro C. B. pin. 127. Hypochæris glabra Sp. pl. 811. Theſe expand about nine in the morning, and cloſe about twelve or one o' clock.

43. Hieracium falcatum alterum Raii Hiſt. 256. Lapſana calycibus fructus undique patentibus, radiis ſubulatis, foliis lyratis Hort. Upſ. 245. Sp. pl. 812. The flowers open at five or ſix, and cloſe between the hours of ten and one.

44. Hedypnois annua Tourn. Inſt. 478. Hyoſeris hedypnois Sp. pl. 809. The flowers open at ſeven or eight, and cloſe again at two in the afternoon.

45. Hieracium montanum alterum leptomacrocaulon Col. Raii Hiſt. 234. Lapſana chondrilloides

Sp.

Sp. pl. 812. *Mountain Hawkweed with long ſlender ſtalks and ſmall flowers.* The flowers are in their expanded or vigilating ſtate from five or ſix in the morning till about ten.

46. Cichoreum ſylveſtre Ger. em. 284. Raii Syn. 172. Cichorium Intybus Sp. pl. 813. *Wild Succory.* On the borders of fields, flowering in Auguſt and September. The flowers open about eight in the forenoon, and keep expanded till about four in the afternoon.

47. Calendula arvenſis C. B. pin. 275. Raii Hiſt. 338. Calendula officinalis Sp. pl. 921. *Wild Marigold.* The flowers expand from nine in the morning till three in the afternoon.

48. Calendula foliis dentatis Roy. Ludg. 177. Miller, p. 50. Tab. 75. f. 1. Calendula pluvialis Sp. pl. 921. *Marigold with indented leaves.* The flowers expand from ſeven in the morning till three or four in the afternoon. Linnæus obſerves of this plant, that if its flowers do not expand about their uſual time in the morning, it will almoſt aſſuredly rain that day; with this reſtriction indeed, that the plant is not affected by thunder ſhowers. Phil. Bot. 275.

49. Sonchus pedunculis ſquamatis, foliis lanceolatis indiviſis ſeſſilibus. Hort. Upſal. 244. Flor. Suec. 2. N°. 690. Lactuca Salicis folio, flore cæruleo. Amman. ruth. 211. Of this plant it is remarked, that whenever the flowers are in the expanded ſtate in the night-time, the following day generally proves rainy.

LXVI.

LXVI. *An Account of the Case of a Boy troubled with convulsive Fits cured by the Discharge of Worms. By the Rev.* Richard Oram, *M. A. Chaplain to the Lord Bishop of* Ely.

Read Jan. 26, 1758.

JOseph, son of John and Mary Postle, of Ingham in the county of Norfolk, was subject to convulsive fits from his infancy; which were common and tolerable till he was about seven years of age. About that time they began to attack him in all the varieties that can be conceived. Sometimes he was thrown upon the ground; sometimes he was twirled round like a top by them; at others he would spring upwards to a considerable height, *&c.* and once he leaped over an iron bar, that was placed purposely before the fire to prevent his falling into it. He was much burned; but was rendered so habitually stupid by his fits, that he never expressed the least sense of pain after this accident. His intellect was so much impaired, and almost destroyed, by the frequency and violence of his fits, that he scarce seemed to be conscious of any thing. He did not acknowlege his father or mother by any expressions or signs; nor seemed to distinguish them from other people. If at any time he escaped out of the house without the observation of the family, he had not understanding to find and return to it; but would pursue the direction or road he first took, and sometimes lose himself. Once he was missing for a whole night; and found the next morning

morning in the middle of a fen, ſtuck faſt in mud as deep as his breaſt. He was very voracious, and would frequently call for ſomething to eat; which was the only indication he gave of his knowing any thing. No kind of filth or naſtineſs can be conceived, which he would not eat or drink without diſtinction. He appeared to be as ill as he really was; for he was become a moſt ſhocking ſpectacle. He was ſo much emaciated, that he ſeemed to have no fleſh upon his bones; and his body ſo diſtorted, that he was rendered quite a cripple. His parents conſulted a phyſician at Norwich, who very judiciouſly (as it will appear) conſidered his diſorder as a worm-caſe, and preſcribed for it accordingly; but (being afraid, I preſume, to give too violent medicines to the boy) without ſucceſs. In ſhort, he was ſo ſingularly afflicted, that his parents told me they could not help thinking him under ſome evil influence.

It was obſerved, that his diſorder varied, and grew worſe, at certain periods of the moon.

In theſe miſerable circumſtances the poor boy continued to languiſh, till he was about eleven years of age (July 1757); when he accidentally found a mixture of white lead * and oil, which had ſome time before been prepared for ſome purpoſe of painting, ſet by on a ſhelf, and placed, as it was thought, out of his reach. There was near half a pint of this mixture when he found it; and, as he did not leave

* It is not improbable, that a conſiderable portion of whiting might be uſed inſtead of pure white lead, which is frequently done: and this ſuppoſition is favoured by the mixture's not proving fatal to the boy, as ſuch a quantity of white lead in all probability would.

much,

much, it is thought he ſwallowed about a quarter of a pint of it. There was alſo ſome lamp-black in the compoſition; which was added to give it a proper colour for the particular uſe it was intended for in painting. It was, as I ſuppoſe it uſually is, linſeed oil, which had been mixed with the lead and lamp-black.

The draught began to operate very ſoon, by vomiting and purging him for near 24 hours in the moſt violent manner. A large quantity of black inky matter was diſcharged; and an infinite number of worms, almoſt as ſmall as threads, were voided. Theſe operations were ſo intenſe, that his life was deſpaired of. But he has not only ſurvived them, but experienced a moſt wonderful change and improvement after them: for his parents aſſured me in November 1757, when I ſaw him, that he had daily grown better from the time of his drinking the mixture, both in body and mind. Inſtead of a ſkeleton, as he almoſt was before, he is become fat, and rather corpulent: and his appetite is no longer ravenous, but moderate and common. His body too is become ſtraight and erect. His underſtanding is at leaſt as much benefited by this peculiar remedy. It cannot be expected, that he ſhould already have attained much knowlege, as he ſeemed, before he was ſo wonderfully relieved, to be almoſt deſtitute of ideas. But he appeared, when I ſaw him, to have acquired nearly as much knowlege in four months, as children uſually do in four years; and to reaſon pretty well on thoſe things, which he knew. He is now capable of being employed on many occaſions; is often ſent a mile or two on errands, which he diſ-

charges

charges as carefully, and then returns as safely, as any person.

It is farther remarkable, that the boy's mother, her father, and sister, are frequently infested with worms. Her father, tho' about 60 years of age, is still much troubled with them: the worms, which he voids, appear flat, and much larger than those, which his children have observed. Her sister is often exceedingly disordered by them. About three months since they threw her into violent convulsions, and for some time deprived her of her senses. But the mother of the boy has been affected in a more extraordinary manner than the rest. About 20 years ago she voided some worms, which forced their way thro' the pores of the skin, as it is supposed; for they were found in small clusters under her arms. As she was very young then, she does not remember how she was particularly affected; only, that she suffered violent struggles and convulsions. She is still, about five or six times in a year, seized with fainting fits, which usually attack her in bed, and last three or four minutes; but she cannot certainly say, tho' there is very little reason to doubt, that they are occasioned by worms.

An Account of the same Subject, in a Letter from Mr. John Gaze, *of* Walket, *in the County of* Norfolk, *to Mr.* Wm. Arderon, *F. R. S. Communicated by Mr.* Henry Baker, *F. R. S.*

Read Jan. 26. 1758.

JOseph Postle, son of John Postle, of Ingham in Norfolk, until about the age of seven years was an healthy well-looking child;

child; but about that age was afflicted with ftoppages, which often threw him into convulfive fits, and at laft rendered him quite an idiot. He continued in this condition for about four years, eating and drinking all that time any thing that came in his way, even his own excrements, if not narrowly watched. His father took the advice of feveral eminent phyficians, both at Norwich and elfewhere; but all their prefcriptions proved of no fervice.

About the beginning of Auguft laft he happened to get at a painting-pot, wherein there was about a pound of white lead and lamp-black mixed up with linfeed oil. This he eat almoft all up before he was difcovered. It vomited and purged him, and brought away prodigious numbers of fmall worms. In a few days he grew well, his fenfes returned, and he is now able to give as rational anfwers as can be expected from a boy of his age. His appetite is good, he is very brifk, and has not had the leaft return of his former diforder.

I heard of the above by feveral people; but not being fatisfied, got my friend to go to Mr. Poftle's houfe, of whom he had the foregoing account.

January 12th, 1758.

LXVII. *An Account of the extraordinary Heat of the Weather in* July 1757, *and of the Effects of it. In a Letter from* John Huxham, *M. D. F. R. S. to* Wm. Watson, *M. D. F. R. S.*

Read Feb. 2, 1758.

I Find by your letter, that the heat at London was not so great in the beginning of July 1757, as at Plymouth by two or three degrees of Fahrenheit's thermometer. We had again, after much rain at the close of the month, and in the beginning of August, excessive heat; *viz.* on the 8th, 9th, and 10th of August; which mounted the mercury in that thermometer to 85; nay, on the 9th, to near 86. I never before remember the mercury in that thermometer to exceed 84; and that is even here a very extraordinary degree of heat.

The consequences of this extremely hot season were hæmorrhages from several parts of the body; the nose especially in men and children, and the uterus in women. Sudden and violent pains of the head, and vertigo, profuse sweats, great debility and oppression of the spirits, affected many. There were putrid fevers in great abundance; and a vast quantity of fluxes of the belly both bilious and bloody, with which the fevers also were commonly attended. These fevers were always ushered in by severe pains of the head, back, and stomach; vomitings of green and sometimes of black bile, with vast oppression of the *præcordia*, continual anxiety, and want of ſleep. Theſe were ſoon ſucceeded by *tremores tendinum*, *ſubſultus*, delirium, or ſtupor. The pulſe was commonly very quick, but ſeldom tenſe or ſtrong; was ſometimes heavy and undoſe. The blood oftentimes florid, but looſe; ſometimes livid, very rarely ſizy: in ſome however, at the very attack, it was pretty denſe and florid. The tongue was generally foul, brown, and ſometimes blackiſh; and towards the criſis often dry. The urine was commonly high coloured, and in ſmall quantity; frequently turbid, and towards the end depoſed a great deal of lateritious ſediment. A vaſt number were ſeized with this fever, during, and ſoon after, the exceſſive heats; tho' but few died in proportion. Long and great heats always very much exalt the acrimony of the bilious humours; of which we had this ſummer abundant inſtances.

Bleeding early was generally beneficial; profuſe, always hurtful, eſpecially near the ſtate of the fever.

LXVIII. *An Account of the foſſile Thigh-bone of a large Animal, dug up at* Stonesfield, *near* Woodſtock, *in* Oxfordſhire. *In a Letter to Mr.* Peter Collinſon, *F. R. S. from Mr.* Joſhua Platt.

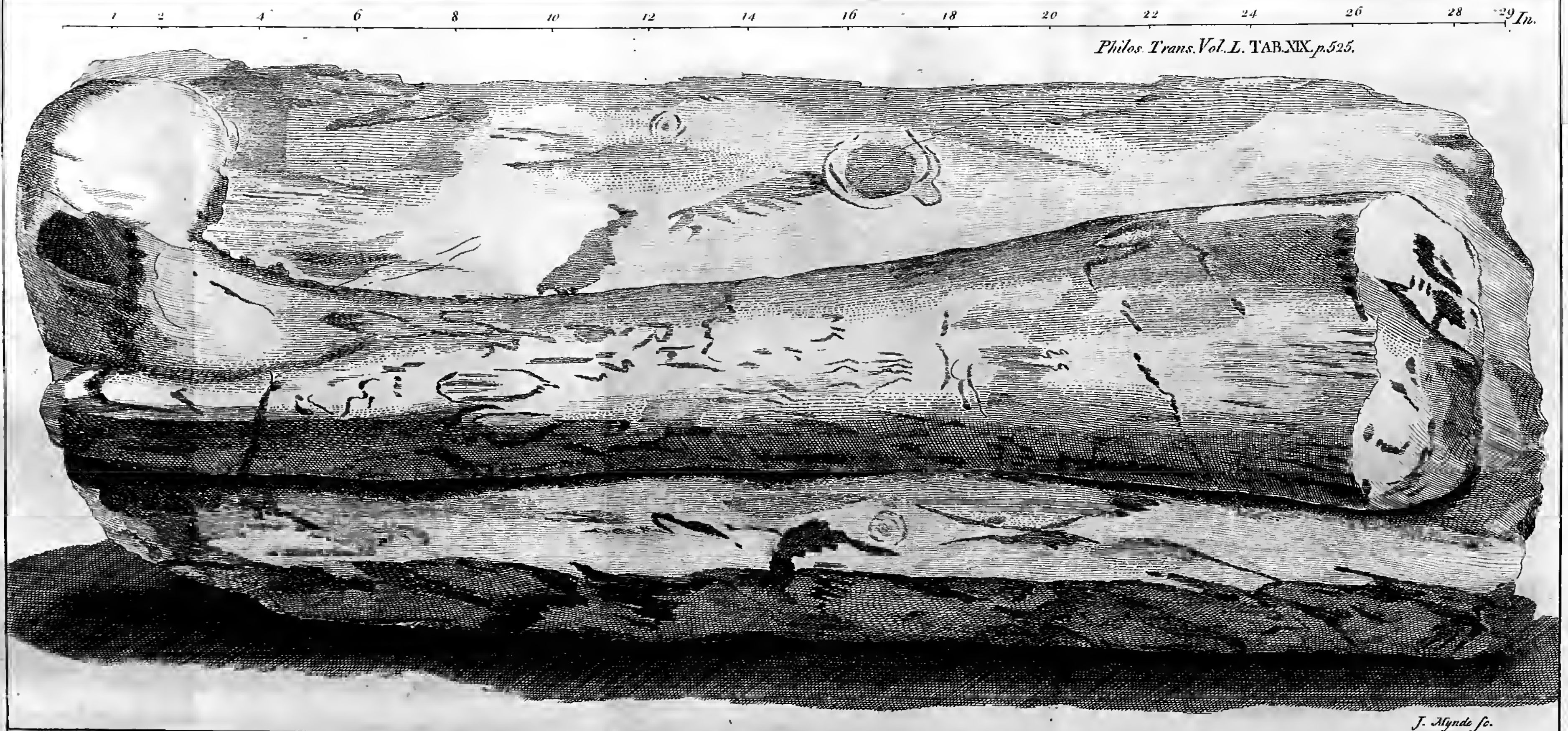
Dear Sir,

Read Feb. 2. 1758.

ABOUT three years ago I ſent you ſome *vertebræ* of an enormous ſize, which were found in the ſlate-ſtone pit at Stonesfield, near Woodſtock, in this county.

I have

Philos. Trans. Vol. L. TAB. XIX. p. 525.



J. Mynde sc.

I have lately been ſo lucky as to procure from the ſame place the thigh-bone of a large animal, which probably belonged to the ſame creature, or one of the ſame genus, with the *vertebræ* above-mentioned.

As the bone, and the ſtone, in which it is bedded, weigh no leſs than two hundred pounds, I have ſent you a drawing of it (*See* TAB. XIX.); from which, and the following ſhort deſcription, you may, I hope, form ſome idea of this wonderful foſſile.

The bone is 29 inches in length; its diameter, at the extremity of the two trochanters, is 8 inches; at the lower extremity the condyles form a ſurface of 6 inches. The leſſer trochanter is ſo well expreſſed in the drawing, that you cannot miſtake it; and both the extremities appear to be a little rubbed by the fluctuating water, in which I apprehend it lay ſome time before the great jumble obtained, which brought it to this place; and from whence I imagine it to have been part of a ſkeleton before the flood. For if it had been corroded by any menſtruum in the earth, or during the great conflux of water before the draining of the earth, it muſt have ſuffered in other parts as well as at each end: but as the extremities only are injured, we can attribute ſuch a partial effect to the motion of the water only, which cauſed it to rub and ſtrike againſt the ſand, *&c.*

The ſmall trochanter was broken in lifting it out of the hamper, in which it was brought to me; but not unhappily; ſince all the *cancelli* were by that means diſcovered to be filled with a ſparry matter, that fixed the ſtone of the ſtratum, in which it lay. The outward coat or cortex is ſmooth, and of a duſky

duſky brown colour, reſembling that of the ſtone, in which it is bedded.

One half of the bone is buried in the ſtone; yet enough of it is expoſed to ſhew, that it is the thigh-bone of an animal of greater bulk than the largeſt ox. I have compared it with the recent thigh-bone of an elephant; but could obſerve little or no reſemblance between them. If I may be allowed to aſſume the liberty, in which foſſiliſts are often indulged, and to hazard a vague conjecture of my own, I would ſay it may probably have belonged to the hippopotamus, to the rhinoceros, or ſome ſuch large animal, of whoſe anatomy we have not yet a competent knowlege.

The ſlate-pit, in which this bone was found, is about a quarter of a mile north-weſt from Stonesfield, upon the declivity of a riſing ground, the upper ſtratum of which is a vegetable mould about eight or ten inches thick: under this is a bed of rubble, with a mixture of ſand and clay, very coarſe, about ſix feet deep, in which are a great number of *anomiæ* both plain and ſtriated, and many ſmall oblong oyſters, which the workmen call the ſickle-oyſter, ſome of them being found crooked, and bearing ſome reſemblance to that inſtrument; but all differing from the *curvi-roſtra** of Moreton.

Immediately under this ſtratum of rubble is a bed of ſoft grey ſtone, of no uſe; but containing the *echini ovarii*, with great *mamillæ*, the *clypeati* of different ſizes, all well preſerved; and alſo many *anomiæ* and *pectines*. This bed, which is about ſe-

* What Lhwyd calls *oſtreum minus falcatum*, N°. 451.

ven or eight feet in depth, lies immediately above the ſtratum of ſtone, in which the bone was found.

This ſtratum is never wrought by the workmen, being arenarious, and too ſoft for their uſe. It is about four or five feet thick, and forms a kind of roof to them, as they dig out the ſtone, of which the ſlates are formed; for they work theſe pits in the ſame manner as they do the coal-pits, leaving pillars at proper diſtances to keep their roof from falling in.

This laſt bed of ſlate-ſtone is about five feet depth, and lower than this they never dig. So that the whole depth of the pit amounts to about 24 or 25 feet.

It was by working out the ſlate-ſtone, that this bone was diſcovered ſticking to the roof of the pit, where the men were purſuing their work; and with a great deal of caution, and no leſs pains, they got it down intire, but attached to a large piece of ſtone; and in this ſtate it now remains in my poſſeſſion.

There is no water in the works, but ſuch as deſcends from the ſurface thro' perpendicular fiſſures; and the whole is ſpent in forming the ſtalactites and ſtalagmites, of which there is great variety, and whoſe dimenſions are conſtantly increaſing. One of the workmen has been ſo curious, as to mark the time of the growth of ſome of them for ſeveral years paſt.

I am, with the greateſt eſteem,

Dear Sir,

Your ever obedient,

and moſt humble Servant,

Oxon,
Jan. 20. 1758.

Joſhua Platt.

LXIX.

LXIX. *A Discourse on the Usefulness of Inoculation of the horned Cattle to prevent the contagious Distemper among them. In a Letter to the Right Hon.* George *Earl of* Macclesfield, *P. R. S. from* Daniel Peter Layard, *M. D. F. R. S.*

My Lord,

Read Feb. 2. 1758.

THE honour you have done me, in condescending to peruse my Essay on the contagious Distemper among the horned Cattle, claims my most respectful thanks; and I am no less obliged to your Lordship for the just remark you made, "That before inoculation could be practised on the horned Cattle, it is necessary to bring "proofs, that this disease is not susceptible more "than once; and also assurances, that a recovery "from the distemper by inoculation guards the beast "from a second infection."

An intire conviction of the analogy between this disease and the small-pox would not permit me to omit mentioning the great advantages, which must arise from inoculation; and therefore, my Lord, I recommend its use: nor do I find any reason to alter my opinion, after having carefully read over what has been published, and made the strictest inquiry I was able in several parts of Great Britain.

I shall, in the concisest manner possible, submit the following particulars to your Lordship's consideration, and the learned Society, over which you so deservedly preside.

The

The Marquis de Courtivron, in two memoirs read before the Royal Academy of Sciences in the year 1748, and publiſhed by that learned body, relates the obſervations he, together with Monſieur Pelverſier de Gombeau, formerly ſurgeon to the regiment de la Sarre, made on the riſe, progreſs, and fatality, of the contagious diſtemper at Iſſurtille, a town in Burgundy; to which are added experiments they made, by application, digeſtion, and inoculation, towards communicating the diſeaſe; and concludes from the failure of theſe attempts, that the diſtemper can only be communicated from one beaſt to another. Beſides, notwithſtanding the Marquis obſerves (1) the regularity of the illneſs, the critical days, on the ſeventh and ninth, and particularly that all ſuch as recovered had more or fewer puſtules broke out in different parts of the body; yet (2) he will not allow of Rammazzini's opinion, of the analogy between this diſtemper and the ſmall-pox, nor that it is an eruptive fever; but ranks it as a plague.

But the Marquis goes ſtill farther. He poſitively ſay, (3) "That in the preceding years, in the pro-
" vinces of Breſſe, Maconnois, and Bugey, ſome pri-
" vate perſons had ſuffered by buying cattle reco-
" vered from the diſtemper, which had, at that time,
" the puſtules remaining on them: which cattle had
" the diſtemper afterwards." Nay, he adds that
" even after recovering twice, a third infection has
" ſeized and killed many."

(1) Memoires de l'Acad. des Sciences, anno 1748. p. 326.
(2) Ibid. p. 338.
(3) Ibid. p. 337.

No wonder, my Lord, that ſuch poſitive aſſertions ſhould ſtagger, and cauſe the practice of inoculation not to be received, till the nature of the diſeaſe be abſolutely determined, and facts prove the contrary of what has been aſſerted.

In a matter of ſo great importance to every nation, it were to be wiſhed, that the Marquis de Courtivron had produced atteſted obſervations of theſe ſecond and third infections: for tho' a nobleman of his rank, character, and great abilities, would not willingly impoſe upon the world; yet it may happen, that he may have received wrong informations.

As to the nature, riſe, progreſs, and fatality, of this diſtemper at Iſſurtille, it appears to be the ſame diſeaſe as raged in theſe kingdoms. All the ſymptoms agree, as deſcribed by Rammazzini, Lanciſi, the Marquis, and in my Eſſay. A diſtempered beaſt gave riſe to the three infections. The illneſs was every-where the ſame in Italy, France, and Britain; and either terminated *fatally* on the fourth or fifth day, when a ſcouring prevented the ſalutary eruptions, or in ſome caſes by abortion; and on the ſeventh or ninth *favourably*, when the puſtules had regularly taken their courſe. Tho' the Marquis did not obſerve, that any particular medicines were of uſe, he ſays, that in general acids were beneficial, eſpecially poor thin wines ſomewhat ſour; and that the diſtempered beaſts were all fond of theſe acids (4).

The fatality was likewiſe the ſame, as will appear from the Marquis's tables. Of 192 head of cattle, 176 died. The mortality was chiefly among the fat

(4) See my Eſſay on the contagious Diſtemper, p. 70.

cattle,

cattle, cows with calf, and young ſucking or yearling calves; and of the ſurviving ſixteen, only two calves out of ſeventy-ſeven lived, and theſe two, with ſeven other beaſts of the ſixteen, eſcaped the infection, tho' conſtantly among the diſeaſed: ſo that it is plain,

Of 192 beaſts, - -	176	died
	7	recovered
	9	eſcaped the infection.
	192	

The mortality was as conſiderable in theſe kingdoms.

Whoever will compare the appearances, progreſs, and fatality, of the ſmall-pox, with what is remarked by authors of authority, as Rammazzini and Lanciſi, and other obſervers, relative to the contagious diſtemper among the horned cattle, will not be at a loſs one moment to determine, whether this diſeaſe be an eruptive fever, like unto the ſmall-pox, or not.

Now if, as the Marquis has granted in both his memoirs (5), it be a general obſervation, that an eruption of puſtules on ſome parts of the body, regularly thrown out, digeſted, and dried, is the means uſed by nature to effect the cure; and that in general the morbid matter does not affect the parotid, inguinal, or other glands, nor produce large carbuncles and abſceſſes, as the plague does: Nay more, ſince it is obſerved by the Marquis, that the difference between the contagious diſtemper of 1745 and 1746, and of 1747 and 1748, was, that in the former the

(5) Pag. 143. and 338.

ſalutary eruptions appeared, but in the latter were, as he juſtly apprehends, checked by the exceſſive cold weather; and ſhould it appear, that by inoculation the ſame regular eruptive fever has been produced, with every ſtage, and the ſame ſymptoms as ariſe in the ſmall-pox; the nature of this diſtemper will then be aſcertained.

I ſhall now proceed, my Lord, to lay before your Lordſhip and the Society the accounts I have received relating to the infection and inoculation of the cattle, and make ſome obſervations on the experiments made at Iſſurtille.

So long, my Lord, as the diſtemper has raged in Great Britain, not one atteſted proof has been brought of any beaſt having this diſeaſe regularly more than once. I make no doubt but theſe creatures may be liable to eruptions of different kinds; but as all ſorts of eruptions, ſays Dr. Mead (6), are not the ſmall-pox, nor meaſles, ſo every puſtule is not a ſign of the plague. Thro' ignorance, or fraud, perſons may have been deceived in purchaſing cattle, and have loſt them, as well in England as in the provinces of France mentioned by the Marquis; but until a ſecond infection be proved, the general opinion muſt prevail in this caſe, as in the ſmall-pox: for tho' many have inſiſted on the ſame thing with regard to the ſmall-pox, yet a ſingle inſtance, properly vouched and atteſted, has never been produced, either after recovery from the natural way, or from inoculation; unleſs what is frequently the caſe with nurſes and others attending the ſmall-pox, that is, puſtules

(6) Eſſay on the Plague.

breaking

breaking out in their arms and face, be allowed as the figns of a fecond infection.

The farmers and graziers in Huntingdonfhire, Cambridgefhire, Lincolnfhire, Kent, and Yorkfhire, from whence I have written teftimonies, all agree, that they never knew of a beaft having the contagious diftemper more than once. In this county particularly, Mr. J. Mehew, the farmer mentioned in my Effay, has now among his ftock at Godmanchefter *eight cows*, which had the contagious diftemper the firft time it appeared in Godmanchefter in 1746. It returned in 1749, 1755, and 1756; the two laft not fo generally over the town as the two former years. All thefe four times Mr. Mehew fuffered by the lofs of his cattle; yet thofe *eight cows*, which recovered in 1746, remained all the while the diftemper was in the farm the three years it raged, were in the midft of the fick cattle, lay with them in the fame barns, eat of the fame fodder, nay of fuch as the diftempered beafts had left and flabbered upon, drank after them, and conftantly received their breath and fteams, without ever being in the leaft affected. Is not this a convincing proof? If in general the cattle be fufceptible of a fecond infection, how comes it, that not one of thefe *eight* cows were affected?

In the years abovementioned the diftemper fpared no beaft, but fuch as had recovered from that difeafe: and this is confirmed to me by Mr. Mehew's father and brother, all the chief farmers of Godmanchefter, and is the opinion of all the farmers and graziers in Huntingdonfhire, who are fo thoroughly convinced of there being no fecond infection, that

they

they are always ready to give an advanced price for ſuch cattle as have recovered from the contagious diſtemper.

The Rev. Mr. Scaife, aſſiſtant to the Rev. Dr. Greene, Dean of Saliſbury, in his pariſh of Cottenham, Cambridgeſhire, acquaints me, that the farmers in that neighbourhood loſt, in 1746 and 1747, twelve hundred head of cattle, in 1751 four hundred and ſeventy; and tells me, that Mr. Ivett, Sayers, Moor, Dent, Lawſon, chief farmers at Cottenham, Mr. Taylor, Sumpter, and Matthews, of his own pariſh of Hiſton, and the farmers of Wivelingham alias Willingham, unanimouſly declare, they never had one inſtance of a beaſt having the diſtemper twice.

Mr. Thorpe, a farmer and grazier near Gainsborough in Lincolnſhire, has had beaſts recovered from the diſtemper, which have herded with cattle fallen ill afterwards, and never met with a ſingle inſtance of a ſecond infection.

Mr. Loftie, an eminent ſurgeon at Canterbury, has inquired for me of the farmers and graziers in that part of Kent, and about Romney-Marſh; and from whence no belief of a ſecond infection can be had.

The Rev. Dr. Fountayne, Dean of York, writes me word, that no beaſt has been known, in his neighbourhood, to have had the diſtemper twice. And ſeveral perſons from that county, and others, have told me the ſame thing.

If the above teſtimony of perſons of character and veracity, together with the concurrent perſuaſion of farmers in general, be allowed of, it muſt be determined, that there is no inſtance of a ſecond infection. Suppoſing now it ſhould appear, that this diſtemper

is

is regularly, as in the natural way, tho' in a milder manner, produced by inoculation, and that inoculation secures a beaſt alſo from a ſecond infection; then undoubtedly inoculation will be recommendable.

The very few trials made in England, and thoſe not with the greateſt exactneſs or propriety, will yet ſerve to put this matter out of all doubt.

The Rev. Dean of York had five beaſts inoculated, by means of a ſkein of cotton dipped in the matter, and paſſed thro' a hole, like a ſeaton, in the dew-lap. Of theſe five, one cow near the time of calving died: the other four, after going thro' the ſeveral ſtages of this contagious diſeaſe, recovered; two of which, being cows young with calf, did not ſlip their calves. All four have herded with diſtempered cattle a long while, and never had the leaſt ſymptom of a ſecond infection.

Mr. Bewley, a ſurgeon of reputation in Lincolnſhire, inoculated three beaſts two years old, for Mr. Wiggleſworth of Manton, in the dew-lap, and with *mucus* from the noſtrils. All three had the regular ſymptoms of the contagious diſtemper in a mild manner, recovered, and tho' they herded a twelvemonth after with five or ſix diſtempered beaſts, they never were the leaſt affected. Mr. Bewley alſo declared to Mr. Thorpe, that there never was one inſtance produced, that he knew of, of a ſecond infection.

Since it is plain, that notwithſtanding neither well-digeſted *pus* was made uſe of, nor inciſions made in the propereſt places, and it may be ſuppoſed few medicines were given; yet inoculation ſucceeded ſo

as

as to bring on the diſtemper in a regular and mild manner, as appears by the cows with calf not ſlipping their calves. One may fairly conclude, that in this contagious diſtemper, like unto the ſmall-pox, the practice of inoculation is not only warrantable, but much to be recommended.

But how comes it then, that neither by application, digeſtion, nor inoculation, the diſtemper was not communicated in France?

The Marquis ſays, that this diſtemper is not communicated but from one beaſt to another immediately. I muſt beg leave to ſay, that to my knowlege the diſtemper in February 1756 was carried from the farm-yard, where I viſited ſome diſtempered cattle, to two other farm-yards, each at a conſiderable diſtance, without any communication of the cattle with each other, and merely by the means of ſervants going to and fro, or of dogs.

The experiments made on four beaſts, by tying over their heads part of diſtempered hides, or pieces of linen and woollen cloth or ſilk, which had received the breath and ſteams of dying cattle, ſerve to ſhew, by the bullock's forcing off the cloth tied about him, that the putrid ſtench was diſagreeable to him; but that neither his blood, nor that of the other three beaſts, was then in a ſtate to receive the infection.

With regard to the puſtules, which the Marquis relates were mixed with oats and bran, or diſſolved in white wine; the diſtempered bile, which was mixed with milk; milk taken from diſeaſed cows; water, in which part of a diſtempered hide had been ſteeped; and the precaution taken to force theſe mixtures into the paunch of calves, by means of a funnel, whoſe end was covered with a piece of raw diſtempered ſkin, that the beaſt might both ſwallow and ſuck in the diſeaſe. All theſe experiments could have no other effect than what followed; which was, that the acrimony of the diſtempered bile created firſt a *nauſea*, and then produced a violent ſcouring, which killed the beaſt, leaving marks of its irritation on the inteſtines.

The practice of inoculation is but lately followed, and even now but little known, in the provinces of France. Its advantages have not long ſince been ſtrangely diſputed at Paris. In the caſe of inoculating cattle, inſtead of a ſlip of raw hide taken from a beaſt juſt dead, or putting a puſtule into the neck, they ſhould either have paſſed in the dewlap cotton or ſilk dipped in well-digeſted *pus*, or have inſerted in proper inciſions cotton-thread or ſilk ſoaked with *pus* either on the ſhoulders or buttocks; the true way of inoculating in the Engliſh manner. Some perſons have indeed thought, that to inoculate with the blood of the infected would anſwer the intention; but moſt of the modern practitioners chuſe to depend on digeſted matter.

Several conſtitutions will not receive infection, let them be inoculated ever ſo judiciouſly. A Ranby, a Hawkins, a Middleton, and other inoculators, will tell us, that the inciſions have ſometimes ſuppurated ſo much, and puſtules have appeared round the edges of the wound, without any other particular marks of the diſeaſe; and yet the patient has never had the ſmall-pox afterwards. The Marquis mentions an inſtance ſomewhat of the ſame kind in his firſt Memoir, p. 147.

The examination of these very important and interesting particulars has, I observe, drawn me into a prolixity, which I fear may prove tedious to your Lordship: but should I have removed all doubts, and brought convincing proofs of the absurdity of fearing a second infection; should I have shewn inoculation to be a necessary practice, and that the contagious distemper may be communicated more ways than one; I hope your Lordship will excuse the length of this letter. I shall only add my earnest wishes, that the legislature may, by effectual means, prevent the importation of distempered cattle and hides into these kingdoms; the only means of naturalizing and perpetuating a dreadful distemper, now, thank God! much decreased among us.

I am, with the greatest respect,

My Lord,

Your Lordship's

Most humble and most obedient Servant,

Huntingdon,
26 Nov. 1757.

Daniel Peter Layard.

LXX. *Trigonometry abridged. By the Rev.* Patrick Murdoch, *A. M. F. R. S.*

Read Feb. 2, 1758.

THE cases in trigonometry, that can properly be called different from one another are no more than *four*; which may be resolved by *three* general rules or theorems, expressed

5 in

Fig. 1.

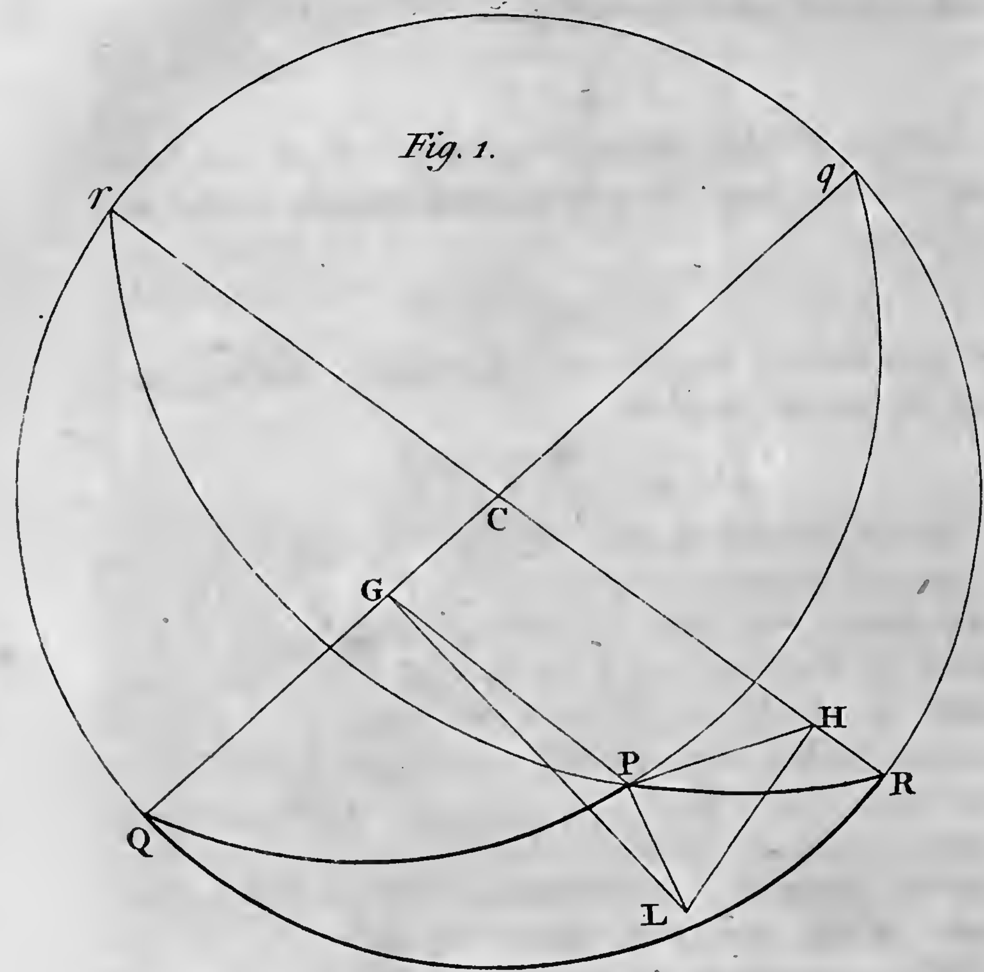
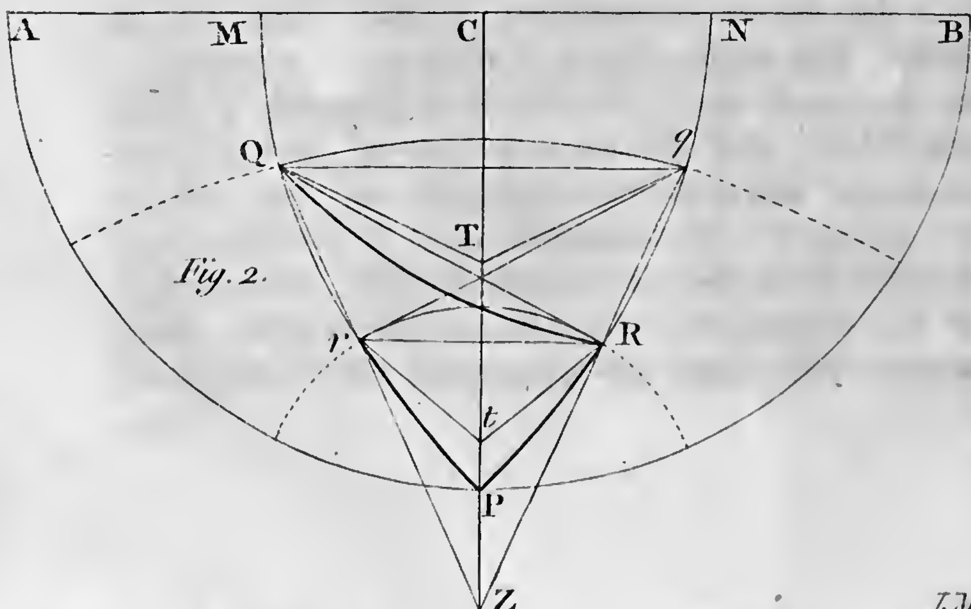


Fig. 2.



J. Mynde sc.

in the ſines of arcs only; uſing the ſupplemental triangle as there is occaſion.

CASE I.

When of three given parts two ſtand oppoſite to each other, and the third ſtands oppoſite to the part required.

THEOREM I.

The ſines of the ſides are proportional to the ſines of angles oppoſite to them.

DEMONSTRATION.

Let QR (TAB. XX. *Fig.* 1.) be the baſe of a ſpherical triangle; its ſides PQ, PR, whoſe planes cut that of the baſe in the diameters QC*q*, RC*r*. And if, from the angle P, the line PL is perpendicular to the plane of the baſe, meeting it in L, all planes drawn through PL will be perpendicular to the ſame, by 18. *el.* 11. Let two ſuch planes be penpendicular likewiſe to the ſemicircles of the ſides, cutting them in the ſtraight lines PG, PH; and the plane of the baſe in the lines LG, LH.

Then the plane of the triangle PGL being perpendicular to the two planes, whoſe interſection is QGC*q*, the angles PGQ, LGQ will be right angles, by 19. *el.* 11. PG likewiſe ſubtends a right angle PLG, and the angle PGL meaſures the inclination of the ſemicircle QP*q* to the plane of the baſe (*def.* 6. *el.* 11.) that is (by 16 *el.* 3. and 10 *el.* 11.) it is equal to the ſpherical angle PQR: whence PG is to PL as the radius to the ſine of PQR. The ſame way PL is to PH as the ſine of PRQ is to the radius: and therefore, *ex æquo*, PG the ſine of the ſide PQ is to PH the ſine of PR, as the ſine of PRQ is to the ſine of PQR.

CASES II. *and* III.

When the three parts are of the ſame name:

And,

When two given parts include between them a given part of a different name, the part required ſtanding oppoſite to this middle part.

THEOREM II.

Let S *and* s *be the ſines of two ſides of a ſpherical triangle,* d *the ſine of half the difference of the ſame ſides,* a *the ſine of half the included angle,* b *the ſine of half the baſe; and writing unity for the radius, we have* $Ssa^2 + d^2 - b^2 = 0$; *in which* a *or* b *may be made the unknown quantity, as the caſe requires.*

DEMONSTRATION.

Let PQR (*Fig.* 2.) be a ſpherical triangle, whoſe ſides are PQ PR, the angle included QPR, the baſe QR, PC the ſemiaxis of the ſphere, in which the planes of the ſides interſect.

To the pole P, draw the great circle AB, cutting the ſides (produced, if needful) in M and N; and thro' Q and R, the leſſer circles Q*q*, *r*R, cutting off the arcs Q*r*, *q*R equal to the difference of the ſides; join MN, Q*q*, *r*R, QR, *qr*.

Then the planes of the circles deſcribed being parallel (*Theod. ſphæric.* 2. 2.), and the axis PC perpendicular to them (10. 1. *of the ſame*), their interſections

tions with the planes of the ſides, as QT, and Rt, will make right angles with PC; that is, QT and Rt are the ſines (S, s.) of the ſides PQ PR, and MC NC are whole ſines. Now the iſoſceles triangles MCN, QTq, rtR, being manifeſtly ſimilar; as alſo MN, the ſubtenſe of the arc which meaſures the angle QPR, being equal to ($2a$) twice the ſine of half that angle; we ſhall have MN : MC :: Qq : QT :: rR : Rt; or, in the notation of the theorem, $Qq = 2Sa$, $rR = 2sa$. And further, the chords Qr qR being equal, and equally diſtant from the center of the ſphere, as alſo equally inclined to the axis PC, will, if produced, meet the axis produced, in one point Z. Whence the points Q, q, R, r, are in one plane (2. *el.* 11.), and in the circumference in which that plane cuts the ſurface of the ſphere: the quadrilateral QqRr is alſo a ſegment of the iſoſceles triangle ZQq, cut off by a line parallel to its baſe, making the diagonals QR, qr, equal. And therefore, by a known property of the circle, $Qq \times rR + \overline{qR}^2 = \overline{QR}^2$; which, ſubſtituting for Qq and Rr the values found above, $2d$ for Qr, $2b$ for QR, and taking the fourth part of the whole, becomes $Ssa^2 + d^2 = b^2$, the propoſition that was to be demonſtrated.

Note 1. If this, or the preceding, is applied to a plane triangle, the ſines of the ſides become the ſides themſelves; the triangle being conceived to lie in the ſurface of a ſphere greater than any that can be aſſigned.

Note 2. If the two ſides are equal, d vaniſhing, the operation is ſhorter: as it likewiſe is when one or both ſides are quadrants.

Note

Note 3. By comparing this propoſition with that of the Lord Neper ‡, which makes the 39th of Keill's Trigonometry, it appears, that if AC, AM, are two arcs, then ſin. $\frac{AC + AM}{2}$ × ſin. $\frac{AC - AM}{2} = (\overline{b + d} \times \overline{b - d} =)$ ſin. $\overline{\tfrac{1}{2} AC + \text{ſin.} \tfrac{1}{2} AM} \times \overline{\text{ſin.} \tfrac{1}{2} AC - \text{ſin.} \tfrac{1}{2} AM}$. And in the ſolution of Caſe II. the firſt of theſe products will be the moſt readily computed.

CASE IV.

When the part required ſtands oppoſite to a part, which is likewiſe unknown : Having from the *data* of Caſe I. found a fourth part, let the ſines of the given ſides be S, s; thoſe of the given angles Σ, σ; and the ſines of half the unknown parts a and b; and we ſhall have, as before, $Ssa^2 + d^2 - b^2 = o$; and if the equation of the ſupplements be $\Sigma\sigma\alpha^2 + \delta^2 - \beta^2 = o$; then, becauſe $\alpha^2 = 1 - b^2 = 1 - \overline{Ssa^2 + d^2}$, and $\beta^2 = 1 - a^2$, ſubſtituting theſe values in the ſecond equation, we get

THEOREM III.

$\frac{1 - \Sigma\sigma \times \overline{1 - d^2} - \delta^2}{1 - Ss\Sigma\sigma} = a^2$; in words thus:

Multiply the product of the ſines of the two known angles by the ſquare of the coſine of half the difference of the ſides : add the ſquare of the ſine of half the difference of the angles ; and divide the complement of this

‡ See Logarith. Canon. deſer. *Edinb.* 1614. p. 48.

ſum

ſum to unity, by the like complement of the product of the four ſines of the ſides and angles; and the ſquare root of the quotient ſhall be the ſine of half the unknown angle.

If we work by logarithms, the operation will not be very troubleſome; but the rule needs not be uſed, unleſs when a table of the trigonometrical analogies is wanting. To ſupply which, the foregoing theorems will be found ſufficient, and of ready uſe; being either committed to memory, or noted down on the blank leaf of the trigonometrical tables.

Note, The ſchemes may be better, raiſed in card-paper, or with bent wires and threads.

LXXI. *An Account of Two extraordinary Caſes of Gall-Stones.* By James Johnſtone, *M.D. of* Kidderminſter. *Communicated by the Rev.* Charles Lyttelton, *L.L.D. Dean of* Exeter.

To the Rev. Dr. Lyttelton, *Dean of* Exeter.

Rev. Sir,

Read Feb. 9, 1758.

ACcording to promiſe I ſend you a ſhort account of the two extraordinary caſes we talked of, the laſt time I had the pleaſure of ſeeing you at Kidderminſter.

The truth of the firſt narrated caſe you are already a ſufficient judge of; and if it is at all neceſſary to aſcertain

aſcertain the ſecond in like manner, I can at any time produce the poor woman and her huſband before you, who will atteſt the truth of ſufferings, which will not eaſily eſcape their memory.

You are at liberty to diſpoſe of this paper as you ſhall think proper. I am,

Reverend Sir,

Your reſpectful and moſt humble Servant,

Kidderminſter,
Sept. 11. 1757.

J. Johnſtone.

THO' it is now pretty well known, that colicky and icteric diſeaſes often ariſe from gall-ſtones generated in the bilious receptacle, and obſtructing its canals; yet an example of one, of ſuch enormous ſize, voided into the *duodenum* from the *ductus communis*, as happened in the firſt of the following caſes, is a very rare, if not intirely an unexampled occurrence. It will encourage us not too eaſily to deſpair of the expulſion of the largeſt *calculi* from the gall-bladder; and will teach us, that all violent attacks of pain about the ſtomach are not owing to gout reflected upon that organ: it will make us more cautious of giving draſtic cathartics, heating and inflaming medicines, upon ſuch a vague preſumption; and ought to diſpoſe thoſe, who are truſted with the lives of their fellow-creatures, to a nicer obſervation of even the minuteſt ſymptoms and circumſtances, which may occur in diſeaſes.

The ſecond caſe points out, under certain circumſtances, the practibility of extracting, by inciſion into the

the gall-bladder itſelf, thoſe *calculi*, which, from their figure, or other impediments, cannot be voided in the natural way. The method of performing this unuſual operation, and ſome inſtances of its ſucceſs, have already been made public in the Memoires de l'Acad. de Chirurg.

1. Mrs. F——, a ſedentary corpulent old lady, had been much ſubject to colicky complaints, without jaundice, in the vigour of life. The ſeat of the pain was chiefly under the right *hypochondrium*, as high as the ſtomach. She had been tolerably free from it for at leaſt eight years paſt. December 5, 1753, about eleven o'clock in the evening, ſhe was ſuddenly ſeized with a violent pain, extending from that part of the ſtomach lying under the right ſide, thro' to her back. She compared it to a ſword driven in that direction. This pain continued not only with unremitted violence, but even increaſed, till ſeven o'clock in the morning: all this time ſhe vomited and ſtrained almoſt inceſſantly; but after her ſtomach was emptied of its contents, nothing came up beſides clear ſlime, ſtreaked with blood. About ſeven o'clock in the morning ſhe felt her pain fall or move lower, as ſhe expreſſed it, and from that time became remarkably eaſier. Soon after this change, ſhe became extremely ſick, and vomited up, for the firſt time, a prodigious quantity of greeniſh yellow bile. She had not before this ſeizure been remarkably coſtive; and in her pain had a free motion to ſtool with effect; but during the remainder of the (6th) day had none, tho' all this time emollient clyſters were injected; and ſhe took regularly

 every

every two hours a powder of *magnes. alb. terr. fol. tartar. tart. vitriol. ana* ℈j. *ol. nuc. mosch. gutt.* j. with a draught of the *succ. limon. & sal. absinth.* But in the middle of the night, and all day (the 7th), she had an abundant discharge of loose bilious stools. She had continued free from excessive pain since the morning of the former day, only now and then complained of uneasiness sometimes in one, sometimes in another, part of her bowels. About twenty-four hours after her first seizure, she felt a great pain striking towards the bottom of her back, and one hour after voided the extraordinary *calculus*, of which the figure and description are subjoined. Some time after pieces of skins were voided by stool, which were evidently of the texture and appearance of the internal villous coat of the intestines and gall-bladder. The above medicines were the only ones she used, by my direction, under her painful complaint, excepting an external fomentation, and bleeding, which the hardness and contractedness of her pulse seemed to require. She was ordered to drink plentifully of thin broths, and other soft diluent liquors. During the course of her disorder she had no appearance of jaundice, nor since; and, considering her years, enjoys at present (Sept. 1757) very good health.

This *calculus*, as appears by the figure, was of a pyriform shape, resembling the form of the *cystis fellea* itself. Its surface was quite smooth and polished, excepting towards the base, at that part marked A, where it was scabrous, as if some other substance had lain contiguous to it. When broken through, it was composed of concentrical laminæ, which were alternately white and ochre-coloured. In length it

measured

meaſured one inch and three tenths; its tranſverſe ſection meaſured at leaſt ſeven tenths of an inch. It had a ſaponaceous ſmoothneſs, like other gall-ſtones, and floated upon water. It weighed only about 126 grains.

Tho' it be difficult to conceive, how ſo bulky a ſubſtance, generated in the gall-bladder, could be conveyed along ſo narrow a paſſage as the common biliary duct, eſpecially conſidering the obliquity of its inſertion for near half an inch of length betwixt the coats of the *duodenum*; yet there ſeem ſufficient *data* in the above caſe to prove, that this animal ſtone was not formed in the alimentary tube, but (large as it was) had come into it from the *ductus communis choledochus*.

The ſhape and ſaponaceous ſmoothneſs, and colour of the laminæ, of this ſubſtance, ſhew it was moulded in the gall-bladder, and formed from bilious particles. The ſevere pain and torture, and enormous vomiting, ſhe underwent, for ſeven hours after her firſt ſeizure, argue, that it muſt then be lodged in ſome canal much narrower and ſtraighter than the alimentary canal; for ſo ſoon as it dropped into that, the ſevere pain in a great meaſure ceaſed.

But that ſtraight canal, in which it was ſituated during thoſe ſeven hours of torture, could be no other than the *ductus communis choledochus*; for, during this ſpace of time, no bile was emptied into the bowels, nor thrown up by the ſtrongeſt efforts of vomiting. But no ſooner had ſhe perceived the cauſe of her pain to move or drop downwards (a ſenſation, which points out the preciſe moment the ſtone muſt have dropped into the *duodenum*), than ſhe began to ſicken, and inſtantly after vomited up a vaſt quantity of bilious matter; which now, from the de-obſtructed duct, began to flow freely into the *duodenum*. The obſtruction of the *ductus choledochus* was of too ſhort a duration (only three hours) to occaſion any obſervable jaundice. And it appears by the bloody fleſh-like knots, thrown up with phlegm by vomiting, that the paſſage of the ſubſtance was not effected without conſiderable laceration of the ſmall bilious ducts. And this eaſily accounts for the ſeparation of the villous coat, which afterwards appeared in this patient's ſtools.


A

This coarſe delineation repreſents the figure and true bulk of the *calculus*; which, I believe, is ſtill in my patient's cuſtody.

2. In February 1752. I was called to relieve a poor woman of this place, Sarah Ewdall, aged 30 years and upwards, and the mother of ſeveral children. She laboured under the jaundice, and complained of a ſevere acute pain ſtriking thro' from the right *hypochondrium* to her back, with frequent vomitings. A præternatural hardneſs, of a compaſs not exceeding the hollow of the hand, was then plainly to be felt at the pit of the ſtomach, or a little nearer to the right *hypochondrium*. When that particular part was preſſed, ſhe complained of great pain. The pain at this part was always increaſed by attempting to lie upon the left ſide. She was blooded,

blooded, fomented externally, had emollient ſaponaceous clyſters injected, and a nitrous apozem, and pills compoſed of *galban. & ſap. Caſtillenſ.* and ſoon after recovered. She had frequent returns of the ſame complaint after this; but I ſaw her not again till Jan. 1755, when ſhe lay inſenſible in a fit, which for ſeveral days deprived her of the uſe of her ſpeech and of all her ſenſes, only ſhe toſſed her limbs about. About a quarter of a year after ſhe had recovered from this fit, Mr. Cooper of this place, her apothecary, informed me, that from a ſmall ſore at the pit of her ſtomach, which came ſince her laſt illneſs, ſhe had voided ſeveral gall-ſtones. Curioſity prompted me to inquire into the matter of fact from herſelf. She ſhewed me the ſore, which was now almoſt cicatrized. She ſaid, that ſoon after her laſt illneſs a little pimple aroſe upon that part of the pit of the ſtomach, which had been hard ever ſince ſhe had been ſubject to the jaundice. This pimple broke, ran matter, and at different times the *calculi*, which ſhe ſhewed me, had come out with the matter. Her ſtomach had been ſomewhat painful before it broke, but was now eaſy. The *calculi*, which ſhe ſhewed me, had the appearance of being fragments of larger ones, and ſome were almoſt duſt; tho' ſhe aſſured me they all came from the ſore in that condition. Of theſe fragments I have two or three of the largeſt now in my cuſtody: they are light, ſwim on water, ſmooth like ſoap; are of a yellow colour, and in ſome parts brown like ſnuff; and conſiſt of ſimilar concentrical layers. The poor woman has ſince then been troubled with returns of pain and jaundice, in the intervals of which her ſkin is perfectly clear and white. She is ſtill alive, and ready to atteſt the truth of this narrative.

Kidderminſter,
Sept. 11th, 1757.

J. Johnſtone.

LXXII. *A remarkable Caſe of Coheſions of all the Inteſtines,* &c. *in a Man of about Thirty-four Years of Age, who died ſome time laſt Summer, and afterwards fell under the Inſpection of Mr.* Nicholas Jenty.

Read Feb. 9, 1758.

THE ſubject was tall, and partly emaciated. I found nothing externally but a wound in the left ſide, which ſeemed to me to have been degenerated into an ulcer. As I did not know the man when he was alive, and had him two days after his deceaſe, I cannot give an immediate account of the cauſe of his death. But in opening his abdomen, I found the epiploon adhering cloſe to the inteſtines, in ſuch a manner, that I could not part it without tearing it. It felt rough and dry. And as I was going to remove the inteſtines, to examine the meſentery, I found them ſo coherent one with the other, that it was impoſſible for me to divide them without laceration. Then I inflated the inteſtinal tube, for the inſpection of this extraordinary phænomenon; but, to my great ſurprize, all the external parts of the inteſtines appeared ſmooth; very few of the circumvolutions were ſeen, occaſioned by the ſtrong lateral coheſions of their ſides with

with each other. The ſubſtance of the inteſtines was rough, and a great many pimples, as big as the head of a pin, appeared in them, and were almoſt free from any moiſture. It is proper to obſerve, that theſe pimples have been taken for glands by the late Dr. James Douglas, and others; whereas they are in reality nothing elſe but the orifices of the exhaling veſſels obſtructed, and are not to be met with except in morbid caſes.

After having made inciſions in that part of the *colon* next to the *rectum*, I found the *peritonæum*, or external membrane which inveſts the inteſtines, and the *viſcera* of the *abdomen*, to be of the thickneſs of a ſix-pence; and I fairly drew all the inteſtines from their external membrane without ſeparating their coheſions; the *peritonæum*, or external membrane, afterwards appearing like another ſet of inteſtines. I found a fluid in the inteſtines; and I will not take upon me to ſay, how the periſtaltic motion muſt have been performed. And afterwards I parted the ſtomach from its external tunic, as I had done the inteſtines. I found no obſtruction in the meſenteric glands; but every evolution of the meſentery firmly cohered together. The liver alſo adhered cloſely to the diaphragm, and its adjacent parts: and in the *veſicula fellis* I found the bile pretty thick, neither too green nor too yellow, but a tint between both. I met with nothing remarkable in the other parts of the *abdomen*. In opening the *thorax*, I found the lungs cloſely adhering to the ribs laterally, and poſteriorly and interiorly cloſe to the *pericardium*. In making an inciſion to open the *pericardium*, I found it ſo cloſely adhering to the heart, that I could not

 avoid

avoid wounding that organ, and with much difficulty could part it from it. I met with no fluid in the *pericardium.* The heart was ſmall; and in the internal ſide the pores of the *pericardium* appeared ſo large, that one might have inſinuated the head of a middling pin into them. They have been deſcribed by ſome anatomiſts, who have met with caſes ſomewhat ſimilar to this, but without ſuch univerſal adheſions; and they have been ſuppoſed to have been glands. The ſame pores likewiſe appeared on the heart; which, in my opinion, are nothing but the extremities of the exhaling veſſels. In removing the heart, I found the *dorſal*, and other lymphatic glands above the lungs, quite large, indurated, and of a dark greyiſh colour. Nothing remarkable appeared in the lungs; only, that the portion of the *pleura*, which inveſts the lungs, and is generally thin, was here thick and rough; and thro' a glaſs it appeared as if covered with grains of ſand; and might in ſeveral places have been eaſily torn from the lungs.

The *aorta* was pretty large; and in that part of it, which runs on the tenth *dorſal vertebra*, I found a *cyſtis*, as big as an olive, full of *pus*; and lower down, immediately before that veſſel perforates the diaphragm, I found another, ſomething leſs, full of matter likewiſe; both which portions I have by me. That portion of the *aorta*, where the *cyſtis* appeared, was rather thicker than the other, and oſſeous. In opening the *cranium*, I found in that part of the *cerebrum*, which lies over the *cerebellum*, a table ſpoonfull of *pus*, of a greeniſh colour; and examining it thro' a glaſs, there was an appearance of *animalcula* in it.

LXXIII.

LXXIII. *Of the beſt Form of Geographical Maps. By the Rev.* Patrick Murdoch, *M. A. F. R. S.*

Read Feb. 9, 1758.

I. WHEN any portion of the earth's ſurface is projected on a plane, or transferred to it by whatever method of deſcription, the real dimenſions, and very often the figure and poſition of countries, are much altered and miſrepreſented. In the common projection of the two hemiſpheres, the meridians and parallels of latitude do indeed interſect at right angles, as on the globe; but the linear diſtances are every-where diminiſhed, excepting only at the extremity of the projection: at the center they are but half their juſt quantity, and thence the ſuperficial dimenſions but one-fourth part:— and in leſs general maps this inconvenience will always, in ſome degree, attend the *ſtereographic* projection.

The *orthographic*, by parallel lines, would be ſtill leſs exact, thoſe lines falling altogether oblique on the extreme parts of the hemiſphere. It is uſeful, however, in deſcribing the circum-polar regions: and the rules of both projections, for their elegance, as well as for their uſes in aſtronomy, ought to be retained, and carefully ſtudied. As to Wright's, or Mercator's, nautical chart, it does not here fall under our conſideration: it is perfect in its kind; and will always be reckoned among the chief inventions of the laſt age. If it has been miſunderſtood, or miſapplied, by geographers, they only are to blame.

 II. The

II. The particular methods of defcription propofed or ufed by geographers are fo various, that we might, on that very account, fufpect them to be faulty; but in moft of their works we actually find thefe two blemifhes, *the linear diftances vifibly falfe*, and *the interfections of the circles oblique*: fo that a quadrilateral rectangular fpace fhall often be reprefented by an oblique-angled rhomboid figure, whofe diagonals are very far from equal; and yet, by a ftrange contradiction, you fhall fee a fixed fcale of diftances inferted in fuch a map.

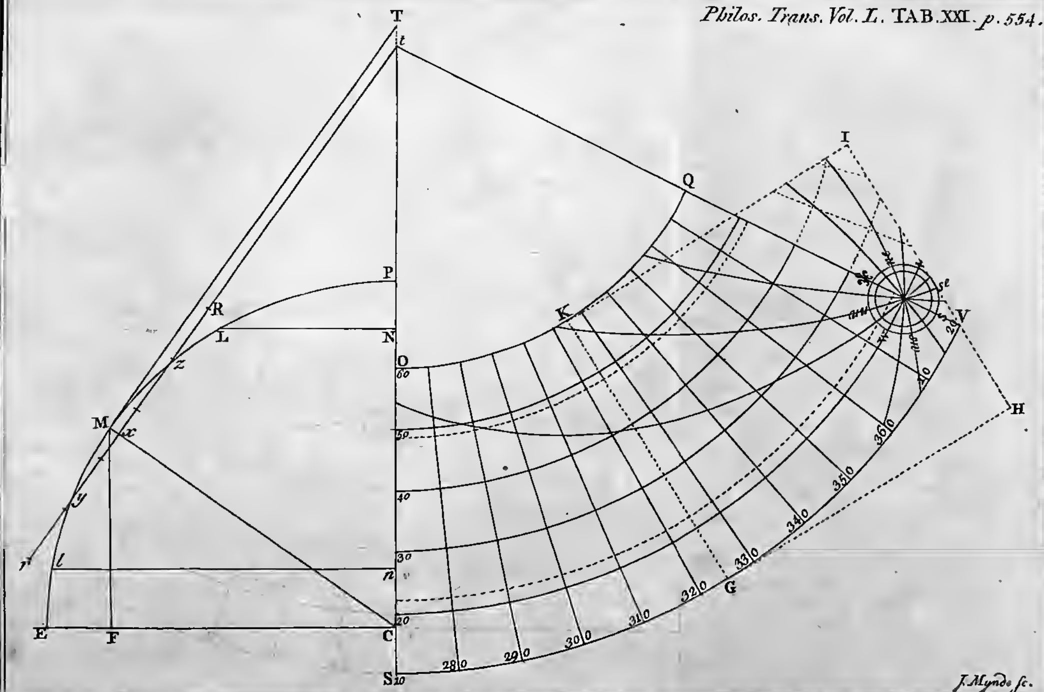
III. The only maps I remember to have feen, in which the laft of thefe blemifhes is removed, and the other leffened, are fome of P. Schenk's of Amfterdam, a map of the Ruffian empire, the Germania Critica of the famous Profeffor Meyer, and a few more ‡. In thefe the meridians are ftraight lines converging to a point; from which, as a center, the parallels of latitude are defcribed: and a rule has been publifhed for the drawing of fuch maps *. But as that rule appears to be only an eafy and convenient approximation, it remains ftill to be inquired, *What is the conftruction of a particular map, that fhall exhibit the fuperficial and linear meafures in their trueft proportions?* In order to which,

IV. Let E*l*LP, in this figure (*See* TAB. XXI.) be the quadrant of a meridian of a given fphere, whofe center is C, and its pole P; EL, E*l*, the latitudes of two places in that meridian, EM their

‡ *Senex* drew feveral of that form.

* See the Preface to the fmall Berlin Atlas.

middle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middle latitude. Draw LN, ln, cofines of the latitudes, the fine of the middle latitude MF, and its cotangent MT. Then writing unity for the radius, if in CM we take $Cx = \frac{Nn}{Ll \times MF \times MT}$, and thro' x we draw xR, xr, equal each to half the arc Ll, and perpendicular to CM; the conical furface generated by the line Rr, while the figure revolves on the axis of the fphere, will be equal to the furface of the zone that is to be defcribed in the fame time by the arc Ll; as will eafily appear by comparing that conical furface with the zone, as meafured by *Archimedes*.

And, laftly, If from the point t, in which rR produced meets the axis, we take the angle CtV in proportion to the longitude of the propofed map, as MF the fine of the middle latitude is to radius, and draw the parallels and meridians as in the figure, the whole fpace SOQV will be the propofed part of the conical furface expanded into a plane; in which the places may now be inferted according to their known longitudes and latitudes.

EXAMPLE.

V. Let Ll, the breadth of the zone, be 50°, lying between 10° and 60° north latitude; its longitude 110°, from 20° eaft of the Canaries to the center of the weftern hemifphere; comprehending the weftern parts of Europe and Africa, the more known parts of North America, and the ocean that feparates it from the old continent.

And becaufe $Cx = \frac{Nn}{Ll \times MF \times MT}$, add thefe three logarithms.

 Log.

Log. 0.8726650 (= 50° to radius 1) — 1.9408476
Log. MF (ſin. 35°) . . . . — 1.7585913
Log. MT (tang. 55°) 0.1547732

Take the ſum . . . . — 1.8542121
from log. N n (= .6923772) . . . . — 1.8403427

the remainder . . . . — 1.9861306
is the logarithm of C x. And becauſe 1 : C x :: MT : xt, to this adding the log. MT 0.1547732

The ſum 0.1409038
is the log. of xt = 1.383260; and xR (= xr = ½ L l) being .4363325, R t will be 0.9469275, rt = 1.8195925. Whence having fixed upon any convenient ſize for our map, the center t is eaſily found. As, allowing an inch to a degree of a great circle, or 50 inches to the line R r, R t the ſemidiameter of the leaſt parallel will be 54.255 inches, and that of the greateſt parallel 104.255 inches.

Again, making as radius to MF ſo the longitude 110° to the angle S t V, that angle will be 63° 5′ $\frac{3}{5}$. Divide the meridians and parallels, and finiſh the map as uſual.

Note, The log. MT being repeated in this computation with a contrary ſign, we may find xt immediately by ſubtracting the ſum of the logarithms of L l and MF from the log. of N n.

VI. A map drawn by this rule will have the following properties:

1. The interſections of the meridians and parallels will be rectangular.

2. The

2. The diſtances north and ſouth will be exact; and any meridian will ſerve as a ſcale.

3. The parallels thro' *z* and *y*, where the line *Rr* cuts the arc L*l*, or any ſmall diſtances of places that lie in thoſe parallels, will be of their juſt quantity. At the extreme latitudes they will exceed, and in mean latitudes, from *x* towards *z* or *y*, they will fall ſhort of it. But unleſs the zone is very broad, neither the exceſs nor the defect will be any-where conſiderable.

4. The latitudes and the ſuperficies of the map being exact, by the conſtruction, it follows, that the exceſſes and defects of diſtance, now mentioned, compenſate each other; and are, in general, of the leaſt quantity they can have in the map deſigned.

5. If a thread is extended on a plane, and fixed to it at its two extremities, and afterwards the plane is formed into a pyramidal or conical ſurface, it may be eaſily ſhewn, that the thread will paſs thro' the ſame points of the ſurface as before; and that, *converſely*, the ſhorteſt diſtance between two points in a conical ſurface is the right line which joins them, when that ſurface is expanded into a plane. Now, in the preſent caſe, the ſhorteſt diſtances on the conical ſurface will be, if not equal, always nearly equal, to the correſpondent diſtances on the ſphere: and therefore, all rectilinear diſtances on the map, applied to the meridian as a ſcale, will, nearly at leaſt, ſhew the true diſtances of the places repreſented.

6. In maps, whoſe breadth exceeds not 10° or 15°, the rectilinear diſtances may be taken for ſufficiently exact. But we have choſen our example of a greater breadth than can often be required, on pur-

poſe

poſe to ſhew how high the errors can ever ariſe; and how they may, if it is thought needful, be nearly eſtimated and corrected.

Write down, in a vacant ſpace at the bottom of the map, a table of the errors of equidiſtant parallels, as from five degrees to five degrees of the whole latitude; and having taken the mean errors, and diminiſhed them in the ratio of radius to the ſine of the mean inclination of the line of diſtance to the meridian, you ſhall find the correction required; remembering only to diſtinguiſh the diſtance into its parts that lie *within* and *without* the ſphere, and taking the difference of the correſpondent errors, in *defect* and in *exceſs*.

But it was thought needleſs to add any examples; as, from what has been ſaid, the intelligent reader will readily ſee the uſe of ſuch a table; and chiefly as, whenever exactneſs is required, it will be more proper, and indeed more expeditious, to compute the diſtances of places by the following canon.

Multiply the product of the coſines of the two given latitudes by the ſquare of the ſine of half the difference of longitude; and to this product add the ſquare of the ſine of half the difference of the latitudes; the ſquare root of the ſum ſhall be the ſine of half the arc of a great circle between the two places given.

Thus, if we are to find the true diſtance from one angle of our map to the oppoſite, that is, from S to Q, the operation will be as follows:

L. ſin.

L. ſin. 30° = — 1.6989700
L. ſin. 80° = — 1.9933515
2 L. ſin. 55° = — 1.8267290

— 1.5190505 = log. of 0.330408
and 2 L. ſin. 25° = — 1.2518966 = log. of 0.178606

Log. of the ſum . . . 0.509014 is — 1.7067297
Whoſe half is — 1.8533648

the L. ſin. of 45° 31′, the double of which is 91° 2′, or 5462 geographical miles.

And ſeeing the lines TS, TQ, reduced to minutes of a degree, are 6255.189 and 3255.189 reſpectively. and the angle STV is 63° 5′$\frac{3}{5}$, the right line SQ on the map will be 5594′, exceeding its juſt value by 132′ or $\frac{1}{42}$ of the whole.

7. The errors on the parallels increaſing faſt towards the north, and the line SQ having, at laſt, nearly the ſame direction, it is not to be wondered that the errors in our example ſhould amount to $\frac{1}{42}$. Greater ſtill would happen, if we meaſured the diſtance from O to Q by a ſtraight line joining thoſe points: for that line, on the conic ſurface, lying every-where at a greater diſtance from the ſphere than the points O and Q, muſt plainly be a very improper meaſure of the diſtance of their correſpondent points on the ſphere. And therefore, to prevent all errors of that kind, and confine the other errors in this part of our map to narrower bounds, it will be beſt to terminate it towards the pole by a ſtraight line KI touching the parallel OQ in the middle point K, and on the eaſt and weſt by lines, as HI, parallel to the meridian thro' K, and meeting the tangent at the middle point of the parallel SV in H. By this means too we ſhall gain more ſpace than we loſe, while the map takes the uſual rectangular

rectangular form, and the ſpaces G H V remain for the *title*, and other inſcriptions.

VII. Another, and not the leaſt conſiderable, property of our map is, that it may, without ſenſible error, be uſed as a ſea-chart; the rumb-lines on it being logarithmic ſpirals to their common pole t, as is partly repreſented in the figure: and the arithmetical ſolutions thence derived will be found as accurate as is neceſſary in the art of ſailing.

Thus if it were required to find the courſe a ſhip is to ſteer between two ports, whoſe longitudes and latitudes are known, we may uſe the following

RULE.

To the logarithm of the number of minutes in the difference of longitude add the conſtant logarithm * — 4.1015105, *and to their ſum the logarithm ſine of the mean latitude, and let this laſt ſum be* S.

The cotangent of the mean latitude being T, *and an arithmetical mean between half the difference of latitude and its tangent being called* m, *from the logarithm of* T + m *take the logarithm of* T — m, *and let the logarithm of their difference be* D; *then ſhall* S — D *be nearly the logarithm tangent of the angle, in which the ſhip's courſe cuts the meridians.*

Note, We ought, in ſtrictneſs, to uſe the ratio of $tx + x$R to $tx - x$R inſtead of T + m to T — m; but we ſubſtitute this laſt as more eaſily computed, and very little different.

* This conſtant logarithm contains the reduction of the diff. of longitude to parts of radius unity, and to *Briggs*'s Modulus.

EXAMPLE

EXAMPLE 1.

Let the latitudes, on the ſame ſide of the equator, be 10° and 60°; then the middle latitude and its complement are 35° and 55°, and half the difference of the latitudes is 25°: and the difference of longitude being 110°, the operation will ſtand as below.

Log. 6600′ (in 110°) . . 3.8195439
Conſtant log. . . . — 4.1015105

— 1.9210544
Log. ſin. 35° . . . — 1.7585913

S = ... — 1.6796457

Again T = 1.4281480
m = .4513202

Log. $\overline{T+m}$ (= 1.8794682) 0.2740350
Log. $\overline{T-m}$ (= 0.9768278) — 1.9898180

Log. 0.2842170 = D = — 1.4536500

S — D (= log. tangent 59° 16′) . . . . . = 0.2259957
agreeing to a minute with the ſolution by a table of meridional parts.

EXAMPLE 2.

The reſt remaining, let the difference of longitude be only 40°; then

Log. 2400′ (in 40°) . . 3.3802112
Conſtant log. . . . — 4.1015105

— 1.4817217
Log. ſin. 35° . . . — 1.7585913

S = ... — 1.2403130
D (as before) = — 1.4536500

S — D (= log. tang. 31° 27′ ½) . . . . — 1.7866630

 EXAMPLE

EXAMPLE 3.

Let the difference of longitude be 40°; but the latitudes 56° and 80°;

$$\left.\begin{array}{l}\text{And log. } 2400' \\ + \text{ log. conſtant}\end{array}\right\} = -\ 1.4817217$$

$$\text{Log. ſin. } 68° \ldots = -\ \underline{1.9671659}$$

$$S = \ldots\ldots -\ 1.4488876$$

$$T \text{ (tang. } 22°) = .4040262$$
$$m = \ldots\ldots\ \underline{.2109980}$$

$$\text{Log. } \overline{T+m}\ (= .6150242) -\ 1.7888921$$
$$\text{Log. } \overline{T-m}\ (= .1830282) -\ \underline{1.2625181}$$

$$\text{Log.} \ldots\ \overline{0.5263740} = D = -\ \underline{1.7212944}$$

$S - D$ (= log. tangent 28° 6′) . . . . = — 1.7275932 wanting of the true anſwer no more than 1° 4′.

And in all caſes that can occur, the error of this rule will be inconſiderable.

It is not meant, however, that it ought to take place of the eaſier and better computation by a table of meridional parts: but it was thought proper to ſhew, by ſome examples, how ſafely the map itſelf may be depended on in the longeſt voyages; provided it is ſufficiently large, and the neceſſary rumb-lines are exactly drawn *.

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* See *Coteſii* Logometr. prop. 6.

LXXIV. *A short Dissertation on Maps and Charts: In a Letter to the Rev.* Thomas Birch, *D. D. and Secret. R. S. By Mr.* Wm. Mountaine, *F. R. S.*

SIR, London, March 21. 1758.

Read April 6. 1758.

AMONG the several improvements made in arts and sciences by ingenious men, the construction of *globes*, *maps*, or *charts*, deserves a place: not only on account of the pleasure and satisfaction that arises to speculative minds, in surveying the extent and divisions of this terraqueous globe, but also for their real use and service to navigation, trade, and commerce.

Globes perhaps were first invented, as bearing the nearest semblance to the natural form of the earth and sea, with proper circles thereon described, and the several empires and kingdoms, according to their extent, latitudes, and longitudes, as far as geography and history would admit.

But tho' these convey the most general and truest ideas of the position and situation of places; yet, as containing but a small surface, they were found not extensive enough to take in particular kingdoms or states, with their subdivisions, cities, and rivers, so as to convey an adequate and sufficient representation. Besides, they were not so portable and commodious in voyages or travels.

Maps and *Charts* were therefore thought of, as being most convenient for both the purposes above-

 mentioned;

mentioned; the accuracy of which depends on representing the meridians and parallels in ſuch manner, that when places are laid thereon, according to their latitudes and longitudes, they may have ſuch reſpect to each other, as they have on the globe itſelf; and thoſe are either *globular* or *rectilinear*.

Globular, or *curvilinear*, are either general or particular.

General, are the hemiſpheres; for the moſt part conſtructed ſtereographically.

Particular, contain only ſome part of the terraqueous globe; and of this ſort there are ſundry modes of conſtruction, which for the moſt part are defective, ſo as not to be applied with accuracy and facility to the purpoſes intended, in determining the courſes or bearings of places, their diſtances, or both.

Rectilinear were therefore very early adopted, on which the meridians were deſcribed parallel to each other, and the degrees of latitude and longitude everywhere equal; the rumbs were conſequently right lines; and hereby it was thought, that the courſes or bearings of places would be more eaſily determined.

But theſe were found alſo inſufficient and erroneous, the meridians being parallel, which ought to converge; and no method or device uſed to accommodate that paralleliſm.

Notwithſtanding the great deficiency in this plane map or chart, it was preferred, eſpecially in nautical buſineſs; and hath its uſes at this day in topographic conſtructions, as in bays, harbours, and very narrow zones.

However,

However, the errors herein were fooner difcovered than corrected, both by mathematicians and mariners, as by Martin Cortefe, Petrus Nonius, Coigniet, and fome fay by Ptolemy himfelf.

The firft ftep towards the improvement of this chart was made by Gerardus Mercator, who publifhed a map about the year 1550, wherein the degrees of latitude were increafed from the equator towards each pole; but upon what principles this was conftructed, he did not exhibit.

About the year 1590, Mr. Edward Wright, an Englifhman, difcovered the true principles upon which fuch a chart fhould be conftructed; and communicated the fame to one Jodocus Hondius, an engraver, who, contrary to his honeft faith and engagement, publifhed the fame as his own invention: This occafioned Mr. Wright, in the year 1599, to exhibit his method of conftruction, in his book, intitled, *Correction of Errors in Navigation*; in the preface of which book may be feen his charge and proof againft Hondius; and alfo how far Mercator has any right to fhare in the honour due for this great improvement in geography and navigation.

Blundevill, in his Exercifes, page 327, publifhed anno 1594, gives a table of meridional parts anfwering to even degrees, from 1° to 80° of latitude, with the fketch of a chart conftructed therefrom; but this table he acknowledgeth to have received from Mr. Wright, in the following words, page 326, *viz.* " In the mean time to reform the faide faults," (in the plane chart) " Mercator hath in his univerfal " chard or mappe made the fpaces of the parallels " of latitude to bee wider everie one than other " from the equinoctial towards either of the poles,

7 " by

" by what rule I know not, unleſs it be by ſuch a
" table as my friend Maiſter Wright of Caius-col-
" lege in Cambridge at my requeſt ſent me (I thank
" him) not long ſince for that purpoſe, which table
" with his conſent, I have plainlie ſet down," *&c.*

About the year 1720, a globular chart was publiſhed, ſaid to be conſtructed by Mr. Henry Wilſon; the errors in which were obviated by Mr. Thomas Haſelden, in a letter to Dr. Halley; who at the ſame time exhibited a new ſcale, whereby diſtances on a given courſe may be meaſured, or laid off, at one extent of the compaſſes, on Wright's projection; and was intended to render the ſame as eaſy in practice as the plane chart.

The above chart was publiſhed in oppoſition to Mr. Wright's, which that author charged with imperfections and errors, and that it repreſented places bigger than they are upon the globe.

It is true, the ſurface is apparently enlarged; but the poſition of places, in reſpect to one another, are in no wiſe diſtorted; and it may be aſſerted, with the ſame parity of reaſon, that the lines of ſines, tangents, and ſecants, are falſe, becauſe the degrees of the circle, which are equal among themſelves, are thereupon repreſented unequal.

Yet if a map or chart was ſo conſtructed, as to ſhew the ſituation and true extent of countries, *&c.* *primâ facie* (if I may be allowed the expreſſion), and yet retain all the properties, uſes, and ſimplicity, of Wright's conſtruction, it would be a truly great improvement; but this ſeems to be impoſſible.

The method exhibited by the Rev. Mr. Murdoch, in his paper, read before the Royal Society on the 9th of February laſt, ſhews the ſituation of places, and

and ſeems better calculated for determining ſuperficial and linear meaſures, than any other that has occurred to me.

This Gentleman illuſtrates his theory with examples juſtly intended to point out the quantity of error, that will happen in a large extent.

For inſtance; Between latitudes 10° and 60° N. and containing 110 degrees difference of longitude, Mr. Murdoch computes the diſtance at 5594 miles; which, upon the arc of a great circle, is found to be 5477, or by other methods 5462; ſo that the difference is only 117, or at moſt 132 miles in ſo great an extent, and to an high latitude; and the higher the latitude the greater the error is like to be, wherever middle latitude is concerned.

His courſes alſo agree very nearly with computations made from the tables of meridional parts.

In example the firſt they are the very ſame:

In example the 2d they agree to half a minute:

In example the 3d they vary 1° 4′, on account of the high latitudes, which extend from 56° to 80° N.

However, I do not eſteem this method ſo ſimple, eaſy, and conciſe, in the practice of navigation, as Mr. Wright's conſtruction, eſpecially in determining the bearings or courſes from place to place: nor will it (I preſume) admit of a zone containing both north and ſouth latitude.

Of theſe inconveniences Mr. Murdoch ſeems to be extremely well acquainted, when he expreſſes himſelf in the following very candid and ingenuous terms, *viz.* " As to Wright's or Mercator's nauti-
" cal chart, it does not here fall under our conſide-
" ration: it is perfect in its kind; and will always
" be reckoned among the chief inventions of the
" laſt

" last age. If it has been misunderstood or misap-
" plied by geographers, they only are to blame."— And again, at the end of his nautical examples, he concludes thus, *viz.* " It is not meant, however, " that it ought to take place of the easier and " better computation by a table of meridional " parts."

I have the honour to be, with the greatest respect,

SIR,

The ROYAL SOCIETY's, and

Your most obedient Servant,

William Mountaine.

ADDENDA *to Mr.* Murdoch's *Paper*, N°. LXXIII.

IF it is required " to draw a map, in which the superficies of a " given zone shall be equal to the zone on the sphere, while " at the same time the projection from the center is strictly geo- " metrical;" *Take* Cx *to* CM *as a geometrical mean between* CM *and* Nn, *is to the like mean between the cosine of the middle latitude, and twice the tangent of the semidifference of latitudes*; and project on the conic surface generated by *xt*. But here the degrees of latitude towards the middle will fall short of their just quantity, and at the extremities exceed it: which hurts the eye. Artists may use either rule: or, in most cases, they need only make C*x* to CM as the arc ML is to its tangent, and finish the map; either by a projection, or, as in the first method, by dividing that part of *xt* which is intercepted by the secants thro' L and *l*, into equal degrees of latitude.

Mr. Mountaine justly observes, " that my rule does not admit of " a zone containing N. and S. latitudes." But the remedy is, *to extend the lesser latitudes to an equality with the greater; that the cone may be changed into a cylinder, and the rumbs into straight lines.*

LXXV.

LXXV. *Cases of the remarkable Effects of Blisters in lessening the Quickness of the Pulse in Coughs, attended with Infarction of the Lungs and Fever: By* Robert Whytt, *M. D. F. R. S. Fellow of the Royal College of Physicians, and Professor of Medicine in the University of* Edinburgh.

Read Feb. 16. 1758.

ONE of the most natural effects of blistering plaisters, when applied to the human body, is to quicken the pulse, and increase the force of the circulation. This effect they produce, not only by means of the pain and inflammation they raise in the parts to which they are applied, but also because the finer particles of the *cantharides*, which enter the blood, render it more apt to stimulate the heart and vascular system.

The apprehension, that blisters must in every case accelerate the motion of the blood, seems to have been the reason, why some eminent physicians have been unwilling to use them in feverish and inflammatory disorders, till after the force of the disease was a good deal abated, and the pulse beginning to sink. However, an attentive observation of the effects, which follow the application of blisters in those diseases, will shew, that instead of increasing, they often remarkably lessen the frequency of the pulse. This I had occasion formerly to take notice

 of

of (1), and ſhall now evince more fully by the following caſes.

I. A widow lady, aged about 50, was ſeized (December 1755) with a bad cough, oppreſſion about her ſtomach and breaſt, and a pain in her right ſide, tho' not very acute. Her pulſe being quick, and ſkin hot, ſome blood was taken away, which was a good deal ſizy: attenuating and expectorating medicines were alſo preſcribed. But as her complaints did not yield to theſe remedies, I was called on December 26th, after ſhe had been ill about ten days; at which time her pulſe beat from 96 to 100 times in a minute, but was not fuller than natural. I ordered her to loſe ſeven or eight ounces more of blood, which, like the former, was ſizy; and next day, finding no abatement of her complaints, I adviſed a bliſter to be applied, in the evening, to that part of her right ſide which was pained. Next morning, when the bliſter was removed, the pain of her ſide was gone, and her pulſe beat only 88 times in a minute, and in two days more it came down to 78. However, after the bliſtered part became dry, the pulſe roſe in one day's time to 96, and continued between that number and 90 for four days; after which I ordered a large bliſter to be put between her ſhoulders. When this plaiſter was taken off, her pulſe beat under 90 times in a minute; and next day it fell to 76, and the day after to 72. The cough and other ſymptoms, which were relieved by the firſt bliſter, were quite cured by the ſecond.

(1) Phyſiological Eſſays, p. 69.

II. John

II. John Graham, bookbinder, in Edinburgh, aged 37, of a thin habit of body, formerly ſubject to coughs, and thought to be in danger of a *phthiſis pulmonalis*, having expoſed himſelf unwarily to cold in the night time, was, about the end of January 1756, ſeized with a bad cough and feveriſhneſs; for which he was blooded, and had a diaphoretic julep, a pectoral decoction, and a mixture with *gum. ammoniacum* and *acetum ſcilliticum*, given him by Mr. James Ruſſell, ſurgeon-apothecary in this place. On the 12th of February, after he had been ill above a fortnight, I was deſired to viſit him. He ſeemed to be a good deal emaciated; his eyes were hollow, and cheeks fallen in: he was almoſt conſtantly in a ſweat; coughed frequently, and ſpit up a great quantity of tough phlegm, ſomewhat reſembling *pus*: his pulſe beat from 112 to 116 times in a minute. In this condition I ordered immediately a bliſter to be applied between his ſhoulders, which leſſened in ſome degree his cough and ſpitting, as well as the frequency of his pulſe; but the bliſtered part no ſooner began to heal, than he became as ill as before, and continued in this bad way nine or ten days, gradually waſting, with continued ſweats, and a great ſpitting of a thick *mucus*. During this time he uſed *tinctura roſarum*, and the mixture with *gum. ammon.* and *acet. ſcillit.* without any ſenſible benefit, and had ſix ounces of blood taken away, which was very watery, and the *craſſamentum* was of a lax texture. In this almoſt deſperate condition, another bliſter, larger than the former, was put between his ſhoulders, which remarkably leſſened his cough and ſpitting, and in two or three days reduced his pulſe to 96 ſtrokes in a

 minute.

minute. After this he continued to recover ſlowly, without the aſſiſtance of any other medicine, except the *tinctura roſarum* and the mixture with *gum. ammon.* and *acet. ſcillit.* and at preſent he enjoys good health.

III. Mrs. ——, aged upwards of 40, who had for ſeveral years been ſubject to a cough and ſpitting in the winter months, was, in October 1756, ſeized with thoſe complaints in a much greater degree than uſual; to remove which, ſhe was blooded, and got ſome attenuating and pectoral medicines from Mr. John Balfour, ſurgeon-apothecary in Leith. I was called on November 11th, after ſhe had been ill ſeveral weeks, and found her in a very unpromiſing condition. She had a frequent and ſevere cough, with great ſhortneſs of breath and a wheezing; her lungs ſeemed to be quite ſtuffed with phlegm, of which ſhe ſpit a vaſt quantity every day, and of ſuch an appearance, that I was apprehenſive it was, in part at leaſt, truly purulent. When ſhe ſat up in a chair, her pulſe beat above 130 times in a minute. She had a conſiderable thirſt, and her tongue was of a deep red colour, with a beginning aphthous cruſt on ſome parts of it. She was ſo weak, and her pulſe ſo feeble, that there was no place for further bleeding: a bliſter was therefore applied to her back, November 11th, which ſomewhat lowered her pulſe, and leſſened the ſhortneſs of breathing and quantity of phlegm in her lungs. November 16th, a ſecond bliſter was laid to her ſide, which gave her ſtill more ſenſible relief than the former, and reduced her pulſe to 114 ſtrokes in a minute. November 25th, a third

bliſter

bliſter was applied to her back; by which her cough and wheezing were rendered conſiderably eaſier, and the phlegm, which ſhe ſpit up, loſt its purulent appearance, became thinner, more frothy, and was much leſs in quantity. Her pulſe beat now only 104 times in a minute. After this, her cough and ſpitting increaſing again, ſhe had, on the 20th of December, a fourth bliſter applied to her back, which, like the former, did her great ſervice. Her ſtomach being extremely delicate, I ſcarce ordered any medicines for her all this time, except a cordial julep, with *ſpir. volat. oleoſ.* tincture of rhubarb as a laxative, and a julep of *aqu. roſar. acet. vin. alb.* and *ſyr. balſam.* of which laſt ſhe took two table ſpoonfuls twice or thrice a day in a quarter of a pint of lintſeed tea. After the fourth bliſter, ſhe drank for ſome time a cupful of *infuſum amarum* twice a day, and continued to recover ſlowly: and tho' during the remaining part of the winter ſhe was, as uſually, a good deal troubled with a cough, yet in the ſpring ſhe got free from it, and is now in her ordinary health.

IV. Chriſtian M'ewen, aged 21, had laboured under a cough, thick ſpitting, pain of her breaſt, and pains in her ſides affecting her breathing, for about a twelvemonth: and after getting, by proper remedies, in a good meaſure free from thoſe complaints, her cough, from catching a freſh cold, increaſed to a greater degree than ever, became hard and dry, and was attended with a conſtant difficulty of breathing, pain in her left ſide, and head-ach. After having been ſeven or eight days in this condition, ſhe was admitted into the Royal Infirmary, January

nuary 9th, 1757. As her pulſe was ſmall, tho' very quick, *viz.* beating 130 in a minute, I thought it unneceſſary to bleed her, as from former experience I did not doubt but that bliſtering alone would relieve her: I ordered, therefore, a large bliſter to be applied to her left ſide, where ſhe complained of pain, and preſcribed for her the following julep:

℞ *Aqu. menth. ſimp. ſpirit. Minderer. ana* ℥iij. *acet. ſcillit.* ℥i. *ſacchar. alb.* ℥ij. *miſce*; *cap. coch.* ij. *ter in die.*

She was alſo deſired to breathe frequently over the ſteam of hot water, and to drink lintſeed tea.

January 10th. Her pulſe beat only 112 times in a minute, and was ſomewhat fuller than on the 9th. The bliſter was not removed till late in the evening, and made a plentiful diſcharge. The cough having been ſo ſevere laſt night, as to keep her from ſleep, I ordered her the following anodyne draught:

℞ *Spirit. Minderer.* ℥ſs. *acet. ſcillit.* ʒi. *ſyr. papav. alb.* ʒvi. *miſce*; *cap. hor. ſomni.*

Jan. 11th. The cough eaſier laſt night; difficulty of breathing leſs; pulſe 108 in a minute. Ordered the anodyne draught to be repeated, and the uſe of the julep, with *acet. ſcillit.* to be continued.

Jan. 12th. Pulſe ſlower; cough and pain of the ſide eaſier; but ſtill complains of a head-ach.

Jan. 13th. Pulſe 94 in a minute; cough continues eaſier in the night, but is troubleſome in the day-time.

Jan. 14th. Every way better; pulſe only 80 in a minute. As her cough is ſtill bound, ordered her, beſides the medicines above-mentioned, a pectoral decoction of *rad. alth.* &c.

Jan. 15th. Cough and other complaints in a great meaſure removed: pulſe 65 in a minute.

From this time her cough gave her little trouble; but on the 18th ſhe complained of a pain in the *epigaſtrium*, with ſickneſs at ſtomach, want of apetite, and a giddineſs in her head, which were conſiderably relieved by a vomit, *infuſum amarum*, and ſtomachic purges; and were almoſt wholly cured by the return of her menſes on the 5th of February, after an interval of eight weeks.

V. A girl 21 months old, who had (December 1756) a great load of the ſmall-pox, and not of a good kind, with a cough and obſtructed breathing, was, on the ſeventh day from the eruption, bliſtered on the back; by which the pulſe was leſſened from 200 to 156 ſtrokes in a minute. Next day her legs were alſo bliſtered, and the pulſe thereby fell to 136. But the child's lungs being much oppreſſed, and her throat being ſo full of puſtules that ſhe could ſcarce ſwallow any thing, ſhe died towards the end of the ninth day.

I could add ſeveral other caſes of the remarkable effects of bliſters in leſſening the quickneſs of the pulſe in coughs attended with fever, pain in the ſide, and pituitous infarction of the lungs: but thoſe above may be ſufficient to put this matter out of doubt, as well as to remove any prejudice, that may ſtill remain againſt the free uſe of ſo efficacious a remedy.

In a true peripneumony, eſpecially where the inflammation is great, repeated bleeding is the principal remedy, and bliſters early applied are not ſo proper.

proper. But when the peripneumony is of a mixed kind; when the lungs are not ſo much inflamed as loaded with a pituitous matter; when bleeding gives but little relief; when the pulſe, tho' quick, is ſmall; when the patient is little able to bear evacuations, and the diſeaſe has continued for a conſiderable time; in all theſe caſes bliſtering will produce remarkable good effects, and, far from increaſing, will generally leſſen the frequency of the pulſe, and fever, more ſpeedily than any other remedy.

On the other hand, when the fever and frequency of the pulſe proceed from a true inflammation of the lungs, from large obſtructions tending to ſuppuration, or from an open ulcer in them, bliſters will be of leſs uſe, nay, ſometimes will do harm, except in the laſt caſe, where they, as well as iſſues and ſetons, are often beneficial, tho' ſeldom able to compleat a cure. But as in pituitous infarctions of the lungs, with cough and fever, repeated bliſters applied to the back and ſides are far preferable to iſſues or ſetons, ſo theſe laſt ſeem moſt proper in an open ulcer of the lungs. The former make a greater and more ſudden derivation, and are therefore adapted to acute caſes; the latter act more ſlowly, but for a much longer time, and are therefore beſt ſuited to chronic diſeaſes. Further, while bliſters evacuate chiefly the ſerous humours, iſſues and ſetons generally diſcharge true purulent matter, and on this account may be of greateſt ſervice in internal ulcers.

In what manner bliſters may leſſen the fever and frequency of the pulſe attending internal inflammations, I have elſewhere endeavoured to explain (2);

(2) Phyſiological Eſſays, p. 69.

and

and ſhall only add here, that in the caſes above recited, where the quick pulſe and feveriſhneſs proceeded more from a pituitous infarction than a true inflammation of the lungs, bliſters, by relieving this organ, in ſome meaſure, of the load of humours oppreſſing it, would render the circulation through its veſſels freer, and conſequently leſſen the quickneſs of the pulſe, and other feveriſh ſymptoms.

It may not, however, be improper briefly to point out the reaſon, why bliſters, which have been obſerved to be remarkably efficacious, even when early applied, in pleuriſies (3), are leſs ſo in true peripneumonies. This difference, I imagine, may be accounted for from there being no immediate communication between the pulmonary veſſels and thoſe of the ſides and back, to which the bliſters are applied; whereas the *pleura*, and intercoſtal muſcles, are furniſhed with blood-veſſels from the intercoſtal arteries, which alſo ſupply the teguments of the *thorax*: ſo that while a greater flow of ſerous humours, and alſo indeed of red blood, is derived into the veſſels of the external parts, to which the veſicatories are applied, the force of the fluids in the veſſels of the inflamed *pleura*, or intercoſtal muſcles, muſt be conſiderably leſſened. Further, as the intercoſtal muſcles and *pleura* are, as well as the teguments of the *thorax*, ſupplied with nerves from the *true* intercoſtals, bliſters applied to the back and ſides may perhaps, on this account alſo, have a greater effect in relieving inflammations there than in the lungs,

(3) Dr. Pringle's Obſervations on the Diſeaſes of the Army, part iii. chap. 2.

which have nerves from the eighth pair, and from the *intercostals* improperly so called.

Edinburgh, May 23d, 1757.

Extract of a Letter from Dr. Whytt, *Professor of Medicine in the University of* Edinburgh, *and F. R. S. to Dr.* Pringle, *F. R. S.*

Edinburgh, 10 Nov. 1757.

WHAT you remark with regard to blisters being freely used by the physicians at London, in the cases mentioned in the paper I last sent you, is very just, and indeed what I knew; but altho' their efficacy in such circumstances is now generally acknowleged both in England and Scotland, yet I do not remember that their remarkable quality in lessening the quickness of the pulse has been particularly attended to. This, therefore, I thought it might not be amiss to ascertain by a few careful observations.

I agree intirely with you, as to the use of blisters in fevers; being of opinion, that when there is no particular part obstructed or inflamed, they are of little service, and sometimes hurtful, unless perhaps towards the end, when the pulse begins to sink. Nay, in fevers, where the substance of the brain is affected, and not its membranes, I have never found any sensible benefit from blisters: and I always suspect the brain itself affected, when a fever and delirium come on without any preceding head-ach, or redness in the *tunica albuginea* of the eyes. This kind of fever I have met with several times, and have observed it to be generally fatal.

LXXVI. *A remarkable Inſtance of Four rough Stones, that were diſcovered in an human urinary Bladder, contrary to the received Opinion; and ſucceſsfully extracted by the lateral Method of Cutting for the Stone. By Mr.* Joſeph Warner, *F. R. S. and Surgeon to* Guy's-Hoſpital.

Read Feb. 23. 1758.

THE favourable reception thoſe few papers have met with from the Royal Society, which I have done myſelf the honour of addreſſing to them, encourages me to take the liberty of offering the following account to their conſideration: and I am the more immediately induced to ſubmit this paper to their peruſal, as the fact hereafter related may poſſibly be not eſteemed a matter of mere curioſity; ſince it is probable, that the inferences deduced from the hiſtory of the ſubſequent caſe, when attended to, may prove of the greateſt conſequence to the future eaſe and welfare of the patient, as well as be a means of preventing the operator from falling into ſuch errors, as cannot fail of drawing an imputation upon his character, in the practice of one of the moſt capital and difficult undertakings in his profeſſion.

It is a maxim laid down by the moſt judicious and beſt received writers upon operations in ſurgery, that when the ſurface of a ſtone, which has been extracted from the bladder, appears to be totally rough, it amounts to a proof of its having been

 there

there alone. But notwithſtanding I admit it is from experience found, that the obſervation is in general well grounded, it may nevertheleſs appear, from the following caſe, that this rule is not unexceptionable: for which reaſon perhaps it may be thought right, that we ſhould not be determined from circumſtances only; but, on the contrary, that it is neceſſary for every ſurgeon to take ſuch methods during the operation, as will enable him to judge with that degree of certainty, without which he cannot be enabled to do ſo.

The methods I would recommend are theſe: That after the extraction of a ſtone from the bladder, tho' the whole of its ſurface be rough, the operator ſhould nevertheleſs introduce the forefinger of his left or right hand thro' the wound into the cavity of the bladder; by which means, if the ſubject be under twelve years of age, he will be enabled to come in contact with every internal part of the bladder with his finger: but if the ſubject be an adult, and of a corpulent habit of body, the finger, under theſe circumſtances, not being found to be ſufficiently long for the purpoſe, he muſt have recourſe to a female catheter, or ſome other inſtrument that is nearly ſtrait, quite ſmooth and poliſhed, and of about nine or ten inches long; which will ſerve the purpoſe equally well, if of a proper form and thickneſs. This is the method I have made uſe of upon the like occaſions of late years, without giving any great degree of pain to the patient, or conſiderably retarding the operation.

Since I have had the opportunity of making the following obſervation, as well as a prior obſervation

tion ſomething ſimilar to this, where two rough ſtones were extracted by me a few years ago from a young man's bladder of 15 years of age, I cannot help ſuſpecting, that there may have been inſtances of one or more ſtones being left behind in the bladder at the time of operating, merely from the operator's putting too great a confidence in this general rule. Which ſuſpicion I am led into from having known people, who have undergone the operation of cutting for the ſtone, relapſe into the like diſorder in a ſhort time after the healing of their wounds, attended with ſuch ſymptoms, as have obliged them to ſubmit to a ſecond operation; when the ſtone, upon being extracted, has appeared of ſo conſiderable a ſize, as to make it ſuſpicious, that this ſtone muſt probably have been of a much longer growth, than the ſhort time betwixt the two operations could admit of. The maxim laid down to us by authors, of a ſmooth and poliſhed ſtone in the bladder being never there alone, but always accompanied with one or more ſtones of the ſame kind, I know no exception to. But if this phænomenon ſhould ever occur, the ſtrict obſervance of that rule (delivered to us by judicious writers in ſurgery) of always ſearching the bladder under the like appearances, on preſumption of one or more ſtones being left behind, cannot be attended with any future miſchief to the patient, when carefully executed by the methods recommended above, and undoubtedly ſhould always be ſtrictly attended to. The ſmooth and poliſhed appearances of the ſurfaces of human *calculi* are univerſally ſuppoſed to ariſe from their rubbing one againſt the other; which may with reaſon be ſup-

poſed

poſed to be the caſe: but I confeſs this inference is not ſatisfactory to me; ſince it is probable, if this was the ſole cauſe of their ſmoothneſs, the ſame effect would probably be always produced, when attended with the ſame degree of friction. But as this may be conſidered as a matter of mere ſpeculation, I refer the deciſion of this point to thoſe of ſuperior abilities.

C A S E.

Mr. William Woodhams, a gentleman farmer, of a corpulent habit of body, in the 46th year of his age, now living in the pariſh of Udimore, within three miles of Rye in Suſſex, was attacked about eight years ago with ſevere complaints in his loins, accompanied with an incapacity of voiding his urine without the aſſiſtance of proper medicines, which were adminiſtered to him by a neighbouring apothecary for that purpoſe. Theſe medicines had the deſired effect: they promoted a ſecretion, and an evacuation of urine; which appeared to be loaded with a conſiderable quantity of gravelly particles mixed with a *mucus* of a whitiſh colour. In the ſpace of three weeks he had perfectly recovered from this attack, and continued well for near five years afterwards, without any return of his complaint, except when he rode hard on horſeback, or drank more freely of ſtrong liquors than uſual. At the expiration of five years he was ſeized with an acute fever, of which he recovered in a few weeks.

Very ſoon after his recovery from this illneſs, he began to complain of exceſſive pain in voiding his urine, or upon going to ſtool; which ſymptoms were

were ſo greatly increaſed for many months before he ſubmitted to the operation, as to quite diſable him from riding, from walking, or from uſing any kind of exerciſe. His urine, of late, was continually and involuntarily flowing from him in ſmall quantities. He complained of great pain and ſoreneſs in his fundament, attended with a *teneſmus.* This account he delivered to me on the ſecond day after the operation; and at the ſame time he very feelingly told me, that he had enjoyed but very few and ſhort intervals of eaſe for the three laſt years, till ſince the operation.

On the 30th of January 1758, I cut him, at his own houſe in Suſſex, having firſt prepared him for the operation in the manner, that is uſual upon the like occaſion. In the operation, I extracted the four ſtones, which I now have the honour of laying before the Royal Society. The whole ſurfaces of theſe ſtones appear to be rough, not having the leaſt marks of ever having rubbed againſt each other during their confinement in the bladder: but yet I conjecture this muſt frequently have been the caſe, as there was no difficulty in embracing theſe *calculi* with the forceps: for had they been contained in different cells or pouches in the bladder, which ſometimes have been obſerved from diſſections, this circumſtance would, in all probability, have rendered it impracticable for me to have ſo immediately got at them, if at all.

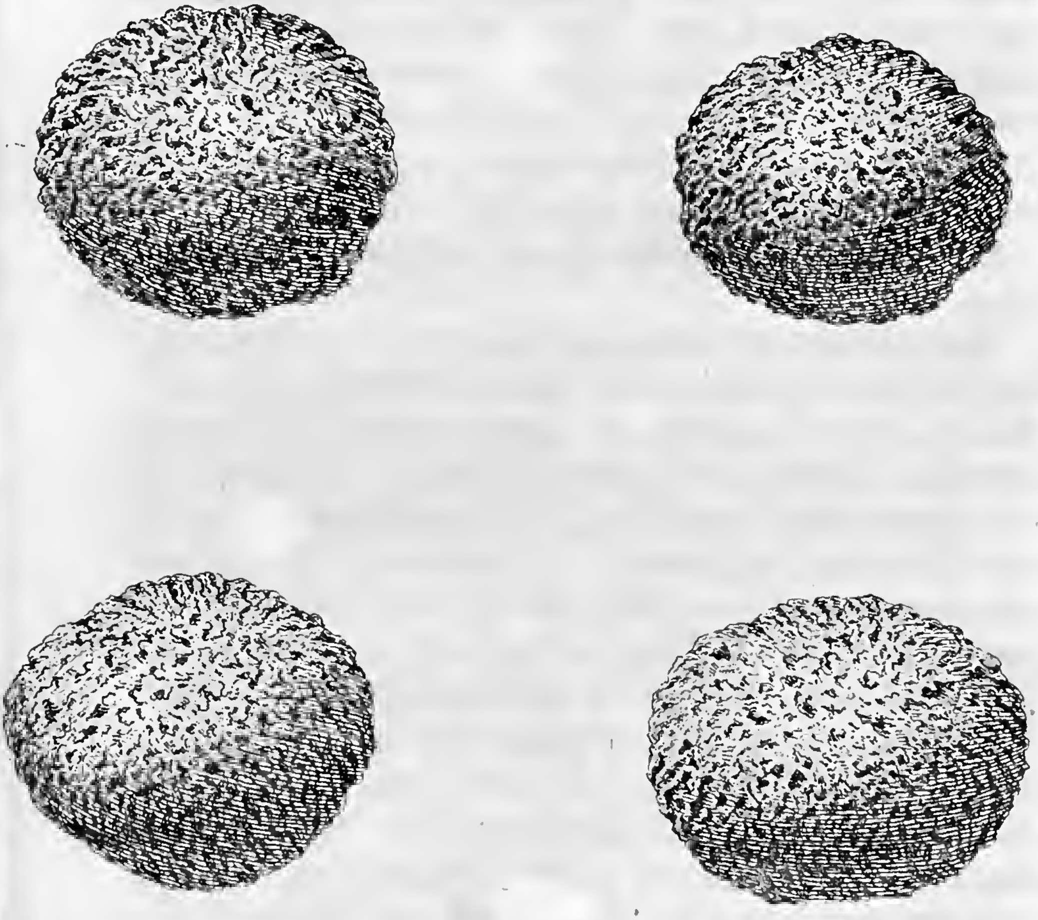
The forceps was introduced only three times into the bladder for effecting the extraction of the three firſt ſtones, and only twice for the extraction of the fourth ſtone. Beſides theſe four ſtones, which I have preſented to the Society for their inſpection, I thought

it

it not improper to produce, at the ſame time, ſome other human *calculi*, for their further ſatisfaction, each of which was found ſingle in the urinary bladders of different ſubjects. The ſurfaces of theſe ſtones may be obſerved to be much ſmoother than the ſurface of either of the four ſtones, that were extracted from Mr. Woodhams's bladder in the operation I have juſt now recited; and therefore it was more reaſonable to expect to find each of theſe ſtones accompanied with one or more ſtones in the ſame bladder (according to the received opinion), than it was to find more ſtones than one in the caſe of Mr. Woodhams's, which has given riſe to theſe obſervations.

But as the fact before us does of itſelf ſhew the impropriety and danger of determining from the ſurfaces of ſuch extraneous bodies, perhaps it may be thought needleſs to enlarge upon this ſubject, to ſtrengthen thoſe precautions ſo reaſonable to be obſerved in this operation. However, as I have already taken notice of the ſmooth and poliſhed appearances of the ſurfaces of ſuch ſtones, as are probably never found ſingle in the bladder; I have produced two ſtones of this kind, that were extracted from the ſame bladder, to ſhew, that theſe ſtones do no more reſemble thoſe ſtones of Mr. Woodhams's, than a piece of poliſhed marble can be ſaid to reſemble a rough block of the ſame ſpecies.

P. S. I am informed, by a letter from Suſſex, dated the 18th inſtant, that Mr. Woodhams is perfectly well in health; that the whole of his urine had paſſed through the urethra for the laſt



This Plate *is an exact representation of the Sizes and external appearances of the four rough Stones described in the preceding paper*

J. Mynde sc.

laſt five or ſix days; and that his wound will, in all probability, be ſoon healed.

Hatton-Garden,
February 22. 1758.

Joſeph Warner.

LXXVII. *Obſervations on the* Limax non cochleata Purpur ferens, *The naked Snail producing Purple. By* John Andrew Peyſſonel, *M. D. F. R. S. Tranſlated from the* French.

Read Feb. 23, 1758.

AMONG the fiſh we meet with in the ſeas of the Antilles of America, we find, that this I am going to deſcribe will appear precious, from the beautiful purple colour it produces, in the ſame manner, that the cuttle-fiſh produces its ink, if a means could be found to procure this liquor in a ſufficient quantity to render it an article of commerce. Theſe fiſhes are ſoft, viſcous, without ſhells, ſcales, or bones; are of the nature of the *polypi*, and ſuch other kinds, without feet, fins, or any thing to ſupply their places. Their motion is vermicular; and, like the ſlugs, they wreath themſelves up, and when touched make themſelves quite round.

They fill up certain membranes of the body with water. Their local motion; *antennæ*, which they lengthen and contract; and a great many other properties, which they have in common with ſnails, ſlugs, and turbinated ſhell-fiſh, made me call them naked ſnails: and altho' they have not the moſt eſſential qualities of ſnails, I thought I might give them the name; for they have no particular appellation in this country. Some call them piſs-a beds, ſome ſea-cats, and others a leſs modeſt name, *tapecon*, taken from Pliny. The Negroes and country-people diſagree upon this ſubject; and therefore I thought all their names ought to be rejected, in order to adopt a more ſignificant one, which I have given them; and that altho' they are without ſhells, a quality eſſential to ſnails, they had a right to that claſs by their other properties and qualities.

This fiſh is commonly four inches long, and two thick; of a greeniſh colour, ſpotted with black, each of which forms a circle. The under part is like that of ſnails, flat, with kinds of *mamillæ*, or rugoſities, which are adheſive; by means of which they advance in a vermicular motion; and when touched become round, by retracting their neck and head; and afterwards protrude them conſiderably, according to their motion and progreſſion, crawling upon rocks to ſeek their food.

The head of this animal has a flatneſs, or is inclinable to a ſquare or parallelogram. On each ſide there are membranes or ſkins, which form kinds of ears; and under them others, which at times fill with water, and are then tranſparent. Under this thick ſkin there is a *cranium*, of a kind of coriaceous or cartilaginous matter; and in the *cranium* we find the brain, which is a white ſubſtance, and very firm. At the baſis of the head its oval wide mouth is placed, being above two lines long, which often diſcovers a white hard edge, with which he crops the fucus's, and other ſea-plants, for his nouriſhment.

About half an inch from the ears there are two horns,

horns, or *antennæ*, like thoſe of ſome teſtaceous animals, which ſerve them for eyes; and theſe *antennæ* extend and contract at will, turning to either ſide alſo. The *oeſophagus* begins at the upper and inner part of the mouth, which is a delicate long tube; near which there is another thick one, and made nearly like the colon, which leads to a bag, or the firſt ſtomach, which may be likened to the craw of a fowl: it is always filled with fucus mixed with ſand. Sometimes this ſtomach is double, or at leaſt lengthens itſelf conſiderably, and the aliment parts it, as it were, into two portions. After this craw, or ſtomach, we find another, which performs the ſame office with the gizzard of fowls. The membranes are thick, and are ſet with twelve ſtones, or horny pieces, of a bright yellow colour, and as tranſparent as fine yellow amber, ending in points like a diamond; ſo that the great ſide, or baſis, is ſet into the membrane of the gizzard as a diamond in its ſocket: others differ in ſize, having different figures, that in acting all together they may be able to break and grind the herbs the animal feeds upon, as well by the ſtrength of the muſcle or gizzard, which puts them into action, as by the ſituation of theſe ſtones, aſſiſted by grains of ſand found in it, turning the whole by this trituration into a liquor. Afterwards, what was thus triturated by the power of the gizzard paſſes into a third belly or ſtomach, which is covered by a purple body, reſembling the *parenchyma* of the liver, and nearly of the ſame conſiſtence: then this belly turns into a long tube, which ſurrounds this *parenchyma*, and is covered in like manner by a very fine membrane: it is full of a white liquor, like chyle, and goes to diſcharge itſelf into another reſervoir, at the ſide of which is a yellowiſh gland, like a *pancreas*. From theſe two bodies or glands, one of which may be called hepatic, and the other pancreatic, two conduits paſs out; that of the *pancreas* is white, the other of a blackiſh purple: the firſt conducts its chyle, condenſed, into a reſervoir or bladder, which may be reſembled to the *receptaculum chyli* of Pequet, and from thence paſſes to the fecal matter: the other conducts to a body made like the meſentery, but which is always found out of the common capacity or cavity, in which all the *viſcera* are contained; which I thus deſcribe:

This common capacity is very large, beginning at the head and ending at the tail of the fiſh: it is ſometimes filled with a yellowiſh water, and is formed by the fleſhy body of the animal; which is only a membrane compoſed of fibres every way interwoven together, open at the top, where the organs are ſituated, which contain the purple juice.

There is a hollow upon the back of the animal, where the canal, filled with a reddiſh juice, paſſes out, carrying it to a fringed body like a meſentery; and it is there the purple juice is brought to perfection; and afterwards goes to a long ſack lying under a kind of horny plate, not like the bone of the cuttle-fiſh, but like the bone of the *ſepia*, or little cuttle-fiſh, which we call *le couteau*. This bone, or horny ſubſtance, is tranſparent; and is of a triangular figure, or approaching the form of a bivalve ſhell. On the right ſide it is faſtened by a ſtrong cartilaginous muſcle, which binds it to the body of the animal; and on the left it is open and detached, and eaſy to be pulled up: then it is eaſy to ſee underneath both the meſenteric body, and the tube or reſervoir of the purple juice. This bone, or horny plate, is covered by a loofe membrane, which is by no means attached to it, but capable of being filled and inflated with water or wind.

The whole is covered with two membranes, which are continuations of the flefh of the fifh's body: the membranes are loofe, and larger than are neceffary to the bone: they are wrinkled or rumpled over one another, to cover the whole, and to defend the bone and *vifcera* from all kinds of preffure; but they are ready to ftretch one from the other, and leave the parts deftined for the purple juice uncovered. They begin a little under the neck, and extend, in the female animal, to the tail, which is flat; and in the male they do not go fo low, but end at fome diftance from the tail.

The females are oviparous; for eggs are found in the grand cavity, at the fide of the pancreatic body.

I have already faid, that when the animal is touched, he makes himfelf round, and throws out his purple juice, as the cuttle-fifh does his ink. This juice is of a beautiful deep colour: it tinges linen, and the tincture is difficult to get out. It remains at prefent to try if we can collect a fufficient quantity of this juice, and to find a means of preferving the tincture; which would then be certainly of great value: to which purpofe I may apply myfelf.

When the fifh is boiled, or put into fpirits, it fhrinks up, and lofes two thirds of its fize; becaufe all the water, which is in the interftices of the fibres, is diffipated, and the dried fibres contract: which clearly appears from diffecting them.

Dated at Guadaloupe,
20 Mar. 1757.

Peyffonel.

LXXVIII. *New Obſervations upon the Worms that form Sponges.* *By* John Andrew Peyſſonel, *M. D. F. R. S.* *Tranſlated from the* French.

Read Feb. 23. 1758.

THE exiſtence of the neſts of corallines and lithophyta, and the mechaniſm of their polypi, made me conjecture, that it was the ſame with reſpect to ſponges; that animals, neſted in the interſtices of their fibres, gave them their origin and growth: but I had not yet ſeen nor diſcovered the inſects, nor obſerved their work. Sponges appeared to me only as ſkeletons: but I at length diſcovered theſe worms, which form ſponges, in the four following ſpecies:

1. *Spongia Americana tubo ſimilis*; The tube-like ſponge of Plumier.

2. *Spongia Americana longiſſima funiculo ſimilis*; The cord-like ſponge of Plumier.

3. *Spongia Americana capitata et digitata*; The fingered ſponge of Plumier.

4. *Spongia Americana favo ſimilis*; The honey-comb ſponge of Plumier.

Theſe four kinds only differ in form: they have the ſame qualities, are made by the ſame kinds of worm, and what may be ſaid of the one agrees exactly with all the reſt; for I made the ſame obſervations upon them all.

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They may be claſſed among the *ſpongiæ hyrcinæ*, ſo called by J. Bauhin, becauſe of the roughneſs of their fibres, by a metaphor, from pieces covered with mud; or among thoſe called by Pliny *tragos*, or *aphyſiæ*, being foul, and difficult to cleanſe; and may take the name, which Father Plumier has given them, drawn from their figure.

Theſe four kinds of ſponges are compoſed of hard, firm, dirty fibres, ſometimes brittle; ſeparated one from another, having large hollows, or cylindrical tubes, diſperſed thro' their ſubſtance. Theſe tubes are ſmooth within. The interſtices of their fibres are filled with a mucilaginous gluey matter, when the ſponge is juſt taken out of the ſea. The mucilage is of a blackiſh colour, ſoon putrifies in the water, or falls into duſt when dried in the ſun.

When a freſh ſponge is ſqueezed, this mucilage comes out frothy, by the mixture of the windings of its fibres: it always iſſues forth with ſand, or little parcels of ſhells cruſhed by the ſea. Theſe fibres, which conſiſt of the twiſted doubles of the ſponge, form as it were a labyrinth filled with worms, which are eaſily cruſhed, and their juice is confuſed with the mucilage; but having carefully torn the ſponges, and their groſs fibres, I diſcovered the living worms, ſuch as I ſhall mention hereafter.

Theſe ſpecies of ſponge commonly grow upon ſandy bottoms. At their origins we perceive, as it were, a nodule of ſand, or other matter, almoſt petrified, round which the worms begin to work, and round which they retire, as to their laſt ſeat or refuge; where I had the pleaſure of ſeeing them play, exerciſe themſelves, and retire, by examining them with the

the microſcope; and I have even made my obſervations without its aſſiſtance.

A Deſcription of the Worms which form the Sponges.

The worms I found in theſe kinds of ſponges are about one-third of a line thick, and two or three lines in length. They are ſo tranſparent, that one may diſcern their *viſcera* thro' their coverings and ſubſtance: the blood may be ſeen to circulate, and all their parts to act. They have a conic figure, with a ſmall black head furniſhed with two pincers: the other extremity is almoſt ſquare, and much larger than the head. Upon the back may be ſeen two white ſtreaks or fillets, as if they contained the chyle: theſe two canals are parallel to each other from the head to the other extremity, where they come together. In the middle, where the belly and *viſcera* ought to be placed, a blackiſh matter is perceivable, which has a kind of circulation: ſometimes it fills all the body of the worm, ſometimes it gathers towards the head, or at the other end, and ſometimes it follows the motion of the animal. This vermicular motion or progreſſion begins at the poſterior extremity, and ends at the head, which is puſhed, and conſequently advances forward. I kept theſe worms alive out of the ſponge, quite detached from it, more than an hour, having examined them thoroughly with a middling magnifier; for a great magnifier would be the grave of the inſect.

I was ſurpriſed, after having finiſhed my obſervations, when I put them near a piece of the freſh ſponge, where the neſts were moiſt, and from which I had

I had pulled them, to ſee them enter into them, and diſappear, being loſt in the windings of the tubes. I thought to have found them again; but it was a difficult taſk to ſearch for them. I cruſhed them, or they were themſelves maſhed in the tubes, which I preſſed, and of which I had conſequently ſpoiled the texture; but I could not find them; and this happened ſeveral times.

Theſe worms have no particular lodge: they walk indifferently into the tubular labyrinth. So that, without offence to Pliny and other naturaliſts, I do not ſee, that it is in their power to dilate and contract the bodies of the ſponges; which always remain in the ſame ſtate of magnitude, without being any way ſenſible to the touch, or any other motion of the ſea, nor to any other accident whateſover, being an inanimate body; for the animal ſenſitive life, or whatever you will have it, belongs only to the worms, that form theſe bodies, and which are their dwelling-places; and which, by the ſlaver or juice they depoſit, make the ſponge increaſe or grow, as bees, waſps, and eſpecially the wood-lice of America, increaſe their neſts or cells.

Theſe ſponges, neſts, or cells, are attached to ſome ſolid body in the ſea. Some kinds are fixed to rocks; others, as thoſe I am ſpeaking of, are faſtened to heaps of ſand, or to pieces of petrified matter, and even upon ſandy bottoms; and the ſea putting in motion the ſand, and the little parcels of broken ſhells, forces them into the holes of the ſponge: there the ſand binds and mixes with mucilaginous juice, and never is looſed from it but when the ſponge is well dried, or with the mucilage when

 putrified,

putrified, or in powder; and yet ſome part will remain, which it is very difficult to take out from the twiſted canals, eſpecially in thoſe ſponges of the *tragos* kind, ſo hard to cleanſe. In a word, the blood or humours, which the ancients have obſerved, is no other than the mucilage or juice of the ſubſtance of theſe worms.

Dated at Guadaloupe,
1 March, 1757.

LXXIX. *Account of an Experiment, by which it appears, that Salt of Steel does not enter the Lacteal Veſſels; with Remarks. In a Letter to the Rev.* Tho. Birch, *D.D. Secr. R.S. By* Edward Wright, *M.D.*

SIR,

Read Mar. 2, 1758.

THO' iron is univerſally allowed to be one of the moſt powerful medicines now in uſe, yet many phyſicians obſerving, that the *fæces* of patients, who uſed it either in a metallic or ſaline form, were tinged of a black colour, have been led to think, that, in a metallic ſtate, it could not be reduced into particles fine enough to be received by the lacteal veſſels; and if taken in a ſaline form, that it underwent a precipitation in the inteſtines, by which, being reduced to an earth or calx, it was in like manner rendered incapable of making its way into the blood. But the accurate experiments, with which Signor Menghini has favoured the public in the Memoirs of the Bononian Academy *, ſufficiently prove, that the ore and filings of iron, finely levigated, enter the blood in conſiderable quantity; as does alſo the *crocus*, *calx*, or earthy part of the metal, tho' in leſs proportion than the two former, which were found to act with a violent *ſtimulus* on the veſſels, and to have diſſolved and broke the *craſis* of the blood of different animals, that had uſed them for ſome weeks in large doſes mixed with their ordinary food. Tho' it muſt be allowed, that theſe experiments are very curious, yet the ſubject ſeems to require a further inquiry, viz. *Whether iron is capable of entering the blood in a ſtate of ſolution, or under a ſaline form:* for, from the violent *ſtimulus*, as well as from the diſſolution of the blood, and other ſymptoms brought on by the uſe of the ore and filings, theſe ſubſtances (not being properly diſſolved) appear to have acted in a manner ſo groſsly mechanical, that, whatever Signor Menghini may think, very little is to be concluded from them, with regard to the action of iron on the human body, in ſuch caſes, as indicate its uſe, and where a rational phyſician would think proper to preſcribe it as a medicine.

Having read Signor Menghini's memoir, I recollected, that in the year 1753 I had, with the aſſiſtance of two friends, made the following experiment, in order to diſcover, whether iron, in a ſaline form, is capable of entering the lacteals.

An ounce and a half of ſalt of ſteel diſſolved in a ſufficient quantity of water, filtrated and mixed with

* Vincentius Menghinus *de Ferrearum particularum progreſſu in Sanguinem. Comment. Acad. Bonon.* T. 11. P. 2. pag. 475.

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about a pound of bread and milk, were forced down the throat of a dog, that had been kept faſting for 36 hours. An hour after he had ſwallowed this mixture, having ſecured him in a ſupine poſture, as is uſual in ſuch experiments, we opened the abdomen, and obſerved the lacteal veſſels, like white threads, running along the meſentery in a very beautiful manner. Upon ſlitting open part of the ſmall guts, we there found a good deal of the mixture, which appeared frothy, but without any black colour, or the leaſt ſign of the ſalt being precipitated; and ſtruck a deep inky colour with infuſion of galls. Tho' the white colour of the lacteals convinced us, that they were full of chyle, yet, as it would have been impoſſible to have collected a ſufficient quantity of it from them, we found it neceſſary to open the thorax, and tie the thoracic duct a little above the receptacle, which, from the ligature, ſoon became turgid, the animal being alive and warm, and the chyle ſtill continuing its courſe towards the thoracic duct. Having cut open the receptacle, we eaſily collected a ſufficient quantity of chyle, and immediately mixed therewith, drop by drop, infuſion of galls; a very ſimple and eaſy method, by which an incredibly ſmall quantity of ſalt of ſteel may be diſcovered in moſt liquors: but not the ſmalleſt change of colour was obſerved, tho' they were rubbed together for ſome time, and allowed to ſtand ſeveral hours. Now had there been a ſingle atom (ſo to ſpeak) of the ſalt in ſo ſmall a portion of chyle, as that uſed in this experiment, which was, as near as I could gueſs, ſomewhat leſs than half an ounce, it is not to be imagined, that it could have failed to

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difcover itfelf by this method of trial; for upon adding one fourth of a grain of the falt, this mixture inftantly became of a bright purple: and I have found, by other experiments, that the fmalleft quantity of falt of fteel fhews itfelf as readily in the chyle by galls, as in any other liquor of the fame confiftence.

This experiment (which was as fair as could have been defired), together with another obfervation I have made, *viz.* that neither the blood nor urine of patients, during the ufe of falt of fteel, in the leaft change colour with galls, renders it more than probable, that this falt *does not enter the blood.*

As the falt was found to have undergone no change in the fmall guts, it appears, that it is not prevented from entering the lacteals by its being decompofed or precipitated, as has been imagined; but, on the contrary, that what renders it incapable of being received by thefe veffels, is its *aftringency:* for the lacteals feem to be endowed with that admirable faculty of admitting fuch particles of pure chyle as they happen to be in contact with, and of accommodating their diameters to them, at the fame time that by their natural irritability, and power of conftriction they obftinately exclude fuch as are aftringent; which, were they to enter the lacteals, would either produce dangerous obftructions in thefe veffels, or, if they got into the blood, would occafion polypous concretions in the larger veffels, or coagulations incapable of being tranfmitted thro' the minute veffels of the lungs; the effects of which would be either fudden death, or at leaft inflammations and fuppurations from obftructions in the pulmonary veffels; inconveniences, which

which nature, by precluding aſtringents from entering the lacteals, has carefully and wiſely avoided.

Salt of ſteel, taken internally, muſt retain its aſtringency until it be precipitated; which can ſcarce ever fail to happen in the great guts, from the putrid *fæces* they contain, which are always obſerved to be tinged of a black colour from the metallic baſis of the ſalt, part of which, as it has little or no aſtringency, may, no doubt, enter the blood, as Signor Menghini obſerved of the *crocus*, which is the ſame ſubſtance; and we know, from the experiments of Liſter and Muſgrave †, that particles much groſſer than thoſe of the white chyle, provided they be not aſtringent, or very acrid, are conveyed by the lacteals. But the metallic baſis being ſeparated from its acid, and thus reduced to a mere calx or earth, can ſcarce be ſuppoſed to have any medicinal quality whatſoever, or at leaſt to have any ſhare in the virtues juſtly attributed to ſalt of ſteel.

As this ſalt is not only aſtringent, and conſequently a ſtrengthener, but at the ſame time acts with a gentle *ſtimulus*, all its virtues (which are known to be very great in diſeaſes, where the fluids are either viſcid, cold, and phlegmatic, or diſſolved and watery, from a laxity of the ſolids) may be accounted for from its immediate effects on the ſtomach and *primæ viæ*, and on the ſyſtem of the ſolids in general by conſent; which it would be needleſs to illuſtrate by ſimilar examples, becauſe well known to every one the leaſt verſed in medical ſtudies. I ſhall therefore only beg

† Phil. Tranſact. by Lowthorpe, vol. iii. p. 102. edit. 1749. the ſame by Jones, vol. v. p. 259.

leave,

leave, from the obvious qualities of this medicine, and from what has been obſerved above, to deduce the following corollaries.

1. That ſalt of ſteel has no deobſtruent or aperient virtue by any immediate action, that it can poſſibly have on the blood, or other animal fluids, as ſome have imagined; but that, on the contrary, it owes this quality to its *not entering the blood*, which it would otherwiſe coagulate, and to *its action on the ſolids alone*.

2. That in diſeaſes proceeding from a laxity of the ſolids, great care ought to be taken to reſtore and invigorate the *primæ viæ*; ſince a medicine (and this we may preſume not the only one) whoſe immediate action is confined to thoſe parts, is yet found by experience to produce ſo ſalutary effects in ſuch diſeaſes.

3. That as this ſalt does not enter the blood, and conſequently cannot be in danger of too much ſtimulating or conſtricting the veſſels, on which it only acts by conſent, it may, in ſmall doſes, be ſucceſsfully uſed in many caſes, where it has been imagined to be hurtful, particularly in conſumptions of the lungs, ſo frequent and fatal in this iſland; which are commonly attended with too great a laxity of the *primæ viæ*, and of the ſolids in general, tho' they ſeem more immediately to proceed from a laxity and weakneſs of the pulmonary veſſels; in which circumſtances it muſt be of the utmoſt conſequence to reſtore the tone of thoſe principal organs of chylification, the *primæ viæ*; as good chyle not only corrects the acrimony of the blood, which in the advanced ſtages of conſumptions ſo much prevails, but likewiſe ſaves

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a great deal of labour, which the lungs (already too much oppreſſed) muſt otherwiſe undergo from a crude and ill-concocted chyle. Agreeably to this we find, in the *Eſſays Phyſical and Literary* of Edinburgh *, two well-vouched hiſtories of patients far gone in conſumptions, with the uſual ſymptoms of pain in the breaſt, cough, groſs ſpitting of fetid matter, difficulty of breathing, hectic fits, and morning ſweats, perfectly cured in a few weeks, by the uſe of the Hartfell-Spaw near Moffat; which, contrary to what is obſerved in moſt natural chalybeat waters, contains a fixed vitriol of iron.

These, Sir, are the few obſervations I had to make at preſent on this ſubject. I have taken the liberty to addreſs them to you, in order, if you ſhall think proper, to be communicated to your illuſtrious Society; which, I hope, will continue to lateſt poſterity thoſe intereſting reſearches for the advancement of every branch of natural knowlege, by which it has already acquired ſo much and ſo deſerved honour; and am, with the greateſt reſpect,

S I R,

Your moſt obedient humble Servant,

Strand, Feb. 28. 1758. Edward Wright.

* Vol. I. art. xii. p. 364.

LXXX.

LXXX. *A Dissertation on the Antiquity of Glass in Windows. In a Letter to the Rev.* Tho. Birch, *D. D. Secret. R. S. By the Rev.* John Nixon, *M. A. F. R. S.*

Dear Sir, London, March 2. 1758.

Read Mar. 2, 1758.

I Had the honour last winter to lay before the Royal Society a few observations upon some of the curiosities found at Herculaneum, &c. (1). Among other articles, I just mentioned a piece of a plate of white glass; and now beg leave to inquire into the uses, to which such plates might be applied in the early age, to which this fragment undoubtedly belongs.

And here a person, who forms his ideas of ancient customs by what he sees practised in later times, may be ready to offer several conjectures; in some of which he will, probably, be mistaken; as in others he may be justified by the genuine evidences of antiquity.

And, first, It is obvious to imagine, that such plates might serve for *specula*, or looking-glasses. And, indeed, that *specula* were anciently made, not only of metals, and some stones, as the (2) phengites, &c. but also of glass, may, I think, be collected from Pliny, who, having mentioned the city of Si-

(1) In a paper read Feb. 24. 1757. See Art. xiii. p. 88.

(2) *Porticuum, in quibus spatiari consueverat (Domitianus) parietes phengite lapide distinxit, e cujus splendore per imagines quicquid a tergo fieret, provideret.* Sueton. Domit. c. 14.

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don as formerly famous for glaſs-houſes, adds immediately afterwards, *Siquidem etiam ſpecula excogitaverat* (3). But then it is to be obſerved, that before the application of quickſilver in the conſtructing of theſe glaſſes (which, I preſume, is of no great antiquity), the reflection of images by ſuch *ſpecula* muſt have been effected by their being beſmeared *behind*, or tinged *thro'* with ſome dark colour, eſpecially black, which would obſtruct the refraction of the rays of light (4). Upon theſe hypotheſes (ſuppoſing the tincture to be given after fuſion) the *lamina* before us may be allowed to be capable of anſwering the purpoſe here aſſigned.

It may further be ſuggeſted, that plates of this kind might be intended to be wrought into lens's, or convex glaſſes, either for burning, or magnifying objects placed in their focus. But this deſignation cannot be ſupported by proper vouchers from antiquity. On the contrary, we are informed, that the ancients uſed either *ſpecula* (5) of metal, or balls (6) of glaſs for

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(3) Plin. Nat. Hiſt. lib. xxxvi. c. 26. §. 66.

(4) Pliny mentions a kind of glaſs or jet called *obſidianum*:—*nigerrimi coloris, aliquando et tranſlucidi. craſſiore viſu, atque in ſpeculis parietum pro imagine umbras reddente*. Nat. Hiſt. lib. xxxvi. c. 26. §. 67.

And that the practice of ſtaining glaſs was known in his time, appears from what he ſays concerning the *obſidianum* mentioned above:—*Fit et genere tincturæ—totum rubens vitrum, atque non tranſlucidum*. Ibid.

(5) Panciroll. Rer. Mem. p. 288.

(6) Theſe glaſs balls had ſometimes water within them: *Cùm additâ aquâ vitreæ pilæ ſole adverſo in tantum excandeſcant, ut veſtes exurant*. Plin. lib. xxxvi. c. 22. §. 45.

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for the former of theſe purpoſes; as it is well known, that glaſs was not applied to the latter, in optical uſes, till the beginning of the XIIIth century (7).

However, we may with greater probability propoſe another uſe, for which the ancients might employ ſuch plates of glaſs, as are now under conſideration, *viz.* the adorning the walls of their apartments by way of wainſcot. This I take to be the meaning of the *vitreæ cameræ* mentioned by Pliny (8); who intimates, that this faſhion took its riſe from glaſs being uſed by M. Scaurus (9) for embelliſhing the ſcene of that magnificent theatre, which he erected for exhibiting ſhows to the Roman people in his ædileſhip (10). And we may collect from the ſame author (11) (what is further confirmed by his contemporary (12) Seneca), that this kind of ornament had

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Invenio medicos, quæ ſunt urenda corporum, non alitèr utilius id fieri putare, quam cryſtallinâ pilâ adverſis poſitâ ſolis radiis. Plin. Nat. Hiſt. lib. xxxvii. c. 6. §. 10.

(7) Vid. Monſ. Renaudot Memoires de l'Acad. des Inſcript. tom. I.

(8) Vid. infra, not. 11.

(9) *Theatrum Scauri —— ſcena ei triplex in altitudinem* CCCLX *columnarum. —— Ima pars ſcenæ e marmore fuit :* media e vitro : *ſumma e tabulis inauratis.* Nat. Hiſt. lib. xxxvi. c. 15.

(10) A. V. 678. Hard. not. Plin. lib. xxxvi. c. 8.

(11) *Agrippa in thermis, quas Romæ fecit, figlinum opus encauſto pinxit, in reliquis albaria adornavit : non dubiè* vitreas facturus cameras, ſi prius inventum id fuiſſet, *aut a parietibus ſcenæ — Scauri perveniſſet in cameras.* Lib. xxxvi. c. 25. §. 64.

(12) Seneca, expoſing the luxury of the Romans with regard to their baths, ſays, *Pauper ſibi videtur ac ſordidus, niſi parietes magnis ac pretioſis orbibus refulſerint — niſi* vitro abſconditur camera. — Ep. 86.

 been

been admitted, in his time, into chambers in houſes, baths, &c. Whether the plates uſed for this purpoſe were ſtained with various colours (as mentioned above), or had tints of divers kinds applied to the back part of them, I ſhall not pretend to determine: but in either way they would have a very agreeable effect.

The laſt deſtination, which the obvious congruity of the thing itſelf, countenanced by the practice of many ages paſt, as well as of the preſent time, would induce one to aſcribe to ſuch plates of glaſs, is that of windows for houſes, baths, portico's, &c. But I am ſenſible, that whoever ſhould be hardy enough to advance ſuch an hypotheſis, would be cenſured as an innovator, in oppoſing the general opinion of the connoiſſeurs in antiquity. Theſe gentlemen are almoſt unanimous in aſſerting, that whenever we meet with mention made of *ſpecularia* in ancient writers (eſpecially thoſe *of*, or near *to*, the age, to which we muſt refer this fragment), we are to underſtand by that term nothing but fences made of *laminæ*, either of a certain ſtone called from its tranſparent quality *lapis ſpecularis* (13), brought firſt from Hiſpania Citerior, and afterwards found in Cyprus, Cappadocia, Sicily, and Africa; or of another ſtone of the ſame nature, *viz.* the phengites. Theſe, tho' expreſsly diſtinguiſhed from each other by Pliny (14), are yet reckoned by ſome moderns (15) as one and

(13) Plin. Nat. Hiſt. lib. xxxvi. c. 22. §. 45.
(14) Nat. Hiſt. lib. xxxvi. c. 22. §. 45.
(15) Vid. Salmaſius in a paſſage to be produced hereafter.

the ſame thing; and thought to have been nothing but a kind of white tranſparent talc, of which (according to Monſ. (16) Valois) there is found a great quantity in Moſcovy at this day.

Now that this *lapis ſpecularis*, or phengites, was really uſed for windows by the ancient Romans in their houſes, *&c.* cannot be denied; ſince (according to the opinion of the learned (17) in antiquity) this uſage is mentioned by Seneca (18) among other improvements in luxury introduced in his time. But whether it was ſo uſed excluſive of other materials (particularly glaſs), may, I think, admit a doubt. Salmaſius is of opinion (19), that nothing can be determined upon this point from the word *ſpecular* itſelf, which ſeems to be a generical term, equally applicable to windows of all kinds, whether conſiſting of the *lapis ſpecularis*, or any other tranſparent ſubſtance.

And as (according to this learned writer) there is nothing in the term *ſpecular* itſelf, which hinders it from being extended to windows made of other ma-

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(16) Hiſt. de l'Acad. des Inſcrip. tom. I.

(17) Montfauc. Antiq. vol. III. part i. lib. iii. c. 4. Lipſius in loc. *&c.*

(18) *Quædam noſtrâ demum prodiiſſe memoriâ ſcimus; ut ſpeculariorum uſum, perlucente teſtâ, clarum tranſmittentium lumen.* Sen. ep. 90.

(19) *Quod feneſtris obducebatur ad tranſlucendum, ac lucem admittendam* ſpecular *vetens Latini vocârunt. Idque ex ſpeculari lapide, quî eſt* φεγγιτης, *aut* ex vitro *fiebat, aut aliâ tranſlucidâ materiâ. Nam* ſpecular dictum, non quod ex ſpeculari lapide *factum eſſet, ſed quod viſum tranſmitteret, ac per id* ſpeculari *liceret.* Salm. Exerc. Plin. in Solin. tom. II. p. 771.

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terials besides those above-mentioned; so others imagine, that there are some intimations in ancient authors, which require, that it should actually be so extended. Thus Mr. Castells, the ingenious illustrator of the villa's of the ancients, thinks (20), that "if this had not been the case, Palladius would not "have given directions to his husbandman to make "*specularia* in the *olearium* (21), or store-room, "where the olives were preserved. For it appears "(says this author) from Pliny's describing a temple (22) built of the *lapis specularis*, or phengites, "as the greatest rarity in his time, and the mention "Plutarch makes of a room in Domitian's palace "lined with it, that it was not common enough "for husbandmen to purchase;" *viz.* in such quantities, as were required for the purposes mentioned above.

I shall not take upon me to decide upon the weight of this argument of Mr. Castells; but only observe, that if any one should be induced by it to think, that the use of glass for windows may be of much greater antiquity than is commonly allowed, or even as old as the fragment, which occasions these remarks, he may find other probable reasons to corroborate his opinion. As, first, that there seems to have been a natural and obvious transition from the practice of

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(20) Villa's of the Anc. illustrated, p. iv.

(21) One of Pliny's cautions for preserving apples is — *Austros specularibus arcere.* Nat. Hist. lib. xv. c. 16.

Martial further informs us, that the Romans used to screen their orchards of choice fruit-trees with *specularia.* Lib. viii. epig. 14.

(22) I suppose he means that of Fortuna Seia. Lib. xxxvi. c. 22.

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uſing glaſs plates for the ornamenting the walls of apartments to that of introducing light into thoſe apartments, (as we find the *lapis ſpecularis* was in fact employed at the ſame time for both thoſe purpoſes) and conſequently it ſeems reaſonable to ſuppoſe, that the latter of theſe applications could not be long in point of time after the former. But it appears from the authorities produced above, that the former of theſe uſages did actually ſubſiſt in the age (23) of Pliny; and therefore before the deſtruction of Herculaneum, where he loſt his life (24). From whence we may draw no improbable concluſion, that the latter deſtination of plates of glaſs, (*viz.* for window-fences) did likewiſe precede the ſame event.

Give me leave to add further, that this preſumptive argument in favour of the antiquity of windows made of plates of glaſs receives an additional force from the cloſe relation, which muſt be allowed to ſubſiſt between them, and thoſe compoſed of the *lapis ſpecularis.* The former muſt be looked upon as an improvement upon the other, as they anſwered

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(23) Salmaſius, ſpeaking of the cuſtom of adorning chambers with glaſs, ſays—*Quod proximè ætatem ſuam incepiſſe fieri narrat Plinius. Quum M. Scaurus*—— Ex. Plin. tom. II. p. 854.

I do not find this expreſly aſſerted by Pliny: but it might have been ſo in fact. This faſhion indeed was not begun till after Agrippa had built his *thermæ:* but if we ſuppoſe that to have been even as late as his third conſulſhip, *viz. ante Chriſt.* 27. (*Helvicus*), when he erected the Pantheon (or at leaſt its portico), near adjoining to thoſe *thermæ*, there would have been ſufficient room, from that period to the birth of Pliny (*viz. anno Chriſti* 24), for the introduction of this uſage.

(24) Plin. Ep. V. l. 111.

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all the purpofes of convenience, and at the fame time were more beautiful; and being the manufacture (25) of Italy, might probably be purchafed at a lefs expence. Upon all which accounts it feems reafonable to conclude, that one of thefe inventions would naturally be introductory to the other: and confequently, that as window-lights of the *lapis fpecularis* began to be ufed within the memory of Seneca, who died (26) under Nero, about *anno Chrifti* 68. *(Helvic.)*, the original of thofe of glafs may have fair pretenfions to a place within the period affigned in the foregoing paragraph, *viz.* fome years before the deftruction (27) of Herculaneum, in whofe ruins the plate before us was buried.

To conclude: I need not obferve to you, that all the evidence here produced to prove the ufage of glafs-windows to have been coæval with the fragment we are now confidering, is of the conjectural kind only: for, I muft confefs, I have not been able to trace it up by any pofitive authority higher than about 200 years fhort of the epocha laft mentioned, *viz.* to the latter end of the third century (28), when it is expreffly mentioned by Lactantius in thefe words: —*Manifeftius eft, mentem effe, quæ per oculos ea, quæ*

(25) Plin. Nat. Hift. lib. xxxvi. c. 26. §. 66.
(26) Vid. fupra.
(27) Anno Chrifti 80.
(28) In order to juftify my placing the teftimony of this Father fo high, I would obferve, that St. Jerome *(De Scriptor. Ecclef.)* fays, that Lactantius—*Extremâ fenectute magifter Cæfaris Crifpi filii Conftantini in Galliâ fuit.* He muft probably have exercifed this

quæ sunt opposita, transpiciat, quasi per fenestras lucente vitro aut speculari lapide obductas.— De opificio Dei, cap. v.

I am,

SIR,

Your most obedient humble Servant,

J. Nixon.

LXXXI. *An Account of an extraordinary Case of the Efficacy of the Bark in the Delirium of a Fever. By* Nic^s. Munckley, *M. D. Physician to* Guy's-Hospital, *and F. R. S.*

Read April 6. 1758.

AS the following case contains some circumstances, which are curious in themselves, and which may be of service to be known, I have thought it proper to be laid before the Society.

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this charge between *anno Christi* 309, when Constantine began to reign, and 320. If he was then of a great age, he might have composed the treatise, out of which this authority is produced, and which was one of the earliest of his works, that are extant (*Vid. Sparkii præf. ad Lactant.*), 40 years before, *viz.* about *anno Christi* 280; which brings us up to 200 years after the overthrow of Herculaneum, as above.

 On

On Sunday the 5th of March I was ſent for to a gentleman, of about 30 years of age, who had been for ſome days ill of a fever. I found him with a degree of heat conſiderably above what was natural, and with a pulſe rather low, but quick, and beating, as meaſured by a ſtop-watch, about a hundred ſtrokes in a minute. In this ſituation he continued, without any remarkable alteration, for the two following days; and, from the appearance of this diſeaſe, I imagined, that it would not be ſpeedily terminated. On Wedneſday, the third day of my ſeeing him, I found him however much better; his heat being conſiderably abated, and his pulſe being more than twenty ſtrokes in a minute ſlower than it had been the day before. On this alteration, ſo much in his favour, it might have been thought he was growing well, had it not been, that there was no appearance either by ſweat or urine, or on the ſkin, by which it could be imagined the diſeaſe was perfectly judged. On this account no alteration was made in his treatment that day: but finding, the next morning, that he had ſlept well the preceding night, and that his pulſe continued quiet, being no more than 74 ſtrokes in a minute, he was allowed to get up in the evening, to have his bed made; and I ſhould have thought him well, had not every appearance of a critical ſeparation been ſtill wanting. On this account, I thought him to be very liable to a return of his fever; and therefore, when early the next morning I was informed, that he had been without any ſleep, and quite delirious, the whole night, I was not greatly alarmed, as thinking he had a feveriſh paroxyſm, to which the bark would probably put an end. When I ſaw him that

that morning, I found him very delirious; but, to my great ſurpriſe, quite free from all kind of fever whatever; his pulſe being then as calm as it had been the preceding day. In this condition he remained all that day, and the following night; nothing, that was attempted to relieve him, having done him the leaſt ſervice: on the contrary, his delirium increaſed ſo much, as to make it very difficult for the attendants to keep him in bed. The next morning he was much as he had been the day before; his imagination continuing greatly diſturbed, and he at times laughing, and playing antic tricks, and uſing geſtures the moſt oppoſite to his common demeanour when well; and which, tho' the pulſe had not been ſo perfectly quiet, had more the appearance of a *mania*, than of the delirium of a fever. In this unhappy ſituation, there was but one thing, which ſeemed likely to bring the affair to a ſpeedy determination: this it was proper to attempt, tho' the indications for it were very obſcure, and the event perfectly uncertain. On recollecting the time of this delirium's coming on, which was about 36 hours after the pulſe had grown quiet; and perceiving, that one glaſs of the water, which had been made in the night, was thick, and ſeemed diſpoſed to drop a ſediment; there was ſome reaſon to ſuſpect, and indeed to hope, that tho' the pulſe had been perfectly calm during the whole time of the delirium, there was ſomething of the fever ſtill at the bottom of this complaint. From theſe indications, obſcure as they were, it was judged proper to make a trial of the bark; which was accordingly ordered to be taken immediately, and to be repeated every two hours.

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This method ſucceeded beyond what could have been imagined; inſomuch that it was obſervable, even by the attendants on this gentleman, that his mind came evidently more and more to itſelf after every doſe: and in the evening, after he had taken ſix drachms, his urine grew thick, and dropt a lateritious ſediment; and, excepting the weakneſs naturally conſequent on ſuch violent emotions as he had undergone, both of mind and body, he was as well as ever he had been in his life. He hath repeated the bark at proper intervals, as is uſual after intermittent fevers, and continues to this day perfectly well.

The uſe of the bark, in the moſt irregular intermittent diſorders, is very happily ſo well known in this iſland, that it might perhaps have been thought needleſs to have recited any caſe merely in confirmation of this practice: and I am too well aware of the inſufficiency of every thing, but a number of facts on which to found any philoſophical truth, to preſume to reſt any thing on one ſingle inſtance only. But the caſe above related is of ſo very extraordinary a kind, as to make it worthy of being mentioned, both on its own account, and for that analogy, which being found by experience to ſubſiſt between diſeaſes, affords the ſureſt method of reaſoning on practical ſubjects. The two remarkable circumſtances of this caſe are, the delirium's coming on, and continuing, without any exacerbation of the pulſe; and the bark's proving ſo ſpeedy and effectual a remedy, tho' given at a time, when there was no appearance of any remiſſion of the ſymptom, which it was intended to remove. It hath been thought, that a quick pulſe is

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ſo eſſential to the definition of a fever, as to be a pathognomonic ſymptom of it. But experience is againſt this notion: perhaps the preſent caſe is a proof of the contrary; however this be, there have not been wanting inſtances, in which, towards the end of a fever, the pulſe has grown quiet, without the abatement of any other ſymptom, and the patient hath generally lain comatoſe, and with the appearance of one, who hath taken a large quantity of opium. Galen, in the third book of the Preſages of the Pulſe, mentions this ſymptom, and pronounces it to be almoſt a fatal ſign: and the ſame thing hath happened in more inſtances than one, which have come to my knowlege. May not then the above-recited caſe lead to this uſeful inquiry, Whether in fevers of every kind, when the pulſe is quiet, the bark is not proper to be given, and likely to prove a remedy? In this caſe it proved abſolutely ſuch: and that it is at leaſt a ſafe medicine in all ſuch caſes, in which any practitioner of experience or judgment would ever think of giving it, is now certainly known. For my own part, I can ſafely declare, that in near ten years experience of it in Guy's-Hoſpital, during which time I find I have given it, on different occaſions, to above five hundred patients in that houſe only, I never, from the moſt accurate obſervation I could make, ſaw it do any harm, or bring on any bad ſymptom, even in caſes where it did not ſucceed according to the intention for which it was ordered; and (which I have thought worth remarking) in chronical caſes, even in thoſe, where the bark hath been by many thought the moſt prejudicial, when, on the coming on of an intermittent fever, the bark hath

hath been neceſſary to cure this ſecondary diſeaſe, the original diſtemper hath gone on, according to the beſt judgment I could form of it, exactly in the ſame manner, as it would have done had the bark never been given.

LXXXII. *An Account of an Earthquake felt at* Lingfield *in* Surrey, *and* Edenbridge *in* Kent, *on the 24th of* January 1758. *By* James Burrow, *Eſq; R. S. V. P.*

Read April 6, 1758.

IN the London Chronicle, N°. 181, publiſhed on the 25th of February 1758, in page 185, is the following article: "We "hear, that about two o' clock in the morning of "the 24th of laſt month" (which was the month of January), "an Earthquake was felt in the pa-"riſhes of Worthe, and Eaſt-Grinſted, in Suſſex; "Lingfield, in Surrey; and Edenbridge, in Kent; "and other adjacent places: which alarmed ſeveral "of the inhabitants very much; but no damage "enſued."

Mr. Burrow, having ſome connection with theſe two laſt pariſhes of Lingfield and Edenbridge, immediately wrote to the Rev. Mr. Goodricke of Lingfield, to inquire into the truth of this report: and Mr. Goodricke's anſwer confirmed the fact of its being felt there, and at other adjacent places; and added, "that it ſhook the beds and windows, and

"made

" made the plates rattle; and went off with a noife,
" like a fmall guft of wind."

However, Mr. Burrow did not then judge it to be either regular or proper to trouble the Society with this account; becaufe Mr. Goodricke only received it from hearfay and report, he himfelf happening to be abfent from Lingfield at that time.

But Mr. Burrow having paffed fome days, during the late recefs of the Society, at a place called Starborough-caftle, which lies nearly *between* the two churches of Lingfield and Edenbridge (fcarce four miles diftant from each other), he has had an opportunity of being more particularly and circumftantially informed of the fact, as far as relates to thofe two parifhes: and he is now affured, that it was certainly and undoubtedly felt and obferved by *fome* perfons in each of thofe two parifhes; tho' (as it happened in the dead of the night, when moft people were faft afleep) it was not *generally* perceived: nor was it much fpoken of, even by thofe, who were fure they felt it.

The perfons, from whofe own mouths he can authenticate the fact, are James Martin, Adam Killick, Mrs. Jewell, and Mr. Chapman: and he has no lefs doubt as to Mr. Orgles and Mrs. Pigott (who was waked and much frighted by it), tho' he did not indeed perfonally converfe with either of the two laft.

Thefe two, and Mrs. Jewell, all inhabit quite clofe to Lingfield church-yard, on different fides of it: and Chapman lives within a quarter of a mile of it, to the fouth-weft.

James Martin lives within a bow-fhot of Starborough-caftle, at the eaftern edge of the parifh of Lingfield,

Lingfield, where it joins to that of Edenbridge; and Adam Killick's habitation is three miles north-eaſt of Starborough, at the north-weſtern point of the pariſh of Edenbridge.

All theſe four, with whom Mr. Burrow perſonally converſed, agreed as to the *time* of the concuſſion; *viz.* between one and two in the morning: and they all agreed as to the *ſhaking* of their beds and windows; and all of them deſcribed the *continuance* of the ſhock as not much more than inſtantaneous: but they did *not* all hear the *noiſe*, which *ſome* of them obſerved it to conclude with; particularly Adam Killick heard NO *noiſe* at all; and yet, he ſays, he was broad awake when it firſt began: and it ſhook his houſe and bed, and made his windows rattle ſo much, that he was apprehenſive of their being broken; and even cauſed one pane of glaſs (which was indeed looſe before) actually to drop out. But James Martin, who was likewiſe fully awake (as was his wife too), *did hear* the noiſe diſtinctly. He ſays, he felt his houſe and bed ſhake, heard his windows rattle, and ſome earthen ware clatter upon a cheſt of drawers; and alſo heard a noiſe, like the diſtant dicharge of a cannon: whereupon he immediately ſaid to his wife, "Lord! what is *that?*" but ſhe happening, at that very inſtant, either to cough or ſneeze (ſhe cannot recollect which of the two), did not, tho' quite awake, perceive any thing at all of the matter. However, ſhe confirmed her huſband's aſking her this queſtion under an apparent ſurprize.

Mr. Burrow had a very particular converſation with theſe two ſeparately: and he had alſo a very minute detail from Adam Killick (who works for him

him as a ſort of gardener at Starborough); who further added, " that the ſhock waked and frighted his " wife, tho' ſhe was faſt aſleep before."

6th April, 1758. James Burrow.

LXXXIII. *An Account of the Caſe of the Firſt Joint of the Thumb torn off, with the Flexor Tendon in its whole Extent torn out. By* Robert Home, *late Surgeon to the Thirtieth Regiment of Foot, and Surgeon at* Kingſton upon Hull. *In a Letter to* John Pringle, *M. D. F. R. S.*

S I R,

Read April 6, 1758.

I Take the liberty of incloſing to you a caſe in ſurgery, which I imagine is not very common. Marchetis indeed has an obſervation of the ſame kind; and there are ſeveral others collected together by Monſ. Morand, in the ſecond volume of the Memoires of the Royal Academy of Surgery at Paris: but as I have not heard of that volume's being tranſlated into Engliſh, and believe there is no obſervation of a ſimilar nature in the Philoſophical Tranſactions, I beg the favour of you to communicate it to the Royal Society, of which you are a Fellow; and at the ſame time to make them an offer of the joint of the thumb, with its adherent tendon, which you will receive at the

 ſame

ſame time with this; hoping they will do me the honour of accepting it, as a teſtimony (tho' trifling) of my great eſteem and reſpect for the moſt learned Society in Europe Your Friend Dr. Knox ſaw the patient dreſſed oftener than once; and Mr. Thornhill, late Surgeon and Manmidwife in Briſtol, ſaw it when near healed.

I beg you will believe me to be, with great truth,

SIR,

Your moſt obedient,

and moſt humble Servant,

Hull, March 27th, 1758.

Robert Home.

JAnuary 2d, 1758, William Taylor, 17 years of age, an apprentice to a white-ſmith in this place, in endeavouring to make his eſcape from one, who was going to correct him, opened the door of a cellar, and threw himſelf into it; but in his hurry ſo intangled his right thumb with the latch, that the whole weight of his body was ſupended by it, until it gave way, and was torn off at the firſt articulation; the flexor tendon being at the ſame time pulled out in its whole length, having broke when it became muſcular. I was immediately ſent for, found little or no hæmorrhage, and the bone of the ſecond phalanx ſafe, and covered with its cartilage, but protruding conſiderably, occaſioned by part of the ſkin belonging to it being irregularly torn off with the firſt joint.

I was doubtful, whether or not I ſhould be obliged, at laſt, to make a circular inciſion, and ſaw the

the bone even with the ſkin; but thought it proper to give him a chance for the uſe of the whole phalanx.

He complained only for the firſt day of a pretty ſharp pain in the courſe of the tendon; to which compreſſes, wrung out of warm brandy, were applied: but his arm was never ſwelled; there was no *ecchymoſis*; nor had he ſo much fever, as to require bleeding even once. The cure proceeded happily, no ſymptoms ariſing from the extracted tendon. At the third dreſſing the bone was covered; and no other application but dry lint was neceſſary during the whole time. No exfoliation happened; yet it was twelve weeks before it was intirely cicatriſed, owing to the loſs of ſkin: and he ſeems to enjoy the uſe of the ſtump as completely, as if that tendon was not loſt.

LXXXIV. *An Account of the late Diſcoveries of Antiquities at* Herculaneum, *and of an Earthquake there; in a Letter from* Camillo Paderni, *Keeper of the Muſeum at* Herculaneum, *and F.R.S. to* Tho. Hollis, *Eſq; F.R.S. dated* Portici, Feb. 1. 1758.

Read April 6, 1758.

WE have been working continually at Herculaneum, Pompeii, and Stabiæ, ſince my laſt of Dec. 16, 1756. The moſt remarkable diſcoveries made there are theſe, which follow.

February 1757, was found a ſmall and moſt beautiful figure of a naked Venus in bronze, the height of which is ſix Neapolitan inches. She has ſilver eyes, bracelets of gold on her arms, and chains of the ſame metal above her feet; and appears in the attitude of looſening one of her ſandals. The baſe is of bronze inlaid with foliage of ſilver, on one ſide of which is placed a dolphin.

In July we met with an inſcription, about twelve Neapolitan palms in length, which I have here copied.

IMP · CAESAR · VESPASIANVS · AVG · PONTIF · MAX

TRIB · POT · $\overline{\text{VII}}$ · IMP · $\overline{\text{XVII}}$ · P · P · COS · $\overline{\text{VII}}$ · DESIGN · $\overline{\text{VIII}}$

TEMPLVM · MATRIS · DEVM · TERRAE · MOTV · CONLAPSVM · RESTITVIT

After having found a great number of volumes of papirus in Herculaneum; many pugillaries, ſtyles, and ſtands with ink in them, as formerly mentioned; at length, in the month of Auguſt, upon opening a ſmall box, we alſo found, to our exceeding great joy, the inſtrument, with which they uſed to write their manuſcripts. It is made of wood, of an oblong form, but petrified, and broke into two pieces. There is no ſlit in it, that being unneceſſary, as the ancients did not join their letters in the manner we do, but wrote them ſeparate.

In September were diſcovered eight marble buſts, in the form of terms. One of theſe repreſents Vitellius, another Archimedes; and both are of the fineſt workmanſhip. The following characters, in a black tint, are ſtill legible on the latter, namely, APXIMEΔ which is all the inſcription that now remains.

In

In October was dug up a curious buſt of a young perſon, who has a helmet on his head, adorned with a civic crown, and cheek-pieces faſtened under his chin. Alſo another very fine buſt of a philoſopher, with a beard, and ſhort thick hair, having a ſlight drapery on his left ſhoulder. Likewiſe two female buſts; one unknown, in a veil; the other Minerva, with a helmet; both of middling workmanſhip.

In November we met with two buſts of philoſophers, of excellent workmanſhip, and, as may be eaſily perceived, of the ſame artiſt; but unfortunately, like many others, without names.

In January was found a ſmall, but moſt beautiful eagle, in bronze. It hath ſilver eyes, perches on a *praeſericulum*, and holds a fawn between its talons.

In the ſame month we diſcovered, at Stabiæ, a term ſix palms high, on which is a head of Plato, in the fineſt preſervation, and performed in a very maſterly manner. Alſo divers vaſes, inſtruments for ſacrificing, ſcales, balances, weights, and other implements for domeſtic uſes, all in bronze.

At length I have finiſhed, with much labour, the examination and arrangement of the ſcales, balances, and weights, which are very numerous in this muſeum; and, what is remarkable, many of the former, with all the weights, exactly anſwer thoſe now in uſe at Naples. At preſent I am conſidering the liquid meaſures; and alſo engaged in diſpoſing the paintings in the new apartment allotted for them. Theſe affairs, with my uſual province of inſpecting the workmen, who are buſied in digging; my being obliged to keep an exact regiſter of every thing, that is diſ-

covered;

covered; besides other daily and accidental occurrences; employ my time so intirely, that I have not a moment's repose, but in my bed.

The square belonging to the palace, in which the museum is deposited, will be finished, and completely ornamented, by Easter. In the center of it I have placed the bronze horse, which was broken in many pieces, and restored by me, as mentioned in my last. In the walls of the colonades are affixed all the inscriptions hitherto discovered: and I shall yet adorn them with altars, curule chairs, and other antiquities proper for such places. The principal entrance into the museum hath been made to correspond with the grand stair-case. On the right side of it stands the consular statue of Marcus Nonius Balbus, the father; and on the left, that of Marcus Nonius Balbus, the son; with two inscriptions relating to, and found near them. Upon the stair-case are placed eight antique statues in bronze, on beautiful pedestals of polished marble. In an opening in the center of the right hand colonade is fixed the statue of the wife of the elder Balbus, with the antique inscription belonging to it. At the entrance of the square, a magnificent pair of iron gates, with palisades, are just put up, ornamented with many bronzes, which are gilt; and on the sides of these gates are two other consular statues of persons unknown.

The whole day and night of the 24th of last month it seemed as if Mount Vesuvius would again have swallowed up this country. On that day it suffered two internal fractures, which intirely changed its appearance within the crater, destroying the little mountain,

mountain, that had been forming within it for ſome years, and was riſen above the ſides; and throwing up, by violent exploſions, immenſe quantities of ſtones, lava, aſhes, and fire. At night the flames burſt out with greater vehemence, the exploſions were more frequent and horrible, and our houſes ſhook continually. Many fled to Naples, and the boldeſt perſons trembled. For my own part, I reſolved to abide the event here at Portici, on account of my family, conſiſting of eight children, and a very weak and aged mother, whoſe life muſt have been loſt by a removal in ſuch circumſtances, and ſo rigorous a ſeaſon. But it pleaſed God to preſerve us; for the mountain having vented itſelf that night and the ſucceeding day, is ſince become calm, and throws out only a few aſhes.

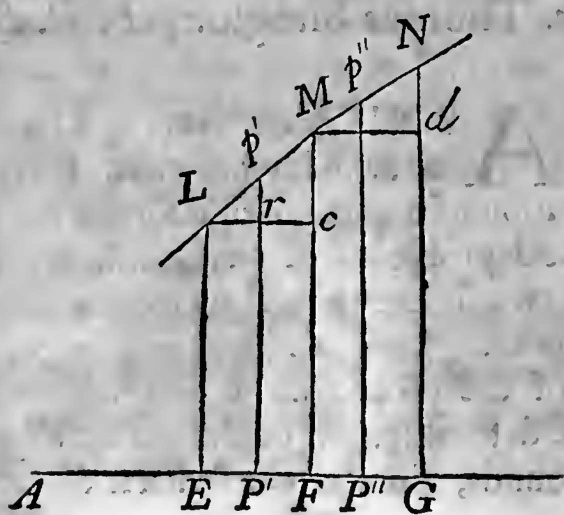
LXXXV. *A further Attempt to facilitate the Reſolution of Iſoperimetrical Problems. By Mr.* Thomas Simpſon, *F. R. S.*

Read April 13. 1758.

ABOUT three years ago I had the honour to lay before the Royal Society the inveſtigation of a general rule for the reſolution of iſoperimetrical problems of that kind, wherein one, only, of the two indeterminate quantities enters along with the fluxions, into the equations expreſſing the conditions of the problem. Under which kind are included the determination of the greateſt figures under given bounds, lines of the ſwifteſt deſcent, ſolids of the leaſt reſiſtance, with innumerable other caſes. But altho' caſes of this ſort do, indeed, moſt frequently occur, and have therefore been chiefly attended to by mathematicians, others may nevertheleſs be propoſed, ſuch as actually ariſe in inquiries into nature, wherein *both* the flowing quantities, together with their fluxions, are jointly concerned. The inveſtigation of a *rule* for the reſolution of theſe, is what I ſhall in this paper attempt, by means of the following

GENERAL PROPOSITION.

Let Q, R, S, T, &c. *repreſent any variable quantities, expreſſed in terms of* x *and* y *(with given coefficients), and let* q, r, s, t, &c. *denote as many other quantities, expreſſed in terms of* $\dot{x}$ *and* $\dot{y}$; *It is propoſed to find an equation for the relation of* x *and* y, *ſo that the fluent of* $Qq + Rr + Ss + Tt$, &c. *correſponding to a given value of* x *(or* y*), may be a* maximum *or* minimum.



Let

Let AE, AF, and AG, denote any three values of the quantity x, having indefinitely ſmall *equi-differences* EF, FG; and let EL, FM, and GN, (perpendicular to AG) be the reſpective values of y, correſponding thereto; and, ſuppoſing $EF (= FG = \dot{x})$ to be denoted by e, let cM and dN (the ſucceſſive values of $\dot{y}$) be repreſented by u and w. Moreover, ſuppoſing $P'p'$ and $P''p''$ to be ordinates at the middle points P' P'', between E, F and F, G, let the former $(P'p')$ be denoted α, and the latter $(P''p'')$ by β; putting $AP' = a$ and $AP'' = b$. Then, if a and α (the mean values of x and y, between the ordinates EL and FM) be ſuppoſed to be ſubſtituted for x and y, in the given quantity $Qq + Rr + Ss + Tt$, &c. and if, inſtead of $\dot{x}$ and $\dot{y}$, their equals e and u be alſo ſubſtituted, and the ſaid (given) quantity, after ſuch ſubſtitution, be denoted by $Q'q' + R'r' + S's' + T't'$, &c. it is then evident, that this quantity $Q'q' + R'r' + S's' + T't'$, &c. will expreſs ſo much of the whole required fluent, as is comprehended between the ordinates EL and FM, or as anſwers to an increaſe of EF in the value of x. And thus, if b and β be conceived to be wrote for x and y, e for $\dot{x}$, and w for $\dot{y}$, and the quantity reſulting be denoted by $Q''q'' + R''r'' + S''s'' + T''t''$, &c. this quantity will, in like manner, expreſs the part of the required fluent correſponding to the interval FG. Whence that part anſwering to the interval EG will conſequently be equal to $Q'q' + R'r'$ &c. $+ Q''q'' + R''r''$ &c. But it is

 manifeſt,

manifest, that the whole required fluent cannot be a *maximum* or *minimum*, unless this part, supposing the bounding ordinates EL, GN to remain the same, is also a *maximum* or *minimum*. Hence, in order to determine the fluxion of this expression ($Q'q' + R'r'$ &c. $Q''q'' + R''r''$ &c.) which must, of consequence, be equal to nothing, let the fluxions of Q' and q' (taking α and u as variable) be denoted by $\bar{Q}\dot{\alpha}$ and $\bar{q}\dot{u}$; also let $\bar{R}\dot{\alpha}$ and $\bar{r}\dot{u}$ denote the respective fluxions of R' and r'; and let, in like manner, the fluxions of Q'', q'', R'', r'', &c. be represented by $\bar{\bar{Q}}\dot{\beta}$, $\bar{\bar{q}}\dot{w}$, $\bar{\bar{R}}\dot{\beta}$, $\bar{\bar{r}}\dot{w}$, &c. respectively. Then, by the common rule for finding the fluxion of a rectangle, the fluxion of our whole expression ($Q'q' + R'r'$ &c. $+ Q''q'' + R''r''$ &c.) will be given equal to $Q'\bar{q}\dot{u} + q'\bar{Q}\dot{\alpha} + R'\bar{r}\dot{u} + r'\bar{R}\dot{\alpha}$ &c. $+ Q''\bar{\bar{q}}\dot{w} + q''\bar{\bar{Q}}\dot{\beta} + R''\bar{\bar{r}}\dot{w} + r''\bar{\bar{R}}\dot{\beta}$ &c. $= 0$.

But $u + w$ being $= GN - EL$, and $\beta - a = \frac{GN - EL}{2}$ (a constant quantity), we therefore have $\dot{w} = -\dot{u}$, and $\dot{\beta} = \dot{\alpha}$: also u being $(= 2rp') = 2\alpha - 2EL$, thence will $\dot{u} = 2\dot{\alpha}$: which values being substituted above, our equation, after the whole is divided by $\dot{\alpha}$, will become

$$2Q'\bar{q} + q'\bar{Q} + 2R'\bar{r} + r'\bar{R}, \text{ \&c.} - 2Q''\bar{\bar{q}} + q''\bar{\bar{Q}} - 2R''\bar{\bar{r}} + r'\bar{\bar{R}}, \text{ \&c.} = 0;$$

$$\text{or, } Q''\bar{\bar{q}} - Q'\bar{q} + R''\bar{\bar{r}} - R'\bar{r} \text{ \&c.} = \frac{q'\bar{Q} + q''\bar{\bar{Q}}}{2} + \frac{r'\bar{R} + r''\bar{\bar{R}}}{2}, \text{ \&c.}$$

But

But $Q''_{\bar{\bar{q}}} - Q'_{\bar{q}}$, the excess of $Q''_{\bar{\bar{q}}}$ above $Q'_{\bar{q}}$, is the increment or fluxion (answering to the increment, or fluxion, $\dot{x}$) arising by substituting b for a, β for α, and w for u. Moreover, with regard to the quantities on the other side of the equation, it is plain, seeing the difference of $q'\bar{Q}$ and $q''\bar{\bar{Q}}$ is indefinitely little in comparison of their sum, that $q'\bar{Q}$ may be substituted in the room of $\frac{q'\bar{Q} + q''\bar{\bar{Q}}}{2}$, &c. which being done, our equation will stand thus:

$$Flux.\ Q'_{\bar{q}} + R'_{\bar{r}}\ \&c. = q'\bar{Q} + r'\bar{R}\ \&c.$$

But $q'\bar{Q} + r'\bar{R}$ &c. represents (by the preceding notation) the fluxion of $q'Q' + r'R'$ &c. (or of $Qq + Rr$ &c.) arising by substituting α for y, making α alone variable, and casting off $\dot{\alpha}$. If, therefore, that fluxion be denoted by $\dot{v}$, we shall have *flux.* $Q'_{\bar{q}} + R'_{\bar{r}}$ &c. $= \dot{v}$, and consequently $Q'_{\bar{q}} + R'_{\bar{r}}$ &c. $= v$. But $Q'_{\bar{q}} + R'_{\bar{r}}$ &c. (by the same notation) appears to be the fluxion of $Q'q' + R'r'$ &c. (or of $Qq + Rr$ &c.) arising by substituting u for $\dot{y}$, making u alone variable, and casting off $\dot{u}$. Whence the following

General Rule.

Take the fluxion of the given expression (whose fluent is required to be a maximum *or* minimum*) making* y *alone variable; and, having divided by* ÿ, *let the quotient be denoted by* v: *Then take, again, the fluxion of the same expression, making* y *alone variable, which divide by* ẏ; *and then this last quotient will be* $= \dot{v}$.

 When

When $\dot{y}$ is not found in the quantity given, υ will then be $= 0$; and, consequently, the expression for $\dot{\upsilon}$, equal to nothing also. But if y be absent, then will $\dot{\upsilon} = 0$, and consequently the value of $\upsilon =$ a constant quantity. It is also easy to comprehend, that, instead of $\dot{y}$ and y, $\dot{x}$ and x may be made successively variable. Moreover, should the case to be resolved be confined to other restrictions, besides that of the *maximum* or *minimum*, such as, having a certain number of other fluents, at the same time, equal to given quantities, still the same method of solution may be applied, and that with equal advantage, if from the particular expressions exhibiting all the several conditions, one general expression composed of them all, with unknown (but determinate) coefficients, be made use of.

In order to render this matter quite clear, let A, B, C, D, *&c.* be supposed to represent any quantities expressed in terms of x, y, and their fluxions, and let it be required to determine the relation of x and y, so that the fluent of $A\dot{x}$ shall be a *maximum*, or *minimum*, when the cotemporary fluents of $B\dot{x}$, $C\dot{x}$, $D\dot{x}$, *&c.* are, all of them, equal to given quantities.

It is evident, in the first place, that the fluent of $A\dot{x} + bB\dot{x} + cC\dot{x} + dD\dot{x}$, *&c.* ($b$, c, d, *&c.* being any constant quantities whatever) must be a *maximum*, or *minimum*, in the proposed circumstance: and, if the relation of x and y be determined *(by the rule)*, so as to answer this single condition (under all possible

possible values of b, c, d, &c.) it will also appear evident, that such relation will likewise answer and include all the other conditions propounded. For, there being in the general expression, thus derived, as many unknown quantities b, c, d, &c. (to be determined) as there are equations, by making the fluents of $B\dot{x}$, $C\dot{x}$, $D\dot{x}$, &c. equal to the values given; those quantities may be so assigned, or conceived to be such, as to answer all the conditions of the said equations. And then, to see clearly that the fluent of the first expression, $A\dot{x}$, cannot be greater than arises from hence (other things remaining the same) let there be supposed some other different relation of x and y, whereby the conditions of all the other fluents of $B\dot{x}$, $C\dot{x}$, $D\dot{x}$, &c. can be fulfilled; and let, *if possible*, this new relation give a greater fluent of $A\dot{x}$ than the relation above assigned. Then, because the fluents $bB\dot{x}$, $cC\dot{x}$, $dD\dot{x}$, &c. are given, and the same in both cases, it follows, according to this supposition, that this new relation must give a greater fluent of $A\dot{x} + bB\dot{x} + cC\dot{x} + dD\dot{x}$, &c. (under all possible values of b, c, d, &c.) than the former relation gives: *which is impossible*; because (whatever values are assigned to b, c, d, &c.) *that* fluent will, it is demonstrated, be the greatest possible, when the relation of x and y is that above determined, by the General Rule.

To exemplify, now, by a particular case, the method of operation above pointed out, let there be proposed the fluxionary quantity $\frac{x^n y^m \dot{y}^p}{\dot{x}^{p-1}}$; wherein the relation of x and y is so required, that the fluent, corresponding to given values of x and y, shall be a *maximum*, or *minimum*. Here, by taking the fluxion, making $\dot{y}$ alone variable (*according to the rule*) and dividing by $\ddot{y}$, we shall have $\frac{p x^n y^m \dot{y}^{p-1}}{\dot{x}^{p-1}} = v$. And, by taking the fluxion a second time, making y alone variable, and dividing by $\dot{y}$, will be had $\frac{m x^n y^{m-1} \dot{y}^p}{\dot{x}^{p-1}} = \dot{v}$. Now from these equations to exterminate v, let the latter be divided by the former; so shall $\frac{m\dot{y}}{py} = \frac{\dot{v}}{v}$; and therefore $ay^{\frac{m}{p}} = v$ (a being a constant quantity). From whence $y^{\frac{m}{p}}\dot{y} = \overline{\tfrac{a}{p}}\big|^{\frac{1}{p-1}} \times \dot{x}x^{-\frac{n}{p-1}}$; and consequently $\frac{p}{m+p} \times y^{\frac{m+p}{p}} = \overline{\tfrac{a}{p}}\big|^{\frac{1}{p-1}} \times \frac{p-1}{p-n-1} \times x^{\frac{p-n-1}{p-1}}$.

Let there be now proposed the two fluxions $x^n y^m \dot{x}$ and $x^p y^q \dot{y}$, the fluent of the former being required to be a *maximum*, or *minimum*, and that of the latter, at the same time, equal to a given quantity. Then the latter, with the general coefficient b prefixed, being joined to the former, we shall here have $x^n y^m \dot{x} + bx^p y^q \dot{y}$. From whence, by proceeding as before, $bx^p y^q = v$, and $mx^n y^{m-1}\dot{x} + qbx^p y^{q-1}\dot{y} = \dot{v}$.

From

From the former of which equations, by taking the fluxions on both ſides, will be had $pbx^{p-1}y^{q}\dot{x} + qbx^{p}y^{q-1}\dot{y}\ (=\dot{v}) = mx^{n}y^{m-1}\dot{x} + qbx^{p}y^{q-1}\dot{y}$. Whence $pbx^{p-1}y^{q} = mx^{n}y^{m-1}$; and therefore $pby^{q-m+1} = mx^{n-p+1}$. And in the ſame manner proper equations, to expreſs the relation of x and y, may be derived, in any other caſe, and under any number of limitations.

LXXXVI. *Obſervations on the* Alga Marina latifolia; *The Sea Alga with broad Leaves. By* John Andrew Peyſſonel, *M.D. F.R.S. Tranſlated from the* French.

Read April 13. 1758.

HAVING caſt anchor at Verdun, the road at the entrance of the river of Bourdeaux, I was fiſhing with a kind of drag-net upon a bank of ſand, which was very fine and muddy. We collected a number of ſea-plants, and among them the great broad-leaved Alga, which I did not know: and as the root or pedicle of this plant appeared to be very particular, I obſerved it with attention. The following is its deſcription, and the detail of my obſervations.

From a pedicle, which is ſometimes flat, and ſometimes round (for they vary in theſe plants, and might be about three lines in diameter, and an inch high, of a blackiſh colour, and coriaceous ſubſtance, approaching to the nature of the bodies of lithophyta), a ſingle a ſingle flat leaf ariſes, about an inch or an inch and half broad, thick in its middle to about three lines, ending at the ſides in a kind of edge, like a two-edged ſabre, almoſt like the common Alga, formed of longitudinal fibres interlaced with other very delicates ones, and the whole filled with a thick juice, like the *parenchyma* of ſucculent plants, ſuch as the Sedum, Aloes, and the like, of a clear yellowiſh green, and tranſparent. This firſt leaf is always ſingle, and ſerves inſtead of a trunk or ſtem to the whole plant.

When it riſes to about a foot high, more or leſs, it throws out at the ſides other leaves formed of a continuation of the longitudinal fibres; and theſe ſecond leaves are of the ſame thickneſs and ſubſtance with the firſt: they are two or three feet long, and the whole plant is five or ſix, or more (for one can hardly tell the length); and is not capable of ſupporting itſelf, but is ſuſtained by the ſtrength of the waters, in which it floats.

The ſubſtance of the plant is not ſo ſolid as that of the common Alga, which is capable of drying as it fades, and of being kept: whereas the leaves of this great Alga ſhrink and wither in the air, become of a blackiſh colour, and very friable, or indeed ſoon fall into putrifaction. I never obſerved, that they bore any fruit: perhaps this was not the ſeaſon.

But what we find particular in this plant is its root or foot: Firſt, this pedicle extends in ribs, like what we call the thighs of certain trees: theſe thighs are in right lines: perhaps they run in the ſame direction or ſituation, that is, placed north and ſouth, or eaſt and weſt; but this I could not obſerve. They are about

about three or four lines high towards the pedicle, and, ending, are loſt. They flouriſh and ſpread at the bottom, forming an elliptical bladder, like an egg, flattened above and below, and rounded at the ſides, being intirely empty: it is rough without, and very ſmooth within. This egg, or oval bladder, is exactly round at the ends of the great diameter, but varies a little in the leſſer diameter, and forms itſelf like the body of a fiddle. The under part is a little flattened; and there is a hole, which is very conſiderable, in the center of the two diameters. This hole is about an inch wide, and is quite round: it gives paſſage to the root, or pivot, which I ſhall by and by mention: the edges appear to turn a little inward: and it is by this hole that the egg fills with ſea-water. The whole ſubſtance of this bladder or egg is of a coriaceous matter, firm and tranſparent, and of a clear green; nor can there be any fibres, either longitudinal or tranſverſe, obſerved upon it.

The vault at the top, ſurmounted by the thighs, is as it were granulated; but at the rounding of the egg it produces a kind of *mammæ*, or little elevations, very round and cylindrical, intirely full; of the ſame nature and ſubſtance with the egg.

In examining the under part of the egg, we found a ſecond rank of theſe *mamellæ*, ſomewhat longer than the firſt, and at equal diſtances from one another, in a circular line; then a third yet longer; then a fourth, which at the extremities were bifurcated; and at laſt a fifth rank, which divided into three, and ſometimes into five, branches: theſe laſt, placed round the hole, were wreathed inwards, and ſeveral were joined together, and only formed a ſmall

 body;

body; and in wreathing themſelves thus they cloſe and embrace the pivot mentioned below. None of theſe *mamellæ* have any apparent opening: their ſubſtance is compact, of the ſame nature with the bladder or egg, that produces them.

Below the trunk and thighs the plant protrudes a pivot, of a like ſubſtance with that of the bladder. This pivot, which is large at its origin, proceeding thus from the trunk and thighs, forms ſomething like the knot of the ſea-tree: it deſcends perpendicularly to the trunk, diminiſhing as it lengthens, and as it grows round; and then divides into a number of *mamellæ*, branched and wreathed inwards ſo firmly, as not to be retracted; of a coriaceous nature, blackiſh, forming a bunch like what we call the Roſe of Jericho. I cannot recollect the name of this plant or flower.

This bunch, or wreathed roſe, incloſes a heap of gravel, as if petrified or hardened, and ends upon a level with the hole of the egg, exactly as high as the laſt rank of *mamellæ*, which wreath upon, embrace, and ſuſtain it, leaving always an empty ſpace to let the ſea-water paſs in, which ſhould fill the inſide of the egg or bladder, and even to let in little fiſhes and ſhells.

I was ſurpriſed to find in one little living muſcles, as they always are attached to ſome ſolid body by their beards. Now by what means could they enter into this egg? I conjectured, that they had their beginning there, by the ſeminal matter of muſcles carried in by the ſea-water. I alſo found ſome ſmall ſtar-fiſh, whoſe rays might be about four or five lines long.

If

If my ſtay here had been longer, I had continued my obſervations; and perhaps ſhould have made ſome diſcoveries. It belongs to the academicians of Bourdeaux to puſh theſe obſervations further, if they think proper.

From the Entrance of the river of Bourdeaux, the 4th of Auguſt, 1756.

Peyſſonel.

LXXXVII. *An Account of the diſtilling Water freſh from Sea-water by Wood-aſhes. By Capt.* William Chapman: *In a Letter to* John Fothergill, *M. D.*

Whitby, 10th 2d mo. Feb. 1758.

Read April 13. 1758.

THY kind acceptance of my laſt emboldens me to inform thee, how, on my return from a voyage to the north part of Ruſſia, I procured a ſufficient quantity of freſh water from ſea-water, without taking with me either inſtruments or ingredients expreſsly for the purpoſe.

Some time in September laſt, when I had been ten days at ſea, by an accident (off the north cape of Finland) we loſt the greateſt part of our water. We had a hard gale of wind at ſouth-weſt, which continued three weeks, and drove us into 73° lat. During this time I was very uneaſy, as knowing, if our paſſage ſhould hold out long, we muſt be reduced to great ſtraits; for we had no rains, but frequent fogs, which yielded water in very ſmall quantities. I now

 blamed

blamed myſelf for not having a ſtill along with me (as I had often thought no ſhip ſhould be without one). But it was now too late; and there was a neceſſity to contrive ſome means for our preſervation.

I was not a ſtranger to Appleby's method: I had alſo a pamphlet wrote by Dr. Butler, intituled, *An eaſy Method of procuring of freſh Water at Sea.* And I imagined, that ſoap might ſupply the place of capital lees, mentioned by him. I now ſet myſelf at work, to contrive a ſtill; and ordered an old pitch-pot, that held about ten quarts, to be made clean: my carpenter, by my direction, fitted to it a cover of fir deal, about two inches thick, very cloſe; ſo that it was eaſily made tight by luting it with paſte. We had a hole thro' the cover, in which was fixed a wooden pipe nearly perpendicular. This I call the ſtill-head: it was bored with an augre of 1 ½ inch diameter, to within three inches of the top or extremity, where it was left ſolid. We made a hole in this, towards the upper part of its cavity (with a proper angle) to receive a long wooden pipe, which we fixed therein, to deſcend to the tub in which the worm ſhould be placed. Here again I was at a loſs; for we had no lead pipe, nor any ſheet-lead, on board. I thought, if I could contrive a ſtrait pipe to go thro' a large caſk of cold water, it might anſwer the end of a worm. We then cut a pewter diſh, and made a pipe two feet long; and at three or four trials (for we did not let a little diſcourage us) we made it quite tight. We bored a hole thro' a caſk, with a proper deſcent, in which we fixed the pewter pipe, and made both holes in the caſk tight, and filled it with ſea-water: the pipe ſtuck without the caſk

caſk three inches on each ſide. Having now got my apparatus in readineſs, I put ſeven quarts of ſea-water, and an ounce of ſoap, into my pot, and ſet it on the fire. The cover was kept from riſing by a prop of wood to the bow. We fixed on the head, and into it the long wooden pipe above-mentioned, which was wide enough to receive the end of the pewter one into its cavity. We eaſily made the joint tight.

I need not tell thee with what anxiety I waited for ſucceſs: but I was ſoon relieved; for, as ſoon as the pot boiled, the water began to run; and in twenty-eight minutes I got a quart of freſh water. I tried it with an hydrometer I had on board, and found it as light as river-water; but it had a rank oily taſte, which I imagine was given it by the ſoap. This taſte diminiſhed conſiderably in two or three days, but not ſo much as to make it quite palateable. Our ſheep and fowls drank this water very greedily without any ill effects. We conſtantly kept our ſtill at work, and got a gallon of water every two hours; which, if there had been a neceſſity to drink it, would have been ſufficient for our ſhip's crew.

I now thought of trying to get water more palateable; and often peruſed the pamphlet above-mentioned, eſpecially the quotation from Sir R. Hawkins's voyage, who "with four billets diſtilled a hogſhead "of water wholſome and nouriſhing." I concluded he had delivered this account under a veil, leſt his method ſhould be diſcovered: for it is plain, that by four billets he could not mean the fuel, as they would ſcarce *warm* a hogſhead of water. When, ruminating on this, it came into my head, that he burnt

burnt his four billets to aſhes, and with the mixture of thoſe aſhes with ſea-water he diſtilled a hogſhead of freſh water wholſome and nouriſhing. Pleaſed with this diſcovery, I cut a billet ſmall, and burnt it to aſhes; and after cleaning my pot, I put into it a ſpoonful of thoſe aſhes, with the uſual quantity of ſea-water. The reſult anſwered my expectations: the water came off bright and tranſparent, with an agreeable pungent taſte, which at firſt I thought was occaſioned by the aſhes, but afterwards was convinced it received it from the reſin or turpentine in the pot, or pipes annexed to it. I was now relieved from my fears of being diſtreſſed thro' want of water; yet thought it neceſſary to adviſe my people not to be too free in the uſe of this, whilſt we had any of our old ſtock remaining; and told them, I would make the experiment firſt myſelf; which I did, by drinking a few glaſſes every day without any ill effect whatever. This water was equally light with the other, and lathered very well with ſoap. We had expended our old ſtock of water before we reached England; but had reſerved a good quantity of that which we diſtilled. After my arrival at Shields, I invited ſeveral of my acquaintance on board to taſte the water: they drank ſeveral glaſſes, and thought it nothing inferior to ſpring-water. I made them a bowl of punch of it, which was highly commended.

I have not the convenience of a ſtill here, or ſhould have repeated the experiment for the conviction of ſome of my friends: for as to myſelf, I am firmly perſuaded, that wood-aſhes mixed with ſea-water will yield, when diſtilled, as good freſh water as can be wiſhed for. And I think, if every ſhip bound a

long

long voyage was to take a ſmall ſtill with Dr. Hales's improvements, they need never want freſh water. Wood-aſhes may eaſily be made, whilſt there is any wood in the ſhip; and the extraordinary expence of fuel will be trifling, if they contrive ſo that the ſtill may ſtand on the fire along with the ſhip's boiler.

I ſhall think myſelf ſufficiently recompenſed, if any hints here may tend to the relief of my brother ſailors from the diſmal extremity of want of water; an extremity too little regarded by thoſe, who have never experienced it.

P. S. During my paſſage from Ruſſia we very rarely had any *aurora borealis*; and thoſe few we ſaw were faint, and of ſhort continuance: at which I was much ſurpriſed; for about ten years ago, being in a high north latitude, we had very beautiful ones almoſt every night in the month of September; which exceeded any I have ſeen deſcribed in the *Philoſophical Tranſactions*, or *Memoires de l'Academie Royale*.

Wm. Chapman.

LXXXVIII.

LXXXVIII. *Observatio Eclipsis Lunaris facta* Matriti *a P^a.* Joanne Wendlingen, *Societatis* Jesu, *in Regali Observatorio Collegii Imperialis ejusdem Societatis, Die* 30 Julii 1757.

Quælibet observatio bis instituta fuit, semel interjecto oculum inter lentemque ocularem vitri clari, cærulei, plani, ac bene tersi, fragmento. Hæ observationes notantur hac voce cerul. *Telescopium, quo usus sum, est* Gregorianum *trium pedum* Anglicanorum, *omnino præclarum.*

Communicated by Matthew Maty, *M. D. F. R. S.*

[Read April 20, 1758.]

IMMERSIONES.		Tempus verum h	′	″	Differentia ″
Principium eclipsis,	*clar.* -	9	47	34	
Mare Humorum,	*clar.* -	—	52	47	
Grimaldus - - - -	*cær.*	—	54	28	— 59
	clar.	—	55	27	
Bullialdus - - - -	*cær.*	10	1	21	— 13
	—	10	1	34	
Keplerus - - - -	—	—	9	35	— 10
	—	—	9	45	
Copernicus - - -	—	—	16	15	— 12
	—	—	16	28	
Heraclides - - - -	—	—	18	14	— 10
	—	—	18	24	

Manilius

IMMERSIONES.		Tempus verum h	'	"	Differentia "
Manilius - - - - -	clar.	10	30	43	— 11
	cær.	10	30	54	
Menelaus - - - -	—	—	34	11	— 9
	—	—	34	20	
Promontorium - -	—	—	44	49	— 9
	—	—	44	58	
Mare Crisium - -	—	—	45	33	— 11
	—	—	45	44	
Proclus, *clar.* - - - - -		—	46	54	
Plato - - - - - -	—	—	54	48	— 14
	—	—	55	2	
Langrenus - - -	—	11	7	3	— 20
	—	11	7	23	

EMERSIONES.		Tempus verum h	'	"	Differentia "
Plato - - - - - -	clar.	11	40	34	— 14
	cær.	11	40	48	
Heraclides - - -	—	—	41	27	— 12
	—	—	41	39	
Grimaldus - - -	—	—	47	57	— 7
	—	—	48	4	
Keplerus - - - -	—	—	52	58	— 10
	—	—	53	8	
Copernicus - - -	—	12	1	36	— 12
	—	12	1	48	
Menelaus - - - -	—	—	17	18	— 10
	—	—	17	28	
Finis eclipseos, *clar.* - -		—	52	15	

Obſervatio Eclipſis Lunaris, facta ab eodem, eodem modo, eodem loco, iiſdemque inſtrumentis Die 24 Januar. *Anni* 1758.

Ab hora 5^{ta} *uſque ad finem obſervationis tantum commovebatur imprægnata plurimum vaporibus athmoſphæra, ut tota lunæ illuminatæ portio præter morem undulare videretur. Flabat boreas, indicante thermometro Reaumuriano.* 1. *grandem infra aquæ congelationem.*

IMMERSIONES.		Tempus verum h	′	″	Differentia ″
Principium - - - - - -		4	7	42	
Grimaldus - - -	*cær.*	—	9	55	— 38
	clar.	—	10	33	
Ariſtarchus - - -	—	—	15	37	— 34
	—	—	16	11	
Mare Humorum - -	—	—	20	48	— 24
	—	—	21	12	
Copernicus - - -	—	—	26	45	— 13
	—	—	26	58	
Plato - - - - - -	—	—	35	41	— 41
	—	—	36	22	
Tycho - - - -	—	—	39	31	— 38
	—	—	40	9	
Menelaus - - - -	—	—	45	43	— 39
	—	—	46	22	
Plinius - - - -	—	—	50	17	— 27
	—	—	50	44	
Promontorium Somni	—	—	58	15	— 27
	—	—	58	42	
Cleomedes - - -	—	5	0	22	— 14
	—	5	0	36	

IM-

IMMERSIONES.		Tempus verum h	′	″	Differentia ″
Proclus - - - -	*cær.*	5	2	9	— 6
	clar.	5	2	15	
Princip. Maris Crisii -	—	—	3	6	— 25
	—	—	3	31	
Langrenus - - -	—	—	7	40	— 14
	—	—	7	54	
Immerſ. tot. Maris Criſii	—	—	8	19	— 11
	—	—	8	30	
Immerſio totalis Lunæ	—	—	12	50	— 40
	—	—	13	30	

In fine cœlum ſerenum, & athmoſphæra quieta.

REFLEXIO.

Notabilis appulſus umbræ terreſtris ad faculas maculaſque lunares differentia, dum partim vitro colore cæruleo tincto, partim abſque eo, obſervationes inſtituuntur, inventa a D°. de Barros, & tum in obſervatorio Pariſino tum alibi ſæpius confirmata, ad me duplicem hanc lunæ eclipſim, ea qua vel licuit circumſpectione, inſtituendam determinavit, ſpe fretus; me phænomeni hujus cauſas, ſi non veras, veritati ſaltem proximas, inventurum; unde in tempore de vitris planis bene terſis, diametri mediæ lineæ, partim colore cæruleo claro, partim flavo tinctis mihi provideram, his tamen ultimis uti non licuit ob nimiam umbræ penumbræque confuſionem.

Interjecto oculum inter, lentemque ocularem vitri cærulei fragmento, ſequentia obſervavi. 1. Umbra terreſtris in immerſione citius maculam aut faculam lunarem attigit, & in emerſione tardius deſeruit, quam dum abſque eo obſervationem inſtitui. 2. Claritas lunæ, alioquin offendens oculum, ſuavior apparebat. 3. Limites umbræ perfecte terminabantur excepta ſecunda eclipſi, in qua (flante borea) ab hora quinta illuminata lunæ pars undulare videbatur.

Suppoſitis his phænomenis, uti et athmoſphæra lunari, de qua vix dubio locus, ſequentia intuli: 1. Quo denſior dicta athmoſphæra fuerit, major radiorum portio ab hac in immerſam umbræ terreſtri lunæ portionem, limitibus ſaltem proximam, reflectetur, eoſque reddet dubios, quod quidem contingit, dum abſque adminiculo per nudum teleſcopium obſervatio inſtituitur, ſecus vero dum oculum inter, lentemque ocularem, vitrum cæruleo colore tinctum interjicitur. Addito ſecundo, ac tertio phænomeno, nempe per vitrum cæruleum lumen multum apparere ſuavius, infertur, ſi color cæruleus ſufficit ad mitigandam tantopere eam lunæ illuminatæ portionem, quæ extra omnem umbram conſpicitur, quanto magis ſufficit, ad tollendam omnem claritatem, quæ ab athmoſphæra lunari in hoc corpus reflectitur? & ecce tibi ſecundam illationem, nempe limites umbræ facilius determinari. 3. Diametrum umbræ majorem videri debere, & vel ideo immerſiones macularum aut facularum lunarium citius, emerſiones vero tardius ſuccedere debere; quæ quidem omnia cum obſervationibus congruunt.

Dixi in prima illatione, reflecti aliquam luminis portionem a lunæ athmoſphæra in ipſam eclipſatam corporis hujus portionem, non ſecus, ac in globo hoc terraqeuo accidit, qui poſt ſolis occaſum aliquo adhuc tempore illuminatur. Hæc lucis reflexio tanto erit major, quanto athmoſphæra fuerit denſior, &

quia

quia ſupponere licat, hanc in luna non ſemper eſſe æqualem, infertur, differentiam temporis appulſus umbræ non in omni eclipſi lunari poſſe eſſe æqualem, quod demum convenire videtur duplici meæ obſervationi, ut ex adnotatis temporum differentiis liquet. Hæc mea eſt circa propoſitum phænomenon opinandi ratio.

LXXXIX. *Obſervations upon a ſlight Earthquake, tho' very particular, which may lead to the Knowlege of the Cauſe of great and violent ones, that ravage whole Countries, and overturn Cities. By* John Andrew Peyſſonel, *M. D. F. R. S. Tranſlated from the* French.

Read April. 20. 1758.

I Went to make my obſervations upon the natural hiſtory of the ſea; and when I arrived at a place called the Cauldrons of Lance Caraibe, near Lancebertrand, a part of the iſland of Grande Terre Guadaloupe, in which place the coaſt runs north-eaſt and ſouth-weſt, the ſea being much agitated that day flowed from the north-weſt. There the coaſt is furniſhed with hollow rocks, and vaults underneath, with chinks and crevices: and the ſea, puſhed into theſe deep caverns by the force and agitation of the waves, compreſſes the air, which, recovering its ſpring, forces the water back in the form of the moſt magnificent fountains;

tains; which ceaſe, and begin again at every great preſſure. This phænomenon is common to many places in this iſland. The explanation of it is eaſy; but the following is what I particularly obſerved.

As I walked within about forty paces from the brink of the ſea, where the waves broke, I perceived, in one place, the plants were much agitated by ſome cauſe, that was not yet apparent. I drew near, and diſcovered a hole about ſix feet deep, and half a foot diameter; and ſtopping to conſider it, I perceived the earth tremble under my feet. This increaſed my attention; and I heard a dull kind of noiſe underground, like that which precedes common earthquakes; which I have obſerved many a time. It was followed by a quivering of the earth; and after this a wind iſſued out of the hole, which agitated the plants round about. I watched to ſee whether the motion extended to any diſtance; but was ſenſible it did not reach above three or four paces from the hole, and that no motion was perceived farther off.

I further obſerved, that this phænomenon never happens till after the ſeventh wave rolls in; for it is a common thing in this country to find the ſea appear calm for ſome time, and then to produce ſeven waves, which break upon the coaſt one after another: the firſt is not very conſiderable; the ſecond is ſomewhat ſtronger; and thus they go on increaſing to the ſeventh, after which the ſea grows calm again, and retires. This phænomenon of the ſeven waves is obſerved by navigators with great attention, eſpecially at low water, in order to be the better able to go in or come out at the very time

that

that the ſea grows quiet. Theſe ſeven waves ſucceſſively fill the caverns, which are all along the coaſt; and when the ſeventh comes to open itſelf, the air at the bottom of the caverns being greatly compreſſed, acted by its elaſticity, and immediately made thoſe fountains and guſhings I have mentioned; and the waters continuing in the caverns, up to the very place of the hole, began to produce that dull noiſe, cauſed the emotion or earthquake, and finiſhed with the violent wind forced up thro' the hole; after which the water retired into the ſea, and having no further impelling cauſe, on account of the waves, rendered every thing quiet again.

I obſerved, that this phænomenon happened at no limited time, but according to the approach of the waves, being ſtrongly put in motion after the ſeventh. I remained near half an hour to obſerve it; and nearly followed the courſe of the cavern to its entrance, directed by the diſpoſition of the coaſt. I made my negroes go down where the water broke; for they doubted the report of the greatneſs of theſe caverns; and when the ſea was calm one of them ventured in, but returned very quickly, or he muſt have periſhed. Therefore I conclude, that theſe ſmall earthquakes round the hole, about forty paces from the wave, were only cauſed by the compreſſed air in ſome great vault about this place, and that by its force was driven up the hole that appeared: that this air in the caverns, compreſſed to a certain degree, firſt cauſed the dull noiſe, by the rolling of the waters, which reſiſted in the cavern; then acting more violently, cauſed the ſmall earthquake, which ceaſed when the wind paſſed out of the hole, and that the ſea retired, and gave liberty to the air, which was contained and compreſſed.

Such are the obſervations I have made; from which the learned, who are endeavouring to find the cauſe of earthquakes, ſince that dreadful one, which deſtroyed the city of Liſbon, may make ſuch concluſions as they ſhall think proper.

At Guadaloupe,
Jan. 6. 1757.

Peyſſonel.

XC. *A Catalogue of the* Fifty Plants *from* Chelſea Garden, *preſented to the* Royal Society *by the worſhipful Company of Apothecaries, for the Year* 1757, *purſuant to the Direction of Sir* Hans Sloane, *Baronet, Med. Reg. & Soc. Reg. nuper Præſes, by* John Wilmer, *M. D. clariſſ. Societatis Pharmaceut.* Lond. *Socius, Hort.* Chelſean. *Præfectus & Prælector Botanic.*

Read April 20, 1758.

1751 ALlium ſylveſtre latifolium. C. B. P. 74.
Allium urſin. bifolium vernum ſylvatic. J. B. 2. 565.

1752 Anacampſeros flavo flore Amman. Ruth. 96.

1753 Anchuſa ſtrigoſa, foliis linearibus dentatis, pedicellis bractea minoribus, calycibus fructiferis inflatis. Leſl. Linn. Sp. Plant. 133.

1754 Aſplenium ſive Ceterach. J. B. 3. 749. Offic. 121.

1755

1755 Bidens calyce oblongo squamoso, seminibus radii corolla non decidua coronatis, Miller. Icon.

1756 Cactus repens decemangularis Lin. Sp. Pl. 467.

1757 Cerasus pumila Canadensis, oblongo angusto folio, fructu parvo, Du Hamel. Mill. Icons.

1758 Ceratocarpus Amæn. Acad. 1. p. 412. Hort. Upf. 281.

1759 Cotula flore luteo, radiato. Tourn. 495.
Buphthalmum Cotulæ folio C. B. P. 134.

1760 Cracca minor Rivini. Vicia segetum cum siliquis plurimis hirsutis C. B. P. 345.

1761 Cucubalus calycibus subglobosis glabris reticulato-venosis, capsulis trilocularibus, corollis subnudis, Flor. suec. 360.

1762 Cucubalus calycibus subglobosis, caule ramoso patulo, foliis linearibus acutis, Mill. Dict.
Lychnis sylvestris quæ Been album vulgo, foliis angustioribus et acutioribus C. B. P. 205.

1763 Cunonia floribus sessilibus, spathis maximis. Butner Cunonia, tab. 1.

1764 Cupressus foliis imbricatis frondibus ancipitibus. Linn. Spec. Plant. 1003.
Cupressus nana Mariana fructu cæruleo parvo. Pluk. Mantiss. 61.

1765 Cyclamen Hederæ folio C. B. P. 308. Offic. 162.

1766 Diosma foliis lineari-lanceolatis subtus convexis, bifariam imbricatis. Linn. Sp. Plant. 198.

1767 Euonymoides Canadensis Saraz. Boerh. Ind. Alt. 237.

1768 Filipendula foliis ternatis Hort. Cliff. 191.

1769 Filipendula vulgaris, an Molon Plinii C. B. 163. Offic. 197.

1770 Heliotropium foliis ovato-lanceolatis, ſpicis plurimis confertis, caule fruticoſo. Miller's Icons.

1771 Hieracium fruticoſum latifolium hirſutum C. B. P. 129.

1772 Hyoſcyamus rubello flore. C. B. P. 169.
Hyoſcyamus Syriacus. Cam. Icon. 21. J. B. 3. 628.

1773 Hypericum floribus monogynis ſtaminibus corolla longioribus, calycibus coloratis caule fruticoſo. Miller's Icons.

1774 Hypericum floribus trigynis, calycibus acutis, ſtaminibus corolla brevioribus, caule fruticoſo. Linn. Hort. Cliff. 380. Miller's Icons.

1775 Iris corollis barbatis, germinibus trigonis, foliis enſiformibus longiſſimis, caule foliis longiore bifloro. Miller's Icons.

1776 Iſatis ſativa, ſive latifolia. C. B. P. 113.
Glaſtum ſativum. J. B. 2. 909.

1777 Juniperus vulgaris fruticoſa C. B. 488. Off. 252.

1778 Ixia foliis gladiolatis linearibus caule bulbifero. Miller's Icons.

1779 Ixia foliis gladiolatis glabris, floribus corymboſis terminalibus. Miller's Icons.

1780 Larix C. B. 493. Officin. 264.

1781 Laſerpitium foliis amplioribus, ſemine criſpo. Tourn. 324.

1782 Linum calycibus capſuliſque obtuſis. *Sibirian Flax.* Miller's Icons.

1783 Liriodendrum. Hort. Cliff. 223.
Tulipifera arbor Virginiana. Hort. Lugd. Bat. 612.

1784 Oenanthe Apii folio C. B. P. 162.

1785 Passerina foliis linearibus. Hort. Cliff. 146. Sp. 1.
1786 Platanus Orientalis verus. Park. 1427.
1787 Platanus Occidentalis aut Virginiensis. Park. 1427.
1788 Platanus Orientalis Aceris folio. T. Cor. 41.
1789 Prenanthes foliis integris serratis scabris, radice repente, flore purpureo cæruleo. Mill. Dict.
1790 Ruta sylvestris linifolia; Hispanica Boccon. Barrel Icon. 1186 H. Mus. p. 2. 82. tab. 73.
1791 Saxifraga muscosa; trifido folio. Tourn.
1792 Scabiosa Virgæ Pastoris folio. C. B. P. 270. Scabiosa latifolia peregrina. Tabern. Icon. 160.
1793 Thalictrum majus, siliqua angulosa aut striata, C. B. P. 336.
1794 Thalictrum majus non striatum. C. B. P. 336.
1795 Thalictrum Canadense majus caulibus viridantibus. Boerhaav.
1796 Thalictrum Alpinum Aquilegiæ foliis. Tourn.
1797 Thalictrum minus Asphodeli radice magno flore. Tourn. 271.
1798 Thuya strobilis squarrosis squamis acuminatis reflexis. Hort. Upsal. 289.
1799 Tordylium Narbonense minus. Tourn. 320.
1800 Tridax. Hort. Cliff. 418. Aster American. procumbens, foliis laciniatis et hirsutis. Houston.

XCI. *An Hiſtorical Memoir concerning a Genus of Plants called* Lichen, *by* Micheli, Haller, *and* Linnæus; *and comprehended by* Dillenius *under the Terms* Uſnea, Coralloides, *and* Lichenoides: *Tending principally to illuſtrate their ſeveral Uſes. Communicated by* Wm. Watſon, *M. D. F. R. S.*

—— *Natura nihil fruſtra creaverit. poſteros tamen tot inventuros utilitates ex* Muſcis *auguror, quot ex reliquis vegetabilibus.*

Cui bono? Amæn. Acad. III. p. 241.

Read Apr. 27 & May 4, 1758.

THE whole claſs of moſſes were taken but very little notice of by the revivers of botany in the ſixteenth century: they indeed took ſome pains to diſtinguiſh the particular ſpecies that the ancients had mentioned, but diſregarded almoſt all the reſt. Modern botaniſts however ſuppoſe, that they were but little ſucceſsful in general in their application of the ancient names to plants: nor is a failure in ſuch attempts to be wondered at, conſidering the too great conciſeneſs, and frequent obſcurity, of their deſcriptions. In the claſs of moſſes, as in many others, the accounts tranſmitted to us are little more than a ſcene of uncertainty and confuſion.

It is to the moderns we are indebted for the diſcovery of the far greater number of the plants of this claſs.

claſs. In this branch of botany our own countrymen Mr. Ray, Buddle, Dale, Doody, Petiver, and Dr. Moriſon, Sherard, Richardſon, and others, have diſtinguiſhed themſelves: and amongſt foreigners M. Vaillant, Sig. Micheli, and the very eminent Dr. Haller: but, beyond all, the late learned and indefatigable profeſſor at Oxford, Dr. Dillenius, has herein made the moſt ample diſcoveries and improvements, of which his elaborate hiſtory will ever remain a ſtanding proof.

The word *lichen* occurs in the writings of Dioſcorides and Pliny; and tho' it may be doubtful, there is nevertheleſs good reaſon to apprehend, that Dioſcorides meant to deſcribe under that name the very plant, or at leaſt one of the ſame genus, to which the commentators agreed to affix his deſcription. Since then the name has been variouſly applied by different authors: on which account it is neceſſary to premiſe, that the *lichen ſive hepatica Off.* or liverwort of the ſhops, does not fall under this generical term, as it is now formed by the three above-named authors. They comprehend under the term *Lichen*, and Dillenius under thoſe of *Uſnea*, *Coralloides*, and *Lichenoides*, the hairy tree-moſs or *uſnea* of the ſhops; the *muſcus pulmonarius*, tree-lungwort, or oak-lungs; the *lichen terreſtris cinereus*, or aſh-coloured ground liverwort; the coralline-moſſes; the cup-moſſes; horned moſſes; the *orchel*, or Canary-weed; the *muſcus iſlandicus* of Bartholine; and a multitude of others found upon trees, walls, rocks, and ſtones, in all parts of the world, and in many parts thereof in very great abundance.

Caſpar Bauhine in his *Pinax*, John Bauhine, and our countrymen Gerard and Parkinſon, and their cotemporaries, as they wrote before the time that generical characters in botany were in uſe, included theſe lichens among the other herbaceous moſſes, under the general name of *muſcus*; adding to the name in general ſome epithet deſcriptive of its form, place of growth, or ſuppoſed virtue.

Mr. Ray, both in his Hiſtory of Plants, and in the Supplement, as he was uſually averſe to the forming of new names, has interſperſed them among other moſſes, under the character of *muſci ſteriles ſeu aſpermi*, retaining the ſynonyms of the two Bauhines, Gerard, and Parkinſon, to the general ſpecies.

Dr. Moriſon ſeems to have been the firſt, who ſeparated them intirely from the herbaceous moſſes; and, from the analogy he ſuppoſed they had with the fungus tribe, formed them into a genus, under the name of *muſco-fungus*. He enumerates fifty ſpecies and upwards under this term in the *Hiſtoria Oxonienſis*, and has divided them into five orders, according to their different appearances, as follows:

1. *Muſco-fungi e terra prominentes, latiores*. 5.
2. *Muſco-fungi pixidati*. 11.
3. *Muſco-fungi corniculati*. 26.
4. *Muſco-fungi cruſtæ modo adnaſcentes*. 37.
5. *Muſco-fungi corticibus arborum dependentes*. 53.

Table the 7th of his 15th ſection exhibits ſeveral good figures of ſome of theſe lichens.

Tournefort was the firſt, who adapted the generical term *lichen* to them; but it was in conſequence of his joining them to the lichen of the ſhops. He has however excluded the coralline-moſſes, and forms them into a genus, by the name of *coralloides*; to which he has connected ſome plants, properly of the fungus tribe. In this diſtinction he is followed by Dr. Boerhaave in his *Index alter Plantarum*.

Dr. Dillenius firſt called them *lichenoides*, in the catalogue of plants growing about Gieſſen, chuſing to retain the word *lichen* to the liverwort of the ſhops. Under this name however, in this work, he does not comprehend the *uſneæ*, or hairy tree-moſſes, but refers them to the *confervæ*, adding the epithet *arborea* to each ſpecies, to diſtinguiſh them from the water kinds. He enumerates upwards of ſixty ſpecies of *lichenoides*, but has applied few or no ſynonyms to them.

Under the ſame generic term he has introduced them into the third edition of Ray's Synopſis of Britiſh Plants, taking in the *uſneæ*, and recounting upwards of ninety ſpecies, all found ſpontaneouſly growing in England. Many of theſe are undoubtedly only varieties. They are in this work very naturally divided into ſeveral orders and ſubdiviſions, for the greater eaſe of diſtinguiſhing them, as follows:

- *Lichenoides*
  - *caulifera*
    - 1. *Capillacea et non tubuloſa ſcutellata.*
    - 2. *Coralliformia tuberculoſa plerumque.*
      - a. *Solida et non tubuloſa.*
      - b. *Tubuloſa.*
    - 3. *Pyxidata.*
    - 4. *Fungiformia.*
  - *cauliculis deſtituta*
    - 1. *Mere cruſtacea.*
    - 2. *Cruſta folioſa ſcutellata ſeu foliis ſcutellatis arcte adnaſcentibus* -
      - a. *Subſtantiæ gelatinoſæ.*
      - b. *Subſtantiæ durioris.*
    - 3. *Foliis magis liberis nec tam arcte adnaſcentibus*
      - a. *Scutellatis et tuberculatis.*
      - b. *Peltatis.*

M. Vaillant, in the *Botanicon Pariſienſe*, retains Tournefort's names. Many of theſe lichens, as well as other moſſes, are accurately repreſented in the elegant tables, which adorn that work. Dr. Haller tells

tells us he learnt to diſtinguiſh almoſt all the moſſes ſolely by the help of theſe tables, ſo well are they expreſſed. The lovers of botanic ſcience are greatly in debted to Boerhaave for his publication of that work.

Micheli, after Tournefort, adopts the term *lichen*, and comprehends all the ſpecies under it, except one or two, which he calls *lichenoides*. This author however does not take into this genus the liverwort of the *materia medica*; he deſcribes the ſpecies of that genus under the name of *marchantiæ*. Near twenty of the plates in his *Nova Plantarum Genera* are taken up in repreſenting various ſpecies of this genus. In this work they are divided into thirty-eight orders or ſubdiviſions; a circumſtance very neceſſary indeed, conſidering how greatly he has multiplied the number of the ſpecies. It is to be regretted, that ſo indefatigable an author, one whoſe genius particularly led him to ſcrutinize the minuter ſubjects of the ſcience, ſhould have been ſo ſolicitous to increaſe the number of ſpecies under all his genera: an error this, which tends to great confuſion and embaraſſment, and muſt retard the progreſs and real improvement of the botanic ſcience.

Dr. Haller retains Micheli's term, and enumerates 160 kinds in his *Enumeratio Stirpium Helvetiæ*: he divides them into ſeven orders, according to the following titles:

1. *Lichenes corniculati & pixidati.*
2. *Lichenes coralloidei.*
3. *Lichenes fruticoſi alii.*
4. *Lichenes pulmonarii.*
5. *Lichenes cruſtacei ſcutis floralibus ornati.*
6. *Lichenes ſcutellis ornati.*
7. *Lichenes cruſtacei non ſcutati.*

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The extensive number of the species, and the difficulty of distinguishing them with a tolerable degree of certainty, has deterred Dr. Haller from adding so full and complete a list of synonyms to the plants of this genus as he has elsewhere done in that splendid work. Plate the 2d exhibits several elegant sorts of these lichens.

Linnæus, and the followers of his method, who seem to have established their generical character from Micheli's discoveries, retain also his generical title. Micheli's passion for the multiplication of species is no-where more conspicuous than in the plants of this genus, which he has most enormously augmented to the number of 298 species. The Swedish professor cannot be charged with this foible: it is one of the excellencies of his writings, that they inculcate the reverse. He has so far retrenched this genus, that in his general enumeration of plants he recounts only eighty species belonging to it. They are in this work divided into eight orders, according to the difference of appearance which they form by their *facies externa*, little or no regard being had to what are usually called the parts of fructification.

1. *Lichenes leprosi tuberculati.*	5. *Lichenes coriacei.*
2. *Lichenes leprosi scutellati.*	6. *Lichenes scyphiferi.*
3. *Lichenes imbricati.*	7. *Lichenes fructiculosi.*
4. *Lichenes foliacei.*	8. *Lichenes filamentosi.*

Dr. Dillenius, in his most elaborate work, intituled, *Historia Muscorum*, has divided this Michelian genus into three, under the names of *usnea*, *coralloides*, and *lichenoides*. Under the word *usnea* he comprehends the hairy tree-mosses, among which are the *usnea* of the ſhops, and the true *uſnea* of the Arabians. Of theſe he deſcribes ſixteen ſpecies. Under *coralloides* he deſcribes thirty-nine ſpecies, among which are the cup-moſſes, and many others, diſpoſed according to the following ſcheme:

Ordo I. *Fungiformia, non tubuloſa, nec ramoſa.* 5.
Ordo II. *Scyphiformia, tubuloſa, ſimplicia et prolifera.*
Series 1. *Scyphis perfectioribus.* 13. Cup-moſſes.
Series 2. *Scyphis imperfectis.* 20. Horned moſſes.
Ordo III. *Ramoſa fruticuli ſpecie ſummitatibus acutis multifariam diviſis.*
Series 1. *Species tubuloſæ.* 30. Tubulous coralline moſſes.
Series 2. *Species ſolidæ.* 39. Solid coralline moſſes; among which is the *orchel.*

The genus of *lichenoides* contains 135 ſpecies, diſpoſed according to the following ſcheme:

Ordo I. *Species aphyllæ mere cruſtaceæ.* { 1. *Tuberculoſæ.* 8. 2. *Scutellatæ.* 18. }

Ordo II. *Species folioſæ.* { 1. *Gelatinoſæ tuberculoſæ et ſcutellatæ.* 35. 2. *Aridiores et exſuccæ, ſcutellatæ.* 100. 3. *Aridiores peltatæ et clypeatæ.* 121. }

Theſe plants are not only largely deſcribed, and accompanied with the moſt perfect aſſemblage of ſynonyms; but every ſpecies is accurately figured, and many of them in various views, and at different ages of their growth; by which this laborious work, notwithſtanding it is converſant upon the minuteſt, and

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consequently the most abstruse parts of botany, may nevertheless be justly esteemed, without any exaggeration, one of the most complete works extant of the kind.

Dr. Hill, in his History of Plants, has disposed them into five genera, under the following names: 1. *Usnea*, comprehending the hairy tree-mosses; 2. *Platysma*, flat-branched tree-mosses, the lungwort, and others; 3. *Cladonia*, containing the orchel and coralline-mosses; 4. *Pyxidium*, the cup-mosses; 5. *Placodium*, the crustaceous mosses.

The plants of this extensive genus are very different in their form, manner of growing, and general appearance: on which account those authors, who preserve them under the same name, saw the propriety and necessity of arranging them into different orders and subdivisions, that the species might be distinguished with greater facility. Upon the same principle Dr. Dillenius and Dr. Hill have formed them into several genera.

So far as the parts of fructification are distinguishable in these plants, they appear in different forms upon different species: on some, in the form of tubercles; on others, in the form of little concave dishes, called *scutellæ*; on others, of oblong flat shields or pelts. All these are conceived by Micheli and Linnæus to be receptacles of male flowers. The female flowers and seeds are suspected by the same authors to be dispersed in the form of farina or dust upon the same plants, and in some instances on separate ones. Dillenius has not dared to determine any thing positively with regard to the real parts of fructification in these lichens: time will hereafter, it is to be hoped, throw more light upon the subject.

In order to convey a more diſtinct idea of the ſeveral plants of this genus, which enter into œconomical or medical uſes in the various parts of the world, we ſhall diſtribute them into ſeveral orders, according to the cuſtom of former writers: and as is not conſiſtent with our plan to deſcribe each of theſe ſpecies, we ſhall refer to the page of the more modern authors, where they may be found.

1. Lichenes filamentoſi.

Such as conſiſt of mere ſolid filaments, of a firm and ſolid but flexible texture, having the appearance of fructification in the form of ſcutellæ, *or flat round bodies growing from the ſides or extremities of theſe filaments.*

This order or diviſion comprehends the hairy tree-moſſes, or *uſnea* of Dillenius and Hill; ſeveral of the ſpecies of the fifth order of lichens of Micheli; and the *lichenes filamentoſi* of Linnæus.

Dr. Dillenius deſcribes ſixteen ſpecies under the term *uſnea*, ſeveral of which are found in England, tho' ſome of them, as the common *uſnea* of the ſhops, but very ſparingly, and none of them in any conſiderable plenty. The thick woods in many other parts of Europe, and the reſt of the globe, afford them in great plenty. They hang from the branches of various kinds of trees, like large tufts of hair, to a conſiderable length: ſome ſpecies grow ſeveral feet long. The rocks on the tops of high mountains afford ſeveral kinds. They are of various colours; ſome whitiſh, aſh-coloured, others grey or blackiſh, and two or three ſpecies have a yellow or orange hue.

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The commentators in general agreed in making the *bryon* of (1) Diofcorides one of thefe hairy tree-moffes, which they called *ufnea*. No wonder, therefore, that at the reftoration of letters it became a matter of controverfy, which of them was the *ufnea* of the ancients. Diofcorides recommends his as an aftringent; and tells us, that "the beft grew upon "the cedar; but that from whatever tree it was ga-"thered, the whiteft and moft fragrant was pre-"ferable to the black." The feveral *ufneæ* would undoubtedly in different countries be found upon different trees. In Italy, that of the larch-tree was the moft odoriferous; and on that account Matthiolus (2) preferred it to all others. That kind, which at length obtained a place in the fhops as the *ufnea* of the ancients, was a fpecies commonly found in our countries on old oaks and other trees, and is called by Dillenius (3) ftringy tree-mofs, or *ufnea* of the fhops. Many excellent virtues have been afcribed to it, on a fuppofition of its being the true *ufnea*; but it does not appear to have deferved them: and the prefent practice, at leaft in England, has quite expunged it, and that perhaps very juftly.

Dr. Dillenius is evidently of opinion however, that this common *ufnea*, tho' it obtained a place in the fhops as fuch, is not the *bryon* of Diofcorides and Pliny, or the *phafeon* of Theophraftus, fince he has

(1) Lib. i. c. 20. See this fubject largely difcuffed in Bodæus à Stapel Comment. in Theoph. p. 156. et feq.

(2) Opera omnia à C. B. edit. 1598. p. 64.

(3) *Ufnea vulgaris loris longis implexis* Hift. Mufc. p. 56. *Lichen plicatus* Lin. Sp. Pl. 1154. *Mufcus arboreus: Ufnea* Officin. C. B. Raii Syn. III. p. 64.

applied

applied theſe names from thoſe fathers of botany to another ſpecies, which he calls the *beard uſnea* (4). Nor does either of theſe ſpecies appear to be the true *uſnea* of the Arabians, whatever title they may ſeem to have to it, either from their colour or ſmell. Bellonius, as he is quoted by Dr. Dillenius, tells us, " that the true *uſnea*, or *bryon*, as he calls it, is ſold " at Conſtantinople under the name of *uſnech*; and " tells us we are deceived in believing ours to be " the true *uſnea*." Dillenius has therefore deſcribed another ſpecies (5), which he received from the Eaſt Indies, from Madagaſcar, and St. Helen's, as the *Uſnea Arabum*. This plant the Indians call *ſaliaga*; and Camelli aſſures us, that, while freſh, it has a very fragrant muſk-ſmell. He adds, that he had himſelf experienced what Serapio ſays of it; *viz.* that a vinous infuſion of it reſtrains fluxes, ſtops vomiting, ſtrengthens the ſtomach, and induces ſleep.

The common *uſnea* of the ſhops was ſaid to be the baſis of that fine perfumed powder, which the French called *corps de cypre gris*, and which formerly made a great article of trade at Montpelier. Dr. Brown hints (6), that the perfumers uſe it ſtill; but he does not add, where. John Bauhine gives us the whole proceſs (7) for making that power, which was vended in great quantities to all parts of France. It

(4) *Uſnea barbata loris tenuibus fibroſis* Hiſt. Muſc. p. 63. *Lichen barbatus* Lin. Sp. Pl. 1155. *Quercus excrementum villoſum* C. B. p. 422. Bauhine took this to be the true *Uſnea Arabum*.

(5) *Uſnea ceratoides candicans glabra et odorata* Hiſt. Muſc. p. 71. *Muſcus arboreus candicans et odorifer* Camelli Raii Hiſt. III. Append. p. 3.

(6) Civil and Natural Hiſtory of Jamaica, p. 80.

(7) Hiſt. Plant. I. par. ii. p. 88.

is neverthelefs true, that other of the lichens had as great a fhare in the compofition as the *ufnea*; as the demand for that powder could not have been anfwered, if the makers had confined themfelves to the *ufnea* alone. It was neceffary too, inafmuch as other fpecies are equally well adapted to the fame ufes (8).

This *ufnea* is abundantly plentiful in the woods of Lapland; and Linnæus (9) relates, that the inhabitants apply it to their feet, when they are fore and excoriated with much walking. The benefit they receive from it in this cafe is undoubtedly owing to its ftyptic quality, which is remarked by Matthiolus, and by Mr. Ray (10) from the German Ephemerides.

The *beard ufnea* before mentioned, which is abundantly common upon the trees both in the northern regions of Europe and America, as well as in the eaftern kingdoms, and is defcribed by Mr. Ray as hanging to the length of two feet, the filaments of which are not thicker than a common thread, and of a greenifh white colour, is ufed by the inhabitants of Penfylvania to dye an orange colour with. This information Dillenius received from Mr. Bartram.

The black *mane ufnea*, which grows in vaft quantities in the Lapland woods, in a defect of the common coralline mofs makes part of the fodder, and is equally acceptable to the rein-deer in the winter time (11).

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(8) Flor. Lap. p. 342. ε. Flor. Suec. Ed. II. p. 416.
(9) Flor. Lap. p. 348.
(10) Hift. Plant. I. p. 115.
(11) *Ufnea jubata nigricans.* Dillen. Hift. Mufc. p. 64. *Lichen jubatus* Lin. Sp. Pl. 1155. *Mufcus corallinis faxatilis fæniculaceus,* Rock-hair. Raii Syn. III. p. 65. n. 7.

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The long beaded *uſnea*, or necklace-moſs (12), enters into the like œconomical uſes in Virginia, where it is very plentiful. The inhabitants find it a very agreeable fodder in the winter ſeaſon to both ſheep and cows (13).

The Norwegians appropriate one of theſe *uſnea* to a ſingular uſe. Pontoppidan tells us (14), " they " have a certain kind of yellow moſs hanging on " the branches of trees of the firs and pines, which " is very venomous, yet applied to a neceſſary uſe; " for being mixed in pottage, or with fleſh, as a " bait for the wolves, they infallibly die of it." That the ſpecies here referred to is the braſs-wired *uſnea* of Dillenius (15), or the *lichen vulpinus* of Linnæus, cannot be doubted, ſince this laſt author mentions (16) the ſame application of it with very little variation. In England it is very rare; in Sweden plentiful, eſpecially in the province of Smoland, where the natives dye woollen goods yellow with it.

John Bauhine deſcribes a very beautiful ſpecies, under the name of *laricus muſcus* (17), which gives a very elegant citron colour upon chewing, or upon maceration in water. Dillenius is doubtful, whether this is what he has deſcribed under the name of the orange-coloured forked *uſnea* (18).

(12) *Uſnea capillacea et nodoſa* Dillen. Hiſt. Muſc. 60. *Muſcus arboreus nodoſus* C. B. p. 361. Raii Syn. III. p. 65. n. 4.

(13) Raii Hiſt. Pl. III. p. 28.

(14) Natural Hiſtory of Norway, p. 148.

(15) *Uſnea capillacea citrina fruticuli ſpecie*. Hiſt. Muſc. p. 73. *Muſcus aureus tenuiſſimus* Merret. Pin. p. 79. Raii ſyn. p. 65. n°. 8.

(16) Flor. Suec. Ed. II. p. 427.

(17) Hiſt. Plant. III. P. ii. lib. 9. p. 273.

(18) *Uſnea dichotoma compreſſa ſegmentis capillaceis teretibus*. Hiſt. Muſc. 72. *Muſcus arboreus aurantiacus ſtaminibus tenuiſſimis* Pluk. Alm. p. 254. Raii Hiſt. III. 28.

We may here obſerve by the bye, that the *uſnea cranii humani*, which thro' the influence of ſuperſtition formerly obtained a place in the catalogues of the *materia medica*, does not belong to this diviſion of the lichens. The writers of thoſe times diſtinguiſhed two kinds of *uſnea humana*, under the names of *cruſtacea* and *villoſa*. Any of the cruſtaceous lichens, but more properly the common grey-blue pitted *lichenoides* of Dillenius, was uſed for the former of theſe; and, as Dale tells us, was held in moſt eſteem. The *villoſa* was a ſpecies of the genus of *hypnum*. Indeed it does not appear, that they were in thoſe days very curious in determining the exact kind; and doubtleſs any moſs, which happened to grow upon an human ſkull, was ſufficient for the purpoſes deſigned.

2. Lichenes fruticuloſi.

Such as conſiſt of a tough flexible matter, formed into ramifications, in ſome ſpecies almoſt ſimple, in others reſembling ſmall ſhrubs: in ſome of the ſpecies the branches are quite ſolid, in others tubular.

This order comprehends the third of Dillenius's genus of *coralloides*; the whole *cladonia* of Hill; the ſecond, and ſeveral ſpecies of the third order of Haller's lichens; ſeveral ſpecies of the fifth, and the whole ſixth, order of Micheli; and the *lichenes fruticuloſi* of Linnæus.

The plants of this genus grow principally upon the ground on heaths, foreſts, and mountainous bar-

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ren places; except the *orcelle*, or Canary-weed, which is found upon the rocks on the ſea-coaſt.

To this diviſion belongs the horned moſs (19). It is found with us in rocky barren ground, and upon old walls not uncommon. It was formerly in great credit as a pectoral; but is now quite in diſrepute.

The common branched coralline-moſs (20) is one of the moſt uſeful plants of all the tribe of lichens. It is pretty frequent with us on our heaths, foreſts, and mountains. The northern regions afford it in abundance; and there it is peculiarly and ſingularly uſeful. It is indeed the very ſupport and foundation of all the Lapland œconomy, and without which the inhabitants could not ſuſtain their rein-deer in the winter time. Linnæus tells us (1), that Lapland affords no vegetables in ſuch plenty as this, and other of the lichens. Plains of ſeveral miles extent are totally covered over with it, as if with ſnow; and where no other plant will even take root, this will thrive and be luxuriant. Theſe dreary and inclement waſtes, theſe *terræ damnatæ*, as a foreigner would readily call them; theſe, are the Lapland fields and fertile paſtures. On this lichen the rein-deer, thoſe ſources of all their wealth, feed in the winter time, when it is in its moſt flouriſhing condition, and no

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(19) *Coralloides corniculis longioribus et rarioribus.* Dillen. Hiſt. Muſc. p. 103. *Muſcus corniculatus* Ger. p. 1372. Park. 1308. Raii Hiſt. I. p. 112. III. p. 28. *Lichenoides tubuloſum cinereum minus cruſtaceum minuſque ramoſum* Raii Syn. 3. p. 67.

(20) *Coralloides montanum fruticuli ſpecie ubique candicans* Hiſt. Muſc. p. 107. *Lichen rangiferinus* Lin. Sp. Pl. 1153. *Muſcus corallinus.* Tab. Ger. em.

(1) Flor. Lappon. p. 332.

other

other vegetable is to be had: with this too they will even become fat. The riches of the Laplanders consist in their number of these cattle: they are cloathed with their skins, fed with their flesh, and from their milk they make both butter and cheese. Nature, by the inclemency of their seasons, has almost denied them the cultivation of their earth: they neither sow nor reap; but live a perpetual migratory life, tending their flocks of rein-deer, upon which their whole care is centered and employed.

The milk of the rein-deer is very remarkably fat and rich: it tastes indeed like cow's milk, with which some butter, and a small quantity of fat or suet, has been intimately united. Dr. Haller (2) suspects, that this richness of the milk is owing to the animals feeding upon this moss. Most of the plants of this family are of an astringent quality, which indeed they manifest to the taste. This astringency of their food will doubtless contribute much to that effect.

The rein-deer are not the only animals that will feed upon the coralline moss. The Novaccolæ (3) gather vast quantities of it to fodder their oxen with in the winter. They take the opportunity of raking it together in the rainy seasons, when it is tough; for in dry weather it easily crumbles into powder. This they moisten with a little water in the winter season when they use it, and find it excellent fodder.

(2) Enum. Stirp. Helv. p. 69. N°. 38.

(3) The Novaccolæ are a people originally sprung from the Finlanders: they fixed themselves in Lapland not long since, and traffick with the old inhabitants.

The coralline moſſes are ſubject to great variation: and altho' there are ſeveral really diſtinct ſpecies, yet they run ſo into one another, that it is no eaſy matter to fix upon the real ſpecific diſtinctions, in many inſtances. Some ſpecies are perfectly white; others have the extremities of the branches reddiſh, ſome brown, and others almoſt black. The common coralline moſs in Lapland not unfrequently grows to be ſeveral inches long, and even a foot high.

The tubular or hollow branched coralline moſſes are not the only kinds upon which the rein-deer will feed. Almoſt all the lichens are abundantly more plentiful in thoſe northern, than in theſe more ſoutherly climates. There are ſeveral ſpecies with ſolid branches; one, which Dillenius calls *The criſp warty Alpine coralloides* (4), which is almoſt as plentiful as the common ſort, and is equally acceptable to thoſe animals (5). It was before obſerved, that, in defect of theſe moſſes, the black *mane uſnea* is a ſubſtitute equally acceptable to thoſe animals.

Another of the moſt remarkable and uſeful plants of this diviſion is the *orchel* (6), or *argol*, as it is

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(4) *Coralloides criſpum et botryforme Alpinum* Hiſt. Muſc. p. 114. *Lichen paſchalis* Lin. Sp. Pl. *Lichenoides non tubulum cinereum ramoſum totum cruſtaceum* Raii Syn. III. 66. N. 11. This moſs is not common in England. Dr. Dillenius found it upon ſome of the mountains in Wales. It is found in many places on Charley-foreſt, Leiceſterſhire.

(5) Flor. Lappon. N°. 489.

(6) *Coralloides corniculatum faſciculare tinctorium fuci teretis facie* Dillen. Hiſt. Muſc. p. 120. *Cladonia tophacea* Hill. Hiſt. Pl. p. 93. *Fucus capillaris tinctorius* Raii Hiſt. I. p. 74. *Lichen (Rocella) fruticuloſus ſolidus aphyllus ſubramoſus tuberculis alternis* Lin. Sp. Pl. 1154.

commonly

commonly called. This enters more into œconomical uſes among us than any other of the whole genus. How conſiderable an article it forms in the dying trade, in which its uſes are various and extenſive, is very well known. Its tinging property has been known from ancient times; and ſome of our moſt celebrated botanic writers are of opinion, that it was uſed as a dye even in the days of Theophraſtus. That father of botany mentions a *fucus*, which, he ſays, grew upon the rocks about the iſland of Crete; and that they dyed woollen garments of a purple, or rather a red colour, with it. It grows on the rocks by the ſea-coaſt in many parts of the Archipelago, and in the Canary Iſlands; from whence we generally import it, as well as from the Cape Verd, which afford it in plenty. The demand for *orchel* is ſo great, that Mr. Hellot (7), of the Royal Academy of Sciences, informs us, they gather yearly, upon an average, from the iſle of Teneriffe 500 quintals, which amounts to 25 ton weight; from the Canary Iſlands 400 quintals, from Forteventura 300, from Lancerota 300, the ſame from Gomera, and from Ferro 800.

The way of manufacturing the *orchel* for the uſes of dying, was for a conſiderable time a ſecret in few hands; but it is now done in London, and other parts of Europe, to great perfection. Mr. Ray, from Imperatus, gives a brief account of the proceſs (8). Micheli has ſince delivered a more exact detail of it.

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(7) L'Art de la Teinture des lains et des Etoffes de lain, Paris 1750, p. 543.

(8) Raii Hiſt. Plant. I. p. 74.

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This, at least, seems to be the method (9), which the dyers at Florence used. From both these accounts, urine and pot-ash appear to be the principal ingredients used in extracting its colour.

Many other plants of this genus contain the same tophaceous matter as the *orchel*; and upon trial have been found to strike a good colour. Micheli, after he has related the preparation of the *orchel*, suggests the same thing; and M. Hellot, in the treatise before mentioned, tells us, there are many other mosses, which will give as good a colour as the *orchel*. In fact, he adds, that M. Bernard de Jussieu brought him some from the forest of Fontainbleau, which, upon experiments with urine and lime, took a purple colour. In the sequel of this memoir we shall point out some of these kinds. M. Hellot has given us a process, which he made use of for discovering whether any of these lichens would yield a red or purple colour. It is as follows: "Put about "two drachms of any of these lichens into a little "glass jar: moisten it well with equal parts of "strong lime-water, and volatile spirit of *sal ammo-* "*niac*: tie a wet bladder close over the top of the "vessel, and let it stand three or four days. At the "end of this time, if the lichen is likely to answer, "that small quantity of liquor, which you will find "in the glass, will be of a deep crimson red; and "the plant will retain the same colour when the li- "quor is all dried up. If neither the liquor nor the "plant have taken any colour, it is needless to make "any further trials with it." This process is simple

(9) Nova Plant. Gener. p. 78.

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and easy, and well worth observation by all who are disposed to prosecute experiments of this nature: and indeed it is worth the trial, whether several lichens, which we have plentifully enough in England, would not answer in this respect.

3. Lichenes pyxidati.

Such as consist of a firm tough flexible matter, formed into simple tubular stalks, whose tops are expanded into the form of little cups.

This division contains the cup-mosses of authors; the second order of *coralloides* of Dillenius; great part of the first order of lichens in Haller; the 7th, 8th, 9th, and 10th order in Micheli; and the *lichenes schyphiferi* of Linnæus. Dr. Hill has constituted a genus intirely of these cup-mosses, under the name of *pyxidium*.

They are common with us on heaths, and other dry and barren places. Some of them are proliferous, even to the third degree, and form a very beautiful appearance. Some have tubercles on the edges of the cups, of a beautiful scarlet colour.

The cup-moss (10) was a long time in great and established use for coughs, and especially for the whooping cough in children; for which it was long accounted a specific. To this end it was given in various forms. Gerard and Parkinson recommend

(10) *Coralloides schyphiforme tuberculis fuscis* Hist. Musc. 79. *Lichenoides tubulosum pyxidatum cinereum.* Raii Syn. III. p. 68. *Pyxidium margine leviter serrato.* Hill. Hist. Plant. p. 94.

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the powder to be taken for ſeveral days together. Dr. Willis was particularly one of its patrons. He has given us (11) ſeveral forms for its exhibition, as that of the powder, a decoction, and a ſyrup from it.

The preſent practice has quite exploded it, and very juſtly perhaps, as in any degree ſpecific in the above diſorder. Nevertheleſs, it ſeems to have ſuſtained that character with as great a reputation, and perhaps with as good a title to it, as almoſt any of the ſpecifics of that age. It has been obſerved before, on another occaſion, that this tribe of moſſes have in general an aſtringent property; as ſuch, the cup-moſſes are conſequently of a ſtrengthening nature: it is no wonder, therefore, that they ſhould be helpful in this diſorder, merely as corroborants. That they were uſeful in ſome meaſure can ſcarcely be doubted; and our very eminent Dr. Huxham (12), in treating upon this obſtinate complaint, ſeems to allow this of the cup-moſs in preference to other idle ſpecifics. Happily for us, the Peruvian bark ſupplies a remedy of infinitely more uſe, where ſuch analeptics are required.

Dr. Liſter, in ſome ingenious obſervations of his, printed in the Philoſophical Tranſactions (13), touching colours and dyes, obſerves, that the ſcarlet heads of theſe moſſes, upon the affuſion of lye, will ſtrike a purple which will ſtand.

(11) Willis Pharm. Rational. ſect. I. cap. 6. *de tuſſi puerorum convulſiva.*

(12) De Aëre et Morbis epidemicis, p. 76, 77. vol. I.

(13) Lowthorp's Abridgment, vol. II. p. 660.

4. Lichenes cruſtacei.

Such as conſiſt of a dry and friable matter, more or leſs thick, formed into flat cruſts, very cloſely adhering to whatever they grow upon.

Some of the ſpecies of this diviſion conſiſt of an exceeding fine thin cruſtaceous, or rather, as Micheli calls it, farinaceous matter, the fructifications appearing in the form of tubercles. Others conſiſt of a thicker ſcabrous cruſt, having the fructifications in the form of little cups, called *ſcutellæ.*

This diviſion contains the firſt order of the *lichenoides* of Dillenius; the 5th, 6th, and 7th orders of Haller's lichens; the *lichenes leproſi* and *cruſtacei* of Linnæus; and ſeveral of the *placodium* of Hill.

The ſpecies are numerous, and moſt of them very common on rocks, ſtones, old walls, the bark of trees, old pales, *&c.* which are commonly covered over with them, in undiſturbed places. They form a very agreeable variety, and ſome of them have a very elegant appearance.

Dr. Dillenius deſcribes a ſpecies of this order, which he found upon the tops of the mountains in Caernarvonſhire in Wales; and which the inhabitants told him they uſed as a red dye, and found it preferable to the cork, or arcel, which they call *kenkerig.* He has intitled it, in Engliſh, *The white tartareous ſcarlet-dying lichenoides* (14). He is of opi-

(14) *Lichenoides tartareum tinctorium candidum tuberculis atris.* Hiſt. Muſc. p. 128.

nion, that this is the moſs which Martin mentions, in his account of the Weſtern Iſlands of Scotland, under the name of *corkir*; with which the inhabitants of the iſland of Sky dye a ſcarlet colour. They prepare it by drying, powdering it, and then ſteeping it for three weeks in urine. Linnæus queries whether this moſs be not the ſame as his *lichen calcareus* (15); a ſpecies ſo peculiar to limeſtone rocks, that where-ever that ſtone occurs among others, it may be diſtinguiſhed at the firſt view by this moſs growing upon it. This is a ſingularity which Dr. Dillenius has not mentioned in his moſs: on the other hand, Linnæus does not mention any tinging property in his.

The *pérèlle d'Auvergne*, or *orſeille de terre*, of the French, belongs to this order of lichens, and is called by Dillenius (16) *The crayfiſh-eye-like lichenoides.* It is gathered in large quantities in the province of Auvergne, and is uſed as *orchel*; to which however it is greatly inferior. They prepare it with lime and urine; and were acquainted with its uſe as a dye long before the Canary weed was known (17) to them; and it is at this day in more common uſe than the *orchel.* We have it frequent with us upon old walls, rocks, and ſtones; but it is to be had in larger quantities in ſeveral other parts of Europe.

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(15) *Lichen (calcareus) leproſus candidus tuberculis atris* Spec. Plant. 1140.

(16) *Lichenoides leproſum tinctorium ſcutellis lapidum Cancri figura* Hiſt. Muſc. 130. *Lichenoides cruſtaceum et leproſum ſcutellare cinereum.* Raii Syn. p. 70.

(17) Tournefort's Voyage to the Levant, Eng. edit. Lond. 1741. in 8°. vol. I. p. 248.

The mealy tartareous *lichenoides* (18) with brown diſhes, forms an article of trade with the people of Weſt Gothland. They manufacture a beautiful red dye from it, which they ſell under the name of *byttelet* (19). Dr. Hill ſays we have this moſs abundantly in Leiceſterſhire and Warwickſhire.

The Welch make a red dye, with urine, from another moſs of this order, which Dillenius deſcribes (20) by the name of *The large leprous lichenoides with yellow plates.* Theſe are not the only ſpecies, which are endowed with a tinging quality: other kinds have been obſerved to give a red or purple colour to paper in which they have occaſionally been incloſed. Doubtleſs ſeveral would, upon ſufficient trials, be found to anſwer equally well with the *orchel.*

With regard to theſe cruſtaceous moſſes in general, it is highly worthy our regard, that in the œconomy of nature they anſwer ſingular and important uſes. To an unobſerving eye, no claſs of vegetables may appear more inſignificant, or leſs adapted to advantageous purpoſes in the creation, than theſe. This vulgar eſtimation of things is frequently erroneous; and it is certainly ſo in the inſtance before us. Theſe minute and ſeemingly inſignificant moſſes ſerve, under ſome circumſtances, to valuable purpoſes. No ſooner is a rock left bare by the ſea, but theſe lichens lay the foundation for its future fertility. Their ſeeds,

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(18) *Lichenoides tartareum farinaceum ſcutellarum umbone fuſco.* Hiſt. Muſc. 132. *Placodium bracteis majuſculis limbo albo cinctis* Hill. Hiſt. Pl. p. 97.

(19) Flor. Suec. Ed. II. p. 407.

(20) *Lichenoides cruſtaceum et leproſum acetabulis majoribus luteis limbis argenteis* Raii Syn. p. 71. N. 46. Hiſt. Muſc. p. 132.

 which

which are presently brought thither by the winds, soon cover it all over. These corrupting, presently afford a soil sufficient to nourish other smaller mosses; which, in their turn, form one deep enough for larger plants and trees; and thus the rock becomes a fertile island (21).

5. Lichenes foliacei scutellati.

Such as consist of a more lax and flexible matter, formed into a foliaceous appearance, having the parts of fructification in the form of scutellæ.

Some of the plants of this division are interspersed with the former in some of the systems of botanic authors. In general this division contains the whole first series of the second order of *lichenoides* in Dillenius; the first division of the second series, and the latter part of the second division, of the same: it comprehends the *lichenes imbricati* and *umbilicati* of Linnæus; and many of the *placodium* of Hill.

The plants of this order are many of them not less common in England than the foregoing, on rocks, stones, old pales, trees, &c. Some adhere very closely to what they grow upon, and seem to be only foliaceous about the edges: others adhere but loosely, and are much expanded and divaricated, so as to form something like ramifications.

It was remarked, from Linnæus's observation, that one of the crustaceous lichens was scarcely ever found growing but upon limestone rocks. On the contrary,

(21) *Vide* Œconom. Natur. in Amæn. Acad. vol. II. p. 17.

the

the ſame author has obſerved of a folioſe lichen belonging to this order, that it will thrive on all kind of rocks but limeſtone rocks. This ſpecies (1) Dillenius calls *The common grey-blue pitted lichenoides.* It is very common with us upon trees, old wooden pales, *&c.* as well as upon rocks and ſtones. It is the *uſnea cranii humani* of the old *materia medica.* Linnæus adds, that it will dye a purpliſh colour.

Hither likewiſe muſt be referred the cork or arcel (2), which is uſed by the Scotch, and others, to dye a purple or ſcarlet colour. The preparation of it is by powdering, and making it into a maſs with urine. Parkinſon tells us (3) the poor people in Derbyſhire ſcrape it from the rocks, and make the ſame uſe of it. Mr. Ray (4) adds to this account, that the Welch, who call it *kenkerig*, have long been acquainted with this property, and have it in common uſe. The colour from this moſs is but very dull; but if the ſame methods were taken to improve it, as have been with the *orchel*, it would undoubtedly be rendered much better, and more durable. Linnæus relates (5), that there is an immenſe quantity of this moſs about the rocks of the

(1) *Lichenoides vulgatiſſimum cinereo-glaucum lacunoſum et cirroſum* Hiſt. Muſc. p. 88. *Lichenoides cruſta folioſa ſuperne cinereo-glauca, inferne nigra et cirroſa ſcutellis nigricantibus.* R. Syn. p. 72.

(2) *Lichenoides ſaxatile tinctorium foliis piloſis purpureis* Raii Syn. p. 74. N°. 70. Hiſt. Muſc. p. 185. *Lichen petræus purpureus Derbienſis* Park. Theat. p. 1315. *Lichen omphalodes* Lin. Spec. Pl. 1143.

(3) Park. Theat. Botan. p. 1315.

(4) Raii Hiſt. Plant. p. 116.

(5) Flor. Lappon. p. 343. V.

iſle

iſle of Aland in the Baltick; where the good women themſelves make a yellow dye with it from a ſimple decoction of the plant, without the addition of any ſaline article. He adds, that thoſe, who would heighten the colour, add a ſmall quantity of *roucou* (*) to the decoction.

Profeſſor Linnæus tells us, that the Gothlanders manufacture a yellow dye from the common curled *lichenoides* with yellow leaves and plates (6). He adds, that it is a celebrated medicine in the eſteem of the country people, as a ſpecific in the jaundice (7). Helwingius, in the Supplement to the *Flora Pruſſica*, affirms, that this moſs will tinge paper and linen of a lively carnation colour, which too will ſtand the teſt of being expoſed to the open ſun for a long time without fading. It ſeems very probable, however, that he muſt mean ſome other plant of this genus, as Dillenius tells us he made the experiment unſucceſſfully.

Sweden affords a moſs of this order, which, as far as hitherto appears, ſeems to be unknown to former botaniſts, and which Linnæus ſays will dye a deep purple colour (8).

(*) Otherwiſe called *arnotto*.

(6) *Lichenoides vulgare ſinuoſum foliis et ſcutellis luteis.* Hiſt. Muſc. p. 180. *Lichenoides cruſta folioſa ſcutellata flaveſcens.* Raii Syn. p. 72. N°. 59.

(7) Flor. Suec. Ed. II. p. 416. N°. 1093.

(8) Linnæus has intitled this moſs *Lichen (ſtygius) imbricatus, foliolis palmatis incurvis atris.* Fl. Suec. I. 949. Spec. Plant. 1143. Fl. Suec. II. N°. 1079.

6. Lichenes

6. Lichenes erecti ramosi plani.

Such as consist of a firm tough matter, disposed into flat and thin ramifications growing erect, and bearing their scutellæ *upon the edges, surfaces, and at the extremities.*

This division comprehends the flat branched tree-mosses of authors; many of the fourth order of Haller's lichens; the first part of the second division of series the second in Dillenius; and the *platisma* of Hill.

The plants of this division grow upon old trees, especially in thick and unfrequented woods; some of them upon rocks: they are many of them extremely common in England upon all kinds of trees. As they were some of the most obvious, so they were some of the first lichens noticed by the old writers, by whom they were called *lichenes arborum*.

The mosses of this order were substituted in the room of the *usnea* in the composition of the *pulvis cyprius*. The very species, which was most frequently used for this purpose, was the channel-leaved *lichenoides* of Dillenius (9), on account of its being easily reduced into a fine powder, of a good white colour. Nevertheless, others are undoubtedly as well adapted to the same purposes: and, if it was of importance

(9) *Lichenoides coralliforme rostratum et canaliculatum.* Hist. Musc. 170. *Lichenoides arboreum ramosum angustioribus cinereo-virescentibus ramulis.* Raii Syn. 75. *Lichen calicaris* Lin. Spec. Plant. 1146.

enough

enough to employ them to any purposes of the like nature in our own country, they might be procured in sufficient plenty.

One of the plants of this order is applicable to the same uses as the Canary-weed, and is reckoned not much inferior to it; and as it is found in the same places, it is very often packed up with it in considerable quantities. Dillenius calls it *The flat dyers lichenoides with longer and sharper horns* (10). It is truly and properly a plant of the lichen genus, tho' the older writers of the last century called it a fucus. They were led into this mistake by its having flat ramifications, and from its growing on the rocks by the sea side. It is found in the East Indies upon trees, and is frequent on the coasts of the Mediterranean, as well as about the Canary Islands.

7. Lichenes peltati.

Such as consist of a tough or coriaceous matter, disposed into a foliaceous appearance; on the edges of which, in general, the parts of fructification are placed, in the form of flattish oblong bodies, in these mosses called shields *or* pelts.

This division contains the third series of the second order of Dillenius's *lichenoides*; the *lichenes coriacei* of Linnæus; and several of the *placodium* of Hill.

That celebrated and well-known plant, the ash-

(10) *Lichenoides fuciforme tinctorium corniculis longioribus et acutioribus.* Hist. Musc. 168. *Platysma corniculatum.* Hill Hist. Plant. 90. *Lichen fuciformis* Lin. Sp. Pl. 1147.

coloured

coloured ground liverwort (11) of Ray belongs to this order. It is very common all over England on dry and barren ground; and indeed almoſt all Europe, and America too, ſeems to afford it in ſufficient plenty, as we find it obſerved by almoſt all the the botanic writers ſince Ray, who was one of the firſt that deſcribed it.

The earlieſt account we have of its uſe for the bite of a mad dog is in the Philoſophical Tranſactions (12), from Mr. Dampier, in whoſe family it had been a ſecret for a number of years. It was communicated firſt to Sir Hans Sloane, as a kind of fungus, or Jew's-ear; and, at the requeſt of Dr. Mead, was ſome years afterwards received into the London diſpenſatory. Scarce any of the boaſted ſpecifics of former ages ever acquired ſo great reputation as this plant has done in modern times, for its prevalence againſt the bite of a mad dog; and the patronage of the late learned Dr. Mead made it ſufficiently known throughout all the world. Happy would it be indeed, if it fully deſerved the high encomiums, which have been beſtowed upon it. A great and eminent phyſician (13) has doubted its efficacy at all in ſuch caſes; and it is well known, that Boerhaave even laughed at it. Dr. Mead had certainly an high opinion of it: he tells us it never failed, thro' the courſe of thirty years experience, where it was duly given

(11) *Lichenoides digitatum cinereum lactucæ foliis ſinuoſis* Dillen. Hiſt. Muſc. 200. *Platyſma ſinuoſum ſcutellis ovato-rotundis* Hill Hiſt. Pl. 89. *Lichen caninus* Lin. Sp. Pl. 1149.

(12) See Lowthorp's Abridgment, vol. III. p. 284.

(13) Dr. Van Swieten. See Comment. in Boerh. Aphor. §. 1147.

 before

before the *hydrophobia* came on (14). Later inſtances have ſhewn, that it is not infallible; and Dr. Van Swieten's ſuppoſition is but too likely to prove true. It muſt be confeſſed, that Dr. Mead's exhibition of it ſeems too much complicated with other means to leave room for judging fully of its real efficacy; and it may really be queſtioned, whether bleeding, pepper, and cold-bathing, have not had more to do in the caſe than the lichen.

The *muſcus pulmonarius officinarum* (15), tree-lungwort, or oak-lungs, belongs to this order. It is found about old oaks, and upon rocks and ſtones overgrown with moſs, in many of our thick woods in England; but not in any great plenty.

Few, perhaps, of the antiquated ſimples were in more repute, in their day, than this plant. It was celebrated for ages, on account of its ſuppoſed prevalence in pulmonary complaints of almoſt all kinds; and yet, upon inquiry into the original of its uſe in ſuch caſes, it would probably appear, that it aroſe more from a fanſied reſemblance they found in the plant to the lungs themſelves, than from any real and well-grounded proofs of its efficacy. As a gentle aſtringent, like moſt other ſpecies of the family, it would doubtleſs contribute to relieve in many caſes where the lungs were affected, as in *hæmoptoës*, and ſome others: but it does not ſeem, by any means, to deſerve that high character in medicine which has been given to it.

(14) Mechanical Account of Poiſons, ed. 4th, p. 156.

(15) *Lichenoides pulmonium reticulatum vulgare marginibus peltiferis* Dill. Hiſt. Muſc. 212. *Lichenoides peltatum arboreum maximum.* Raii Syn. p. 76. *Muſc. pulmonarius* C. B.

The

The people in Herefordſhire, where this moſs is called *rags*, dye their ſtockings of a brown colour with it. This is done by a very ſtrong but ſimple decoction in water, and the colour ſtands well (16).

The fine green *lichenoides* with black warts (17), is a celebrated medicine, and in very frequent uſe, with the country people about Upſal, for the thruſh in children: to this end they give an infuſion of it in milk. A medicine of this kind is of great importance in thoſe countries, where that diſorder occurs much more frequently than with us (18). It is not received into the Swediſh diſpenſatory; but is known however in the ſhops, under the name of *muſcus cumatilis*. We have it not in England; and Dillenius found it but in one place about Geiſſen: in the woods of Sweden it is more plentiful. A ſingular caſe, which is related in the *Amœnitates Academicæ* (19), has given riſe to an opinion of its uſefulneſs in the worms alſo. The caſe briefly was this: A country girl had, for near half a year, complained of excruciating pains in her ſtomach and bowels, which were attended with vomiting, anxiety, and great watchfulneſs. All that had been preſcribed for her by Profeſſor Linnæus and others, who took her caſe for the worms, proved altogether fruitleſs. Being afterwards left to the care of her neighbours and relations, ſome good women gave her a decoction of this moſs, which the Uplanders call

(16) Dillen. Hiſt. Muſc. p. 213.

(17) *Lichenoides digitatum læte virens verrucis nigris notatum.* Ibid. p. 207.

(18) Boerhaav. Aphoriſm. §. 982.

(19) Vol. II. p. 69. *De Tænia.*

 elfnefwer.

elfnefwer. After fhe had taken it a few days, fhe vomited up fix or feven roundifh worms, and was cured. Thefe were found, upon examination, to be the maggots of a kind of brown bee-fly, defcribed by Mr. Ray (20), and by Linnæus (1).

However infufficient this hiftory may be, to prove the ufefulnefs of this plant as a vermifuge, it will at leaft ferve to exemplify this fact; namely, that other animals of the infect kind, befides the *teniæ*, *lumbrici*, and *afcarides*, may fubfift a long time in the *primæ viæ* of the human body, and be the caufe of great difturbances therein (2).

Neceffity is frequently the parent of the moft ufeful and important difcoveries: and the ufes to which a plant of this order is appropriated by the natives of Iceland, is a ftanding proof of the truth of this obfervation. That climate will fcarcely permit the cultivation of any kind of grain; but the want of it is in a great meafure happily fupplied by the eryngo-leaved *lichenoides* (3), which is abundant in the northern regions; and in that ifland particularly the natives have long been acquainted with the methods

(20) *Mufca apiformis, tota fufca, cauda obtufa, ex ejula caudata in latrinis degente orta.* Raii Hift. Infect, p. 272.

(1) Faun. Suecica, N°. 1084.

(2) See two cafes nearly of this kind obferved by Dr. Lifter. Lowthorp's Abridgment, vol. III. p. 135.

(3) *Lichenoides rigidum eryngii folia referens* Dillen. Hift. Mufc. p. 209. Raii Syn. p. 77. *Lichen foliis oblongis laciniatis marginibus conniventibus ciliaribus.* Flor. Lappon. Hall. Helv. 75. *Lichen (iflandicus) foliaceus adfcendens laciniatus marginibus elevatis ciliaribus* Lin. Flor. Suec. I. 959. II. 1085. Mat. Med. N°. 493. Spec. Plant. 1145.

of applying it both to the purposes of food and of physic.

Ray has long since informed us (4), from Bartholine, that in the spring time, while it is young, it will purge; in consequence of which it is used as common spring physic This quality it loses in a short time; and what serves for physic in the spring, is converted the remaining part of the year into food. They collect large quantities of it, grind it into meal, and make both pottage and bread of it. It is in common use not only with the islanders, but in several parts of Sweden also, where it is found to be a very appropriate diet in phthisical cases (5). These accounts of the excellent use of this lichen correspond perfectly well with the last accounts of it in Mr. Horrebow's Natural History of Iceland, just published; and which I shall take the liberty of transcribing, as follows: "There is another herb, "called *muscus catharticus islandiæ*, or mountain-"grass, which they cook up into a delicate dish. I "have often eat of it; at first out of curiosity, but "afterwards for its palateableness and wholesomeness. "The excellent qualities of this herb are described "in the Memoires of the Society of Arts and Sci-"ences in Sweden. It grows in great abundance; "and those that live near the places, where it is "found, gather great quantities for their own use, "and to send to market. People that live at a "great distance will send and fetch horse-loads "away. Many use no meal or flour at all, when

(4) Raii Hist. Plant. p. 114.
(5) Flor. Lappon. N°. 445.

"they

" they are ſtocked with this herb, which in every " reſpect is good and wholeſome food" (6).

This moſs is not very common in the ſouthern countries of Europe. England affords it but very ſparingly. Mr. Newton and Dr. Dillenius found it in Wales; Sibbald, in Scotland. It is frequent on the Alps of Switzerland; and Dr. Haller mentions it in his *Iter Hercynium.* Sweden and Lapland have it in plenty: and on account of its great abundance and uſefulneſs in Iceland, Bartholine, and after him others, called it *muſcus iſlandicus.*

CONCLUSION.

I cannot help remarking, by way of concluſion, that we have in this genus of plants a convincing inſtance of the utility which may reſult from the ſtudy of natural ſcience in general, and even of its minuter and hitherto moſt neglected branches. From a view of the foregoing memoir it is evident, I preſume, that the œconomical uſes of the lichens, in the various parts of the world, are already very conſiderable and important: and altho' it does not appear, that the ſenſible qualities of any of them, or the experience of former ages, will warrant our aſcertaining any ſingular powers to them in a medicinal way, yet poſterity will doubtleſs find the means of employing them to many valuable purpoſes in human life to us unknown.

It will at once be acknowleged, that the vegetable kingdom ſupplies us with the far greater ſhare of the

(6) Horrebow's Natural Hiſtory of Iceland, p. 36.

neceſſaries,

neceſſaries, the conveniencies, and even the elegancies, of life. The cultivation of that knowlege, which leads to the inveſtigation of its ſubjects, cannot, therefore, but be highly uſeful and neceſſary: and altho' the bare ſcience of natural knowlege is of itſelf worthy of applauſe, yet it ought to be conſidered, in reality, as the neceſſary means only of applying the ſubjects of nature's kingdoms to their true ends and purpoſes, the ſervice of mankind. To know and diſtinguiſh, by determined and ſpecific characters, even but a ſmall ſhare of that amazing multitude of objects, with which the great Parent of nature has furniſhed our globe, is a taſk far more than equal to the duration of human life. To inveſtigate and aſcertain their various qualities and uſes is equally arduous and impracticable. While the naturaliſts, therefore, are employed in diſtinguiſhing the forms of things, let others exert the united efforts of genius and application to inveſtigate their various properties and uſes. I need not ſay the field for both is boundleſs: it doubtleſs will be ſo for ages yet to come. The hopes of diſcovering ſome latent property, which may turn out to the advantage of his fellow creatures, will animate the man, whoſe mind is truly formed for reliſhing the pleaſures of natural ſcience; and however the reſult may be, the inſpection and contemplation of nature's productions will ever afford that ſatisfaction, which will amply repay him for his trouble. The minuter, and, as they are commonly eſtimated, the moſt abject and inſignificant things are not beneath our notice; and an attentive mind will readily conceive how much farther, and more extenſively uſeful, every branch of nature's kingdom may

may yet prove in the œconomy of human life. The man, therefore, whom a genius and love for natural hiſtory has allured into its purſuits, and whoſe leiſure permits his gratification in ſuch reſearches, if he is not happy enough to be crowned with ſucceſs, at leaſt deſerves it, and merits the thanks of his fellow-creatures for his application and diligence.

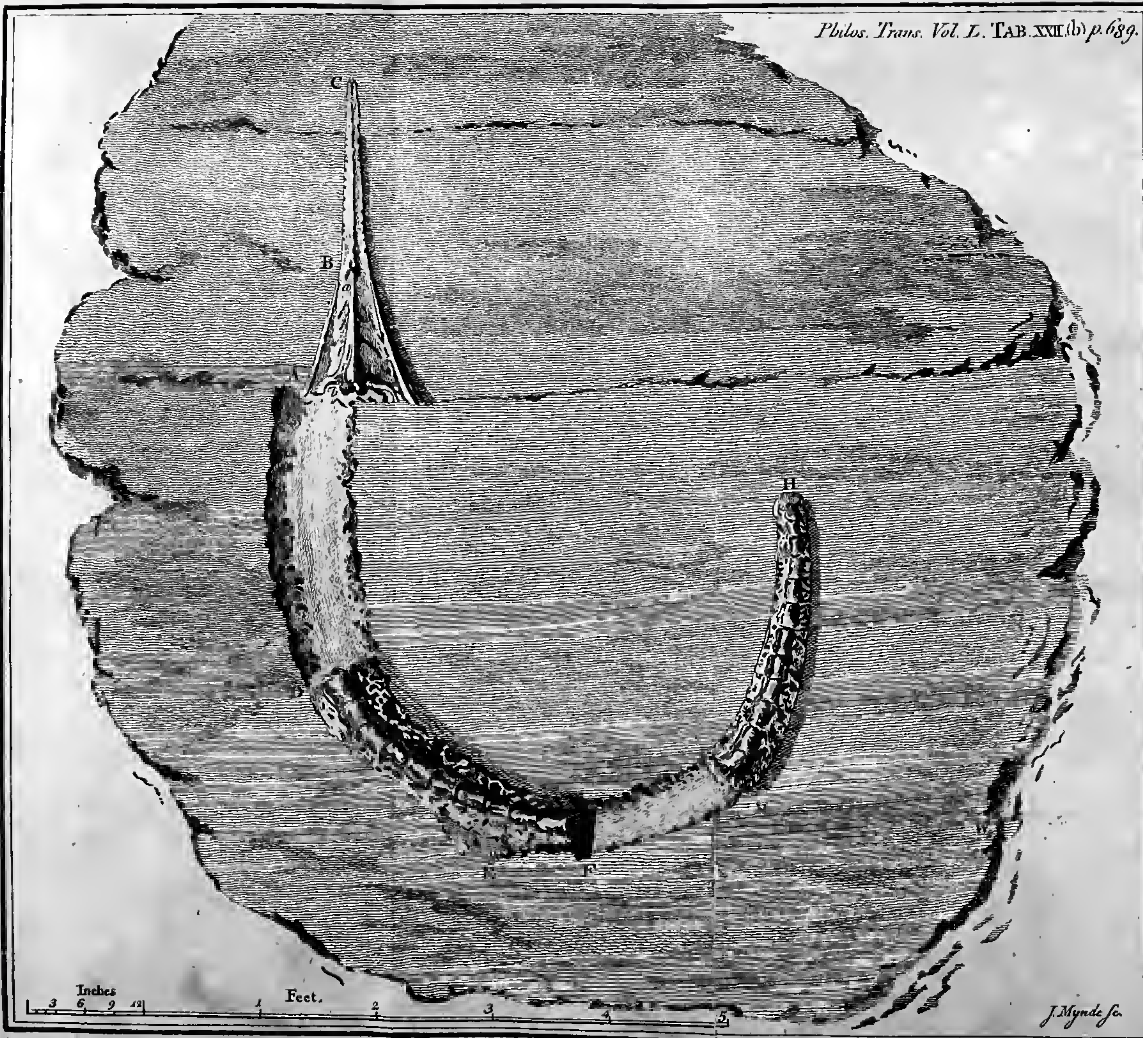
XCII. *An Account of the foſſile Bones of an Allegator, found on the Sea-ſhore, near* Whitby *in* Yorkſhire. *In a Letter to* John Fothergill, *M. D. from Capt.* William Chapman.

Whitby, 20th of 1ſt mo. 1758.

Read May. 4, 1758.

A Few days ſince we diſcovered on the ſea-ſhore, about half a mile from this place, part of the bones of an animal, appearing as in the annexed figure (*See* Tab. XXII.). The ground they laid in is what we call allum-rock; a kind of black ſlate, that may be taken up in flakes, and is continually wearing away by the ſurf of the ſea, and the waſhing of ſtones, ſand, *&c.* over it every tide.

The bones were covered five or ſix feet with the water every full ſea, and were about nine or ten yards from the cliff, which is nearly perpendicular, and about ſixty yards high, and is continually wearing away, by the waſhing of the ſea againſt it; and, if I may judge by what has happened in my own memory,


C
B
H
F
Inches
3 6 9 12
Feet.
1 2 3 4 5
J. Mynde sc.

memory, it muſt have extended beyond theſe bones leſs than a century ago. There are ſeveral regular ſtrata or layers of ſtone, of ſome yards thickneſs, that run along the cliff, nearly parallel to the horizon and to one another. I mention this to obviate an objection, that this animal may have been upon the ſurface, and in a ſeries of years may have ſunk down to where it lay; which will now appear impoſſible, at leaſt when the ſtones, *&c.* have had their preſent conſiſtence.

References to the Draught.

A, B, C, the head and bill, not in the ſame line or range with the reſt of the bones.

a, b, A bone, with its proceſſes, which I take to be ſimilar to that, which includes the brain in fiſhes. The part between the bone and out-lines appeared to be a ſmooth membrane; but was ſo thin, that in taking up it broke.

It is evident this is the upper part of the head inverted.

B, C, the ſuperior *maxilla* intire, and in ſome places covered with the inferior one for four or five inches together. Where this happens, the vacuity is filled with matter like the rock in which it lays; and there are large teeth in each jaw, at ſuch diſtances, and ſo poſited, that thoſe in one jaw fill up the vacuities in the other, and appear like one continued row, the mouth being ſhut.

Where there is only the ſuperior *maxilla* remaining, there are no teeth; but the ſockets are

are visible and deep, and at the same distances from each other as the teeth in the other part of the jaw. The tip or extremity of the bill was intire for four or five inches, having both *maxillæ*, with their teeth, and towards the point large fangs. Part of the bill and head were covered with the rock; which was removed before they appeared as in the figure.

A, D, F, G, cavities in the rock, about two inches deep, where, I suppose, the wanting *vertebræ* have laid, as they are exactly suited to have received them.

D, F, Ten *vertebræ*, from three to four half inches in diameter, and about three inches long, some of them separated in taking up. They were about two inches in the rock.

E. Here we observed something like bone to stretch from the *vertebræ*, and intending to take it up whole, begun to cut at what we thought a proper distance; but found we cut thro' a bone; and with the *vertebræ* brought up three or four inches of the *os femoris*, with the ball, covered with the *periosteum*: but the animal has been so crushed hereabouts, that we could make little of the socket or *os innominata*. Several of the ribs came up with the *vertebræ*: they were broke, and laid parallel to the *vertebræ*; but not quite close, there being some of the rock between them. The *periosteum* is visible on many of the bones.

G, H, Twelve *vertebræ* remaining in the rock, with which they are almost covered, especially towards the extremity.

The

The place, where theſe bones lay, was frequently covered with ſea-ſand, to the depth of two feet, and ſeldom quite bare; which was the occaſion of their being rarely ſeen: but being informed that they had been diſcovered by ſome people two or three years ago, we had one of them with us upon the ſpot, who told us, that when he firſt ſaw it, it was intire, and had two ſhort legs on that part of the *vertebræ* wanting towards the head. Altho' we could not ſuſpect the veracity of this perſon, we thought he was miſtaken; for we had hitherto taken it for a fiſh. But when we took it up, and found the *os femoris* above-mentioned, we had cauſe to believe his relation true, and to rank this animal amongſt thoſe of the lizard kind: by the length (ſomething more than ten feet) it ſeems to have been an allegator; but I ſhall be glad to have thy opinion about it.

I am thy friend,

William Chapman *Sen.*

The bones were ſent up, and are herewith preſented to the Royal Society by

J. Fothergill.

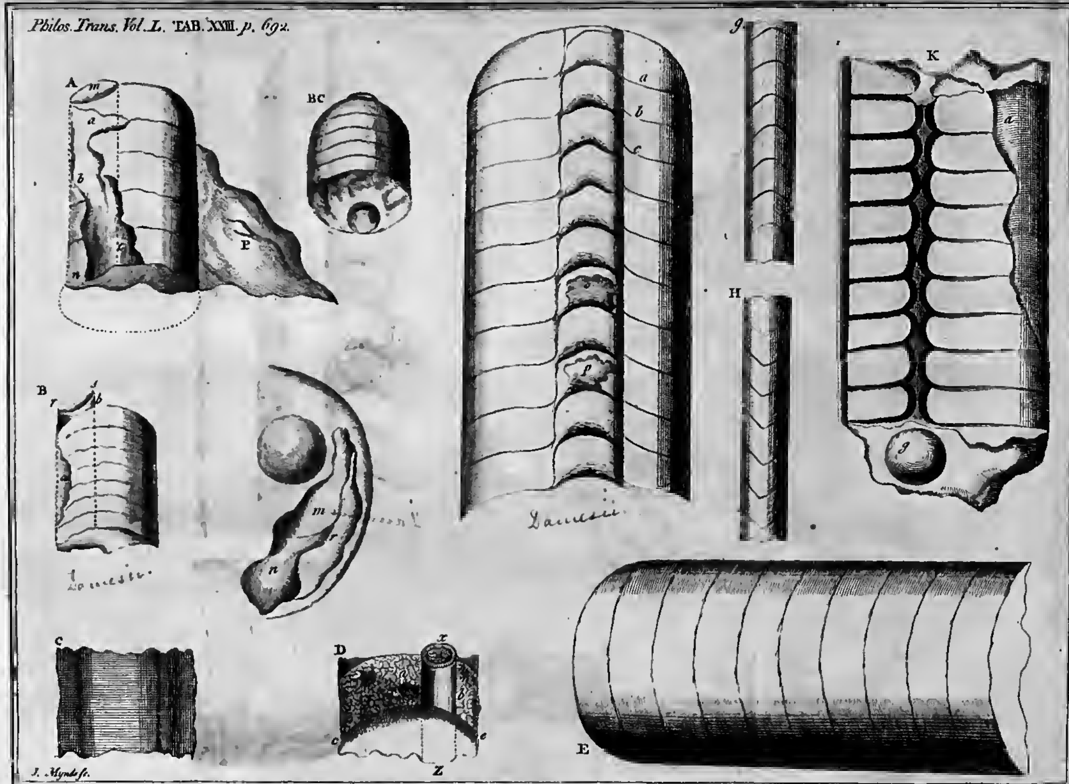
XCIII. *De rariori quadam* Orthoceratitis *Specie, in* Suecia *reperta, tractatus : in literis a* Nicholao de Himſel, *M. D.* Riga Livono, *ad* Gul. Watſon, *M. D. R.S.S.*

Read May 11, 1758.

ORthoceratiti recti in loco quodam Kelwika dicto, prope Fahlunam in Dahlia, reperti. Inhærebant lapidi cineracei coloris calcareo, variæ magnitudinis orthoceratiti, quorum portiones hic delineatas deſcribo.

Vide TAB. XXIII.

Fig. A. Orthoceratitis portio, cujus pars inferior ſaxo adhuc adhæret; ex lapide calcareo conſtans lente in apicem decreſcens. Licet ex parvis ejus fragmentis judicari poſſit, cylindrum eſſe orthoceratitem, ea tamen ſi conjunguntur, verum formant conum, et mihi videtur ex craſſitie ſiphonis, orthoceratitem hunc conicum duos fere ſuperaviſſe pedes. Vidi orthoceratitem in alio lapide calcareo, quem etiam ibidem loci, Kelwikæ, reperi, longitudine duorum cum ſemiſſe pedum : ſed impoſſibile erat, integrum eum excutere, nimis enim fragile erat. Eſt portio hæc orthoceratitis teſta ſua ambiente veſtita in *a b c*. Quinque conſpiciuntur articuli, thalami quondam, arctiſſime ſibi invicem inſidentes, per quos a latere procedit ſipho *m n* ſat craſſus, qui in omnibus fere, quas poſſideo portionibus orthoceratitarum,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rum, a centro ſemper remotus, hic ad peripheriam poſitus conſpicitur. Sipho admodum lente decreſcit, ex quo etiam de longitudine coni hujus judicare licet. Cruſtæ vel teſtæ *a b c* interior pars, quæ articulos tegit, cryſtallina eſt, ex ſpati cryſtallis tenuioribus irregularibus conſtans.

Fig. B. Portio alia, in qua articuli minus craſſi; ſipho quoque ad peripheriam poſitus, teſta ſua in *a* tecta. Conſpicitur ſeptum illud teſtaceum in *b*, communi tenuior, quod ab ipſo articulo ſuperiori procedens, ſiphonis partem *r s* inveſtit.

Fig. B, C. Portio orthoceratitis ex lapide calcareo cineracei coloris: ſipho vero, fluore ſpatoſo egregie cryſtalliſato, conſtat.

Fig. C. Portio alia per axin diviſa, cujus pars exterior, teſta quæ ſtriis circularibus levioribus externe ornata, inveſtita conſpicitur.

Ex parte interiori *Fig. D.* confirmatio ejus interna adparet. Sipho *x z* gracilior, inter centrum et peripheriam poſitus, dimidia parte ambiente articulo denudatus adparet; dimidia altera, inferiori articulo *c d e* tegitur. Articulus *a b* ſpato cryſtalliſato pellucido polygono repletus eſt. Articulus *c d e* vero, ſaxo ſpatoſo incarnato paululum repletus eſt. *x.* Siphonis pars ſuperior, ubi radii a peripheria ad centrum tendentes conſpiciuntur. Inter cryſtallos ſpatoſos in articulo *a b* ſtriæ hinc et inde adparent nigræ, aſphalto repletæ; ita etiam cavitas articuli *a b*, æque ac ſuperficies convexa articuli *c e*, quæ in primam concavam recipitur, lamina aſphalti veſtitæ ſunt.

7 *Fig.*

rum, a centro ſemper remotus, hic ad peripheriam poſitus conſpicitur. Sipho admodum lente decreſcit, ex quo etiam de longitudine coni hujus judicare licet. Cruſtæ vel teſtæ *a b c* interior pars, quæ articulos tegit, cryſtallina eſt, ex ſpati cryſtallis tenuioribus irregularibus conſtans.

Fig. B. Portio alia, in qua articuli minus craſſi; ſipho quoque ad peripheriam poſitus, teſta ſua in *a* tecta. Conſpicitur ſeptum illud teſtaceum in *b*, communi tenuior, quod ab ipſo articulo ſuperiori procedens, ſiphonis partem *r s* inveſtit.

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Fig. E. Pars alia orthoceratitis majoris, et quidem facies exterior.

Fig. F. Facies ejus interior, in medio divisi, cum siphone transeunte satis crasso. *a b c* et reliquæ striæ leves, sunt diaphragmata, articulos *a b* invicem separantia, siphonem proprie constituentia, siphonisque tenuiorem membranam, quæ in *o* et *p* adhuc conspicitur, ambientia. Sunt diaphragmata hæc crassiora in siphonis vestigiis, et sibi invicem ab inferiori parte insident. Sipho hic inter centrum et peripheriam positus est.

Fig. G. Materies calcarea, quæ siphonem replevit striata, et quidem pars ejus interior, qua centrum orthoceratitis respicit, peripheriæ opposita.

Fig. H. Facies posterior, peripheriæ propior.

Fig. I. Pars concava articuli majoris orthoceratitis, in qua diaphragmatis testacei jam crystallisati portiunculæ albicantes *m n r* conspiciuntur cum siphone transeunte.

Fig. K. Portio alia orthoceratitis majoris, ejusque facies exterior, cum siphone *g* ad peripheriam posito. Conspiciuntur hic diaphragmata, quæ ab utroque latere, ab articulis procedunt, se invicem conjungunt, et siphonem ab exteriori parte obtegunt. *a* est testæ satis crassæ portiuncula, qua portio hæc orthoceratitis vestita adhuc est.

XCIV. *A further Account of the Effects of Electricity in the Cure of some Diseases* *: *In a Letter from Mr.* Patrick Brydone *to Dr.* Robert Whytt, *Professor of Medicine in the University of* Edinburgh, *and F.R.S.*

Coldinghame, January 9th, 1758.

Read May 11. 1758.

A Young woman of Aiton, a village about two miles from this place, had her right leg drawn back by a contraction of the muscles that bend the knee, so that she had not been able to put that foot to the ground for near a twelvemonth. She had taken the advice of some Surgeons in the country, and had used several remedies to no purpose. At last, hearing of the cure of the paralytic woman, whose case I sent you some time ago, she insisted on being brought hither; and underwent a course of electrical shocks for near two months, receiving every day at least fifty or sixty in the following manner. She sat close by the machine, and grasping the phial in her hand, she presented the wire to the barrel or conductor, and drew the sparks from it for about half a minute. The phial being thus charged, she then touched her knee with the wire, and thereby received such severe strokes, as would sometimes instantly raise a blister on the part. The joint was at last so much relaxed, as that she could walk home with the help of a crutch, tho' her leg was so weak, that she had very little use of it. After

* For the first account, see part first, p. 392.

she

3

ſhe had continued in this ſtate for ſome weeks, ſhe was adviſed to uſe the cold bath: but that ſoon brought back the contraction; and I have been ſince informed that ſhe was worſe than ever.

A ſoldier's wife, a genteel looking woman, of about 30 years of age, was ſeized with a ſlight palſy, about Newcaſtle, on her way to this country: but before ſhe got to this place, ſhe had loſt all the feeling in her left ſide, and ſo far the power of it, that ſhe was brought to us in a cart. After receiving 600 ſtrokes from the electrical machine in the uſual way, and in the ſpace of two days, ſhe recovered the uſe of her ſide, and ſet out on foot to make out the reſt of her journey. However, for fear of a relapſe, I gave her a recommendatory letter to Mr. Sommer, Surgeon at Haddington, as ſhe was to paſs thro' that town, and as I knew that he was likewiſe provided with an electrical apparatus.

A young woman from *Home*, a village in this ſhire, but at a good diſtance, complained of a coldneſs and inſenſibility in her left hand and wriſt, of two years ſtanding. When I felt that hand, it was as cold as a ſtone, whilſt the other was ſweating; and ſhe told me, that it never had been warmer all that time. I made her draw the ſparks from an egg (which for ſome other purpoſe was ſuſpended by a wire from the conductor) for about half an hour; and at the end of that time I found the dead hand in a far greater ſweat than the other. She then wrapt it up in a piece of flannel, as ſhe uſed to do, and retired. Next day ſhe told me, that ſince the operation ſhe had been able to put off and on her cloaths without help,

help, which ſhe had not been able to do for a twelvemonth before. She was again electriſed; and believing ſhe was then quite well, ſhe went away: but ſome weeks after, upon the coldneſs of her hand beginning to return, ſhe made me another viſit, was again electriſed, and was diſmiſſed a ſecond time apparently cured. This is about two months ago, and I have heard nothing of her ſince.

As theſe two laſt women are at ſuch a diſtance, I cannot pretend to ſend you their own teſtimony of their cure. But for the two caſes in the ſeparate paper, as the perſons are inhabitants of this place, I have taken care that they themſelves ſhould ſign them, along with my father; ſince you have acquainted me, that accounts of this kind ſhould have the atteſtation both of the patients and the miniſter of the pariſh.

I ſhall only add here, that ſeveral perſons have been relieved of rheumatic pains, by electriſing the parts affected. And a woman was cured of a deafneſs of ſix months ſtanding, contracted, as ſhe imagined, by cold. This woman held the phial in her hand, whilſt another perſon ſtanding on a cake of reſin gave her the ſhock, by putting the end of the wire into her ear. This manner of electriſing brought always on a profuſe ſweat over the head, which we encouraged, by wrapping it up in flannel. The firſt day ſhe came here, ſhe could ſcarce hear what was ſpoken by thoſe about her; but in five days ſhe ſeemed to be perfectly cured.

I am, *&c.*

Patrick Brydone.

Copy of the ſeparate Paper before mentioned.

Robert Haigs, of Coldinghame, a labouring man of about 45, after having been for ten days ill of a regular tertian ague, at my deſire underwent the electrical ſhocks in the common way. After having received about thirty or forty very ſevere ones, he grew pale, and ſtaggering for ſeveral ſteps, would have fallen down, had he not been ſupported. He then fell into a ſweat, which continued near half an hour. I deſired him to come back the next morning, immediately before the fit, which he ſaid came on about ten o' clock. He accordingly came, and told me he had not the uſual ſymptoms preceding the fit. He was that day again ſtrongly electriſed; and has been without any aguiſh ſymptom ever ſince; *viz.* for the ſpace of four months.

The truth of this is atteſted by

ROBERT HAIGS, *the perſon cured.*

ROB^T. BRYDONE, *Miniſter of Coldinghame.*

Ann Torry, of Coldinghame, a young woman of about 20, had a regular tertian (being the firſt time ſhe ever had the ague) for near a fortnight. The fit came on early in the morning. She was electriſed on her well day in the afternoon; and the next morning, having had only a ſlight ſhivering, ſhe was

was electrised again about ten o'clock, and has had no symptom of the ague since; *viz.* for three months.

The above is attested by

ANN TORRY, *the person cured.*

ROB[T]. BRYDONE, *Minister of Coldinghame.*

XCV. *An Account of the Black Assize at* Oxford, *from the Register of* Merton College *in that University. Communicated by* John Ward, *LL. D. With some additional Remarks.*

Anno nono D. Bickley *Custodis*, 1577.

Read May 25, 1758.

VIcessimo (1) primo Julii in vestiario Dñus custos et octo Seniores dispensarunt cum *Decreto de concione et appictantia habendis, die Dominico post festum S[ti] Petri ad vincula*; ne vocata et conveniente turba, morbus ille, qui ante quinque dies quamplurimos infestarat, dissipatior et periculosior fiat. Etenim 15, 16, et 17, hujus Julii aegrotant plus minus trecenti homines; et infra duodecim dierum spatium mortui sunt (ne quid errem) centum scholares, praeter cives non paucos. Tempus sine dubio calamitosissimum et luctu plenum.

(1) Sic in regist. et postea haud semel.

 Nam

Nam quidam lectos differentes (2), agitati nescio quo morbi et doloris furore, suos custodes baculis caedunt et abigunt; alii per areas et plateas insanientium more circumcursant; alii in profundam aquarum praecipites insiliunt; nemo tamen, summo Deo gratia, desperanter perit. Franguntur omnium animi. Fugiunt medici, non propter necessitatem fratrum, sed propter se et cistas creati. Relinquuntur miseri. Domini, doctores, et collegiorum praefecti, ad unum pene omnes abeunt. Custos noster, longe omnium vigilantissimus, domi apud nos manet; in aegrotis omnem curam, laborem, diligentiam impensus (3) collocat; die toto, et nocte etiam intempesta, eos sedulo invisit. Moriuntur e nostris quinque. Omnis aula, omne collegium, aut domi, aut in via ad patriam, suos habet mortuos. Mirari quis posset multitudinem ad medicastrorum domos cum matulis citato cursu properantium. Pharmacopolarum etiam conservata syrupos, olea, aquas dulces, pixides, cujusque generis confectiones, brevissimo tempore exhausta. Laborant aegroti vehementissimo tum capitis tum stomachi dolore; vexantur phrenesi; privantur intellectu, memoria, visu, auditu, et caeteris etiam sensibus. Crescente morbo, non capiunt cibos, non dormiunt, ministros aut custodes non patiuntur. Semper, vel in ipsa morte, mirae eorum strenuitas et corporis robur; et eo declinante, omnia modis impense contrariis eveniunt. Nulli complexioni aut constitutioni parcitur; cholericos tamen praecipue hic morbus molestos habet; cujus ut causas, sic et curas ignorant medici. Natum suspicantur multi, vel ex

(2) Sic in regist. (3) Sic in regist.

foetida

foetido et peſtilenti furum e carceribus prodeuntium aëre (quorum duo vel tres ſunt ante paucos dies in vinculis mortui) vel ex artificioſis diabolicis et plane papiſticis flatibus e Lovanienſi barathro excitatis, et ad nos ſceleſtiſſime et clam emiſſis. Nam illi ſolum et hic et alibi decumbunt aegroti, qui in caſtro, et *guilda*, quam appellant, aula, quinto et ſexto hujus menſis adſunt (4). Aſſiſiorum judices, dominus Robertus Bell, capitatis baro ſcaccarii etc. qualem hactenus non peperit Anglia; dominus Johannes Barrham, dominae reginae ſerviens ad legem; papiſticae pravitatis uterque apertiſſimi hoſtes et acerrimi vindices: vicecomes Oxonienſis comitatis (5), equites aurati duo, armigeri et pacis juſticiarii octo, generoſi plures, horum non pauci famuli, omnes (uno aut altero exceptis) *de grandi*, ut loquuntur, *jure*, ſtatim poſt fere relictam Oxoniam mortui ſunt. Et ut quiſque fortiſſimus, ita citiſſime moritur. Foeminae non petuntur, nec certe pauperes; neque etiam inficitur quiſquam, qui aegrotorum neceſſitatibus ſubminiſtrarit, aut eos inviſerit. Sed ut fuit morbus hic inſigniter violentus, ita neque diu duravit. Nam infra unius menſis curriculum ad priſtinam pene ſanitatem reſtituuntur omnes; ut jam denuo mirari poſſis tot ſcholares, tot etiam cives, urbem et plateas linteis capitibus obambulantes, et nomen clementiſſimi Dei noſtri in omne aevum ſuſpicere (6).

Viceſſimo quarto Julii Joannes May, ſocius et artium magiſter, in collegio vitam finit. Sepelitur in eccleſia.

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(4) Sic in regiſt. (5) Sic in regiſt. (6) Sic in regiſt.

Viceſſimo

Viceſſimo ſeptimo ejuſdem Browne clericus moritur in collegio.

Viceſſimo octavo ejuſdem Gaunte portioniſta moritur in collegio.

Viceſſimo nono Dnus Lea, electus probationarius 20 Julii, moritur in collegio.

Additional Remarks, by Tho. Birch, *D. D. Secret. R. S.*

CAmden, in his Annals of Queen Elizabeth (1), obſerves, that almoſt all, except women and children, who were preſent at the aſſizes at Oxford, at the tryal of Rowland Jenkes, a Bookſeller there, for ſeditious words, died, to the number of about three hundred. Mr. John Stow, in his *Chronicle of England* (2), enlarges this number, and affirms, that there died in Oxford three hundred perſons, and in other places two hundred and odd, from the 6th of July to the 12th of Auguſt; *after which died not any of that ſickneſs; for one of them infected not another:* And this hiſtorian agrees with Camden, that not any one woman or child died thereof. Dr. George Ethryg, a phyſician, who practiſed at that time at Oxford (3), in the 2d book of his *Hypomnemata quædam in aliquot Libros Pauli Æginetæ, ſeu*

(1) Page 285. edit. Lugd. Batav. 1625.
(2) Page 681. edit. London, 1631.
(3) Wood Hiſt. et Antiqu. Univerſit. Oxon. lib. i. p. 295. and Athen. Oxon. vol. I. col. 237.

Obſerva-

Obſervationis Medicamentorum, quæ hâc ætate in uſu ſunt, printed at London in 1588, in 8vo, mentions, that on the firſt night of the appearance of the diſ-ſeaſe about ſix hundred fell ſick of it; and that the next night an hundred more were ſeized in the villages near Oxford. Lord Bacon, in his *Natural Hiſtory*, evidently refers to this, and one or two more inſtances of the ſame kind, in the following paſſage, *Century* X. *N*°. 914. " The moſt pernicious infection next " the plague is the ſmell of the goal, where priſoners " have been long and cloſe and naſtily kept; where-" of we have had in our time experience twice or " thrice, when both the judges, that ſat upon the " goal, and numbers of thoſe, that attended the " buſineſs, or were preſent, ſickened upon it, and " died. Therefore it were good wiſdom, that in " ſuch caſes the goal were aired before they be " brought forth." We have likewiſe an account in Mr. Anthony Wood (4), that at the quarter-ſeſſion at Cambridge, in Lent in the year 1522, and the 13th of the reign of Henry VIII. the juſtices, gentlemen, and bailiffs, with moſt of the perſons preſent, were ſeized with a diſeaſe, which proved mortal to a conſiderable number of them; thoſe, who eſcaped, having been very dangerouſly ſick. With regard to the unhappy inſtance of the ſame kind of contagion, which happened at the ſeſſion in the Old Baily in May 1750, ſee Dr. Pringle's excellent work, intitled, *Obſervations on the Diſeaſes of the Army in Camp and in Gariſon* (5).

(4) Hiſt. & Antiquit. Univerſit. Oxon. ubi ſupra.
(5) Page 290, 2d edit.

XCVI.

XCVI. *A Description of the Plan of* Peking, *the Capital of* China; *sent to the Royal Society by Father* Gaubil, è Societate Jesu. *Translated from the* French.

KING CHE. THE COURT.

Read June 1. 1758.

IN this plan are the inclosures of walls, which form as it were three cities.

Kong tching, Tse kin.

The first is the imperial palace, or imperial city. It is called *Kong tching* or *Tse kin.* The numbers 11, 17, 21, 24, mark the great gates of this inclosure.

Hoang tching.

The second inclosure is *Hoang tching.* The numbers 3, 18, 30, 86, mark four great gates of this inclosure.

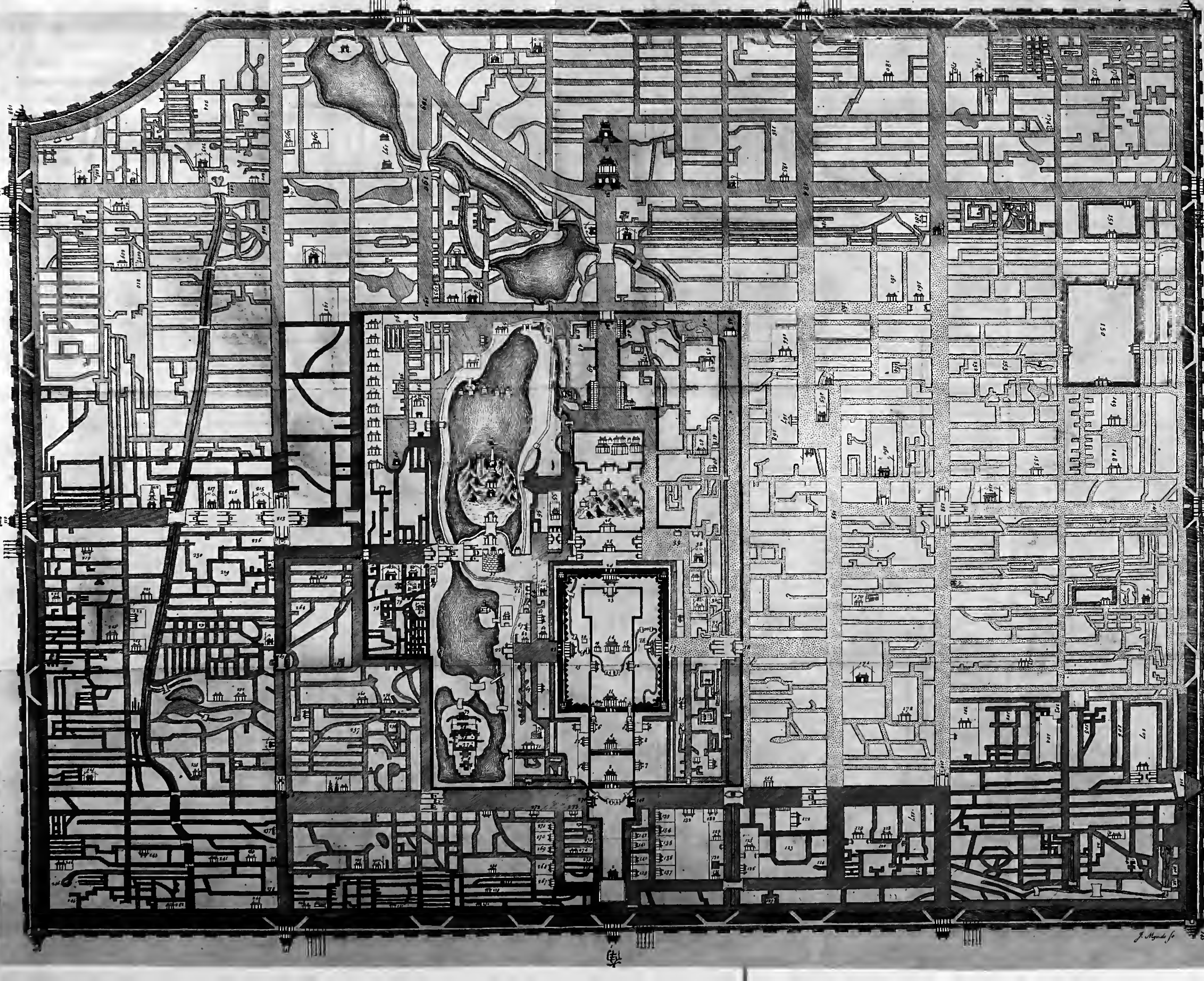
King tching.

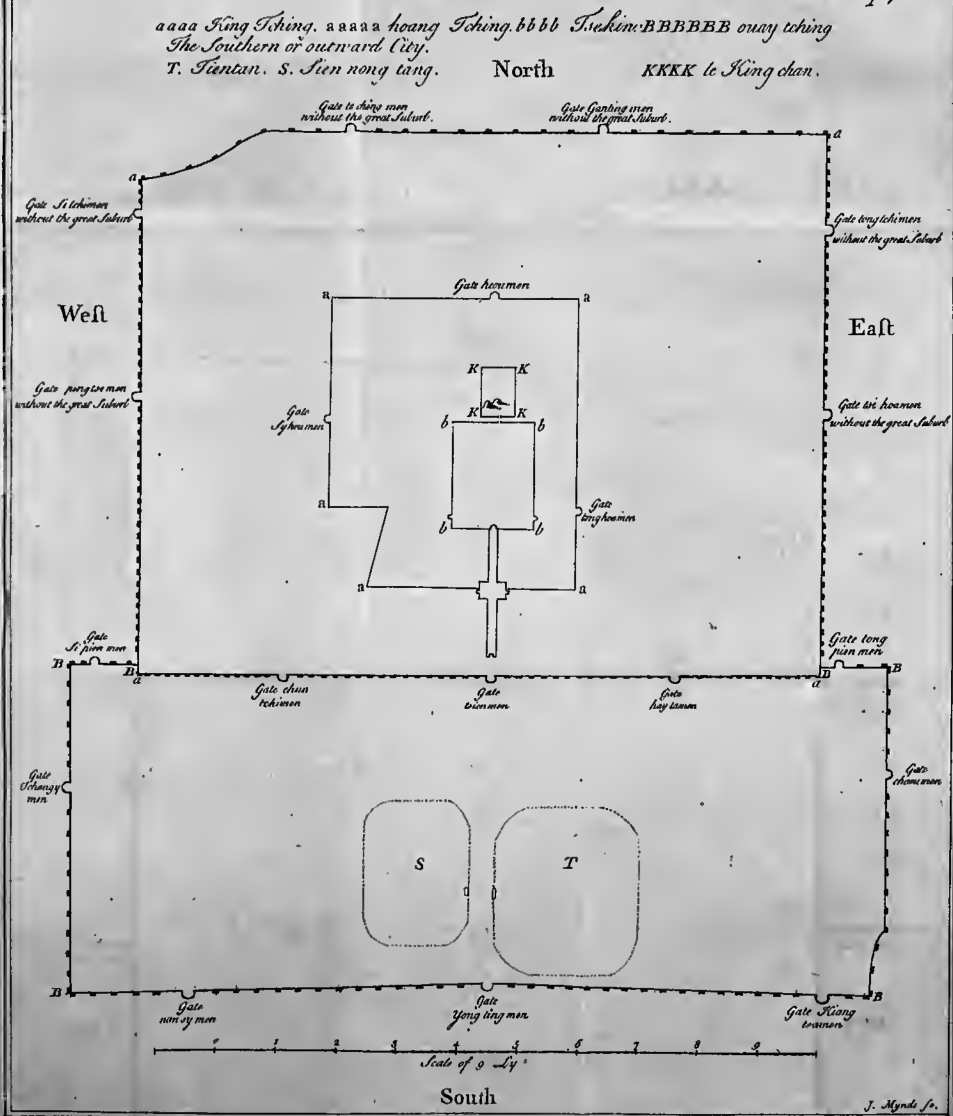
The third inclosure is *King tching*, or Royal City. The numbers 235, 1, 99, 146, 173, 183, 188, 199, 211, mark nine gates of this inclosure.

At the four angles east and west of the north and south walls is a large pavillion in the form of a fortress. It is a kind of arsenal or magazine of arrows, bows, guns, bucklers, cuirasses, pikes, small cannon, *&c.*

Observe the angle made by the inclosure *Hoang tching* on the south of the gate N°. 84, to the north of

北




aaaa King Tching. aaaaa hoang Tching. bbbb Tsekin. BBBBBB ouay tching
The Southern or outward City.
T. Tientan. S. Sien nong tang.
North
KKKK le King chan.
Gate te ching men without the great Suburb.
Gate Ganting men without the great Suburb.
Gate Si tchimen without the great Suburb
Gate tong tchimen without the great Suburb
West
East
Gate heou men
Gate pong tse men without the great Suburb
Gate tsi hoamen without the great Suburb
Gate Syhoamen
Gate tonghoamen
Gate Si pien men
Gate tong pien men
Gate chun tchimen
Gate tienmen
Gate hay tamen
Gate Schongy men
Gate chamemen
S
T
Gate nan sy men
Gate Yong ting men
Gate Kiang tsamen
0 1 2 3 4 5 6 7 8 9
Scale of 9 Ly
South
J. Mynde sc.

of N°. 260. The inclosure extends to the east, then to the south, and continues to the east, passing by N°. 3.

1. is the great gate *Hien men*. As you go on to the north, 2, 143, 214, are three gates of a great court with magnificent walls. Thro' the gate 3 you enter into a court, where is the *Tay miao* N°. 7. There are reposited the tablets of the ancestors of the reigning emperor, and of the illustrious subjects deceased, who have served the dynasty. This *miao* or palace is a vast one, and well kept. At regular times the emperor, princes, and great men, go thither to perform ceremonies.

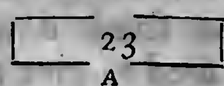
N°. 9 is the *Che tsi tan*, where are performed, at regular times, the ceremonies to the ancients, who have taught the art of agriculture. This palace is a very beautiful one. 4, 5, 6, are the gates of a court, where the *reguli* and princes go frequently to receive the emperor's orders. There are halls for their reception. The mandarins give them tea to drink, and mark their names in a register. When upon the fixed days they cannot attend, they are required to give notice of it. It is in this court, that the tributary princes, or their envoys, do homage, and receive the presents of the emperor; which presents are considered as rewards.

N°. 11 is *Ou men*, the great gate with a beautiful pavillion of a considerable height, in which is a large bell *. This gate, with those marked N°. 12, 13, are those of the great court; whence going to the

* When the emperor goes out or comes into the palace, this bell is rung.

 north,

north, you enter into the beautiful and vaſt court *Tay ho tien*, the gates and galleries of which, with the balconies, make a fine appearance. In this court, on the firſt day of the year, and on other fixed days, the mandarins, according to their ranks, perform the ceremony to the emperor, who is ſeated on his throne in the hall called *Tay ho tien.* This hall is a vaſt and magnificent one. The princes, miniſters, and great men of the firſt order, place themſelves there by the emperor. It is in this hall, that the emperor gives audience to foreign princes and their ambaſſadors. You go up to this hall by magnificent ſteps.

To the north of *Tay ho tien* is a large court, whither the princes, great men, miniſters, and principal mandarins, go in turns every day, to receive the emperor's orders, or to preſent their petitions. To the north of this court are the apartments of the emperor, the empreſs, the queens, and ladies. The great gate of the place, where theſe apartments are, is N°. 23. All theſe apartments are in the ſpace contained within the walls, which have this figure 

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At A is a beautiful gate to the ſouth. The walls of the incloſure of the apartments of the emperor and empreſs are higher than thoſe of the incloſures of the queens and ladies. In them are orchards, jets d'eau, flowering ſhrubs, and a great number of ſmall chambers for the eunuchs.

To the weſt of the court *Tay ho tien* is the fine palace *Tſi ning kong.* The empreſs-mother lives there at preſent. Every thing in this palace is beautiful. There are little gardens very neat and well

kept.

kept. At the eaſt of the *Tay ho tien* is likewiſe a fine palace, where the prince heir, with his court, reſided in the time of the emperor *Kanghi*. It is a very beautiful palace, and highly ornamented.

In the incloſure of *Kong tching*, or *Tſe kin*, there are tribunals, a great number of magazines, manufactures, the imperial apothecary's ſhop and printing-houſe; ſchools for the Chineſe and Tartar languages; and ſeveral temples of idols, one of which, lately made for the lamas, coſt immenſe ſums.

N°. 26, 28, 29, are the gates of the great incloſure called *Kin chan*. It is properly a beautiful pleaſure-houſe, which the preſent emperor has cauſed to be extremely embelliſhed. There are in it fine gardens with walks of trees, very rich and elegant apartments, halls for the muſicians and comedians. From the mountain *m*, the laſt emperor of the dynaſty *Ming*, ſeeing the city taken by the rebels, hanged himſelf on the morning of the 15th of April of the year of our Lord 1644. On the day before, the 14th of April, the empreſs hanged herſelf in the evening in the palace. The mountain in *Kin chan* was made by art a long time ago.

At the weſt of the incloſure *Kin chan* and *Tſe kin* obſerve the great laos. 54 is the *peta*, or white pyramid. This pyramid ſtands on a ſmall mountain, which makes an iſland. The preſent emperor has built there, in the form of an amphitheatre, I do not know how many apartments with covered and open galleries, well built, and in a good taſte: the point of view is charming, and the galleries, which run over the lake, are extremely beautiful. There are two or three temples of idols. 53 is a fine building

building with a temple of idols; and in it a ſtatue of *Fo* of an extraordinary height. It is of copper, gilt, and coſt great ſums. 76 is a very beautiful palace called *Yng tay*, with fine gardens, fine halls, and fine walks.

55 is the palace, in which is placed the tablet of the emperor *Kang hi*, grandfather to the preſent emperor, who at regular times goes thither, in order to honour the memory of that great prince, one of the moſt illuſtrious and fortunate ſovereigns of the empire of China.

81 is the houſe and church of the French Jeſuits. The houſe ſtands in 39° 55′ of northern latitude, or poſſibly ſome ſeconds more, and 114° to the eaſt of the obſervatory of Paris. This ſituation, with regard to latitude and longitude, is founded upon a conſiderable number of aſtronomical obſervations. By means of a ſcale, which may be made, we have the diſtance between this houſe and the other parts of the city, north and ſouth, eaſt and weſt; as likewiſe the latitude and longitude of all the places in the city of Peking. 248 is the houſe and church of the Portugueſe Jeſuits; 170 the houſe and church of the Portugueſe Jeſuits *; 131 the houſe and church of the Ruſſians. A little to the eaſt of N°. 176 is a ſmall houſe and chapel for the Ruſſians ſettled at Peking for above ſeventy years paſt.

31 is *Kou leou* †, the Tower of the Drum; 32 is

* In theſe two houſes are Jeſuits of other nations. They are ſtiled Portugueſe, becauſe theſe houſes and churches depend on the miſſion of the Jeſuits founded by the king of Portugal.

† There are beaten there the five watches of the night. The ſound is heard thro' the whole city.

Tchong

Tchong leou, the Tower of the Bell; in which is a very large bell ‡.

179 was formerly the palace of the fourth ſon of the emperor *Kang hi* after the death of *Kang hi*. This prince reigned under the name of *Yong tching*. His ſon the preſent emperor cauſed this palace to be demoliſhed, and to be rebuilt with an extraordinary magnificence. In the hall is the tablet of *Yong tching*; and there are in this palace grand apartments for the emperor, when he goes thither to honour the memory of his father. The emperor has erected here a temple of idols for the lama of Thibet; and there are apartments for above three hundred lama's. Theſe have Chineſe and Tartar diſciples to the number of two hundred. Here are taught, in the Thibetan language, called here *Tan gout*, the ſciences, arts, mathematics, phyſic, ſpirituality, and the pagan religion. In this beautiful incloſure there are ſtatuaries and painters. This building is not at all inferior in beauty and magnificence to thoſe of the palace of Peking, or to thoſe, which the preſent emperor is going on to erect in his pleaſure-houſes.

180 *Koue he kien* is the imperial college. The great hall, where Confucius is honoured, is a very beautiful one. There are likewiſe halls for honouring the diſciples of this philoſopher and ſeveral eminent Chineſe learned men, who have followed his doctrine with ſucceſs. The emperor goes thither ſometimes to perform the ceremony to Confucius as maſter and inſtructor to the empire. The avenues,

‡ *Yong lo*, emperor of the laſt dynaſty *Ming*, built theſe two towers.

courts, and apartments, of *Koue he kien* have a most majestic appearance.

70 the smaller observatory.

108 the imperial observatory, built by *Kia hing*, emperor of the last dynasty *Ming*.

136 the tribunal of mathematics, *Kin tien kien*.

137 the tribunal of mandarins, *Ly pou*.

139 the tribunal of rites and ceremonies *, *Ly pou*.

133 *Ping pou*, the tribunal of war.

134 *Kong pou*, the tribunal for public works.

140 *Heu pou*, the tribunal for the finances.

142 the tribunal of princes, *Tsong gin fou*.

168 *Hing pou*, the tribunal for criminal causes.

144 *Li fan yuen*, the tribunal for foreign nations, Thibetans, Eleuthians, Russians, and indeed for all foreigners, who come by the way of Tartary from the west

369 *Tou tcha yuen*, the tribunal of the censors of the empire. It has under it the *provosts* and *marechaussée*.

233 the tribunal of *Kieou men ti tou*, or governor of the nine gates, that is, the governor of the city.

185 the tribunal of the judge of the city. This judge is here called *Fou yn*. He has under him two judges named *Tchi hyen*. One of these is the judge of the district called *Ouang ping hien* 193. The other is called the district of *Tay tsing hien* 182. These districts are within the city and without it. What is called at Peking *tou yn* is called elsewhere *tchi fou*.

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* The tribunals of the ministers and grand masters of the emperor's house are in the inclosure *Tse kin*.

128 is the tribunal of *Han lin*, or the choſen doctors of the empire. This tribunal, called *Han lin yuen*, is a very conſiderable one: it has the care of the regiſters for the Chineſe hiſtory. All the learned men of the empire, and the colleges and ſchools, depend upon this tribunal. Here are choſen the judges and examiners of the compoſitions for the degrees of the learned men; as likewiſe thoſe, who are moſt capable of writing verſes and pieces of eloquence for the uſe of the palace and emperor.

107 *Kong yuen* is the incloſure, where the compoſitions are drawn up for the examination of the learned men. Here are a great number of little chambers or cells for the compoſers, and fine apartments for the mandarins appointed to preſerve good order, and to prevent thoſe, who compoſe, from making uſe of the compoſitions of others.

273 *Tchoua kou ting* is a pavillion, in which is a drum. Mandarins and ſoldiers keep guard here day and night. In ancient times, when any perſon had not juſtice done him, and thought himſelf oppreſſed, he went and beat this drum; at the ſound of which the mandarins ran, and were obliged to carry the complaint of the party oppreſſed to the great men or miniſters. Upon which information was taken of the fact, and juſtice done. At preſent the uſe of this drum is aboliſhed; but it has been thought proper to preſerve this ancient monument of the Chineſe government.

217 *Ti ouang miao* is a palace, wherein are the tablets of a great number of the ancient emperors of China. At the time of the equinoxes the emperor goes thither to perform the ceremonies to theſe de-

ceaſed emperors. See the notes on the *Ti ouang miao*, p. 723.

92, and the continuation of the buildings to the north, contain the magazines of gunpowder, ſalt-petre, and nitre. In the city are many other magazines. I do not name them here. They have their numbers. Theſe magazines are of cloth, mats, ſkins, oil, wine, vinegar, wood, coal, porcelain, tea, varniſh, ſilk, *&c.*

The city is divided into eight quarters for the bannieres of the Tartars *Mantcheou*, the Tartars *Mongou*, and the Chineſe called *Han kun*, who follow the Tartars *Mantcheou*, and ſubmitted to them when they entered China. Since that time the Chineſe *Han kun* are become numerous and powerful. Theſe eight bannieries are divided by this means as it were into twenty-four; *viz.* eight of *Mantcheou*, eight of *Mongou*, and eight of *Han kun*. Each bannièry has its officers, magazines, and arſenal. Theſe are pretty ſpacious incloſures, each of which has it number.

94 is an incloſure, in which are kept tygers; and 240 an incloſure, wherein are elephants.

65 *Tſan yuen* is an incloſure for ſilk-worms.

147, 150, 151, are public granaries, very well built. Without the gates 146, 173, are many of theſe public granaries; as alſo in the environs of the city to the north, ſouth, eaſt, and weſt. The largeſt and moſt magnificent are in the city of *Tong tcheou*, four French Leagues to the eaſt of Peking.

37, 38, 42, 52, 54, 59, 60, 66, 80, 83, 84, 85, 91, 93, 117, 118, 152, 154, 156, 160, 165, 178, 196, 203, 210, 215, 218, 225, 229, 230, 250, 255,

261,

261, these numbers mark temples of idols. Some of these numbers mark halls for honouring of illustrious deceased persons; but of these there are only a few. There are several small *miao*, which are not numbered. In the Chinese city, in the suburbs, are many temples of idols; and some even in the emperor's palace. And almost all the palaces of the princes have idol temples.

33, 35, 36, 61, 62, 64, 67, 68, 71, 109, 126, 128, 133, 134, 135, 136, 137, 139, 140, 141, 142, 144, 180, 182, 185, 193, 219, 222, 233, 243, 251, 252, 253, 254, 255, 259, 260, 267, 268, 269, 270, 271, 297, these numbers mark the tribunals, as well those, which I have already mentioned, as many other subaltern ones, which depend on them. There is one for the physicians.

101, 119, 121, 124, 125, 129, 148, 149, 155, 161, 162, 166, 172, 174, 175, 176, 192, 194, 195, 202, 208, 209, 216, 220, 221, 224, 232, 237, 238, 239, 241, 244, 247, 249, 262, 263, 264, mark the palaces of the princes of the blood, who are divided into several classes *Tsing ouang*, *reguli* of the first order; *Kun ouang*, *reguli* of the second order; *Pey le*, *reguli* of the third order; *Pey tse*, *reguli* of the fourth order; *Kong*, or counts, divided still farther into other classes; and *Tsiang kun*, or generals of armies, divided likewise into other classes.

Some years ago the emperor caused to be measured the circumference of the walls of *King tching*, of *Hoang tching*, and of *He kin*, *&c.* as likewise the breadth of the streets, the space filled by the *miao*, our three churches, that of the Russians, palaces, *&c.* The Chinese city was not measured. A drawing

ing of all this was made at large, and then reduced to a ſmaller ſcale, as it appears here. I will not undertake for the perfect exactneſs of it, either in the meaſures or the reduction. All this is by a Chineſe hand. The foot made uſe of in this menſuration is to that of France as 1000 to 1016. 1800 of theſe feet make a *ly* *. By the ſcale to be ſeen in the ſmall plan, and from the dimenſions of the ſouth and eaſt walls of *King tching*, may be deduced all the dimenſions. The circumference of the walls of the Chineſe city has been formerly meaſured, and well, by ſeveral meaſures; and the reſult of them may be ſeen here by the ſcale.

The ſouth wall of *King tching* is from eaſt to weſt eleven *ly* and near a third. The eaſt wall from north to ſouth is nine *ly* and ſome paces. So that the city is not ſquare, as ſeveral perſons have written.

The perſons employed by the emperor to meaſure did not think of meaſuring the ſpace, which contains the houſe and church of the congregation *de propagandâ fide*. This houſe and church are ſituated to the ſouth between number 207 and a ſmall bridge to the weſt of number 201.

In the accounts ſufficient mention has been made of the walls and gates of the city of *King tching*; for which reaſon it is not neceſſary for me to ſay any thing concerning it.

In the year of our Lord 1267, the Tartar emperor *Koublay han* (in Chineſe *Yuen chi tſou)* built

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* The feet are different in China; but 1800 feet always make a *ly*. According to the meaſure of the foot the *ly* will be greater or leſs.

the city called *Ta tou.* It is the principal part of the preſent city of *King tching.* It contained the *Kin chun*, a palace *Yng tay*, *Hoang tching*, *Tſe kin*, &c. the walls of the city, an obſervatory, the towers of the Drum and the Bell. *Yong lo*, emperor of the laſt dynaſty *Tay ming*, made great alterations in the city built by *Yuen chi tſou.*

In the year 1406 the emperor *Yong lo* undertook to build ſtronger and higher walls, and more magnificent gates, to the city; to rebuild the *Hoang tching*, the emperor and empreſs's proper habitation, and the ſeveral parts of *Tſe kin*, the courts, hall of the throne or of *Tay ho tien*, the *Kou leou*, the *Tchong leou.* He undertook alſo to build the *Sien nong tan* and *Tien tan*, which are now in the Chineſe city. On account of the wars with the Tartars, the works undertaken by *Yong lo* were not finiſhed till the year of our Lord 1421. Since that time, in the *Kin tchin* ſome alterations have been made in the palace, and a good number of new *miao* and palaces have been built. The emperor *Kia tſing* built the Chineſe city in the year of Chriſt 1544.

The gates and walls of the Chineſe city are not all equal in beauty to thoſe in the city *King tching.* The ſtreets are neither ſo broad, nor ſo well kept in repair. More than a third of the ſpace of the Chineſe city is not inhabited. It conſiſts only of fields and gardens. The ſpaces occupied by the *Sien nong tan* and the *Tien tan* are vaſt; and between theſe two there is a very broad road. In this Chineſe city are ſome moſques for the Mahometans. The inhabited part of this city is much more ſo than the city *King tching* and *Hoang tching.* In the Chineſe city are vaſt inns for thoſe, who come out of the ſouthern provinces to Peking. Here are likewise a curious manufacture of *lieou ly* or Chinese glass, rich merchants of women's ornaments, of gold, of the plant *gin cheng* so much esteemed and so dear here, of varnished furniture, tea, stuffs of value, &c. The booksellers shops are also in this city. It is to be remarked, that the walls of the Chinese city and *King tching* do not run directly north and south and east and west, but decline towards the north-west 2° 30′, and as much south-east. It is probable, that the architects employed in directing the building of these walls made use of a compass; and that the declinatiation of the needle was then what is mentioned above.

What I have said of the walls of the city is likewise to be said of the walls of *Hoang tching* and of *Tse king.*

At the time of building the city *King tching*, and the Chinese city, the Chinese astronomers very well understood, that the north and south of the compass was not the north and south of the heavens at Peking; they knew, that the needle declined to the north-west and south-east; but that this declination was not considerable.

Without the gates of the Chinese city, and of *King tching*, I mark the suburbs; which are very full of people and merchants, and like so many cities. In most of these suburbs there are fine temples of idols.

The *Sien nong tan* in the Chinese city is almost six *ly* in circuit. These three words signify, The hill of the ancient husbandmen.

The emperor goes thither every year in the spring

to

to till the ground, and facrifices on that hill to heaven. The emperor's apartments there have nothing magnificent in them; but the ceremony of ploughing is a folemn and curious one, and deferves a particular defcription. The emperor tills under a fmall covering of mat. When he has ploughed about half an hour, he afcends a large alcove, from whence he fees the princes, great men, and mandarins, plough in the fields, which are not covered with mats. While the emperor is ploughing, a good number of peafants fing ancient fongs on the importance of ploughing. The emperor, princes, and great men, are dreffed in the habit of plough-men, and their inftruments of hufbandry are very neat, and kept in a magazine. There are granaries for the grain produced by this tillage; and it is carefully remarked, that the grain from the emperor's tillage is much better than that from the labour of others. From this grain are made feveral cakes for the various facrifices to Heaven or *Chang ti*. The emperor prepares himfelf for this ceremony by fafting, prayers to heaven, and a kind of retreat: and the intention of it is to keep up a memorial of thofe times, in which the princes themfelves tilled the ground. This ceremony is of the higheft antiquity in China.

Over againft the *Sien nong tan* is the *Tien tan*, or Hill of Heaven, near ten *ly* in circuit. Every thing here is magnificent. The emperor goes thither every year at the winter folftice to facrifice to heaven. He prepares himfelf three days for this ceremony by fafting, in a palace of *Tien tan*, called the *palace of fafting*. The hill, on which the emperor facrifices, is magnificently adorned. At the four avenues are

beautiful

beautiful triumphal arches of fine marble; and the hill is aſcended by elegant ſteps. In this ceremony are introduced many uſages contrary to the ancient Chineſe doctrine concerning the ſacrifice to heaven. On the day of the winter ſolſtice are added the honours paid to the five planets, that is, to their ſpirit. Theſe ceremonies added to the ſacrifice to heaven are not very ancient. There are likewiſe honours to the firſt founders of the reigning dynaſty. At ſeveral other times the emperor goes to *Tien tan* to perform a ſacrifice to heaven, and to honour his deceaſed anceſtors.

To the north of the Hill of Heaven is a large and high terrace, on which is a moſt magnificent hall in honour of *Chang ti*, or the ſovereign Lord, and of his anceſtors. On the frontiſpiece of this hall the preſent Tartar emperors have cauſed an inſcription to be placed to *Ap cai han*, or the Lord of heaven. To this Tartar inſcription anſwers the Chineſe character *Kien*; which has the ſame meaning as the character *Tien*, heaven; and it ſignifies the *Chang ti*, who is intended to be honoured in this hall. The tablet for the *Chang ti* is in a place, which ſhews, that the honour paid to *Chang ti* is of a different kind from the honour paid to anceſtors.

Without the eaſtern gate of *King tching*, N°. 145, is *Ge tan*, or Hill of the Sun. At the vernal equinox the emperor ſends hither a prince or great man to honour the ſun, that is, the ſpirit of the ſun. This incloſure, tho' elegant enough, has nothing very remarkable; nor is the ceremony very ancient.

Without the north gate of *King tching*, at N°. 183, is *Ti tan*, or the Hill of the Earth. At the

ſummer

ſummer ſolſtice the emperor goes thither to ſacrifice to the earth on the hill. Many of the learned men at preſent diſtinguiſh this ſacrifice in the *Ti tan* from the ſacrifice in the *Tien tan*. But, according to the doctrine of Confucius, the ſacrifice to the earth has the ſame object as the ſacrifice to heaven. In both the ſupreme Lord *Chang ti* is to be honoured. I do not know, whether the emperor adheres to the pure doctrine of Confucius, and whether he does not pretend to honour the earth, or ſpirit of the earth, by performing a ſacrifice, which originally had for its object the *Chang ti*, as we are aſſured by Confucius. The incloſure of *Ti tan* is a vaſt one; but is not at all equal in beauty to the *Tien tan*.

Without the weſtern gate of *King tching*, N°. 211, is *Yue tan*, the Hill of the Moon. At the autumnal equinox the emperor ſends thither a prince or great man to honour the moon, or ſpirit of the moon. This ceremony is not very ancient. This incloſure is a neat one, and pretty large.

Between the two north gates of *King tching*, N°. 183 and 188, is a vaſt eſplanade for the exerciſe of the troops both horſe and foot.

To the north of this eſplanade are two beautiful temples of idols for the lamas. Theſe two monaſteries are very elegant. The emperor and the Tartars *Mon gou* lay out great ſums on theſe two monaſteries and the two temples of the lamas.

In the year 1111 before Chriſt, *Ou ouang*, founder of the dynaſty *Tcheou*, nominated his brother *Tchao kong* prince of *Yen*. *Yen* is the ancient name of a pretty extenſive country, in which Peking ſtands. This prince of *Yen* built a city there, a league and half

half south-west of the city *King tching*. This city was called *Yen king*, or the court of *Yen*. It became afterwards considerable; and the prince of *Yen* very powerful in the country of *Petcheli* and *Leao tong*. In the year 222 before Christ the emperor *Tsin chi hoang* destroyed the power of the princes of *Yen*, the descendants of *Tchao kong*, and seized their dominions. The founder of the dynasty *Han* destroyed the power of the family of *Tsin chi hoang*. In the time of the dynasty *Tsin*, before the Christian æra, and of the dynasty *Han*, the city of *Yen* was an important government, on account of the neighbourhood of the Tartars. Some time after the dynasty *Han* several Tartar princes *Sien pi* made themselves masters of the country of *Yen*. During the dynasty of *Tang* the city of *Yen* was still a considerable one. After the destruction of that dynasty the Tartars *Ki tan** made themselves masters of Tartary, and the provinces of *Chansy*, *Petcheli*, and *Leao tong*. Their power was formidable to the Chinese. Their court was in the city of *Yen*, which they adorned and inlarged. These Tartars had, like the Chinese emperors, tribunals; one for the mathematics, and another for history †. They had likewise some illustrious princes, and kept some correspondence with the Caliphs.

The Tartars *Nuntche* destroyed the power of *Leao*. Their court was also at *Yen*; and they made it as magnificent and large a city as Peking is now. The Mogol Tartars destroyed the empire of the

* This power is called in China the dynasty *Leao*.

† There is extant, in the Chinese and Tartar *Mantcheou* languages, an history of the dynasty of *Ki tan*.

Nuntche

Nuntche or *Kin*. Their court was at firſt at *Yen*; but the Tartar Mogol emperor *Koublay* demoliſhed that city, and built what is now called *King tching*: at leaſt *King tching* is a good part of the city built by *Koublay*, which was ſome *ly* larger. The emperor's palace was likewiſe larger.

This city *King tching* is that, which Marco Paulo calls *Cambalu*. *Car* is *khan*, which ſignifies a *king*; and *balu* is a corruption of an old Mogol word *balga*, or *balah*, which ſignifies a *city*: whence is formed the word *balgaſan* in Mogol or Mongou, which ſignifies city. *Khan balu*, or *khan balou*, ſignifies the royal city. *King tching*, in the time of Marco Paulo, was the capital of the empire of China. The Perſians and Arabians, from the Mongou word *khan balou*, or *khan balgaſun*, or *khan balga*, formed the word *khan balik* or *khan balek*, which ſignifies alſo the royal city. This name was given by the eaſtern people to the city of *Caifong fou*, the capital of *Honan*, and to that of *Nanking*, the capital of *Kiangnan*, at the time when theſe cities were the court of princes. This name was alſo given to the cities of Tartary, when ſome powerful princes kept ſometimes their court there. What I have remarked concerning the words *khan balik*, *khan balek*, *khan balga*, &c. is to be applied to the words *ordo balik*, *ordou balik*. *Ordo*, or *ordou*, or *orto*, ſignifies royal, imperial, in the Mogol or Mongou language. So *ordou balik* ſignifies a court, a royal city; and theſe words are in fact the names of ſome old cities, where the Mogol or Mongou kings kept their courts.

REMARKS *on* N°. 5, *Fan king tchang*; which is the place where the foreign claſſical books are kept.

Tchang ſignifies magazine, or large place, where any thing is contained. *Fan* ſignifies ſtranger or foreigner; and *king* ſignifies a claſſical book.

The Jews of *Caifong fou*, the capital of *Honan*, firſt told the Jeſuit miſſionaries, that they conceived, that the Hebrew Bible was preſerved at Peking in the place called *Fan king tchang*. Theſe firſt miſſionaries neglected to make a ſearch for it at Peking, or did not think of it. But it did not eſcape the attention of Father Bouvet, a French Jeſuit, who went to *Fan king tchang*. The antient place, where the foreign books were kept, had been deſtroyed; and thoſe books removed into a neighbouring *miao*, where there were bonzes. Father Bouvet went to this *miao* with two other French Jeſuits; but they found only the Koran, fragments of the claſſical books of the Indians, and the claſſical books of the lamas; the whole in bad condition. Father Bouvet thought, that he ſaw in an old coffer Chaldee, Syriac, and Hebrew characters. The bonze would not ſhew the place, where Father Bouvet thought that he had ſeen thoſe characters, which, on returning to the *miao*, were not found. The emperor had ordered the bonzes to ſhew every thing to Father Bouvet. All the claſſical books were afterwards removed to the palace; the *miao* was demoliſhed; and there remained nothing but the name of *Fan king tchang*. When I paſſed thro' *Caifong fou*, the Jews, in the preſence

presence of Father Gozani, who served me as interpreter, assured me, that I should find the Bible in the *Fan king tchang*. These Jews had not been at Peking. What they said was in consequence of what they had been told by old Jews, who were deceased. When I arrived at Peking, I made inquiries myself, and caused inquiries to be made by others; but I could not find the Bible. It is not yet an hundred years since there were at Peking some Jewish families; which afterwards turned Mahometans. A Mahometan, who was a man of parts, assured me several times, that the Bible was in the possession of the Mahometans here, whose ancestors were Jews. But when, in consequence of what he said, inquiries were made, nothing was found. This Mahometan informed me likewise, that he had made inquiries; but if he had done so, his researches proved unsuccessful.

REMARKS *on the* Ti ouang miao, N°. 217.

1. The emperors, whose memory is honoured there, are

The emperors *Tou hi*, *Chin Nong*, *Hoang ti*.

The emperors *Chao hao*, *Tchouen hiu*, *Ty co*, *Yao*, *Chun*.

The emperor *Yu*, the founder of the dynasty *Hia*, and thirteen other emperors of that dynasty.

The emperor *Tching tang*, the founder of the dynasty *Chang*, and twenty-five emperors of that dynasty.

The emperor *Ou ouang*, the founder of the dynasty *Tcheou*, and thirty-one emperors of that dynasty.

The founder of the dynaſty *Han*, and twenty emperors of that dynaſty, who are called weſtern *Han*, eaſtern *Han*, and later *Han*.

The founder of the dynaſty *Tang*, and fourteen emperors of that dynaſty.

The founder of the dynaſty *Song*, and thirteen emperors of that dynaſty; which is called the northern *Song* and the ſouthern *Song*.

Gen tchis khan, or *Temoug in*, the founder of the dynaſty *Yuen*, is the dynaſty of the Mongol or Mogol Tartars. Beſides the founder of this dynaſty, there are ten other emperors of this dynaſty, whoſe memory is honoured in the *Ti ouang miao*. The four firſt emperors of this dynaſty, *viz.* *Gen tchis khan*, *Ogo tay*, *Kouey yevou*, and *Meng ko*, reigned in the northern provinces, and had not conquered all China. The emperor *Cobilay*, or *Koublay*, in Chineſe *Yuen chitſou*, completed the conqueſt of China.

The founder of the dynaſty *Ming*, and the eleven emperors of this dynaſty.

The emperor *Ogo tay*, the ſecond of the dynaſty *Yuen*, completed the deſtruction of the dynaſty of the eaſtern Tartars, called *Kin*. It reigned to the north as long as the dynaſty *Song* reigned to the ſouth. In the *Ti ouang miao* is honoured the memory of the founder of this dynaſty *Kin*, and four other emperors of it.

The founder of the Tartar dynaſty *Kin* deſtroyed the dynaſty of the Tartars *Ki tan*, called *Leao*, which conquered a great part of North China and Tartary.

In the *Ti ouang miao* is honoured the memory of this Tartar dynaſty *Leao*, and five other emperors of the Tartars *Ki tan*, whoſe country was in that of Parin in Tartary, among the Mongou or Mogols.

Continuation of the Remarks on the Ti ouang miao.

2. In the palace of Peking, and elsewhere, there are great halls, in which honours are paid to the memory of the deceased emperors of the reigning dynasty of the *Mantcheou*. The first and second emperor reigned in East Tartary. The emperor *Chun tchi* began to reign in China. If we reckon the present emperor in the number, there are six emperors *Mantcheou*. Father Couplet, and others, are mistaken in reckoning one more. This error was occasioned by the years of the reign of *Tay hong*, the second emperor, having had two names. Father Couplet, and others, took the two names of the years of the reign for the name or title of the two emperors.

3. In the *Ti ouang miao* is honoured the memory of some illustrious persons in the different dynasties. The same is done in the hall, where honour is paid to the memory of the deceased emperors *Montcheou*: and there are there tablets for so many illustrious persons among those emperors.

4. In the *Ti ouang miao* are placed none of the emperors of the dynasty *Hin* before Christ, nor any of those between the dynasties *Tang* and *Han*, nor of those of the five small dynasties after that of *Tang*. Besides, in each dynasty there are some emperors, whose tablets are not placed in the *Ti ouang miao*. The reigning dynasty has not thought it a duty to pay honours to those emperors, but considered them as unworthy the pompous title of *Tin tse*, or *Sons of Heaven*.

5. The

5. The Tartars *Sien pi*, who came from the confines of *Leao tong* and Mongol or Mogol Tartary, had hords named *To pa*. One of these hords made themselves masters of Tartary *Leao tong*, and of several northern provinces of China. This Tartar power has the Chinese name of *Ouey*. It has produced several great princes. The year of Christ 386 is reckoned the first of that dynasty *, which reigned above 180 years. I do not know why the reigning dynasty has not placed the name of any of these emperors in the *Ti ouang miao*.

6. If we suppose, first, that all the books of the history of China should be lost, or the contents of them should not be known in Europe; and secondly, that the catalogue of the emperors, who are mentioned in the *Ti ouang miao*, should fall into the hands of some European critics; it is probable, that such a catalogue would occasion many false reasonings with relation to the succession of the emperors, who have reigned in China.

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* Of which dynasty there is extant a very curious history.

XCVII.

XCVII. *An Attempt to improve the Manner of working the Ventilators by the Help of the Fire-Engine. In a Letter to* Tho. Birch, *D. D Secret. R. S. from* Keane Fitz-Gerald, *Esq; F. R. S.*

SIR,

Read June 8, 1758.

THE reverend and ingenious Dr. Hales, from whom mankind has received ſuch benefit by his uſeful application of ventilators, being inclined to extend its uſe to thoſe, who work in mines at great depths under ground, where the lives of many are loſt by damps and noxious vapours, occaſioned by the want of a free circulation of air; and finding by experience, that ventilators worked by wind do not operate above one third part of the year, and in calm hot weather, when moſt wanted, do not operate at all; did me the honour of applying to me for aſſiſtance in contriving a machine to work the ventilator, by the help of the fire-engine, which is now generally uſed in all mines for drawing off the water; and which I have accordingly attempted, and hope it will anſwer the purpoſe.

As the lever of the fire-engine works up and down alternately, and performs at a common medium about a dozen ſtrokes in a minute, it was neceſſary to contrive ſome way to make the beam, tho' moving alternately, to turn a wheel conſtantly round one way, and alſo to increaſe the number of ſtrokes to fifty or ſixty in a minute.

The

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The model of a machine for this purpofe is compofed of four wheels of different fizes, two clicks, three pinions, and a fly; which is put into motion by the part of a wheel fixed to the arch of the lever of the fire-engine.

The wheel, which is turned by the lever, or rather moved up and down by it, is loofe on its arbor; and likewife one of the rochets, and the wheel next to it. The outfide rochet and outfide wheel are fixed on the arbor.

There are two pinion-wheels fixed on the arbor; one on each fide, near the edge of the wheel moved by the lever, which turns them.

There are alfo two clicks; one fixed to the great wheel, the other to the frame. Thefe exclufive of the wheel that moves the fly.

The effect is, When the lever moves the wheel downwards, its click forces the rochet fixed on the arbor to move along with it, and the other wheels the fame way. When it moves upwards, the click fixed on the frame ftops the larger rochet, and the wheel next to it, which are pinned together. This wheel being ftopped, and the great wheel carried upwards by the lever, the pinion towards the edge of the great wheel is forced round it, and moves the pinion on the other fide the great wheel; which pinion moves the wheel fixed on the arbor, the contrary way to the great wheel, which is carried upwards by the lever. By which means, the arbor is conftantly turned the fame way, when the lever of the fire-engine is moved either upwards, or downwards.

Upon the arbor there is alfo another great wheel fixed, which turns a pinion: on the arbor of which pinion

pinion is a crank to move the ventilator, and alſo a fly fixed to the end, to help the motion of the crank, which in the model is turned three times for each ſtroke of the lever, and may be increaſed or diminiſhed, according to the number of teeth in the pinion.

The number of teeth in the great wheel moved by the lever is ſixty-ſix; but need not have teeth above half way round.

The wheel fixed to the rochet has thirty-three teeth, and its pinion eleven.

The wheel fixed on the arbor, on the outſide, has twenty-four teeth, and its pinion ſixteen.

The wheel, which turns the fly, has ninety teeth, and the pinion turn'd by this wheel ten.

The greater the number of teeth in the rochets, the better.

This machine may alſo be applied to other uſeful purpoſes at mines; and it may be eaſily made to turn a mill to grind corn; or to turn a wheel to raiſe coals, or whatever elſe is wanted to be raiſed from the mines. As I have not met with any thing of the kind deſcribed, I take the liberty of deſiring you to lay it before the Society; and I hope it may be made ſome way uſeful to the public.

I am, Sir,

Your moſt obedient humble Servant,

Poland-Street,
June 7th, 1758.

Kea. Fitz-Gerald.

Explanation of the Three Tables.

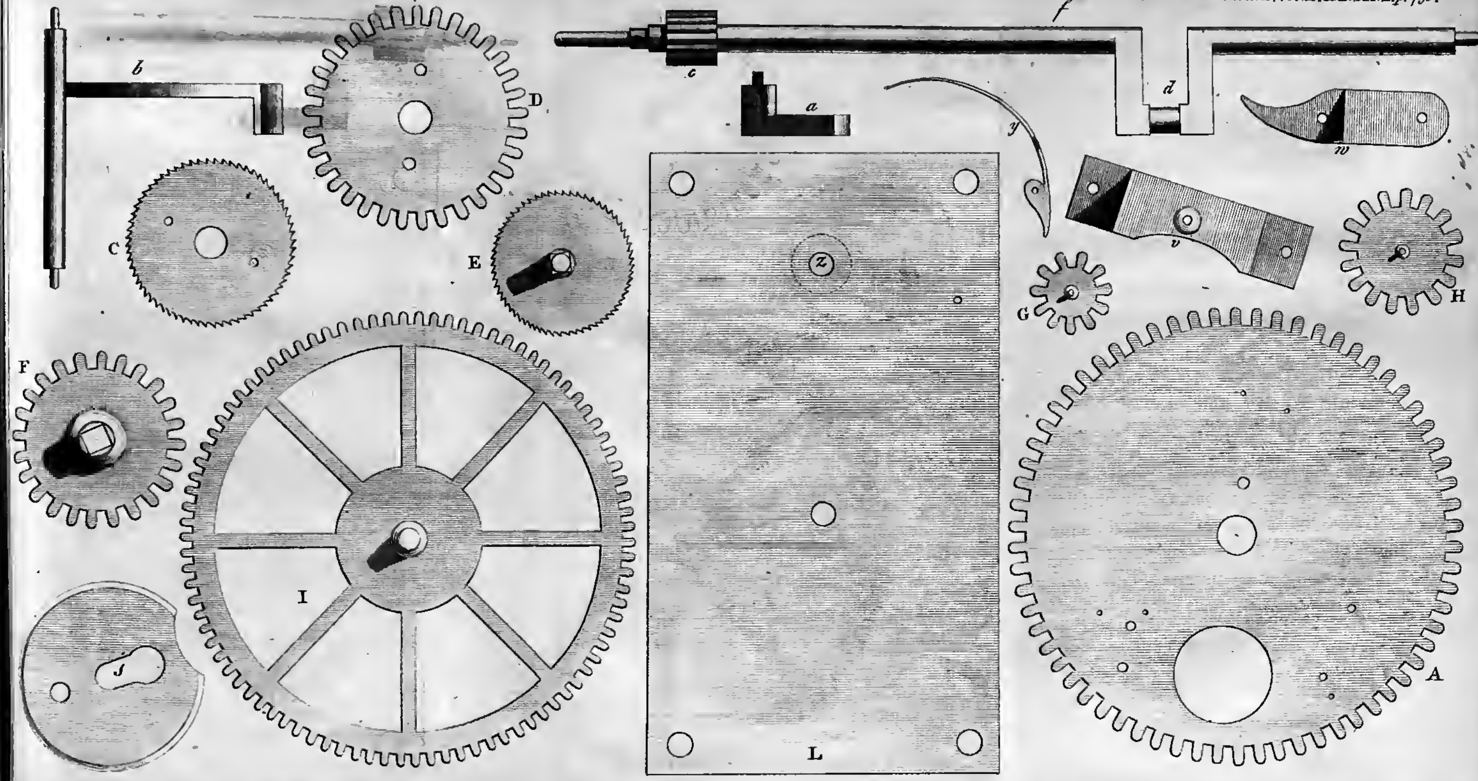
The wheel A (*Tab.* 26.), which is turned by the lever B (*Tab.* 27.), or rather moved up and down by it, is loofe on its arbor; and likewife one of the rochets C (*Tab.* 26.), and the wheel next to it D. The outfide rochet E, and outfide wheel F, are fixed on the arbor.

There are two pinion-wheels G and H fixed on one arbor; one on each fide, near the edge of the wheel A, moved by the lever.

There are alfo two clicks *a* and *b*; one *a* fixed to the great wheel A, the other *b* fixed to the frame. Thefe exclufive of the wheel I, that moves the pinion *c*, on the arbor of which, the crank *d*, and fly *e*, (*Tab.* 27.) are fixed.

The effect is, when the lever B moves the wheel A downwards; its click *a*, forces the rochet E, fixed on the arbor K, to move along with it, and the other wheels the fame way. When it moves upwards, the click *b* fixed to the frame, ftops the larger rocket C, and the wheel D next to it, which are pinned together; and as the wheel A is carried upwards by the lever, the pinion G towards the edge of it, is forced round the wheel D, and moves the pinion H, on the other fide the great wheel A, which moves the wheel F fixed on the arbor K, the contrary way to the wheel A. By which means, the arbor K is conftantly turned the fame way, when the lever of the fire-engine moves either upwards, or downwards.

The pinion G, by being made proportionally fmaller than the pinion H, keeps the arbor K in the fame



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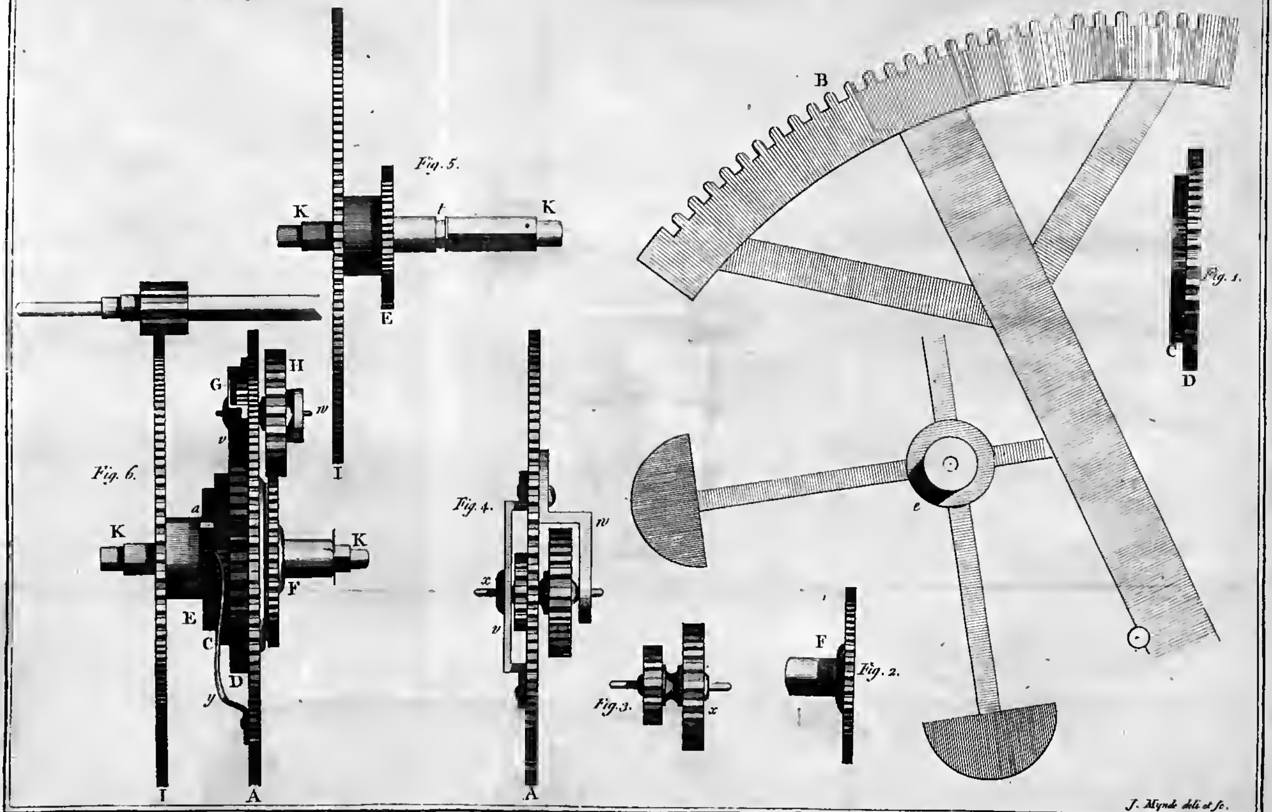
B
Fig. 1.
C
D
Fig. 5.
K
t
K
E
I
e
H
G
w
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Fig. 6.
a
K
K
F
E
C
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Fig. 4.
w
x
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A
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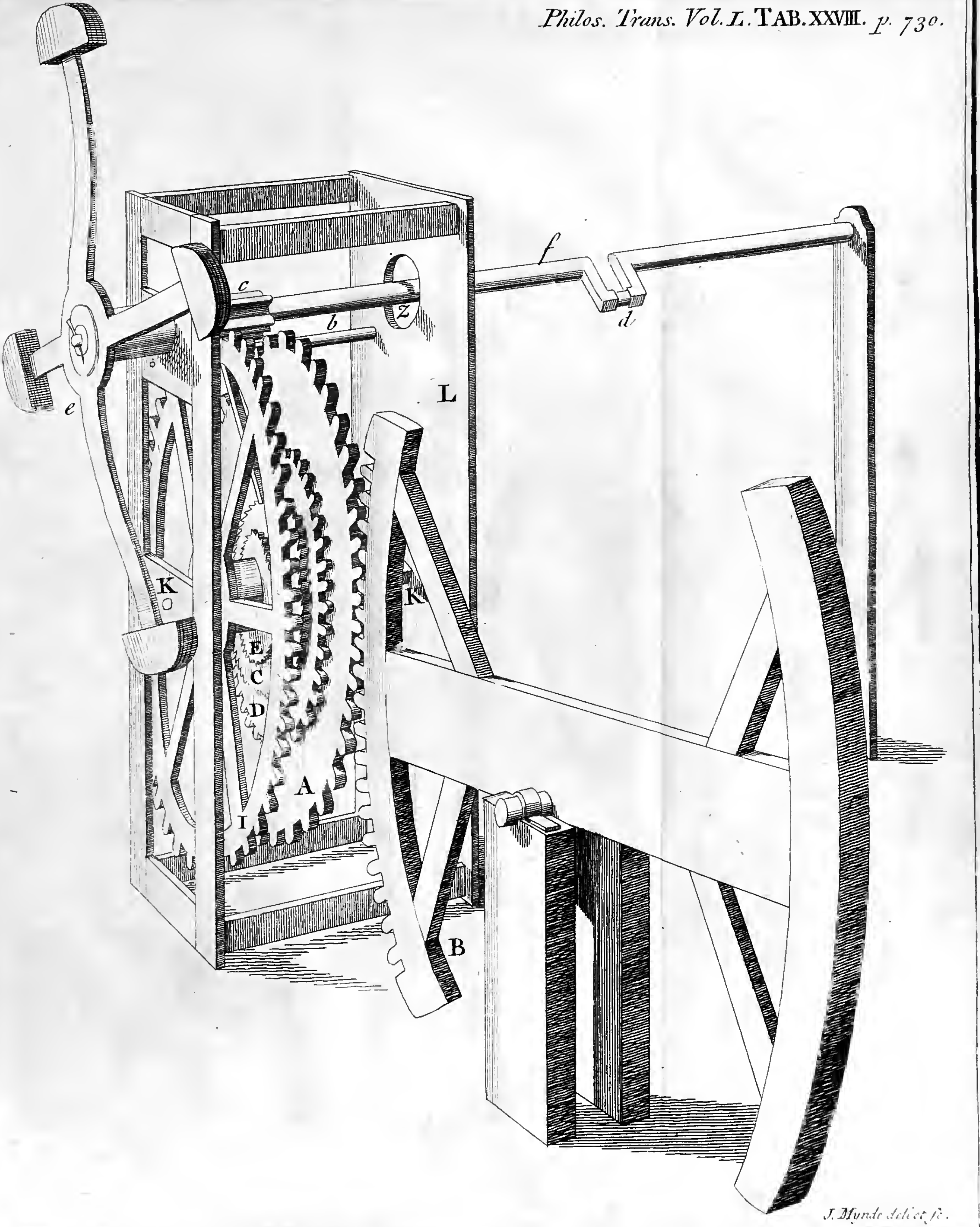
Fig. 2.
Fig. 3.
x
J. Mynde deli et sc.



J. Mynde delin. et sc.

ſame ſwiftneſs of motion, when the lever is moved upwards, as downwards.

The great wheel I, fixed on the arbor K, turns the pinion *c*, on the arbor of which the crank *d* (to move the ventilator), and the fly *e* (to help the motion), are fixed. The pinion *c*, is turned three times by each alternate motion of the lever; which may be increaſed, or diminiſhed, according to the number of teeth in the pinion *c*.

The number of teeth in the wheel A is ſixty-ſix, but need not be toothed above half way. Inſtead of this wheel there might be a barrel, with a chord round it, fixed at each end of the arch of the lever, and projecting ſomewhat from it; which, by the motion of the lever, would work in the ſame manner in other reſpects, and be eaſier made, and at leſs expence.

The wheel D fixed to the rochet C has thirty-three teeth, and its pinion G eleven.

The wheel F fixed on the arbor K has twenty-four teeth, and its pinion H ſixteen.

The greater the number of teeth in the rochets, the better.

Tab. 26. contains the plan (in parts) of the whole machine, except the lever B and fly *e*, which are in *Tab.* 27.

Tab. 27. alſo contains the elevation of the arbor, with its different fixtures; *viz.*

Fig. 1. The rochet C and wheel D (*Tab.* 26.) fixed together.

2. The outſide wheel F that works the pinion-wheel H (*Tab.* 26).

Fig. 3. The two pinion-wheels H and G (*Tab.* 26.) fixed on their arbor.

4. The ſame fixed to the wheel A (*Tab.* 26.) by means of two cocks *u* and *w* (*Tab.* 26).

5. The arbor, with the wheel L and rochet E fixed; *t* the place, where the wheel A is fixed.

6. The elevation of the whole arbor.

Tab. 28. The elevation of the whole machine, the lever B (*Tab.* 27.) working the wheel A (*Tab.* 26).

s (*Tab.* 26.) a thin piece of metal ſcrewed to the wheel A, to keep it in its place *t* on the arbor K (*Tab.* 27.)

u (*Tab.* 26.) the cock, that faſtens the pinion G, to the inſide of the wheel A.

w (*Tab.* 26.) the cock, that faſtens the pinion H on the outſide of the wheel A.

x (*Tab.* 27.) the arbor, on which the pinions G and H are fixed.

y (*Tab.* 26.) a ſpring, that keeps the click *a* in its place.

L (*Tab.* 26.) a frame-plate with the centers marked.

z The oppoſite hole enlarged, to admit the pinion *c* to paſs through.

XCVIII.

XCVIII. *An Account of some Experiments concerning the different Refrangibility of Light. By Mr.* John Dollond. *With a Letter from* James Short, *M. A. F. R. S. Acad. Reg. Suec. Soc.*

To the Rev. Dr. Birch, *Secret. R. S.*

Dear Sir,

Read June 8, 1758.

I Have received the inclosed paper from Mr. Dollond, which he desires may be laid before the Royal Society. It contains the theory of correcting the errors arising from the different refrangibility of the rays of light in the object-glasses of refracting telescopes; and I have found, upon examination, that telescopes made according to this theory are intirely free from colours, and are as distinct as reflecting telescopes. I am,

Dear Sir,

Your most obedient humble Servant,

Ja. Short.

Surrey-street, 8th June, 1758.

IT is well known, that a ray of light, refracted by passing thro' mediums of different densities, is at the same time proportionally divided or spread into a number of parts, commonly called homogeneal rays, each of a different colour; and that these, after refraction, proceed diverging: a proof, that they are differently

differently refracted, and that light consists of parts that differ in degrees of refrangibility.

Every ray of light passing from a rarer into a denser medium, is refracted towards the perpendicular; but from a denser into a rarer one, from the perpendicular; and the sines of the angles of incidence and refraction are in a given ratio. But light consisting of parts, which are differently refrangible, each part of an original or compound ray has a ratio peculiar to itself; and therefore the more a heterogene ray is refracted, the more will the colours diverge, since the ratios of the sines of the homogene rays are constant; and equal refractions produce equal divergencies.

That this is the case when light is refracted by one given medium only, as suppose any particular sort of glass, is out of all dispute, being indeed self-evident; but that the divergency of the colours will be the same under equal refractions, whatsoever mediums the light may be refracted by, tho' generally supposed, does not appear quite so clearly.

However, as no medium is known, which will refract light without diverging the colours, and as difference of refrangibility seems thence to be a property inherent in light itself, Opticians have, upon that consideration, concluded, that equal refractions must produce equal divergencies in every sort of medium: whence it should also follow, that equal and contrary refractions must not only destroy each other, but that the divergency of the colours from one refraction would likewise be corrected by the other; and there could be no possibility of producing any such thing as refraction, which would not be affected

by

by the different refrangibilty of light; or, in other words, that however a ray of light might be refracted backwards and forwards by different mediums, as water, glafs, &c. provided it was fo done, that the emergent ray fhould be parallel to the incident one, it would ever after be white; and, converfely, if it fhould come out inclined to the incident, it would diverge, and ever after be coloured. From which it was natural to infer, that all fpherical object-glaffes of telefcopes muft be equally affected by the different refrangibility of light, in proportion to their apertures, whatever material they may be formed of.

But it feems worthy of confideration, that notwithftanding this notion has been generally adopted as an inconteftable truth, yet it does not feem to have been hitherto fo confirmed by evident experiment, as the nature of fo important a matter juftly demands; and this it was that determined me to attempt putting the thing to iffue by the following experiment.

I cemented together two plates of parallel glafs at their edges, fo as to form a prifmatic or wedge-like veffel, when ftopped at the ends or bafes; and its edge being turned downwards, I placed therein a glafs prifm with one of its edges upwards, and filled up the vacancy with clear water: thus the refraction of the prifm was contrived to be contrary to that of the water, fo that a ray of light tranfmitted thro' both thefe refracting mediums would be refracted by the difference only between the two refractions. Wherefore, as I found the water to refract more or lefs than the glafs prifm, I diminifhed

or

or increafed the angle between the glafs plates, till I found the two contrary refractions to be equal; which I difcovered by viewing an object thro' this double prifm; which, when it appeared neither raifed nor depreffed, I was fatisfied, that the refractions were equal, and that the emergent rays were parallel to the incident.

Now, according to the prevailing opinion, the object fhould have appeared thro' this double prifm quite of its natural colour; for if the difference of refrangibility had been equal in the two equal refractions, they would have rectified each other: but the experiment fully proved the fallacy of this received opinion, by fhewing the divergency of the light by the prifm to be almoft double of that by the water; for the object, tho' not at all refracted, was yet as much infected with prifmatic colours, as if it had been feen thro' a glafs wedge only, whofe refracting angle was near 30 degrees.

N. B. This experiment will be readily perceived to be the fame as that which Sir Ifaac Newton mentions *; but how it comes to differ fo very remarkably in the refult, I fhall not take upon me to account for; but will only add, that I ufed all poffible precaution and care in the procefs, and that I keep the apparatus by me to evince the truth of what I write, whenever I may be properly required fo to do.

I plainly faw then, that if the refracting angle of the water-veffel could have admitted of a fufficient

* Book I. Part ii. Prop. 3. Experiment 8. of his Optics.

increafe

increaſe, the divergency of the coloured rays would have been greatly diminiſhed, or intirely rectified; and there would have been a very great refraction without colour, as now I had a great diſcolouring without refraction: but the inconveniency of ſo large an angle, as that of the veſſel muſt have been, to bring the light to an equal divergency with that of the glaſs priſm, whoſe angle was about 60 degrees, made it neceſſary to try ſome experiments of the ſame kind, by ſmaller angles.

I ground a wedge of common plate glaſs to an angle of ſomewhat leſs than 9 degrees, which refracted the mean rays about 5 degrees. I then made a wedge-like veſſel, as in the former experiment, and filling it with water, managed it ſo, that it refracted equally with the glaſs wedge; or, in other words, the difference of their refractions was nothing, and objects viewed thro' them appeared neither raiſed nor depreſſed. This was done with an intent to obſerve the ſame thing over again in theſe ſmall angles, which I had ſeen in the priſm: and it appeared indeed the ſame in proportion, or as near as I could judge; for notwithſtanding the refractions were here alſo equal, yet the divergency of the colours by the glaſs was vaſtly greater than that by the water; for objects ſeen by theſe two refractions were very much diſcoloured. Now this was a demonſtration, that the divergency of the light, by the different refrangibility, was far from being equal in theſe two refractions. I alſo ſaw, from the poſition of the colours, that the exceſs of divergency was in the glaſs; ſo that I increaſed the angle of the water-wedge, by different trials, till the divergency of the light

light by the water was equal to that by the glaſs; that is, till the object, tho' conſiderably refracted, by the exceſs of the refraction of the water, appeared nevertheleſs quite free from any colours proceeding from the different refrangibility of light; and, as near as I could then meaſure, the refraction by the water was about $\frac{5}{4}$ of that by the glaſs. Indeed I was not very exact in taking the meaſures, becauſe my buſineſs was not at that time about the proportions, ſo much as to ſhew, that the divergency of the colours, by different ſubſtances, was by no means in proportion to the refractions; and that there was a poſſibility of refraction without any divergency of the light at all.

Having, about the beginning of the year 1757, tried theſe experiments, I ſoon after ſet about grinding teleſcopic object-glaſſes upon the new principles of refractions, which I had gathered from them; which object-glaſſes were compounded of two ſpherical glaſſes with water between them. Theſe glaſſes I had the ſatisfaction to find, as I had expected, free from the errors ariſing from the different refrangibility of light: for the refractions, by which the rays were brought to a focus, were every-where the differences between two contrary refractions, in the ſame manner, and in the ſame proportions, as in the experiment with the wedges.

However, the images formed at the foci of theſe object-glaſſes were ſtill very far from being ſo diſtinct as might have been expected from the removal of ſo great a diſturbance; and yet it was not very difficult to gueſs at the reaſon, when I conſidered, that the radii of the ſpherical ſurfaces of thoſe glaſſes were

were required to be ſo ſhort, in order to make the refractions in the required proportions, that they muſt produce aberrations, or errors, in the image, as great, or greater, than thoſe from the different refrangibility of light. And therefore, ſeeing no method of getting over that difficulty, I gave up all hopes of ſucceeding in that way.

And yet, as theſe experiments clearly proved, that different ſubſtances diverged the light very differently, in proportion to the refraction; I began to ſuſpect, that ſuch variety might poſſibly be found in different ſorts of glaſs, eſpecially as experience had already ſhewn, that ſome made much better object-glaſſes, in the uſual way, than others: and as no ſatisfactory cauſe had as yet been aſſigned for ſuch difference, there was great reaſon to preſume, that it might be owing to the different divergency of the light by their refractions.

Wherefore, the next buſineſs to be undertaken, was to grind wedges of different kinds of glaſs, and apply them together, ſo that the refractions might be made in contrary directions, in order to diſcover, as in the foregoing experiments, whether the refraction and divergency of the colours would vaniſh together. But a conſiderable time elapſed before I could ſet about that work; for tho' I was determined to try it at my leiſure, for ſatisfying my own curioſity, yet I did not expect to meet with a difference ſufficient to give room for any great improvement of teleſcopes; ſo that it was not till the latter end of the year that I undertook it, when my firſt trials convinced me, that this buſineſs really deſerved my utmoſt attention and application.

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I diſcovered a difference, far beyond my hopes, in the refractive qualities of different kinds of glaſs, with reſpect to their divergency of colours. The yellow or ſtraw-coloured foreign ſort, commonly called Venice glaſs, and the Engliſh crown glaſs, are very near alike in that reſpect, tho' in general the crown glaſs ſeems to diverge the light rather the leaſt of the two. The common plate glaſs made in England diverges more; and the white cryſtal or flint Engliſh glaſs, as it is called, moſt of all.

It was not now my buſineſs to examine into the particular qualities of every kind of glaſs that I could come at, much leſs to amuſe myſelf with conjectures about the cauſe, but to fix upon ſuch two ſorts as their difference was the greateſt; which I ſoon found to be the crown, and the white flint or cryſtal. I therefore ground a wedge of white flint of about 25 degrees, and another of crown of about 29 degrees, which refracted nearly alike; but their divergency of the colours was very different. I then ground ſeveral others of crown to different angles, till I got one, which was equal, with reſpect to the divergency of the light, to that in the white flint: for when they were put together, ſo as to refract in contrary directions, the refracted light was intirely free from colour. Then meaſuring the refractions of each wedge, I found that of the white glaſs to be to that of the crown nearly as 2 to 3; and this proportion would hold very nearly in all ſmall angles. Wherefore any two wedges made in this proportion, and applied together, ſo as to refract in a contrary direction, would refract the light without any difference of refrangibility.

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To make therefore two ſpherical glaſſes, that ſhall refract the light in contrary directions, it is eaſy to underſtand, that one muſt be concave, and the other convex; and as the rays are to converge to a real focus, the exceſs of refraction muſt evidently be in the convex; and as the convex is to refract moſt, it appears from the experiment, that it muſt be made with crown-glaſs, and the concave with white flint glaſs.

And further, as the refractions of ſpherical glaſſes are in an inverſe ratio of their focal diſtances; it follows, that the focal diſtances of the two glaſſes ſhould be inverſely as the ratio's of the fractions of the wedges: for being thus proportioned, every ray of light, that paſſes thro' this combined glaſs, at whatever diſtance it may paſs from its axe, will conſtantly be refracted, by the difference between two contrary refractions, in the proportion required; and therefore the different refrangibility of the light will be intirely removed.

Having thus got rid of the principal cauſe of the imperfection of refracting telelefcopes, there ſeemed to be nothing more to do, but to go to work upon this principle: but I had not made many attempts, before I found, that the removal of one impediment had introduced another equally detrimental (the ſame as I had before found in two glaſſes with water between them): for the two glaſſes, that were to be combined together, were the ſegments of very deep ſpheres; and therefore the aberrations from the ſpherical ſurfaces became very conſiderable, and greatly diſturbed the diſtinctneſs of the image. Tho' this appeared at firſt a very great difficulty, yet I was

not

not long without hopes of a remedy: for consider-ing, the surfaces of spherical glasses admit of great variations, tho' the focal distance be limited, and that by these variations their aberrations may be made more or less, almost at pleasure; I plainly saw the possibility of making the aberrations of any two glasses equal; and as in this case the refractions of the two glasses were contrary to each other, their aberrations, being equal, would intirely vanish.

And thus, at last, I obtained a perfect theory for making object-glasses, to the apertures of which I could scarce conceive any limits: for if the practice could come up to the theory, they must certainly admit of very extensive ones, and of course bear very great magnifying powers.

But the difficulties attending the practice are very considerable. In the first place, the focal distances, as well as the particular surfaces, must be very nicely proportioned to the densities or refracting powers of the glasses; which are very apt to vary in the same sort of glass made at different times. Secondly, the centres of the two glasses must be placed truly on the common axis of the telescope, otherwise the desired effect will be in a great measure destroyed. Add to these, that there are four surfaces to be wrought per-fectly spherical; and any person, but moderately practised in optical operations, will allow, that there must be the greatest accuracy throughout the whole work.

Notwithstanding so many difficulties, as I have enumerated, I have, after numerous trials, and a resolute perseverance, brought the matter at last to such an issue, that I can construct refracting tele-

scopes,

ſcopes, with ſuch apertures and magnifying powers, under limited lengths, as, in the opinion of the beſt and undeniable judges, who have experienced them, far exceed any thing that has been hitherto produced, as repreſenting objects with great diſtinctneſs, and in their true colours.

John Dollond.

XCIX. *An Account of ſome extraordinary Effects ariſing from Convulſions; being Part of a Letter to* John Huxham, *M.D. and F.R.S. from* William Watſon, *M.D. F.R.S.*

6 June, 1758.

Read June 15. 1758.

IN the month of January 1757, I was concerned for a young gentlewoman, who, if the number, continuance, and frequency of their returns, be conſidered, ſuffered the moſt violent and ſevere convulſions I ever knew. At ſome times the muſcular ſpaſms were general; at other times ſingle muſcles only, or a number of them, ſubſervient to ſome particular purpoſe in the animal oeconomy, were affected. And ſuch was the peculiarity of this caſe, that after and in proportion as any ſingle muſcle, or any determined number of muſcles, had been in a ſtate of ſpaſm, a paralytic inability ſucceeded to thoſe muſcles, which very much diſordered and impaired, and ſeveral times even for no ſmall continuance prevented the patient

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from performing, ſeveral of her neceſſary functions. When the muſcles, for inſtance, ſubſervient to deglutition had been convulſed, for many hours after the fits had left her, ſhe has not been able to ſwallow a ſingle drop of liquid: ſo that when attempts have been made to cauſe her to drink, unleſs the liquor was immediately thrown back, there was imminent danger of her being ſtrangled. When her eyes have been affected, ſeveral times a compleat *gutta ſerena*, and total blindneſs, has enſued; the patient being able to bear the ſtrong day-light with open eyes, without being ſenſible of its influence, or in the leaſt contracting her widely dilated pupils. After one of theſe fits the blindneſs continued full five days; and I began to be in fear for the return of her ſight.

You, Sir, who are ſo excellently well verſed in the animal oeconomy, are not to be informed, that vocification is performed in the *aſpera arteria*; but that the articulation of ſounds into ſyllables and words is modulated principally by the tongue, and muſcles about the larynx. In the caſe before you, very early in the diſeaſe, the ſpaſms ſeized the muſcles about the larynx: the conſequence of which was, that after they were over, the patient was unable to utter a word. This faculty however ſhe again once recovered; but it continued a very ſhort time, as the fits returned, which again left her deprived of the power of ſpeech. After having loſt her voice a ſecond time, her power of ſpeech did not return, even after ſhe was freed from her convulſions, and her general health reſtored. Fourteen months paſſed, whilſt this patient continued abſolutely ſpeechleſs;

when,

when, after having violently heated herſelf by four hours dancing, on a ſudden her power of ſpeech returned, and it has continued perfectly free ever ſince.

What is ſtill further remarkable in this caſe is, that during the whole time of this patient's continuing ſpeechleſs, her life was rendered yet more uncomfortable by her having, from the injury to her brain by the ſpaſms, forgot how to write, ſo as to expreſs her meaning that way: but upon the recovery of her ſpeech, this faculty likewiſe returned, which ſhe has retained ever ſince. During the ſeverity of this diſeaſe, which continued ſeveral weeks, almoſt every day of which, from the number and violence of the convulſions, I feared would be the patient's laſt, nothing was left unattempted, which I imagined could tend to prevent the return of the ſpaſms, or leſſen their effects. My endeavours ſo far happily ſucceeded, that her fits did not return; but the conſequences of them continued, more particularly her inability to ſpeak. After ſome months however, when ſhe was recruited in her ſtrength, I was deſirous of trying the effects of electricity, more particularly applied about her throat. This was accordingly attempted; but ſuch was the ſtate of her nerves, and their ſenſibility to its effects, that electrizing brought back the fits, which again affected her ſight: ſo that I was compelled to deſiſt, leſt, in endeavouring to reſtore her ſpeech, I might not only fail in this attempt, but might bring poſſibly on a permanent blindneſs. I determined therefore to truſt the whole to time, which has happily removed all her complaints.

C. *An Account of an extraordinary Storm of Hail in* Virginia. *By* Francis Fauquier, *Esq; Lieutenant Governor of* Virginia, *and F. R. S. Communicated by* William Fauquier, *Esq; F. R. S.*

To the Rev. Tho. Birch, *D. D. Secret. R. S.*

SIR,

Read Nov. 9, 1758. IN a letter I received from my brother, the lieutenant governor of Virginia, he gives an account of a very remarkable ſtorm of hail; which, if you think it worth communicating to the Society, is very much at their ſervice.

It happened on Sunday the 9th of July, about four o' clock in the afternoon, and was preceded by ſome thunder and lightning. It was a ſmall cloud, that did not ſeem to threaten much before its breaking, and did not extend a full mile in breadth. It paſſed over the middle of the town of Williamſburgh, and the ſkirts of the town had but little of it. Its courſe was from N. by W. to S. by E. The hail-ſtones, or rather pieces of ice, were moſt of them of an oblong ſquare form; many of them an inch and half long, and about three fourths of an inch wide and deep; and from one ſide of moſt of them there proceeded ſharp ſpikes, protuberant at leaſt half an inch. He ſays he cooled his wine, and froze cream, with ſome of them the next day; and they were not totally diſſolved when he went to bed on Monday

Monday night. This storm broke every pane of glass on the north side his house, and destroyed all his garden things intirely.

He mentions likewise the heats to have been rather more than usual in that country this summer; and particularly on the 9th of August his thermometer (which is hung on the outside of his house on the north aspect) was at 97, by Fahrenheit's graduation, and some other days as high as 94 or 95. I am,

SIR,

Your most obedient humble Servant,

Jermyn-street,
18 October, 1758.

Wm. Fauquier.

CI. *An Account of an extraordinary Case of a diseased Eye: In a Letter to* Matthew Maty, *M. D. F. R. S. By* Daniel Peter Layard, *M. D. F. R. S.*

Dear Sir, Huntingdon, 20th May, 1758.

Read Nov. 9. 1758.

IN October 1755. I communicated to you, and you inserted in the last volume of your *Journal Britannique*, the case of Susannah Earle, of Hemmingford-Grey in this County, who, in consequence of the whooping cough, was afflicted with a protruded eye. The case I now send you, somewhat similar to that young girl's in its first appearance and progress, but by accident attended with a second disease, will perhaps deserve your attention.

tention, and not ſeem unworthy of being preſented to the Royal Society.

John Law, of Fenny-Stanton, alſo in the County of Huntingdon, a ſtrong and robuſt lad, thirteen years and ſix months old, in Eaſter week 1756, beating dung about a cloſe with unuſual force, on a ſudden felt a violent pain in his left eye. The pain increaſed, an inflammation enſued, and the eye grew daily larger. The poor boy's mother followed the directions, which ſhe received, without the leaſt benefit to her child, after having, beſides other expences, been defrauded by a quack of two guineas; a great ſum for a poor cottager!

The widow Law, in her diſtreſs, heard of Suſannah Earl's cure. She went to ſee her; and determined to bring her ſon to Huntingdon, for Mr. Hopkins's aſſiſtance. Accordingly, October the 7th 1756, ſhe came to Mr. Daniel Hopkins, ſurgeon, in this town; and having deſired my opinion, we both examined the eye together.

The left eye was protruded out of its orbit, and hung down over the cheek to the upper lip. The coats were greatly diſcoloured, all the veſſels turgid, the ſight totally loſt, and the humours appeared like fluctuating pus. We ſaw the neceſſity of an immediate extirpation, to ſave the right eye, already greatly inflamed; and having apprized the mother and boy of the ſtate the eye was in, a conſultation was deſired with two ſurgeons of St. Ives. Mr. Dawkes, who was preſent with Mr. Skeeles at Suſannah Earle's operation, being dead ſince that time, Mr. Thomas Skeeles and Mr. Thomas Want very charitably met Mr. Hopkins and me the next day, October the 8th, at the widow Law's cottage.

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The eye appeared to theſe gentlemen as I have related: and upon Mr. Want's preſſing with his finger on the pupil, the globe burſt at the edge of the *Iris*, and diſcharged pus. The extirpation of the eye was unanimouſly agreed upon, and immediately performed.

Mr. Hopkins made a puncture with a lancet cloſe to the external and ſmall canthus of the eye, and then with a pair of crooked ſciſſars took off all the diſtended globe cloſe to the eye-lids. He then cleaned the cavity of the purulent humours, and filled it with ſoft lint, over which he applied bolſters dipped in warm red wine and water, and the *monoculus* bandage to keep on the whole dreſſings. The lad was bled in the arm; nitrous medicines, and anodynes, were preſcribed, and a ſuitable regimen. The fever, and inflammation of the eye, gradually decreaſed; the ſuppuration of the wound in few days was good, the diſtended eye-lids contracted, and a cure was ſoon expected.

But on November the 7th the lad went to open the ſtreet-door, and it being a cold and rainy evening, he quickly felt the bad effects of the cold wind, which drove the rain in upon him. That night the wound became again very painful, the eye-lids puffed up, and next day appeared much inflamed, as were all the contents of the orbit. Fungous excreſcences ſoon followed, and an intermittent fever. An emetic being improper, he was purged with rhubarb, and afterwards took the bark infuſed in red wine. The fever was removed after ſome time; but the contents of the orbit continued increaſing, and the fungous excreſcences became ſo large and ſpongy, as to be of

equal

equal bulk with the diſeaſed eye before extirpation. All topical applications, to contract this fungus, were ineffectual, and the application of cauſtics or eſcharotics was prudently avoided, leſt they ſhould produce a carcinomatous ulcer. The diſcharge was chiefly a purulent ſerum: on which account, ever ſince the beginning of November he was kept upon a dry diet.

In February 1757. the remaining coats of the eye began to appear at the moſt prominent parts of the excreſcence, and ſeemed white like a part of the *conjunctiva*. On touching it with the finger, a diſtinct fluctuation was felt, and an *hydrophthalmia* perfectly diſcovered; but neither the thickneſs of the coats, nor the ſenſibility of the parts, would permit a puncture to be made, till the cyſt, which appeared formed by the diſtenſion of one of the coats of the eye, was freer from the fungus.

The cyſt continued daily to extend itſelf, and to ſeparate the fungous edges; the fluctuation became more manifeſt, and the membranes thinner. At length, on the 15th of June 1757, Mr. Hopkins opened the cyſt with the point of a lancet, and let out a large cup-full of limpid ſerum, without ſmell or taſte. The boy felt very little pain in this operation. The cavity was filled with dry lint, and compreſſes dipt in warm red wine and water were applied over it. All the night following, and ſeveral days after, a great diſcharge of ſerum came away. On the 19th the fungus was conſiderably leſſened. Mr. Hopkins then dreſſed the wound with warm *unguentum é gummi elemi*, and waſhed the fungus with a lotion of *aquarum calcis, roſarum, et tinc-*

turæ myrrhæ. On the 23d, upon his removing the dreſſings, he ſaw the cyſt looſe and collapſed; which he extracted with his forceps, without the leaſt difficulty, or pain to his patient. The fungus daily waſted afterwards, the wound digeſted well, and the lad was intirely cured on the 7th of Auguſt.

His right eye is perfectly ſtrong, and he has been free from complaint ever ſince. The remainder of the coats of the eye, and of the muſcles, bear up the eye-lids, that when uncovered he only ſeems to have cloſed the left eye: however, he has wore all the winter a back patch over it, to guard againſt freſh cold.

The cyſt, when firſt taken away, meaſured three inches and half in length, one inch and half in diameter, and contained a large cup-full of water. It appeared to be the *tunica ſclerotica*, was of a clear pellucid white, and of ſo delicate a texture, as ſcarce to admit of being touched without tearing; and when dried with all poſſible care, became ſo brittle, that Mr. Hopkins could hardly preſerve it in the manner I now ſend it.

REMARKS.

In both Suſannah Earle and John Law's caſes, the eye was diſtended by the accumulation of the aqueous humour, ſeparated in great quantity by the repeated ſtraining of the blood-veſſels in the whooping cough, which might gradually relax and enlarge the aqueous ducts of Suſannah Earle's eye; and poſſibly by the rupture of thoſe ducts, and of ſome blood-veſſels, at the time John Law exerted himſelf violently in beat-

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ing dung about the clofe: for in either cafe the *impetus* of the blood muft have been fo violent, as to produce thofe effects. However, from the *hydrophthalmia* fucceeding the operation on John Law, the fungous excrefcence, and continual ferous difcharge during feveral months from the wound, it plainly appears, that an abundance of aqueous humour was difcharged at firft by the diftenfion or laceration of the aqueous ducts, and latterly for want of a contraction of thofe veffels, and of the lymphatics, which were no longer of ufe.

Both thefe cafes fhew the neceffity of inquiring particularly into the caufes of difeafes of the eyes, as well as of other parts of the body; for by barely attending to the fymptoms, the difeafe will not be removed, tho' the fymptoms be alleviated. Bleeding, and moderate evacuations, would certainly have, at firft, decreafed the tenfion and pain, and affuaged the inflammation; but both topical applications, and internal medicines, were properly to be adapted, and a fuitable diet regulated.

Not to mention the abfurd and impertinent abufe of empirics, what benefit could accrue, in both thefe cafes, from unctuous, laxative, or emollient applications, from draftic and mercurial purges? Tho' fuch applications might be well intended, to take off the tenfion and inflammation; yet, as the diftenfion of the blood-veffels only increafed gradually, as the globe of the eye was enlarged; fo whatever application relaxed the coats of the eye, muft infallibly ftretch out the veffels yet farther, and caufe a greater pain and inflammation; which draftic and mercurial purges would alfo increafe.

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The only method then to be purſued in ſuch bad caſes would be at firſt to endeavour to remove the fullneſs of the blood, and make uſe of ſuch topical remedies as would contract without irritation. If the cauſe remains, as the whooping cough in Suſannah Earle's caſe, no amendment of the eye can be expected, while the patient's blood-veſſels are continually ſtrained by frequent coughing. This illneſs therefore ſhould be attended to, and removed as ſoon as poſſible.

But ſhould the eye be ſo enlarged, as to protrude itſelf out of the orbit, there ſeems no other way to leſſen the bulk of the eye, than by making a puncture with a proper inſtrument, to let out the aqueous humour; and then apply ſuch agglutinant and contracting *collyria*, as may reduce the diſtended coats and veſſels to their former ſize. This operation ſhould be performed before the humours are vitiated, the ſight loſt, the veſſels in a ſtate of ſuppuration, and the coats of the eye too far extended; for at that time nothing leſs than extirpation can be of uſe.

Profeſſor Nuck, in his *Tractatus de Ductibus Oculorum Aquoſis*, p. 120, *& ſeq.* relates the ſucceſs he had in curing a young man by five repeated punctures, and a ſtrict obſervance in a proper uſe of all the non-naturals.

I am, with the greateſt regard and eſteem,

Dear Sir,

Your moſt affectionate Brother,

and very humble Servant,

D. P. Layard.

CII. *An Account of the Heat of the Weather in* Georgia: *In a Letter from his Excellency* Henry Ellis, *Esq; Governor of* Georgia, *and F. R. S. to* John Ellis, *Esq; F. R. S.*

Dear Sir, Georgia, 17 July, 1758.

Read Nov. 16, 1758.

THO' ſome weeks have paſſed ſince I wrote to you, yet ſo little alteration has happened in the ſtate of our affairs, that nothing occurs to me relative to them worth committing to paper. This indeed I need not regret, as one cannot ſit down to any thing, that requires much application, but with extreme reluctance; for ſuch is the debilitating quality of our violent heats at this ſeaſon, that an inexpreſſible languor enervates every faculty, and renders even the thought of exerciſing them painful.

'Tis now about three o' clock; the ſun bears nearly S. W. and I am writing in a piazza, open at each end, on the north-eaſt ſide of my houſe, perfectly in the ſhade: a ſmall breeze at S. E. blows freely thro' it; no buildings are nearer, to reflect the heat, than 60 yards: yet in a thermometer hanging by me, made by Mr. Bird, and compared by the late Mr. George Graham with an approved one of his own, the mercury ſtands at 102. Twice it has riſen this ſummer to the ſame height; *viz.* on the 28th of June, and the 11th of July. Several times it has been at 100, and for many days ſucceſſively at 98; and

and did not in the nights ſink below 89. I think it highly probable, that the inhabitants of this town breathe a hotter air than any other people on the face of the earth. The greateſt heat we had laſt year was but 92, and that but once: from 84 to 90 were the uſual variations; but this is reckoned an extraordinary hot ſummer. The weather-wiſe of this country ſay it forebodes a hurricane; for it has always been remarked, that theſe tempeſts have been preceded by continual and uncommon heats. I muſt acquaint you, however, that the heats we are ſubject to here are more intenſe than in any other parts of the province, the town of Savannah being ſituated upon a ſandy eminence, and ſheltered all round with high woods. But it is very ſufficient, that the people actually breathe ſo hot an air as I deſcribe; and no leſs remarkable, that this very ſpot, from its height and dryneſs, is reckoned equally healthy with any other in the province.

I have frequently walked an hundred yards under an umbrella, with a thermometer ſuſpended from it by a thread to the height of my noſtrils, when the mercury has roſe to 105; which is prodigious. At the ſame time I have confined this inſtrument cloſe to the hotteſt part of my body, and have been aſtoniſhed to obſerve, that it has ſubſided ſeveral degrees. Indeed, I never could raiſe the mercury above 97 with the heat of my body.

You know, dear Sir, that I have traverſed a great part of this globe, not without giving ſome attention to the peculiarities of each climate; and I can fairly pronounce, that I never felt ſuch heats any-where as in Georgia. I know experiments on this ſubject are

 extremely

extremely liable to error; but I preſume I cannot now be miſtaken, either in the goodneſs of the inſtrument, or in the fairneſs of the trials, which I have repeatedly made with it. This ſame thermometer I have had thrice in the equatorial parts of Africa; as often at Jamaica, and the Weſt India iſlands; and, upon examination of my journals, I do not find, that the quickſilver ever roſe in thoſe parts above the 87th degree, and to that but ſeldom: its general ſtation was between the 79th and 86th degree; and yet I think I have felt thoſe degrees, with a moiſt air, more diſagreeable than what I now feel.

In my relation of the late expedition to the north-weſt, if I recollect right, I have obſerved, that all the changes and variety of weather, that happen in the temperate zone throughout the year, may be experienced at the Hudſon's Bay ſettlements in 24 hours. But I may now extend this obſervation; for in my cellar the thermometer ſtands at 81, in the next ſtory at 102, and in the upper one at 105; and yet theſe heats, violent as they are, would be tolerable, but for the ſudden changes that ſucceed them. On the 10th of December laſt the mercury was at 86; on the 11th it was ſo low as 38 of the ſame inſtrument. What havock muſt this make with an European conſtitution? Nevertheleſs, but few people die here out of the ordinary courſe; tho' indeed one can ſcarce call it living, merely to breathe, and trail about a vigorleſs body; yet ſuch is generally our condition from the middle of June to the middle of September. Dear Sir,

Yours moſt affectionately,

Henry Ellis.

CIII.

CIII. *The Invention of a General Method for determining the Sum of every 2d, 3d, 4th, or 5th, &c. Term of a Series, taken in order; the Sum of the whole Series being known. By* Thomas Simpſon, *F. R. S.*

Read Nov. 16, 1758.

AS the doctrine of Series' is of very great uſe in the higher branches of the mathematics, and their application to nature, every attempt tending to extend that doctrine may juſtly merit ſome degree of regard. The ſubject of the paper, which I have now the honour to lay before the Society, will be found an improvement of ſome conſequence in that part of ſcience. And how far the buſineſs of finding fluents may, in ſome caſes, be facilitated thereby, will appear from the examples ſubjoined, in illuſtration of the general method here delivered.

The ſeries propounded, whoſe ſum (S) is ſuppoſed to be given (either in algebraic terms, or by the meaſures of angles and ratio's, *&c.*) I ſhall here repreſent by $a + bx + cx^2 + dx^3 + ex^4$, &c. and ſhall firſt give the ſolution of that caſe, where every third term is required to be taken, or where the ſeries to be ſummed is $a + dx^3 + gx^6 + kx^6$, &c. By means whereof, the general method of proceeding, and the reſolution of every other caſe, will appear evident.

Here, then, every *third* term being required to be taken, let the ſeries $(a + dx^3 + gx^6$, &c.), whoſe value

value is fought, be conceived to be compofed of *three* others.

$$\tfrac{1}{3}\times\overline{a+b\times\overline{px}+c\times\overline{px}|^2+d\times\overline{px}|^3+e\times\overline{px}|^4}, \text{\&c.}$$

$$\tfrac{1}{3}\times\overline{a+b\times\overline{qx}+c\times\overline{qx}|^2+d\times\overline{qx}|^3+e\times\overline{qx}|^4}, \text{\&c.}$$

$$\tfrac{1}{3}\times\overline{a+b\times\overline{rx}+c\times\overline{rx}|^2+d\times\overline{rx}|^3+e\times\overline{rx}|^4}, \text{\&c.}$$

having all the *fame form*, and the *fame coefficients* with the feries firft propofed, and wherein the converging quantities px, qx, rx, are alfo in a determinate (tho' yet unknown) ratio to the original converging quantity x. Now, in order to determine the quantities of thefe ratios, or the values of p, q, and r, let the terms containing the fame powers of x, in the two equal values, be equated in the common way:

So fhall,

$$\tfrac{1}{3}b\times px+\tfrac{1}{3}b\times qx+\tfrac{1}{3}b\times rx=0$$
$$\tfrac{1}{3}c\times p^2x^2+\tfrac{1}{3}c\times q^2x^2+\tfrac{1}{3}c\times r^2x^2=0$$
$$\tfrac{1}{3}d\times p^3x^3+\tfrac{1}{3}d\times q^3x^3+\tfrac{1}{3}d\times r^3x^3=dx^3$$
$$\tfrac{1}{3}e\times p^4x^4+\tfrac{1}{3}e\times q^4x^4+\tfrac{1}{3}e\times r^4x^4=0$$

&c.

And confequently,

$$p+q+r=0$$
$$p^2+q^2+r^2=0$$
$$p^3+q^3+r^3=3$$
$$p^4+q^4+r^4=0, \text{ \&c.}$$

Make, now, $p^3=1$, $q^3=1$, and $r^3=1$; that is, let p, q, and r, be the three roots of the cubic equation $z^3=1$, or $z^3-1=0$: then, feeing both the fecond and third terms of this equation are wanting, not

not only the ſum of all the roots $(p+q+r)$ but the ſum of all their ſquares $(p^2+q^2+r^2)$ will vaniſh, or be equal to nothing (by common algebra), as they ought, to fulfil the conditions of the two firſt equations. Moreover, ſince $p^3=1$, $q^3=1$, and $r^3=1$, it is alſo evident, that $p^4+q^4+r^4$ $(=p+q+r)=0$, $p^5+q^5+r^5$ $(=p^2+q^2+r^2)=0$, $p^6+q^6+r^6$ $(=p^3+q^3+r^3)=3$. Which equations being, in effect, nothing more than the firſt three repeated, the values of p, q, r, above aſſigned, equally fulfil the conditions of theſe alſo: ſo that the ſeries ariſing from the addition of three aſſumed ones will agree, in every term, with *that* whoſe ſum is required: but thoſe ſeries' (whereof the quantity in queſtion is compoſed) having all of them the *ſame form* and the *ſame cofficients* with the original ſeries $a+bx+cx^2+dx^3$, &c. $(=S)$, their ſums will therefore be truly obtained, by ſubſtituting px, qx, and rx, ſucceſſively, for x, in the given value of S. And, by the very ſame reaſoning, and the proceſs above laid down, it is evident, that, if every n^{th} term (inſtead of every third term) of the given ſeries be taken, the values of p, q, r, s, &c. will then be the roots of the equation $z^n-1=0$*; and that, the

* If α, β, γ, δ, &c. be ſuppoſed to repreſent the co-ſines of the angles $\frac{360^\circ}{n}$, $2\times\frac{360^\circ}{n}$, $3\times\frac{360^\circ}{n}$, &c. (the radius being unity); then the roots of the equation $z^n-1=0$ (expreſſing the ſeveral values of p, q, r, s, &c.) will be truly defined by 1, $\alpha+\sqrt{\alpha\alpha-1}$, $\alpha-\sqrt{\alpha\alpha-1}$, $\beta+\sqrt{\beta\beta-1}$, $\beta-\sqrt{\beta\beta-1}$, &c. The demonſtration of this will be given farther on.

ſum

ſum of all the terms ſo taken, will be truly obtained by ſubſtituting px, qx, rx, sx, &c. ſucceſſively for x, in the given value of S, and then dividing the ſum of all the quantities thence ariſing by the given number n.

The ſame method of ſolution holds equally, when, in taking every n^{th} term of the ſeries, the operation begins at ſome term after the firſt. For all the terms preceding *that* may be tranſpoſed, and the whole equation divided by the power of x in the firſt of the remaining terms; and then the ſum of every n^{th} term (beginning at the firſt) will be found by the preceding directions; which ſum, multiplied by the power of x that before divided, will evidently give the true value required to be determined. Thus, for example, let it be required to find the ſum of every third term of the given ſeries $a + bx + cx^2 + dx^3 + ex^4$, &c. $(= S)$, beginning with cx^2. Then, by tranſpoſing the two firſt terms, and dividing the whole by x^2, we ſhall have $c + dx + ex^2 + fx^3$, &c. $= \frac{S - a - bx}{xx}$ $(= S')$. From whence having found the ſum of every third term of the ſeries $c + dx + ex^2 + fx^3$, &c. beginning at the firſt (c), that ſum, multiplied by x^2, will manifeſtly give the true value ſought in the preſent caſe.

And here it may be worth while to obſerve, that all the terms preceding *that* at which the operation (in any caſe) begins, may (provided they exceed not in number the given interval n) be intirely diſ-

regarded,

regarded, as having no effect at all in the refult. For if in that part $\left(\frac{-a-bx}{xx}\right)$ of the value of S', above exhibited, in which the firft terms, a and bx, enter, there be fubftituted px, qx, rx, fucceffively, for x (according to the *prefcript)* the fum of the quantities thence arifing will be

$$-\frac{a}{p^2x^2}-\frac{a}{q^2x^2}-\frac{a}{r^2x^2}$$
$$-\frac{b}{px}-\frac{b}{qx}-\frac{b}{rx}$$

which, becaufe $p^3=1$, $q^3=1$, &c. (or $p^2=\frac{1}{p}$, $q^2=\frac{1}{q}$, &c.) may be expreffed thus;

$$-\frac{a}{xx}\times\overline{p+q+r}$$
$$-\frac{b}{x}\times\overline{p^2+q^2+r^2}$$

But, that $p+q+r=0$, and $p^2+q^2+r^2=0$, hath been already fhewn; whence the truth of the general obfervation is manifeft. Hence it alfo appears, that the method of folution above delivered, is not only general, but includes this fingular beauty and advantage, that in all feries' whatever, whereof the terms are to be taken according to the fame affigned order, the quantities (p, q, r, &c.), whereby the refolution is performed, will remain invariably the fame. The greater part of thefe quantities are indeed *imaginary* ones; and fo likewife will the quantities be that refult from them, when fubftitution is made in the given expreffion for the value of S. But by adding, as is ufual in like cafes, every two correfponding values,

lues, ſo reſulting together, all marks of *impoſſibility* will diſappear.

If, in the ſeries to be ſummed, the alternate terms (*viz.* the 2d, 4th, 6th, *&c.*) ſhould be required to be taken under ſigns contrary to what they have in the original ſeries given; the reaſoning and reſult will be no-ways different; only, inſtead of making $p^3 + q^3 + r^3$ (or $p^n + q^n + r^n$, &c.) $= + 3$ (or $+ n$), the ſame quantity muſt, here, be made $= - 3$ (or $- n$). From whence, p^n being $= - 1$, $q^n = - 1$, &c. the values of p, q, r, &c. will, in this caſe, be the roots of the equation $z^n + 1 = 0$.

It may be proper, now, to put down an example, or two, of the uſe and application of the general concluſions above derived. Firſt, then, ſuppoſing the ſeries, whoſe ſum is given, to be $x + \frac{x^2}{2} + \frac{x^3}{3} + \frac{x^4}{4} \ldots\ldots + \frac{x^m}{m} + \frac{x^{m+1}}{m+1} + \frac{x^{m+2}}{m+2} \ldots\ldots + \frac{x^{m+n}}{m+n} + \frac{x^{m+n+1}}{m+n+1} +$, &c. $= -$ H. Log. $\overline{1 - x}$ $(= S)$; let it be required, from hence, to find the ſum of the ſeries $\left(\frac{x^m}{m} + \frac{x^{m+n}}{m+n} + \frac{x^{m+2n}}{m+2n}\right.$ &c.) ariſing by taking every n^{th} term thereof, beginning with that whoſe exponent (m) is any integer leſs than n. Here, the terms preceding $\frac{x^m}{m}$ being tranſpoſed, and the whole equation divided by x^m,

we

we shall have $\frac{1}{m} + \frac{x}{m+1} + \frac{x^2}{m+2} + \frac{x^3}{m+3}$, &c. $= -\frac{1}{x^m} \times$ H. Log. $\overline{1-x} - \frac{x + \frac{1}{2}x^2, \&c.}{x^m}$. In which value, let px, qx, rx, &c. be, successively, substituted for x (according to prescript) neglecting intirely the terms $\frac{x + \frac{1}{2}x^2}{x^m}$, as having no effect at all in the result: from whence we get $-\frac{1}{\overline{px}|^m} \times$ Log. $\overline{1-px} - \frac{1}{\overline{qx}|^m} \times$ Log. $\overline{1-qx} - \frac{1}{\overline{rx}|^m} \times$ Log. $\overline{1-rx}$, &c. Which multiplied by x^m (the quantity that before divided) gives $-\frac{1}{p^m} \times$ Log. $\overline{1-px} - \frac{1}{q^m} \times$ Log. $\overline{1-qx} - \frac{1}{r^m} \times$ Log. $\overline{1-rx}$, &c. $=$ n times the quantity required to be determined.

But now, to get rid of the imaginary quantities q, r, &c. by means of their known values $\alpha + \sqrt{\alpha\alpha - 1}$, $\alpha - \sqrt{\alpha\alpha - 1}$, &c. it will be necessary to observe, that, as the product of any two corresponding ones ($\overline{\alpha + \sqrt{\alpha\alpha - 1}} \times \overline{\alpha - \sqrt{\alpha\alpha - 1}}$) is equal to unity, we may therefore write $\overline{\alpha - \sqrt{\alpha\alpha - 1}}|^m$ $(= r^m)$ instead of its equal $\frac{1}{q^m}$, and $\overline{\alpha + \sqrt{\alpha\alpha - 1}}|^m$ $(= q^m)$ instead of its equal $\frac{1}{r^m}$: by which means the two

terms,

terms, wherein these two quantities enter, will stand thus; $-\overline{\alpha - \sqrt{\alpha\alpha - 1}}|^{n} \times \text{Log.}\ \overline{1 - qx} - \overline{\alpha + \sqrt{\alpha\alpha - 1}}|^{m} \times \text{Log.}\ \overline{1 - rx}$.

But, if A be assumed to express the co-sine of an arch (Q), m times as great as that $\left(\frac{360^\circ}{n}\right)$ whose co-sine is here denoted by α; then will $A - \sqrt{AA - 1} =$ * $\overline{\alpha - \sqrt{\alpha\alpha - 1}}|^{m}$, and $A + \sqrt{AA - 1} =$

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* Because $\frac{-\dot{x}}{\sqrt{1 - xx}}$ and $\frac{-\dot{X}}{\sqrt{1 - XX}}$ are known to express the fluxions of the circular arcs whose co-sines are x and X, it is evident, if those arcs be supposed in any constant ratio of 1 to n, that $\frac{n\dot{x}}{\sqrt{1 - xx}} = \frac{\dot{X}}{\sqrt{1 - XX}}$, and consequently that $\frac{n\dot{x}}{\sqrt{xx - 1}}$ $\left(= \frac{n\dot{x}}{\sqrt{-1} \times \sqrt{1 - xx}} = \frac{\dot{X}}{\sqrt{-1} \times \sqrt{1 - XX}}\right) = \frac{\dot{X}}{\sqrt{XX - 1}}$. From whence, by taking the fluents, $n \times \text{Log.}\ \overline{x + \sqrt{xx - 1}}$ (or Log. $\overline{x + \sqrt{xx - 1}}|^{n}$) $= \text{Log.}\ X + \sqrt{XX - 1}$; and consequently $\overline{x + \sqrt{xx - 1}}|^{n} = X + \sqrt{XX - 1}$: whence also, seeing $x - \sqrt{xx - 1}$ is the reciprocal of $x + \sqrt{xx - 1}$, and $X - \sqrt{XX - 1}$ of $X + \sqrt{XX - 1}$, it is likewise evident, that $\overline{x - \sqrt{xx - 1}}|^{n} = X - \sqrt{XX - 1}$. Hence, not only the truth of the above assumption, but what has been advanced in relation to the roots of the equation $z^n - 1 = 0$, will appear manifest. For if $x \pm \sqrt{xx - 1}$ be put $= z$, then will z^n ($= \overline{x \pm \sqrt{xx - 1}}|^{n}$) $= X \pm \sqrt{XX - 1}$: where, assuming $X = 1 =$ co-s. $0 =$ co-s. $360^\circ =$ co-s. $2 \times 360^\circ =$ co-s. $3 \times 360^\circ$, &c. the equation will become $z^n = 1$, or $z^n - 1 = 0$; and the different values of x, in the expression ($x \pm \sqrt{xx - 1}$) for the root z, will consequently be the co-sines of the arcs, $\frac{0}{n}$, $\frac{360^\circ}{n}$, $\frac{2 \times 360^\circ}{n}$, &c. these arcs being

the

$\overline{\alpha + \sqrt{\alpha\alpha - 1}}|^m$: which values being fubftituted above, we thence get

$$-A \times \text{log.}\ \overline{1 - qx} + \text{log.}\ \overline{1 - rx}$$
$$+ \sqrt{AA - 1} \times \text{log.}\ \overline{1 - qx} - \text{log.}\ \overline{1 - rx};$$

whereof the former part (which, exclufive of the factor A, I fhall hereafter denote by M) is manifeftly equal to $-A \times \text{log.}\ \overline{1 - qx} \times \overline{1 - rx}$ (by the nature of logarithms) $= -A \times \text{log.}\ \overline{1 - \overline{q + r}.x + qrx^2} = -A \times \text{log.}\ \overline{1 - 2\alpha x + xx}$ (by fubftituting the values of q and r): which is now intirely free from imaginary quantities. But, in order to exterminate them out of the latter part alfo, put $y = \text{log.}\ \overline{1 - qx} - \text{log.}\ \overline{1 - rx}$; then will $\dot{y} = \frac{-q\dot{x}}{1 - qx} + \frac{r\dot{x}}{1 - rx} = -\frac{\overline{q - r} \times \dot{x}}{1 - \overline{q + r} \times x + xx} = -\frac{2\sqrt{\alpha\alpha - 1} \times \dot{x}}{1 - 2\alpha x + xx} = -\frac{2\sqrt{-1} \times \sqrt{1 - \alpha\alpha} \times \dot{x}}{1 - 2\alpha x + xx}$; where $\frac{\sqrt{1 - \alpha\alpha} \times \dot{x}}{1 - 2\alpha x + xx}$ expreffeth the fluxion of a circular arch (N) whofe radius is 1, and fine $= \frac{\sqrt{1 - \alpha\alpha} \times \dot{x}}{1 - 2\alpha x + xx}$; confequently y will be $= -2\sqrt{-1} \times N$: which, multiplied by $\sqrt{AA - 1}$, or its equal $\sqrt{-1} \times \sqrt{1 - AA}$, gives $2\sqrt{1 - AA} \times N$;

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the correfponding *fubmultiples* of thofe above, anfwering to the cofine X ($= 1$). —— In the fame manner, if X be taken $= -1 =$ co-f. $180^\circ =$ co-f. $3 \times 180^\circ =$ co-f. $5 \times 180^\circ$, &c. then will $z^n = -1$, or $z^n + 1 = 0$; and the values of x will, in this cafe, be the co-fines of $\frac{180^\circ}{n}$, $3 \times \frac{180^\circ}{n}$, $5 \times \frac{180^\circ}{n}$, &c.

and,

and, this value being added to that of the former part (found above), and the whole being divided by n, we thence obtain $\frac{-AM + 2\sqrt{1-AA} \times N}{n}$, or $\frac{1}{n} \times \overline{-\text{co-f.}\,\mathcal{Q} \times M + \text{fin.}\,\mathcal{Q} \times 2N}$ for that part of the value fought depending on the two terms affected with q and r. From whence the fum of any other two correfponding terms will be had, by barely fubftituting one letter, or value, for another: So that,

$$\frac{1}{n} \times \begin{cases} -\log.\,\overline{1-x} \\ -\text{co-f.}\,\mathcal{Q} \times M + \text{fin.}\,\mathcal{Q} \times 2N \\ -\text{co-f.}\,\mathcal{Q}' \times M' + \text{fin.}\,\mathcal{Q}' \times 2N' \\ -\text{co-f.}\,\mathcal{Q}'' \times M'' + \text{fin.}\,\mathcal{Q}'' \times 2N'' \\ -\text{\&c.} \qquad\qquad + \text{\&c.} \end{cases}$$

will truly exprefs the fum of the feries propofed to be determined; M, M', M'' &c. being the hyperbolical logarithms of $1 - 2\alpha x + xx$, $1 - 2\beta x + xx$, $1 - 2\gamma x + xx$, &c. N, N', N'' &c. the arcs whofe fines are $\frac{x\sqrt{1-\alpha\alpha}}{\sqrt{1-2\alpha x+xx}}$, $\frac{x\sqrt{1-\beta\beta}}{\sqrt{1-2\beta x+xx}}$, $\frac{x\sqrt{1-\gamma\gamma}}{\sqrt{1-2\gamma x+xx}}$, &c. and $\mathcal{Q}$, $\mathcal{Q}'$, $\mathcal{Q}''$ &c. the meafures of the angles expreffed by $\frac{360°}{n} \times m$, $2 \times \frac{360}{n} \times m$, $3 \times \frac{360}{n} \times m$, &c. And here it may not be amifs to take notice, that the feries $\frac{x^m}{m} + \frac{x^{m+n}}{m+n} + \frac{x^{m+2n}}{m+2n} +$ &c. thus determined, is that expreffing the fluent of $\frac{x^{m-1}\dot{x}}{1-x^n}$; correfponding to one of the two famous

3 *Cotefian*

Coteſian forms. From whence, and the reaſoning above laid down, the fluent of the other *form*, $\frac{x^{m-1}\dot{x}}{1+x^n}$, may be very readily deduced. For, ſince the ſeries $\left(\frac{x^m}{m} - \frac{x^{m+n}}{m+n} + \frac{x^{m+2n}}{m+2n} - \frac{x^{m+3n}}{m+3n}\right.$ &c.) for this laſt fluent, is that which ariſes by changing the ſigns of the alternate terms of the former; the quantities p, q, r, &c. will here (agreeably to a preceding obſervation) be the roots of the equation $z^n + 1 = 0$; and, conſequently, $\alpha, \beta, \gamma, \delta$, &c. the co-ſines of the arcs $\frac{180°}{n}$, $3 \times \frac{180°}{n}$, $5 \times \frac{180°}{n}$, &c. (as appears by the foregoing note). So that, making Q, Q', Q'', &c. equal, here, to the meaſures of the angles $\frac{180°}{n} \times m$, $3 \times \frac{180°}{n} \times m$, $5 \times \frac{180°}{n} \times m$, &c. the fluent ſought will be expreſſed in the very ſame manner as in the preceding caſe; except that the firſt term, — log. $\overline{1-x}$ (ariſing from the *rational* root $p = 1$) will here have no place.

After the ſame manner, with a ſmall increaſe of trouble, the fluent of $\frac{x^{m-1}\dot{x}}{1 \pm 2lx^n + x^{2n}}$ may be derived, m and n being any integers whatever. But I ſhall now put down one example, wherein the impoſſible quantities become exponents of the powers, in the terms where they are concerned.

The ſeries here given is $1 - x + \frac{x^2}{2} - \frac{x^3}{2.3} + \frac{x^4}{2.3.4} - \frac{x^5}{2.3.4.5}$, &c. = the number whoſe hyp. log. is is $-x$, and it is required to find the ſum of every n^{th} term thereof, beginning at the firſt. Here the quantity ſought will (according to the general rule) be truly defined by the n^{th} part of the ſum of all the numbers whoſe reſpective logarithms are $-px$, $-qx$, $-rx$, &c.; which numbers, if N be taken to denote the number whoſe hyp. log. $= 1$, will be truly expreſſed by N^{-px}, N^{-qx}, N^{-rx}, &c. From whence, by writing for p, q, r, &c. their equals $1, \alpha + \sqrt{\alpha\alpha - 1}, \alpha - \sqrt{\alpha\alpha - 1}, \beta + \sqrt{\beta\beta - 1}, \beta - \sqrt{\beta\beta - 1}$, &c. and putting $\acute{\alpha} = \sqrt{1 - \alpha\alpha}$, $\beta' = \sqrt{1 - \beta\beta}$, &c. we ſhall have $\frac{1}{n} \times \overline{N^{-px} + N^{-qx} + N^{-rx}}$, &c. $= \frac{1}{n}$ into $N^{-x} + N^{-\alpha x} \times \overline{N^{-\acute{\alpha} x\sqrt{-1}} + N^{\acute{\alpha} x\sqrt{-1}}} + N^{-\beta x} \times \overline{N^{-\beta' x\sqrt{-1}} + N^{\beta' x\sqrt{-1}}} +$ &c. But $N^{-\acute{\alpha} x\sqrt{-1}} + N^{\acute{\alpha} x\sqrt{-1}}$ is known to expreſs the double of the co-ſine of the arch whoſe meaſure (to the radius 1) is $\acute{\alpha} x$. Therefore we have $\frac{1}{n}$ into $N^{-x} + N^{-\alpha x} \times 2$ co-ſ. $\acute{\alpha} x +$ $N^{-\beta x} \times 2$ co-ſ. $\beta' x$, &c. for the true ſum, or value propoſed to be determined.

The ſoluion of this caſe, in a manner a little different, I have given ſome time ſince, in another place; where the principles of the general method, here extended and illuſtrated, are pointed out. I ſhall put an end to this paper with obſerving, that if, in the

ſeries

ſeries given, the even powers of x, or any other terms whatever, be wanting, their places muſt be ſupplied with cyphers; which, in order the of numbering off, muſt be reckoned as real terms.

CIV. *Obſervatio Eclipſis Lunæ Die* 30 Julii 1757. *habita Oliſſipone à* Joanne Chevalier, *Congregationis Oratorii Preſbytero, é Regia* Londinenſi *Societate. Communicated by* Jacob de Caſtro Sarmiento, *M.D. F.R.S.*

Tubo optico 8 pedum.

Read Nov. 16. 1758.

	h	′	″
INitium penumbræ ——	9	15	18
Initium dubium eclipſis	9	22	24
Certo jam incœperat —— ——	9	23	34
Umbra ad mare humorum obſervata vitro plano cæruleo —— ——	9	31	2
Solo tubo optico obſervata —— ——	9	31	29
Vitro flavo obſervata —— ——	9	31	48
Umbra tangit Grimaldum obſervata vitro plano cæruleo —— ——	9	31	20
Solo tubo optico —— ——	9	31	50
Vitro plano flavo —— ——	9	32	8
Totus Grimaldus tegitur obſervatus vitro plano cæruleo —— ——	9	34	4
Solo tubo optico —— —— ——	9	34	28
Vitro flavo —— —— ——	9	34	47

	h	′	″
Umbra ad Tychonem obſervata vitro plano cæruleo — — —	9	38	25
Solo tubo optico — — —	9	38	42
Vitro flavo — — —	9	38	59
Umbra ad Harpalum vitro cæruleo obſervata — — —	9	55	6
Solo tubo optico — — —	9	55	35
Umbra ad Fracaſtorium — —	9	59	57
Umbra ad Mare Nectaris —	10	00	50
Obſervata vitro flavo — —	10	1	8
Umbra ad Dionyſium — —	10	5	2
Umbra tangit Mare Tranquillitatis	10	5	50
Umbra ad Mare Serenitatis —	10	10	16
Umbra tegit Menelaum obſervata vitro cæruleo — — —	10	11	4
Solo tubo optico — — —	10	11	29
Vitro flavo — — —	10	11	50
Totum Mare Fœcunditatis tegitur —	10	18	39
Umbra tangit Mare Criſium vitro cæruleo obſervata — —	10	22	52
Solo tubo optico — — —	10	23	12
Vitro flavo — — —	10	23	29
Umbra ad Proclum — —	10	23	33
Poſſidonius totus tegitur — —	10	23	50
Totum Mare Serenitatis tegitur —	10	24	36
Totum Mare Criſium ab umbra tegitur	10	30	27
Plato tegitur vitro cæruleo obſervatus	10	31	26
Solo tubo optico — — —	10	31	48
Vitro flavo — — —	10	32	4
Obſcuratio maxima — —	10	55	40

EMER-

EMERSIONES.

	h	′	″
Plato emergit obſervatus vitro flavo	11	19	5
Solo tubo optico — —	11	19	31
Vitro cæruleo — — —	11	19	50
Ariſtarchus emergit — —	11	21	3
Gaſſendus incepit emergere obſervatus vitro flavo — —	11	25	36
Obſervatus ſolo tubo optico —	11	25	52
Obſervatus vitro cæruleo — —	11	26	11
Gaſſendus totus extra umbram —	11	28	2
Schicardus incipit emergere —	11	45	44
Totus extra umbram — —	11	47	10
Totum Mare Humorum extra umbram	11	46	50
Menelaus extra umbram —	11	55	36
Mare Serenitatis extra umbram —	11	59	46
Tycho extra umbra obſervatus vitro flavo	12	00	33
Solo tubo optico — —	12	00	52
Vitro cæruleo — —	12	1	14
Incipit emergere Mare Criſium —	12	8	31
Totum Mare Criſium extra umbram	12	16	28
Finis eclipſis — — —	12	28	26

Obſervatio hæc peracta é cœlo claro; umbra autem terræ ita diluta erat, ut maculæ in ea conditæ ſatis dignoſcerentur.

CV. *Singular Obſervations upon the* Manchenille Apple. *By* John Andrew Peyſſonnel, *M. D. F. R. S. Tranſlated from the* French.

Read Nov. 16, 1758.

THE cruel effects of the tree called Manchenille are known to all the world: its milk, which the ſavages make uſe of to poiſon their arrows, makes the wounds inflicted with them mortal. The rain, which waſhes the leaves and branches, cauſes bliſters to riſe like boiling oil; even the ſhade of the tree makes thoſe who repoſe under it to ſwell; and its fruit is eſteemed a deadly poiſon. I was informed, as a very extraordinary thing, that a breeding woman was ſo mad as to eat three of them, which did her very little harm; and this was looked upon as a miracle, and a proof of the ſurpriſing effects of the imagination and longings of women with child.

But here is a fact, which will ſcarce be credited by many perſons, who have frequented theſe Iſlands: which I declare to be true.

One Vincent Banchi, of Turin in Piedmont, a ſtrong robuſt man, and an old ſoldier, of about forty-five years of age, belonging to the horſe, was a ſlave with the Turks eleven years, having been taken priſoner at the ſiege of Belgrade. He was overſeer of my habitation towards the month of July of the year 1756. He was one day walking upon the ſea ſide, and ſeeing a great number of apples upon the ground, was charmed with their beautiful colours, and

ſweet

ſweet ſmell, reſembling that of the apple called d'apis: he took and eat of them, without knowing what they were; he found they had a ſubacid taſte; and having eaten a couple of dozen of them, he fill'd his pockets, and came home, eating the reſt as he came. The Negroes, that ſaw him eat this cruel fruit, told him it was mortal; upon which he ceaſed to eat them, and threw away the reſt.

About four in the afternoon, *viz.* an hour after this repaſt, his belly ſwelled conſiderably, and he felt as it were a conſuming fire in his bowels. He could not keep himſelf upright; and at night the ſwelling of his belly increaſed, with the burning ſenſation of his bowels. His lips were ulcerated with the milk of the fruit, and he was ſeized with cold ſweats; but my principal Negro made him a decoction of the leaves of a *Ricinus* * in water, and made him drink plentifully of it, which brought on a vomiting, followed by a violent purging; both which continued for four hours, during which it was thought he would die. At length theſe ſymptoms grew leſs; and my Negroes made him walk, and ſtir about by degrees; and ſoon after they were ſtopped. Rice-gruel, which they gave him, put an end to all theſe diſorders; and in four-and-twenty hours he had no more ailments nor pain; the ſwelling of his belly diminiſhed in proportion to his evacuations upwards and downwards, and he has continued his functions without being any more ſenſible of the poiſon. We ſee by this, that the effects of the poiſon of the Manchinelle are different from thoſe of the fiſh at Guadaloupe, which I mentioned.

Dec. 2. 1756.

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* *Avellana purgatrix*; in French, *medicinier*.

CVI. *Abstract of a Letter from Mr.* William Arderon, *F.R.S. to Mr.* Henry Baker, *F. R. S. on the giving Magnetism and Polarity to Brass. Communicated by Mr.* Baker.

Dear Sir,

Read Nov. 16, 1758.

FOR some time past I have been making experiments on the magnetism of brass, and amongst many pieces that I have tried, find several that readily attract the needle; but whether they have had this property originally, or have received it by hammering, filing, clipping, or any other such-like cause, I cannot yet determine.

I have a very handsome compass-box made of pure brass, as far as I can judge: the needle being taken out, and placed upon a pin fixed properly in a board, and clear of all other magnetics, the box will attract this needle at half an inch distance; and, if suffered to touch, will draw it full 90 degrees from the north or south points; and I think those parts of the box marked north and south attract the strongest. The cover of the box also attracts the needle nearly as much as the box itself.

As to your supposition, that iron may be mixed with the brass, I do not know; but I have been informed it cannot be, as brass fluxes with a much less degree of heat than iron, and iron naturally swims on fluid brass. Besides, many of the specimens of brass I have tried were new as they came from the mill, where they were wrought into plates, and I presume

were

were not mixed *; yet these I have given the magnetic virtue to, when they had it not; and some pieces of brass, which naturally attract the needle, seem to the eye as fine a bright yellow as any other, and are as malleable as any I ever met with.

Pieces of brass without any magnetic power, by properly hammering and giving them the double touch, after Mr. Mitchel's method, I have made attract and repel the needle, as a magnet does, having two regular poles: and I now send you one such piece of brass, which I have thus made magnetical. You will also receive a couple of needles, which I made myself after the late Zachary Williams's method, and a little stand whereon to place them, the better to shew how this magnetic bar attracts and repels the needle when properly applied; for it must be noted, that in making these experiments it is necessary to employ a very good needle, about $3\frac{1}{2}$ inches long, well and tenderly set, and not covered with glass.

You will observe, when you try this bar, that the same poles repel each other, and the contrary poles attract; which proves this piece of brass to be indued with true magnetic virtue and polarity. However it must be noted, that though the same poles repel each other, yet, like natural magnets, in contact, or nearly so, they attract each other; therefore when you would shew the repelling power of this brass bar, you must not bring it nearer the needle than $\frac{2}{10}$ of an inch.

Magnetic brass does not attract iron, not even the least particle, so far as I can find: whether this is

* This refers to Mr. Baker's having supposed, that old iron and old brass may be mixt sometimes, and melted down together.

owing

owing to the weaknefs of magnetifm in the brafs, or to fome other caufe, I don't pretend to know.

I have tried to infufe magnetic virtue into feveral pieces of copper, lead and pewter; but all my endeavours have not been able to make them attract the needle at all. Indeed, when I have held a piece of pewter, that I have tryed to make magnetical, to the needle, the needle would tremble, but not approach the pewter.

I fend you another piece of brafs, whofe either end attracts either of the poles; this I have infufed the magnetic virtue into, and can at any time, fo as to attract and repel the needle; but, like fteel that is fet a low blue, it lofeth that polarity in a few hours; which may arife for its being too fhort for its weight, or from its different temper of hardnefs or foftnefs.

A third piece I alfo fend you, which with all my endeavours I cannot make attract the needle in the leaft; and yet I can perceive no difference between the appearance of this piece and that of thofe which do.

Would fome ingenious man purfue thefe experiments, perhaps we might have needles made of brafs to act as ftrongly as fteel ones do, which would have the advantage of being lefs liable to ruft at fea than fteel ones are.

But my whole defign was to fhew, that brafs is by no means a proper metal to make compafs-boxes of, or to be employed in any inftrument where magnetifm is concerned. For as it is demonftrable, beyond all contradiction, that fome brafs is found endued with a power of attracting the magnetic needle; that other pieces are capable of receiving it either by accident or deſign, (let it be from its being mixed with iron, or any other cauſe whatever) braſs muſt be a very improper metal for compaſs-boxes, as it may occaſion many ſad and fatal accidents.

Norwich, Octob. 20th, 1758.

It is well known, that braſs has been ſometimes found to affect and diſturb the magnetic needle; but, to give magnetiſm and polarity to braſs, has not, that I have yet heard, been before attempted. I therefore have taken the liberty to lay the above account before this Royal Society, and have alſo brought the pieces of braſs mentioned therein, which have been thus made magnetical.

London,
Nov. 15. 1759. H. Baker.

CVII. *An Account of the* Sea Polypus, *by Mr.* Henry Baker, *F. R. S.*

To the Right Honourable the EARL *of* MACCLESFIELD, Preſident *of the* Royal Society.

My Lord,

Read Nov. 23, 1758. I now return the marine animal your Lordſhip did me the honour to recommend to my examination; which I find to be a ſpecies of one kind of the Sea Polypi, mentioned by naturaliſts; but I think not very accurately deſcribed.

The kinds of Sea Polypi are underſtood to be, *First*, The Polypus, particularly so called, the Octopus, Preke, or Pour-contrel: to which kind our subject belongs.

Secondly, The Sepia, or Cuttle-fish.

Thirdly, The Loligo, or Calamary. And each of these has its different species and varieties*. The ancients add the Nautilus; and some sorts of Star-fish might perhaps be not improperly ranged among them.

All of the first kind have eight arms, placed at equal distances round the head; below the arms are two eyes, and the body is short and thick.

The Cuttle-fish, and the Calamary, have each of them ten arms; of which eight are shorter ones, tapering gradually to a point from the head, where they all rise, to their extremities: the other two (frequently called Tentacula) are three or four times as long, perfectly round, slender, and of an equal thickness for above two thirds of their whole length; then spreading into a form nearly like that of the shorter arms. Great numbers of *acetabula*, or suckers, are placed somewhat irregularly on each of the shorter arms, and on the spreading parts of the Tentacula, where some of the suckers are a great deal larger than the rest.

The body of the Cuttle-fish is broad and flat, having within it a broad friable white bone; that of the Calamary is a sort of cartilaginous case holding the intestines, of a roundish oblong shape, furnished with two fins, and having within it a thin transparent elastic substance like Isinglass.

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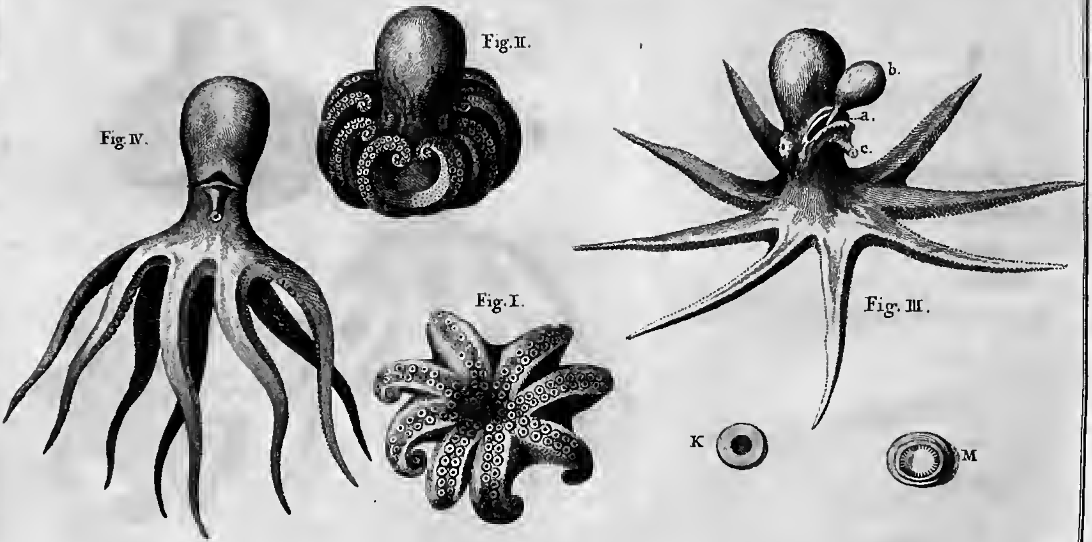
* Vide Wilkins's real Character, p. 131. Bellon. aquat. p. 330.



G. Edwards delin A. 1758

J. Mynde sc.

The mouth of the Pour-contrel, Cuttle-fifh, and Calamary, is placed in the fore-part of the head, between the arms, having an horny beak, hard and hooked like a parrot's, which fome writers call the teeth. The eyes of them all are nearly in the fame pofition.

As the fubject under examination refembles in fome particulars all the above kinds of Polypi, this fhort account of them may, it is hoped, render the following defcription of it the more intelligible: and with the fame view, Mr. George Edwards, Fellow of the Royal Society, has been fo obliging as to make drawings of the animal itfelf, in four different pofitions, and of the natural fize; which drawings are herewith prefented to your Lordfhip.

Our Polypus is of the Pour-contrel kind, and I believe of that fpecies called Bolytæna; which is faid to have a mufky fmell; but if ours had fuch a fmell, the fpirits wherein it lies have taken it quite away.

In the drawing [*See* TAB. XXIX. *Fig.* 1.] is fhewn the anterior part of this animal, which has much the appearance of a Star-fifh. Here are eight arms about three inches in length, united at their roots, and placed circularly at equal diftances in the fame plane, which has a confiderable finking towards the center. Thefe arms diminifh from their rife to their extremities, and end exceedingly fmall. Near the head they are quadrilateral, but the under-fide contracting gradually to an edge, they become towards the ends trilateral. On the upper fide of each arm are two rows of *acetabula*, or fuckers, ftanding in a beautiful order, as clofe as they can well be placed, and beginning from the center of all the arms. Thefe fuckers are perfectly circular, with edges flat on the top, and a round cavity in the middle of each. They are largest in the widest part of the arm, and lessen as the arm diminishes, till they become so small as hardly to be discernable. It is very difficult to tell their number: I counted as far as fifty in a row, but am certain there are many more; and I don't imagine the eight arms have so few as a thousand on them. They rise some height above the surface of the skin; and wherever they are not, the skin of the arms (unless on the under-side) is granulated like shagreen *.

As in the other kinds of Polypi the mouth is placed between the arms conspicuously enough, I expected to find it so in this; but the spirits had contracted it so much, that I could discern no opening at all where I thought the mouth must be; and therefore could not say, with assurance, that the mouth was placed there. Under this difficulty I applied to Sir Hans Sloane's most valuable collection of natural history in the British Musæum, where I found several species of this kind of Polypi, and amongst the rest a small dried specimen of the same species as ours, and a much larger one in spirits, of a species that comes very near it.

This large specimen afforded the information I stood in need of: for though here also the mouth was closed, and the beak drawn down into the center between the arms, so as not to be seen at all; yet, by the help of Dr. Morton and Mr. Empson, I had the satisfaction to see the mouth opened, and the beak in

* Some of the Pour-contrel kind have but one row of suckers on the arms: such an one I have seen, whose arms were thirty inches long.

the

the ſame ſituation, and of the ſame form and ſubſtance, as in the other kinds of Polypi. Having gained this knowledge, by applying the point of a bodkin, I eaſily felt the beak in our Polypus; but in ſo ſmall a ſubject it cannot be brought to view without diſſection, which is the reaſon it does not appear in theſe drawings.

Fig. 2. repreſents the Polypus ſo placed as to ſhew the ſituation of the eyes and the form of its body, and alſo in what manner the arms are turned back in the ſpecimen before us; but we may ſuppoſe them thus diſpoſed merely in the act of dying, and that when alive they are moveable in all directions.

On that ſide of the body oppoſite to the eyes, and which therefore may be termed the belly-part, there appears a tranſverſe ſlit or opening in the ſkin, not in a ſtrait line, but a little ſemicircular; from the anterior part whereof a tube or pipe proceeds, about one third of an inch in length, ſmaller at the extremity, where it opens with a round orifice, than at the baſe, and reaching to within a ſmall diſtance of the arms. As both the Cuttle-fiſh and Calamary have a pipe nearly in the ſame ſituation, though ſomewhat different in figure, through which they occaſionally diſcharge an inky liquor, and ſome writers ſay the fæces alſo, it is probable the pipe in this animal may ſerve to a like purpoſe; and as the body of the Calamary is included in a caſe, the ſlit acroſs the body of this animal ſhews its belly part to have alſo a ſort of caſe, though on its back there is no ſeparation as in the Calamary.

Out of the aforeſaid ſlit or opening a bag iſſues with a very ſlender neck, extending towards the tail, and

and enlarging gradually to its end. This bag is above half the length of the body, and appears like another body appendant thereto. I ſhould be intirely at a loſs concerning this bag, did not ſome paſſages in Mr. Turberville Needham's curious obſervations on the milt veſſels of the Calamary enable me to form ſome conjectures about its uſe.

Having diſſected ſeveral Calamaries on the coaſt of Portugal, without the leaſt indication of milt or roe, and conſequently without knowing which were male or female, he was much ſurpriſed (about the middle of the month of December) to find a new veſſel forming itſelf in an obvious part, and replete with a milky juice. This was an oval bag, in which the milt veſſels formed themſelves gradually, the bag unfolding as theſe framed and diſpoſed themſelves in bundles. Before that time he had obſerved two collateral tubes, which are alike in both ſexes; but a regular progreſs in the expanſion of the milt-bag and formation of the milt-veſſels had not preſented itſelf before. Thoſe tubes till then appeared open at one extremity, much reſembling the female parts of generation in a ſnail, but did not terminate in a long oval bag extending in a parallel with the ſtomach more than half the length of the fiſh, as he found them afterwards when the milt veſſels that filled the whole cavity were ripe for ejection. The ſame ducts without the bag are found in the female alſo, perhaps for the depoſition of the ſpawn. Vid. *Needham*'s *Microſcopical Diſcoveries, cap.* v.

It appears from this account that the male Calamary (at a certain time of the year only) has a bag wherein the milt-veſſels are contained, and that the female

female has no ſuch bag. Since therefore the bag of our Polypus is found in the ſame ſituation as that of the Calamary, (which is alſo a kind of Polypus) we may ſuppoſe it to be the milt bag, and that our Polypus is a male, taken at a time when the milt was ready for ejection. In the dried ſpecimen at the Britiſh Muſeum, and alſo in the other ſpecimens, there is the ſame opening, with the pipe that riſes above it towards the arms, but not the leaſt appearance of the bag in queſtion: they are therefore probably females, or if males, were caught before ſuch bag was formed.

Fig. 3. preſents another view of this Polypus, its arms extended circularly with their under-ſides next the eye, and the body ſo diſpoſed as to ſhew the tranſverſe opening *a*, the oval bag iſſuing therefrom *b*, and the pipe riſing upwards towards the arms *c*.

Fig. 4. ſhews the Polypus with its tranſverſe opening and the pipe riſing therefrom, but without the oval bag; it is figured thus by Rondeletius and Geſner, and the ſpecimen at the Britiſh Muſeum has alſo this appearance. It is here ſhewn with the arms extended forwards. K is a magnified figure of one of the *acetabula*, or ſuckers; of which there are two rows on each arm of this Polypus, as before deſcribed.

Mr. Needham, in his deſcription of the ſuckers of the Calamary, (which he had many opportunities of examining whilſt alive, and whoſe mechaniſm is probably the ſame as in thoſe of our Polypus) informs us, " that the action of the ſuckers depends partly " on their ſhape, which, when they are extended " reſembles nearly that of an acorn-cup, and partly " upon a deep circular cartilaginous ring, armed with " ſmall hooks, which is ſecured in a thin membrane

" ſomething

" ſomething tranſparent, by the projection of a ledge
" inveſting the whole circumference about the middle
" of its depth, and not to be extracted without ſome
" force. That each ſucker is faſtened by a tendi-
" nous ſtem to the arm of the animal: which ſtem,
" together with part of the membrane that is below
" the circumference of the cartilaginous ring, riſes
" into and fills the whole cavity when the animal
" contracts the ſucker for action. In this ſtate
" whatever touches it is firſt held by the minute
" hooks, and then drawn up to a cloſer adheſion by
" the retraction of the ſtem and inferior part of the
" membrane, much in the ſame manner as a ſucker
" of wet leather ſuſtains the weight of a ſmall ſtone."
Vid. *Microſcopical Diſcoveries*, p. 22.

M ſhews one of the cartilaginous rings armed with ſmall hooks, of its real ſize. The ring this is drawn from was taken out of a large ſucker of a larger Polypus, and is preſented herewith.

By theſe ſuckers the Polypus can fix itſelf to rocks, and prevent its being toſſed about in ſtorms and tempeſts; but their principal uſe muſt undoubtedly be to ſeize and hold its prey: and to this purpoſe they are moſt admirably adapted; for when they are all applied and act together, unleſs the Polypus pleaſes to withdraw them, nothing can get from it whoſe ſtrength is inſufficient to tear off its arms. Something like theſe ſuckers is found by the microſcope in the minute freſh water Polype, whereby it is able to bind down and manage a worm much larger and ſeemingly ſtronger than itſelf*. In like manner the

* Of this I gave an account ſome years ago, in my attempt towards a Natural Hiſtory of the Polype, chap. v.

ſtella

ſtella arboreſcens (which may alſo be called a Polypus), though it has not ſuckers, yet by the hooks along its arms, and the multiplicity of their branchings, which have been counted as far as 80,000, it can, by ſpreading its arms abroad like a net, ſo fetter and entangle the prey they incloſe when they are drawn together, as to render it incapable of exerting its ſtrength: for however feeble theſe branches or arms may ſingly be, their power united becomes ſurpriſing. And we are aſſured nature is ſo kind to all theſe animals, that if in their ſtruggles any of their arms are broken off, after ſome time they will grow again; of which a ſpecimen at the Britiſh Muſeum is an undoubted proof; for a little new arm is there ſeen ſprouting forth in the room of a large one that had been loſt.

It is evident from what has been ſaid, that the Sea Polypus muſt be terrible to the inhabitants of the waters, in proportion to its ſize (and Pliny mentions one whoſe arms were thirty feet in length); for the cloſe embraces of its arms and the adheſion of its ſuckers muſt render the efforts of its prey ineffectual either for reſiſtance or eſcape, unleſs it be endued with an extraordinary degree of ſtrength.

Sea Polypi are frequent in the Mediterranean: but Mr. Haviland of Bath, to whom we are obliged for this, which is of a different ſpecies, thinks it came from the Weſt Indies, where it is called a Cat-fiſh. That like it in the Britiſh Muſeum alſo came from thence.

As the Polypus I have endeavoured to deſcribe is much contracted by lying long in ſpirits, and diſſection would deſtroy a ſpecimen well worth preſerving, I hope to be excuſed if this account ſhould be found deficient in ſeveral particulars, or chargeable with ſome miſtakes.

Permit me the honour to be,

My LORD,

Your Lordſhip's

Moſt humble and obedient Servant,

Strand,
Nov. 23d, 1758.

H. Baker.

CVIII. *A Deſcription of the foſſil Skeleton of an Animal found in the Alum Rock near* Whitby. *By Mr.* Wooller. *Communicated by* Charles Morton, *M. D. F. R. S.*

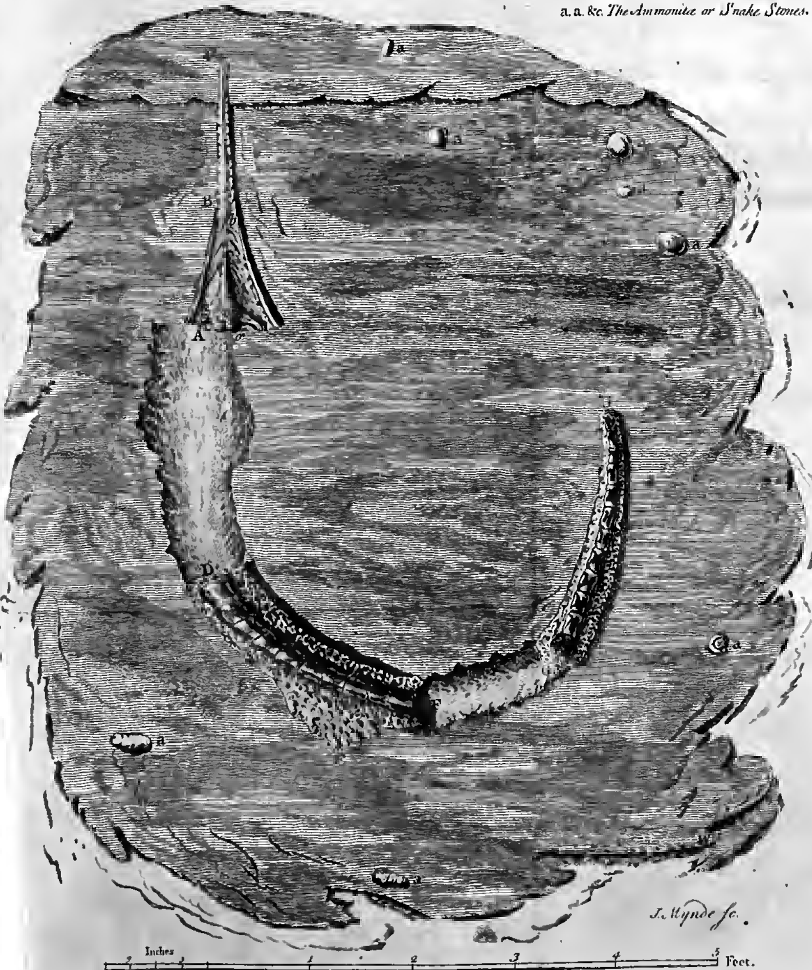
Read Nov. 23. 1758.

IT is in this rock, that the Ammonitæ, or Snake-ſtones, as they are commonly called, are found, which have undoubtedly been formed in the *exuviæ* of fiſhes of that ſhape; and though none of that ſpecies are now to be met with in the ſeas thereabouts, yet they in many particulars reſemble the Nautilus, which is well known. The internal ſubſtance of thoſe ſtones, upon a ſection thereof, appears to be a ſtony concretion, or muddy ſparr. Stones of the ſame matter or ſubſtance, in the ſhape of muſcles, cockles, &c. of various ſizes, are alſo found therein, and now and then pieces of wood hardened and cruſted over with a ſtony ſubſtance are likewiſe found in it.

Many naturaliſts have already obſerved, that among the vaſt variety of extraneous ſubſtances found at ſeveral

Part of the Fossil Skeleton of an Animal as it appeared on and united to the Allom Rock near Whitby, Jan. 3. 1758.

a. a. &c. The Ammonitæ or Snake Stones.



J. Mynde sc.

veral depths in the earth, where it is impoſſible they ſhould have been bred, there are not ſo many productions of the earth as of the ſea; and it appears by the accounts of authors both ancient and modern, that bones, teeth, and ſometimes entire ſkeletons of men and animals, have been dug up or diſcovered in all ages, and the moſt remarkable for ſize commonly the moſt taken notice of. In the firſt particular this ſkeleton will moſt probably appear to have belonged to an animal of the lizard kind, quadruped and amphibious; and as to its ſize, much larger than any thing of that kind ever met with or found in this part of the world; though, from the accounts of travellers, ſomething ſimilar is ſtill to be met with in many of the rivers, lakes, &c. of the other three.

When the annexed drawing thereof was taken January 5, 1758. [*See* TAB. XXX.] there remained no more of the *vertebræ* than is therein expreſſed; that is, 10 between D and F, and 12 between G and H: but when it was firſt diſcovered, about 10 years ago, they were compleat; and there was beſides the appearance of what was then thought to have been fins, near the back part of the head at A, the ſame as appeared further backward at E, when this deſign was made. The *vertebræ*, &c. now wanting having been either dug up by curious perſons, or waſhed away by the violence of the waves at high water, and the accidental beating about of ſtones, ſand, &c. during that time; the water covering this ſkeleton ſeveral feet at high water in ſpring tides; the cavities in the rock ſtill remaining as in the deſign.

The ſubſtance of the bones, with their *perioſtium*, on the covered or under ſide, in moſt parts remains

 intire,

intire, and their native colour in ſome places in a good meaſure preſerved, and the teeth with their ſmooth poliſh plainly to be diſcovered. Part of the mandible near the extremity was covered with a ſhelf of the rock about three inches thick; which being cut away and removed, both the mandibles appeared under it compleat, with the teeth of the upper and under one, plainly locking or paſſing by each other. Theſe appeared to be of the *dentes exerti* or fang kind, as well as all the others in the narrow part of the mandible, and further backwards they were not obſerved. From this ledge or ſhelf the mandible towards B is ſingle, and appears to be the upper one of the living animal; and from the head not being exactly in the line of the body, that part has been inverted, or quite turned over, and the body itſelf, as appears from the tranſverſe proceſſes of the *vertebræ*, lies on the right ſide. There appears one row of teeth only on each ſide of the mandible, and they are about $\frac{3}{4}$ of an inch aſunder.

The mandible B A, the *cranium g h*, and the *vertebræ* from D to F, were attempted to be taken up whole; but the bones being rendered extremely brittle, and the rock in which they were fixed being a brittle blackiſh ſlate, with joints or fiſſures running in every direction, would not hold together: the whole therefore fell in many pieces, the *vertebræ* in the joints only, which makes them eaſy to join together again, and beſides ſhows very plainly the tranſverſe and ſpinal proceſſes thereof, with the foramen in the latter for the ſpinal marrow. It was now that a piece of the *os femoris*, about four inches long, ſhewed itſelf in the ſparry concreted ſubſtance at E, together with

a piece

a piece of the *os innominatum*, to which it had been articulated or joined. This, with what has been before remarked, will ſufficiently prove this to have been an animal of the quadruped, and probably, from the ſhape of the cranium peculiar to fiſhes, of the amphibious kind. At the ſame time many pieces of the *coſtæ* or ribs, as broke and cruſhed up againſt the *vertebræ*, were plainly viſible. The cavities of all the bones were filled with a ſubſtance, which appeared the ſame as the rock itſelf; and the ſubſtance on each ſide the *vertebræ*, as they laid, was a mixture of ſparry concreted matter with that of the rock itſelf, which is a blackiſh ſlate. The animal, when living, muſt have been at leaſt 12 or 14 feet long. And the dimenſions of the whole, or particular parts of the ſkeleton, may be meaſured from the ſcale annexed thereto.

This ſkeleton lay about ſix yards from the foot of the cliff, which is about ſixty yards in perpendicular height, and muſt have been covered by it probably not much more than a century ago. The cliff there is compoſed of various *ſtrata*, beginning from the top, of earth, clay, marle, ſtones both hard and ſoft, of various thickneſſes, and intermixed with each other, till it comes down to the black ſlate or alum rock, and about 10 or 12 feet deep in this rock, this ſkeleton laid horizontally, and exactly as deſigned. The probability, that this cliff has formerly covered this animal, and extended much more into the ſea, is not in the leaſt doubted of by thoſe that know it. The various *ſtrata*, of which it is compoſed, are daily mouldering and falling down; and the bottom, being the ſlaty alum rock, is alſo daily beat, waſhed, and

wore

wore away, and the upper parts undermined, whence many thousand tuns often tumble down together. Many antient persons now living, whose testimony can be no way doubted of, remember this very cliff extending in some places twenty yards further out than it does at present. In short there is sufficient evidence, that at the beginning it must have extended near a mile further down to the sea than it does at present; and so much the sea has there gained of the land.

These are the principal facts and circumstances attending the situation and discovery of this skeleton; which from the condition it is in, and from the particular disposition of the *strata* above the place where it is found, seem clearly to establish the opinion, and almost to a demonstration, that the animal itself must have been antediluvian, and that it could not have been buried or brought there any otherwise than by the force of the waters of the universal deluge. The different *strata* above this skeleton never could have been broken through at any time, in order to bury it, to so great a depth as upwards of 180 feet; and consequently it must have been lodged there, if not before, at least at the time when those *strata* were formed, which will not admit of a later date than that above-mentioned.

P. S. In the xlixth vol. page 639, of the *Philosophical Transactions*, an animal is described by Mr. Edwards, which was brought from the Ganges, and resembles this in every respect. He calls it *Lacerta (crocodilus) ventre marsupio donato, faucibus Merganseris rostrum æmulantibus.*

CIX.

PHŒNICIAN Coins.

J. Mynde sc.

CIX. *A Dissertation upon the* Phœnician *Numeral Characters antiently used at* Sidon. *In a Letter to the Rev.* Thomas Birch, *D. D. Secret. R. S. from the Rev.* John Swinton, *M. A. of* Christ-Church, Oxon, *F. R. S.*

Reverend Sir,

Read Dec. 7, 1758.

HAVING, by the assistance of the Palmyrene numeral characters, lately made a discovery, which may perhaps hereafter be of considerable service to chronology; I could not longer defer, though now deeply engaged in other matters, communicating it to the Royal Society. Nor will the memoir containing this, I flatter myself, be deemed altogether unworthy the attention of that learned and illustrious body. For, unless I am greatly deceived, it will bid fair to ascertain, with a sufficient degree of precision, the Phœnician dates of several antient Sidonian coins, one of which was struck above a century before the birth of CHRIST, hitherto utterly unknown; and evince the notation of the Phœnicians, at least those of Sidon, when they first appeared, to have been extremely similar to, if not nearly the same with, that of the Palmyrenes.

I.

A small brass coin of Sidon (1), now in my possession, exhibits on the reverse three Phœnician letters,

(1) See Plate xxxi. Fig. 1.

ters, that form the word SIDON, over the prow of a ſhip, the uſual ſymbol of the city wherein it was ſtruck. This coin, which is in good conſervation, I formerly (2) publiſhed and explained. The characters however in the exergue, which I could then make nothing of, were not with ſufficient accuracy deſcribed. This has induced me to tranſmit you another draught of the ſame medal, wherein proper care has been taken to remedy that defect. The two firſt of thoſe characters, though ſomewhat imperfect, appear manifeſtly enough to be *Schin* and *Tzade*; as the former occurs on the Palmyrene (3) marbles, and the latter on ſeveral very valuable (4) Phœnician coins. The others ſo nearly reſemble the numeral characters of the Palmyrenes, that they may undoubtedly be conſidered as pointing out to us a date. Which if we admit, the *Schin* and *Tzade* will ſeem to be the initial letters of the words שנת צדן, THE YEAR OF SIDON, or IN THE YEAR OF SIDON; as the elements *Pe* and *Schin* apparently denote פסח שנת, THE PASCHA OF THE YEAR, or IN THE BEGINNING OF THE YEAR, on the reverſe of the famous Samaritan coin of Bologna, publiſhed by Sig. Bianconi (5) not many years ſince. Nor can the phraſe, THE YEAR OF SIDON, or IN THE YEAR OF SIDON, intimating the year

(2) *De Num. quibuſd. Sam. et Phœn. &c. Diſſert.* p. 56—59. & Tab. II. Oxon. 1750.

(3) *Marm. Palmyren. a Cl.* Dawk. *edit.* paſſ.

(4) Vid. Hadr. Reland. *Palæſt. Illuſtrat.* p. 1014. Traject. Batavor. 1714. Eraſm. Froel. ad *Annal. Compendiar. Reg. & Rer. Syr.* Tab. VIII. &c. Viennæ, 1754.

(5) *De Antiq. Hebræor. et Græcor. Lit. Libel.* Joan. Baptiſt. Biancon. p. 31, 32. Bononiæ, 1748.

of

of the proper æra of that city, be looked upon as repugnant either to the Jewiſh or Phœnician genius; a ſimilar expreſſion having been uſed, both in their writings (6) and on their coins (7), about the time that the Phœnician medal before me was ſtruck, by the Jews. That the firſt of the numeral characters here ſtands for TWENTY, we may infer from the correſpondent one of the Palmyrenes, to the form of which it is by no means unlike. This will likewiſe be confirmed by the dates preſerved on other Phœnician coins, which will be immediately produced. The next, denoting a leſſer number, and not repreſenting FIVE, which we find always expreſſed by minute right lines on the Sidonian medals, muſt indubitably occupy the place of TEN. The ſix following ſtrokes, after what has been juſt obſerved, will be acknowleged to add SIX to the foregoing numbers; ſo that the inſcription in the exergue will no longer remain a myſtery, the whole only importing, IN THE YEAR OF SIDON XXXVI.

II.

I have three other coins of Sidon (8), of almoſt intirely the ſame type; only one of them exhibits a date in Greek numerals, and two bear Phœnician dates. The Greek numerals are EOT, CCCLXXV; and the Phœnician correſpond with the numbers CXX, CXXVII, to both of which are prefixed the above-mentioned

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(6) 1. Maccab. i. 10.

(7) Hadr. Reland. *De Num. Vet. Hebr.* paſſ. Trajecti ad *Rhenum*, 1709.

(8) See Plate xxxi. Fig. 2.

 initial

initial letters. We meet with draughts of two ſimilar medals in (9) Arigoni, adorned with characters, expreſſing the numbers CXXVIII, CXXX. All theſe coins preſent to our view a turrited head and a branch of palm, pointing out to us the country to which they belong, and on the reverſe the uſual ſymbol of Sidon. The year handed down to us by the Greek date EOT, is the 375th of the æra of Seleucus; and thoſe denoted by the Phœnician numerals anſwer to the 120th, 127th, 128th, and 130th, of the proper æra of Sidon, as will be hereafter more fully evinced. Hence we may certainly collect, that theſe pieces were ſtruck at Sidon in the years of CHRIST 11, 18, 19, 21, and 64.

III.

Three coins of Sidon, different from the former, occur in (10) Sig. Haym, and ſeven (11) more in my little cabinet, whoſe type is altogether the ſame, with Phœnician dates, preceded by the two aforeſaid initial letters, upon them. To which we may add five, preſerved in the noble (12) cabinet bequeathed to Chriſt-Church, Oxon. by Archbiſhop Wake, and another in the valuable collection of the Rev. Dr. Barton (13), Canon of the ſaid collegiate church, and a worthy member of this Society. On one ſide

(9) Honor. Arigon. *Num. Phœnic.* Tab. I. Num. 3, 6. Tarviſii, 1745.

(10) Nicol. Haym Roman. *Del Teſor. Britan.* Vol. i. p. 106. In Londra, 1719.

(11) See Plate xxxi. Fig. 3.

(12) See Plate xxxi. Fig. 3.

(13) See Plate xxxi. Fig. 3.

theſe

these medals all exhibit the head of Jupiter, and on the reverse the prow of a ship, the common symbol of Sidon. Most of them had various Phœnician letters at first imprest on the upper part of the reverse, and one of them (which is pretty remarkable) nearly the same characters there that appear in the exergue. The first of the coins mentioned here was struck in the year of Sidon 5. This has been perfectly well preserved, and is more curious than any of the rest; which were emitted from the mint at Sidon in various years of the proper æra of that city, *viz.* the 107th, 108th, 110th, 111th, 112th, 114th, 115th, 116th, 117th, and 119th. We meet on none of these medals with the figure denoting TWENTY, used by the Sidonians, during the period I am now upon. It not a little resembles that which prevailed at Tadmor (14) in the reign of the emperor Claudius, about forty-nine years after the birth of CHRIST. The most antient of the Phœnician coins I am now considering preceded the commencement of the Christian æra 104 years, and is consequently 153 years older than the earliest Palmyrene inscription that has hitherto come to our hands (15).

IV.

Some years since I published a small brass medal of Sidon (16), with the heads of Jupiter and Juno on one side, and the prow of a ship on the reverse; but

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(14) See the Phœnician Numerals in Plate xxxii.
(15) *Philosoph. Transact.* Vol. xlviii. Par. ii. p. 726.
(16) *De Num. quibusd. Sam. et Phœn. &c. Dissert. p.* 59—61. & Tab. II. Oxon. 1750.

but did not accurately enough defcribe the numeral characters, and two initial letters, in the exergue. I therefore take the liberty to fend (17) you a new draught, perfectly well done, of that infcription. Two more coins of the fame type I have fince acquired, and another may be feen in (18) Sig. Haym. Thefe four pieces only exhibit the years of Sidon 125 and 132.

V.

My fmall collection likewife affords two (19) other Phœnician medals of Sidon, (20) and Archbifhop Wake's noble cabinet one, of the fame type, with different Phœnician dates in the exergue. To thefe may be added five, with the publication of which the learned world has been obliged by Sig. Arigoni (21). The anterior faces of thefe coins are adorned with a veiled head, reprefenting the genius of the city wherein they were ftruck; and the reverfes with a human figure leaning upon a pillar, and holding a branch of palm in its right hand. Several Phœnician letters alfo there appear, which may perhaps at firft fight feem to render it fomewhat doubtful, whether the medals belong to Sidon or not. But every fufpicion arifing from hence muft immediately vanifh, when we caft our eyes upon the two initial elements, and the numeral characters, in the exergue; which clearly enough indicate the pieces to have been ftruck

(17) See Plate xxxi. Fig. 4.
(18) Haym, ubi fup. p. 107.
(19) See Plate xxxi. Fig. 5.
(20) See Plate xxxi. Fig. 5.
(21) Honor. Arigon. *Num. Phœnic.* Tab. I, II. Tarvifii, 1745.

at

at Sidon, in the 83d, 87th, 95th, 105th, 106th, 108th, 114th, and 116th years of the æra peculiar to that city. A Phœnician coin of Sidon likewise occurs in one (22) of Sig. Arigoni's plates, and another (23) in my collection, with the turrited head and branch of palm visible on three of the (24) medals above described, which indisputably appertain to that city, together with the very Phœnician letters and symbol imprest on the Sidonian coins now before me. This, exclusive of other considerations, that might be offered, must set the point I am here insisting upon beyond dispute.

VI.

I have another brass Phœnician medal of Sidon (25), not a little resembling those above-mentioned, both in workmanship and size, presenting to our view on one side the head of Jupiter, and on the other a human figure with a lance in its right hand. This coin, which has never yet been published, is adorned with a Phœnician legend on the reverse, different from those of all the others that have hitherto appeared. I therefore judged that a draught of it would not be unacceptable, though the date imprest originally in the exergue (answering to the 26th year of Sidon) has a little suffered from the injuries of time.

VII.

The next Phœnician medal of Sidon, which I shall take the liberty here to describe, is a small brass

(22) Id. ibid. Tab. I. N. 5.
(23) See Plate xxxi. Fig. 6.
(24) See p. 793, 794.
(25) See Plate xxxi. Fig. 7.

one

one (26), now in my hands, with a veiled head on the anterior face, and the prow of a ſhip on the reverſe. M. Bouteroüe (27), who has publiſhed it, rightly aſſerts it to be a Phœnician coin. The year of Sidon, preſerved in the exergue of mine, is 74; and that in the exergue of M. Bouteroüe's, 73, though the firſt numeral character of the latter is ſomewhat deformed.

VIII.

The laſt Phœnician medals I ſhall at preſent produce, in order to ſettle the point in view, are (28) two in my poſſeſſion, intirely agreeing both in type and form, as remarkable as any of the others here touched upon. A ſimilar coin has been publiſhed by Sig. Arigoni (29), and another (30) by M. Bouteroüe; both of which, on ſeveral accounts, merit the attention of the learned. They exhibit on one ſide the head of Jupiter laureated, with a beard; and on the reverſe a double cornucopia, together with three or four Phœnician elements, one or two of which are in a great meaſure defaced. A braſs medal of Sidon occurs in Archbiſhop Wake's (31) collection, as well as one in (32) mine, with the head of Jupiter done exactly after the ſame manner as that on the pieces before me, and Europa carried by a bull

(26) See Plate xxxi. Fig. 8.
(27) *Recherches Curieuſes des Monoyes de France &c. Par* Claude Bouteroüe, p. 33. A Paris, 1666.
(28) See Plate xxxi. Fig. 9.
(29) Honor. Arigon. ubi ſup. Tab. I. Num. 2.
(30) Claud. Bouteroüe, ubi ſup. p. 24.
(31) See Plate xxxi. Fig. 9.
(32) See Plate xxxi. Fig. 9.

on

on the reverſe; which, excluſive of the inſcriptions in the exergue, demonſtrate the latter to belong to Sidon. The firſt of mine was ſtruck in the 143d year of the proper æra of that city, and the ſecond five years after. They correct the barbarous date aſſigned by Sig. Arigoni to his coin. M. Bouteroüe has not favoured the learned world with an explication of the medal, of which he has given us a draught. Nor has M. l'Abbé Barthelemy, who likewiſe mentions this very coin, informed us to what place it appertains; but contented himſelf with barely (33) obſerving, that the letters preſerved on the reverſe are Phœnician. I flatter myſelf therefore that I ſhall not be charged with plagiariſm by this celebrated antiquary, in caſe what is here ſubmitted to the conſideration of the Royal Society ſhould be ſo happy as to meet with the approbation of that learned and illuſtrious body; not even by *only* acquainting the public, with a ſort of *politeſſe* ſo peculiar to his countrymen, that it is now become one of the moſt diſtinguiſhing characteriſtics of their nation (34), "that "a certain Oxford doctor has done him the honour "to *adopt* the explication he had given."

IX. For

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(33) *Mémoires de Litterature, tirés des Regiſtres &c.* Tom. xxiv. p. 64. A Paris, 1756.

(34) The whole note, here referred to, in the original runs thus. "J'avois lû ce Mémoire à l'Académie en 1749, je le communiquai dans le même temps à un étranger qui ſe trouvoit alors à "Paris, & qui ayant paſſé tout de ſuite en Angleterre, fit part à "un docteur d'Oxford de l'explication que j'avois donnée de la "médaille de Jonathan. Ce dernier *m'a fait l'honneur de l'adopter* "dans une ſavante Diſſertation imprimée a Oxford en 1750, à "la ſuite d'une autre Diſſertation ſur deux inſcriptions Phéni-"ciennes."

IX.

For the farther illuſtration of what has been here advanced, it will be requiſite to obſerve, that two æra's were antiently followed at Sidon; the æra of Seleucus, and another peculiar to the inhabitants of that

" ciennes." *Mémoires de Litterature, tirés des Regiſtres de l'Académie Royale des Inſcriptions & Belles-Lettres, &c.* Tom. xxiv. p. 60. A Paris, 1756.

For the better underſtanding of this note, it will be proper to obſerve, that the ſtranger therein mentioned was M. Brucker, Profeſſor of Hiſtory in the Univerſity of Baſil; with whom I contracted an acquaintance when at Oxford, towards the cloſe of March 1750. This gentleman then informed me, that M. l'Abbé Barthelemy communicated to him draughts of three Samaritan coins of Jonathan, prince and high-prieſt of the Jews. He added, that one of theſe exhibited the words ΒΑΣΙΛΕΩΣ ΑΛΕΞΑΝΔΡΟΥ; which, according to him, M. l'Abbé Barthelemy interpreted of Alexander the Great, taking the piece to have been twice ſtruck. This M. Brucker afterwards in a great meaſure confirmed, by a letter he wrote to me at Oxford; which I publiſhed intire in 1750, and endeavoured to prove, that the foregoing inſcription was to be underſtood of Alexander I. king of Syria, and not of Alexander the Great. The Samaritan inſcription, which M. Brucker only juſt touched upon, as is manifeſt from his letter, I likewiſe attempted to explain; producing proper vouchers, in ſupport of what I advanced. Thus ſtands the fact, which ſeems to have given ſome offence to M. l'Abbé, ſtated in the moſt conciſe manner poſſible; and from it, thus ſtated, as I apprehend, are naturally deducible the following obſervations.

1. As I differed in opinion from M. l'Abbé, with regard to the words ΒΑΣΙΛΕΩΣ ΑΛΕΞΑΝΔΡΟΥ, as well as in ſeveral other reſpects, and ſupported by indiſputable authorities what I in all points advanced, without receiving from any perſon whatſoever the leaſt information relative thereto; it very evidently appears, that I did not *adopt* M. l'Abbé's explication of the coin in queſtion.

2. By publiſhing M. Brucker's letter, which I have ſtill by me, intire, I both did him juſtice, and clearly acknowledged M. l'Abbé to have firſt diſcovered the medals it treats of to belong to Jonathan,

that city (35). On the Greek brass coins of Sidon, according to F. Frœlich (36), both these epochs seem

than, prince and high-prieſt of the Jews; and therefore have by no means endeavoured, as he would inſinuate, to rob him of the glory of ſuch a diſcovery.

3. As M. l'Abbé in effect owns himſelf to have ſeen my diſſertation, and has (if M. Brucker rightly informed me) ſince the reading of his memoir, ſubſtituted my notion, relating to the words, ΒΑΣΙΛΕΩΣ ΑΛΕΞΑΝΔΡΟΥ, in the room of his own; ſome people may perhaps imagine, that I have at leaſt as much reaſon to recriminate on this occaſion, as he had to charge me with the *adoption* of his explication. Nay, as he expreſſly acquaints the public, that M. Brucker imparted to me the very interpretation of the coin he (M. l'Abbé) had before communicated to him, and as this interpretation moſt evidently makes it to have been firſt ſtruck in the reign of Alexander the Great; every unprejudiced perſon, unacquainted with the elevated genius and extenſive erudition of M. l'Abbé, will be ſtrongly induced to believe, that there would be no great injuſtice in a recrimination. But far be it from me to retort the accuſation upon M. l'Abbé. His uncommon learning, his ſingular modeſty, his ſtrict honour, his utter contempt of vanity and oſtentation in every ſhape, ſo conſpicuous to all the world, muſt ſet him infinitely above the reach of ſuch an imputation. However, notwithſtanding the ſuperior merit and exalted abilities of M. l'Abbé, notwithſtanding the known averſion of the French writers to the practice here hinted at, and their moſt generous and candid treatment hitherto of thoſe belonging to the Britiſh nation, it will perhaps hereafter be thought expedient, by the ACADEMY OF INSCRIPTIONS AND BELLES LETTRES, not frequently to ſuffer an interval of ſeven years to elapſe, between the reading and publication of their memoirs. For by ſuch unaccountable delays, if often repeated, a handle may poſſibly be given to many of the *haughty iſlanders* of reflecting upon, or at leaſt entertaining unfavourable ſentiments of, ſome of the members of that illuſtrious body.

See *De Num. quibuſd. Sam. & Phœn. &c. Diſſert.* p. 61—72. Oxon. 1750.

(35) F. Henric. Nor. Veronenſ. *An. et Epoch. Syromaced. &c.* p. 414—424. Lipſiæ, 1696.

(36) Eraſm. Frœl. *Annal. Compend. Reg. et Rer. Syr.* p. 113. Viennæ, 1754.

to have been uſed. However, the ſupputation pointed out to us by the date on the Greek medal abovementioned was undoubtedly made according to the æra of Seleucus; ſince otherwiſe the year exhibited by that date muſt have been nearly coincident with the 266th of CHRIST, which by thoſe verſed in this kind of literature will never be allowed. For had the piece preſented to our view ſo recent a date, as Sidon firſt became a Roman colony in the reign of Elagabalus (37), above forty years before; the reverſe ought to have been adorned with ſome other letters intimating this, as were thoſe of the Sidonian (38) coins poſterior to that event. As certain is it that all the Phœnician medals of Sidon, whoſe numeral characters have been interpreted here, acknowledge no other epoch than the proper one of that city, which commenced in the year (39) of Rome 643. This, I flatter myſelf, from the following conſiderations, excluſive of others that might, with equal facility, be offered, will even to demonſtration appear.

1. The fifth year mentioned by the oldeſt of theſe coins cannot be the fifth year of the æra of Seleucus, becauſe the Sidonians were then ſubject to Antigonus (40), in whoſe territories the ſupputation according to that epoch did not take place; and conſequently the piece itſelf muſt have been ſtruck in the fifth

(37) Joan. Harduin. *Op. Select.* p. 155, 156. Amſt. 1709. Joan. Foy Vaillant Bellovac. *Numiſmat. Ær. Imperator. &c. Par. Alt.* p. 97. Pariſiis, 1695.

(38) Iidem ibid. & alib.

(39) F. Henr. Nor. Veronenſ. ubi ſup.

(40) Diod. Sic. lib. xix. Plutarch. in *Demetr.* Appian. in *Syriac.*

year

year of the proper æra of Sidon, nearly coincident with the 648th of Rome (41).

2. No dates ever occurred upon the medals of the Syrian kings presiding over the people of Sidon, either to F. Frœlich or Dr. Vaillant (42), who have so eminently distinguished themselves in this branch of literature, before the year of Seleucus 112; and therefore neither the Phœnician dates preserved on the aforesaid Sidonian coins whose numeral characters do not amount to 112, nor the Greek dates on others falling short of that number, can rationally be supposed to bear any relation to the æra of that prince. This certainly must be considered as a strong presumption, or rather an incontestable proof, that the last-mentioned Phœnician dates were deduced from the commencement of the proper Sidonian epoch, as from their genuine cardinal point. Which reasoning will by analogy extend, as the numeral characters exhibited by all the coins here explained are of the same kind, to every one of the rest.

3. None of the medals of the Syrian kings, with Phœnician letters upon them (43), hitherto published, bear any Phœnician dates. This, after what has been said, renders it extremely probable, that the pieces of Sidon I am considering were posterior to those coins; and even that their Phœnician dates referred to an æra different from that of Seleucus, followed by the Greek dates on the medals of the Syrian kings. Which if we admit, this æra could have been

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(41) F. Henr. Nor. Veronens. ubi sup.

(42) Erasm. Frœl. ubi sup. p. 39. Joan. Foy-Vaill. *Seleucidar. Imper.* p. 1—150. Lutet. Parisior. 1681.

(43) Joan. Foy-Vaill. Erasm. Frœl. Nicol. Haym Roman. &c.

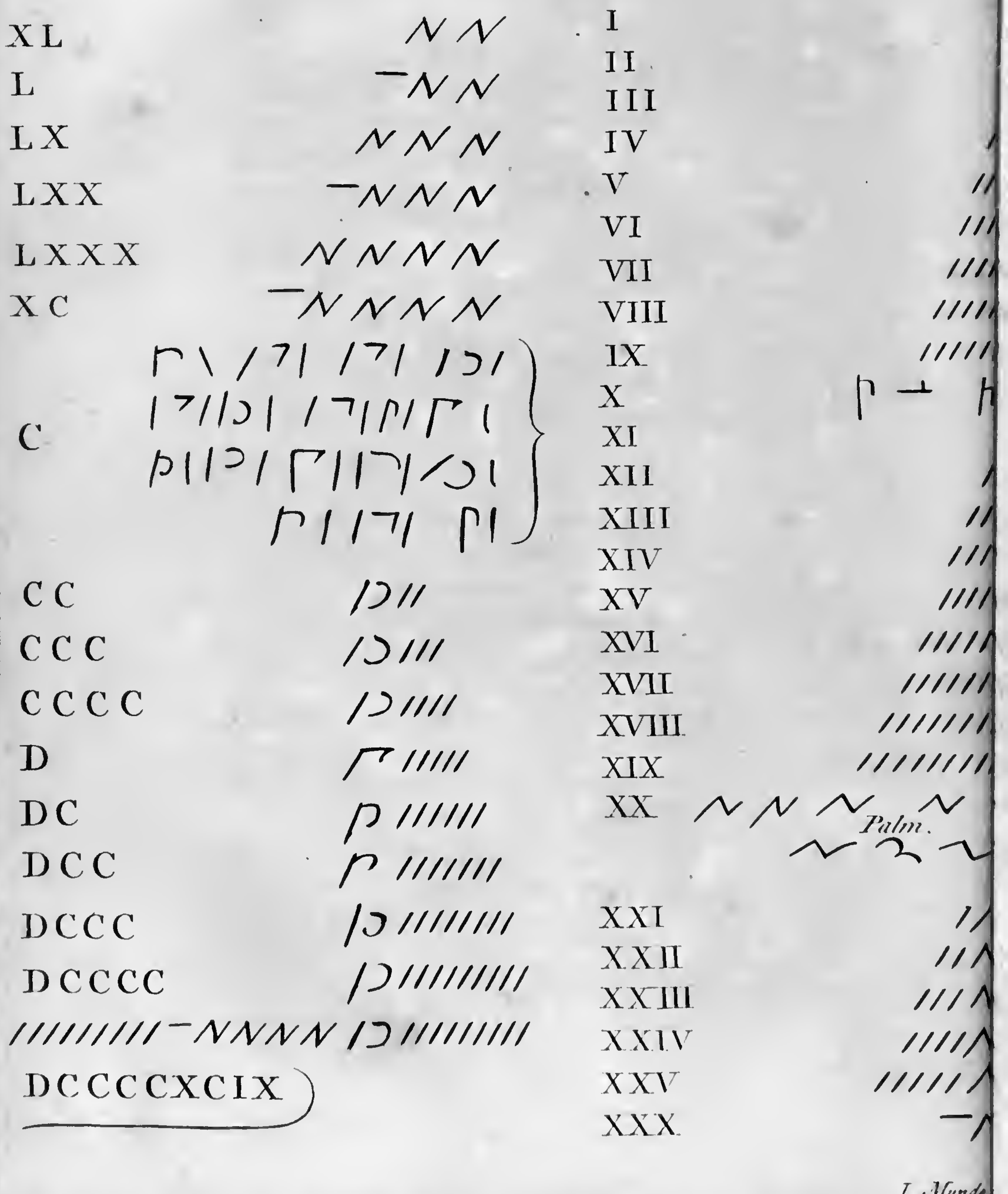
no other than the new one of the Sidonians, that commenced in the ſeventh century of Rome.

4. That the dates viſible on theſe coins were ſupputed according to the latter epoch of Sidon, will be manifeſt from an examination of the Greek and Phœnician braſs medals of that city explained, in (44) the beginning of this paper; whoſe type and workmanſhip are extremely ſimilar, if not almoſt intirely the ſame. For this circumſtance is to me an evident proof, that they could not have been ſtruck at very diſtant times. Now if we take the Greek coin to have followed the æra of Seleucus, as was undoubtedly the caſe, and the others that peculiar to Sidon; the firſt of the Phœnician dates (45) will not be prior to the Greek one above fifty-three years, nor the laſt of them precede it above forty-three years. Whereas if we ſuppoſe the numeral inſcriptions in the exergues of the Phœnician Sidonian coins to have been ſupputed according to the Seleucian epoch, the difference between the aforeſaid dates will be five times as much; which with the ſimilarity of workmanſhip and type, already obſerved, will be altogether incompatible.

5. As the Jews (46), about the time that the firſt of our medals was ſtruck, denominated the æra of Seleucus, THE ÆRA OF THE KINGDOM OF THE GREEKS; we cannot well doubt but it went amongſt the Sidonians, who were neighbours to the Jews, under the ſame denomination. From whence it will follow, that the epoch ſtyled by them emphatically, THE ÆRA OF SIDON, muſt have been different from the æra of Seleucus; and conſequently

(44) See above, p. 793, 794.
(45) Eraſm Frœl. ubi ſup. p. 101.
(46) 1. Maccab. i. 10.

PHŒNICIAN Numerals antiently used at SIDON, from *One* to a *Thousand*.



J. Mynde

quently that which, after the 643d year of Rome, was peculiar to them.

The powers of the Phœnician numeral characters antiently ufed at Sidon, which I flatter myfelf are now difcovered, having been for many ages unknown; the Society will perhaps not be difpleafed to fee accurate draughts of the principal Phœnician medals, from whence they are deduced. I have therefore taken the liberty to tranfmit them (47) fuch draughts, which may be intirely depended upon. I have alfo conftructed a table (48) of the numeral characters themfelves, from UNITY to A THOUSAND; which will demonftrate, in the cleareft manner poffible, the great affinity between them and thofe of the Palmyrenes.

1. From this table it plainly appears, that the people of Sidon had no particular character to denote FIVE, whilft the Phœnician numerals here explained were in vogue amongft them; that they expreffed TWENTY by a character, during that period, not very different from the correfpondent one ufed at Tadmor; and that in all other refpects the Phœnician notation then prevailing at Sidon was, in a manner, the fame with that of the (49) Palmyrenes.

2. It may not be improper to obferve, that two of the Sidonian coins I have been confidering (50)

(47) See Plate xxxi.
(48) See Plate xxxii.
(49) It may not however be amifs to remark, that moft of the forms of the Phœnician centenary and decimal numeral characters rather refemble the correfpondent Palmyrene numerals of Gruter than thofe of Mr. Dawkins; as will be obvious to every one, who fhall think proper to compare all thofe different characters one with another. *Philofoph. Tranfact.* Vol. xlviii. Par. ii. p. 721, 741.
(50) See Plate xxxi. Fig. 5. & Arigon. Tab. II. Num. 11.

exhibit the Phœnician word מא, equivalent to the Hebrew מאה, and Syriac מאא, AN HUNDRED, inſtead of the centenary numeral character. This, in conjunction with the appearance of that character, occupying the very place of the term מא, on others of thoſe coins, firſt induced me to believe, that the inſcription preſerved by every one of them in the exergue could be nothing elſe but a date.

3. I ſhall beg leave farther to remark, that none of the indubitable medals of Tyre, adorned with Phœnician letters, as far as I have been able to diſcover, preſent to our view any Phœnician dates at all. This ſtill more clearly evinces the ſecond element prefixed to the Phœnician numerals in the exergue to point out to us the city of Sidon, and not that of Tyre; which (51), indeed, ſeems already to have been ſufficiently proved.

4. From the foregoing obſervations we may likewiſe collect, that the coin aſſigned to Demetrius III. by Mr. Maſſon, F. Frœlich (52), and Sig. Haym, exhibiting a Phœnician legend, without a Phœnician date, in the exergue, ought in reality to be attributed to Demetrius I. Thoſe three learned men therefore have been guilty of a miſtake in this particular. Nor can the head on this medal be denied to bear ſome reſemblance to that of Demetrius I. (53) with a moderate beard, as it appears on a coin publiſhed by Dr. Vaillant, and in one of F. Frœlich's plates. That the letters A K, behind the head, in-

(51) See above, p. 791, 792.

(52) Nicol. Haym Roman. ubi ſup. p. 100. Eraſm. Frœl. ubi ſup. p. 111. Tab. XV.

(53) Joan. Foy-Vaill. ubi ſup. p. 238. Eraſm. Frœl. ubi ſup. p. 57. Tab. VII. Num. 1.

dicate

dicate the piece to have been ſtruck in the twenty-firſt year of the proper Sidonian æra (54), as Mr. Maſſon and F. Frœlich are pleaſed to aſſert, can never be proved. On the contrary, the improbability of ſuch a notion may be inferred from two ſimilar letters, behind the turrited head of the *Dea Syria* (55), on a Phœnician coin, which Mr. Maſſon makes to point out the forty-firſt year of the proper epoch of Sidon; whereas, in truth, that piece ſeems to have been ſtruck either in the reign of Demetrius I. or Antiochus IV. (56) many years before. Nay, that it was actually ſtruck when Demetrius I. ſat upon the Syrian throne, is rendered almoſt inconteſtable by a medal of that prince now in my poſſeſſion, with a *Beta* behind the head on the anterior part, and the very reverſe of the laſt-mentioned coin. From the former of which circumſtances it farther appears, that the alphabetic characters M A, ſuppoſed by Mr. Maſſon to denote 41, are by no means to be taken for a date. To which we may add, that the head on a Phœnician medal, with the two Greek elements A K behind it, publiſhed by Mr. Reland (57), is apparently that of Demetrius I.; and that the poſterior part of this coin is nearly the ſame, in all reſpects, with the reverſe of that ſuppoſed to (58) appertain to Demetrius III. by Mr. Maſ-

(54) Nicol. Haym Roman. ubi ſup. p. 101. Eraſm. Frœl. ubi ſup. p. 111.
(55) Nicol. Haym Roman. ubi ſup. p. 105, 106.
(56) Joan. Foy-Vaill. ubi ſup. p. 200. Eraſm. Frœl. ubi ſup. p. 63. Tab. VIII. Num. 30.
(57) Hadr. Reland. *Palæſt. Illuſtrat.* p. 1014.
(58) Nicol. Haym Roman. ubi ſup. p. 100, 101.

ſon

ſon and Sig. Haym. But to wave all other conſiderations, relative to the point in view, that may occur, the features and turns of the face on the medals of Demetrius III. are ſo different (59), that no inference of any validity can be drawn from the pretended identity or ſimilitude of them, in ſupport of Mr. Maſſon's opinion.

5. The Palmyrene and Phœnician numerals, deduced from coins and inſcriptions, may perhaps be thought not unworthy a place amongſt the arithmetical characters of various nations, formerly (60) collected by Biſhop Beveridge; and conſequently may be allowed to render ſomewhat more complete the chronological inſtitutions, or rather the chronological arithmetic, of that learned and judicious author.

You will pardon the prolixity of this letter, which the novelty of the ſubject may perhaps render a little more excuſable than it would otherwiſe have been; and believe me to be, with the moſt perfect conſideration and eſteem,

SIR,

Your moſt obedient humble Servant,

Chriſt Church, Oxon.
Nov. 17. 1758.

J. Swinton.

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(59) Joan. Foy-Vaill. ubi ſup. p. 375, 378. Haym, ubi ſup. p. 100. Eraſm. Frœl. ubi ſup. p. 111. Tab. XV.

(60) Gul. Bevereg. *Inſtitut. Chronologic.* p. 278—331. Lond. 1721.

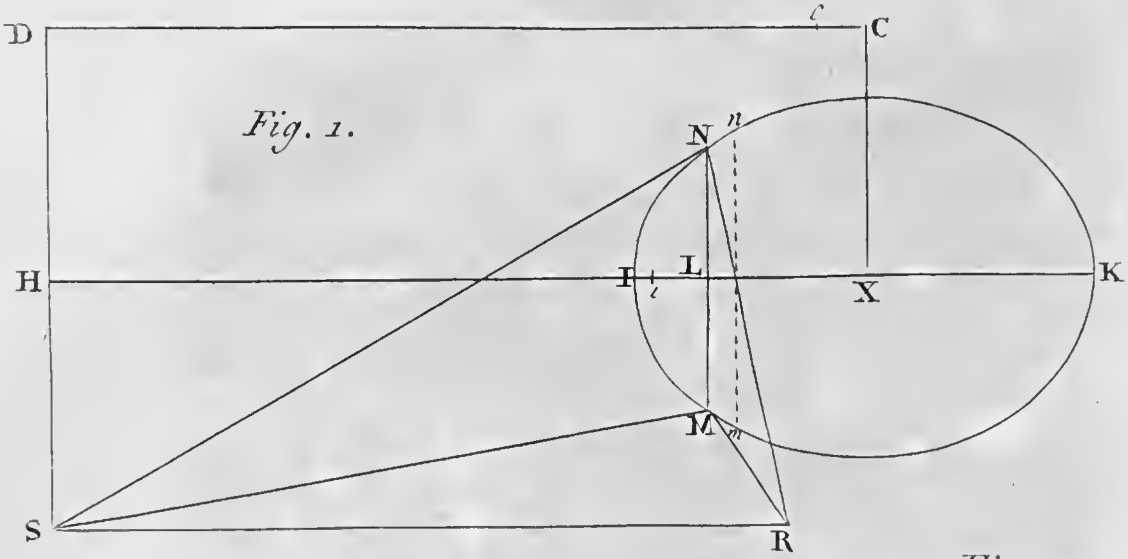

Fig. 1.

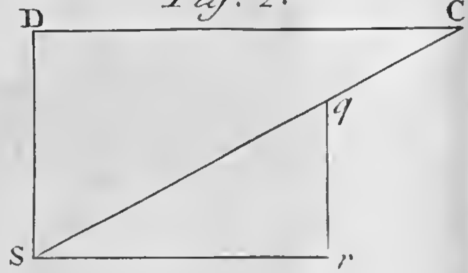

Fig. 2.

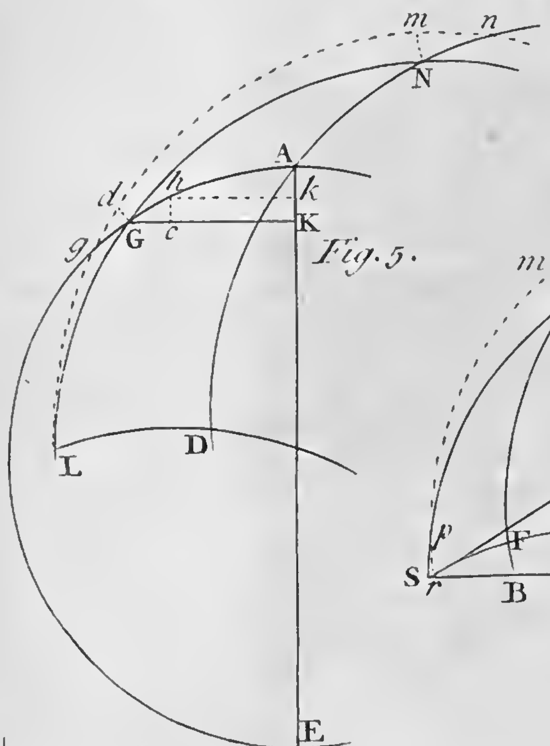

Fig. 5.

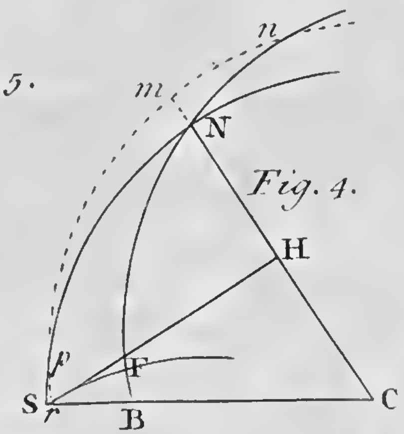

Fig. 4.

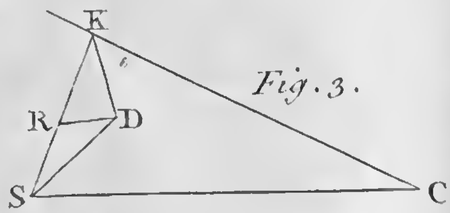

Fig. 3.

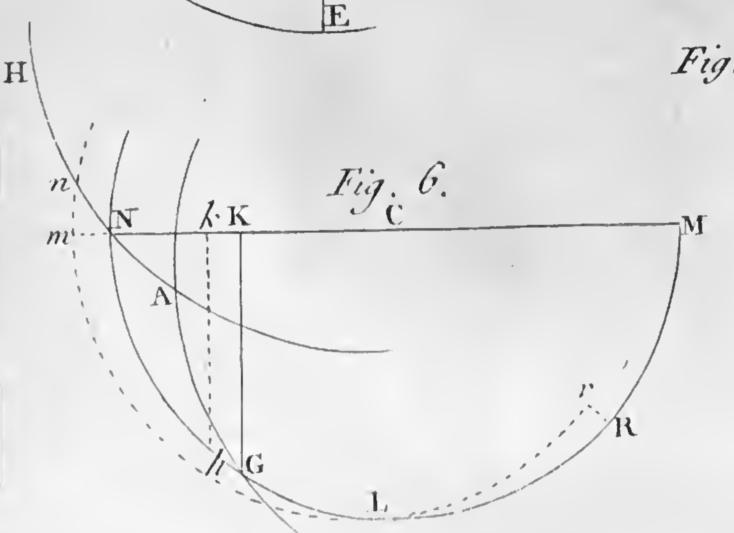

Fig. 6.

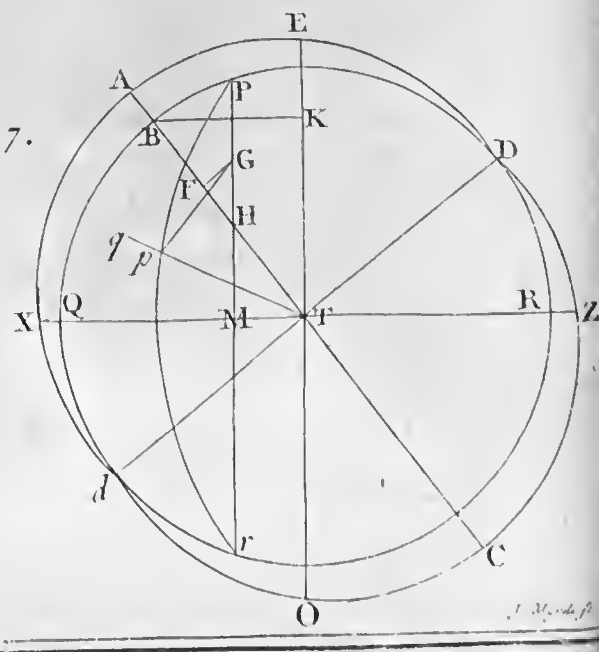

Fig. 7.

CX. *Of the Irregularities in the Motion of a Satellite arising from the spheroidical Figure of its Primary Planet: In a Letter to the Rev.* James Bradley *D. D. Astronomer Royal, F. R. S. and Member of the Royal Academy of Sciences at* Paris; *by Mr.* Charles Walmesley, *F. R. S. and Member of the Royal Academy of Sciences at* Berlin, *and of the Institute of* Bologna.

Reverend Sir,

Read Dec. 14, 1758.

SINCE the time that astronomers have been enabled by the perfection of their instruments to determine with great accuracy the motions of the celestial bodies, they have been solicitous to separate and distinguish the several inequalities discovered in these motions, and to know their cause, quantity, and the laws according to which they are generated. This seems to furnish a sufficient motive to mathematicians, wherever there appears a cause capable of producing an alteration in those motions, to examine by theory what the result may amount to, though it comes out never so small: for as one can seldom depend securely upon mere guess for the quantity of any effect, it must be a blameable neglect entirely to overlook it without being previously certain of its not being worth our notice.

Finding therefore it had not been considered what effect the figure of a planet differing from that of a ſphere might produce in the motion of a ſatellite revolving about it, and as it is the caſe of the bodies of the Earth and Jupiter which have ſatellites about them, not to be ſpherical but ſpheroidical, I thought it worth while to enter upon the examination of ſuch a problem. When the primary planet is an exact globe, it is well known that the force by which the revolving ſatellite is retained in its orbit, tends to the center of the planet, and varies in the inverſe ratio of the ſquare of the diſtance from it; but when the primary planet is of a ſpheroidical figure, the ſame rule then no longer holds: the gravity of the ſatellite is no more directed to the center of the planet, nor does it vary in the proportion above-mentioned; and if the plane of the ſatellite's orbit be not the ſame with the plane of the planet's equator, the protuberant matter about the equator will by a conſtant effort of its attraction endeavour to make the two planes coincide. Hence the regularity of the ſatellite's motion is neceſſarily diſturbed, and though upon examination this effect is found to be but ſmall in the moon, the figure of the earth differing ſo little from that of a ſphere, yet in ſome caſes it may be thought worth notice; if not, it will be at leaſt a ſatisfaction to ſee that what is neglected can be of no conſequence. But however inconſiderable the change may be with regard to the moon, it becomes very ſenſible in the motions of the ſatellites of Jupiter both on account of their nearer diſtances to that planet when compared with its ſemidiameter, as alſo becauſe the figure of Jupiter ſo far recedes from that of a ſphere. This I have ſhewn and exemplified in the fourth ſatellite; in which caſe indeed the computation is more exact

exact than it would be for the other satellites: for as my first design was to examine only how far the moon's motion could be affected by this cause, I supposed the satellite to revolve at a distance somewhat remote from the primary planet, and the difference of the equatoreal diameter and the axis of the planet not to be very considerable. There likewise arises this other advantage from the present theory, that it furnishes means to settle more accurately the proportion of the different forces which disturb the celestial motions, by assigning the particular share of influence which is to be ascribed to the figure of the central bodies round which those motions are performed.

I have added at the end a proposition concerning the diurnal motion of the earth. This motion has been generally esteemed to be exactly uniform; but as there is a cause that must necessarily somewhat alter it, I was glad to examine what that alteration could amount to. If we first suppose the globe of the earth to be exactly spherical, revolving about its axis in a given time, and afterwards conceive that by the force of the sun or moon raising the waters its figure be changed into that of a spheroid, then according as the axis of revolution becomes a different diameter of the spheroid, the velocity of the revolution must increase or diminish: for, since some parts of the terraqueous globe are removed from the axis of revolution and others depressed towards it, and that in a different proportion as the sun or moon approaches to or recedes from the equator, when the whole quantity of motion which always remains the same is distributed through the spheroid, the velocity of the diurnal rotation cannot be constantly the same. This variation however will ſcarce be obſervable, but as it is real, it may not be thought amiſs to determine what its preciſe quantity is.

I am ſenſible the following theory, as far as it relates to the motion of Jupiter's ſatellites, is imperfect and might be proſecuted further; but being hindered at preſent from ſuch purſuit by want of health and other occupations, I thought I might ſend it you in the condition it has lain by me for ſome time. You can beſt judge how far it may be of uſe, and what advantage might ariſe from further improvements in it. I am glad to have this opportunity of giving a freſh teſtimony of that regard which is due to your diſtinguiſhed merit, and of profeſſing myſelf with the higheſt eſteem,

Reverend Sir,

Your very humble Servant,

Bath, Oct. 21. 1758.

C. Walmeſley.

Lemma I.

Invenire gravitatem corporis longinqui ad circumferentiam circuli ex particulis materiæ in duplicatâ ratione diſtantiarum inverſè attrahentibus conſtantem.

Esto NIK (*Vid.* Tab. xxxiii. *Fig.* 1.) circumferentia circuli, in cujus puncta omnia gravitet corpus longinquum S locatum extra planum circuli. In hoc planum agatur linea perpendicularis SH, et per circuli centrum X ducatur recta HXK ſecans circulum in I et K, et SR parallela ad HX: producatur autem SH ad diſtantiam datam SD, et agantur rectæ

D C,

DC, XC, ipsis HX, SD, parallelæ. Tum ductâ chordâ quavis MN ad diametrum IK normali eamque secante in L, ex punctis M, N, demittantur in SR perpendiculares MR, NR, concurrentes in R; junctisque SM, SN, erit $SM = SN$, $MR = NR$, $SR = HL$. Dicantur jam SD, k; HX sive DC, h; XL, x; CX, z; XI, r; eritque $HL = h - x$, et $SH = k - z$. Est autem SM ad SH ut attractio $\frac{1}{\overline{SM}^2}$ corporis S versus particulam M in directione SM ad ejusdem corporis attractionem in directione SH, quæ proinde erit $\frac{SH}{\overline{SM}^3}$: sed est $SR = HL$, et $\overline{SM}^2 = \overline{SR}^2 + \overline{MR}^2 = \overline{SR}^2 + \overline{SH}^2 + \overline{ML}^2$; unde fit $\frac{SH}{\overline{SM}^3} = \frac{SH}{\overline{\overline{HL}^2 + \overline{SH}^2 + \overline{ML}^2}^{\frac{3}{2}}}$, et ductâ mn parallelâ ad MN, vis qua corpus S attrahitur ad arcus quàm minimos Mm, Nn, exponitur per $\frac{SH \times 2Mm}{\overline{SM}^3} = SH \times 2Mm \times \overline{\overline{HL}^2 + \overline{SH}^2 + \overline{ML}^2}^{-\frac{3}{2}}$. Est autem $\overline{HL}^2 + \overline{SH}^2 + \overline{ML}^2 = kk - 2kz + zz + hh - 2hx + rr$, hincque ponendo $kk + hh = ll$, $\overline{\overline{HL}^2 + \overline{SH}^2 = \overline{ML}^2}^{-\frac{3}{2}} = \frac{1}{l^3} + \frac{3kz}{l^5} + \frac{3hx}{l^5} - \frac{3rr}{2l^5} - \frac{3zz}{2l^5} + \frac{15kkzz}{2l^7} + \frac{15khzx}{2l^7} + \frac{15hhxx}{2l^7}$, neglectis terminis ulterioribus ob longinquitatem quam supponimus corporis S. Quarè, si scribatur d pro circumferentiâ IMKN, gravitas corporis S ad totam illam circumferentiam secundum SH, sive fluens fluxionis $SH \times 2Mm \times \overline{\overline{HL}^2 + \overline{SH}^2 + \overline{ML}^2}^{-\frac{3}{2}}$ evadit $\overline{k - z} \times d$ in $\frac{1}{l^3} + \frac{3kz}{l^5} - \frac{3rr}{2l^5} - \frac{3zz}{2l^5} +$

$\frac{15kkzz}{2l^7}$

$\frac{15kkzz}{2l^7} + \frac{15hhrr}{4l^7}$. Simili modo obtinebitur gravitas ejusdem corporis S secundum SR. *Q. E. I.*

LEMMA II.

Corporis longinqui gravitatem ad Sphæroidem oblatam determinare.

Retentis iis quæ sunt in lemmate superiori demonstrata; esto C centrum sphæroidis, cujus æquatori parallelus sit circulus IMK. Sphæroidis hujus semiaxis major sit a, semiaxis minor b, eorum differentia c, quam exiguam esse suppono; et dicatur D circumferentia æquatoris. Centro C et radio æquali semiaxi minori describi concipiatur circulus qui secet IK in i, eritque gravitas in directione SD, qua urgetur corpus S versus materiam sitam inter circumferentiam IMKN et circumferentiam centro X et radio Xi descriptam, æqualis gravitati in lemmate præcedenti definitæ ductæ in rectam Ii. Sed est Ii . c :: IX . a, atque d . D :: IX . a; unde I$i \times d$. D $\times c$ :: $\overline{IX}^2$. aa, hoc est, ex naturâ ellipseos, ob CX $= z$, et IX $= r$, I$i \times d$. D $\times c$ :: $bb - zz$. bb, adeoque I$i \times d = \frac{D \times c}{bb} \times \overline{bb - zz}$, atque $rr = aa - \frac{aazz}{bb}$; scribi autem potest in sequenti calculo $bb - zz$ pro rr ob parvitatem differentiæ semiaxium in quam omnes termini ducuntur. Gravitas igitur corporis S in materiam inter circumferentias supradictas consistentem exprimetur per $\frac{D \times c}{bb} \times \overline{bb - zz} \times \overline{k - z}$ in $\frac{1}{l^3} + \frac{3kz}{l^5} - \frac{3bb}{2l^5} - \frac{15zz}{4l^5} + \frac{15bbhh}{4l^7} + \frac{45kkzz}{4l^7}$. Et si addatur gravitas in similem materiam

ex

ex alterâ parte centri C ad æqualem à centro diſtantiam, quia tunc CX ſive z evadit negativa, gravitas corporis S in hanc duplicem materiam erit $\frac{D \times c}{bb} \times \overline{bb - zz}$ in $\frac{2k}{l^3} - \frac{6kzz}{l^5} - \frac{3kbb}{l^5} + \frac{15k^3zz}{l^7} + \frac{15bbkbb}{2l^7} - \frac{15bbkzz}{2l^7}$. Ducatur jam gravitas hæc in $\dot{z}$, et ſumptâ gravitatum omnium ſummâ, factâ $z = b$, gravitatio tota corporis S in totam materiam globo interiori ſuperiorem ſecundum directionem SD æquatori perpendicularem prodit $D \times c \times \overline{\frac{4kb}{3l^3} - \frac{4kb^3}{5l^5} + \frac{2kbbb^3}{l^7}}$. Simili ratiocinio gravitatio corporis S in eamdem materiam ſecundum directionem SR æquatori parallelam invenitur æqualis $D \times c \times \overline{\frac{4bb}{3l^3} + \frac{2bb^3}{5l^5} - \frac{2bkkb^3}{l^7}}$. Tum ſi addatur gravitatio corporis S in globum interiorem, ex unâ parte ſcilicet $\frac{2b^3kD}{3al^3}$, et ex alterâ $\frac{2b^3bD}{3al^3}$, habebitur gravitas corporis S in totum ſphæroidem. *Q. E. I.*

Coroll.

Igitur gravitas corporis S ſecundum SD eſt ad ejuſdem gravitatem ſecundum SR ſive DC in materiam ſphæroidis globo interiori incumbentem ut $\frac{2k}{3} - \frac{2kb^2}{5l^2} + \frac{kbbb^2}{l^4}$ ad $\frac{2b}{3} + \frac{bb^2}{5l^2} - \frac{bkkb^2}{l^4}$, adeoque ſi gravitas prior exponatur per k, poſterior exprimetur per $b - \frac{3bb^2}{5l^2}$ quamproximè. Unde cum ſit $DC = b$, patet gravitatem corporis S in ſphæroidem oblatam non tendere

ad

ad centrum C, ſed ad punctum c rectæ DC in plano æquatoris jacentis vicinius puncto D.

PROPOSITIO I.

PROBLEMA.

Vires determinare quibus perturbatur motus Satellitis circa Primarium ſuum revolventis.

Exhibeat jam ſphærois prædicta planetam quemvis figurâ hac donatum, et corpus S ſatellitem circa planetam tanquàm primarium gyrantem. Quantitas materiæ globo ſphæroidis interiori incumbentis æqualis eſt $\frac{4bbcD}{3a}$ ſive $\frac{4bcD}{3}$ proximè, et ſi materia illa locaretur in centro ſphæroidis C, attraheret ſatellitem S ſecundum SC vi $\frac{4bcD}{3l^2}$, quæ reducta ad directionem SD fit $\frac{4bckD}{3l^3}$, et ad directionem DC fit $\frac{4bchD}{3l^3}$. Cum igitur vis $\frac{4bcD}{3l^2}$ non turbat motum ſatellitis, utpote quæ tendat ad centrum motûs et quadrato diſtantiæ ab eodem centro ſit reciprocè proportionalis, vires illæ $\frac{4bckD}{3l^3}$, $\frac{4bchD}{3l^3}$, in quas reſolvitur, etiam motum non turbabunt. Itaque ex vi $D \times c \times \overline{\frac{4kb}{3l^3} - \frac{4kb^3}{5l^5} + \frac{2khhb^3}{l^7}}$ auferatur vis $\frac{4bckD}{3l^3}$, et ex vi $D \times c \times \overline{\frac{4hb}{3l^3} + \frac{2hb^3}{5l^5} - \frac{2hkkb^3}{l^7}}$ auferatur $\frac{4bchD}{3l^3}$, et remanebunt vires $D \times c \times \overline{-\frac{4kb^3}{5l^5} + \frac{2khhb^3}{l^7}}$, $D \times c \times \overline{\frac{2hb^3}{5l^5} - \frac{2hkkb^3}{l^7}}$, motuum ſatellitis S perturbatrices. Deſignetur vis $D \times c \times$

$\overline{\frac{2bb^3}{5l^5} - \frac{2bbkb^3}{l^7}}$ per rectam Sr (*Fig.* 2.) ac reſolvatur in vim Sq tendentem ad centrum planetæ primarii C et ob triangula ſimilia Srq, SDC, æqualem $D \times c \times \overline{\frac{2b^3}{5l^4} - \frac{2kkb^3}{l^6}}$, exiſtentibus ut priùs, $SD = k$, $DC = b$, $SC = l$; et in vim rq rectæ SD parallelam et æqualem $D \times c \times \overline{\frac{2kb^3}{5l^5} - \frac{2k^3b^3}{l^7}}$; atque hæc vis poſterior ſubducta ex vi $D \times c \times \overline{-\frac{4kb^3}{5l^5} + \frac{2kbbb^3}{l^7}}$ relinquet $D \times c \times \frac{4kb^3}{5l^5}$ pro vi perturbatrice in directione SD. Unde cum maſſa tota planetæ ſit $\frac{2abD}{3}$, gravitas ſatellitis tota in planetam erit $\frac{2abD}{3l^2}$ proximé, vel etiam $\frac{2bbD}{3l^2}$, et hæc gravitas eſt ad vim $D \times c \times \frac{4kb^3}{5l^5}$ ut 1 ad $\frac{6kbc}{5l^3}$.

Deinde vis illius $D \times c \times \frac{4kb^3}{5l^5}$ ſecundum SD pars ea quæ agit in directione SC eſt $D \times c \times \frac{4kkb^3}{5l^6}$, quæ addita vi Sq dat $D \times c \times \overline{\frac{2b^3}{5l^4} - \frac{6kkb^3}{5l^6}}$ vim perturbatricem tendentem ad centrum planetæ primarii, atque hæc vis eſt ad ſatellitis gravitatem $\frac{2bbD}{3l^2}$ in primarium ut $\frac{3bc}{5l^2} - \frac{9kkbc}{5l^4}$ ad 1. *Q. E. I.*

Coroll.

Deſignet CK (*Fig.* 3.) lineam interſectionis planorum æquatoris planetæ et orbitæ ſatellitis, et reſolvatur vis $SD = \frac{6kbc}{5l^3}$, quæ agit perpendiculariter ad planum æquatoris, in vim DR perpendicularem ad planum orbitæ ſatellitis, et in vim SR jacentem in eodem plano. Producatur SR donec occurrat CK in K, eritque SK normalis ad CK, et planum SDK normale ad planum orbis ſatellitis; ac propterea ob ſimilia triangula SDK, SRD, ſi m denotet ſinum ad radium 1 et n coſinum anguli SKD, inclinationis ſcilicet orbitæ ſatellitis ad æquatorem planetæ, erit $DR = SD \times n = \frac{6kbcn}{5l^3}$, et $SR = SD \times m = \frac{6kbcm}{5l^3}$, exiſtente 1 gravitate totâ ſatellitis in primarium ſuum. Jam quoniam vis SR jacet in plano orbitæ ſatellitis, hujus plani ſitum non mutat; accelerat quidem vel retardat motum ſatellitis revolventis, ſed hæc acceleratio vel retardatio ob brevitatem temporis ad quantitatem ſenſibilem non exurgit: vis DR eidem plano perpendicularis continuò mutat ejus ſitum, et motum nodi generat, quem ſequenti propoſitione definiemus.

PROPOSITIO II.

Problema.

Invenire motum nodi ex prædictâ cauſâ oriundum.

Per motum nodi in hac propoſitione intelligo motum interſectionis planorum æquatoris planetæ et orbitæ ſatellitis; orbitam autem ſatellitis quamproximè circularem ſuppono. Eſto S locus ſatellitis in orbe ſuo SN cujus centrum C, (*Fig.* 4.) SF arcus centro C deſcriptus perpendicularis in circulum æquatoris planetæ FN; SB arcus eodem centro deſcriptus perpendicularis ad orbem SN, atque in SB ſumatur lineola Sr æqualis duplo ſpatio, quod ſatelles percurrere poſſet impellente vi DR in Coroll. præced.

 deter-

determinatâ, quo tempore in orbe ſuo deſcriberet arcum quàm minimum pS: per puncta r, p, deſcribatur centro C circulus rpn ſecans equatorem in n, qui exhibebit ſitum orbitæ ſatellitis poſt illam particulam temporis, nodo N tranſlato in n. Agantur SC, CN, et SH perpendicularis in lineam nodorum CN, et Nm perpendicularis in rpn. Jam cum ſint lineolæ Sr, Nm, ut ſinus arcuum Sp, SN, erit Sp. Sr :: SH . Nm; deinde in triangulo rectangulo Nmn habetur m . 1 :: Nm . Nn; unde per compoſitionem rationum S$p \times m$. Sr :: SH . N$n = \frac{Sr \times SH}{Sp \times m}$: dato igitur arcu S$p$, eſt N$n$ ſive motus nodi ut S$r \times$ SH. In triangulo ſphærico rectangulo SFN eſt ſinus anguli N, hoc eſt, anguli inclinationis orbitæ ſatellitis ad æquatorem planetæ, ad ſinum arcûs SF, ut radius ad ſinum arcûs SN, id eſt, $m . \frac{k}{l}$ :: 1 . SH, adeoque $\frac{k}{l} = m \times$ SH; eſt igitur $\frac{k}{l}$ ut SH. Vis autem Sr per Coroll. Prop. præced. eſt ut $\frac{k}{l}$, adeoque ut SH; quamobrem eſt S$r \times$ SH, proindeque et Nn, ut $\overline{SH}^2$, hoc eſt, motus horarius nodi vi præfatâ genitus eſt in duplicatâ ratione diſtantiæ ſatellitis à nodo. Et quoniam ſumma omnium $\overline{SH}^2$, quo tempore ſatelles periodum ſuam abſolvit, eſt dimidium ſummæ totidem $\overline{SC}^2$, ideò motus periodicus eſt ſubduplus ejus qui, ſi ſatelles in declinatione ſuâ maximâ ab æquatore planetæ continuò perſtaret, eodem tempore generari poſſet. Sit igitur ſatelles in maximâ ſuâ declinatione ſive in quadraturâ cum nodo, eritque SN quadrans circuli, et Nm menſura anguli Npm ſive Spr, eritque in hoc caſu Nn ſive motus horarius nodi ad Nm, hoc eſt, ad angulum Spr, ut 1 ad m;

eſt autem angulus Spr ad duplum angulum, quem ſubtendit ſinus verſus arcûs Sp ſatellitis gravitate in primarium eodem tempore deſcripti, id eſt, ad angulum SCp qui eſt motus horarius ſatellitis circa primarium, ut vis Sr ad gravitatem ſatellitis in primarium, hoc eſt (per Coroll. Prop. I.), ut $\frac{6kbcn}{5l^3}$ ad 1, ſive, quia eſt in hoc caſu $\frac{k}{l} = m$, ut $\frac{6bcmn}{5l^2}$ ad 1. Unde conjunctis rationibus eſt motus horarius nodi ad motum horarium ſatellitis ut $\frac{6bcn}{5l^2}$ ad 1; et ſi S denotet tempus periodicum ſolis apparens, et L tempus periodicum ſatellitis circa primarium ſuum, cum ſit motus horarius ſatellitis ad motum horarium ſolis ut S ad L, erit motus horarius nodi ad motum horarium ſolis ut $\frac{6bcn}{5l^2} \times \frac{S}{L}$ ad 1, et in eadem ratione erit motus nodi annuus ad motum ſolis annuum, hoc eſt, ad 360°. Quarè, ſi ſatelles maneret toto anno in maximâ ſuâ declinatione ab æquatore primarii, vis prædicta ex figurâ ſphæroidicâ planetæ primarii proveniens generaret eodem tempore motum nodi æqualem $\frac{6bcn}{5l^2} \times \frac{S}{L} \times 360°$, et ex ſupradictis motus verus nodi annuus erit hujus ſubduplus, nempe $\frac{3bcn}{5l^2} \times \frac{S}{L} \times 360°$. *Q. E. I.*

Coroll.

Si computatio inſtituatur pro lunâ, aſſumendo mediocrem ejus orbitæ inclinationem ad æquatorem terreſtrem, erit n coſinus anguli $23° \, 28'\frac{1}{2}$; et poſito ſemiaxi terræ $b = 1$, erit diſtantia lunæ à centro terræ mediocris $l = 60$ circiter, indeque in hypotheſi quod ſit

ſit differentia ſemiaxium $c = \frac{1}{229}$, erit $\frac{3bcn}{5l^2} \times \frac{S}{L} \times 360° = 11''\frac{1}{2}$; et ſi fuerit $c = \frac{1}{177}$, manente terrâ uniformiter denſâ, erit ille motus $= 15''$. Hic erit motus nodorum annuus lunæ regreſſivus in plano æquatoris terreſtris, qui reductus ad eclipticam, uti poſteà docebitur, pro vario nodorum ſitu evadet multò velocior.

Notabilis multò magis erit motus interſectionis orbitarum ſatellitum Jovis in plano æquatoris Jovialis; et computabitur ſatis accuratè per formulam ſuprà traditam, modò ſatelles non ſit Jovi nimis vicinus. Sic pro ſatellite extimo erit $L = 16^d\ 16^h\ 32'$, $b = 1$, $l = 25{,}299$ circiter, ſemiaxium Jovis differentia $c = \frac{1}{13}$; et poſitâ orbis hujus ſatellitis inclinatione ad æquatorem Jovis æquali $3°$, erit n coſinus hujus inclinationis, atque inde prodibit $\frac{3bcn}{5l^2} \times \frac{S}{L} \times 360° = 34'$ circiter, motus ſcilicet nodorum annuus ſatellitis quarti in plano æquatoris Jovis in antecedentia. Si minùs vel magìs inclinatur orbis ad Jovis æquatorem, augeri vel minui debet hic motus in ratione coſinûs hujus inclinationis.

Cæterùm patet motum hunc nodorum in plano æquatoris planetæ primarii, æſtimando diſtantiam ſatellitis in ſemidiametris primarii, generatìm eſſe, dato tempore, in ratione compoſitâ, ex ratione directâ differentiæ ſemiaxium planetæ et coſinûs inclinationis orbis ſatellitis ad planetæ æquatorem, conjunctìm; et ex ratione inverſâ temporis periodici ſatellitis et quadrati diſtantiæ ſatellitis à centro planetæ, item conjunctìm.

PRO-

PROPOSITIO III.

PROBLEMA.

Motum nodorum Lunæ ſupra determinatum ad Eclipticam reducere.

Sunto NAD (*Fig.* 5.) æquator, AGE ecliptica ſecans æquatorem in A, E æquinoctium vernum, A autumnale, LGN orbis lunæ ſecans eclipticam in G et æquatorem in N, LD circulus maximus perpendicularis in æquatorem; et ſunto DN, LN, quadrantes circuli. Tempore dato vi prædictâ transferatur interſectio N in n, et deſcribatur circulus Lgn exhibens ſitum orbis lunaris poſt illud tempus, ſecetque eclipticam in g. Ut autem interſectiones N et G ſine verborum ambagibus diſtinguantur, priorem in poſterum vocabo *Nodum Æquatorium*, poſteriorem *Nodum Eclipticum*. Ductis itaque Nm, Gd, perpendicularibus in orbem lunæ, eſt Nn : Nm :: 1 : ſin. GNA, et Nm : Gd :: 1 : ſin. LG, itemque Gd : Gg :: ſin. Ggd : 1; unde conjunctis rationibus provenit Nn : Gg : : ſin. Ggd : ſin. GNA × ſin. LG, adeoque $Gg = Nn \times \frac{\text{ſin. GNA} \times \text{ſin. LG}}{\text{ſin. } Ggd}$. Scribantur s pro ſinu et t pro coſinu anguli Ggd, inclinationis ſcilicet orbitæ lunaris ad eclipticam, ad radium 1, v pro ſinu et u pro coſinu arcûs EG, p pro ſinu et q pro coſinu obliquitatis eclipticæ; atque per reſolutionem trianguli ſphærici GAN, habebitur coſ. GNA $= n = qt + psu$, indeque ſin. GNA $= \sqrt{1 - qqtt - 2pqstu - p^2s^2u^2}$; ſed ſcribi poteſt 1 pro t, et rejici terminus $p^2s^2u^2$ ob exiguitatem ſinûs s anguli

5°

$5° 8'\frac{1}{2}$, proindeque erit ſin. GNA $= \sqrt{pp - 2pqsu}$; præterea eſt ſin. GNA : ſin. GA ſive v :: ſin. GAN ſive p : ſin. GN, ideoque ſin. GN ſive coſ. LG $= \frac{pv}{\text{ſin. GNA}}$, et ſin. LG $= u - \frac{qsvv}{p}$, ac ſin. GNA × ſin. LG $= pu - qs$ quamproximé. Quarè fit Gg $=$ N$n \times \frac{pu - qs}{s}$, atque hic eſt motus nodorum lunarium tempore dato in plano eclipticæ: quod ſi tempus illud datum ſit annus ſolaris, habetur Nn $= \frac{3bcn}{5l^2} \times \frac{S}{L} \times 360°$, unde motus ille eclipticus nodorum annuus, nullâ habitâ ratione mutationis ſitûs nodorum ex aliâ cauſâ per id temporis factæ, fiet $\frac{3bc}{5l^2} \times \overline{qt + psu} \times \frac{pu - qs}{s} \times \frac{S}{L} \times 360°$, vel etiam $\frac{3bcq}{5l^2} \times \frac{pu - qs}{s} \times \frac{S}{L} \times 360°$ proximé. *Q. E. I.*

Quo motum nodi lunaris in hac propoſitione ad eclipticam reduximus, eodem prorſùs ratiocinio motus nodi ſatellitis cujuſvis ad orbitam planetæ primarii reducetur.

Coroll. I.

Exinde liquet nullum eſſe hunc motum nodi, ubi ſin. LG $= 0$, vel etiam ubi $pu = qs$, quod contingit ubi orbitæ lunaris arcus GN eclipticam et æquatorem æqualis eſt 90°, ſive ubi nodi lunares verſantur in punctis declinationis lunaris maximæ, ſive ubi arcus AG, cujus coſinus eſt u, evadit æqualis 78° 5′, id eſt, ubi nodus aſcendens lunæ verſatur in 11° 55′ Cancri, vel 18° 5′ Sagittarii. Eritque progreſſivus hic motus, id eſt, fiet ſecundum ſeriem ſignorum, dum nodus aſcendens lunæ tranſit retrocedendo ab

18°

18° 5′ Sagittarii ad 11° 55′ Cancri, regreſſivus autem in reliquâ parte revolutionis; et maximus evadit motus regreſſivus, ubi $u = -1$, id eſt, ubi nodus aſcendens verſatur in principio Arietis; et maximus progreſſivus, ubi $u = 1$, id eſt, ubi idem nodus occupat initium Libræ. Itaque cùm motus ille nodorum annuus, de quo hîc agitur, univerſaliter ſit æqualis $\frac{3bcq}{5l^2} \times \frac{pu - qs}{s} \times \frac{S}{L} \times 360°$, hoc eſt, per Coroll. Prop. 2. æqualis $11''\frac{1}{2} \times \frac{pu - qs}{s}$ vel $15'' \times \frac{pu - qs}{s}$ prout differentia ſemiaxium terræ fuerit $\frac{1}{229}$ vel $\frac{1}{177}$, exiſtentibus ſcilicet p ſinu et q coſinu anguli 23° 28′$\frac{1}{2}$, atque s ſinu anguli 5° 8′$\frac{1}{2}$; eo anno, in cujus medio circiter nodus lunæ aſcendens tenuerit principium Arietis, motus nodorum regreſſivus, qui et maximus, erit 1′ 2″ vel 1′ 20″; ubi verò idem nodus ſubierit ſignum Libræ, motus maximus progreſſivus erit 41″ vel 53″. In aliis nodorum poſitionibus eodem modo computabitur.

Coroll. II.

Si deſideretur exceſſus regreſſûs nodi ſupra progreſſum in integrâ nodi revolutione, ſequenti ratione inveſtigabitur. Jungantur equinoctia diametro EA, in quam demittatur perpendiculum GK, et ſumpto arcu Gh quem deſcribit nodus eclipticus G quo tempore nodus equatorius N deſcribit arcum Nn, ducatur hc perpendicularis in GK. Per hanc propoſitionem eſt $Gg \,.\, Nn :: \frac{pu - qs}{s} \,.\, 1$, ſive, quia eſt $1 \,.\, u :: Gh \,.\, Gc$, fit $Gg \,.\, Nn :: \frac{p \times Gc}{s} - q \times Gh \,.\, Gh$; adeoque ſumma omnium G$g$ erit ad ſummam omnium

nium Nn, hoc eſt, motus nodi ecliptici in integrâ ſui revolutione erit ad motum nodi æquatorii eodem tempore factum, ut ſumma omnium in circulo quantitatum $\frac{p \times Gc}{s} - q \times Gb$ ad ſummam totidem arcuum Gb, hoc eſt, ut $-q$ ad 1. Signum autem — denotat motum fieri in antecedentia ſive regreſſum nodi excedere ejuſdem progreſſum. Unde cum motus nodi æquatorii N ſit $11''\frac{1}{2}$ vel $15''$ quo tempore nodus eclipticus deſcribit $19^\circ\ 20'\frac{1}{2}$, motus ille nodi æquatorii tempore nodi ecliptici periodico evadit $11''\frac{1}{2} \times \frac{360^\circ}{19^\circ\ 20'\frac{1}{2}} = 3'\ 34''$ vel $15'' \times \frac{360^\circ}{19^\circ\ 20'\frac{1}{2}} = 4'\ 39''$; quo pacto prodit motus nodi ecliptici præfatus æqualis $q \times 3'\ 34''$ vel $q \times 4'\ 39''$, proindeque *eſt radius ad coſinum obliquitatis eclipticæ ut* $3'\ 34''$ *vel* $4'\ 39''$ *ad motum quæſitum*, nempe $3'\ 16''$, exiſtente $\frac{1}{229}$ differentiâ axium terræ, vel $4'\ 16''$ eâ exiſtente $\frac{1}{177}$: atque hic eſt exceſſus regreſſûs nodi ſupra progreſſum in integrâ nodi revolutione vi prædictâ genitus. Exceſſu igitur hoc minuatur motus nodi lunaris periodicus 360°, et remanebit motus ille quem generat vis ſolis.

PROPOSITIO IV.

PROBLEMA.

Variationem inclinationis orbis lunaris ad planum eclipticæ ex figurâ terræ ſpheroidicâ ortam determinare.

Eſto ANH (*Fig.* 6.) æquator, AG ecliptica, et A punctum æquinoctii autumnalis: ſit NGRM orbis lunæ ſecans eclipticam in G et æquatorem in N, in

quo ſumantur arcus NL, GR, æquales quadrantibus circuli. Jam ſi nodus æquatorius N per temporis particulam vi prædictâ transferri intelligatur in n, et per punctum L deſcribatur circulus n L r, exhibebit hic ſitum orbis lunæ poſt tempus elapſum, et ſi in eumdem demittantur perpendicula Nm et Rr, poſterius Rr deſignabit variationem inclinationis orbitæ lunaris ad eclipticam eodem tempore genitam. Eſt autem Nn : Nm :: 1 : m, itemque Nm : Rr :: 1 : ſin. LR; ſed ob NL = GR, eſt NG = LR; unde conjunctis rationibus eſt Nn : Rr :: 1 : m × ſin. NG; ex quo patet variationem inclinationis momentaneam eſſe proportionalem ſinui diſtantiæ nodi lunaris ecliptici à nodo æquatorio. Ad diametrum NM demittatur perpendiculum GK, et exiſtente Gh decremento arcûs NG facto quo tempore nodus æquatorius N deſcribit arcum Nn, agatur hk parallela ipſi GK, eritque 1 : GK ſive ſin. NG :: Gh . Kk; proindeque jam erit Nn : Rr :: Gh : m × Kk, adeoque ſumma omnium variationum Rr, quo tempore nodus eclipticus G deſcripſit arcum MG, genitarum erit ad ſummam totidem motuum Nn, hoc eſt, ad motum nodi æquatorii N eodem tempore factum, ut ſumma omnium Kk ducta in m, ad ſummam totidem arcuum Gh, id eſt, ut m × MK ad MG. Sit NH motus nodi N tempore revolutionis nodi G ab uno equinoctio ad alterum, eritque variatio inclinationis eodem tempore genita, hoc eſt, variatio tota æqualis $\frac{2m \times NH}{MGN}$.
Unde cùm $\frac{NH}{MGN}$ exprimat rationem motûs nodi æquatorii ad motum nodi ecliptici, prodit theorema ſequens: *Eſt motus nodi lunaris ecliptici ad motum nodi æquatorii, ut ſinus duplicatus inclinationis medio-*

cri

cris orbitæ lunaris ad æquatorem, ad ſinum variationis totius inclinationis ejuſdem orbitæ ad eclipticam.

In hoc computo inclinationem mediocrem orbis lunaris ad æquatorem, nempe $23^\circ\ 28'\frac{1}{2}$, uſurpo, cum in revolutione nodi tantum ex unâ parte augetur, quantum ex alterâ minuitur, et omnes minutias hîc expendere ſupervacaneum foret. Motus autem nodi lunaris ecliptici eſt ad motum nodi lunaris æquatorii ut $19^\circ\ 20'\frac{1}{2}$ ad $11''\frac{1}{2}$ vel $15''$, ſive ut 6055 vel 4642 ad 1, unde per theorema ſupra traditum prodit variatio inclinationis tota æqualis $27''$ vel $35''$, prout differentia axium terræ ſtatuitur $\frac{1}{229}$ vel $\frac{1}{177}$. Hac igitur quantitate augetur inclinatio orbis lunaris ad eclipticam in tranſitu nodi aſcendentis lunæ ab æquinoctio vernali ad autumnale, et tantumdem minuitur in alterâ medietate revolutionis nodi. In loco quolibet G inter æquinoctia variatio inclinationis eſt ad variationem totam ut ſinus verſus arcûs MG ad diametrum, ut patet; ſive differentia inter ſemiſſem variationis totius et variationem quæſitam eſt ad ipſam ſemiſſem variationis totius ut coſinus arcûs MG ad radium, hoc eſt, ut $u - \frac{qsvv}{p}$ ad 1. *Q. E. I.*

PROPOSITIO V.

PROBLEMA.

Motum apſidum in orbe ſatellitis quamproximè circulari, quatenùs ex figurâ planetæ primarii ſphæroidicâ oritur, inveſtigare.

Per propoſitionem primam vis perturbatrix, quâ trahitur ſatelles ad centrum planetæ primarii, eſt ad ſatellitis gravitatem in ipſum primarium, ut $\frac{3bc}{5l^2} - \frac{9kkbc}{5l^4}$ ad 1, ſive, quia per Prop. 2. eſt $\frac{k}{l} = m \times SH$ (*Fig.* 4.) ponendo ſcilicet m pro ſinu inclinationis orbitæ ſatellitis ad æquatorem primarii, et ſcribendo y pro SH, ut $\frac{3bc}{5l^2} \times \overline{1 - 3m^2y^2}$ ad 1; et ſumma harum virium in totâ circumferentiâ cujus radius eſt 1, eſt ad gravitatem ſatellitis toties ſumptam ut $\frac{3bc}{5l^2} \times \overline{1 - \frac{3m^2}{2}}$ ad 1. Vis igitur mediocris, quæ uniformiter agere in ſatellitem ſupponi poteſt, dum revolutionem ſuam in orbitâ propemodùm circulari abſolvit, eſt ad ejus gravitatem in primarium ut $\frac{3bc}{5l^2} \times \overline{1 - \frac{3m^2}{2}}$ ad 1; atque hac vi movebuntur apſides, ſi nulla habeatur ratio vis alterius quæ orbis radio eſt perpendicularis et per medietatem revolutionis ſatellitis in unum ſenſum tendit, per alteram medietatem in contrarium. Jam quia ex demonſtratis in hac et primâ propoſitione ſequitur gravitatem ſatellitis circa planetam, cujus figura eſt ſphærois oblata, revolventis in diſtantiâ l generaliter eſſe ad ejuſdem gravitatem in majori diſtantiâ L, ut $\frac{1}{l^2} + \frac{B}{l^4} \times \overline{1 - \frac{3m^2}{2}}$ ad $\frac{1}{L^2} + \frac{B}{L^4} \times \overline{1 - \frac{3m^2}{2}}$, exiſtente B quantitate datâ exigui valoris, ſive ut $\frac{1}{l^2}$ ad $\frac{1}{L^2} - \frac{B}{l^2L^2} \times \overline{1 - \frac{3m^2}{2}} + \frac{B}{L^4} \times \overline{1 - \frac{3m^2}{2}}$ quamproximè, ideò gravitas ſatellitis diminuitur in majori quam duplicatâ ratione diſtantiæ auctæ quoties m minor eſt quantitate $\sqrt{\frac{2}{3}}$, id eſt, ubi inclinatio orbitæ ſatellitis ad planetæ æquatorem non attingit 54° 44′;

44′; diminuitur autem in minori ratione, quoties eſt m major quàm $\sqrt{\frac{2}{3}}$, id eſt, ubi illa inclinatio ſuperat 54° 44′; adeoque in priore caſu progrediuntur apſides orbis ſatellitis, in poſteriori regrediuntur. Quantitas autem hujus progreſſûs vel regreſſûs ſic innoteſcet.

Per exemplum tertium prop. 45. lib. 1. *Princ. Math. Newt.* ſi vi centripetæ, quæ eſt ut $\frac{1}{l^2}$, addatur vis altera ut $\frac{e}{l^4}$, hoc eſt, quæ ſit ad vim centripetam $\frac{1}{l^2}$ ut $\frac{e}{l^2}$ ad 1, angulus revolutionis ab apſide unâ ad eamdem erit $360° \sqrt{\frac{1+e}{1-e}}$ vel $\frac{360°}{1-e}$ quamproximé, exiſtente e quantitate valdé minutâ. Porrò cum ſit motus ſatellitis in orbitâ ſuâ revolventis ad motum apſidis ut $\frac{360°}{1-e}$ ad $\frac{360°}{1-e} - 360°$, hoc eſt, ut 1 ad e, erit motus apſidis tempore revolutionis ſatellitis ad ſidera æqualis $360° \times e$, et hic motus apſidis erit ad ejuſdem motum tempore alio quovis dato ut tempus periodicum ſatellitis ad tempus datum. Eſt autem in hac noſtrâ propoſitione $e = \frac{3bc}{5l^2} \times \overline{1 - \frac{3m^2}{2}}$; unde datur motus apſidum quæſitus. *Q. E. I.*

Coroll.

Si ad lunam referatur hæc determinatio, habebuntur $b = 1$, $l = 60$, $m =$ ſinui anguli 23° 28′½, et ſi fuerit $c = \frac{1}{229}$, erit $e = \frac{1}{1803203}$, atque motus apogæi lunæ ſpatio centum annorum æqualis 16′ proximé in conſequentia; ſi fuerit $c = \frac{1}{177}$, erit $e = \frac{1}{1393742}$, et motus apogæi æqualis 20′, 7. Hac igitur quantitate minuendus eſt motus medius apogæi lunæ

prout

prout obſervationibus determinatur, ut habeatur motus ille quem generat vis ſolis.

Pro quarto autem Jovis ſatellite, erunt $b=1$, $l=25{,}299$, $c=\frac{1}{13}$, $m=$ ſinui anguli 3°, $e=\frac{1}{13924{,}7}$; hincque motus apſidis ſpatio unius anni ſolaris prodit $33'{,}95$ vel ferè $34'$ in conſequentia, qui tempore annorum decem fit $5^{\circ}\ 40'$. Inſuper autem notandum eſt vi ſolis perturbari motum ſatellitis ſimili modo quo perturbatur motus lunæ; ideoque, quoniam vis ſolis, quâ perturbatur motus lunæ eſt ad lunæ gravitatem in terram in duplicatâ ratione temporis periodici lunæ circa terram ad tempus periodicum terræ circa ſolem, hoc eſt, ut 1 ad 178,725; pariter vis ſolis, qua perturbatur motus ſatellitis Jovialis, eſt ad ipſius ſatellitis gravitatem in Jovem in duplicatâ ratione temporum periodicorum ſatellitis circa Jovem et Jovis circa ſolem, hoc eſt, ut 1 ad 67394,6: vires igitur, quibus perturbantur motus lunæ et ſatellitis, ſunt ad ſe invicem, relativé ad eorum gravitates in planetas ſuos primarios ut $\frac{1}{178{,}725}$ ad $\frac{1}{67394{,}6}$ ſive ut 37,708 ad 1. Unde cum viribus ſimilibus proportionales ſunt motus his viribus dato tempore geniti, ſi vis prior vel ejuſdem vis pars quælibet motum apſidis generat æqualem $40^{\circ}\ 40'\frac{1}{2}$ in orbe lunari annuatìm, vis poſterior vel ejuſdem pars ſimilis et proportionalis motum apſidis eodem tempore generabit æqualem $6'\frac{1}{2}$ in orbe ſatellitis, atque decem annorum ſpatio $1^{\circ}\ 5'$ in conſequentia. Addatur $1^{\circ}\ 5'$ ad $5^{\circ}\ 40'$, et motus apſidum totus in orbe ſatellitis extimi Jovialis ex duabus prædictis cauſis oriundus ſpatio decem annorum erit $6^{\circ}\ 45'$ in conſequentia. Obſervationibus Aſtronomicis collegit Ill. *Bradleius* hunc motum tempore prædicto eſſe quaſi 6°; differentia illa qualiſcumque

liſcumque 45′ inter motum obſervatum et computatum actionibus ſatellitum interiorum debebit aſcribi.

SCHOLIUM.

Ex præcedentibus colligere licet motuum lunarium inæqualitates originem ſuam omnem non ducere ex vi ſolis, ſed earum partem aliquam deberi actioni Telluris quatenùs induitur figurâ ſphæroidicâ. Sufficiat hîc illarum computaſſe valorem, et legem, quâ generantur, demonſtraſſe: utrum autem hujuſmodi correctiones tales ſint ut tabulis Aſtronomicis inſcribi mereantur, dijudicent Aſtronomi.

Item manifeſtum eſt præter inæqualitates eas, quæ in motibus ſatellitum Jovialium ex vi ſolis et actionibus ſatellitum in ſe invicem naſcuntur, oriri alias ex figurâ Jovis ſphæroïdicâ ità notabiles ut Obſervationes Aſtronomicas continuò afficere debeant.

De Variatione motûs Terræ diurni.

Si terra globus eſſet omninò ſphæricus quicumque foret revolutionis axis, manente eâdem in globo motûs quantitate, eadem maneret rotationis velocitas: ſecùs autem eſt, ubi ob vires ſolis et lunæ terra induit formam ſphæroidis oblongæ per aquarum aſcenſum. Hîc enim non conſidero figuram telluris oblatam ob materiæ in æquatore redundantiam, ſed ſphæricam ſuppono niſi quatenùs per aquarum elevationem et depreſſionem in ſphæroidicam mutatur. Jam verò in ſphæroide hujuſmodi, quamvis eadem maneat motûs quantitas, mutatâ inclinatione axis tranſverſi ad axem revolutionis, mutabitur revolutionis velocitas, uti ſatis manifeſtum eſt: cùm autem axis tranſ-

tranſverſus tranſit ſemper per ſolem vel lunam, ſingulis momentis mutabit ſitum ſuum reſpectu axis revolutionis ob motum quo hi duo planetæ recedunt ab æquatore terreſtri et ad eum viciſsìm accedunt.

Problema.

Variationem motûs terræ diurni ex prædictâ cauſâ oriundam inveſtigare.

Exhibeat ſphærois oblonga ADCd (*Fig.* 7.) terram fluidam, cujus centrum T, AC axis tranſverſus jungens centra terræ et ſolis vel lunæ, Dd axis minor, EO diameter æquatoris, et XZ axis motûs diurni. Centro T et radio TD deſcribatur circulus BDd ſecans axem tranſverſum AC in B, et agatur BK perpendicularis in TE: tum ex quovis circuli puncto P ductâ PM ad axem XZ normali quæ ſecet TA in H, ſit Ppr circumferentia circuli quam punctum P rotatione ſuâ diurnâ deſcribit, ad cujus quodvis punctum p ducatur Tp et producatur donec occurrat ſuperficiei ſphæroidis in q; deinde demiſſâ pG perpendiculari in PM, et GF perpendiculari in TA, ſi per puncta AqC tranſire intelligatur ellipſis ellipſi ADC ſimilis et æqualis, erit ex naturâ curvæ, quia ſphærois noſtra parùm admodùm differt à ſphærâ, $pq = AB \times \frac{\overline{TF}^2}{\overline{TP}^2}$ quamproximé. Jam deſignet U velocitatem particulæ in terræ æquatore revolventis motu diurno circum axem XZ ad diſtantiam ſemidiametri TP, eritque $\frac{U \times PM}{TP}$ velocitas particulæ P circulum Ppr deſcribentis, et cum ſit $TF = \frac{\overline{GM - HM} \times TK}{TP} + TH$, erit

motus

motus totius lineolæ pq æqualis $pq \times \frac{U \times PM}{TP} = \frac{U \times AB \times PM}{\overline{TP}^3} \times \frac{\overline{\overline{GM - HM} \times \overline{TK}^2}}{TP} + TH$, adeoque ſumma horum motuum in circuitu circuli Ppr, hoc eſt, motus ſuperficiei inter circulum Ppr et ſphæroidem in directione Tp contentæ, æquabitur circumferentiæ hujus circuli ductæ in $\frac{U \times AB \times PM}{\overline{TP}^3} \times \overline{\frac{\overline{TK}^2 \times \overline{PM}^2}{2\,\overline{TP}^2} + \frac{\overline{TK}^2 \times \overline{HM}^2}{\overline{TP}^2} - \frac{2\,TK \times HM \times TH}{TP} + \overline{TH}^2}$ ſive quia eſt $HM . TM :: TK . BK$, et $TH . HM :: TP . TK$, ſcribendo D pro circumferentiâ circuli BDd, æquabitur ille motus quantitati $\frac{U \times AB \times D}{2\,\overline{TP}^6} \times \overline{\overline{TK}^2 \times \overline{PM}^4 + 2\,\overline{BK}^2 \times \overline{TM}^2 \times \overline{PM}^2}$. Deinde horum motuum ſumma in toto circuitu globi collecta, hoc eſt, motus totius materiæ globo BDd incumbentis prodibit æqualis $\frac{U \times AB \times DD}{32} \times \frac{3\,\overline{TP}^2 - \overline{BK}^2}{\overline{TP}^2}$. Ubi planeta in plano æquatoris conſiſtit, fit $BK = 0$, et motus prædictus æqualis $\frac{U \times 3AB \times DD}{32}$. Motus autem globi QPR circa eundem axem eſt (uti facilé demonſtratur) $\frac{U \times TP \times DD}{16}$, adeoque motus terræ totius fit $\frac{U \times TP \times DD}{16} + \frac{U \times AB \times DD}{32} \times \frac{3\,\overline{TP}^2 - \overline{BK}^2}{\overline{TP}^2}$, qui cum idem ſemper manere debeat, denotet V velocitatem in ſuperficie æquatoris terreſtris ubi planeta verſatur in plano æquatoris, eritque $\frac{U \times TP \times DD}{16} + \frac{U \times 3AB \times DD}{32} =$

$\frac{U \times TP \times DD}{16} + \frac{U \times AB \times DD}{32} \times \frac{3\overline{TP}^2 - \overline{BK}^2}{\overline{TP}^2}$; unde ſcribendo 1 pro TP quatenùs eſt radius ad ſinum BK anguli BTK, habetur $V . U :: TP + \frac{3AB}{2} - \frac{AB \times \overline{BK}^2}{2} . TP + \frac{3AB}{2}$, indeque, quia minima eſt altitudo AB reſpectu ſemidiametri TP, $U - V . V :: AB \times \overline{BK}^2 . 2TP$, et $U - V = V \times \frac{AB \times \overline{BK}^2}{2TP}$: pro V autem patet ſcribi poſſe velocitatem angularem terræ mediocrem quia ab eâ differt quàm minimé et ducitur in quantitatem perexiguam $\frac{AB \times \overline{BK}^2}{2TP}$, et quia tempora revolutionum terræ circa centrum ſuum ſint reciprocé ut motus angulares U, V, fiet differentia revolutionum terræ ubi planeta æquatorem tenet et ubi ab æquatore diſtat angulo BTK, æqualis $23^h\ 56' \times \frac{AB \times \overline{BK}^2}{2TP}$. Quoniam igitur eſt acceleratio horaria ad motum terræ horarium mediocrem circa centrum ſuum ut $AB \times \overline{BK}^2$ ad 2 TP ſive (quia eſt ſinus p inclinationis eclipticæ ad æquatorem ad radium 1 ut ſinus BK ad ſinum diſtantiæ planetæ ab æquinoctio, quem ſinum dico K) ut $AB \times p^2 \times K^2$ ad 2 TP; adeoque acceleratio horaria rotationis terræ creſcit in ratione duplicatâ ſinûs diſtantiæ planetæ à puncto æquinoctii, et ſumma omnium illarum accelerationum, quo tempore tranſit planeta ab æquinoctio ad ſolſtitium, eſt ad ſummam totidem motuum horariorum mediocrium, hoc eſt, acceleratio tota eo tempore genita eſt ad tempus illud ut ſumma quantitatum omnium $AB \times p^2 \times K^2$ in circuli quadrante ad ſummam

mam totidem 2 T P, id eſt, quia ſumma omnium K^2 in circuli quadrante dimidium eſt ſummæ totidem quadratorum radii, ut $AB \times p^2$ ad 4 TP. Quamobrèm, ſi denotet P quartam partem temporis planetæ periodici circa terram, erit acceleratio tota motûs terræ circum axem ſuum in tranſitu planetæ ab æquinoctio ad ſolſtitium genita æqualis $\frac{AB \times P \times p^2}{4\ TP}$, atque eadem erit retardatio in tranſitu planetæ à ſolſtitio ad æquinoctium. Unde ſponte naſcitur hoc Theorema: *Eſt quadratum diametri ad quadratum ſinûs obliquitatis eclipticæ ut quarta pars temporis periodici ſolis vel lunæ ad tempus aliud*; deinde, *eſt ſemidiameter terræ ad differentiam ſemiaxium ut tempus mox inventum ad accelerationem quæſitam.*

Aſcenſus aquæ AB vi ſolis debitus eſt duorum pedum circiter, exiſtente ſemidiametro terræ mediocri TP = 19615800, unde prodit per theorema acceleratio terræ circa centrum ſuum gyrantis facta quo tempore incedit ſol ab æquinoctio ad ſolſtitium, æqualis 1‴ 55^{iv} in partibus temporis; et ſi vi lunæ aſcendunt aquæ ad altitudinem octo pedum, acceleratio revolutionis terræ inde orta, quo tempore luna tranſit ab æquatore ad declinationem ſuam maximam, erit 34^{iv}: et ſumma harum accelerationum, quæ obtinet ubi hi duo planetæ in punctis ſolſtitialibus verſantur, cùm non ſuperet duo minuta tertia temporis cum ſemiſſe ſive 37 minuta tertia gradûs, vix obſervabilis erit. *Q. E. I.*

Cùm igitur tantilla ſit hujuſmodi variatio in hypotheſi ſphæricitatis terræ; qualis evaderet, terrâ exiſtente ſphæroide oblatâ, fruſtrà quis inquireret.

CXI. *Some Observations on the History of the* Norfolk *Boy. By* J. Wall, *M. D. In a Letter to the Rev.* Charles Lyttelton, *LL. D. Dean of* Exeter.

SIR,

Read Dec. 14, 1758.

THE history of the Norfolk Boy, which, you inform me, has been communicated to the Royal Society, seems to deserve a place in the memoirs of that illustrious body, as well on account of its utility, as its singularity.

The symptoms in this case most evidently arose from worms in the intestines; which often occasion unaccountable complaints, and frequently elude the most powerful medicines, as they did in the instance before us, till at last they were dislodged by the enormous quantity of oil-paint, which the poor boy devoured; and the cause being thus removed, all the effects ceased.

At first sight it appears wonderful, that this immense quantity of white lead did not prove fatal; and that it was not so, could be owing to nothing but the oil, by which it was enveloped, and its contact and immediate action on the coats of the intestines thereby prevented. But the oil did not only obviate the dangerous effects of this mixture, but appears, to me at least, to have been the chief cause of the success, with which it was happily attended. I speak this with some restriction, because the lead, as its stypticity was thus covered, might, by its weight, assist in removing

removing the verminous filth, especially as the bowels were made slippery by the oil.

Oil has long been observed to be noxious to insects of all kinds, so that not only those, which survive after being cut into several pieces, but those also, which live long with very little air, and those, which revive by warmth after submersion in water, die irrecoverably, if they are immerged in, or covered with oil. Rhedi and Malpighi have made many experiments to this purpose; and account for the event very rationally from the oil stopping up all the air-vessels, which in these animalcula are very numerous, and distributed almost over their whole bodies.

On this account oil has been recommended as a vermifuge both by Andry and Hoffmann, though I believe it has been seldom used in practice in that intention; or at least has not been given in quantities sufficient to answer it. Indeed Hoffmann * himself seems

* Oleosis magna tribuitur efficacia, quæ maxime experimento Fr. Rhedi videtur confirmata, dum muscas et alia insecta variis liquoribus immersa in vivis permansisse refert, exceptis aliis oleo perunctis et infusis, quæ invicem mortua vitam non receperunt, licet radiis solaribus fuerint exposita. Equidem libenter concedo hæc omnia veritati esse consona, atque etiam oleosa, ut ol. oliv. rapar. et amygd. dulc. non sine fructu adhiberi: sed scire licet minime illa eo unquam scopo posse offerri, ut vermes enecent, quia admodum magna oleorum copia requireretur, si immediatè vermes per totum intestinorum volumen dispersos deberent extinguere. Multo magis oleosa in gravibus a lumbricis symptomatibus ideo censerem utilia, quia sensibiles intestinorum tunicas spasmo constrictas relaxant, et mucilagine quasi obliniunt atque defendunt, ut postea acriora quædam et purgantia remedia magis securè et sine læsione exhiberi possint. Ita ego sæpius mirabili cum effectu ad vermes enecandos et symptomata lenienda ol. amygd. d. ad aliquot cochlearia, imo ℥j vel

ſeems not to lay much ſtreſs on it as an anthelmintic, recommending it only as ſerving to line the inſide of the inteſtines, and to relax ſpaſms in them; and therefore as a proper preparative to be given before any acrid purgatives are ventured on.

The medicines commonly preſcribed, and moſt depended on, are either of a virulent and draſtic nature, or ſuch as are ſuppoſed to be able to deſtroy thoſe animals by ſome mechanical qualities *e. g.* to cut, tear, or otherwiſe affect their tender bodies, and yet not have force enough to lacerate or injure the ſtomach or inteſtines. Of the former kind are the leaves and juice of helleboraſter, the bark of the Indian cabbage-tree, coloquintida, reſin of jalap, glaſs of antimony, and the like; the effects of which are commonly violent and dangerous, and ſometimes fatal. Of the latter claſs are crude mercury, and the milder preparations of that mineral, aloes and other bitters, tin filings, neutral ſalts, and vitriolic acids. Every one converſant in practice too well knows, how often theſe medicines are adminiſtred ineffectually. When I had therefore attentively conſidered the hiſtory of the Norfolk Boy, I determined to try the efficacy of oil in ſuch caſes, as it ſeemed capable of producing great effects, and yet could not be attended with any hazard or danger.

The firſt perſon, to whom it was given, with this view, was ——— ———, a patient of our Infirmary,

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vel ℥ij circa lecti introitum vel ſummo mane pueris præſcripſi ſumendum, ſubjungendo aliquot horas poſt pilulas ex extracto panchymagogo Crollii, reſina jalappæ, et mercurio dulci paratas.
Hoffmann. Supplement. ad Med. Syſtemat. de Infant. Morb. cap. 10. *de Vermibus.*

who

who was judged to have worms, but had taken ſeveral approved medicines for a conſiderable time without ſucceſs. In a conſultation with the other phyſicians, the following form was preſcribed.

℞. *Ol. Oliv. lb.ſs. Sp. vol. aromat.* ℨij *M. cap. Cochl.* iii. *mane et H. S.*

The volatile ſpirit was added here to make the oil ſaponaceous, and by that means more eaſily miſcible with the juices in the ſtomach and *primæ viæ*. This medicine anſwered our expectations, and in a few days brought away ſeveral worms.

——— Lacy, a poor boy of the pariſh of Feckenham in this county, aged 13 years, was, as I was informed, about three or four years ago ſeized with convulſive fits, which gradually deprived him of his ſenſes, and reduced him to a ſtate of idiocy. He had taken ſeveral anthelmintics and purgatives, particularly the *Pulv. Cornachin.* but never had voided any worms, though all the ſymptoms ſeemed plainly to ſhew, that they were the cauſe of his diſorder. As he greedily ſwallowed any thing, which was offered him, without diſtinction, I at firſt ordered him a mixture of linſeed oil ℥vij *Tinct. ſacr.* ℥j: of which he took four large ſpoonfuls night and morning. He perſiſted in the uſe of this one whole week without at all nauſeating it, towards the latter end of which time, he voided one round worm of a great length. He now began to ſhew much averſion to the medicine; on which account the *Tinctur. ſacr.* was omitted, and he was ordered to take the oil alone in the ſame quantities. This he continued to do a fortnight longer, during which time he voided 60 more worms, and in

a great

a great meaſure recovered the uſe of his reaſon *. This account I had from the Apothecary, who, by my directions, ſupplied him with the medicines.

Soon after this I ordered the ſame medicine to be given to Elizabeth Abell, a poor girl in the ſame neighbourhood, reduced by epileptic fits to ſuch a ſtate of idiocy, as to eat her own excrements. It cauſed her to void ſeveral worms, but ſhe did not recover her ſenſes.

Since this time I have given the oil to ſeveral perſons with good ſucceſs, and therefore I cannot but recommend a further tryal of it; ſince it is a remedy, which may be uſed with ſafety in almoſt any quantity; a character, which very few of the anthelmintic medicines deſerve.

It is probable, that ſome oils are more deſtructive to worms than others. Andry (*Traité de la Generation des Vers, cap.* 8) prefers nut oil, and tells us, that a human worm, voided alive, being put into that oil, died inſtantly; whereas another worm, voided at the ſame time, lived ſeveral hours in oil of ſweet almonds, though in a languiſhing ſtate. This difference he afterwards (*Cap.* 9) endeavours to account for, by ſuppoſing, that the oil of almonds is more porous, and conſequently leſs able to preclude the entrance of air into the worms. And indeed there is ſome reaſon to conclude, that oils, which dry in the open air, ſuch as nut and linſeed oils, are of a cloſer texture, leſs mixed with water, and conſequently more anthelmin-

* I have ſince been informed, that the boy's parents being extremely poor, the medicines were left off as ſoon as he began to recover; and that, upon their diſuſe for ſome time, he was again attacked with the ſame fits as before.

tic,

tic, than thofe oils, which freeze by cold, and will not dry in the open air;* fuch as thofe from olives or almonds. Andry tells us, that at Milan the mothers have a cuftom to give their children once or twice a week toafts dipt in nut oil, with a little wine, to kill the worms: and I know a lady in the country, who gives the poor children in her neighbourhood the fame oil with great fuccefs.

I would recommend this remedy to be ufed in as large dofes as the ftomach will well bear: to which purpofe it may be adviseable to join it either with aromatics, bitters, or effential oils, fuch as the cafe may require. Andry orders the oil to be taken fafting, affigning this for a reafon, that the ftomach being then moft empty, it more readily embraces and ftifles the worms. During this courfe it will be neceffary, at proper intervals, to give rhubarb, mercurial or aloetic medicines.

I cannot clofe this paper without obferving, that, from the hiftory of the Norfolk Boy, we may learn, in fimilar cafes, where the head is not idiopathic, never to defpair abfolutely of a cure, notwithftanding the difeafe has been of very long ftanding. For in this boy, though the oppreffion in the brain and nerves had continued many years, and had been fo violent, as to deprive him not only of his intellectual faculties, but almoft all his fenfations; yet were not the organs much impaired thereby, but he recovered all his fenfes again, as foon as the irritation and fpafms

* All oils dry more readily after they have been boiled; by which the fuperfluous aqueous parts are carried off. Drying oils are alfo made by the addition of fuch fubftances, as abforb humidities.

in the inteſtines, which firſt cauſed all theſe terrible ſymptoms, were removed. The ſame thing in a leſs degree was obſervable in the Feckenham Boy, mentioned before; and we have had two remarkable inſtances of the ſame kind at the Worceſter Infirmary; where a boy and his ſiſter, of the name of Moyſes, received a perfect cure, and recovered the entire uſe of their ſenſes, after having been rendered idiots (though not in ſo high a degree as the Norfolk Boy) for more than two years, by epileptic fits proceeding from worms.

Worceſter
Dec. 7, 1748.

J. Wall.

P. S. As the following hiſtory has ſome analogy with the ſubject we are now upon, I beg leave to ſubjoin it by way of poſtcript.

A young girl of the name of Lowbridge, at Ledbury, in Herefordſhire, nine years old, had been long troubled with a gnawing pain at the ſtomach, which growing gradually more violent, I was at laſt called to her. About a quarter of an hour before I reached the houſe, ſhe was ſeized with a violent vomiting, whereby ſhe brought up an amazing number of living animals ſuppoſed, to be upwards of a thouſand, together with a vaſt quantity of clear viſcid phlegm. In ſhape they exactly reſembled millepedes, except that ſome of them, being examined by a magnifying glaſs, appeared to have a ſmall filament, which aroſe from the middle of the belly, and might probably have ſerved to fix them to their nidus. They were of different ſizes, from that of the largeſt millepede, to

ſome

ſome, that were ſcarce perceptible; ſo that they appeared to have been generated at different times, and grown in the ſtomach. As the child was ſuddenly ſeized with this effort to vomit, ſhe diſcharged her ſtomach on the floor of the parlour where ſhe was ſitting. The millepedes, they told me, were at firſt very lively, and crept briſkly different ways; but they did not live long in the open air. They were lying in the ſlime when I came to her, ſo that I could not be impoſed on as to the verity of the fact. After this evacuation, the child's ſtomach grew perfectly eaſy, and continued ſo.

CXII. *Obſervations upon the* Corona Solis Marina Americana; *The* American Sea-Sun-Crown. *By* John Andrew Peyſſonel, *M.D. F.R.S. Tranſlated from the* French.

Read Dec. 14, 1758.

I Shall call this inſect by this name, becauſe of the reſemblance it bears to the flower called *Corona Solis*; ſince it is, like this, open and ſpread.

This inſect adheres to the rocks by its baſis, which is flat and round; and tho' this roundneſs is ſometimes miſ-ſhapen, it is only occaſioned by the inequalities of the rocks, to which it ſticks. Its diameter is about two or three inches, bearing, from the center, certain rays, like white nerves, upon a moiſt fleſh, of a livid violet colour. Theſe rays or nerves paſs from the centre to the circumference; they, too, conſiſt

consist of a soft fleshy substance, which resembles bowels or intestines; the whole length of which is covered with glandulous bodies of a dirty grey colour; and all these glands filled up the middle of the fish, making the flowrets, or petals, that form the disk of the flowers. There is an infinite number of these glands attached to those filets or nerves, all very distinct from one another: these filets are well ranged when viewed downwards; but the upper part is covered by these glands, which are placed in a confused manner. These filets pass to the circumference, forming an edge full of rugosities, which leaves the body of the animal full of flaws. These hard bodies, upon which it lives, are not always permanent in the same place, but capable of changing their places from this edge or circumference; like a skin or texture of fibres or flesh, such as the body of the sea snail I have already described; of the same thickness, of a greenish colour, and sometimes of a greenish spotted grey, without shell, bone, or stay. The body or muscular fleshy skin raises itself up perpendicularly to three inches; rounds itself at the top, when it is touched; but it leaves a hole like a sphincter, formed by the reunion of the fleshy body, which enlarges itself again. The base opens to the whole extent of the bottom, makes a reversed prepuce, and immediately brings to view three rows of *papillæ*, which are of a conical figure, of one or two lines long, resembling the glands under the tongues of oxen, and which may here be compared to the demi-flowers or radiated flowers of the *Corona Solis*.

After this threefold ray of conical pointed *papillæ*, there appears a body of a livid violet colour; I took

it

Lepades Pedatæ.	Barnicles *with Stems.*
1. Lepas nuda carnosa aurita	1. Naked fleshy Barnicle with Ears.
1.a. Ejusdem pars superior interna	1.a. The inside of the upper part of the same.
1.b. Foramen auris internum	1.b. The internal opening of the Ear.
1.c. Cirrhi (1.d.) Proboscis et (1.e.) Os	1.c. The Plumes (1.d.) Trunck (1.e.) and Mouth.
1.f. Dens serratus, quorum octo sunt	1.f. A saw edg'd tooth of which there are 8.
1.g. Idem per Microscopium visus	1.g. The same magnified.
1.h. Scapus longitudinaliter dissectus	1.h. The Stem cut in two lengthways.
2. Scalpellum Norvegicum Keratophytum	2. The Norway Seafan Penknife.
2.a. Idem per Microscopium visum	2.a. The same magnified.
3. Scalpellum ex mari Britannico	3. The British Channel Penknife.
4. Cornu copia, Pousse-pieds Gallorum	4. The Horn of plenty, or French Poussepieds.
5. Concha Anatifera vulgaris	5. The common Duckbearing Barnicle.
6. Concha Anatifera prolifera	6. The branch'd Duckbearing Barnicle.
A. Animal Lepadis seu Triton Linnæi.	A. Animal of the Barnicle or Linnæus's Triton.

Lepades Sessiles Balani dictæ.	Barnicles *adhering by the base of their Shells.*
7. Pediculus Ceti (7.a.) Idem reversus	7. The Whales Louse (7.a.) The underside.
8. Calyciformis Orientalis	8. The East India cup shap'd Barnicle.
9. Tintinnabuliformis	9. The Bell shap'd Barnicle.
10. Tulipiformis ex Corallio rubro	10. The Red Coral Tulip Barnicle.
11. Fistulosa conica (11.a.) eadem reversa	11. The pipy conical Barnicle (11.a.) The underside.
12. Verruca Testudinaria (12.a.) eadem reversa	12. The Tortoise Wart (12.a.) The underside.
13. Verruca Cancri Americani (13.a.) eadem alatere	13. The American Crab's Wart (13.a.) The same sideway.
14. Capensis ore obliquo (14.a.) cum operculis cornutis	14. The Cape sidemouth Barnicle (14.a.) with horn'd covers.
15. Subovalis crassa, ore minore	15. The Egg shap'd thick Barnicle with a small mouth.
16. Cornubiensis conica, ore minore	16. The Cornish cone Barnicle with a small m...
17. Anglica vulgaris ore patulo	17. The common English Barnicle with a wide ...
18. Arctica Patelliformis	18. The Greenland Limpet shap'd Barn...
19. Calceolus (19.a.) Idem Keratophyto involutus	19. The Slipper (19.a.) The same covered with the ...
20. Diadema Persarum	20. The Persian Crown

it for a particular ſubſtance or body; but having examined it, I obſerved it was only a pellicle, or membrane, that covered a part of the *papillæ* I mentioned. This membrane has ſixteen ſeparations, which form kinds of purſes, and yet leave, in the center of the animal, an empty ſpace, wherein ſeveral glands are brought in view. I do not know, whether, in the natural ſtate, theſe membranes do not retire to the circumference, in order to diſcover the glands within, which they uſually hide, and which fill up all the middle of the crown; but when the fleſhy body is gone up again, it covers all the interior parts, cloſes them in, and preſerves them from the touch of any extraneous body. I cannot tell how theſe fiſhes live, or what is their mechaniſm; for I could not diſtinguiſh either a mouth, or any *viſcera*, nor any other organ ſerving to their nouriſhment.

CXIII. *An Account of ſeveral rare Species of Barnacles. In a Letter to Mr.* Iſaac Romilly, *F. R. S. from* John Ellis, *Eſq;* *F. R. S.*

Dear Sir, London, Dec. 21. 1758.

Read Dec. 21, 1758.

THOSE rare and very extraordinary new ſpecies of Barnacles, which you have lately received from abroad, are ſo different from any of the common ſpecies, that I have ſeen, that I was reſolved to inquire into the nature of an animal, which, like a Proteus, appears in ſo many different

different ſhapes or coverings in different parts of the the world. For this end I have conſulted that excellent collection in the Britiſh Muſeum, and ſome others in the cabinets of my curious friends.

In this inquiry I met with ſome very rare ones, which have not yet been deſcribed, as you will obſerve in the annexed plate [*See* TAB. XXXIV.], where I have given exact drawings of yours, as well as the other ſpecies of this genus.

This marine animal is called, by writers on natural hiſtory, Balanus, and Concha Anatifera: but the celebrated Profeſſor at Upſal, Dr. Linnæus, calls the internal active part, or fiſh, the Animal Triton, and the covering or teſtaceous habitation Lepas, which he ſays is a multivalved ſhell, compoſed of unequal valves. The Animal Triton he deſcribes, as having an oblong body, a mouth with a tongue in it, twiſted about in a ſpiral manner; ſixteen tentacula or claws: ſix of the hinder ones on each ſide, he ſays, are cheliferous.

This account differing from that given by the ingenious Mr. Turberville Needham, F. R. S. in his Microſcopical Eſſays, I ſhall give the character of this animal, as it appeared to me from the many obſervations I made on it, while alive in ſalt water; and theſe I compared not only with many dried ſpecimens of other varieties, but likewiſe with ſome of yours, that were preſerved in ſpirits; and I found that the parts of the animal agree in all the ſpecies.

The experiments, that I made, were on the common Engliſh Barnacle, which is very frequently met with, at this time of the year, on oyſters and other ſhell-fiſh. The microſcope, that I made uſe of to obſerve

obſerve it, was Mr. Cuff's aquatic one; where the animal, when taken out of the ſhell, may be put into the watch-glaſs with ſalt water, or ſpread on the round glaſs plate on the ſtage of the microſcope, and kept moiſt with a hair pencil and ſalt water during the time of obſervation: this will keep the claws and proboſcis alive and in motion for many hours together.

This animal has 24 claws, or cirrhi (*See Fig.* A), which are diſpoſed in the following manner: the 12 longeſt ſtand erect, ariſing from the back part of the animal: they are all joined in pairs near the bottom, and inſerted in one common baſe. Theſe appear like ſo many yellow curled feathers: they are clear, horny, and articulated. Every joint is furniſhed with two rows of hairs on the concave ſide. The animal, in order to catch its prey, is continually extending and contracting theſe arched hairy claws, which ſerve it for a net.

The 12 ſmalleſt claws are placed next to theſe, ſix on each ſide: theſe are divided into pairs; that is, two claws to one ſtem, like the chelæ or claws of the crab. Theſe are more pliable, and fuller of hairs, than the others, and ſeem to do the office of hands for the animal.

The whole number of claws leſſen in ſize gradually each way, from the talleſt in the back, to the laſt but one of each ſide in the front; which laſt two are of the middle ſize.

The proboſcis, or trunk, riſes from the middle of the baſe of the larger claws, and is longer than any of them: this the animal moves about in any direction with great agility: it is of a tubular figure,

tranſ-

tranſparent, compoſed of rings leſſening gradually to the extremity, where it is ſurrounded with a circle of ſmall briſtles, which likewiſe are moveable at the will of the animal. Theſe, with other ſmall hairs on the trunk, diſappear when it dies.

Along the inſide of this tranſparent proboſcis the ſpiral dark-coloured tongue appears very plain: this the animal contracts and extends at pleaſure.

The mouth appears like that of a contracted purſe, and is placed in front, between the fore claws. In the folds of this membraneous ſubſtance are ſix or eight horny laminæ or teeth ſtanding erect, each having a tendon proper to direct its motion. Some of theſe teeth are ſerrated, others have tufts of ſharp hairs inſtead of indentations on the convex ſide, that point down into the mouth; ſo that no animalcule that becomes their prey can eſcape back.

Under the mouth lie the ſtomach, inteſtines, and the tendons by which they adhere to the ſhell.

This then is the general character of the animal of the whole genus, whether with ſtems or without.

I ſhall now give you a ſhort deſcription of the ſeveral kinds I have met with, beſides thoſe of your own, and ſhall divide them into two kinds; thoſe that have ſtems, and thoſe that adhere by their ſhelly baſes.

The firſt and moſt remarkable of thoſe that have ſtems is the Barnacle, *Fig.* 1. This differs from the Lepas of Linnæus in not having a teſtaceous, only a cartilaginous or fleſhy covering. On the top of it are two erect tubular figures like ears: theſe have a communication with the internal parts of the animal (*See Fig.* 1. *b*). Theſe inner parts agree with the general

general character already given. The ſtem, which is here diſſected, was full of a ſoft ſpongy yellow ſubſtance, which appeared, when magnified, to conſiſt of regular oval figures, connected together by many ſmall fibres, and no doubt are the ſpawn of the animal.

This extraordinary animal (of which there were ſeven together) was found ſticking to the Whale Barnacle (*See fig.* 1. & 7.), by Mr. Smith of Stavenger in Norway, who cut both kinds together off a whale's lip, that was thrown upon that coaſt laſt year, 1757, and immediately immerſed them in ſpirits of wine; by which means we have been able more exactly to deſcribe them.

I have called this animal the Naked Fleſhy Barnacle with Ears; but it appears to claim the name of Triton rather than Lepas, according to Linnæus, as having no ſhelly habitation.

Fig. 2. is the next animal of this claſs: this is not yet deſcribed. I found ſeveral of them ſticking to the Warted Norway Sea Fan, which Dr. Pantoppidan, the Biſhop of North Bergen, ſent you: from its appearance, I have called it the Norway Sea Fan Penknife. The ſtem of this is covered with little teſtaceous ſcales. The upper part of the animal is incloſed in thirteen diſtinct ſhells, ſix on each ſide, beſides the hinge-ſhell at the back, which is common to both ſides: theſe are connected together by a membrane that lines the whole inſide. One of theſe is magnified a little at fig. 2. *a*, in order to expreſs the figure and ſituation of each ſhell the better.

Fig. 3. is taken from D'Argentville's *Lithologie*, *Pl.* 30. *fig.* H, who ſays it is found in the Britiſh channel

channel ſticking to ſea plants; and that theſe ſhells conſiſt of five pieces. This, from its appearance, I have called the Britiſh Channel Penknife, to diſtinguiſh it from the other.

Fig. 4. is a ſpecies of Barnacle called Pouſſepieds by the French, and deſcribed by Rondeletius as commonly found adhering to rocks on the coaſt of Brittany. He ſays the people there boil and eat the ſtem, which is firſt of a mouſe-colour, and afterwards becomes red like our prawns. There are many heads, that ariſe out of one ſtem, each of which conſiſts of two ſhells, in which are the ſame parts of the animal as in the other ſpecies. This I have called the Cornucopia Barnacle. Some of the ſhells of this Barnacle were drawn from a ſpecimen in the Britiſh Muſeum. This Lepas is the Mitella of Linnæus.

Fig. 5. and 6. are the Barnacles called Conchæ Anatiferæ: theſe are the ſorts ſo well known to ſailors, and formerly ſuppoſed to produce a large ſpecies of duck called a Barnacle. Theſe conſiſt of five ſhells. The tube, that ſupports one of theſe kinds, branches out like ſome ſpecies of corallines, bearing a ſhelled animal at the end of each branch. They are generally found adhering to pieces of wood in the ſea, and moſt ſhips have ſome of them ſticking to their bottoms. Thoſe of the ſouthern and warmer climates are generally of a larger kind than thoſe of the colder and more northern climates.

The next diviſion of theſe animals is, thoſe that adhere by the baſe of their ſhells, having no ſtems.

Here I muſt obſerve, that the bottoms of the ſeveral ſpecies of this diviſion conform in ſhape to the ſubſtances they adhere to, or graſp them in ſuch a peculiar

peculiar manner, as to render their ſituation ſecure from the violence of the element they live in. Another proviſion of nature for the ſecurity of theſe animals are the four opercula, which, upon their retreating into the great ſhell, they can draw to ſo cloſe after them, as to ſecure themſelves from outward danger.

Fig. 7. repreſents the Whale Barnacle, called Pediculus Ceti, juſt as it was cut off the whale's lip, with the ſeven naked Barnacles with ears, already deſcribed. *Fig*. 7. *a* is the bottom of the ſhell. This has the appearance of the gills of a muſhroom. All the ſpaces between theſe laminæ were filled with the blubber of the whale: by this means they adhere to the griſtly ſkin of the fiſh. The narrow cavities between the branched laminæ are the places where the ligaments or tendons, that move the opercula, are inſerted.

Fig. 8. is the Cup Barnacle, taken off an Eaſt India ſhip from Sumatra. The teſtaceous flat bottom of this was marked with the ſeams and lines of the ſheathing, and with the ruſt of the nails. In one of theſe ſhells the animal is repreſented protruding his claws thro' the opercula.

Fig. 9. is called the Bell-ſhaped Barnacle. This was taken off the bottom of a ſhip from Jamaica, and had its flat teſtaceous baſe marked as the former.

Fig. 10. This repreſents part of a moſt elegant ſpecimen in the curious collection of Dr. John Fothergill. It is called the Tulip Barnacle, and very properly, as well from the ſhape of its ſhell, as the beautiful ſtripes of red mixt with white. It adheres to a piece of the true red coral, and was fiſhed up near Leghorn, on the coaſt of Italy. It is not improbable, but that theſe groups of Barnacles, growing at the ſame time with the animals that formed the red coral, may have received an addition to their fine red colour from the coral.

Fig. 11. is a group of Barnacles of a conical form, compoſed of purpliſh tubes like ſmall quills. *Fig.* 11. *a* repreſents one of the ſame, with a view of its baſe, from the collection of Mr. Peter Collinſon, F. R. S. This was brought from the Eaſt Indies. The inſides of theſe ſhells have the appearance of the ſpongy parts of bones.

Fig. 12. is called the Tortoiſe-wart Barnacle, being often found upon that animal. This ſhell is of a plano-convex ſhape, and looks like poliſhed ivory. The diviſions between the valves repreſent a ſtar with ſix points. If theſe ſhells are put into ſoap lees, they will in a few hours ſeparate into ſix pieces or valves, each ſhelly valve having two ears, like the ſcallop-ſhell: ſo that this ſpecies has its valves connected by membranes, inſtead of teſtaceous ſutures, as moſt of the others have. *Fig.* 12. *a* repreſents the under part of the ſame ſhell.

Fig. 13. This ſhell is marked with ſix rays like a ſtar, as the former; but is much deeper in proportion to its diameter. Several of this kind were found ſticking to a crab, that was lately brought from the iſland of Nevis; from whence I have called it the American Crabs-wart.

Fig. 14. is called the Side-mouth Barnacle. This was found on the ſouthern coaſt of Africa, near the Cape of Good Hope, where it adheres to a particular ſpecies of ſtriated purple muſcle. *Fig.* 14. *a* repre-

ſents

ſents two of the opercula of this Barnacle remarkably horned. The ſhell of this is very thin; but its obliquity may probably be owing to its ſituation.

Fig. 15. This egg-ſhaped Barnacle with a ſmall mouth is found in cluſters ſticking to the Buccinum tribe of ſhells in the Weſt Indies.

Fig. 16. is the Corniſh Barnacle, ſhaped like a cone, and with a ſmall mouth. This is deſcribed and figured by the Rev[d]. Mr. William Borlaſe, F.R.S. in his Natural Hiſtory of Cornwall, lately publiſhed.

Fig. 17. This is the common Engliſh Barnacle, that is found in ſuch plenty upon all rocks and ſhells round this iſland. From the animal of this, examined in the microſcope, I have taken the character of the fiſh of the Barnacle genus.

Fig. 18. This I have called the Limpet-ſhaped Barnacle, from its likeneſs to ſome ſpecies of that ſhell. I am indebted to our late worthy member, Mr. Arthur Pond, for this ſhell, who aſſured me it was brought to him from Greenland. It was, with ſeveral more, found ſticking to a very large ſpecies of muſcle.

Fig. 19. *a.* This Sea-Fan, with the Barnacles incloſed in it, was brought from Gibraltar. I have called it the Slipper Barnacle, from its ſhape. *See Fig.* 19. Theſe ſhell-fiſh adhere, while they are young, to the ſlender branches, which are produced by the animals that compoſe this ſpecies of Sea-fan; and as the next ſucceſſion of young animals of this ſea-fan creep up its ſides, to increaſe the bulk and extenſion of theſe firſt-formed ramifications, they incloſe the ſhells all round, leaving only their mouths or apertures open, for the Barnacles to procure their food,

food. But it frequently happens, that the animals of the Sea-fans deſtroy theſe Barnacles, by overrunning and involving them in the very center of their ſtems. Theſe ſmall Barnacles, interſperſed here and there on the branches, have been taken for fruit or berries by ſome gentlemen, who look upon the internal or horny part of the Sea-fans to be vegetables.

Fig. 20. is a very curious Barnacle, taken from an elegant ſpecimen in the Britiſh Muſeum; which, from its figure, I have called the Perſian Crown.

I ſhall now add ſome further obſervations on the nature of theſe animals.

Upon opening the ſhells of many of the common Engliſh Barnacles (*Fig*. 1.) while they were alive, I found the lower part of the ſhell, which contained a cavity equal to two thirds of the whole, full of ſpawn; ſo that the Barnacles, which adhere by the baſe of their ſhells, as well as thoſe that are ſupported by fleſhy tubes, are propagated by eggs, which they ſend forth in inconceivable numbers; as appears by the cluſters of young ſhells, which we find adhering not only to the parent animals, but to all hard ſubſtances near them.

The bottom ſhell of theſe animals, as well as their upper ſhells, vary in form according to their ſituation, which occaſions ſome difficulty in determining their ſeveral ſpecies with exactneſs. The form of the baſe ſhell of our common Engliſh Barnacle, is the flat radiated figure repreſented adhering to a ſcallop ſhell in the front of a group of them at *Fig*. 17. The Barnacles at *Fig*. 8, 9. 14, 15. and 20. have the ſame kind of baſe.

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I have very lately obſerved a ſingular kind of flat Balanus, on a white Mandrepora coral from the coaſt of Italy, in the poſſeſſion of Mr. Mendez D'Acoſta, F.R.S. whoſe baſe appears ſunk into the coral, and of the form of an inverted cone, bending a little to one ſide. The inward ſurface of this conical baſe ſhell appears curiouſly ſtriated with tubular radii, which terminate on the ſurface of the coral, to receive the extremities of the ſix valves, that compoſe the upper ſhell. This peculiar form of the baſe ſeems owing to the animals of the coral and of the Barnacle growing up together, the latter keeping poſſeſſion of its proper ſpace, while the former grew cloſe about it.

The bottom ſhell of the Barnacle like a Limpet, at *Fig.* 18. increaſes from a ſmall point by many thin ſhelly margins, which exactly correſpond to the indentations which we obſerve on the baſe of the outward ſhell; ſo that it appears not unlike the drawing of a fortification in miniature.

I am,

Dear Sir,

Your moſt affectionate Friend,

John Ellis.

P. S. The Rev. Mr. William Borlaſe is now of opinion, that the Corniſh Barnacle at *Fig.* 16. which he has deſcribed in his Hiſtory of Cornwall, is rather a Limpet or Patella.

CXIV.

CXIV. *A further Account of the poiſonous Effects of the* Oenanthe Aquatica Succo viroſo crocante *of* Lobel, *or* Hemlock Dropwort, *by* W. Watſon, *M.D. F.R.S.*

To the Royal Society.

Gentlemen,

Read Dec. 21, 1758.

IN the month of June 1746. I communicated to you ſome obſervations concerning the *Oenanthe aquatica Succo viroſo crocante* of Lobel, in relation to its poiſonous effects upon ſome French priſoners at Pembroke. Theſe obſervations were afterwards publiſhed in the *Philoſophical Tranſactions* *, with an accurate repreſentation of the plant itſelf, from an original drawing by that compleat artiſt Mr. Ehret. This at that time I thought the more neceſſary, as it was of no ſmall importance to the public, to be well acquainted with a plant, the effects of which, when taken into our bodies, were ſo much to be dreaded. This account of mine, as well as the repreſentation of the plant, were republiſhed from the Tranſactions into the periodical works of that time; from whence a more extenſive knowlege of and acquaintance with this plant might have been hoped for. A late inſtance however has evinced, that theſe endeavours have not had their full effect, as the plant in queſtion is not yet ſufficiently known, and attended to.

* See Phil. Tranſ. N°. 480. p. 227.

John Midlane, a cabinet-maker of Havant in Hampſhire, aged about 58, and of a groſs habit of body, was adviſed to make uſe of the water parſnep, as a remedy for a ſevere ſcorbutic diſorder, which he had long been troubled with; and for which he had taken a variety of medicines. Inſtead of the water parſnep, which he purpoſed to take, there were gathered for him ſome roots of the *oenanthe* above mentioned; a large one of which was pounded in a mortar, and the juice thereof ſqueezed through a linen cloth, and amounted to about five ſpoonfuls. This was ſuffered to ſtand all night, and the next morning (Mar. 31. 1758.), at about half an hour paſt five, he drank the whole quantity, except the ſediment.

In about an hour and half after he had taken this juice, he walked about the town upon ſome buſineſs; and a little before ſeven, upon his return home, about an hundred yards from his own houſe, he firſt complained that he was ill; and having walked about thirty yards further, was ſo bad as to go into a neighbour's houſe to reſt himſelf. He was ſoon led from thence to his own houſe by two men, and told them, that he was affected as though he had loſt the uſe of his limbs. When he was placed in his chair, he complained greatly of pain all over him; but particularly in his head. His ſtomach was immediately after affected, and he had great reachings to vomit. At the ſecond attempt he threw up about half a pint of a clear watry liquor; at the firſt and third attempt he diſcharged ſcarce any thing. He was then ſeized with a great propenſity to go to ſtool, which went off in about three minutes. After this, he with the greateſt difficulty was conducted up ſtairs to bed, where he pulled off part of his cloaths himſelf. When he was put to bed, he was attacked with very ſevere convulſions, which in about a quarter of an hour deprived him of his ſenſes; and continued, with a few intermiſſions, till he died, a little before nine o'clock; which was about three hours and half after the juice had been taken. A profuſe ſweat accompanied the whole of theſe ſymptoms: he foamed conſiderably at the mouth, and his belly ſwelled greatly. He purged very much ſoon after he was dead, but not before.

As this poor man had taken this doſe before his family were up, no one could imagine from whence his diſorder aroſe; and conſequently the apothecary, who was called to him, was able to form a judgment of his caſe only from the ſymptoms; as on his coming he found his patient ſenſeleſs, and who had not, while his mind was undiſturbed, told any one the probable cauſe of his complaints. He took from him however about ten ounces of blood, and endeavoured to get ſome *vinum ipecacuanhæ* into his mouth: but his jaws were cloſed ſo faſt, not above a ſpoonful paſſed, and that by the accident of his mouth opening of itſelf.

The ſymptoms, with which the perſon abovementioned was attacked, were much the ſame as thoſe which were obſerved in the French priſoners, who were poiſoned by the ſame root at Pembroke. In both inſtances occurred thoſe ſevere muſcular ſpaſms, which kept the under jaw ſo cloſe to the upper, that, while the ſpaſm continued, ſcarce any force could ſeparate them. In both inſtances likewiſe


J. Mynde sc.

wiſe a conſiderable time paſſed before the perſons, who had eaten of this root, though they had taken enough of it to deſtroy them, perceived themſelves diſordered by it.

I am obliged for this communication to Richard Warner, Eſq; of Woodford, a gentleman of great merit, whoſe zeal for the promotion of uſeful knowlege I have many times experienced.

The expediency of laying before you obſervations of this ſort, which may tend, by making people careful of what they take, to the ſaving the lives of many, makes no apology neceſſary for ſo doing. I am, with all poſſible regard,

Gentlemen,

Your moſt obedient humble Servant,

Lincoln's-Inn-Fields,
20 Dec. 1758.

W. Watſon.

CXV. *Extract of a Letter to* John Eaton Dodſworth, *Eſq; from Dr.* George Forbes *of* Bermuda, *relating to the* Patella, *or* Limpet Fiſh, *found there.*

2 April, 1758.

Read Dec. 21, 1758.

AS a curioſity for your eſteemed friend Mr. Theobald, the Captain will deliver you two fiſhes, intirely ſingular here, and never before obſerved amongſt us. The one is of the ſhell kind, and changed its figure ſo often, that it was difficult to make a drawing. However

I got a young man to take it in two different positions, and have ſent the drawings with the fiſh. *See* TAB. XXXV.

The ſmall one may be called the ſea-batt; and in ſome ſort reſembles that ſpecies of animals when it is ſwimming.

Additional Remark by Charles Morton, *M.D. F.R.S.*

The Patella, or Limpet Fiſh, whoſe generic characters, as enumerated by Biſhop Wilkins, are, that it is an exanguious teſtaceous animal, not turbinated; an univalve, or having but one ſhell; being unmoved; ſticking faſt to rocks or other things; the convexity of whoſe ſhell doth ſomewhat reſemble a ſhort obtuſe-angled cone, having no hole on the top.

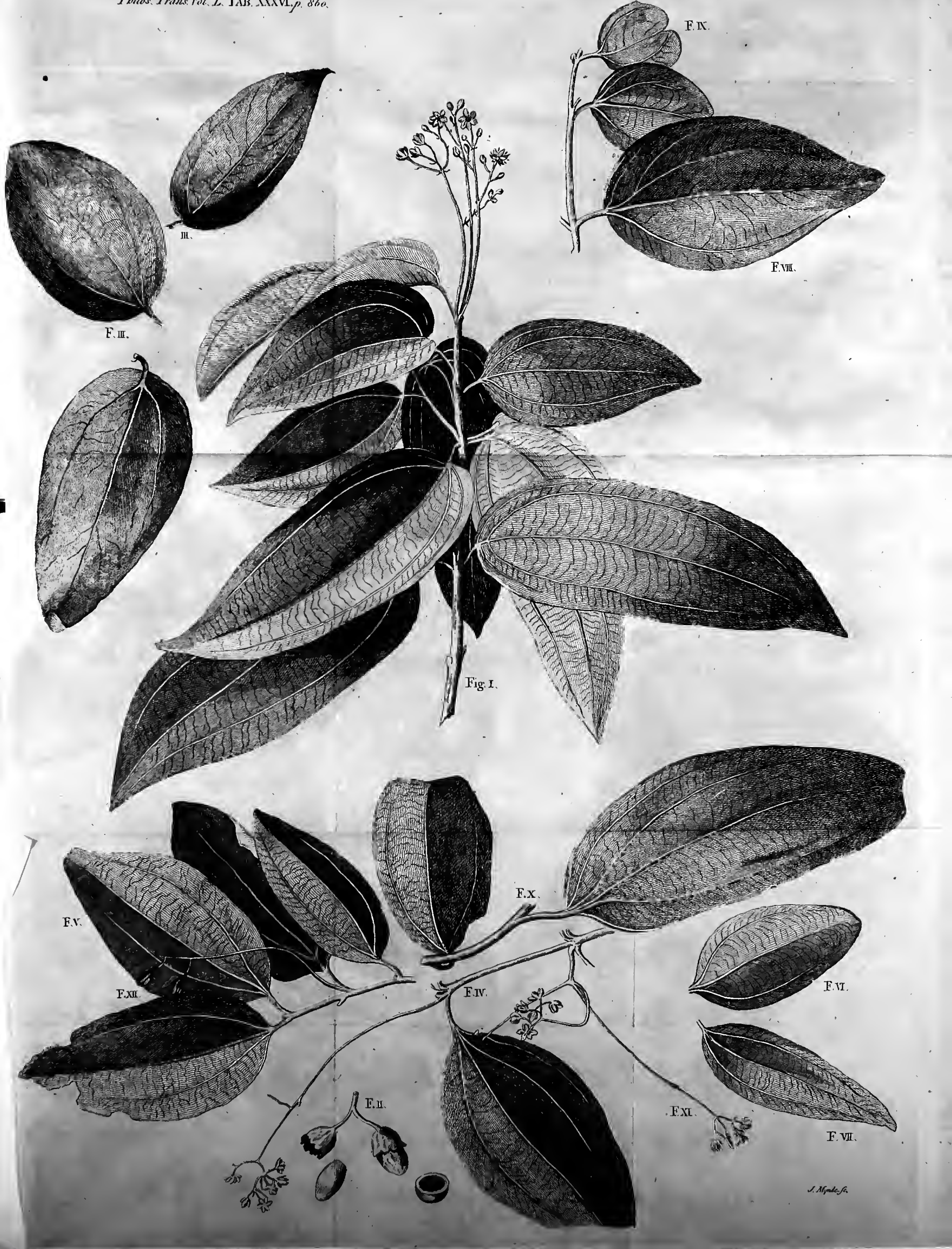
CXVI. *A Diſcourſe on the* Cinnamon, Caſſia, *or* Canella. *By* Taylor White, *Eſquire, F. R. S.*

Read Dec. 21, 1758.

THE Cinnamon, Caſſia, or Canella, are ſhrubs of no great height: they grow in Ceylon, Malabar, Java, Sumatra, and other places in the Eaſt Indies; as I think, in the iſland of St. Thomas, and on the coaſt of Coromandel.

They are deſcribed by Mr. Ray, in his *Hiſtory of Plants*, vol. ii. f. 1559. under the title *de Arboribus Pruniferis*.

Linnæus,


F. IX.
III.
F. III.
F. VIII.
Fig. I.
F. X.
F. V.
F. XII.
F. IV.
F. VI.
F. II.
F. XI.
F. VII.
J. Mynde sc.

Linnæus, in his *Species Plantarum*, places them under the title *Enneandria Monogynia*, by the name Laurus.

The leaf, flower, and fruit, of this plant, are particularly deſcribed by Mr. Ray.

The leaf is ſmooth and ſhining; has one large vein running thro' the midſt, and a remarkable one on each ſide; the middle one generally running near the length of the leaf.

The leaves differ in ſhape, ſome being more acute, others more oval or obtuſe.

The flowers grow in an umbel, ſomewhat like the Laurus Tinus; but they are ſmall, conſiſting of one petal, of a tubular form at the bottom, and divided at the top into ſix ſegments in the form of a ſtar.

The flowers are ſucceeded by berries growing out of a capſula, like acorns in ſhape; which berries contain a ſhining ſeed.

The deſcription of Mr. Ray of the flower, in his deſcription of the Cinnamon of Malabar, is extremely accurate; as is alſo the figure in the *Hortus Malabaricus*, N°. 54. and the deſcription, fol. 107. under the name Carua. I ſhall therefore refer to thoſe.

I ſhall not trouble you with the queſtion debated by Mr. Ray, whether the Cinnamon and Caſſia of the ancients were, or were not, the ſame with thoſe ſo called by the moderns? whether the Cinnamon of the ancients was the twigs of the tree bearing cloves, or any plant now unknown to us? Mr. Ray has largely treated on this ſubject; and to him I refer ſuch as are curious to be informed on this ſubject.

But as the Cinnamon and Caſſia of the ancients are ſaid to have been uſed as perfumes, and to make

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perfumed ointments, I think they muſt have differed from ours, whoſe ſmell is not very fragrant, nor is emitted to any great diſtance.

The matter of the preſent inquiry is, whether the Cinnamon of Ceylon is the ſame ſort of plant with that growing in Malabar, Sumatra, *&c.* differing only by the ſoil or climate, in which it grows, which is the opinion of Garcias; or from the culture or manner of curing the plant, as I am inclined to believe; or whether it is really a different genus or ſpecies of plant, as many people believe, and ſome botanical writers ſeem to indicate.

I ſhall endeavour to explain this matter by producing, 1ſt, The deſcriptions of the moſt celebrated authors:

2dly, By producing the moſt accurate figures of the plants of Sumatra and Ceylon: [*See Tab.* xxxvi.]

3dly, By ſhewing the ſpecimen of the leaves and branches brought from Sumatra.

I have no ſpecimen from Ceylon; but have carefully examined the ſpecimens kept in the Britiſh Muſeum, with the aſſiſtance of Dr. Maty and Mr. Empſon, and compared them with the ſpecimens I have from Sumatra; from whence I traced exactly the figures brought herewith: which ſpecimens are undoubtedly brought from Ceylon, and were the collections of Boerhaave, Courteen, Plukenet, and Petiver.

But, previous to this inquiry, I would premiſe, that the writers, who give the deſcription of the Cinnamon of Ceylon, were probably not acquainted with that of Malabar at the time of their publiſhing their works.

Mr.

Mr. Ray alſo, who ſo accurately deſcribes the flower of the Cinnamon of Malabar, ſeems not ſo well acquainted with its fruit; and probably had then never ſeen the ſpecimens of the Cinnamon from Ceylon; for his deſcription is plainly borrowed from others, and not his own. Tho' I have reaſon to think he afterwards ſaw the ſpecimens of Mr. Courteen, and was convinced, that the plants were the ſame.

In his deſcription of the Cinnamon of Ceylon, he ſuppoſes differences in the manner of veining the leaf; which are not found in the leaves themſelves. He ſuppoſes, that the Cinnamon of Ceylon differs from that of Malabar by its berries growing in cups like acorns; which is apparently the ſame in both, as may be ſeen in its figure in the *Hortus Malabaricus.*

The other differences taken notice of by the botanic writers are as follow:

In the *Flora Zeylanica,* p. 545. and in the *Materia Medica,* 190. the Cinnamon of Ceylon is called *Laurus foliis trinerviis ovato-oblongis nervis unientibus:* which deſcription is adhered to in the *Hortus Cliffordienſis,* p. 154. under the name *Laurus foliis oblongo-ovatis nitidis planis.* And Burman, in his *Flora Zeylanica,* 62. T. 27. calls it *Cinamomum foliis latis ovatis.* Whereas the Caſſia of Sumatra is diſtinguiſhed by theſe writers: that in *Flora Zeyl.* 146. and in *Materia Medica,* 191. is called *Laurus foliis trinerviis lanceolatis nervis ſupra baſin unitis:* and Burman, *Zeylan.* 63. T. 28. calls it *Cinamomum perpetuo florens folio tenuiore acuto.*

The diſtinction therefore, which theſe writers would make us believe there is between theſe plants, conſiſts

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in the leaves of the one being oval, the other ſharp-pointed; and that the nerves are limited at the bottom in the Cinnamon, but not ſo in the Caſſia: for as to the *ſemper florens*, mentioned by Burman, that muſt undoubtedly be common to both.

Now as to the different ſhape of the leaves, we know how often this happens by ſeminal varieties, and from the age of plants, as in the leaves of holly and ivy; and that even the ſhapes of leaves vary greatly on the very ſame plant, and ſometimes on the ſame branch; as in the aſh, and many other plants, the leaves of the young ſhoots are more oval than thoſe on the old boughs, which are generally more pointed. But this variety is much more frequent in the plants of warm countries. In the ſaſſafras, part of the leaves generally near the bottom of the plant are plain, whilſt the other leaves are divided into three lobes or ſegments. I have obſerved great difference alſo in the leaves of almoſt every one of the American oaks.

In the Virginian cedar, the berries of the ſame plant produce ſome plants with juniper leaves, and others with leaves like the ſavin; and ſome plants with both leaves growing on the ſame plant.

I muſt obſerve, that Burman has, in his figures of the two plants before mentioned, made them extremely different. In that of Ceylon he has made all the leaves oval; and, to make the difference greater, has drawn the rudiments of the berries; to which he has added the flower, or part of it, at the top of the ſtyle or rudiment of the fruit: and in that of Malabar he has drawn the flower growing in the umbel.

On theſe drawings I muſt obſerve, that his drawing of the Cinnamon of Ceylon agrees with no one ſpecimen in the Britiſh Muſeum; and ſcarcely is one leaf to be found of the ſhape, which he gives.

The firſt figure, which I ſhall produce, is a drawing, which I procured from the ingenious Mr. Ehret in the year 1754: which, as I am informed by Mr. Empſon, was from a ſpecimen, given to Mr. Ehret by him in that year, of the Cinnamon of Ceylon. *See Fig.* 1.

This agrees in every thing with the drawing of the Cinnamon of Malabar in the *Hort. Malab.* fig. 54, fol. 107. and there called Carua; except that it wants the fruit: but that defect is ſupplied by Mr. Ray's deſcription of the Cinnamon of Ceylon above mentioned. *See fig. of the fruit, Fig.* 2.

In the figure in the *Hort. Malabar.* it may be obſerved, that the nerves do not go quite to the bottom of the leaf. But this is merely accidental, as will appear by the leaves of the ſame plant brought from Sumatra, which I ſhall produce; in which, part of the leaves have veins going quite to the bottom, and united there, and the others not ſo. *See Fig.* 3.

The next drawing I ſhall produce contains that of the leaves of the Cinnamon plant, from ſpecimens in the Britiſh Muſeum.

Fig. 4. A ſpecimen, with the flower, from the collection of Mr. Courteen, who lived long in Ceylon. Theſe leaves were more pointed, but were broke at the end.

Fig. 5. A whole leaf, with its point, in the ſame collection, growing on a branch, on which are the rudiments of the fruit.

Fig. 6. A leaf in Plukenet's ſpecimens.

Fig. 7. Another leaf of the ſame collection, and of the ſame plant.

Fig. 8. A leaf of a large ſpecimen from Boerhaave's collection.

Fig. 9. Another leaf on the ſame branch.

Fig. 10. A ſpecimen from Petiver's collection. The points of the leaves are broken off.

Fig. 11. The flower of the firſt ſpecimen.

Fig. 12. In the rudiment of the ſeed before formed, in the ſtate given in Burman's firſt drawing.

Note, It is to be obſerved alſo, that the ſpecimens of the Cinnamon of Ceylon are probably of cultivated plants.

From all theſe ſpecimens it plainly appears, that the diſtinction of *foliis ovatis & lanceolatis* does not appear well founded.

But were it otherwiſe, and that the leaves of the plants differed, it would by no means be a proof of any material difference in the nature or quality of the plants; as is well known to perſons converſant in natural hiſtory.

Before I leave this ſubject of the deſcription of the plant, it may be proper to mention, that Bauhin calls the one of theſe plants *Cinnamomum* or *Canella Malabarica & Javanenſis*, and the other *Cinnamomum Canella Zeylanica*, Bauhin. *pinax* 408 and 409; but neither from theſe names, nor from his deſcription, can any concluſive argument be formed: and that Herman, in his *Hort. Lugd. Batav.* 129. t. 1655. calls this Cinnamon of Ceylon *Caſſia Cinnamonia*.

If any conjecture can ariſe from hence, it may be, that the Cinnamon of Ceylon was formerly, as well

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as that of Sumatra and Malabar, called Caſſia; but that the Dutch writers, being acquainted with the excellent qualities, which the ancients aſcribed to their Cinnamon, choſe to add the name Cinnamon to that of Caſſia: and in proceſs of time they have found the name of Cinnamon more profitable than that of Caſſia, by which we chuſe to call our Canella, to our national loſs of many thouſands a year.

Having now given an account of the figure of theſe plants, and in what reſpect they are ſaid herein to differ; I ſhall proceed to conſider the pretended differences in the Canella itſelf; which are ſuppoſed not to be in form only, but ſubſtantial and material; and are generally underſtood to be ſo by perſons ſuppoſed to be acquainted with the ſubject.

Mr. Ray ſtates this matter fully in his *Hiſt. Plant.* vol. ii. p. 1560. in theſe words: *Officinæ noſtræ Caſſiam ligneam a Cinnamomo ſeu Canella diſtinctam faciunt, Caſſiam Cinnamomo craſſiorem plerumque eſſe, colore rubicundiorem, ſubſtantiâ duriorem, ſolidiorem & compactiorem, guſtu magis glutinoſo, odore quidem & ſapore Cinnamomum aptius referre, tamen Cinnamomo imbecilliorum & minus vegetam eſſe, ex accurata obſervatione Tho. Johnſon.*

From theſe reaſons Mr. Ray draws a concluſion (I muſt own not very inſtructive), that the Cinnamon of Ceylon is Cinnamon; and the Cinnamon of Malabar, &c. is the Caſſia of the ſhops.

From the ſpecimens I ſhall now produce, it will moſt plainly appear, that theſe differences are merely accidents ariſing from the age of the Canella, the part of the tree from whence it is gathered, and from the manner of cultivating and curing it.

 In

In the *Philosoph. Transact.* N°. 278. p. 1099. in Mr. Strachan's account of Ceylon, which is abridged by Eames and Martyn, vol. ii. p. 183. he ſays, that there are two ſorts of Cinnamon-trees, of which the tree, which is eſteemed the beſt, has a leaf much larger and thicker than the other; but otherwiſe no difference is to be perceived.

Note, Here is no mention of the *folio ovato.*

I remember, in an account given ſome years ago to the Royal Society, three or four ſorts were mentioned; and it was ſaid the beſt ſort was cut every three or four years.

This ſuperiority I then gueſſed (as well as the difference of leaves mentioned by Mr. Strachan) to ariſe from the cutting the tree down every three or four years; which occaſioned it to produce ſtrong and vigorous ſhoots, thicker and larger leaves, as well as greater quantity of bark, and of a ſuperior quality.

A large ſhoot or ſucker of this plant was produced in the year 1750. or 51. by my worthy friend Dr. William Watſon, together with an account of the Cinnamon-tree; which is publiſhed in the *Philoſoph. Tranſact.* vol. xlvii. p. 301. This ſhoot was a plain proof to me, that the Cinnamon was frequently cut down, and that this ſhoot aroſe from the root of a plant ſo cut; for it was of the ſize of a walking-cane; and no ſhrub could have produced ſuch a ſhoot, unleſs a ſtrong plant cut down.

This method of treating this plant accounts for the miſtake of Garcias, mentioned by Mr. Ray; *viz. Quæ Garcias habet de duplice hujus arboris cortice ad modum ſuberis, nobis ſuſpecta ſunt, quæque de deliberatione*

liberatione ſemel triennio facta; non enim puto renaſcitur cortex ſemel detractus.

This ſhews, that the bark was gathered every three years: but Mr. Ray was not acquainted, that the plant was cut down, in order to take off the bark, once in three years.

In the account above mentioned to be given to the Society by Dr. Watſon, no deſcriptions are given either of the plants of Ceylon, or Malabar; but he quotes Burman, who ſays, that he had nine different ſorts of Cinnamon from Ceylon, of which that, which is the beſt, is brought to us, and called by the name *Raſſe Coronde.*

What the differences between theſe ſorts were, does not appear; whether in leaf or bark, or manner of culture. And I muſt obſerve, that in all the ſpecimens in the Britiſh Muſeum I could obſerve no difference of ſpecies. But this is to be underſtood, that every ſort coming from Ceylon is, by the Dutch and by the ſhops, called Cinnamon; and that of our own growth is by them always called Caſſia. The reaſon is obvious.

The ſpecimens, which I now produce, of the Canella or bark of the Cinnamon of Sumatra, I procured in the year 1755. from Mr. Tho. Combes, a gentleman then in the ſervice of the Eaſt India Company in Sumatra, by means of a friend.

I was then attempting to form a ſociety for the carrying on a General Natural Hiſtory, to try proper experiments, and to employ proper painters and engravers ſuitable to the importance of the ſubject; and therefore attempted to eſtabliſh a correſpondence in thoſe parts, whoſe productions are as yet little known to the public.

I men-

I mention this deſign, becauſe it would not be poſſible elſe to explain what Mr. Combes means by the word *Society*, which he ſo often mentions in his letter; of which I ſhall produce an extract, ſo far as it relates to the preſent inquiry.

It ſeemed to me very improbable (as the ſame plants are generally found in the ſame latitude and ſoil), that the ſpices now in the poſſeſſion of the Dutch ſhould grow only in that ſmall tract of land, which is in their poſſeſſion. And I had many credible informations, that, whatever they may pretend to the contrary, this is only a pretence.

I therefore deſired to obtain the beſt information of the nature and culture of the plants producing ſpices, as well as of many other things, which are foreign from this inquiry.

I deſired to know, how the ſpices were dried and cured; and that different ſpecimens might be ſent me of the plants, their ſeed, flower, leaf, and bark, and properly cured and prepared.

This produced the anſwer I lay before you herewith, together with the ſpecimens now produced.

You ſee hereby, that the Dutch dry their Cinnamon in ſand; probably to take away that viſcoſity, which is complained of in the Caſſia.

And you will obſerve alſo, that the ſpecimen produced dried and cured is alſo as free from any viſcoſity, as the Cinnamon of Ceylon: That it agrees alſo with the Cinnamon in every other quality, and in colour; and that none of the diſtinctions mentioned by Mr. Ray can be found herein; but that they may ariſe from the part of the tree, from whence the bark was taken; the inner bark of the large wood being red, as you ſee by the other ſpecimen produced.

produced. And the common Caſſia taken from the larger branches, and not cured, has the viſcoſity complained of in ſome degree, tho' much leſs than it had four years ſince, when I received it.

Mr. Ray ſays, that one is weaker in taſte, as he ſuppoſes, than the other. That may be ſo from its manner of drying, or keeping of it. Dried in large quantities, and by a ſtronger heat, it will probably be ſtronger, than if it is dried in a leſſer quantity, and ſlower.

As for the viſcoſity, the glutinous part is found in every plant in ſome degree, as well as in every animal. It preſerves the parts from moiſture; but will be conſumed by heat or time; and it will be a preſervative to the plant, till it is deſtroyed; which was the reaſon, as I ſuppoſe, that Mr. Ray mentions Caſſia to have kept good thirty years, the viſcoſity not having been deſtroyed by drying.

I ſuppoſe the reaſon, which the Dutch have to dry it, is to make it ſooner fit for the market, and poſſibly fitter for diſtillation.

You will ſee from Mr. Combes's letters and ſpecimens, that he thinks there may be two ſorts of Caſſia or Cinnamon in Sumatra: poſſibly there may be the ſame difference in Ceylon; but, if ſo, I ſuſpect them both to be only ſeminal varieties, and that their virtues are the ſame.

Mr. Barlow, ſome time ſince a Surgeon in the ſervice of the India company, made a conſiderable quantity of oil of the Caſſia of Sumatra, which was very little, if any thing, inferior to that drawn from Cinnamon; and it was ſold to great profit.

If theſe plants are really the ſame, or if they are of equal goodneſs, ſuppoſing there was a ſmall difference

ference in the form of the leaf, it might be well worth the attention of the East India company to try to cultivate these plants in the manner they do in Ceylon; that is, to make plantations in a proper soil; and to have regard to the proper distance from the sea of the place, where they try the experiment: for some plants require to be near the sea, and others far from it, in Sumatra; which is the case of the Mango, and Mangosteen; the one of which must be near the sea, the other at a distance from it.

I think the plants should be suffered to grow strong, to be six or seven years old, and then cut every three years, the bark peel'd off and dried in hot sand, and packed close, and kept dry. This I take to be all necessary to be done, to try, if our Cinnamon will not produce as good a price as that of the Dutch.

Perhaps the plants need not stand so long before cut; for the vegetation of plants in hot countries is very great.

There are many other most valuable vegetables in Sumatra, which might be made staple commodities, as sagoe, camphire, several sorts of ginger, rice, and many other, which are foreign to the present inquiry.

But it may not be amiss to recommend it to the traders to Sumatra to bring some quantity of the twig-bark of the true Cassia, well cured; and also to the company, to have a chemist at Sumatra, to extract carefully the oil of Cassia; which is best, and in greatest quantities, produced from the bark of the body, and of the larger branches of the tree: and also that the company would procure an exemption of all customs or duties on Cassia, or on the oil of Cassia, for some time: and also that the college of physicians in their dispensatory would direct Cassia or Cinnamon of Malabar or Sumatra to be used, instead of the Cinnamon of Ceylon; and that the same should be used by apothecaries and distillers, and in all simple and compound waters, in which Cinnamon is used.

Extract of a Letter from Mr. THOMAS COMBES, *dated* Fort Marlborough, 5 Jan. 1755.

IN regard to the first article of your paper, now before me, which is the inquiry desired to be made concerning the spices, I am of opinion, that the true Cinnamon grows no-where but on the island of Ceylon, unless Cassia be allowed to be the same tree, which I am inclined to think.

N°. 9. contains seeds of the Cassia or wild Cinnamon-tree. As for the seeds of the true Cinnamon-tree, I believe they are very difficult to be got; for as the Dutch are the sole masters of this spice, and get a good deal of money by it, I fancy, according to their usual custom, they have very well guarded against the transplantation of it. I hope however, that these seeds will not be unacceptable to the society, as Cassia itself is of some value; and as I am very doubtful, whether this tree is not the same with the true Cinnamon, being of opinion, that the difference observed in them arises from the different method of curing their barks, or from the taking the bark from different parts of the tree, or at different seasons, or of different ages, or perhaps all these.

I have made inquiry concerning this from some very intelligent persons, and found them to be of opinion, that the Caſſia and Cinnamon-tree were of the ſame genus. I have inquired further concerning the method of curing it at Ceylon; but as this is done by the natives, the Dutch are not very well acquainted with it; nor could I obtain any good account of it, different people giving me different relations. Some ſaid, it was the inner bark, ſome the middle, and ſome the outer; 'tho' of the young branches, they ſeemed in general to agree, that it was gathered at a certain ſeaſon of the year, and that one part of the cure was burying it in ſand for ſome time. This may be tried with Caſſia, and may perhaps take away that viſcoſity or glutinous quality obſerved by chewing it, and which is the principal mark for diſtinguiſhing it from Cinnamon. As to their chemical oils, I have heard many people ſay, that they are not diſtinguiſhable otherwiſe, than that from Cinnamon is generally better, or, as it may be called, ſtronger, than that from Caſſia; and accordingly bears a better price. But the Dutch company's chemiſt at Batavia, if I may give him this title, informed me, that they are eſſentially different, and plainly diſtinguiſhable. But I muſt confeſs myſelf very doubtful of the knowlege or veracity of this chemiſt, and ſtrongly ſuſpect, that they are no otherwiſe different than in goodneſs, as many other oils drawn from the ſame ſubject are.

I obſerve the price of Caſſia is greatly riſen in England within theſe two or three years; but whether this be owing to an increaſe in the conſumption, or a decreaſe in the importation of this commodity, I cannot ſay.

The Dutch government of Batavia has this year, in ſome new regulations of their trade, prohibited to

all

all persons the dealing in any of the fine quilled sort of Cassia, and declared the same to be contraband, and reserved for their company only; and put it upon the same footing as their Cinnamon.

What reasons induced them to this, I am yet a stranger to; but it makes me suspect, that the rise of this commodity in Europe is owing to some other cause than a deficiency in the importation thereof. Perhaps some discovery has been made rendering Cassia equal to Cinnamon.

In Persia, I think, they make not so great a difference between them as elsewhere; and I myself, for want of Cinnamon here for some months past, made use of the fine quilled Cassia; and the difference I observe between them I imagine to arise rather from the greenness and want of dryness in the Cassia, than any thing else, or perhaps from the method of curing it: for if there happens to be a little too much Cassia put into my chocolate (and other things I use in it), a little bitterish taste arises, something like what we meet with in most barks; tho' I do not remember to have observed this of Cinnamon: but as to its boiling to a jelly, as Quincy mentions, I find no such thing, and think it bears boiling as well as Cinnamon. Nor do I think its distilled water more subject to an empyreuma than that of Cinnamon.

I have inquired of the country people here, who bring it us, and they tell me the finest sort is the inner bark of the small branches; and indeed that it is the inner bark, I think, is evident in Cinnamon as well as Cassia; no outer bark of the youngest branches of any tree having, in my opinion, that smooth surface observable in both these barks.

I once thought, that it was better to take the bark from the body of the tree than from the branches, imagining that the bark from the trunk or body of all trees muſt in general be ſtronger, let its natural taſte be what it will, than from its branches. This I find to be ſo in Caſſia; and I have been informed, that the large ligneous pieces of Caſſia have afforded rather more oil in diſtillation than the fine quilled ſort, their weight being equal; but upon trial I could not make the bark from the trunk curl or roll up, as it ought to do, owing, as I ſuppoſe, to my unſkilfulneſs, or to rigidity, or the natural poſition of its fibres; for the bark of the younger branches curled of itſelf, wanting hardly any other aſſiſtance than the ſun.

I have already obſerved, that Caſſia is found in chewing to have a viſcidneſs, which Cinnamon has not. I have endeavoured to remove this in a little I ſend you, marked B: pray let me know, if it anſwers; and be aſſured, it was taken from the younger branches of the tree, of which I ſend you the ſeeds.

I ſend you alſo, marked C, ſome of the bark taken from the ſame tree; as alſo ſome of the leaves, marked D.

I have ſent you alſo a little of the bark of the trunk of a tree, which, tho' called Caſſia, ſeems not to be ſo, marked E; and alſo the leaves of the ſame tree, marked F.

END *of the* FIFTIETH VOLUME.

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