THE

PHILOSOPHICAL TRANSACTIONS

OF THE

ROYAL SOCIETY OF LONDON,

FROM THEIR COMMENCEMENT, IN 1665, *TO THE YEAR* 1800;

Abridged,

WITH NOTES AND BIOGRAPHIC ILLUSTRATIONS,

BY

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RICHARD PEARSON, M.D. F.S.A.

VOL. IV.

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1809.

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* ERRATUM.

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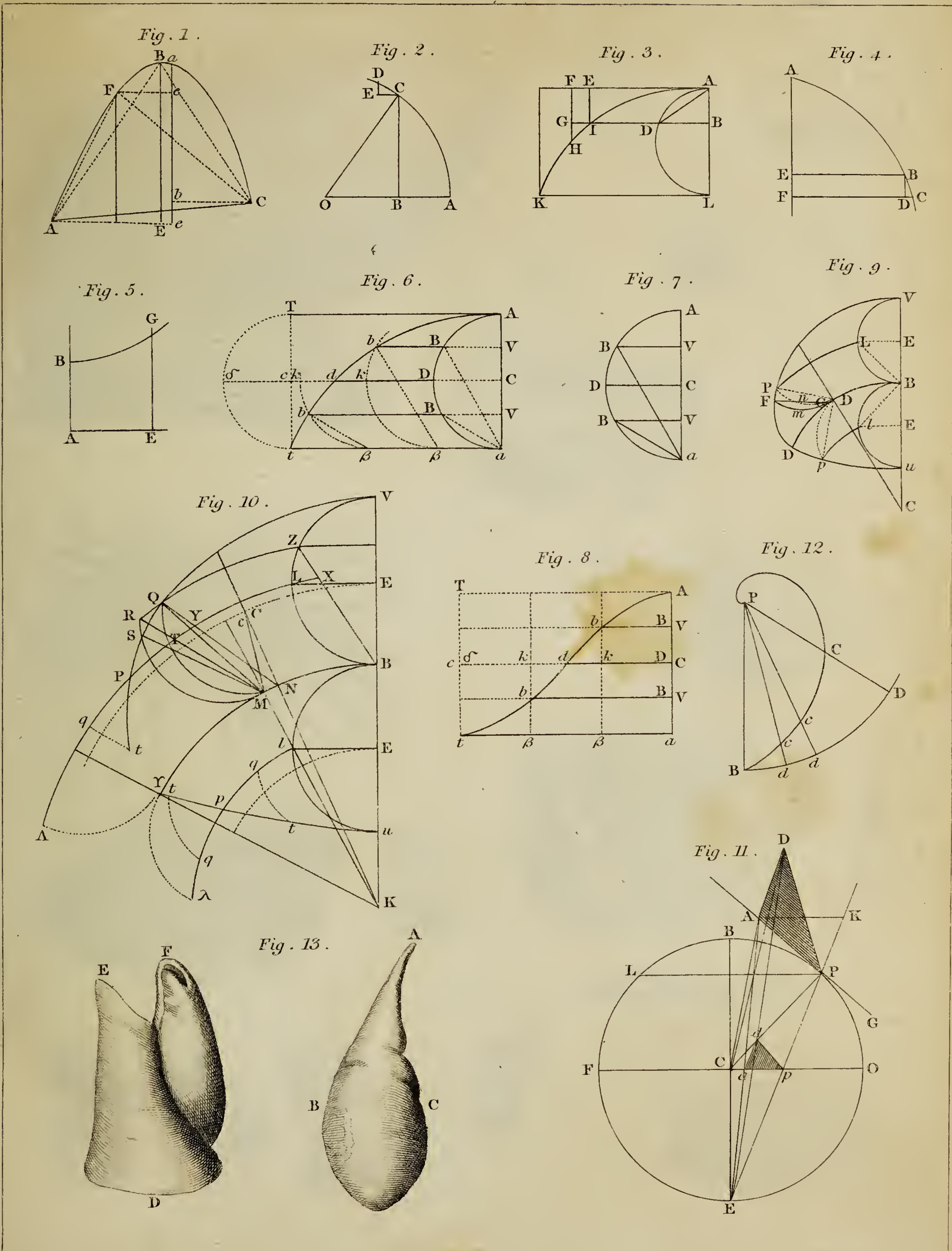

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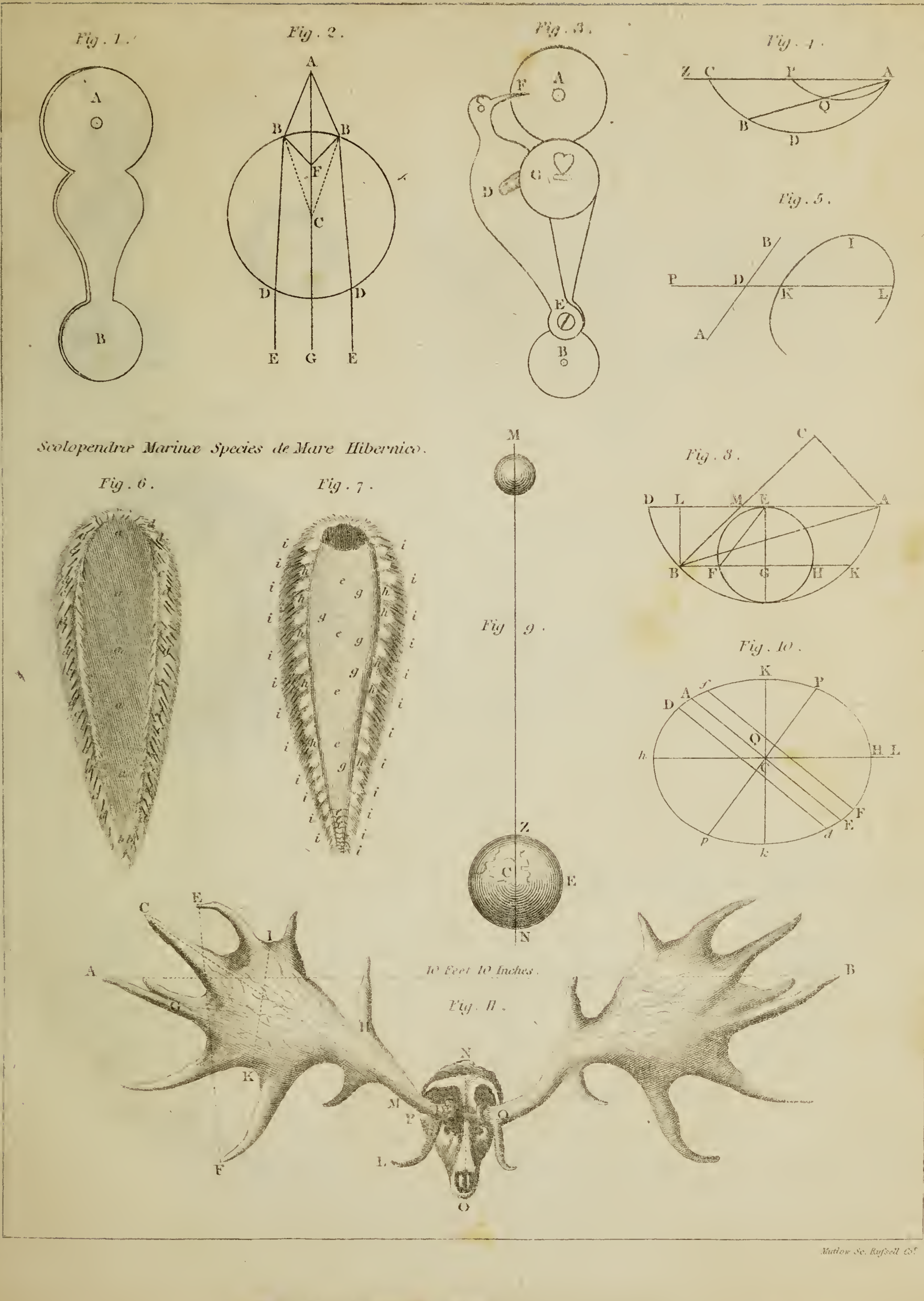

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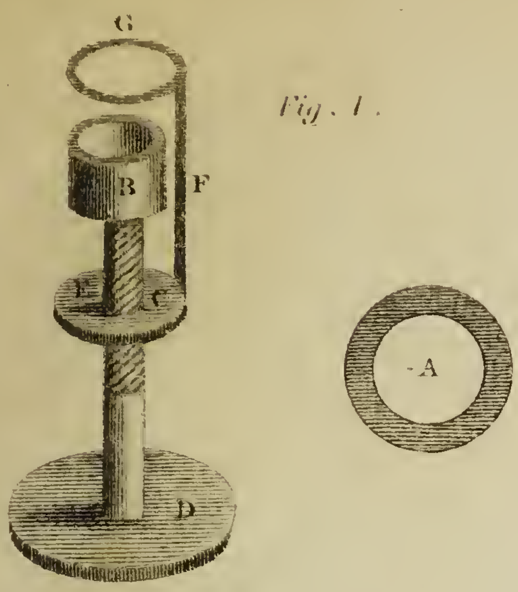

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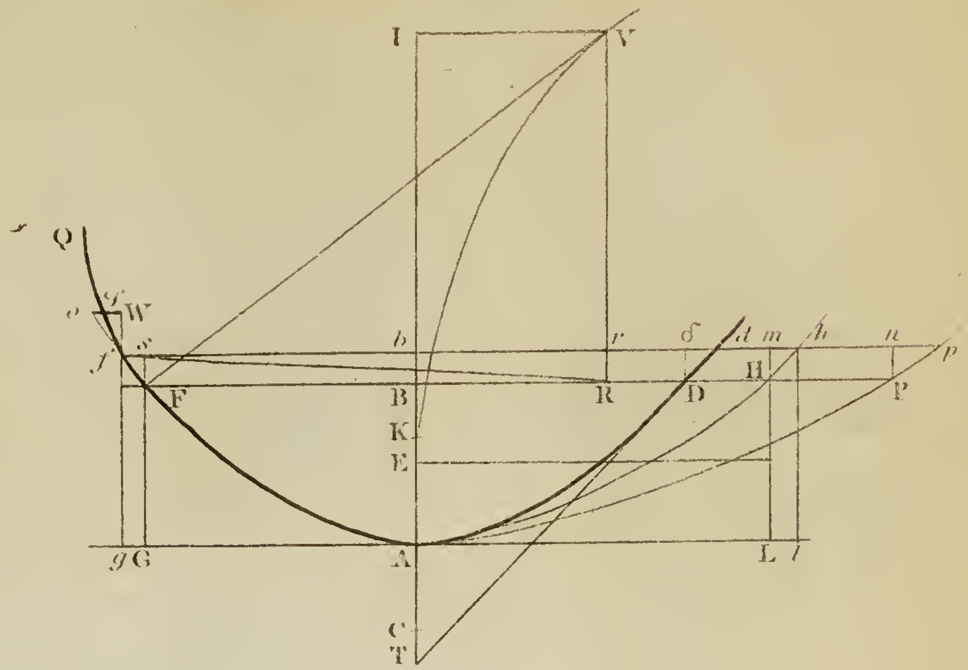

Pectinis Anatome.

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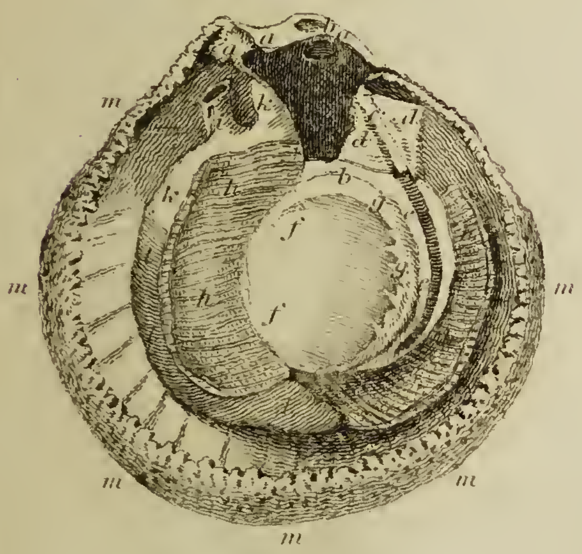

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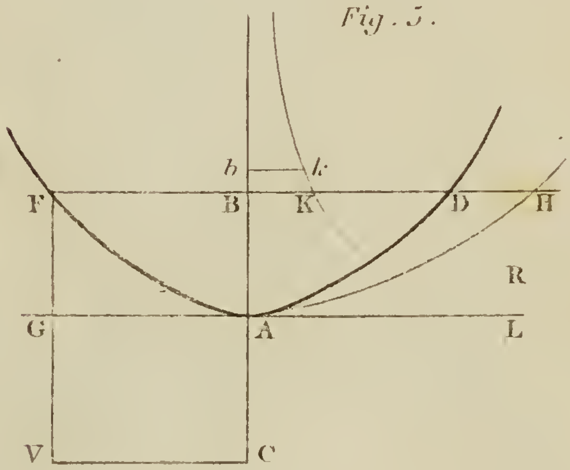

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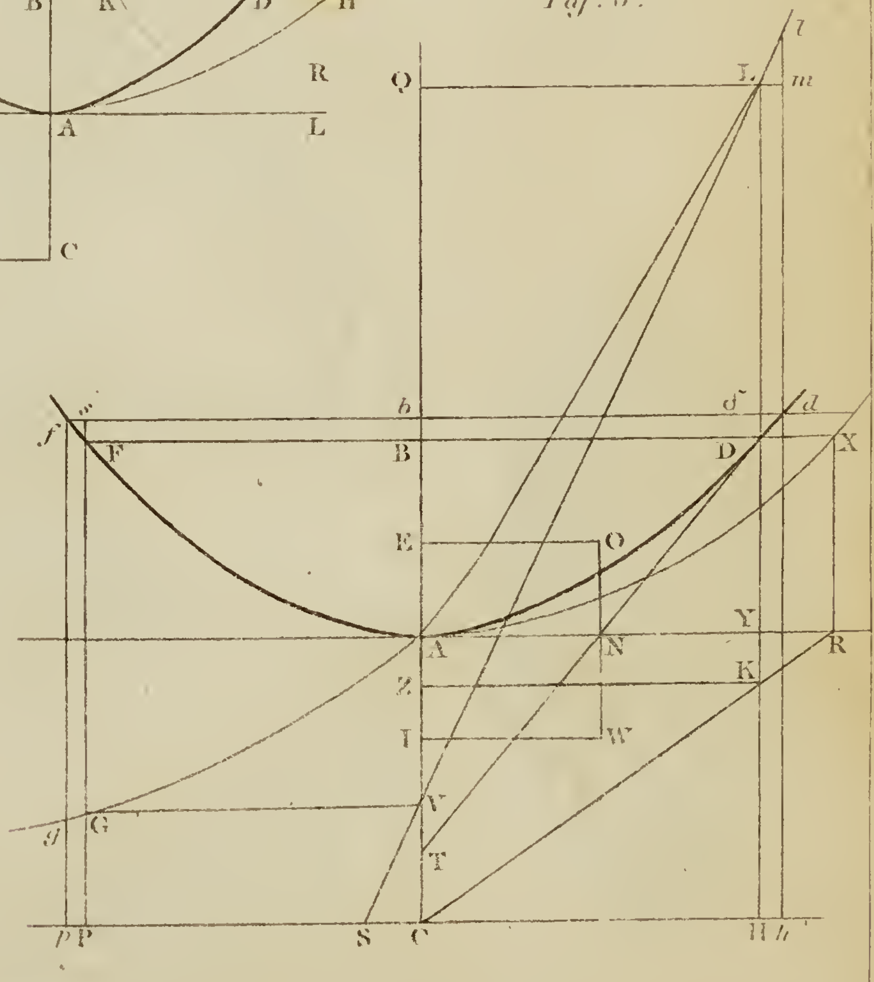

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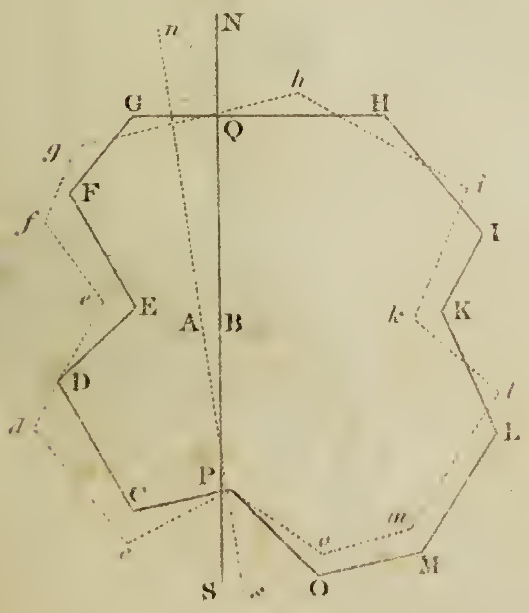

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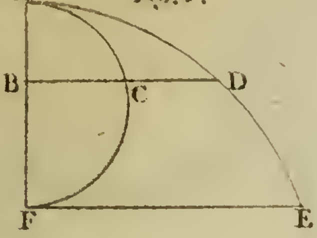

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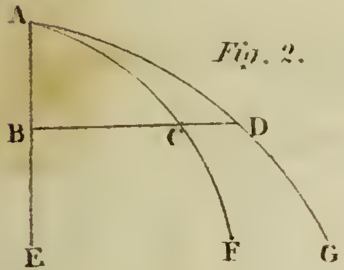

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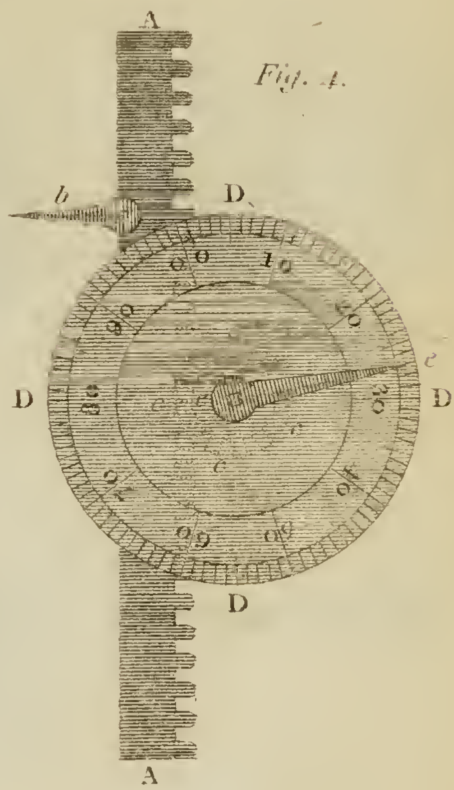

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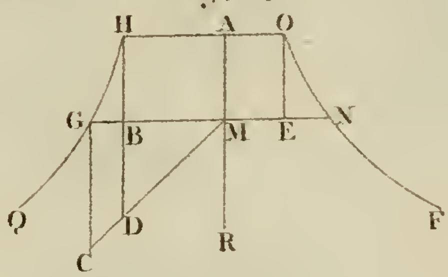

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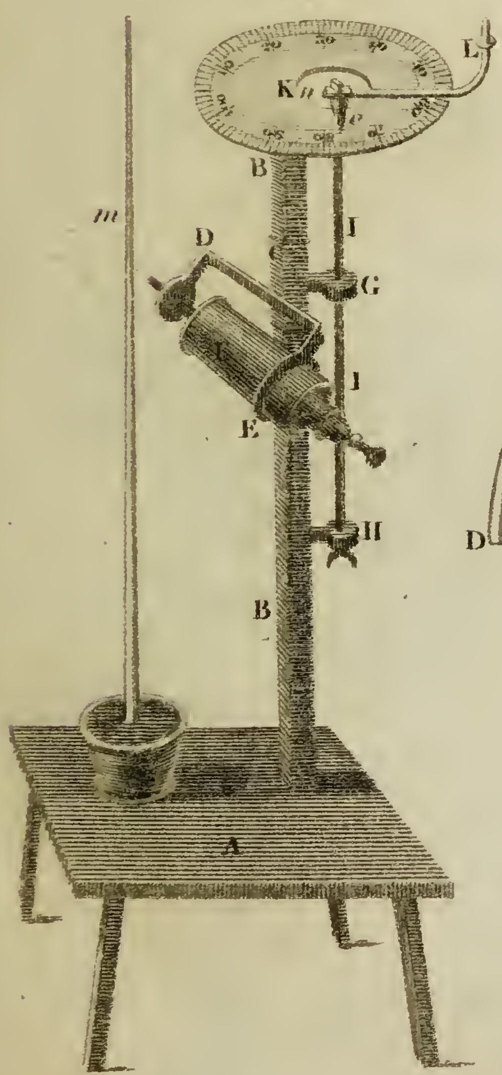

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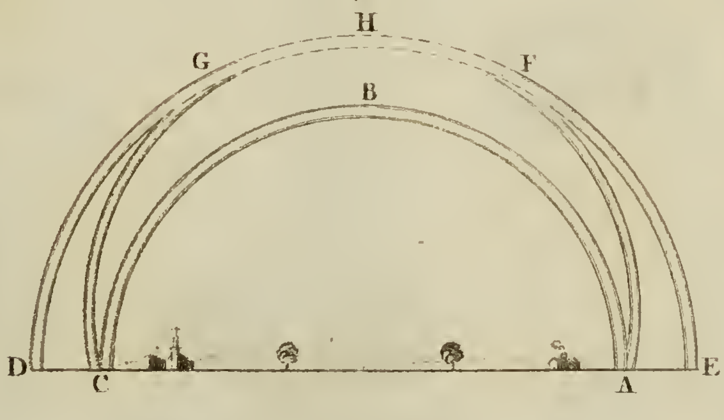

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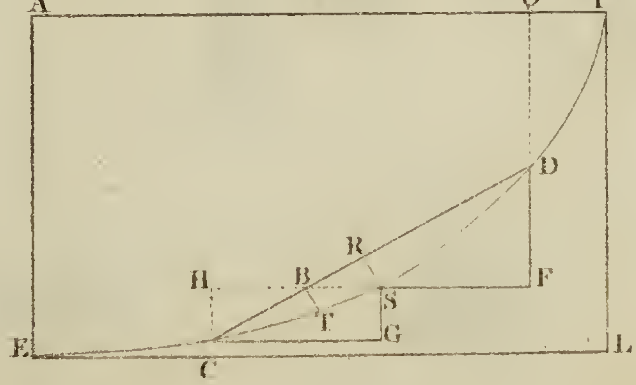

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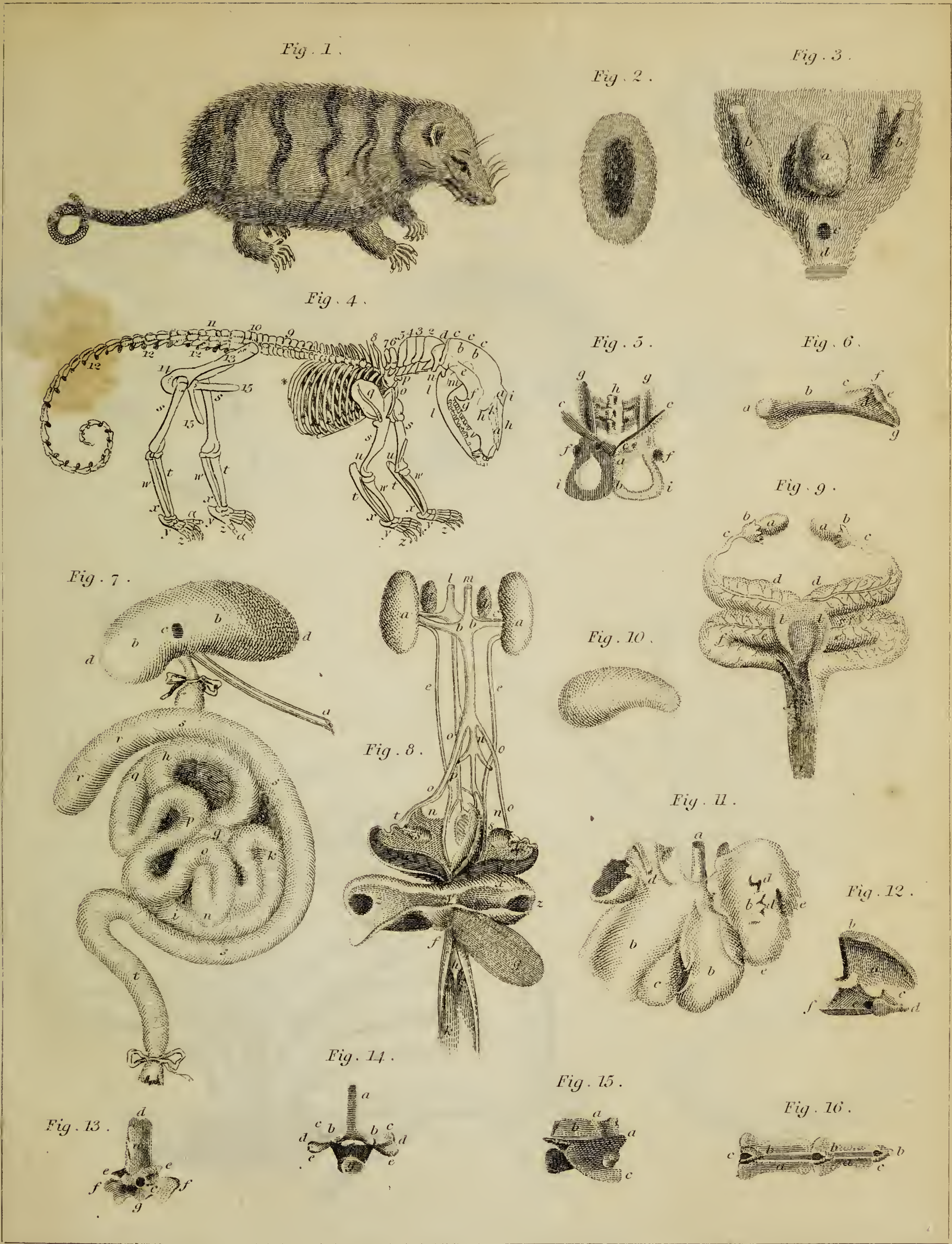

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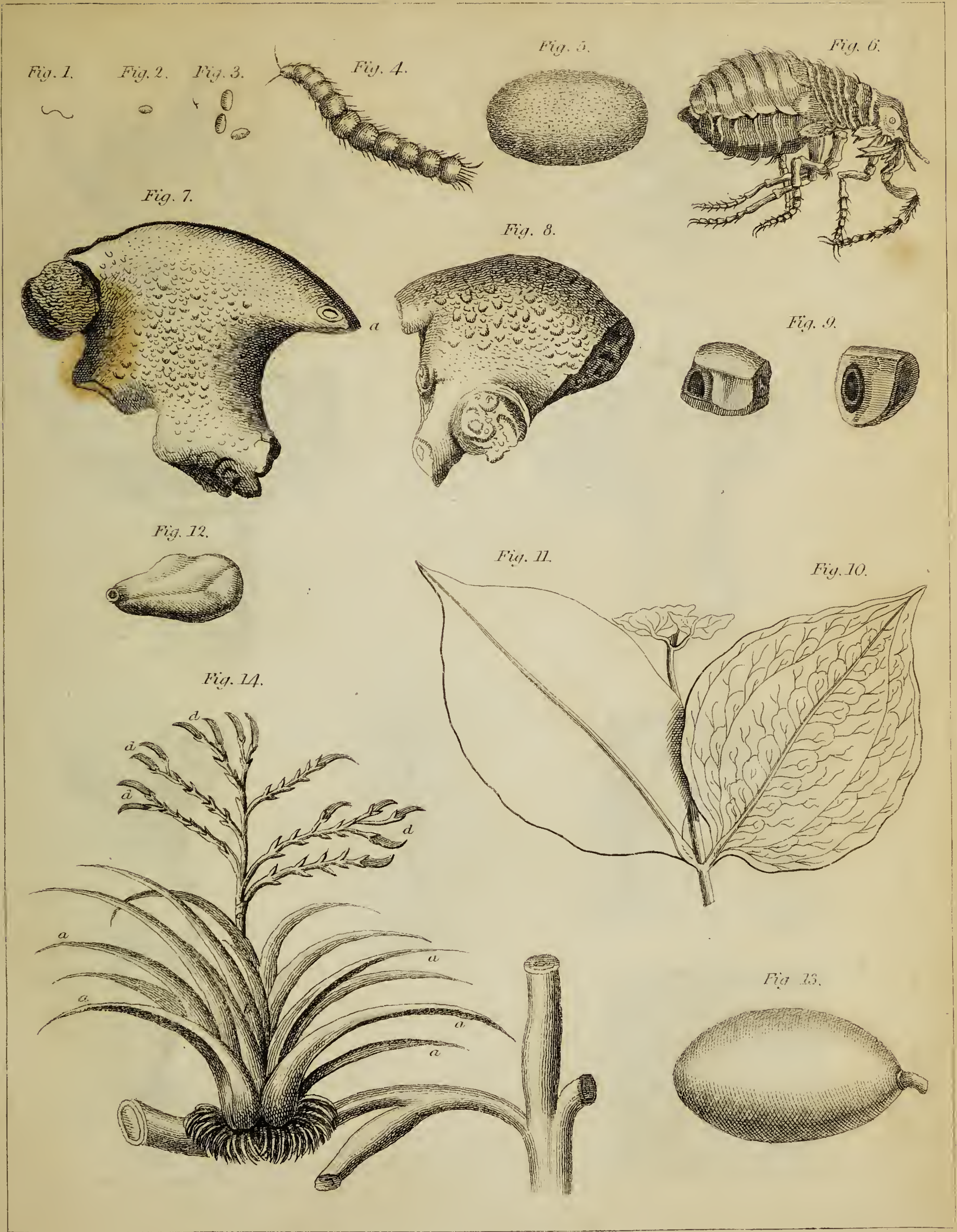

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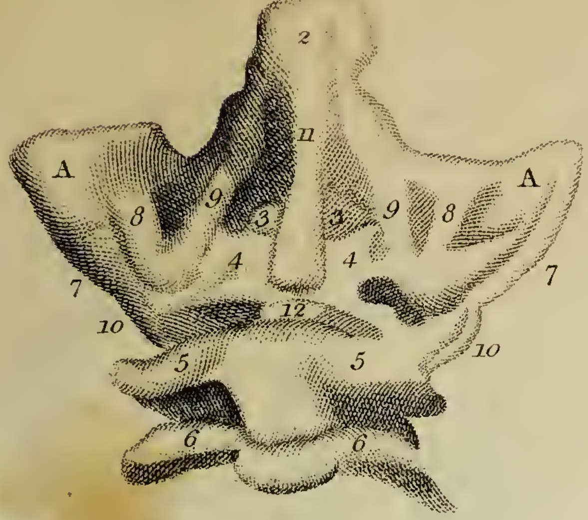

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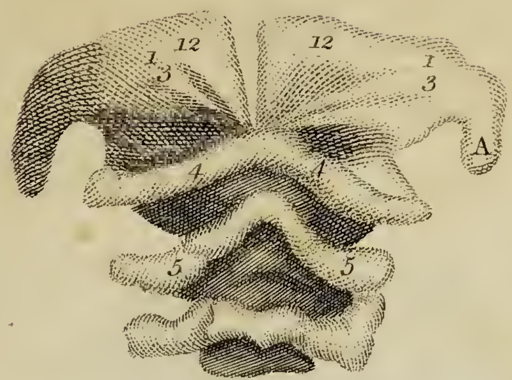

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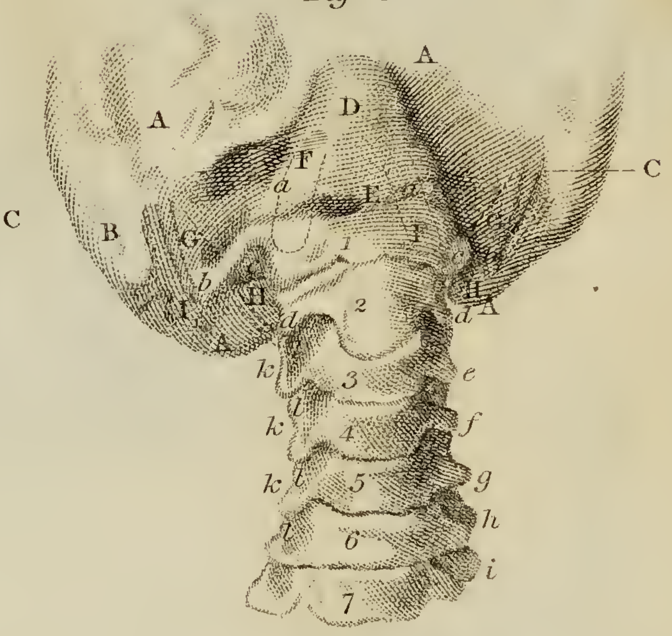

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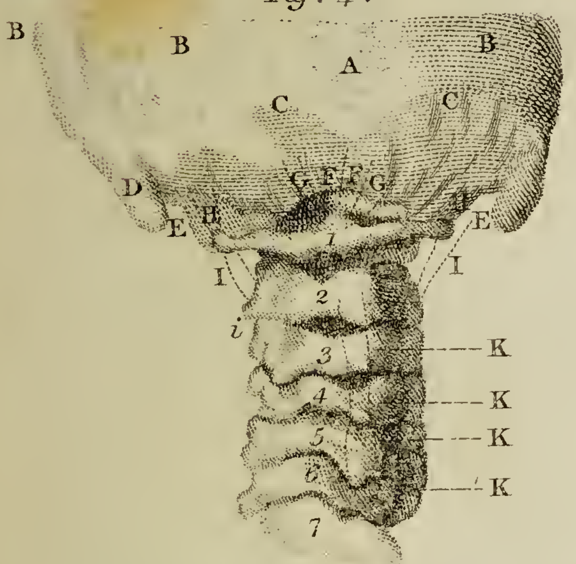

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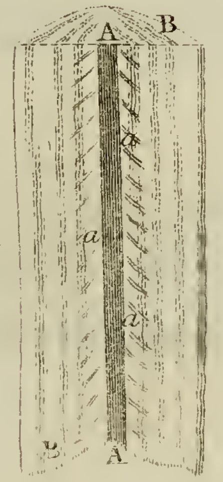

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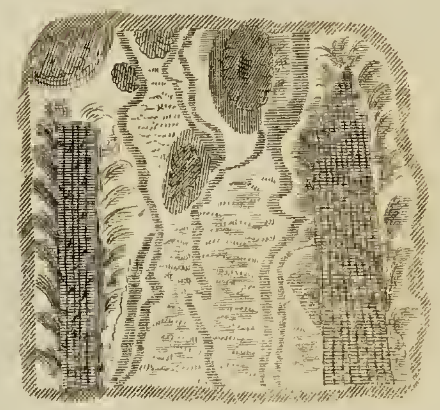

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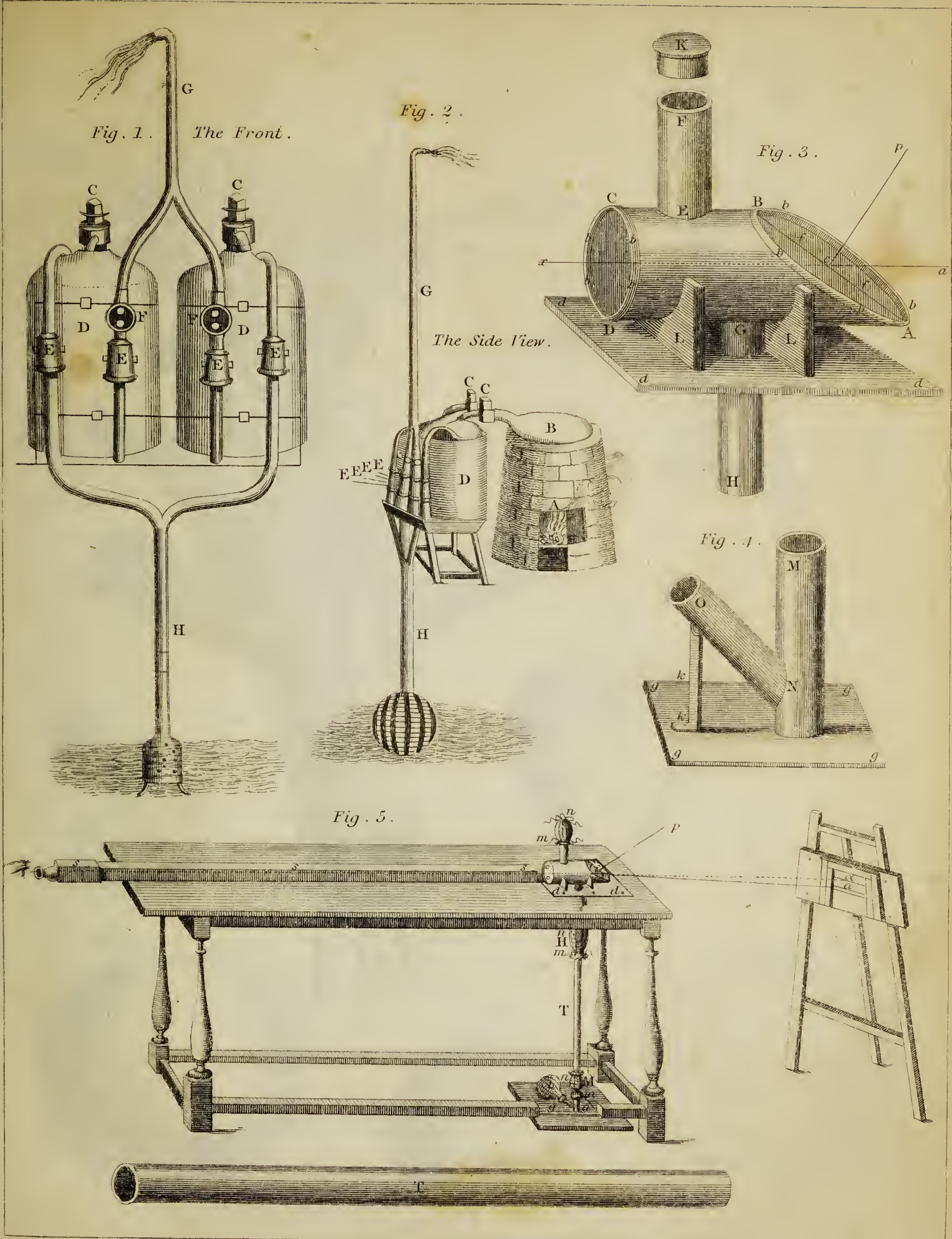

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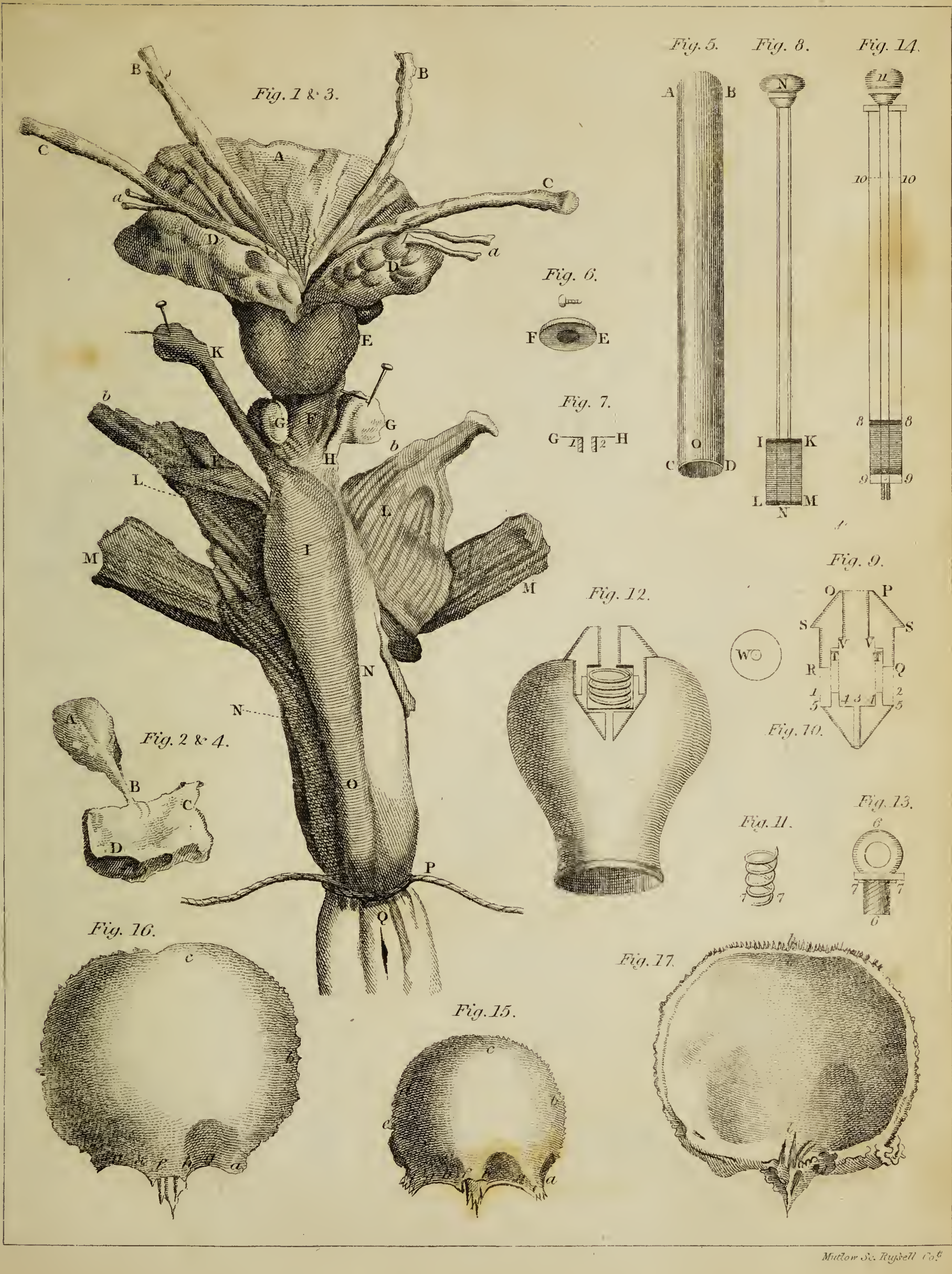

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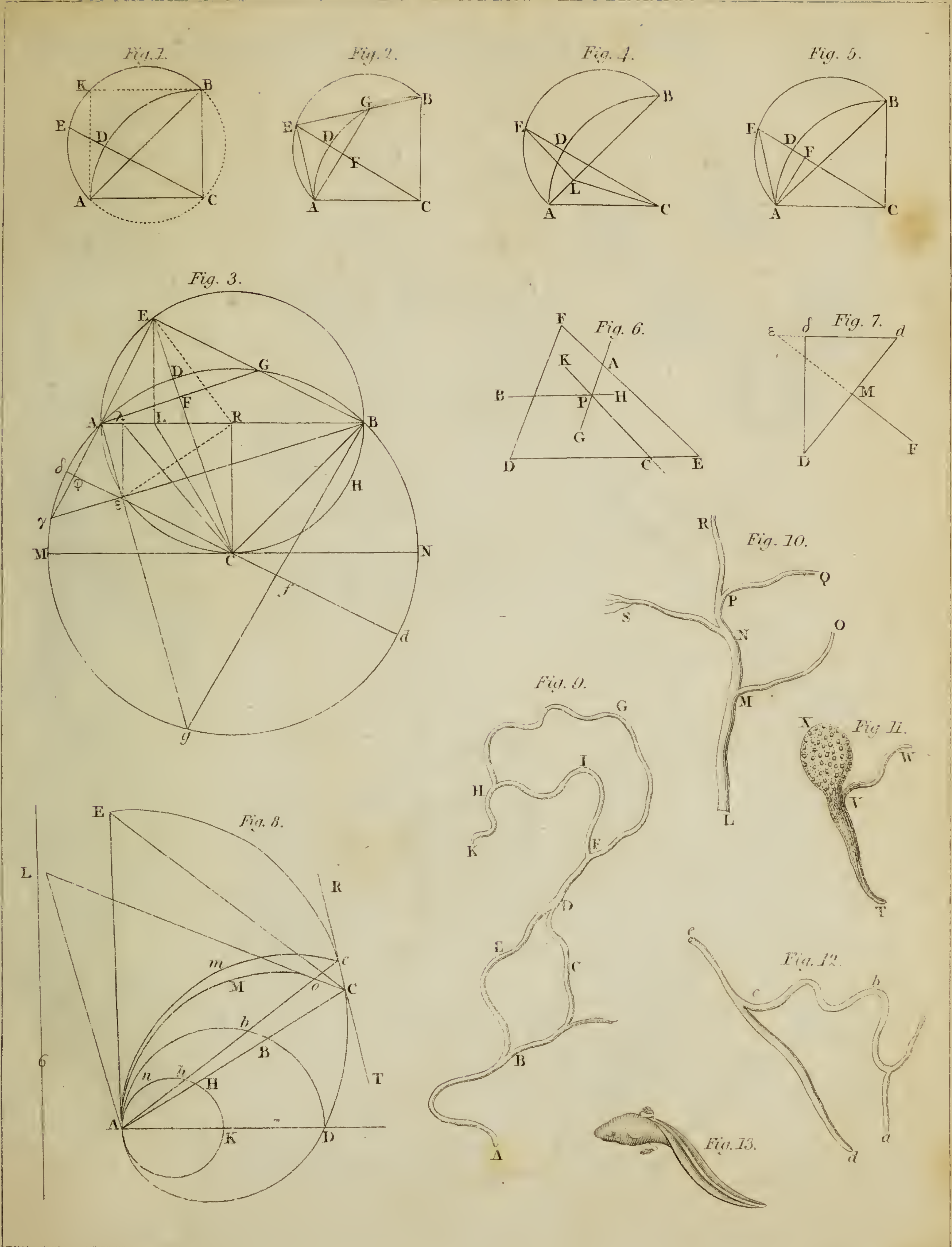

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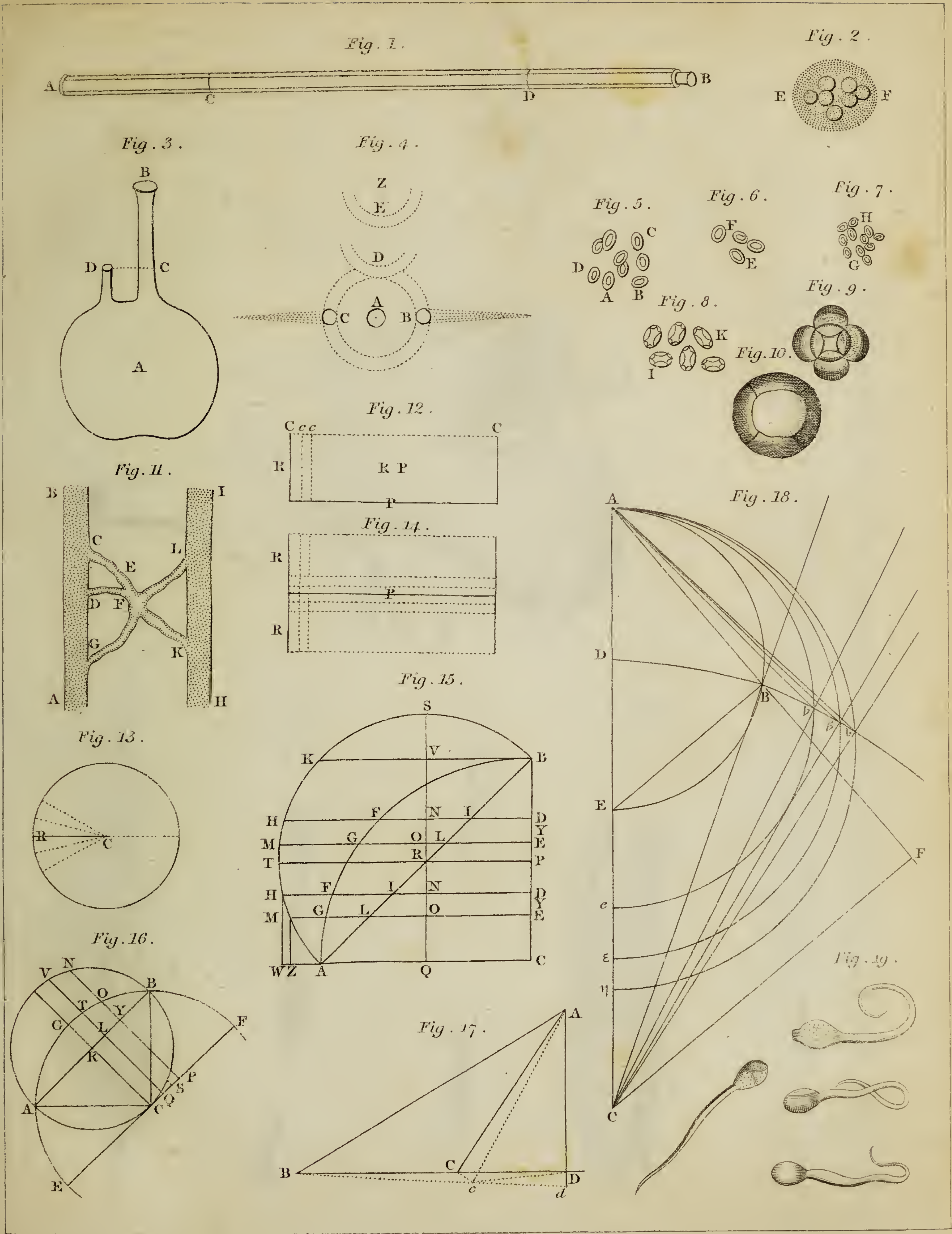

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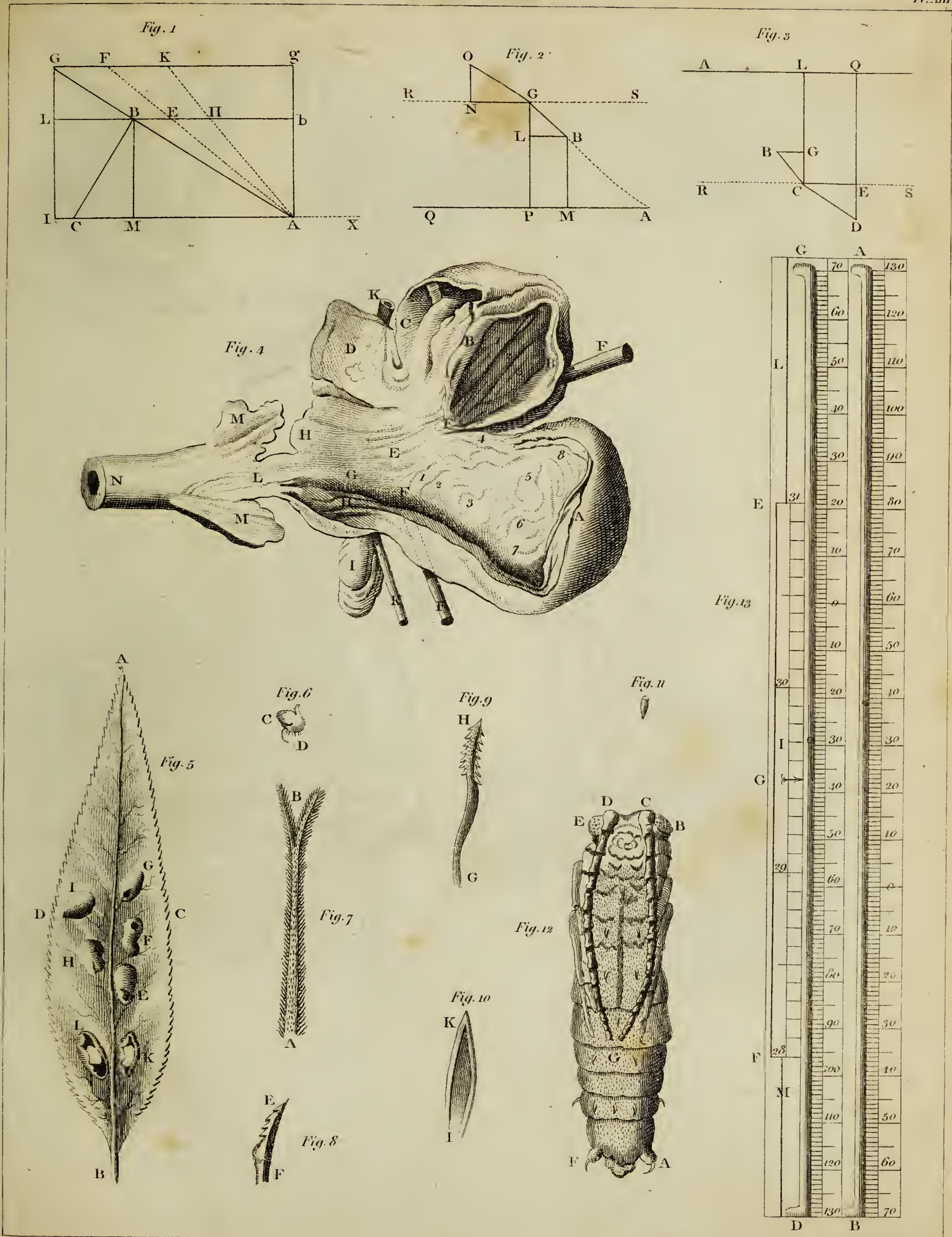

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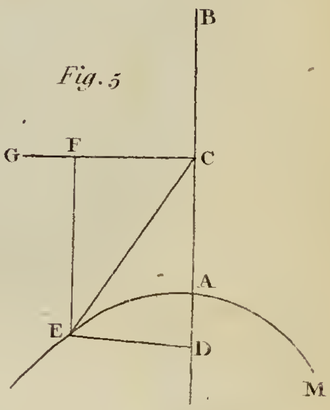

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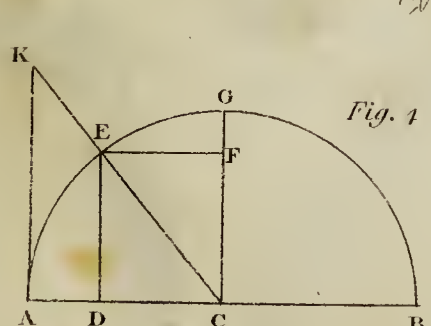

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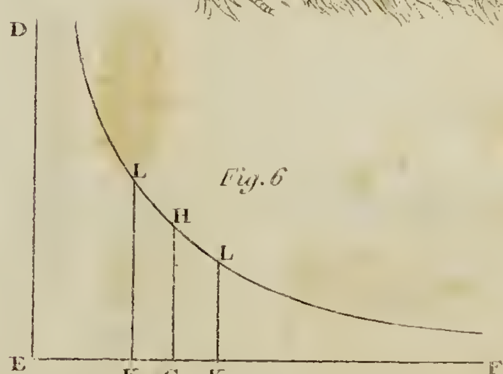

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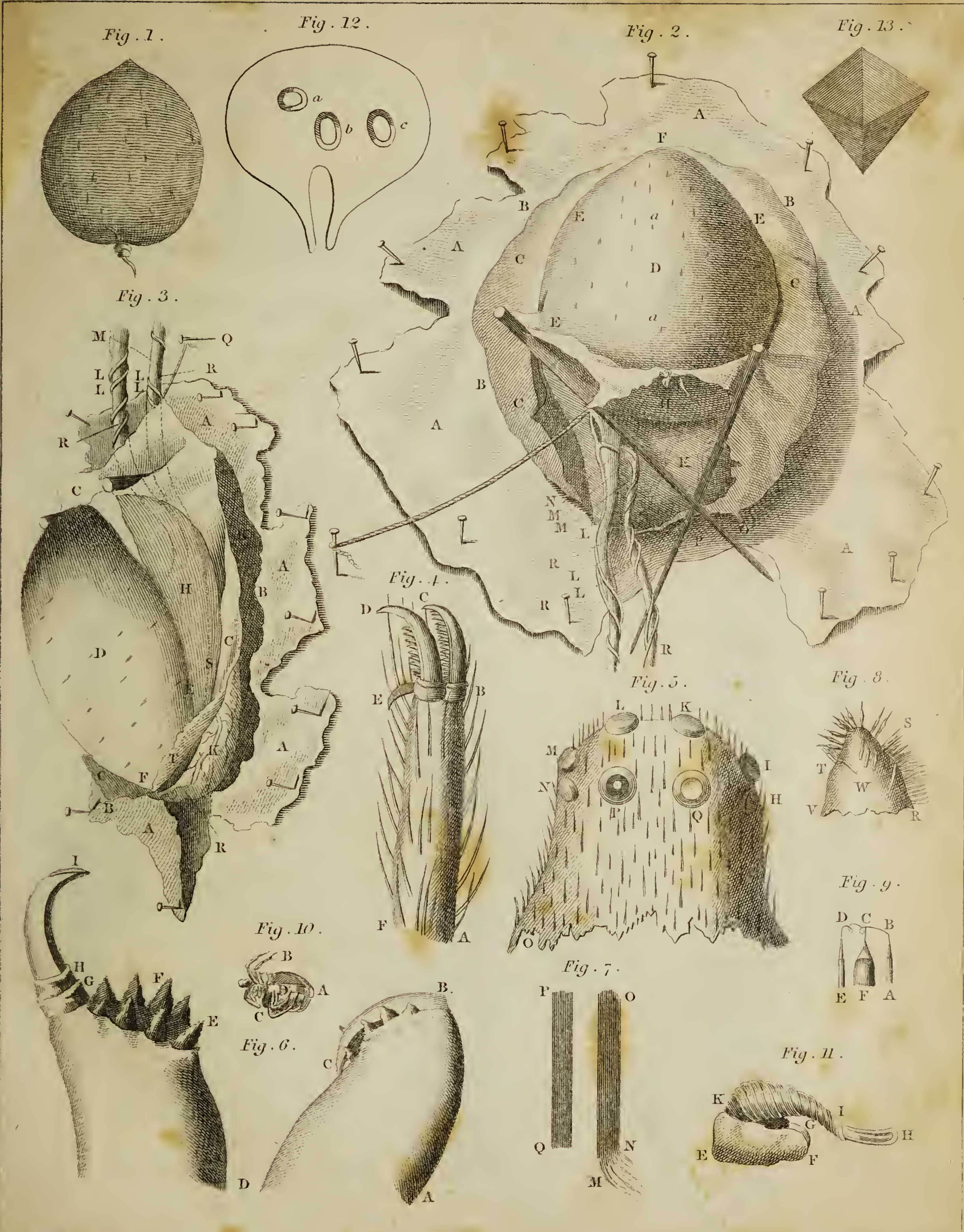

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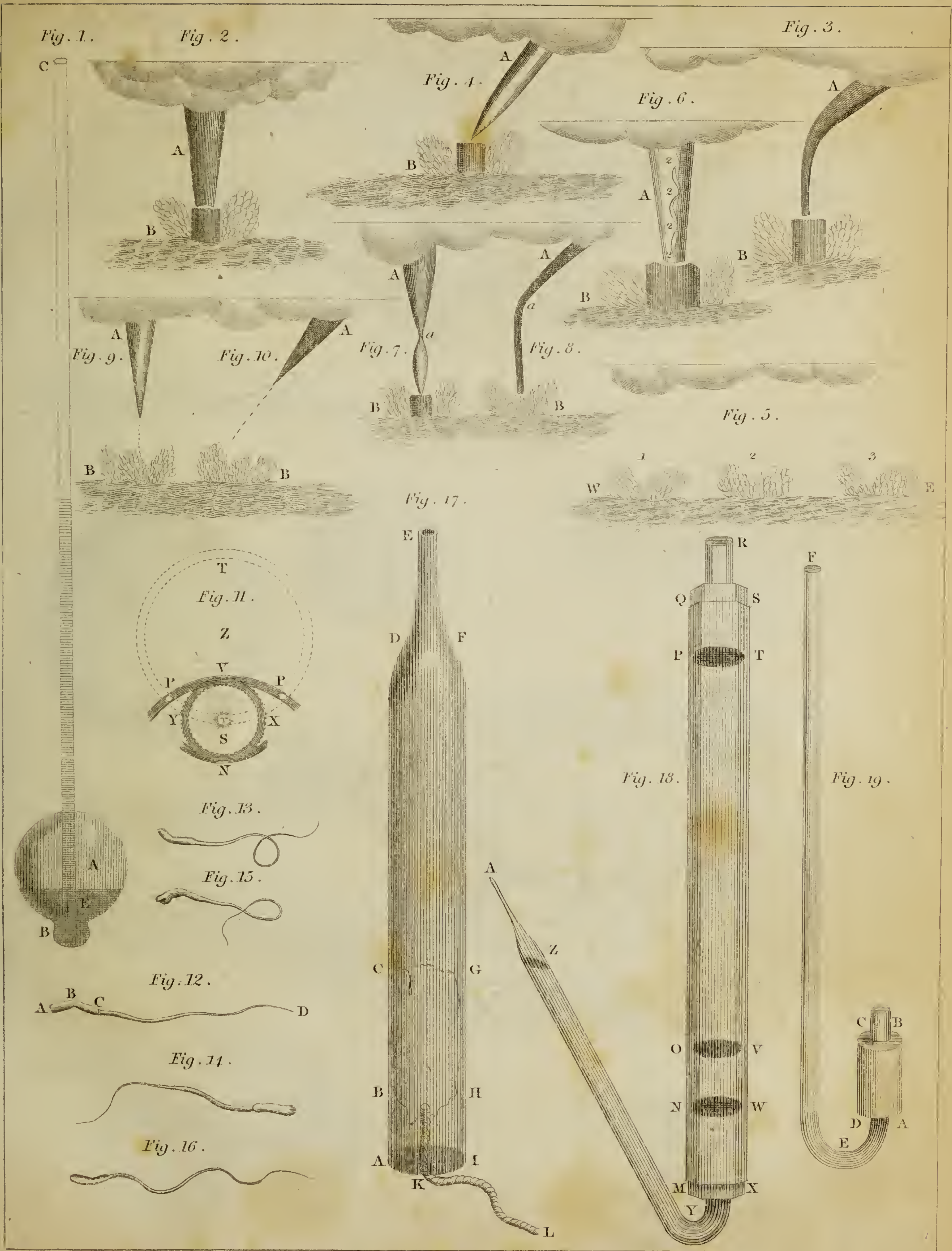

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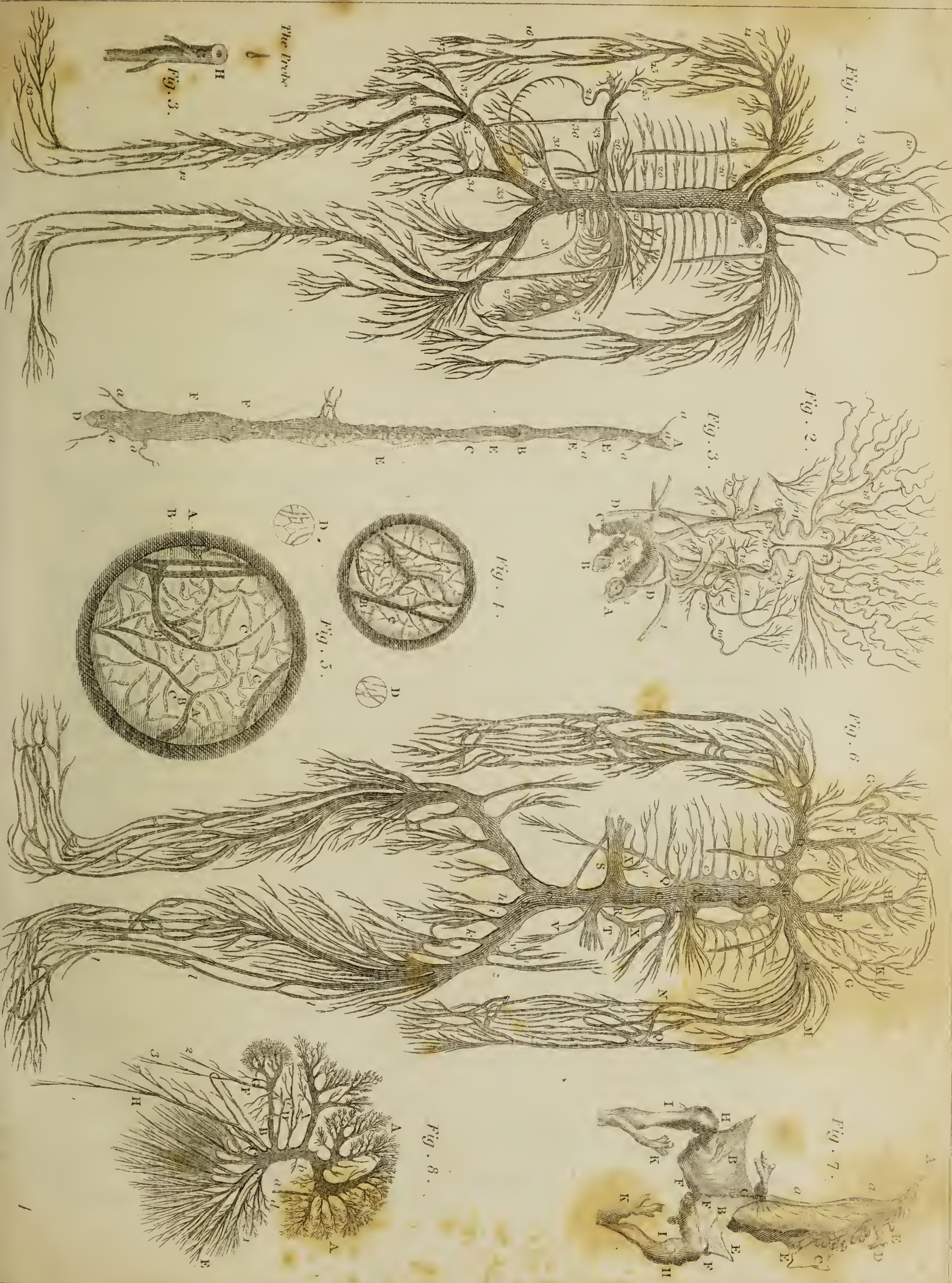

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THE

PHILOSOPHICAL TRANSACTIONS

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ABRIDGED.

On the Methods of Approximation in the Extraction of Surd Roots. By John Wallis, S. T. D. and Savilian Professor of Geometry at Oxford. N° 215, p. 2. *Vol. XIX.*

THE several methods of approximation, which have been mentioned of late years, for extracting the roots of simple or affected equations, give occasion to say somewhat on that subject. It is agreed by all, and I think demonstrated by the Greeks long ago, that if a number proposed be not a true square, it is in vain to hope for a just quadratic root of it, explicable by rational numbers, integers, or fractions. And therefore, in such cases, we must content ourselves with approximations, without pretending to accuracy. And so for the cubic root, of what is not a perfect cube. And the like for superior powers.

Now the ancients had their methods of approximation in such cases; some of which have descended down to us. But since the methods of decimal fractions have come into practice, it has been usual to prosecute such extractions in the places of decimal parts, to what accuracy we please.

Mr. Newton's method of approximation for extracting roots, even of affected equations, I have given some account of in my English Algebra; and somewhat more fully in the Latin edition; where I gave an account also of Mr. Raphson's method. Since which time, M. de Lagny has published his Method of Approximation, principally for single equations, or extracting the root of a single power. And Mr. Halley has since improved this method, with a further advantage, especially as to affected equations.

These may all, or any of them, be of use for making more speedy approaches, and by greater leaps, in many cases, than Vieta's method, pursued and improved by Mr. Oughtred and Mr. Harriot of our own country, and by others abroad;

especially as to simple equations, if we suppose such extractions to be pursued to the full extent.

But if we make use of Mr. Oughtred's expedient, for multiplication, division, extraction of roots, and other like operations, by neglecting so much of this long process, as is afterward to be cut off and thrown away as useless, which I think is generally practised, the work will be much abridged, and the advantage of the other methods much less considerable.

And if we further consider, what preparative operations are to be made in some of those other methods, before we come to the prescribed division for giving the root desired; the advantage will not be so great as may at first be apprehended. But, without disparaging these methods, what I here intend, is, to show the true foundation of the methods used by the ancients, and the just improvement of them. Which though anciently scarce applied beyond the quadratic, or perhaps the cubic root, yet are equally applicable, by due adjustments, to the superior powers also.

I shall begin with the square root, for which the ancient method is to this purpose: from the proposed non-quadrate, suppose N, subtract the greatest square in integers, suppose A^2. The remainder, suppose $B = 2AE + E^2$, is to be the numerator of a fraction, for designing the near value of E, the remaining part of the root sought, viz. $A + E = \sqrt{N}$, whose denominator or divisor is to be 2 A, or 2 A + 1, the true value falling between these two; sometimes the one, sometimes the other, being nearer to the true value. But the latter is commonly directed. This method M. de Lagny affirms to be more than 200 years old: and it is so; for I find it in Lucas Paccioluś, otherwise called Lucas de Bergo, or de Burgo Sancti Sepulchri, printed at Venice in the year 1494, if not even sooner, for I find there have been several editions of it; and it seems much older, for he does not deliver it as a new invention of his own, but as a received practice, and derived from the Moors or Arabs, from whom they had their algorism, or practice of arithmetic by the ten numeral figures now in use. And it is continued down hitherto in books of practical arithmetic in all languages, which teach the extraction of the square root, and this method of approximation, in case of a non-quadrate.

The true ground of the rule is this: A^2 being the greatest integer square contained in N, it is evident that E must be less than 1. Now if the remainder $B = 2AE + E^2$ be divided by 2 A, the result will be too great for E; but if we diminish the quotient, by increasing the divisor, adding 1 to it, it then becomes too little; because the divisor is now too great. For, E being less than 1, $2A + 1$ is more than $2A + E$, and therefore too great. As for instance; if the non-quadrate proposed be $N = 5$, the greatest integer-square is $A^2 = 4$, the square of A or 2: which being subtracted, leaves $N - A^2 = 5 - 4 = 1 = B = 2AE + E^2$. Which divided by $2A = 4$, gives $\frac{1}{4}$: but divided by $2A + 1 = 4 + 1 = 5$, gives $\frac{1}{5}$: that too great, and this too little for E. And therefore the true root ($A + E = \sqrt{N}$) is less than $2\frac{1}{4} = 2.25$, but greater than $2\frac{1}{5} = 2.2$. And this was anciently thought an approach near enough.

If this approach be not now thought near enough, the same process may be again repeated; and that as often as is thought necessary. Thus, take now for A, $2\frac{1}{5} = 2.2$, whose square is $4.84 = A^2$; this, subtracted from 5.00, leave a new remainder $B = 0.16$: which divided by $2A = 4.4$, gives $\frac{.16}{4.40} = \frac{2}{55} = 0.03636 +$, too much; but divided by $2A + 1 = 4.5$, it gives $\frac{.16}{4.50} = \frac{8}{225} = 0.03555 +$, too little. The true value, between these two, being 2.236 proxime, whose square is 4.999696.

If this be not thought near enough, subtract this square from 5.000000; the remainder $B = 0.000304$, divided by $2A = 4.472$, or by $2A + 1 = 4.473$, gives, either way, 0.000068 —; which added to $A = 2.236$, makes 2.236068 —, somewhat too large; but 2.236067 + would be much more too little.

Proceed we now to the cubic root. For which, the rule is this: from the non-cubic proposed, suppose N, subtract the greatest cube in integers, suppose A^3; the remainder, suppose $B = 3A^2E + 3AE^2 + E^3$ is to be the numerator of a fraction for designing the value of E, the remaining part of the root sought $A + E = \sqrt[3]{N}$. To this numerator, if, for the denominator or divisor, we subjoin $3A^2$, the result will certainly be too great for E, because the divisor is too little. If, for the divisor, we take $3A^2 + 3A + 1$, it will certainly be too little, because the divisor is too great. It must therefore, between these limits, be more than this latter. And therefore this latter result being added to A, will give a root whose cube may be subtracted from the non-cubic proposed, in order to another step. This approach I find in Wingate's Arithmetic, published in the year 1630, and must therefore be at least so old; how much older I know not. But if for the divisor we take $3A^2 + 3A$, the result may be too great; or, in case B be small, it may be too little.

Thus, for instance; if the non-cube proposed be $9 = N$. The greatest integer cube is $8 = A^3$, whose cubic root is $A = 2$; which cube subtracted, leaves $9 - 8 = 1 = B = 3A^2E + 3AE^2 + E^3$. This divided by $3A^2 = 12$, gives $\frac{1}{12} = 0.08333 +$, too great for E. But the same divided by $3A^2 + 3A + 1 = 12 + 6 + 1 = 19$, gives $\frac{1}{19} = 0.05263 +$, too little. Or, if but by $3A^2 + 3A = 12 + 6 = 18$, it gives $\frac{1}{18} = \frac{5}{90} = 0.05555 +$, yet too little. For the cube of $A + 0.06, = 2.06$, is only 8.742 —, which is short of 9. And so much short of it, that we may safely take 2.07 as not too great; or perhaps 2.08; and upon trial it will be found not too large; for the cube of 2.08 is but 8.998912.

If this first step be not near enough, this cube subtracted from 9.000000, leaves a new $B=0.001088$, which divided by $3A^2=12.9796$, gives 0.000084—; which will be somewhat too great but not much. So that if to 2.08 we add 0.000084 —, the result 2.080084 will be too great, but 2.080083 will be more too little. So that either of them, at the second step, gives the true root within an unit in the sixth place of decimal parts.

Hitherto I have pursued the method most affected by the ancients, in seeking a square or cube, and the like of other powers, always less than the just value, that it might be subtracted from the number proposed, leaving B a positive remainder; thereby avoiding negative numbers. But since the arithmetic of negatives is now so well understood, it may in this be advisable, to take the next greater, in case that be nearer to the true value, rather than the next less. According to this notion, for the square root of 5, I would say, it is 2 +, somewhat more than 2, and inquire, how much more? but for the square root of 8 I would say, it is 3 —, somewhat less than 3; and inquire, how much less? taking, in both cases, that which is nearest to the just value. And what is said of these is easily applicable to the higher powers.

I shall omit that of the biquadrate, because here perhaps it may be thought most advisable to extract the square root of the number proposed, and then the square root of that root. But if we would do it at once, we are from N to subtract A^4, the greatest biquadrate contained in it, to find the remainder $B = 4A^3E + 6A^2E^2 + 4AE^3 + E^4$; which remainder, if we divide by $4A^3$, the quotient will certainly be too large for E; if by $4A^3 + 6A^2 + 4A + 1$, it will certainly be too little; and we are to use our discretion in taking some intermediate number. And if we chance not to hit on the nearest, the inconvenience will be only this, that our leap will not be so great as otherwise it might be. Which will be rectified by another B at the next step.

For the sursolid of five dimensions, we are, from N to subtract A^5, the greatest sursolid therein contained, to find the remainder $B = 5A^4E + 10A^3E^2 + 10A^2E^3 + 5AE^4 + E^5$; which if we divide by $5A^4$, the result will be somewhat too great, if by $5A^4 + 10A^3 + 10A^2 + 5A + 1$, the result will certainly be less than the true E. The just value of E being somewhat between these two; where we are to use our discretion, what intermediate number to take. Which, according as it proves too great or too little, is to be rectified at the next step.

If, to direct us in the choice of such intermediate number, we should multiply rules or precepts for such choice, the trouble of observing them would be more than the advantage to be gained by it. And, for the most part, it will be safe enough, and least trouble, to divide by 5 A^4, which gives a quotient somewhat too great; which we may either rectify at discretion, by taking a number somewhat less, or proceed to another B, affirmative or negative, as the case shall require, and so onward to what exactness we please. Which is, for substance, in a manner coincident with Mr. Raphson's method, even for affected equations. How far this method may be coincident with some of those beforementioned, I do not trouble myself to inquire, nor whether, or for what causes, all or any of those may be more eligible. My design being only to show the true natural ground from whence such rules of approach are, or might have been derived, and by which they may be examined.

In affected equations, especially where the coefficients are great, and some affirmative, others negative, the cases will be more perplexed. And to multiply rules for each case would increase the trouble, with no great advantage. Which therefore I leave to the prudence of each to take some intermediate, between a greater and a less. Or, if they please, to accommodate that in my Commerc. Epistol. to the present case, which is there applied to a case not less intricate. Or to make use of some of the methods delivered by others to this purpose. Where this is to be considered, that such affected equations are capable of more roots than one, according to the number of dimensions to which they arise.

A Method of discovering the true Moment of the Sun's Ingress into the Tropical Signs. By E. Halley. N° 215, p. 12.

It may perhaps pass for a paradox, if not seem extravagant, if I should assert that it is an easier matter to be assured of the moments of the tropics, or of the times of the sun's entrance into Cancer and Capricorn, than it is to observe the true times of the equinoctials, or ingress into Aries and Libra. I know the opinion both of ancient and modern astronomers to the contrary, as Ptolemy, Riccioli, &c. and this because of the exceeding slowness of the change of the sun's declination on the day of the tropic, being not a quarter of a minute in 24 hours. This indeed would make it very difficult, nor would any instruments suffice to do it, were the moment of the tropic to be determined from one single observation. But by three subsequent observations made near the tropic, at proper intervals of time, I hereby design to show a method to find the moment of the tropics, capable of all the exactness the most accurate can desire; and that without any consideration of the parallax of the sun, of the refractions of the air, of the greatest obliquity of the ecliptic, or latitude of the place; all which are required to ascertain the times of the equinoctials from observation, and which being faultily assumed, have occasioned an error of near 3 hours in the times of the equinoctials deduced from the tables of Tycho Brahe and Kepler; the vernal being so much later, and the autumnal so much earlier, than by the calculus of those famous authors.

Now before we proceed, it will be necessary to premise the following lemmata, serving to demonstrate this method, viz. 1. That the motion of the sun in the ecliptic, about the time of the tropics, is so nearly equable, that the difference from equality is not sensible, from 5 days before the tropic, to 5 days after; and the difference arising from the little inequality that there is, never amounts to above $\frac{1}{4}$ of a single second in the declination, and this by reason of the nearness of the apogæon of the sun to the tropic of Cancer. 2. That for 5 degrees before and after the tropics, the differences by which the sun falls short of the tropics are as the versed sines of the sun's distance in longitude from the tropics; which versed sines, in arches under 5 degrees, are beyond the utmost nicety of sense, as the squares of those arches. From these two follow a third; 3. That for 5 days before and after the tropics, the declination of the sun falls short of the utmost tropical declination, by spaces which are in duplicate proportion, or as the squares of the times, by which the sun is wanting of or past the moment of the tropic.

Hence it is evident, that if the shadows of the sun, either in the meridian or any other azimuth, be carefully observed about the time of the tropics, the spaces by which the tropical shade falls short of, or exceeds, those at other times, are always proportionable to the squares of the intervals of time between those observations and the true time of the tropic; and consequently if the line, on which the limits of the shade is taken, be made the axis, and the correspondent times from the tropic expounded by lines be erected on their respective points in the axis, as ordinates, the extremities of those lines shall touch the curve of a parabola, as may be seen in fig. 1, pl. 1. Where a, b, c, e, being supposed points observed, the lines a B, b C, c A, e F, are respectively proportional to the times of each observation before or after the tropical moment in Cancer.

This premised, we shall be able to bring the problem, of finding the true time of the tropic by three observations, to this geometrical one, having three points in a parabola A, B, C, or A, F, C, given, together with the direction of the axis, to find the distance of those points from the axis. Of this there are two cases, the one when the time of the second observation B is precisely in the middle time between A and C; in this case putting t for the whole time between A and C, we shall have Ac, the interval of the remotest observation A from the tropic, by the following analogy: as $2\,ac - bc$ to $2\,ac - \frac{1}{4}\,bc$ :: so is $\frac{1}{2}$ t or AE : to A c, the time of the remotest observation A from the tropic. But the other case, when the middle observation is not exactly in the middle between the other two times, as at F, is something more operose, and the whole time from A to C being put $= t$, and from A to F $= s$, $ce = c$, and $bc = b$, the theorem will stand thus $\frac{ttc - bss}{2tc - 2bs} =$ A c, the time sought.

To illustrate this method of calculation, it may perhaps be requisite to give an example or two, for the sake of those astronomers that are less instructed in the geometrical part of their art. Anno 1500 Bernard Walther, in the month of June, at Nuremburg, observed the chord of the distance of the sun from the zenith by a large parallactic instrument of Ptolemy, as follows:

June 2, 45467		June 8, 44975
June 9, 44934	and	June 12, 44883
June 16, 44990		June 16, 44990.

In both which cases the middle time is exactly in the middle between the extremes, and therefore in the former three, $ac = 533$, $bc = 477$, and t the time between, being 14 days; by the first rule, the time of the tropic will be found by this proportion, as 589 to $827\frac{1}{2}$ :: so $\frac{1}{2}$ t or 7 days, to 9 days 20h. 2m. whence the tropic, Anno 1500, is concluded to have fallen June 11d. 20h. 2m. In the latter three, ac is $= 107$, and $bc = 15$, and the whole interval of time is 8 days $= t$; whence as 199 : to $206\frac{1}{4}$ :: so is 4 days to 4d. 3h. 37m., which taken from the 16th day at noon, leaves 11d. 20h. 23m. for the time of the tropic, agreeing with the former to the third part of an hour.

Again, Anno 1636, Gassendus, at Marseilles, observed the summer solstice by a gnomon of 55 feet high, in order to determine the proportion of the gnomon to the solstitial shade; and he has left us these observations, which may serve as an example for the second rule.

June 19, N. S.	shadow 31766	parts, whereof the gnomon was 89428.
June 20,	31753	
June 21,	31751	
June 22,	31759.	

These being divided into two sets, of three observations each, viz. the 19th, 20th, and 22d, and the 19th, 21st, and 22d; we shall have in the first three, $c = 13$, and $b = 7$, $t = 3$ days, $s = 1$; and in the second, $c = 15$, and $b = 7$, $t = 3$, and $s = 2$; whence, according to the rule, the 19th day at noon the sun wanted of the tropic a time proportionate to one day, as $ttc - ssb$ to $2tc - 2bs$, that is, as 110 to 64 in the first set, or 107 to 62 in the second set; that is, 1d. 17h. 15m. in the first, or 1d. 17h. 25m. in the second set;

so that we may conclude the moment of the tropic to have been June 10d. 17h. 20m. in the meridian of Marseilles.

Now that these two tropical times thus obtained, will be found to confirm each other's exactness from their near agreement, appears by the interval of time between them, viz. 1d. 2h. 30m. less than 136 Julian years; of which 1d. 1h. 8m. arises from the defect of the length of the tropical year from the Julian, and the rest from the progression of the sun's apogæon in that time; so that no two observations made by the same observer in the same place, can better answer each other, and that without any the least artifice or force in the management of them.

What were the methods used by the ancients to conclude the hour of the tropics, Ptolemy has no where delivered; but it were to have been wished that they had been aware of this, that we might have been more certain of the moments of the tropics we have received from them, which would have been of singular use to determine the question, whether the sun's apogæon be fixed in the starry heaven; or if it move, what is its true motion? It is certain, that if we take the account of Ptolemy, the tropic said to be observed by Euctemon and Meton, Junii 27 manè, Ann. 432 ante Christum, can nowise be reconciled, without supposing the observation made the next day, or June 28 in the morning. And Ptolemy's own tropic observed in the third year of Antoninus, Anno Christi 140, was certainly on the 23d, and not the 24th day of June; as will appear to those that shall duly consider and compare them with the length of the year deduced from the diligent and concordant observations of those two great astronomers, Hipparchus and Albatâni; established and confirmed by the concurrence of all the modern accuracy. For these observations give the length of the tropical year such, as to anticipate the Julian account only one day in 300 years; but we are now certain that the said period of the sun's revolution anticipates very nearly 3 days in 400 years; so that the tables of Ptolemy founded on that supposition, err about a whole day in the sun's place, for every 240 years. Which principal error in so fundamental a point, vitiates the whole superstructure of the Almagest, and serves to convict its author of want of diligence, or fidelity, or both.

But to return to our method: the great advantage we have hereby, is, that any very high building serves for an instrument, or the top of any high tower or steeple, or even any high wall that may be sufficient to intercept the sun, and cast a true shade: nor is the position of the plane on which you take the shade, or that of the line therein, on which you measure the recess of the sun from the tropic, very material; but in what way soever you discover it, the said recess will be always in the same proportion, by reason of the smallness of the angle, which is not six minutes in the first five days: nor need you inquire the height or distance of your building, provided it be very great, so as to make the spaces you measure large and fair. But it is convenient that the plane on which you take the shade be not far from perpendicular to the sun, at least not very oblique, and that the wall which casts the shade be straight and smooth at top, and its direction nearly east and west, for reasons that will be well understood by a reader skilful in the doctrine of the sphere. And it will be requisite to take the extreme greatest or least deviation of the shadow of the wall, because the shade continues for a good while at a stand, without alteration, which will give the observer leisure to be assured of what he does, and not to be surprised by the quick transient motion of the shade of a single point at such a distance. The principal objection is, that the penumbra, or partile shade of the sun, is, in its extremes, very difficult to distinguish from the true shade, which will render this observation hard to determine nicely. But if the sun be transmitted through a telescope, after the manner used to take his species in a solar eclipse, and the upper half of the object-glass be cut off by a paper pasted thereon, and the exact upper limb of the sun be seen just emerging out of, or rather contingin the species of the wall, the position of the telescope being regulated by a fine hair extended in the focus of the eye-glass, I am assured that the limit of the shade may be obtained to the utmost exactness: and of this I design to give a specimen by an observation to be made in June next, by the help of the high wall of St. Paul's church, London, of which some following Transaction may give an account. In the mean time what I have premised may suffice to set others at work, where such or higher buildings are to be met with. I shall only advertise, that the winter tropic, by this method, may be more certainly obtained than the summer's, by reason that the same gnomon affords a much larger radius for this kind of observation.

On the probable Causes of the Pain in Rheumatisms; and on the Cure of a total Suppression of Urine, not caused by a Stone, by the use of Acids. By Dr. Edward Baynard, Fellow of the Coll. of Physicians. N° 215, p. 19.

This ingenious physician was always of opinion, that the pains in a rheumatism were not caused by any saline or acid particles in the blood, &c. but rather by its clamminess and density distending the channels through which it passes, which distension produces those sharp and pungent pains which rheumatic persons so generally complain of; for although the proper coats of the veins and arteries seem to be insensible in themselves, yet those thin membranes which beset them are of most exquisite sense, and full of lymphæducts, which being dilated and stretched, cause an inflammatory symptomatic fever, with continual sweats; the blood being glutinous and sizy, as in quinsies and pleurisies, and all other inflammatory distempers. The fever being increased by the great quantity of alkaline corrosive salts lodging in the blood, causing thirst, &c. and not diluted and washed off by urine, which urine is always thick, turbid, and high coloured, and almost, if not totally devoid of any saline impregnations, as was proved upon analysis.

A patient had laboured for 7 or 8 days under a total suppression of urine. Upon trying with a catheter, there was not the least appearance of any stone, nor a drop of water in his bladder; upon which Dr. Baynard caused the patient to take a quantity of acids, which produced a great discharge of urine, and restored him to health.

An Extract of a Letter from Bernard Connor, M. D. to Sir Charles Walgrave, giving an Account of an extraordinary Human Skeleton, having the Vertebræ of the Back, the Ribs, and several Bones down to the Os Sacrum, all firmly united into one solid Bone, without Jointing or Cartilage.* N° 215, p. 21.

This was not an entire skeleton, but consisted only of the os ilium, the os sacrum, the 5 vertebræ of the loins, 10 of the back, 5 entire ribs on the right side, and 3 on the left; the bottoms or ends of the other were closely united to the transverse apophyses of their vertebræ. The vertebræ of the neck, the claviculæ and sternum were wanting. All these bones which are naturally distinct from each other, were here so straightly and intimately conjoined, their

* Dr. Bernard Connor was a native of Ireland, and is supposed to have been born in 1666. In 1686 he went to Montpellier, where he prosecuted his medical studies, and from thence he removed to Paris. While he was here he was fortunate enough to be appointed travelling physician to the two sons of the chancellor of Poland, whom he accompanied to Warsaw, passing through Italy, Austria, Moravia, and Silesia. Not long after his arrival at Warsaw, the King of Poland made him one of his physicians. This honour was conferred upon him when he was only 28 years of age. During his stay at Warsaw he evinced his medical skill and penetration in several difficult cases, whereby he acquired a great degree of professional celebrity; but being fond of travelling, and at the same time desirous of returning to England, we are told that he gladly embraced the opportunity of accompanying, as physician, the King of Poland's daughter, Princess Theresa, who had been married to the Elector of Bavaria, to Brussels. This journey being completed, he quitted the service of the princess, and proceeded through Holland to England. He now resided partly at Oxford and partly in London, delivering lectures, at both places, on the animal economy. These he rendered highly interesting by the introduction of much new information on anatomical, physiological, and chemical subjects, which he had collected during his travels on the continent. These lectures were afterwards read at Cambridge. At this time he published his Dissertationes Medico-physicæ de Antris lethiferis, de Montis Vesuvii Incendio, &c. of which an account will be found in a subsequent number of these Transactions. In 1697 he published a small treatise, entitled Evangelium Medici, which raised him many enemies, especially among the clergy, it being considered as "an attempt to account for the miracles of the Bible upon natural principles." *(Gen. Biog. Dict.)* His last publication was a History of Poland. Dr. Connor died of a fever 1698, before he had attained his 33d year.

ligaments so perfectly bony, and their articulations so effaced, that they really made but one uniform continuous bone; so that it was as easy to break one of the vertebra into two, as to disjoint or separate it from the other vertebræ, or the ribs, or the os sacrum from those of the ilia. Nor could I observe any greater distinction between all these bones than is usually seen in adult persons between the os pubis, the ischion, and ilium, which are but one entire bony substance. The roots of all the ribs made but one equal, smooth, and plain superficies with the vertebræ and their apophyses. The oblique apophyses of all the vertebræ were so confounded and lost, that it was not possible to observe any marks of them. The cartilaginous edge of the vertebræ themselves was become perfect bone. In short, they were as entire as a skeleton cut out of the same piece of wood by a carver. Being willing to see if these vertebræ were united throughout their whole diameter, or at the edges only, I sawed two of them asunder at the commissure, and found this uniting did not enter above 2 lines deep, and that afterwards their middles were separated as they usually are, and touched each other only at the edges. On the left side at half a finger's breadth from the vertebræ, two ribs were joined together for the space of an inch, and afterward ran separated and parallel, like the rest, to the sternum. The figure of this trunk was crooked, making part of a circle. The spine forming the convex, and the inside of the vertebræ the concave part of this segment. If the other vertebræ of the back and neck had been preserved, and had bent in the same curve, they would have made near the half of a circle. The direction of the ribs was unnatural, for instead of terminating at the sternum in parallel semicircles nearly horizontal, their extremities where they reached the sternum, dipped so much down towards the hypogastrium, as to touch the sides of the ossa ilii.

This trunk seemed to be of a grown person, the bones being of a proportion and thickness equal to those of old men. The vertebræ of the loins were larger than those of the back, as they naturally are; there was no unnatural bunching out, their joining together being very regular, no one vertebra standing out beyond the other, either before, behind, or on the sides. The cavity for the spinal marrow had no fault but its bending figure. The bones of the os pubis were separated as usual. The socket or cavity of the last spurious rib on the right side, being smooth and polished, seemed as if that rib had not been so firmly united as the rest. In the extremity of the ribs next the sternum, the usual cavities for the cartilages to move in were observable, which as it seems by this were not bony, nor continuous with the ribs.

It was a surprising sight to see the sport of nature in the fabric and hardening of these bones, which naturally move upon each other, are separated by cartilages, and held together only by cords and ligaments, and chiefly that the ribs should be thus joined with the rest, which are perpetually raised in respiration, and whose motion is upon the vertebræ as its centre; and we see motion hinders the lips of a wound from closing, and a broken bone from uniting. The author supposes the bones to have been thus united in the fœtal state.

He further remarks, that necessarily the body of this person must have been immoveable, that he could neither bend nor stretch himself out, rise up nor lie down, nor turn upon his side, having only the head, feet, and hands moveable. The great difficulty seeming to be in the respiration, how that could be performed when the ribs were thus immoveable: he endeavours to obviate this by observing, first, how little motion of the breast is necessary to continue the motion of the blood through the lungs, as is visible in hysteric fits, &c. Again, the ribs of his skeleton, though fixed at the centre, might yet be moved at the extremities, and so the thorax be enlarged by a much less strength than that of the muscles used for that purpose; besides, the diaphragm, the chief organ of respiration, was in this subject free in its acting. But it is likely this person breathed very short, the quickness of the returns supplying the defect of a large draught of air at once. And possibly the foramen ovale might continue open, and by it and the arterial canal the blood might pass from the cava to the aorta, and but a part of it pass through the lungs. He confirms this by an observation he lately made in a girl of 4 or 5 years old, in whom the foramen ovale was but half closed up, and in the form of a crescent.

To this our author adds another observation of the bones of the thigh and leg growing together in an adult person, the place of their joining being much more solid than any other part. These bones were so bent at the knee as to make an acute angle, yet were they without any exostosis, rottenness, fracture, or unnatural figure. It is more surprising to find the knee, whose motion is free and large, to be thus united than that of the ribs of the skeleton, whose motion is obscure, and scarcely sensible.

Concerning a Spout of Water that happened at Topsham, on the River between the Sea and Exeter. By Mr. Zachary Mayne. N° 215, p. 28.

These phænomena are very frequent abroad, yet rarely if ever seen with us, though some pretend to have seen them in the Downs. The French call them trombes, I suppose from their figure, and the noise they make, that word signifying a sort of humming top. They are certain elevations of water, during storms and tempests, reaching from the surface of the sea to the clouds. They happen several ways; sometimes the water is seen to boil, and raise itself for a considerable space round, about a foot from the surface, above which appears, as it were, a thick and black smoke, in the middle of which is observed a sort of stream or pipe resembling a tunnel, which rises as high as the clouds; at other times these pipes or tunnels are observed to come from the clouds, and suck up the water with great noise and violence. They move from the place where they were first collected, according to the motion of the wind, and discharge themselves sometimes into the sea, to the unavoidable destruction of such ships as are in their way, if they be small vessels, and to the damaging of large ones: sometimes they fall on the shore, beating down all they meet with, and raising the sand and stones to a prodigious height. It is said, that vessels that have any force usually fire their guns at them, laden with a bar of iron, and if they be so happy as to strike them, the water is presently seen to run out of them with a mighty noise, without farther mischief.

An Account of a Book, viz.—The Anatomy of the Brain, containing its Mechanism and Physiology, together with some new Discoveries and Corrections of Ancient and Modern Authors upon that Subject: to which is annexed, a particular Account of Animal Functions and Muscular Motion. By Hen. Ridley, Col. Med. Lond. Soc.* N° 215, p. 32.

Account of the upper Part of the Burning Mountain in the Isle of Ternata. N° 216, p. 42.

This is a tedious uninteresting narrative.

Account of the sad Mischief which befel the Inhabitants of the Isle of Sorea, near the Moluccas, for which they have been forced to leave their Country. In a Letter to M. Nicholas Witzen, of Amsterdam, 1693. *And communicated to Dr. Lister, S. R. S.* N° 216, p. 49.

In the beginning of the easterly season, the isle Sorea, situated towards the south-east of these islands, consisting for the most part of one mountain, which now is more terribly shaken than ever before, casting out abundance of fire and smoke, only with some short intermissions. And when the easterly wind had blown about 6 or 7 weeks, till about the 4th of June, the inhabitants being almost so far used to the trembling and casting up of fire that they were careless, the mountain Sorea began early in the morning to cast out more fire than ordinary, which continued for 5 or 6 days; during which it was dark and cloudy weather, till at last it brought forth not only a most prodigious flame, but also such a black and sulphureous vapour, that the inhabitants of Hislo, a village in the western part of the island, and nearest to the opening of the mountain, were wholly covered by it; and afterwards followed a whole stream of burning brimstone, which consumed many that could not escape. After-

* This work of Ridley's on the brain, wherein several things are noticed which had escaped others, deserves to be numbered among those productions of the English anatomists of the 17th century, which are distinguished for their utility and ingenuity. The plates, however, as Haller has remarked, are upon too small a scale.

wards the inhabitants perceived that a part of the mountain was sunk down, and 3 or 4 days after another part; and so from time to time, until the burning lake was become almost half the space of the island. Wherefore the inhabitants went on board their vessels and boats, from whence they perceived that huge pieces of the mountain fell into this fiery lake, as into a bottomless pit, with a most prodigious noise, as if a large cannon were discharged. It was remarkable, that the more vehement the fire was, the less the island was shaken.

The inhabitants of another town, called Woroe, upon the east side of the island, not thinking themselves in so great danger, the opening or fiery lake being yet at some distance, remained a month longer, until they saw the same continually approaching them: they observed that when great pieces fell down, and that the lake became wider, the noise was so much the greater: so that they saw no likelihood but that all the island would be swallowed up. Wherefore they unanimously transported themselves to Banda, leaving all their moveables for want of vessels.

Several burning mountains have now been filled up, and quenched; others have begun to open themselves, and to cast out fire, as in the isle Chiaus. There is likewise a burning mountain on the island Celebes. And in an infinite number of places there is hot water found if you dig but 10 feet deep. In the mountains of Ternata is always heard a terrible noise, as of the crying of a great many people, caused by the fire; it often throws out stones, and probably is exceedingly deep, and the rather because it is likely that the several burning mountains of the Molucca islands are beneath consumed by the same fire, which joins the spacious openings together. The burning mountain on Banda throws out a vast quantity of smoke and ashes, often much fire; and makes a noise as if many of the largest cannon were heard all at once. This mountain has cast out so many stones, and some near 6 feet long, that the adjacent sea, which has been 40 or 50 fathoms deep, is not only filled up there, but become many fathoms higher than the water.

*Specimens of the Use of Fluxions in the Solution of Geometric Problems. By Mr. Abr. Demoivre.** N° 216, p. 52. *Translated from the Latin.*

You have here a method for the quadrature of curve figures; for the measure

* Abraham Demoivre was originally a Frenchman, and born at Vitry in Champagne, 1667; but on the revocation of the edict of Nantes he came to England, where he continued to study the mathematics, of which he became a celebrated master, and taught it for his living; and also occasionally answered for gentlemen curious and difficult questions in chances, games, and other subjects. He died at London in 1754, at 87 years of age. Mr. Demoivre was admitted a member of the Royal Society, and contributed a number of papers to the Philosophical Transactions. He was also author of several other works; as, 1. Animadversions on Dr. Chene's Fluxions, 8vo. 1704; 2. Doctrine of Chances, 4to. 1718, which has been much esteemed; 3. Miscellania Analytica, 4to. 1730,

of the surfaces and solidities of solids formed by the rotation of planes; for the rectification of curves; and for the calculation of their centres of gravity. But before proceeding further you must understand, that I assume what the great Newton has demonstrated, in p. 251, &c. of his Principia, concerning the momentary increments or decrements of quantities, which either increase or decrease by perpetual flux, and especially that the moment of any power $A^{\frac{n}{m}}$ is $\frac{n}{m} \dot{a} A^{\frac{n}{m}-1}$. Hence the fluxion $\frac{n}{m} \dot{a} A^{\frac{n}{m}-1}$ being given, on the contrary we may find the flowing quantity $A^{\frac{n}{m}}$, 1st, by taking $\dot{a}$ out of the fluxion; 2d, by increasing the index of the fluxion by unity; 3d, by dividing the fluxion by the index so increased by unity. In what follows, the absciss of the curve shall be denoted by x, its fluxion by $\dot{x}$, the ordinate by y, and its fluxion by $\dot{y}$.

This being supposed, to proceed now to quadratures, first let the value of the ordinate be obtained, by means of the equation expressing the nature of the curve; 2d, multiply this value by the fluxion of the absciss; then the rectangle hence arising will be the fluxion of the area; 3d, find the fluent of this fluxion of the area, and the required area will be found.

Let there be proposed the equation $x^m = y_n$, expressing the nature of any paraboloid, in which the value of the ordinate is $y = x^{\frac{m}{n}}$; which being multiplied by $\dot{x}$, the rectangle $x^{\frac{m}{n}} \dot{x}$ will be the fluxion of the area; therefore the area required will be $\frac{n}{m+n} x^{\frac{m}{n}+1}$ or $\frac{n}{m+n} xy$, putting y for $x^{\frac{m}{n}}$.

Again, let there be proposed the curve whose equation is $x^4 + a^2 x^2 = y^2$, which is the first of Mr. Craig's examples. Then taking $x\sqrt{xx+aa}=y$, the fluxion of the area will be $x\dot{x}\sqrt{xx+aa}$. Now since this is involved in a radical sign, suppose $\sqrt{xx+aa} = z$; hence $xx+aa = z^2$, and therefore $x\dot{x} = z\dot{z}$; hence putting $z\dot{z}$ and z for $x\dot{x}$ and $\sqrt{xx+aa}$, the fluxion freed from surds will be $z^2 \dot{z}$; this reduced back to its origin will be $\frac{1}{3} z^3$; which, by restoring $\sqrt{xx+aa}$ for z, gives $\frac{1}{3} . \overline{xx-aa} \sqrt{xx-aa}$ for the area required.

And that it may appear with what ease these quadratures may be obtained, take one example more, viz. let the equation of the curve be $\frac{x^2}{x+a} = y^2$; therefore $y = \frac{x}{\sqrt{x+a}}$, and $\frac{x\dot{x}}{\sqrt{x+a}}$ is the fluxion of the area. Suppose $\sqrt{x+a} = z$;

being a good treatise on infinite series, and other miscellaneous tracts in mathematics; 4. A Treatise on Annuities on Lives, &c. Mr. Demoivre was one of the commissioners of the Royal Society, who decided in Newton's favour in the celebrated dispute between that great man and Leibnitz, respecting the discovery of the doctrine of fluxions.

hence $x = z^2 - a$, and $\dot{x} = 2 z \dot{z}$; therefore $\frac{x \dot{x}}{\sqrt{x + a}} = 2 z^2 \dot{z} - 2 a \dot{z}$, and hence $\frac{2}{3} z^3 - 2 a z$ or $\overline{\frac{2}{3} x - \frac{4}{3} a} \sqrt{x + a}$ will be the area sought.

But it often happens that some curves, such as the circle or hyperbola, are of such a nature, that it would be in vain to endeavour to free their fluxions from surds, in which case the value of the ordinate must be reduced to an infinite series; then every term of this series being multiplied by the fluxion of the absciss, as above, the fluent of every term must be separately found, and the new series thus arising will exhibit the quadrature of the curve proposed.

With the same ease may this method be accommodated to the measures of solids formed by the rotation of a plane, viz. by assuming for their fluxion the product of the circular base into the fluxion of the absciss. Let the ratio of a square to its inscribed circle be 1 to n; then the equation to the circle being $y y = d x - x x$, therefore $4 n . \overline{d x \dot{x} - x^2 \dot{x}}$ is the fluxion of a portion of the sphere, and consequently $4 n . \overline{\frac{1}{2} d x^2 - \frac{1}{3} x^3}$ is the portion itself. But the cylinder circumscribed about this is $4 n . \overline{d x^2 - x^3}$; therefore the ratio of the portion of the sphere to the circumscribed cylinder, is as $\frac{1}{2} d - \frac{1}{3} x$ to $d - x$.

The rectification of curves will be obtained if the hypothenuse of the right-angled triangle, whose sides are the fluxions of the absciss and ordinate, be considered as the fluxion of the curve; observing that, in the expression of that hypothenuse, only one of the fluxions be retained, and only the indeterminate quantity of the same; as will be plain from the examples.

From the right sine B C, (fig. 2, pl. 1) of the arc A C, being given, to find the arc. Putting A B $= x$, B C $= y$, O A $= r$; let C E be the fluxion of the absciss, D E the fluxion of the ordinate, and C D the fluxion of the arc A C. Now from the property of the circle, $2 r x - x x = y y$; hence $2 r \dot{x} - 2 x \dot{x} = 2 y \dot{y}$, and $\dot{x} = \frac{y \dot{y}}{r - x}$; but C D$^2 = \dot{y} \dot{y} + \dot{x} \dot{x} = \dot{y} \dot{y} + \frac{y^2 \dot{y} \dot{y}}{r r - 2 r x + x x} = \dot{y} \dot{y} + \frac{y^2 \dot{y} \dot{y}}{r r - y y} = \frac{r r \dot{y} \dot{y}}{r r - y y}$, therefore C D $= \frac{r \dot{y}}{\sqrt{r r - y y}}$; but $\frac{r \dot{y}}{\sqrt{r r - y y}}$ is the product of $\frac{1}{\sqrt{r r - y y}}$ or $\overline{r r - y y}|^{-\frac{1}{2}}$ into $r \dot{y}$; hence if $\overline{r r - y y}|^{-\frac{1}{2}}$ be thrown into an infinite series, and every term multiplied by $r \dot{y}$, and the fluent of every product be found, there will be obtained the length of the arc A C.

In like manner may the arc be found, from the versed sine being given. Thus, resuming the equation $2 r \dot{x} - 2 x \dot{x} = 2 y \dot{y}$, it gives $\dot{y} = \frac{r \dot{x} - x \dot{x}}{y}$; but C D$^2 = \dot{x} \dot{x} + \dot{y} \dot{y} = \dot{x} \dot{x} + \frac{r r \dot{x} \dot{x} - 2 r x \dot{x} \dot{x} + x^2 \dot{x} \dot{x}}{y y} = \dot{x} \dot{x} + \frac{r r \dot{x} \dot{x} - 2 r x \dot{x} \dot{x} + x^2 \dot{x} \dot{x}}{2 r x - x x}$, or, reducing all to the same denominator, and expunging the parts which cancel each other, it is $= \frac{r r \dot{x} \dot{x}}{2 r x - x x}$, and hence C D $= \frac{r \dot{x}}{\sqrt{2 r x - x x}}$; then, from what has been done above, the length of the arc will be easily obtained.

Sometimes the fluxion of the curve is more easily found by comparing together the similar triangles C D E, C B O, making this proportion C B : C O :: C E : C D, that is, for the circle, $\sqrt{2rx - xx} : r :: \dot{x} : \frac{r\dot{x}}{\sqrt{2rx - xx}}$.

The curve of the cycloid may be known in the same manner. Let A K L be a semicycloid, whose generating circle is A D L (fig. 3). Any point B being assumed in the diameter A L; let B I be drawn parallel to the base K L, meeting the circle in the point D; complete the rectangle A E I B; also draw F H parallel and infinitely near, to E I, cutting B I produced in G, and the curve A K in H. Then, putting A L $= d$, A B = E I $= x$, G H $= \dot{x}$, it is known that the right line B I is everywhere the aggregate of the arc A D and the right sine B D, and hence it is manifest that the fluxion I G is the sum of the fluxions of the arc A D and of the sine B D. But the fluxion of the arc A D is found to be $= \frac{\frac{1}{2}d\dot{x}}{\sqrt{dx - xx}}$, and the fluxion of the sine B D is $= \frac{d\dot{x} - 2x\dot{x}}{2\sqrt{dx - xx}}$, therefore I G $= \frac{d\dot{x} - x\dot{x}}{\sqrt{dx - xx}}$; consequently I H^2 = I G^2 + G H^2 $= \frac{dd\dot{x}\dot{x} \quad dx\dot{x}\dot{x}}{dx - xx}$, and I H $= \frac{\dot{x}\sqrt{dd - dx}}{\sqrt{dx - xx}} = \frac{\dot{x}\sqrt{d}}{\sqrt{x}} = d^{\frac{1}{2}}x^{-\frac{1}{2}}\dot{x}$; therefore A I $= 2d^{\frac{1}{2}}x^{\frac{1}{2}} = 2\sqrt{dx} =$ 2 A D.

This same conclusion may be deduced with very little trouble from the known property of the tangent. For since its particle I H is always parallel to the chord A D, it makes the two triangles I G H, A B D to be similar; whence A B : A D :: G H : H I, that is, $x : \sqrt{dx} :: \dot{x} :$ H I $= \frac{\dot{x}\sqrt{dx}}{x} = d^{\frac{1}{2}}x^{\frac{1}{2}}\dot{x}$, as before.

Now by the help of the fluxion I H we may find the area of the cycloid. For the fluxion of the area A E I is the rectangle E I G $= \frac{dx\dot{x} - x^2\dot{x}}{\sqrt{dx - xx}} = x\sqrt{dx - xx}$; but the fluxion of the portion A B D is the same; therefore the area A E I and the corresponding portion A B D, of the circle, are always equal.

Let A B (fig. 4) be the curve of a parabola, its axis A F, and parameter a: Put A E $= x$, E B $= y$, A B = z, B D $= \dot{x}$, D C $= \dot{y}$, B C $= \dot{z}$; then assuming the equation expressing the nature of the parabola, viz. $ax = yy$, it gives $a\dot{x} = 2y\dot{y}$, and hence $\dot{x} = \frac{2y\dot{y}}{a}$; but B C^2 = B D^2 + D C^2, that is, $\dot{z}\dot{z} = \dot{x}\dot{x} + \dot{y}\dot{y} = \frac{4y^2\dot{y}\dot{y}}{aa} + \dot{y}\dot{y} = \frac{4y^2\dot{y}\dot{y} + aa\dot{y}\dot{y}}{aa}$, therefore $\dot{z} = \frac{\sqrt{4y^2 + aa}}{a}\dot{y} = \frac{\sqrt{y^2 + \frac{1}{4}aa}}{\frac{1}{2}a}\dot{y}$; if therefore $\frac{\sqrt{y^2 + \frac{1}{4}aa}}{\frac{1}{2}a}\dot{y}$ be transformed into an infinite series, the curve A B may thence be easily known.

Now it will also appear that if the hyperbolic space were given, this would be given also, and vice versa. For $\frac{1}{2}a\dot{z} = \dot{y}\sqrt{y^2 + \frac{1}{4}aa}$, and hence $\frac{1}{2}az =$ the space whose fluxion is $\dot{y}\sqrt{y^2 + \frac{1}{4}aa}$; but this space is no other than the exterior equilateral hyperbola ABGE (fig. 5), whose semi-axis is AB $= \frac{1}{2}a$, abscisse AE $= y$, and ordinate EG $= x$.

For measuring the superficies produced by the rotation of a curve about its axis, there must be assumed for its fluxion, the cylindrical superficies, whose altitude is the fluxion of the curve, and its distance from the axis is the ordinate belonging to this fluxion. For example, let AC (fig. 2) be a circular arc, which, by revolving about the axis AB, generates a spherical superficies, proposed to be measured. The fluxion CD of the arc is already found to be $\frac{r\dot{x}}{\sqrt{2rx - xx}}$; hence, if we multiply this by the circumference to the radius BC, that is by $\frac{c}{r}\sqrt{2rx - xx}$ (supposing the ratio of the circumference to the radius to be $\frac{c}{r}$), we shall have the fluxion of the spherical surface $= c\dot{x}$, and therefore the surface itself is cx.

As to what respects the centre of gravity: having found the fluxion of the superficies or solid, and drawn this into its distance from the vertex, we must then resort back to the fluent; which being divided by the superficies or solid itself, will give the distance of the centre of gravity from the vertex. Thus, let it be required to find the centre of gravity of all paraboloids: the fluxion of these is generally expressed by $x^{\frac{m}{n}}\dot{x}$; this multiplied by x gives $x^{\frac{m}{n}+1}\dot{x}$, the fluent of which is $\frac{n}{m+m}x^{\frac{m}{n}+2}$, which being divided by the area of the paraboloid, $\frac{n}{m+n}x^{\frac{m}{n}+1}$, gives $\frac{m+n}{m+2n}x$ for the distance of the centre of gravity from the vertex.

Much in the same way is found the centre of gravity in the portion of a sphere. For its fluxion $4n \,.\, \overline{dx\dot{x} - xx\dot{x}}$, drawn into x, is $4n \,.\, \overline{dx^2\dot{x} - x^3\dot{x}}$, the fluent of which $4n \,.\, \frac{1}{3}dx^3 - \frac{1}{4}x^4$, divided by $4n \,.\, \frac{1}{2}dx^2 - \frac{1}{3}x^3$, the solidity of the portion, produces $\frac{\frac{1}{3}d - \frac{1}{4}x}{\frac{1}{2}d - \frac{1}{3}x}x$, or $\frac{4d - 3x}{6d - 4x}x$, for the distance of the centre of gravity from the vertex.

A most compendious and facile Method for constructing the Logarithms, exemplified and demonstrated from the Nature of Numbers, without any regard to the Hyperbola; with a speedy Method for finding the Number from the Logarithm given. By E. Halley. N° 216, p. 58.

The invention of the logarithms is justly esteemed one of the most useful discoveries in the art of numbers, and accordingly has had an universal reception and applause: and the great geometricians of this age have not been wanting to cultivate this subject with all the accuracy and subtilty a matter of that consequence deserves; and they have demonstrated several admirable properties of these artificial numbers, which have rendered their construction much more facile than by those operose methods at first used by their truly noble inventor, the Lord Napier, and our worthy countryman Mr. Briggs.

But notwithstanding all their endeavours, I find very few of those who make constant use of logarithms, to have attained an adequate notion of them, to know how to make or examine them: or to understand the extent of the use of them; contenting themselves with the tables of them as they find them, without daring to question them, or caring to know how to rectify them, should they be found amiss; being, I suppose, under the apprehension of some great difficulty therein. For the sake of such, the following tract is principally intended, but not without hopes however to produce something that may be acceptable to the most knowing in these matters.

But first, it may be requisite to premise a definition of logarithms, in order to render the ensuing discourse more clear, the rather because the old one numerorum proportionalium æqui differentes comites seems too scanty to define them fully. They may much more properly be said to be, numeri rationum exponentes: wherein we consider ratio as a quantitas sui generis, beginning from the ratio of equality, or 1 to 1 = 0; being affirmative when the ratio is increasing, as of unity to a greater number, but negative when decreasing; and these rationes we suppose to be measured by the number of ratiunculæ contained in each. Now these ratiunculæ are so to be understood, as in a continued scale of proportionals infinite in number, between the two terms of the ratio, which infinite number of mean proportionals, is to that infinite number of the like and equal ratiunculæ between any other two terms, as the logarithm of the one ratio, is to the logarithm of the other. Thus, if there be supposed between 1 and 10 an infinite scale of mean proportionals, whose number is 100000 &c. in infinitum; between 1 and 2 there shall be 30102 &c. of such proportionals, and between 1 and 3 there will be 47712 &c. of them, which numbers therefore are the logarithms of the rationes of 1 to 10, 1 to 2, and 1 to 3; and not so properly to be called the logarithms of 10, 2 and 3.

This being laid down, it is obvious that if between unity and any number proposed, there be taken any infinity of mean proportionals, the infinitely little augment or decrement of the first of those means from unity, will be a ratiuncula, that is, the momentum or fluxion of the ratio of unity to the said number.: and seeing that in these continual proportionals, all the ratiunculæ are equal, their sum, or the whole ratio, will be as the said momentum is directly; that is, the logarithm of each ratio will be as the fluxion thereof. Wherefore, if the root of any infinite power be extracted out of any number, the differentiola of the said root from unity, will be as the logarithm of that number. So that logarithms thus produced may be of as many forms as you please to assume infinite indices of the power whose root you seek: as, if the index be supposed 100000 &c. infinitely, the roots will be the logarithms invented by the Lord Napier; but if the said index were 2302585 &c. Mr. Briggs's logarithms would immediately be produced. And if you please to stop at any number of figures, and not to continue them on, it will suffice to assume an index of a figure or two more than your intended logarithm is to have, as Mr. Briggs's did, who to have his logarithms true to 14 places, by continual extraction of the square root, at last came to have the root of the 140737488355328th power; but how operose that extraction was, will be easily judged by those who shall undertake to examine his calculus.

Now, though the notion of an infinite power may seem very strange, and to those that know the difficulty of the extraction of the roots of high powers, perhaps impracticable; yet by the help of that admirable invention of Mr. Newton, whereby he determines the unciæ or numbers prefixed to the members composing powers, on which chiefly depends the doctrine of series, the infinity of the index contributes to render the expression much more easy: for, if the infinite power to be resolved be put, after Mr. Newton's method, $\overline{p+pq}$, $\overline{p+pq}|^{\frac{1}{m}}$ or $\overline{1+q}|^{\frac{1}{m}}$, instead of $1 + \frac{1}{m} q + \frac{1-m}{2mm} qq + \frac{1-3m+2mm}{6m^3} q^3 + \frac{1-6m+11mm-6m^3}{24m^4} q^4$, &c. which is the root when m is finite, becomes $1 + \frac{1}{m} q - \frac{1}{2m} qq + \frac{1}{3m} q^3 + \frac{1}{4m} q^4 + \frac{1}{5m} q^5$, &c. mm being *infinitè* infinite, and consequently whatever is divided thereby vanishing. Hence it follows that $\frac{1}{m}$ multiplied into $q - \frac{1}{2} qq + \frac{1}{3} qqq - \frac{1}{4} q^4 + \frac{1}{5} q^5$, &c. is the augment of the first of our mean proportionals between unity and $1 + q$, and is therefore the logarithm of the ratio of 1 to $1 + q$; and whereas the infinite index m may be taken at pleasure, the several scales of logarithms to such indices will be as $\frac{1}{m}$ or reciprocally as the indices. And if the index be taken 10000 &c. as in the case of Napier's logarithms, they will be simply $q - \frac{1}{2} qq + \frac{1}{3} qqq - \frac{1}{4} q^4 + \frac{1}{5} q^5 - \frac{1}{6} q^6$, &c.

Again, if the logarithm of a decreasing ratio be sought, the infinite root of $1 - q$, or $\overline{1 - q}|^{\frac{1}{m}}$, is $1 - \frac{1}{m} q - \frac{1}{2m} q^2 - \frac{1}{3m} q^3 - \frac{1}{4m} q^4 - \frac{1}{5m} q^5 - \frac{1}{6m} q^6$, &c. whence the decrement of the first of our infinite number of proportionals will be $\frac{1}{m}$ into $q + \frac{1}{2} q q + \frac{1}{3} q^3 + \frac{1}{4} q^4 + \frac{1}{5} q^5 + \frac{1}{6} q^6$, &c. which therefore will be as the logarithm of the ratio of unity to $1 - q$. But if m be put 10000 &c. then the said logarithm will be $q + \frac{1}{2} q q + \frac{1}{3} q^3 + \frac{1}{4} q^4 + \frac{1}{5} q^5 + \frac{1}{6} q^6$, &c.

Hence, the terms of any ratio being a and b, q becomes $\frac{b-a}{a}$, or the difference divided by the lesser term, when it is an increasing ratio; or $\frac{b-a}{b}$ when it is decreasing, or as b to a. Whence the logarithm of the same ratio may be doubly expressed; for putting x for the difference of the terms a and b, it will be either

$$\frac{1}{m} \text{ into } \frac{x}{b} + \frac{x^2}{2bb} + \frac{x^3}{3b^3} + \frac{x^4}{4b^4} + \frac{x^5}{5b^5} + \frac{x^6}{6b^6}, \text{ \&c. or}$$

$$\frac{1}{m} \text{ into } \frac{x}{a} - \frac{x^2}{2aa} + \frac{x^3}{3a^3} - \frac{x^4}{4a^4} + \frac{x^5}{5a^5} - \frac{x^6}{6a^6}, \text{ \&c.}$$

But if the ratio of a to b be supposed divided into two parts, viz. into the ratio of a to the arithmetical mean between the terms, and the ratio of the said arithmetical mean to the other term b, then will the sum of the logarithms of those two rationes be the logarithm of the ratio of a to b; and substituting $\frac{1}{2} z$ instead of $\frac{1}{2} a + \frac{1}{2} b$, the said arithmetical mean, the logarithms of those rationes will be by the foregoing rule,

$$\frac{1}{m} \text{ into } \frac{x}{z} + \frac{xx}{2zz} + \frac{x^3}{3z^3} + \frac{x^4}{4z^4} + \frac{x^5}{5z^5} + \frac{x^6}{6z^6}, \text{ \&c. and}$$

$$\frac{1}{m} \text{ into } \frac{x}{z} - \frac{xx}{2zz} + \frac{x^3}{3z^3} - \frac{x^4}{4z^4} + \frac{x^5}{5z^5} - \frac{x^6}{6z^6}, \text{ \&c.}$$

the sum whereof $\frac{1}{m}$ into $\frac{2x}{z} * + \frac{2x^3}{3z^3} * + \frac{2x^5}{5z^5} * + \frac{2x^7}{7z^7}$, &c. will be the logarithm of the ratio of a to b, whose difference is x and sum z. And this series converges twice as swift as the former, and therefore is more proper for the practice of making of logarithms: which it performs with that expedition, that where x the difference is but a 100th part of the sum, the first step $\frac{2x}{z}$ suffices to seven places of the logarithm, and the second step to twelve; but if Briggs's first 20 chiliads of logarithms be supposed made, as he has very carefully computed them, to 14 places, the first step alone is capable to give the logarithm of any intermediate number true to all the places of those tables.

After the same manner may the difference of the said two logarithms be very fitly applied to find the logarithms of prime numbers, having the logarithms of the next two numbers above and below them: for the difference of the ratio of a to $\frac{1}{2}$ z and of $\frac{1}{2}$ z to b, is the ratio of $a\,b$ to $\frac{1}{4}$ z z, and the half of that ratio is that of $\sqrt{a\,b}$ to $\frac{1}{2}$ z, or of the geometrical mean to the arithmetical. And consequently the logarithm thereof will be the half difference of the logarithms of those rationes, viz.

$$\frac{1}{m} \text{ into } \frac{x\,x}{2\,z\,z} + \frac{x^4}{4\,z^4} + \frac{x^6}{6\,z^6} + \frac{x^8}{8\,z^8} \text{ \&c.}$$

Which is a theorem of good dispatch to find the logarithm of $\frac{1}{2}$ z. But the same is yet much more advantageously performed by a rule derived from the foregoing, and beyond which in my opinion nothing better can be hoped. For the ratio of $a\,b$ to $\frac{1}{4}$ z z or $\frac{1}{4}\,a\,a + \frac{1}{2}\,a\,b + \frac{1}{4}\,b\,b$, has the difference of its terms $\frac{1}{4}\,a\,a - \frac{1}{2}\,a\,b + \frac{1}{4}\,b\,b$, or the square of $\frac{1}{2}\,a - \frac{1}{2}\,b = \frac{1}{4}\,x\,x$, which in the present case of finding the logarithms of prime numbers is always unity, and calling the sum of the terms $\frac{1}{4}$ z z $+ a\,b = y\,y$, the logarithm of the ratio of $\sqrt{a\,b}$ to $\frac{1}{2}\,a + \frac{1}{2}\,b$ or $\frac{1}{2}$ z will be found to be

$$\frac{1}{m} \text{ into } \frac{1}{y\,y} + \frac{1}{3y^6} + \frac{1}{5y^{10}} + \frac{1}{7y^{14}} + \frac{1}{9y^{18}} \text{ \&c.}$$

which converges much faster than any theorem hitherto published for this purpose.

Here note that $\frac{1}{m}$ is all along applied to adapt these rules to all sorts of logarithms. If m be 10000 &c. it may be neglected, and you will have Napier's logarithms, as was hinted before; but if you desire Briggs's logarithms, which are now generally received, you must divide the series by

2,302585092994045684017991454684364207601101488628772976033328,

or multiply it by the reciprocal thereof, viz.

0,4342944819032518276511289189166050822943970058036665661144 54.

But to save so operose a multiplication, which is more than all the rest of the work, it is expedient to divide this multiplicator by the powers of z or y continually, according to the direction of the theorem, especially where x is small and integral, reserving the proper quotes to be added together, when you have produced the logarithm to as many figures as you desire, of which method I will give a specimen.

If the curiosity of any gentleman, who has leisure, would prompt him to undertake to do the logarithms of all prime numbers under 100000, to 25 or 30 figures, I dare assure him that the facility of this method will invite him thereto, nor can any thing more easy be desired. And to encourage him, I here give the logarithms of the first prime numbers under 20, to 60 places, computed by the accurate pen of Mr. Abraham Sharp, from whose industry and capacity the world may in time expect great performances, as they were communicated to me by our common friend, Mr. Euclid Speidall.

Number.	Logarithm.
2	0,301029995663981195213738894724493026768189881462108541310427
3	0,477121254719662437295027903255115309200128864190695864829866
7	0,845098040014256830712216258592636193483572396323965406503835
11	1,041392685158225040750199971243024241706702190466453094596539
13	1,113943352306837769206541895026246254561189005053673288598083
17	1,230448921378273028540169894328337030007567378425046397380368
19	1,278753600952828961536333475756929317951129337394497598906819

The next prime number is 23, which I will take for an example of the foregoing doctrine; and by the first rules, the logarithm of the ratio of 22 to 23 will be found to be either

$$\frac{1}{22} - \frac{1}{968} + \frac{1}{31944} - \frac{1}{937024} + \frac{1}{25768160} \text{ \&c. or}$$

$$\frac{1}{23} + \frac{1}{1058} + \frac{1}{36501} + \frac{1}{1119364} + \frac{1}{32181715} \text{ \&c.}$$

As likewise that of the ratio of 23 to 24 by a like process,

$$\frac{1}{23} - \frac{1}{1058} + \frac{1}{36501} - \frac{1}{1119364} + \frac{1}{32181715} \text{ \&c. or}$$

$$\frac{1}{24} + \frac{1}{1152} + \frac{1}{41472} + \frac{1}{1327104} + \frac{1}{39813120} \text{ \&c.}$$

And this is the result of the doctrine of Mercator, as improved by the learned Dr. Wallis. But by the second theorem, viz. $\frac{2x}{z} + \frac{2x^3}{3z^3} + \frac{2x^5}{5z^5}$ &c. the same logarithms are obtained by fewer steps. To wit,

$$\frac{2}{45} + \frac{2}{273375} + \frac{2}{922640625} + \frac{2}{2615686171875} \text{ \&c. and}$$

$$\frac{2}{47} + \frac{2}{311469} + \frac{2}{1146725035} + \frac{2}{3546361843241} \text{ \&c.}$$

which was invented and demonstrated in the hyperbolic spaces analogous to the logarithms, by the excellent Mr. James Gregory, in his Exercitationes Geometricæ, and since farther prosecuted by the aforesaid Mr. Speidall, in a late treatise in English by him published on this subject. But the demonstration, as I conceive, was never till now perfected without the consideration of the hyperbola, which in a matter purely arithmetical, as this is, cannot so properly be applied. But what follows I think I may more justly claim as my own, viz.

That the logarithm of the ratio of the geometrical mean to the arithmetical, between 22 and 24, or of $\sqrt{528}$ to 23, will be found to be either

$$\frac{1}{1058} + \frac{1}{1119364} + \frac{1}{888215334} + \frac{1}{626487882248} \text{ \&c. or}$$

$$\frac{1}{1057} + \frac{1}{3542796579} + \frac{1}{659676558485285} \text{ \&c.}$$

All these series being to be multiplied into 0,4342944819, &c. if you design to make the logarithm of Briggs. But with great advantage in respect of the work, the said 4342944819 &c. is divided by 1057, and the quotient thereof again divided by 3 times the square of 1057, and that quotient again by $\frac{3}{5}$ of that square, and that quotient by $\frac{7}{5}$ thereof, and so on till you have as many figures of the logarithm as you desire. As for example, the logarithm of the geometrical mean between 22 and 24 is found by the logarithms of 2, 3, and 11, to be

	1.36131696126690612945009172669805
1057) 43429 &c. (	41087462810146814347315886368
3 in 1117249) 41087 &c. (	12258521544181829460074
$\frac{3}{5}$ in 1117249) 12258 &c. (	6583235184376175
$\frac{5}{7}$ in 1117249) 65832 &c. (	4208829765
$\frac{7}{9}$ in 1117249) 42088 &c. (	2930
Summa	1.36172783601759287886777711225117

Which is the logarithm of 23 to thirty-two places, and obtained by five divisions with very small divisors, all which is much less work than simply multiplying the series into the said multiplicator 43429 &c.

Before I pass on to the converse of this problem, or to show how to find the number appertaining to a logarithm assigned, it will be requisite to advertise the reader, that there is a small mistake in the aforesaid Mr. James Gregory's Vera Quadratura Circuli et Hyperbolæ, published at Padua, Anno 1667, wherein he applies his quadrature of the hyperbola to the making the logarithms: in p. 48 he gives the computation of the Lord Napier's logarithm of 10, to 25 places, and finds it 2302585092994045624017870 instead of 2302585092994045684017991,* erring in the 18th figure, as I was assured upon my own examination of the number I here give you, and by comparison thereof with the same wrought by another hand, agreeing therewith to 57 of the 60 places. Being desirous to be satisfied how this difference arose, I took the no small trouble of examining Mr. Gregory's work, and at length found

* This mistake was before noticed by Euclid Speidall, viz. in his Logarithms, published Anno 1688.

that in the inscribed polygon of 512 sides, in the 18th figure was a 0 instead of 9, which being rectified, and the subsequent work corrected therefrom, the result agreed to a unit with our number. And this I propose, not to cavil at an easy mistake in managing of so vast numbers, especially by a hand that has so well deserved of the mathematical sciences, but to show the exact coincidence of two so very differing methods to make logarithms, which might otherwise have been questioned.

From the logarithm given, to find what ratio it expresses, is a problem that has not been so much considered as the former, but which is solved with the like ease, and demonstrated by a like process, from the same general theorem of Mr. Newton: for as the logarithm of the ratio of 1 to $1 + q$ was proved to be $\overline{1 + q}|^{\frac{1}{m}} - 1$, and that of the ratio of 1 to $1 - q$ to be $1 - \overline{1 - q}|^{\frac{1}{m}}$: so the logarithm, which we will from henceforth call L, being given, $1 + L$ will be equal to $\overline{1 + q}|^{\frac{1}{m}}$ in the one case; and $1 - L$ will be equal to $\overline{1 - q}|^{\frac{1}{m}}$ in the other: consequently $\overline{1 + L}|^{m}$ will be equal to $1 + q$, and $\overline{1 - L}|^{m}$ to $1 - q$; that is, according to Mr. Newton's said rule, $1 + mL + \frac{1}{2}m^2L^2 + \frac{1}{6}m^3L^3 + \frac{1}{24}m^4L^4 + \frac{1}{120}m^5L^5$ &c. will be $= 1 + q$, and $1 - mL + \frac{1}{2}m^2L^2 - \frac{1}{6}m^3L^3 + \frac{1}{24}m^4L^4 - \frac{1}{120}m^5L^5$ &c. will be equal to $1 - q$, m being any infinite index whatever; which is a full and general proposition, from the logarithm given, to find the number, be the species of logarithm what it will. But if Napier's logarithm be given, the multiplication by m is saved, which multiplication is indeed no other than the reducing the other species to his, and the series will be more simple, viz. $1 + L + \frac{1}{2}LL + \frac{1}{6}L^3 + \frac{1}{24}L^4 + \frac{1}{120}L^5$ &c. or $1 - L + \frac{1}{2}LL - \frac{1}{6}L^3 + \frac{1}{24}L^4 - \frac{1}{120}L^5$ &c. This series, especially in great numbers, converges so slowly, that it were to be wished it could be contracted.

If one term of the ratio, whereof L is the logarithm, be given, the other term will be had easily by the same rule: for if L were Napier's logarithm of the ratio of a the less, to b the greater term, b would be the product of a into $1 + L + \frac{1}{2}LL + \frac{1}{6}LLL$ &c. $= a + aL + \frac{1}{2}aLL + \frac{1}{6}aL^3$ &c. But if b were given, a would be $= b - bL + \frac{1}{2}bLL - \frac{1}{6}bL^3$ &c. Whence, by the help of the chiliads, the number appertaining to any logarithm will be exactly had to the utmost extent of the tables. If you seek the nearest next logarithm, whether greater or less, and call its number a if less, or b if greater than the given L, and the difference thereof from the said nearest logarithm you call l; it will follow that the number answering to the logarithm L, will be either a into $1 + l + \frac{1}{2}ll + \frac{1}{6}lll + \frac{1}{24}l^4 + \frac{1}{120}l^5$ &c. or else b into $1 - l + \frac{1}{2}ll$,

$-\frac{1}{6}lll+\frac{1}{24}l^4-\frac{1}{120}l^5$ &c. wherein as l is less, the series will converge the swifter. And if the first 20000 logarithms be given to 14 places, there is rarely occasion for the three first steps of this series, to find the number to as many places. But for Vlacq's great canon of 100000 logarithms, which is made but to ten places, there is scarcely ever need for more than the first step $a+al$ or $a+mal$ in one case, or else $b-bl$ or $b-mbl$ in the other, to have the number true to as many figures as those logarithms consist of.

If future industry shall ever produce logarithmic tables to many more places, than now we have them; the aforesaid theorems will be of more use to deduce the correspondent natural numbers to all the places thereof. In order to make the first chiliad serve all uses, I was desirous to contract this series, wherein all the powers of l are present, into one, wherein each alternate power might be wanting; but found it neither so simple nor uniform as the other. Yet the first step thereof is I conceive most commodious for practice, and withal exact enough for numbers not exceeding 14 places, such as are Mr. Briggs's large table of logarithms; and therefore I recommend it to common use. It is thus: $a+\frac{al}{1-\frac{1}{2}l}$ or $b-\frac{bl}{1+\frac{1}{2}l}$ will be the number answering to the logarithm given, differing from the truth by only one half of the third step of the former series. But that which renders it yet more eligible is, that with equal facility it serves for Briggs's or any other sort of logarithms, with the only variation of writing $\frac{1}{m}$ instead of 1, that is,

$$a+\frac{al}{\frac{1}{m}-\frac{1}{2}l} \text{ and } b-\frac{bl}{\frac{1}{m}+\frac{1}{2}l}, \text{ or } \frac{\frac{1}{m}a+\frac{1}{2}la}{\frac{1}{m}-\frac{1}{2}l} \text{ and } \frac{\frac{1}{m}b-\frac{1}{2}lb}{\frac{1}{m}+\frac{1}{2}l},$$

which are easily resolved into analogies, viz.

As 43429 &c. $-\frac{1}{2}l$ to 43429 $+\frac{1}{2}l$ :: So is a } to the number sought.
or As 43429 &c. $+\frac{1}{2}l$ to 43429 $-\frac{1}{2}l$ :: So is b }

If more steps of this series be desired, it will be found as follows,

$a+\frac{al}{1-\frac{1}{2}l}-\frac{\frac{1}{12}al^3}{1-l}+\frac{\frac{1}{35}al^5}{1-2l}$ &c. as may easily be demonstrated by working out the divisions in each step, and collecting the quotes, whose sum will be found to agree with our former series.

Thus I hope I have cleared up the doctrine of logarithms, and shown their construction and use independent of the hyperbola, whose affections have hitherto been made use of for this purpose, though this be a matter purely arithmetical, nor properly demonstrable from the principles of geometry. Nor have I been obliged to have recourse to the method of indivisibles, or the arithmetic of infinites, the whole being no other than an easy corollary to Mr. Newton's general theorem for forming roots and powers.

A Proposition of General Use in the Art of Gunnery, showing the Rule of laying a Mortar to pass, in order to strike any Object above or below the Horizon. By E. Halley. N° 216, p. 68.

It was formerly the opinion of those concerned in artillery, that there was a certain requisite of powder for each gun, and that in mortars, where the distance was to be varied, it must be done by giving a greater or less elevation to the piece. But now our later experience has taught us that the same thing may be more certainly and readily performed, by increasing and diminishing the quantity of powder, whether regard be had to the execution to be done, or to the charge of doing it. For when bombs are discharged with great elevations of the mortar, they fall too perpendicular, and bury themselves too deep in the ground, to do all that damage they might, if they came more oblique, and broke upon or near the surface of the earth; which is a thing acknowledged by the besieged in all towns, who unpave their streets, to let the bombs bury themselves, and thereby stifle the force of their splinters. A second convenience is, that at the extreme elevation, the gunner is not obliged to be so curious in the direction of his piece, but it will suffice to be within a degree or two of the truth; whereas in the other method of shooting, he ought to be very exact. But a third, and no less considerable advantage is, in the saving the powder, which in so great and so numerous discharges, as we have lately seen, must needs amount to a considerable value. And for sea-mortars, it is scarcely practicable otherwise to use them, where the agitation of the sea continually changes the direction of the mortar, and would render the shot very uncertain, were it not that they are placed about 45 degrees elevation, where several degrees above or under makes very little difference in the effect.

In N° 179 of these Transactions, I considered and demonstrated all the propositions relating to the motion of projectiles, and gave a solution to this problem, viz. to hit an object above or below the horizontal line, with the greatest certainty and least force.* That is, that the horizontal distance of the object being put $= b$, and the perpendicular height $= h$, the charge requisite to strike the object with the greatest advantage, was that which with an elevation of 45° would throw the shot on the horizontal line to the distance of $\sqrt{bb + hh} + h$ when the object was above the horizon; or if it were below it, the charge must be less, so as to reach on the horizon at 45° elevation, at no greater a distance than $\sqrt{bb + hh} - h$, that is, in the one case, the sum of the hypothenusal distance of the object from the gun, and the perpendicular

* See p. 270, vol 3, of these Abridgments.

height thereof above the gun; and in the other case, when the object is below the horizon, the difference of the same, per 47, 1. Eucl. And I then showed how to find the elevation proper for the gun so charged, viz. As the horizontal distance of the object, to the the sum or difference of the hypothenusal distance and perpendicular height :: so radius to the tangent of the elevation sought. But I was not at that time aware that the aforesaid elevation did constantly bisect the angle between the perpendicular and the object, as is demonstrated from the difference and sum of the tangent and secant of any arch being always equal to the tangent and cotangent of the half complement thereof to a quadrant. Having discovered this, I think nothing can be more compendious, or bids fairer to complete the art of gunnery, it being as easy to shoot with a mortar at any object on demand, as if it were on the level; neither is there need of any computation, but only simply laying the gun to pass, in the middle line between the zenith and the object, and giving it its due charge. Nor is there any great need of instruments for this purpose: for if the muzzle of the mortar be turned truly square to the bore of the piece, as it usually is, or ought to be, a piece of looking-glass plate applied parallel to the muzzle, will by its reflection give the true position of the piece; the bombardeer having no more to do, but to look perpendicularly down on the looking-glass, along a small thread with a plummet, and to raise or depress the elevation of the piece, till the object appear reflected on the same point of the speculum on which the plummet falls; for the angle of incidence and reflection being equal, in this case a line at right angles to the speculum, as is the axis of the chase of the piece, will bisect the angle between the perpendicular and the object, according as our proposition requires. So that it only remains by good and valid experiments to be assured of the force of gunpowder, how to make and conserve it equal, and to know the effect thereof in each piece; that is, how far different charges will throw the same shot out of it: which may most conveniently be engraven on the outside thereof, as a standing direction to all gunners, who shall from thenceforward have occasion to use that piece: and were this matter well ascertained, it might be worth the while to make all mortars of the like diameter, as near as may be alike in length of chase, weight, chamber, and all other circumstances.

This discovery, that the utmost range on an inclined plane, is when the axis of the piece makes equal angles with the perpendicular and the object, compared with what I have demonstrated of the same problem in the aforesaid N° 179, leads to and discovers two very ready theorems; the one to find the greatest horizontal range at 45° elevation, by any shot made on any inclined plane, with any elevation of the piece whatever: and the other to find the elevations proper to strike a given object, with any force greater than what suffices to reach it with the aforesaid middle elevation. Both which being performed by one single proportion, may be very serviceable to such as are concerned in the practice of gunnery, but are unwilling to trouble themselves with tedious and difficult rules. The two propositions are these:

Prop. 1.—A shot being made on an inclined plane; having the horizontal distance of the object it strikes, with the elevation of the piece, and the angle at the gun between the object and the perpendicular: to find the greatest horizontal range of that piece, laden with the same charge; that is, half the latus rectum of all the parabolæ made with the same impetus.

Rule.—Take half the distance of the object from the nadir, and take the difference of the given elevation from that half; the versed sine of that difference subtract from the versed sine of the distance of the object from the zenith: then shall the difference of those versed sines, be to the sine of the distance of the object from the zenith, as the horizontal distance of the object struck, to the greatest horizontal range at 45°.

Prop. 2.—Having the greatest horizontal range of a gun, the horizontal distance and angle of inclination of an object to the perpendicular; to find the two elevations necessary to strike that object.

Rule.—Halve the distance of the object from the nadir, this half is always equal to the half sum of the two elevations we seek. Then say, As the greatest horizontal range is to the horizontal distance of the object, so is the sine of the angle of inclination, or distance of the object from the perpendicular, to a 4th proportional; which 4th being subtracted from the versed sine of the distance of the object from the zenith, leaves the versed sine of half the difference of the elevations sought; which elevations are therefore had by adding and subtracting that half difference to and from the aforesaid half sum.

I shall not need to speak of the facility of these solutions, I shall only observe that they are both general, without exception or caution, and derived from the knowledge that these two elevations are equidistant above and below the line bisecting the angle between the object and the zenith.

An Account of Books, viz. I. *The Mathematical Works of Dr. John Wallis, Savilian Professor of Geometry at Oxford, and F. R. S.* 2 *Vols. fol. Oxon.* N° 216, p. 73.

In the former of them are contained, 1. His Inaugural Oration, when he entered on that employment, Oct. 31, 1649. 2. His Mathesis Universalis, or Opus Arithmeticum; containing not only numeral arithmetic, but the specious and algebraic, or the calculus geometricus, with many discourses or smaller tracts intermixed, relating to the same. 3. A Treatise concerning Proportions; with a Preface concerning Cubic Equations. 4. A Treatise of Conic Sections, in a new and easy method; considered as plain figures, out of the cone. 5. His Arithmetic of Infinites, being a new method of investigation, or inquiry into the quadrature of the circle and other curve-lined figures; and many other mysteries in mathematics. 6. An Observation of a Solar Eclipse at Oxford, Aug. 2, 1654. O. S. 7. A Treatise of the Cycloid, with the bodies and surfaces thence derived. 8. A Treatise of the Cissoid; and the Rectification and Complanation of Curve Lines and Surfaces. 9. His Mechanica, or a large Treatise of Motion: wherein are handled, not only the machines or engines, commonly called the mathematical or mechanical powers, but the whole doctrine of motion, derived and demonstrated from its genuine and first principles: the doctrine of percussions, repercussions, springs, and reflexions; the doctrine of hydrostatics, from the counterpoise of the air; and many other things newly discovered.

In the latter volume are contained, 1. A large Treatise of Algebra, Historical and Practical: showing the origin and progress of that art, from time to time, and the steps by which it has attained to its present height. 2. A Treatise of Combinations, Alternations; and Aliquot Parts and divers Problems relating to the same. 3. A Treatise of Angular Sections, with other things appertaining; as the Canon of Sines, Tangents, and Secants, &c. 4. A Treatise of the Angle of Contact, showing it to be of no magnitude, and not any part of a right-lined angle. 5. A Defence of that Treatise, against the Objections of Leotaud and others; with several Discourses concerning Composition of Magnitudes, Inceptives of Magnitudes, and Compositions of Motion. 6. A Discourse concerning Euclid's Fifth Postulate, and his Fifth Definition of his Sixth Book. 7. A Treatise of the Cono-Cuneus, or a Body representing partly a Cone, and partly a Wedge, with the sections thereof made by a Plane; considered in like manner as what are called the Conic Sections. 8. A Geometrical Disquisition of Gravity and Gravitation; wherein the doctrine of the counterpoise of the air is defended against that of the ancients' Fuga Vacui. 9. A New Hypothesis concerning Tides, or the Sea's Ebbing and Flowing; derived from the common centre of gravity of the earth and moon, considered as conjunct bodies. 10. Commercium Epistolicum: being a collection of letters which passed between Messrs. Fermat and Frenicle on the one part, and Lord Brounker and Dr. Wallis on the other part, by the intervention of Sir Kenelm Digby; concerning divers mathematical questions. 11. A Treatise of Trigonometry, plain and spherical, of Mr. John Caswell.*

* A third, very large volume, was published afterwards, containing many miscellaneous pieces.

II. *Tractatus de Salis Cathartici amari in Aquis Ebshamensibus et hujusmodi aliis contenti Naturâ et Usu. Aut. Nehemia Grew, M. D. Utriusque Reg. Soc. Soc. Lond.* 12*mo*. N° 216, p. 76.

This book is divided into 2 parts. The former, on the nature of the purging waters, and of its purging salt. The latter, of their use. The former has 6 chapters. The 1st shows how these waters came to be commonly known and used. The 2d the nature of the waters. The 3d the nature of the purging salt of these waters. Where, among many other experiments, it is observed, that its crystals, when permitted to shoot at a due distance, are most of them rectangular prisms with 4 parallelogram planes. By which, and divers other properties, it is distinguished from all other salts. The 4th shows the difference between this salt and alum: and that the waters are falsely supposed by many to be aluminous. As also between this and common salt; although some quantity of common salt be contained in all the purging waters. The 5th demonstrates the difference of this salt, both from nitre, and from the salt of lime; notwithstanding it has been taken for a calcareous nitre. The 6th contains some further observation on this bitter purging salt,* grounded chiefly on the foregoing experiments.

The latter part has 7 chapters. The 1st shows the use of the waters, and of their purging salt in general. The 2d shows the ways of using the salt; whereof one of the best is to take it dissolved in its own purging water, raw, or first a little boiled: whereby the said water will work, both in a far less quantity, and more kindly and effectually. The 3d, 4th, 5th, and 6th show in what diseases this medicine is to be used. The last chapter mentions the diseases wherein it is improper and hurtful.

A Relation of one Hannah Taylor, a very extraordinary Child of about 6 *Years of Age, who in Face, &c. was as large as a full grown Woman; and of what appeared on the Dissection of her Body: by Dr. Henry Sampson, F. of the Coll. of Physicians.* N° 217, p. 80.

Hannah Taylor was born in Crutched Friars, June 12, 1682. She was, till 3 years old, very sickly, lean, and not able to go alone; but about Bartholomew-tide, 1685, she began to grow strong and fat, which increased till the time of her death: she was also a very forward child of understanding, had her pubes

* This bitter purging salt consists of vitriolic or sulphuric acid and magnesia; being the sulphate of magnesia of the French nomenclature, and the magnesia vitriolata of Bergman and the London Pharmacopœia.

grown thick and long, as also hair under her arm-pits, and a downiness on her chin, unusual with those of her sex, except in some aged persons.

About ½ a year before she died she began to complain of pains, especially on her left side, and voided gravel often by urine, and with pain. Her breath was short, as is usual to fat people, especially when she went up a pair of stairs: yet on that very evening before she died, she walked abroad, was merry and lively, went to bed, and slept as at other times, but after midnight awaked, cried out of a great pain in her side, and said, Mother, I want breath, I shall die; and in less than ¼ of an hour was quite dead.

The measures and weight of her body were as follow. Round the breast 1 yard and 2 inches, over the hips at the navel 1 yard 5 inches, over the stomach a yard, her height 1 yard wanting an inch, round the thigh 1 foot 9 inches ½, calf of the leg 13 inches, upper part of the arm 14 inches ½, the wrist 7 inches, her weight 95lb. She had a face as large and broad as any fat grown woman of 20 years. Her chin and breast were so thick laid with fat, that she was forced to hold up her head, or rather throw it backward, as she walked. These measures were all taken before the dissection. The thickness of the fat on the muscles of the abdomen was 2 inches, and not much less on the sternum: after the fat was removed, the abdomen was still very protuberant and round, and yet the fat contained therein not extraordinary much, neither on the omentum nor mesentery (which was as much as is usually in most fat and grown up persons) these, with the other internal parts, were of the largest size. The guts were all inflamed and thick, the liver large, the left kidney, where was the seat of her misery, exceedingly large, and double the size of that on the right side; on dissecting it, there issued out a vast quantity of blood, both from all the vessels of it, and out of its pelvis; and although it was several times sponged from it, yet it came flowing in from the emulgent artery; a certain argument of a great plenitude in the descending trunk. Here was also some small gravel, which possibly had choked up the ureter, though that was not examined; but because there was no blood in the bladder I justly make this conjecture. The uterine parts were not larger than in others of her age. The ovaria were large, but smooth and white, without protuberances or show of eggs. The bladder had a purulent matter in it. When the breast was denuded of its fat, it showed no larger than of another child of her age. The cavity was totally filled with the lungs and heart. The heart was natural. But the lungs, besides that they were extended to fill up the whole cavity, were annexed strongly to several parts of the pleura, and had several protuberances as large as nutmegs filled with a pulp like an atheroma, and were in divers places rotten and corrupted. Quære, Why one with so bad lungs was so fat? Why had she not rather a consumption?

The evident cause of her death lay in the inflammation of the lower parts, though the parts concerned in respiration were also disordered. Her face and head were miserably coloured with redness of stagnant blood. The head was not opened.

Account of Tadmor, or Palmyra, in Syria; and a Journey from Aleppo to that Place. By the Rev. Mr. William Halifax. N° 217, p. 83.

We left Aleppo on Michaelmas-day, 1691, and in 6 easy days' travel over a desert country, nearly in a south direction, but a little inclining to the east, came to Tadmor. As we rode into the town we observed a castle, about half an hour's distance from it, and so situated as to command both the pass into the hills, by which the town is entered, and the city too. But we could easily perceive it was no old building, showing no traces of the exquisite workmanship and ingenuity of the ancients. We were informed it was built by Man-Ogle, a prince of the Druces, in the reign of Amurath the third, anno 1585. But it does not appear that either Man-Ogle, or any Drucian prince, was ever powerful in these parts, their strength lying on Mount Libanus, and along the coast of Sidon, Berytus, &c. It is a work of more labour than art, and the very situation alone is sufficient to render it almost impregnable; standing on the top of a very high hill, enclosed with a deep ditch, cut out of the very rock, over which there is only one passage, by a draw-bridge, which however is now broken down; so that there is no entrance remaining, unless you will be at the pains to clamber up the rock, which may be done in one place, but so difficult and hazardous, that a small slip may endanger a man's life. Nor is there any thing within to be seen sufficient to recompense the trouble of getting up to it, the building being confused, and the rooms very ill contrived. Upon the top of the hill there is a well of a prodigious depth. This castle stands on the north side of the town, and from hence you have the best prospect of the country all about. You see Tadmor below, inclosed on three sides with long ridges of mountains, which open gradually towards the east to the distance of about an hour's riding; but to the south stretches a vast plain beyond the reach of the eye; in which is a large valley of salt, which is more probably the valley of salt mentioned 2 Sam. viii. 13, where David smote the Syrians, and slew 18000 men, than another, which lies but 4 hours from Aleppo, and has sometimes passed for it. The air is good, but the soil exceedingly barren; nothing green is to be seen, save some few palm-trees in the gardens, and here and there about the town; and from them it probably had its name, both in Hebrew, Tadmor, which signifies a palm-tree, and in Latin, Palmyra; and the whole country is thence denominated Syria Palmyrena; and sometimes Solitudines Palmyrenæ: so that the Latins did not change but only translate the old name, which therefore still obtains in these eastern parts, and the more modern is wholly unknown.

The city itself appears to have been of a large extent, by the space now occupied by the ruins; but there are no foot-steps of any walls remaining, nor is it possible to judge of the ancient figures of the place. The present inhabitants, as they are a poor, miserable, dirty people, so they have shut themselves up, to the number of about 30 or 40 families, in little huts made of dirt, within the walls of a spacious court, which inclosed a most magnificent heathen temple. Certainly the world itself cannot afford the like mixture of remains of the greatest state and magnificence, with the extremity of filth and poverty.

The whole inclosed space is a square of 220 yards each side, encompassed with a high and stately wall, built of large square stone, and adorned with pilasters within and without, to the number of 62 on a side. And had not the barbarity of the Turks, enemies to every thing that is splendid and noble, out of a vain superstition, purposely beat down those beautiful cornishes both here and in other places, we had seen the most curious and exquisite carvings in stone which perhaps the world could ever boast of: as here and there a small remainder, which has escaped their fury, abundantly evidences. The west side, where is the entrance, is most of it broken down, and near the middle of the square, another higher wall erected out of the ruins, which seems to have been a strong but rude castle. Within were to be seen the foundations of another wall, which probably might answer the front; and probably the Mamalukes, whose workmanship it seems to have been, built the castle here for the security of the place. Before the whole length of this new front, except a narrow passage which is left for an entrance, is cut a deep ditch, the ascent whereof on the inner side is faced with stone to the very foot of the wall, which must have rendered it very difficult to be assaulted. The passage and the door are very narrow, not wider than to receive a loaded camel, or that two men may well walk a-breast. And as soon as you are within the first door, you make a short turn to the right, and pass on to another of the like size; which leads into the court. This outward wall quite shrouds that magnificent entrance, which belonged to the first fabric; of the stateliness of which we may judge by the two stones which support the sides of the great gate, each of which is 35 feet in length, and artificially carved with vines and clusters of grapes, exceedingly bold, and to the life. They are both standing and in their places, and the distance between them, which gives us the width of the gate, 15 feet. But all this is now walled up to the narrow door before-mentioned.

On entering the court are seen the remains of two rows of marble pillars, 37 feet high, with their capitals of most exquisite carved work; of these only 58 remaining entire; but there must have been a great many more, for they appear to have gone quite round the whole court, and to have supported a most spacious double piazza or cloister. Of this piazza the walks on the west side, which is opposite to the front of the temple, seem to have exceeded the other in beauty and spaciousness, and at each end are two niches for statues, at their full length, with their pedestals, borders, supporters, and canopies, carved with the greatest art and exactness. The space within this once beautiful enclosure, which is now filled with nothing but the dirty huts of the inhabitants, seems to have been an open court, in the midst of which stands the temple, encompassed with another row of pillars of a different order, and much higher than the former, being above 50 feet high, of which only 16 remain. The whole space, contained within these pillars, is 59 yards in length, and near 28 in breadth. In the middle of which space is the temple, extending in length more than 33 yards, and in breadth 13 or 14. It points north and south, with a most magnificent entrance on the west, exactly in the middle of the building, which by the small remains yet to be seen, seems to have been one of the most glorious structures in the world. I never saw vines and clusters of grapes cut in stone so bold, so lively, and so natural, in any place. Just over the door we could just discern part of the wings of a large spread eagle, extending its whole width. Of this temple there is nothing at present but the outward walls standing, in which it is observable, that as the windows were not large, so they were made narrower towards the top than they were below; but all adorned with excellent carvings. Within the walls the Turks, or more probably the Mamalukes, have built a roof, which is supported by small pillars and arches, but a great deal lower, as well as in all other respects disproportionate and inferior to what the ancient covering must have been. And they have converted the place into a mosque, having added to the south end new ornaments after their manner, with Arabic inscriptions and sentences out of the Alcoran, written in flourishes and wreaths, not without art. But at the north end of the building, which is shut out of the mosque, are relics of much greater art and beauty. They are beautified with the most curious fret-work and carvings; in the middle of which is a dome or cupola, above 6 feet diameter, and above is of one piece, either hewn out of one entire rock, or made of some artificial composition, strongly hardened by time; in a word, it is a most exquisite piece of workmanship.

Presently after we were struck with an amazing sight of a multitude of marble pillars standing scattered up and down, for the space of near a mile of ground, but so disposed as to afford no foundation to judge what sort of structures they formerly formed. Passing the remains of a handsome mosque, we had the prospects of such magnificent ruins, that if we may frame a conjecture of the original beauty of the place, by what is still remaining, it may be questioned whether any city in the world could have vied with it in magnificence. Towards the north is a stately obelisk, consisting of 7 large stones, besides its capital and the wreathed work above it; the carvings are exceedingly fine; its height is above 50 feet, and upon it probably stood a statue, which the Turks may have thrown down and broken in pieces. It is in compass, just above the pedestal, 12½ feet. On each side of this, towards the east and west, are seen two other large pillars, each a quarter of a mile distant, and part of another standing near that of the east, which would incline one to think there was once a continued row of them. The height of that to the east is more than 42 feet, and the circumference in proportion. Upon the body of it is an inscription, in ancient Greek capitals, from which it seems evident they were a free state, governed by a senate and people, though perhaps under the protection of greater empires, the Parthians, and afterwards the Romans, who for a long time contended for the mastery; and this government might continue among them till about the time of Aurelian, who demolished the place, and led Zenobia, wife of Odenatus, captive to Rome; who, though she be called queen, yet we find not that ever her husband had the title of king: but was only one of the chief inhabitants, a leading man in the senate; who, while the Romans were busied in Europe, made himself great here, and by his own force repelled the Parthians; who, having mastered whatever was held by the Romans on the other side of the Euphrates, made an incursion into Syria, but were driven back beyond the river by Odenatus. In the course of these wars Odenatus was slain; but his wife Zenobia, being a woman of a masculine spirit, not only maintained her ground against her enemies abroad, but preserved her authority at home, keeping the government in her hands. Afterwards, out of a desire to cast off the Roman yoke, she caused the whole garrison, which was left there by Aurelian, to be barbarously cut off: which bringing Aurelian back with his army, he quickly took the city and destroyed it, putting the inhabitants to the sword, and carrying Zenobia captive to Rome, which was the fatal period of the glory of the place. The other pillar towards the west in height and circumference answers this, and has upon the side a similar inscription engraved.

Proceeding forward, directly from the obelisk, about 100 paces, you come to a magnificent entrance, very large and lofty, and for the exquisiteness of the workmanship not inferior to any thing before described. This entrance leads to a noble piazza of more than half a mile in length, and 40 feet in breadth, enclosed with two rows of stately marble pillars, 26 feet high, and 8 or 9 in compass. Of these 129 remain standing and entire; but originally there could not have been less than 560. On almost all the pillars are found inscriptions, both in Greek and the unknown language, of which we had time to take but few, and those not very instructive.

And what we may collect from both, and several others of a like import, is, that as the state, the senate, and people, sometimes honoured those that had been in public trust with inscriptions on these pillars, so when this was not done by them, private persons had the liberty to do the same for their friends.

The upper end of this spacious piazza was shut in by a row of pillars, standing somewhat closer than those on each side; and perhaps there might have been a kind of banqueting house above, but now no certain footsteps remain; but a little farther to the left hand are the ruins of a very stately building, which I am apt to believe might have been for such a use; it is built of better marble, and has an air of delicacy and exquisiteness in the work beyond what is discernible in the piazza. The pillars which supported it are of one entire stone; and one of them that is fallen down, but so firm and strong that it has received no injury thereby, measured 22 feet in length, and in compass 8 feet and 9 inches. In the west side of the great piazza are several openings for gates, leading into the court of the palace: two of which when they were in their perfection were perhaps the most magnificent in the world, both for the elegance of the work in general, and particularly for those stately porphyry pillars with which they were adorned. Each gate had four, not standing in a line with the others of the wall, but placed by couples in the front of the gate, facing the palace, two on one hand and two on the other. Of these only two remain entire, and but one standing in its place. They are about 30 feet in length, and 9 in circumference, of a substance so hard, that it was with great difficulty we broke off a few shivers; the art of making which I think is quite lost. The palace itself is so entirely ruined, that no judgment can be made what it was in its ancient splendour, either for its figure or workmanship.

Hot sulphureous baths are frequent in this country, and hence it obtained the name of Syria Salutifera. The scent of the waters here is much like those of Bath in England, but not so strong, neither is the taste so offensive. On the contrary, when they have run so far from the fountain, as to become cold, they are potable, and are the only waters the inhabitants use. But we, during our stay there, sent to a fountain of very excellent water, about an hour's journey from the city.

On the east side of the long piazza stands a vast number of marble pillars, some perfect and others deprived of their beautiful capitals; but so scattered and confused, that it is not possible to reduce them into any order, so as to conjecture to what they anciently served. In one place are 11 ranged together in a square, paved at the bottom with broad flat stones, but without any roof or covering. And at a little distance from that are the ruins of a small temple, of very curious workmanship, but the roof is wholly gone, and the walls much defaced. Before the entrance, which looks to the south, is a piazza supported by six pillars, two on one hand of the door, and two on the other, and one at each end; the pedestals of those in the front have been filled with inscriptions, both in Greek and the other language; but they are become unintelligible.

Their sepulchres are very curious, being square towers, four or five stories high, and standing on both sides of a hollow way, towards the north part of the city. They stretch out in length the space of a mile, and perhaps formerly might extend a great way further. They were all of the same form, but of different splendour and size, according to the circumstances of their founders. There were two which stood almost opposite to each other, and seemed most perfect of any, though not without marks of the Turkish fury. They are two square towers, rather larger than ordinary steeples, and five stories high, the outside being of common stone, but the partitions and floors within of good marble; and beautified with admirable carvings and paintings, and figures both of men and women, as far as the breast and shoulders, but miserably defaced and broken. We entered one of these by a door on the south side, from which was a walk across the whole building just in the middle. But the floor was broken up, and so gave us a view of a vault below, divided after the same manner. The spaces on each side were subdivided into six partitions by thick walls, each partition being capable of receiving the largest corpse, and piling them one above another, as their way appears to have been, each of those spaces might contain at least 6 or 7 bodies. For the lowest, second, and third stories, those partitions were uniform, and altogether the same, except that from the second floor, which answered the main entrance, one partition was reserved for a stair-case. Higher than this, the building, being somewhat contracted towards the top, would not afford space for the continuation of the same method: therefore the two uppermost rooms were not so parted, nor perhaps ever had any bodies laid in them. Unless it was that of the founder alone, whose statue wrapped up in funeral apparel, and in a lying posture, is placed in a nich, or rather window in the front of the monument, so as to be visible both within and without.

The other monument opposite was much like this, only the front and entrance are towards the north, and it is not altogether so smooth nor so well painted. But the carvings are as good, and it appears altogether as stately and magnificent as the former. Besides it has the advantage in age of a whole century of years, as appears from the date of the inscription. It is placed above a nich in the front adorned with handsome borders and cornices, the place, doubtless, of some statue, and probably that of the founder.

On the Cycloidal Spaces which are perfectly Quadrable. By Dr. Wallis. N° 217, p. 111.

It is generally supposed that no part of the semicycloid figure, adjacent to the curve, is capable of being geometrically squared but these two, viz. 1. The segment A *b* V, fig. 6, pl. 1, taking A V = $\frac{1}{4}$A α, (which was first observed by Sir Christopher Wren, and after him by Huygens and others,) and it is = $\frac{3}{4}s$ R = $\frac{3}{4}$ R^2 $\sqrt{3}$.—2. The trilinear A *d* D, taking *d* D, in the parallel *d* D C, passing through the centre C; which is = R^2.

But it is otherwise, as I have showed in my treatise De Cycloide, and that De Motu; the figures of which latter I retain here, so far as they concern this occasion, there being other portions of it, equally capable of quadrature.

In order to which, I there show (De Motu, cap. 5, prop. 20. A. pp. 802, 803, 804) that not only the cycloid is triple to the generating circle, which was known before, but that the respective parts of that are triple to those of this; which is the foundation on which I build my whole process concerning the cycloid in both treatises, and which is not pretended, that I know of, to have been observed, or known by any person before me; that is, *b* β α A, fig. 6, triple to the sector B α A, taking *b* β parallel to *b* α, wherever, in the curve A τ, we take the point *b*.

I then show that the cycloid is a figure compounded of these two; the semicircle A D α, and the trilinear A D α τ *b* A, lying between the two curves A D α and A *d* τ, and therefore, to square any part of these, is the same as to square the respective part of the cycloid.

I show further (ibid. p. 804) that this trilinear is but a distorted figure, by reason of the semicircle thrust in between it and its axis; which being restored to its due position, by taking out the semicircle, into a different figure, as fig. 7, and thrusting the lines *b* B home to the axis, so as that B V be the same point, it is the same with A τ α, fig. 8 (the parallelograms *b* β α B being set upright, which in the cycloid stand sloping, and the circular arcs *b* β, fig. 6, becoming straight lines in fig. 8, and the lines *b* B being, in both, equal to the respective arcs B A every where;) which therefore I call trilineum restitutum, the trilinear restored to its due position, which figure I do not find that any before me has considered: so that to square any part of this is the same as to square the respective part of the cycloid, or of the trilinear in the cycloid: that which in the cycloid lies between two arcs of the generating circle in different positions, answering to that which, in the restored figure, lies between the respective straight lines.

And therefore A d D A, $=$ T d δ T, fig. 6, $=$ A d D A $=$ T d δ T, fig 8, $=$ R^2. And A b k D A, T b k δ T, fig. 6, $=$ A b k D A, T b k δ T, fig. 8, $=$ sR. And bkd, fig. 6, $=$ bkd, fig. 8, $= R^2 - s$R, ibidem, cap. 17, b. p. 756. Where, if b be taken above d k D C, passing through the centre C, these figures are within the cycloid, and within the restored figure, but without them, if b be taken below that line, and adjacent to the curve A b T, in both cases.

By R, I understand the radius of the generating circle; and by s, the right sine of the arc B A, whose versed sine is V A. And wherever in my whole discourse on the cycloid, or the restored trilinear (which is a figure of arcs, and a figure of versed sines) the arc a is no ingredient in the designation; such part or portion of them is capable of being geometrically squared. But when I exclude a, I therein exclude P (for that is an arc also) and $f = a + s$, and $e = a - s$, because a is therein included.

Mr. Caswell, not being aware that I had squared these figures, had done the same by a method of his own, which he showed me lately, which I would have inserted here, but that he thought it not necessary; and instead thereof, has given me the quadrature of a portion of the epicycloid, which you will receive with this, and I think it is purely new.

*The Quadrature of a Portion of the Epicycloid. By Mr. Caswell.** N° 217, p. 113.

Suppose D P V, fig. 9, pl. 1, to be half of an exterior epicycloid, V B its axis, V the vertex, V L B half of the generating circle, E its centre, D B the base, C its centre; bisect the arc of the semicircle V B in L, and on the centre C through L draw a circle cutting the epicycloid in P: then I say the curvilinear triangle V L P will be $=$ B E^2 into $\frac{\text{C E}}{\text{C B}}$; that is, the square of the semidiameter of the generating circle will be to the curvilinear triangle V L P, as C B the semidiameter of the base to C E, which C E in the exterior epicycloid is the sum of the semidiameters of the base and generant, but in the interior epicycloid D p u it is the difference of the said semidiameters.

Corol. 1. In the interior epicycloid, if C E be $\frac{1}{2}$C B, the epicycloid then dege-

* Of Wadham College, Oxford, and author of "A brief, but full, Account of the Doctrine of Trigonometry, both Plane and Spherical;" printed at the end of Dr. Wallis's Treatise on Algebra.

nerating into a right line, the quadrature of the triangle *l p u* will be in effect the same with the quadrature of Hippocrates's lunes.

Corol. 2. If the semidiameter of the base be supposed infinite, the epicycloid then being the common cycloid, the area of the said triangle will be equal to the square of the radius of the generant, and so it falls in with that theorem which Lalovera found, and calls Mirabile.

Though I do not think the aforesaid quadrature can easily be deduced from what has been yet published of the epicycloid, I have not added the demonstration; but think it enough to name a general proposition from whence I deduced it, viz. The segments of the generating circle are to the correspondent segments of the epicycloid, as C B to 2 C E + C B. For example, suppose F *m* G the position of part of the generant when the point F of the exterior epicycloid was designed, then the segment F *m* G *n* is to the segment D F *n* G :: as C B to 2 C E + C B. And consequently the whole epicycloid to the whole generant in the same proportion, which is the only case demonstrated by M. De la Hire. It follows also that in the common cycloid, its segments are triple of the correspondent sectors of the generant, which was first shown by Dr. Wallis.

An Account of Books.—1. *An Essay towards a Natural History of the Earth, and Terrestrial Bodies, especially Minerals; as also of the Sea, Rivers, and Springs. With an Account of the Universal Deluge, and of the Effects that it had upon the Earth. By John Woodward,* M. D. Professor of Physic in Gresham College, and F. R. S.* 1695, 8*vo.* N° 217, p. 115.

The author begins this essay (which is only a prelude to a larger work which he promises) with an account of his observations on the grosser and more massy parts of the terrestrial globe, all which lie stratum super stratum in the earth;

* This medical philosopher, who acquired so much celebrity by the work above noticed, (with its progressive enlargements,) was a native of Derbyshire, and was born in 1665. After he had been some years at a grammar school in the country, he was sent to London, where (we are told) he was articled to a linen draper; a situation ill adapted to a person of his studious turn. Accordingly he soon quitted it for the pursuit of philosophy and physic; in both which he made very great progress in the course of a few years. In 1692, through the recommendation of his friend and patron, Dr. Barwick, he was appointed to the vacant professorship at Gresham college; and in 1695 the degree of doctor of physic was conferred upon him by a patent from Archbishop Tenison. He was afterwards admitted to the same degree at Cambridge. Besides his Natural History of the Earth, his Method of Fossils, and several papers inserted in the Philosophical Transactions, he wrote a tract, entitled, The State of Physic and Diseases, with an inquiry into the late increase of them, &c. printed in 1718. He died in 1728, bequeathing to the University of Cambridge his collection of fossils (of which a catalogue was published in 1728), with an endowment for a lecturer on his favourite subject of inquiry, the natural history of the earth.

such as marble, stone, coal, chalk, sand, gravel, clay, marl, and other sorts of earth. Among other things, he observes that there are lodged vast numbers of sea-shells, and other marine bodies, in these terrestrial strata, as well as in the more solid ones, as stone and marble, wherewith they are incorporated, being lodged among the matter they consist of, and found in the midst of the stone of rocks and quarries, as in those that are not so hard, such as chalk, clay, and the like; and this in the most midland countries as well as in those which are nearer to the sea. He observes, that these shells are thus found inclosed in this terrestrial matter from the surface of the earth down to the very bottom of the deepest quarries and mines; ; that they lie according to the order of their specific gravity, the heavier kinds deeper, the lighter nearer the surface of the earth, and both among terrestrial matter, that is of the same specific gravity that they are of ; and this not only in England, but in other parts of Europe, Asia, Africa, and America, or in short, all over the world. But because many learned men of late have doubted whether these were truly shells or not, he removes that doubt, and answers their objections, proving these to be the real shells of once living shell-fish, and that they were originally generated in the sea.

He then proceeds to the body of the work, which is divided into 6 parts. In the 1st of which he examines the ways whereby other authors have thought these shells were brought to land ; and particularly those who suppose that there happen great changes of sea and land. E. gr. That there have been many and great islands raised from the bottom of the sea by earthquakes, such as Rhodes and others ; that the centre of gravity in the terraqueous globe shifts and moves, and consequently the water of the sea moves also : so that it deserts those tracts of land which it formerly covered, and betakes itself to others which were till then dry land. That the mud which is carried down into the sea by rivers, and precipitated at their ostia, makes daily additions to the earth, which therefore encroaches and gains upon the sea, as the sea in other places does upon the earth ; that the sea by these means being forced off, and having left many parts of the globe, it also left there behind it shells and other sea productions.

But to these opinions our author replies, that they are destitute of all true foundation, and repugnant to observation ; that on them can never possibly be accounted for the circumstances of these marine bodies, as their being lodged in the middle of the rocks, their numbers, order, variety, depth in the earth, distance from any sea, and the like. So that though such changes as they suppose had really happened, yet these shells, &c. could never by them have been put into the condition wherein they are now found ; but he further adds, that there is not any reason to believe that such changes did ever happen, having not the least countenance either from the present face of the earth, or any credible and authentic records of the ancient state of it, but that the globe is to this day nearly in the same condition that the universal deluge left it.

In the 2d part he treats of the universal deluge, to prove that these marine bodies were then left at land, and that at the deluge there were made several great alterations in the terrestrial globe: particularly that the whole globe was then dissolved, the particles of stone, marble, and all other solid fossils dissevered, taken up into the water, and there sustained, together with sea-shells, and other animal and vegetable bodies; that at length all these subsided from the water, according to the order of their gravity, the heaviest bodies first, then those which were lighter, but all that had the same degree of gravity settled down at the same time; so that those shells or other bodies that were of the same specific gravity with sand sunk down together with it, and so were inclosed in the strata of stone which that sand formed; those shells which were lighter, and but of the same gravity with chalk, subsided at the same time that the chalky particles did, and by that means became lodged in the strata of chalk: and in like manner all the rest. He shows how the present earth was formed out of this promiscuous mass of sand, earth, shells, and the rest, falling down again and subsiding from the water; and that this sediment was plain and equal, the strata continuous, and consequently the globe at first even and spherical, the water lying above all, covering and environing the whole globe; that after a while the said strata were broken and dislocated, some elevated, and others depressed, by which means all the inequalities of the globe, fissures, grottos, mountains, valleys, islands, the channel of the sea, and all others were formed; the whole terraqueous globe being at the time of the deluge put into the condition that we at this day behold. He concludes this part with an account of the trees which are found in great plenty buried in mosses, fens, or bogs, both in England and other countries, showing that they were deposited there by the deluge, and by what means they have been preserved down to our times.

The 3d part, which is concerning the fluids of the globe, he subdivides into 2 sections, the former whereof comprehends the present and natural state of the water within and upon the earth, showing that there is a vast mass of water inclosed in the bowels of the earth which is what Moses calls the great abyss; that this abyss communicates with the ocean by means of certain hiatuses passing between them, and is the standing fund which supplies water to the surface of the earth, as well springs and rivers, as vapours and rain; that there is a nearly uniform and constant fire or heat disseminated throughout the body of the earth, which evaporates the water of the abyss, elevating it thence up to the surface of the earth, where part of it issues forth in vapour, ascends into the atmosphere, and is returned back again in rain, &c. the rest is condensed or collected, and sent forth in springs and rivers; the several circumstances of which he considers and accounts for, as also the final cause of this distribution of water to the surface of the earth; that this subterranean heat is the cause of earthquakes, the many strange phænomena of which he relates, showing whence each proceeds; that volcanos, such as Ætna and Vesuvius, are nothing but eruptions or discharges of this subterranean fire; and that the thermæ or hot-springs also owe their heat entirely unto it. In the latter section of this part he treats of the universality of the deluge; shows where that mighty volume of water which overflowed the earth in the days of Noah is now concealed; inquires what time of the year the deluge began: in what order, and at what apertures the water of the abyss was brought out upon the earth, as also how it retreated back again.

In the 4th part he treats of the origin and formation of metals and minerals, and shows that these were all dissolved at the deluge as well as stone, marble, and the like, and that all metallic and mineral nodules whatever, both those which are in rude lumps, such as the common pyrites, flints, agates, onyxes, pebbles, jaspers, cornelians, and the like, and those which are of a more regular and observable shape, such as the selenites, belemnites, and mineral coral, were all amassed and formed during the time that the water covered the earth; and gives an account of their varieties, mixtures, colours, and figures, particularly of the ores of metals, flint, spar, vitriol, and other minerals that resemble the shells of echini, conchæ, cochleæ, and other shells; for which reason they have been called echinitæ, conchitæ, cochlitæ; showing that these bodies were formed and moulded in the cavities of those shells which they so resemble, and by what means. That at the general subsidence metals and minerals, as well those which were thus amassed into lumps, as those which continued asunder and in single corpuscles, sunk down to the bottom along with sand, coal, marl, &c. and so were lodged in the strata which the sand, &c. constituted. That all the metallic and mineral matter, which is now found in the fissures or perpendicular intervals of the strata, was originally lodged in single particles among the sand, &c. in the bodies of those strata, having been detached and drawn thence by little and little by the water, which continually pervades the strata in its passage from the abyss to those fissures, and so on to the surface of the earth; with an account of the minerals and ores of metals which lie in these fissures, and particularly of the formed ones, e. gr. of several sorts of stalactitæ, the iron-rhombs, tin-grains, mundic-grains, crystallized native salt, alum, vitriol, and sulphur; as also the gems found here, as crystal, the psud-adamants, the amethyst, and others; likewise considerations touching the growth of metals and minerals in the earth; and touching the petroleum, bitumen, salt, alum, vitriol, and other minerals in the water of springs; the incrustations or petrifactions of bodies in springs and rivers; the effect that the subterranean heat has on minerals, occasioning damps in mines, explosions in earthquakes, oftentimes forcing the said minerals in steams out at the surface of the earth, where they sometimes occasion fevers and other malignant distempers; and mounting up still higher in the atmosphere form meteors, are the cause of thunder and lightning, &c. He closes this 4th part with a discourse concerning amber, which he proves to be neither a gummous substance nor a marine production, but a natural fossil, as flints, agates, &c. are, and formed at the deluge as they were.

The 5th part is concerning the alterations which the terraqueous globe has undergone since the time of the deluge. And having in the former part dispatched what concerns the changes which happen in the interior parts of the earth, by the transitions and removes of metals and minerals there, in this he considers those alterations which befal the superficial or exterior parts of it, showing that the upper or outermost stratum of earth, being the common fund and promptuary out of which the matter of all animals and vegetables is derived, and into which that matter is at last all returned back again, is in a continual flux and revolution: and takes occasion here to discourse of the first particles or elements of natural things, that rocks and mountains grow lower and lower, the earth, sand, &c. being washed away, and borne down by rains, &c.

The 6th part is concerning the state of the earth, and the productions of it, before the deluge; wherein he asserts, against the author of the theory, that the face of the antediluvian earth was not smooth, but uneven, and distinguished with mountains, valleys, and plains, as also with sea, lakes, and rivers; that the sea was then of the same extent, and intermixed with the land as now it is; that the water of the sea was salt, and that it was agitated with tides as at present; that the sea was abundantly replenished with fish, as were also the lakes and rivers; and that the earth was as plentifully stocked with vegetables and animals; that the vegetables and animals of the primitive earth did not in anywise differ from those of the present earth; that there were both metals and minerals in the antediluvian earth; that the terraqueous globe had then the same site and position, in respect of the sun, as now, and that there were the same vicissitudes of heat and cold, wet and dry, summer and winter, as at present. These propositions our author deduces from his observations on the vegetable and animal remains of the antediluvian earth; and having carefully compared it with the account which Moses has left us of the earth, and of the deluge, he finds it punctually and exactly agreeable to this account which we have from nature; and endeavours to show that Dr. Burnet, in his theory, having in almost all these heads receded from the Mosaic account, has manifestly receded from nature and matter of fact.

An Account of a Paper, entituled, Archibaldi Pitcarnii, M. D. Dissertatio de Febribus, &c. An Extract from the Latin.* N° 217, p. 123.

This author shows that the solution and termination of fevers are effected by an elimination of the morbific matter, (humorem morbificum) through some one or other of the excretory passages, whether that matter shall have been derived from without or generated within the body.

He next shows that the perspiration (including the halitus from the lungs which is analogous to the cutaneous exhalation), is, in the human subject, ten times as much as the alvine excretion. Hence he infers, that fevers are ten times oftener cured by medicines which increase perspiration, than they are by those which evacuate the bowels; adding, however, that an evacuation of the bowels, when produced by a gentle cathartic, tends at the same time to promote perspiration, to which therefore the benefit that follows should in part be referred.

He then attempts to demonstrate from the known laws of mechanics, that in fevers (in which the pulse is more frequent than natural) the velocity of the blood is greater than natural; and that if the pulse be both greater and more frequent than natural, the quantity also as well as the velocity of the blood circulating within a given time, must be greater than natural.

* Dr. Archibald Pitcairn was born at Edinburgh in 1652, and after studying hoth divinity and law, he at length took to the profession of physic. Having made himself known by a Latin dissertation, De Inventoribus, 1688, wherein he vindicated in a very able manner the merits of Harvey, and his discovery of the circulation of the blood, he was invited to hold a medical professorship in the university of Leyden, where he went in 1692; but he returned to Edinburgh the year following, to fulfil a matrimonial engagement with a daughter of Sir Archibald Stephenson. In consequence of this event he was obliged to resign his appointment in Holland, as the lady's parents objected to her going abroad. He died in 1713. Besides 8 or 10 Dissertationes Medicæ, we have his Elementa Medicinæ, being the substance of the lectures he read to his pupils. His writings on medical subjects were reprinted at Leyden in 1737, under the title of Opera omnia medica, 4to. Dr. Pitcairn was a man of great learning and classical acquirements; and at the same time was well versed in the science of mathematics; upon the principles of which he endeavoured, after the example of Borelli and Bellini, to account for the principal phænomena, both natural and morbid, which occur in the animal body: as if it were possible to reduce to mathematical demonstration the action of tubes and pores whose diameters are perpetually varying, and which moreover are subject to a power, (the living principle,) whose degree of intensity is at no two moments of our existence precisely the same; a power which scarcely admits of definition, much less of being estimated by geometrical rules.

In the next place he shows, how it was possible for Bellini to find that the quantity of perspirable matter, emitted every minute from a villous or excretory portion of the skin, weighing a scruple, is equal to the 1200th part of a scruple.

He rejects the use of ferments, both in accounting for the production of diseases, and the business of secretion; which, in his opinion, no person can pretend to explain who is not thoroughly acquainted with the philosophy of Newton.

A general Proposition for measuring all Cycloids and Epicycloids, &c. By E. Halley. N° 218, p. 125. *Translated from the Latin.*

The Prop.—The area of a cycloid or an epicycloid, whether it be primary, or contracted, or prolate, is to the area of the generating circle; and also the areas of the generating parts in the same curves, to the areas of the analogous segments of the circle; as the sum of the double velocity of the centre and the velocity of the circular motion, is to the velocity of the circular motion.

Demonstr.—Let any epicycloid YPSQVB (fig. 10, pl. 1,) be described, by the revolution of the circle VLB on the circular base YMNB. Let the centre of the generating circle be *c*, and drawing *c*MK, let the circle stand on the base at the point M, and let S be the delineating point. Now, separating the motions, let the point S be transferred to R by the circular motion that the arc MS may be increased by the indivisible particle RS; then let the centre *c* proceed forward to C. By this motion the segment RSM being transferred to the situation QTN, the point Q will meet the curve. It appears that the triangle RSM is the moment or fluxion of the area of the circular segment: and the trapezium QSMN is the fluxion of the area of the curvilinear space generated in the same time. Now since SM, RM, QM, are supposed to differ from one another only by a point, conceive the areola QSMN to consist of three sectors RMS, RMQ, MQN; then the areola RMS is to the areola QSMN, as the angle RMS is to the sum of the three angles RMS + RMQ + MQN. But the angles RMQ + MQN are equal to the angles MCN + MKN, or to the angle *c*MC; because of the lines RM, QN being inclined to each other in an angle equal to MKN, and because of the angle MQN being the half of MCN, by Eulc. iii. 20. Therefore the angle RMS is to the angles RMS + *c*MC, that is, by the same Prop. as the arc ½RS to the two arcs C*c* + ½RS; or RS to 2C*c* + RS, as the areola RSM to the areola QSMN, or as the moment of the circular segment QTN, to the moment QSYMN of the epicycloidal segment generated in the same time. And as these moments are always in the same ratio, wherever the point Q is taken, it follows that the areas themselves QTN, QSYMN, generated by these moments, have the same constant ratio, viz. that of the velocity of the circular motion R S, to double the velocity of the centre added to the circular motion, or 2 C c + R S. Also as the area V B Z to the area Q V B N, so is therefore the area of the semicircle V L B to the curvilineal space V Q Y N B. Hence the proposition appears. And there is no difference in the manner of demonstrating when the generating semicircle moves on the arc of a concave base, except that the angle c M C, in this case, is the difference of the angles M C N, M K N. But if the base be a right line, then M K N vanishing, and R M, Q N being parallel, the proof becomes easier. Now in all these curves there are quadrable portions, analogous to those portions, which in the primary cycloid Dr. Wallis found to be perfectly quadrable, as easily follows from the premises.

With the centre K, through the point Q describe the circular arc Q Z, and draw Z B cutting off the segment Z L B equal to the segment Q T N; then bisect the semicircle V B in L, and through the point L, from the same centre K, describe the arc P L, cutting the epicycloid in P, the generating circle in T, and the chords Q N, Z B, in Y and X. Now put the arc V Z $= a$, and its sine $= s$, the generating radius $= r$, and the radius of the base = R; and let the arc C E or motion of the centre $= m$. It is plain, that the sector C K E has the same ratio to the space X Y N B, as the square of K E, to the difference of the squares of K L and K B; or as R R + 2 R r + rr to 2 R r + 2rr; that is, as R + r to 2 r, or K E to B V; and therefore the rectangle B E × C E, or rm, is equal to the space X Y N B. But the space V Z B is equal to the rectangle $\frac{1}{2}ar + \frac{1}{2}sr$; and therefore, according to our proposition, it will be as a to 2 m, so is $\frac{1}{2}ar + \frac{1}{2}sr$ to $\frac{mar + msr}{a}$, which is equal to the curvilinear space Q V Z L B N Q : from this subduct the space X Y N B $= rm$, and there will remain the space Q V Z X Y $= \frac{mrs}{a}$. And since the spaces Z X L, Q Y T are equal to each other, the space Q V L T Q is also equal to $\frac{mrs}{a}$. Therefore, whenever a is to m, or the circular motion to the progressive motion of the centre, in a given ratio, then there will also be given the perfect quadrature of the curvilinear spaces Q V L T Q : also the whole space V P L, to the square of the radius B E, will be in the same ratio of the motions m to a, that is, in every primary epicycloid, in the ratio of the radii K E to K B; which is Mr. Caswell's proposition. But the less spaces Q V L T Q will be to one another, as the sines of the arcs V Z; and the triangular spaces Q T P, by the same way of reasoning, will be as the versed sines of the arcs Q T or Z L; and are therefore quadrable. In like manner it may be proved that the spaces P Λ Υ, plu, p λ Υ are always to the square of the radius B E (in all these figures) in the same ratio of m to a: and their portions $p\,q\,t$, as the versed sines of the intercepted arcs $q\,t$. But the remaining segments, as $q\,t\,\Upsilon\,\Lambda$, $q\,t\,\Upsilon\,\lambda$, &c. will be as the sines of the complements of the same arcs $q\,t$.

Now the ratio of the velocities m to a, is compounded of the ratio of the radii K E, B E, and the ratio of the angles C K E, V E Z, uniformly described in the same time; and therefore, that ratio of the angles being given, all the aforesaid epicycloidal spaces will also be squared.

Extract from the Journals of two several Journeys of the English Merchants of the Factory of Aleppo, to Tadmor, or Palmyra. N° 218, p. 129.

July 18, at 5 in the morning, we set out from Aleppo, being 16 English; but with servants and muleteers, in all 40; and in 4 hours and $\frac{1}{2}$, travelling south by east, we arrived at a village called Cafferabite, being at the edge of the desert, where we reposed the rest of the day. July 19, we rose at 1 in the morning, and directed our course S. S. E. over the desert, towards a fountain called Churraick; but our guide losing his way, there being no path, it was near noon before we found it. This well has no signs near it to discover it by. Here we pitched our tents, and refreshed ourselves and horses: the water is of a purgative quality. In our way we found two Arabs with two asses, one carrying water and a little bread, the other they rode on by turns; they had one gun, with which they shot gazels, the bullet being a hard stone broken round, and cased with lead; they had on the palms of their hands, elbows, knees, and feet, some gazel-skin tied, that they might creep the better on the ground, to shoot; one of the asses walking by as a stalking-horse, and the Arab imitating the cry of the gazel till he got within shot: these Arabs are called Selebee. At the well came to us some Arabs that were making ashes of the ordinary sort of weeds called chuddraife, ruggot, and cuttaff; these they cut and dry, and putting them into a pit, set fire to them, and the ashes cake at the bottom. The ashes they carry to Eglib and Tripoli, to make soap of: but the best sort of ashes are made of the weed shinon, which grows about Tadmor, Soukney, Tibe, and Yarecca; it grows like broom in England, and in shape resembles coral.

July 20, we rose at 4 in the morning, and travelling two hours E. S. E. we arrived at Andrene, where we found the ruins of two or three churches, and of a great town lying in a large plain; where having tarried about an hour and a half, and taken some fragments of Greek inscriptions, which afforded no certain sense, but yet were evidently christian, we marched again S. by E. and in about 4 hours time came to a pleasant aqueduct called Sheck-alal; this aqueduct is cut through the main rock, for a great way from the mountains; and where it ends, the Arabs have made a garden, which afforded us melons, cucumbers, purslain, &c. In a grotto hard by, there dwelt an Arab with his family; he had a dozen buffaloes, which they used both for their milk, and to plough the ground, sowing both wheat and barley: hither the Arabs resort, when they have committed any robbery about Aleppo, or Hama, and here they repose, and divide the spoil.

July 21, we rose at 4 in the morning, and riding two hours south, we came to a ruin called Briadeen. From hence going south-east, in 4 hours more we came to a well called Costal, or a spring. Most part of our way through the desert we were troubled with rat-holes in great numbers, like coney-boroughs, which by the sinking in of the earth, very much incommoded our horses and mules. These rats have at the ends of their tails a bush of hair, and the Arabs eat them all, excepting one part. From this well we arose about 4 in the afternoon, and began to ascend small hills, covered with trees, which, for the most part, were the small pistachos which the Arabs pickle with salt; but eaten green, are good to quench thirst. We travelled on for three hours up the hills, where we pitched that night, having no other water but what we carried with us; and at night we had a small shower of rain, a thing unusual in that country at that time of the year. July 22, we rose by 2 in the morning, and travelling E. S. E. we came by 11 to a well called G'hor.

July 23, we rose by 1 in the morning, and travelling mostly east, we came to a large plain, where we saw before us, on a high mountain, a great castle, called by the Arabs Anture. Having travelled two or three hours in this plain, we espied an Arab driving towards us a camel, with his lance, at full speed, so we supposed him sent as a spy: being come up to us, he told us he was of Tadmor, and that his prince, the Emir Melkam, had that day made friendship with Hamet Shideed, another prince, and that together they had 400 men: so he kept us company an hour or two, and inquired of our muleteers if we were not Turks disguised, with intent to seize on Melkam; for we travelled with a bandiero, the impress being a hanjarr, or Turkish dagger, and a half-moon. We told him we were Franks, which he could hardly believe, wondering that we travelled thus in the desert, only out of curiosity. Being come near to Tadmor, he went a little before us, and on a sudden ran full speed towards the ruins. Our guide told us he was gone to acquaint the Arabs who we were, and that we ought to suspect and prepare for the worst; so we dismounted 20 of our servants, each having a long gun, and pistols at his girdle, and placed them abreast before us: we following at a little distance behind, on horse-back, with carbines and pistols. In this order we proceeded, and came to a most stately aqueduct, which runs under ground in a direct passage 5 miles, and is covered with an arch of bastard marble all the way, and a path on both sides the channel for two persons to walk abreast; the channel itself being about an English yard in breadth, and ¾ of a yard in depth. At 20 yards distance all the way are ventiducts for the air to pass, and the holes are surrounded with small mounts of earth to keep the sand and dust from falling down. We marched close by these mounts, which might serve us for defence, expecting every moment that the Arabs would come to assail us, having the disadvantage of sun and wind in our faces: we therefore travelled hard to gain an eminence, where we might post ourselves advantageously, and stop and repose a little, to consider what was best to do. The Arabs finding us come on with this order and resolution, thought it not fit to attack us: so we gained the hill, from whence we might discern these vast and noble ruins, having a plain like a sea for extent to the southward of it. Here having refreshed our men, we fetched a small compass, and descended by the foot of a mountain, on which stands a great castle, but uninhabited. Here two Arabs came to us with lances, one being Chiah to Melkam; and we sent two to meet them. They told us the Emir had understood of our coming, and had sent them to acquaint us that he was our friend, and that all the country was ours. We sent back with them our janizary and a servant to visit the prince in his tents, which were in a garden. In the mean time we dismounted at a watering place among the ruins, but did not unload till our janizary and servant returned with the Emir's Tescarr, assuring us of friendship and protection, a writing which the Arabs were never known to violate before. With them came also one that belonged to the Sheck of the town, for whom we had letters from Useffe Aga, the Emeen of Aleppo. He desired us for greater security to pitch our tents under the town walls, in the ruins of a large palace, the walls still standing very high, the town within being but small, and the houses, excepting two or three, no better than hog-sties. So we pitched in a deep sandy ground, where we found it exceedingly hot. Here we waited till 3 o'clock without eating any thing, expecting the Sheck should have made us presents, according to the usual custom of the Turks to their friends, and have given some answer to the letters we brought him; but on the contrary we found by the gestures of the people, that we had reason to suspect them. Upon this, two of our company, believing that the want of a present to the Emir was the cause thereof, resolved to adventure to give him a visit, and taking the janizary and one servant, they carried him a present of two pieces of red cloth, and four of green, and several other things: being come, he welcomed them into his tent, and placed the one on his right hand and the other on his left. Melkam was a young man, not above 25, well featured, and an excellent horseman; Hamet Shideed, the other prince, was more elderly, being about 40, and was not in the tent, but sat under a palm-tree near it. He treated them with coffee, camels' flesh, and dates, and inquired of their journey, and the cause of their coming: they told him it was only curiosity to see those ruins; he said that formerly Solomon Ibn el Doud built a city in that place, which being destroyed, it was built again by a strange people; and he believed, that we understanding the writing on the pillars, came to seek after treasure, he having but 6 moons before found a pot of corra crusses. After this he went out of the tent, leaving them smoking tobacco, to the janizary and servant, and told them, that never till that day any Franks had been at that place, and that now we know the way through the desert, we might inform the Turks to their ruin and destruction, so that it would be convenient for them to destroy us all: but that we coming as friends, he would only have 4000 dollars as a present, else he would hang them and the two Franks up, and go fight the rest. This message being brought them, they wished they had excused themselves from this embassy, and answered, they could say nothing to that demand, not knowing our minds, but if he would permit them to go and speak with the rest, they would return an answer. Hearing this, he threatened present death, but at length gave leave to our janizary to carry us a letter from them, wherein they showed the danger they were in, and earnestly intreated us to redeem them, the price set on them being 2000 dollars, one half in money, the other half in goods, as swords, clothes, tents, &c. which the Emir promised to estimate at their worth.

In consequence we made him up in money and goods to the value of 1500 dollars, which was all we could; he valuing our things as he pleased; his design being not so much to complete the sum, as to take from us all we had. On account of this usage the ruins could not be examined, and the party returned to Aleppo.

As far as we could conclude from our journeys, and the position of the ways taken by two good compasses, the distance of Tadmor from Aleppo is about 150 English miles, and the course S. S. E. or rather somewhat more southerly, considering the variation of the compass, which is above half a point west in these parts.

In the second journey, we set out from Aleppo for Tadmor, on Michaelmas-day, 1691, being in all 30 men, well armed, having obtained a promise of security from Assyne, then king of the Arabs, and one of his own people for a guide. This day our road pointed S. by E. and in 4 hours we came to a fountain called Caphir-Abiad, leaving Old Aleppo about an hour distant on the right hand: here we made but a short stay, and proceeded to a better fountain at the foot of a very high hill, covered with loose stones, the ruins of a village called Broeder, of which there was not one house remaining; and dining here, we advanced in an hour and a quarter more, in the afternoon, through a fertile open plain, to a place called Emghir, famous for the best wheat that is brought to Aleppo. This we made our first stage; and mounting again in the morning about 5 o'clock, in less than an hour, passed by an uninhabited village, called Urghee, our road pointing as before, through the fruitful pleasant plain: but when we came to ascend the hills, where I reckoned we entered the desert, and were to take our leave of mankind, at least of an inhabited country for some days, we had a troublesome passage over loose great stones, without any appearance of a road.

Our guide had promised to conduct us through pleasant groves and forests; but no such thing appeared, unless we bestow that name on low withered shrubs that grew in the way; only one tree we saw, which was of good use to us, serving as a land-mark. All the country hereabouts is stored with gazels, which are the food of a barbarous sort of people, and necessity has taught them to be no mean artists in their way, for they lie down behind the stones, and shoot them as they pass by. After this we bent our course to the S. E. or something more easterly, and came to the side of a bog, called by the name of Zerga, where we found water enough, but it was neither palatable nor wholesome.

October 1, we departed from Zerga, about two hours before sun rising, and as soon as it was light, had the prospect of a very high hill, which was to be the boundary of our journey that day, called Esree, where we arrived about 11 o'clock, and found excellent water: here we could discern the foundations of a spacious city, and a piece of a thick wall, built of a chalky stone, was standing: this we judged to be the remains of a castle situated on the side of the hill so as both to defend and command the city. On the top of the hill, above the castle, stands the ruins of a fabric, in appearance very ancient, built of very hard stone, yet exceedingly worn by the weather; it is of an oblong figure, pointing near to the N. E. and S. W. with only one door on the east end, which was once adorned with good carvings, of which there are still some remains, but the greatest part is either worn away or purposely defaced; and those marks of ancient beauty that remain are very obscure, and scarcely discernible: the outside of the walls is beautified with pilasters quite round, with their pedestals and capitals regular and handsome: but the roof is all fallen down, and within appears nothing either great or beautiful.

October 2, we departed from Esree, about an hour and a half after midnight, and in 6 hours and a half arrived at two wells, the water 18 fathoms and 2 feet deep, known by the name of Imp malcha Giub; through the greatest part of this stage we had a broad beaten road, and where that was not discernible, we guided ourselves by a ridge of chalky hills, under which the wells lay; the water we found very bad, and of so noisome a scent, that we could not endure it so much as at our noses. In our way hither we were shown the true plant which they burn for soap-ashes, which has no leaves but a soft juicy stalk shooting into several branches, and something resembling our samphire, only more round; the ashes in burning run into cakes, not much unlike the cinders of a forge, only they are heavier, and not so full of pores, nor so hard. In the afternoon, we proceeded on our voyage two hours and a half, to a place called Almyrrha, passing rather between than over the hills. Our journey hitherto had been altogether southerly, and but little varying to the eastward of due south.

October 3, we set out from Almyrrha between 5 and 6 in the morning, making to the point of a high ridge of mountains, through an uneven desert way; we came to the ascent after about 4 hours travel, which we found not difficult. This mountain was covered on both sides with great plenty of turpentine trees, which was an object very pleasing, having seen very few greens in our whole journey; this tree grows very thick and shady, and several of them we saw loaded with a vast abundance of a small round nut, of which oil is made; though some eat them, and account them as great a regalio as pistaches; their outward husk is green, and more oily than that of pistaches, and within a very thin shell is contained a kernel very much resembling them, both in colour and relish. From this hill we had a tedious descent, and coming at the foot into a narrow gut, winding this way and that between the mountains, our passage seemed very long, hot, and tiresome: our want of water however obliged us to proceed, having had a shower of rain the night before, we hoped to have found water standing in the hollows of the rocks; but either the rain had not reached so far, or not in such plenty as to fill those naturally hewed cisterns: our other expectation was from the wells that were in the road; but these our guide advancing before and examining, met us with the unwelcome news, that they were all dried up, and the best advice he could give us was to pitch where we were, and content ourselves with the remains of what we had brought two days in our vessels, till our horses and mules might be sent to a fountain two hours out of our way, and being watered there themselves, bring a fresh supply for us: this way, with some difficulty, we assented to, as more eligible than, weary as we were, to wander so far out of the road, to have the same ground to stage over again the next morning: we resolved therefore to send our guide, with one or two of our servants, in search of the water, and afterwards others with our horses, while in the mean time we pitched our tents. About 2 o'clock a small drizzling rain, which we had about half an hour, encreased to a very plentiful shower, which put us upon producing all the vessels we had to catch it as it fell from the heavens, or ran down the skirts of our tents, our horses at the same time greedily drinking it from the ground; but we might have spared our pains, for in less than half an hour's time, our camp was in a manner afloat, and we were surrounded with water not only sufficient for us, but for an army of 20,000 men; those hollow guts which we passed over without the least appearance of moisture, were, by the cataracts which descended from the mountains, become rivers, yet the next morning, all this great quantity of water was passed away, so that in about two hours' riding we could hardly perceive that there had been any rain at all. This memorable place is known by the name of Al-Wishal.

October 4, from Al-Wishal we proceeded for Tadmor, our way lay southward, but the gut in which we travelled would not permit us to keep a direct course; however, in about an hour's walk, we passed by Antor mountains, through a gut or rent, both sides of which so directly answered one to the other, they would tempt a man to believe they were separated by art, for an entrance into the country; but almost as soon as we were well got within the open space, we were obliged to ascend another hill, and so our road continued over hills and valleys interchangeably all the way. We had hardly proceeded 4 hours, when we came to the brow of a rocky mountain, separated from that whereon the castle of Tadmor stands, only by a narrow valley; in this hill there appeared some quarries of fine stone, which probably might afford materials for the curious buildings in the city, where we soon arrived.

Having tired ourselves with roving from ruin to ruin, and searching among old stones, and not thinking it safe to linger too long in a place, where the mountain Arabs might either fall upon or endeavour to intercept us in our return: therefore on Thursday, Oct. 8, about half an hour after 4 in the morning, we departed from Tadmor, being very well satisfied with what we had seen, and glad to have escaped so dreaded a place, without any trouble or pretences upon us; but with some regret, for having left a great many things behind, which deserved a more particular and curious inspection. Our road lay almost due east, or a little inclining to the north; and on the left-hand, a ridge of hills stretched along for a great space, sometimes about half an hour distant from the road, and sometimes opening wider: these hills were said to abound in rich veins of minerals, and afforded all that vast quantity of marble, the remains whereof we had seen at Tadmor; and it was from a fountain called Abulfarras, at the foot of one of them, they brought out water, which we drank; the inhabitants contenting themselves with that which runs from the hot springs. To the right hand lay a vast barren plain, perfectly bare, and hardly any thing green to be seen therein, except it were a few gourds. We made a very short day's journey, finding a fountain of excellent water in about 5 hours and a half's riding; which, as it was a most welcome refreshment to us in such a thirsty desert, so it was the only good water we met with till we came to the Euphrates, which was not till the third day from this place, called Yarecca.

October 9, from Yarecca we set out early, and travelling N. E. or near that point, in 7 hours' time arrived at Soukney. The road we found much like what we had the day before, lying over a barren plain; only we had hills on both sides, and sometimes at the distance only of half an hour's ride of each other. The village has its name from the hot waters, which are of the same nature with those of Tadmor.

October 10, continuing our voyage still to the N. E. or something more easterly, we found it another pleasant and easy stage to another called Tiebe, so called from the goodness of the waters, which however we found not extraordinary; they had the taste, and were doubtless tinctured with the same mineral, with those of Soukney and Tadmor, though not so strongly. The village is pleasantly situated, and makes a good appearance as one approaches; the prospects being improved by a well-built steeple, to which now their mosque adjoins: but I am apt to believe it the remains of a Christian church, being built with more art and beauty than is found in Turkish fabrics. From hence we departed again in the afternoon, and proceeded about two hours and a half farther to shorten our next day's stage, having travelled this day, in all; about 7 or 8 hours: the place we pitched at was a fountain, and known by the name of Alcome; but the water was not fit to be drunk, being of the same nature with that of Soukney, and almost as warm.

October 11, from Alcome we set out about an hour and a half after midnight, by the help of the stars directing our course more northerly. As soon as it was light enough to look about us, we found ourselves in a wild open desert, the ground in some places covered with a sort of heath, and in others quite bare. Nor had we travelled long after the sun was up, before, by the help of a rising ground, we discovered Arsoffa, the place whither we were tending, but the tiresome road made it ten o'clock before we reached it: and finding no water any where near, we were necessitated to proceed forward to the river Euphrates, which we found 4 hours distant from hence. Arsoffa, or (as the Arabs call it) Arsoffa Emir, seems to be the remains of a monastery, being one continued pile of building of an oblong figure, stretching longwise east and west, and inclosing a very capacious area: at a distance it makes a glittering show, being built of Gypsine stone, or rock isinglass, resembling alabaster, but not so hard; several quarries of which we passed by in our way to it. When the sun shines upon it, it reflects the beams so strongly, that they dazzle the eyes of the spectators. Art or accuracy in the workmanship we found none: and but very little carved work, and that mean enough; and the cement little better than dirt. Round about were the little apartments or chambers for the monks, built archwise, only one story above ground: but underneath are several cells or vaults, larger than the chambers, which perhaps might serve for their schools, or working-houses. In the midst of the area stand the ruins of several buildings, some of which seem to have been cisterns for water, and perhaps bathing places; but one heap was most remarkable, which probably was the abbot's or bishop's house; and another, which was the ruins of their church. This was formerly no unhandsome structure, being built in the form of our churches, and distinguished into three aisles, of which the middle one is supported by 18 turned marble pillars, with capitals upon them, not of marble but of a sort of clay, and cast into the shape they are in, but of a colour exactly resembling the pillar itself. That which persuades to believe them cast, is a Greek inscription to be seen on all of them; the letters whereof are not made by incision in the stone, but seem to be stamped, standing out higher than the distance between them: and on one of them by mistake, they are so placed as to be read after the oriental manner, from the right hand to the left.

From hence our guide led us to the river, by the assistance of two little hills, which are known by the name of Aff Dien, our way lying north, and a little bending to the east. We pitched on a reach of the river, where it was not very broad, not being above half a musket shot over.

October 12, about sun-rise, we proceeded on our journey, keeping along the banks of the river, which, for the most part, led us west and north-west; and here we had pleasant travelling, having the river on the right hand, and hills of marble or other fine stone on the left: and delightful groves of tamarisk, mulberry, and other trees to pass through. Here every thing about us looked fresh and verdant, and we frequently met men and women passing. We had also a pleasing prospect of the oposite shore, and could see a great way into Mesopotamia, but could meet with no convenience to cross the river, which we wished to have done.

October 13, this day afforded similar scenes to the former, travelling as near the river as the road would permit; and having made a stage of about six hours, we rested under the shade of the tamarisk trees by the river side. In our way we observed the ruins of a city called Baulus, where the Turks had formerly a sangiac; but now there is neither inhabitant, nor any house standing, but only the ruins of houses, and an octagonal tower of a considerable height, viz. 107 steps, and beautified on the outside with flourishes and an Arabic inscription round about. It is a handsome structure, and probably the work of the Mamalukes, since whose time little has been done to adorn, but a great deal to destroy and waste this country. After dinner we mounted sooner than ordinary, hoping to reach the tents of Assyne in good time, yet it was near sun-set before we reached Fay, a fountain by which he lay. We had travelled still on the same point N. W. with the prospect of the river the greater part of the way. The king's tents spread over a large plain, and took up so vast a space, that from a rising ground we could not see the utmost extent of them. The king's tent was nearly in the middle; the rest were pitched about it, not in a circular manner, but stretching out in length as the plain opened, or for the better conveniency of a current of water, which from the fountain ran through the middle of the tents. It was no otherwise distinguishable from the rest, but by its size, being all made of a sort of hair-cloth. It cannot well be doubted but they are descended from the old Arabs Scenitæ, living just in the same manner, without any settled abode, but remove from fountain to fountain, as they find water and grass for their sheep and camels. They affect to derive themselves from Ishmael, the son of Abraham. As soon as alighted, we were attended by the officers of the Emir, and conducted to a very noble tent, built after the Turkish mode, and pitched next to his own. Before supper the king made us a visit in person, bidding us welcome to Fay, and asking what we had seen in our travels that pleased us? how we liked Tadmor? and whether we had found a treasure there? For this people hold the notion, that the Franks go to see old ruins, only because they there meet with inscriptions which direct them to some hidden treasures. And therefore it is no unusual thing with them, when they find a stone with an inscription on one side, to turn that down to the ground, that it may not be seen or read by any. When supper was brought in, there was victuals enough for three times our number; a large dish of pilaw in the middle, and 12 or 15 dishes of several sorts of meat about it, all dressed after their manner, but exceedingly good. After having ate and drank what we pleased, our servants took our places; it being the custom of the Arabs and Turks, from the highest to the lowest, to eat at the same table, the better sort sitting down first, and so in order till all have done.

Next morning the king went to a great entertainment, made for him by one of his grandees, and expected we should follow him: two young camels were killed to furnish out this sumptuous feast; which is the highest piece of magnificence and greatness to which these people, whose greatest riches consist in camels, can arrive. The tent was very large, and to be still more capacious, it was left open towards the west. The king was seated at the north end, about the middle of the tent, on a place raised with cushions and quilts and carpets before him; neither did he sit cross-legged, as all the rest of the company were obliged to do, but in a leaning posture. They seemed to observe an exact order in their places; and when any person of note entered, those that were near his place, rose up and stood till he had seated himself. But far the greatest part could not come within the compass of the ring, but stood behind the backs of the rest, leaving a spacious area vacant in the middle. When we entered, they made room for us on the king's left hand, which here is esteemed the more honourable place. Before mid-day a carpet being spread in the middle of the tent, dinner was brought in, being served up in large wooden bowls, carried by two men, of which there were about 50 or 60 in number, perhaps more; with many small ones, carried by one man each, placed here and there among the larger, for a border or garnish round the table. In the middle of all was one of a larger size than all the rest, in which were the camels' bones, and a thin broth in which they were boiled: the other greater ones seemed all filled with one and the same sort of food, a kind of plum broth made of rice, and the fleshy part of the camel, with currants and spices. The smaller dishes were, for the most part, charged with rice, dressed after several modes, some of them having leben, a thick sour milk, poured upon them, which is in great esteem in these hot countries, being very useful to quench thirst. Knives, forks, spoons, trenchers, &c. are silly impertinent things in the esteem of the Arabs. When the table was thus plentifully furnished, the king arising from his seat, went and set down to that dish that was directly before him; as did also the rest, as many as it would contain, which could not be much short of a hundred: and thus, without further ceremony, they fell to, thrusting their hands into the dishes, and eating by handfuls. And because those dishes in the middle were too remote to be reached, there was an officer on purpose, who stepping in among them, and standing in the spaces designedly left for that purpose, with a long ladle in both his hands, helped any one according to their desire. When the king had eaten what he thought fit, he rose up and washed, and retired back to his former seat: and we also did the like; others being ready to fill our places.

October 15, in the morning, we proceeded on our journey homewards, and finding nothing remarkable in our road, in about three hours and a half arrived at Seray; and hence, after a short repast, we continued our journey to Sherby fountain, which took us up about the same time: from which place we had but 7 or 8 hours travel to Aleppo, where we arrived the next day.

Some Account of the Ancient State of the City of Palmyra, with Remarks on the Inscriptions found there. By E. Halley. N° 218, p. 160.

The city of Tadmor, whose remains in ruins so evidently show its once happy condition, seems very plainly to be the same city which Solomon, the great king of Israel, is said to have founded under that name in the desert, both in 1 Kings ix. 18, and 2 Chron. viii. 16, in the translation of which, the vulgar Latin version, said to be that of St. Jerome, has it, Condidit Palmyram in Deserto. And Josephus tells us, that he built a city in the desert, and called it Thadamora; and the Syrians at this day, says he, call it by the same name: but the Greeks call it Palmyra. The name is therefore Greek, and consequently has no relation to the Latin Palma; and seems rather derived from Παλμυὸς or Πάλμυς, which Hesychius interprets βασιλεὺς πατὴρ: or perhaps it is from Παλμύτης, which, according to the same author, was an Egyptian God. Nor is the word תדמר but תמר, which in Hebrew signifies a palm-tree.

History is silent as to the fate and circumstances of this city, during the great revolutions in the several empires of the east; but it may well be supposed, that so advanced a garrison as this was, being above 300 miles from Jerusalem, continued not long in the possession of the Jews, who immediately after Solomon fell into civil dissension, and divided their force: so that it is not to be doubted, but that it submitted to the Babylonian and Persian monarchies, and afterwards to the Macedonians under Alexander and the Seleucidæ. But when the Romans got footing in these parts, and the Parthians seemed to put a stop to their further conquests in the east, then was this city of Palmyra, by reason of its situation, being a frontier town, and in the midst of a vast sandy desert, where armies could not well subsist to reduce it by force, courted and caressed by the contending princes, and permitted to continue a free state, a mart or staple for trade, for the convenience of both empires, as fully appears from the words of Appian and Pliny.

Appian, lib. 5, de Bellis Civil. tells us, that M. Antony, after his victory at Philippi, about 40 years before Christ, sent his horse to plunder the city of Palmyra, pretending only that they were not sufficiently in the Roman interest, ὅτι Ρωμαίων καὶ Παρθυαίων ὄντες ἔφοροι ἐς ἑκατέρας ἐπιδεξίως εἶχον, and that, being merchants, they conveyed the Indian and Arabian commodities by the way of Persia into the Roman territories; though the true reason was their riches: but the Palmyrenes being informed of the design, took care to prevent them, and so escaped plunder: and this attempt of Antony's occasioned a rupture between the two empires. The words of Pliny (lib. 5, Nat. Hist.) above 100 years after, do likewise testify that this city then continued in the same enjoyment of its liberties. They being very much to the purpose, I thought fit to copy them: Palmyra urbs nobilis situ, divitiis soli atque aquis amœnis, vasto undique ambitu arenis includit agros, ac velut terris exempta à rerum natura; privata sorte inter duo imperia summa Romanorum Parthorumque, et prima in discordiâ semper utrinque cura. Whence it appears, that it was a commonwealth in the time of Vespasian; and its situation is truly described, as it were an island of fertile land, surrounded with a sea of barren sands. Such spots Strabo tells us were frequent in Lybia, and by the Egyptians were called Abases; whence possibly the name of the Abassyne nation is derived.

With these advantages of freedom, neutrality, and trade, for near two centuries, it is not strange that it acquired that state and wealth answerable to the magnificence of these noble structures. But when the Romans, under Trajan, had taken Babylon, and Ctesiphon the then seat of the Parthian empire, the Palmyrenes were at length determined to declare for them; which they did by submitting themselves to the emperor Adrian, about the year of Christ 130, when he made his progress through Syria into Egypt. And that magnificent emperor, being highly delighted with the natural strength and situation of the place, was pleased to adorn and rebuild it: when probably he bestowed on it the privileges of a colony juris Italici, which it enjoyed, as Ulpian assures us. And the inhabitants, in gratitude to the emperor, wished to call themselves Hadrianopolitæ, ἐπικτισθείσης τῆς πόλεως ὑπὸ τȣ̃ Αὐτοκράτορος, says Stephanus. Nor is it unlikely that many of those marble pillars were the gift of that emperor, and particularly those of the long porticus; for none of the inscriptions are prior to that date. And it was usual for the Cæsars to present cities, that had obliged them, with marble pillars to adorn their public buildings. These at this place were not far to fetch, the neighbouring mountains affording marble quarries: but the magnitude of the porphyry columns is indeed very remarkable, considering how far those vast stones must have been brought by land carriage to this place; it being not known that any other quarries yield it, except those of Egypt, which lie about midway between Cairo and Siena, between the Nile and the Red Sea. The stone is very valuable for its colour and hardness, and because it rises in blocks of any magnitude required; Quantislibet molibus cædendis sufficiunt lapidicinæ, (Plin. lib. 36.) It is therefore a great mistake of those who suppose it factitious.

From the time of Adrian to that of Aurelian, for about 140 years, this city continued to flourish and increase in wealth and power, to such degree, that when the emperor Valerian was taken prisoner by Sapores, king of Persia, Odænathus, one of the lords of this town, was able, whilst Gallienus neglected his duty both to his father and country, to bring a powerful army into the field, and to recover Mesopotamia from the Persians, and to penetrate as far as their capital city Ctesiphon. Thus rendering so considerable a service to the Roman state, that Gallienus thought himself obliged to give him a share in the empire. But by a strange reverse of fortune, this honour and respect to Odænathus occasioned the sudden ruin and subversion of the city. For he and his son Herodes being murdered by Mæonius their kinsman, and dying with the title of Augustus, his wife Zenobia, in right of her son Waballathus, then a minor, pretended to take upon her the government of the East, which she administered to admiration: and soon after, Gallienus being murdered, she seized the government of Egypt, and held it during the short reign of the emperor Claudius Gothicus. But Aurelian coming to the imperial dignity, he would not suffer the title of Augustus in this family, though he allowed them to hold under him as Vice Cæsaris; as plainly appears by the Latin coins of Aurelian on the one side, and Waballathus on the other, with these letters V. C. R. IM. OR. which P. Harduin has very judiciously interpreted Vice Cæsaris Rector Imperii Orientis, but without the title of Cæsar or Augustus, and with a laurel instead of a diadem.

But nothing less than a participation of the empire contenting Zenobia, and Aurelian persisting not to have it dismembered, he marched against her, and having in two battles routed her forces, he shut her up and besieged her in Palmyra: and the besieged finding that the great resistance they made, availed not against that resolute emperor, they surrendered the town; and Zenobia, flying with her son, was pursued and taken: with which Aurelian being satisfied, spared the city; and leaving a small garrison, he marched for Rome with this captive lady: but the inhabitants, believing he would not return, set up again for themselves, and, according to Vopiscus, they slew the garrison he had left in the place. Which Aurelian understanding, though by this time he was got into Europe, with his usual fierceness, speedily returned; and collecting a sufficient army by the way, he again took the city without any great opposition, and put it to the sword, with an uncommon cruelty, and gave it up to the pillage of his soldiers. And it is observable, that none of the Greek inscriptions are after the date of this calamity, which befel the city in or about the year of Christ 272, after it had been 9 or 10 years the seat of the empire of the East.

In this appears the great utility of coins to illustrate historical facts; for by them alone it is made out, that there was such a prince as Waballathus, by Vopiscus called Balbatus; and from the same coins it appears, that Odænathus had the title of Augustus 4 years, and Waballathus 6 at least: and that the first year of Aurelian was the 4th of Waballathus. And, by the testimony of Pollio, Odænathus was declared emperor of the East, Gallieno et Saturnino Coss. which was Anno Christi 263, and died before Gallienus, but in the same year, viz. Anno 267, which, by the coins, was the first of Waballathus. He therefore immediately succeeded Odænathus, and was doubtless his sldest son by Zenobia, and not his grandson, the son of Herodes, as some learned men have supposed; for if Zenobia could not bear that Herodes, son of Odænathus by a former wife, should succeed his father, in prejudice of her children, and for that reason was consenting to his murder, as Pollio intimates in Herodes and Mæonius, much less would she suffer the title of Augustus in the son of Herodes, especially when her own sons were probably older than such grandson. So that it is most likely that Herennianus and Timolaus, whom Pollio reckons among his 30 tyrants, might be the younger sons of Zenobia, on whom also, out of motherly affection, she might bestow the same titles of honour.

But it must be observed, that in the Greek coins that prince's name is usually written ΑΥΤ. ЄΡΜΙΑϹ ΟΥΑΒΑΛΛΑΘΟϹ. ΑΘΗΝΟΥ, as Tristan says he found it on several medals, but Patin has the last word only ΑΘΗ. But I am inclined to believe that his true name was Æranes Waballathus, though perhaps the remoter cities of Asia and Ionia might, by mistake, write it Hermias. And it is probable that ΑΘΗΝ might be for the first letters of ΟΔΗΝΑΘΟϹ, which in Syriac began with an aleph; and the Δ they used instead of Θ, as we see the month Zanthicus, written Ξανδικὸς in many of the inscriptions, which doubtless was pronounced like D blæsum, or the Saxon Ð.

Though this city was then so roughly treated by Aurelian, yet it is certain that he did not burn it or destroy the buildings; and though Zosimus, on this occasion, uses the words τὴν πόλιν κατασκάψας, yet that seems only to relate to his demolishing the walls and defences of the place; and that emperor's own letter, extant in Vopiscus, sufficiently shows that he spared the city itself, and that he took care to reinstate the beautiful temple of the sun that was there, which had been plundered by his soldiers. However the damage then sustained was never retrieved by the inhabitants, and I do not find that ever this city made any figure in history afterwards. About the year of Christ 400, it was the head-quarters of the legio prima Illyricorum; and though Stephanus gives it no better title than φρούριον, yet it appears to have been an archbishop's see, under the metropolitan of Damascus. To say in what age, or from what hand it received its final overthrow, which reduced it to the miserable condition it now appears in, there is no light in history; but probably it perished long since, in the obscure ages of the world, during the wars of the Saracens; and being burnt and desolated it was never rebuilt, which occasions the ruins to lie so entire, in a manner as they were left, neither being used to other structures on the place, nor worth carrying away, because of its great distance from any other city.

As to the geographical site of Palmyra, Ptolemy places it in the latitude of Tripoli on the coast of Syria, and 4 degrees more easterly, and he makes it the capital of 16 cities in Syria Palmyrena, whereof Alalis, Danaba, and Evaria, were afterwards bishops' sees. Pliny places it 203 miles from the nearest coast of Syria, and 337 from Seleucia on the Tygris near Bagdat. Josephus places it one day's journey from the Euphrates, and six from Babylon, which must be understood of a horseman's journey of about 60 miles a day, it being more than so much from the Euphrates. Ptolemy mentions also a river running by Palmyra, which did not appear to our travellers, unless that gut or channel in which they were overflowed by the rain waters, was its bed; which may possibly run with a constant stream in the winter, or times of much rain; but this, as the rivers of Aleppo and Damascus at this day, is made by Ptolemy to have no exit; but to go off in vapour, and to be imbibed by the thirsty earth of these deserts.

The æra, or account of years, observed by the Palmyrenes in their inscriptions, is evidently that of Seleucus, called afterwards Dhilcarnain or Bicornis by the Arabs, and by them kept in use till above 900 years after Christ, and not that of the death of Alexander. This may be demonstrated from an inscription, where Alexander Severus is stiled ΘΕΟϹ; that is, after the death and consecration of that emperor, or after the year of our Lord 234; and from the name of Julius, who, when this inscription was set up, was Præfectus Prætorio, and could be no other than Julius Philippus Arabs, who might be esteemed by the Palmyrenes as their countryman, it follows, that it was in the last year of Gordian, Anno Christi 242 or 243; and that emperor being soon after murdered by the treachery of this Philip, who succeeded him, and his treason coming afterwards to light, it is not strange that his name was purposely effaced in this inscription. Its date, anno 554, shows the beginning of this account 311 or 312 years before Christ, coincident with the æra of Seleucus, which was likewise observed by several other cities in the East.

It is taken for granted, that old Aleppo was anciently the city of Berrhœa, and I think I may without scruple conclude, that Andrene is the ruins of the city of Androna; and Esree that of Seriane, both mentioned in the itinerary of Antoninus, in the journey à Dolicâ Seriane. But this whole country is laid about half a degree more southerly than it ought by Ptolemy, who places Berrhœa in lat. 36°. For the meridian altitude of the tropical sun at Aleppo is found there but 77°; whence the lat. 36° 30′, as it was observed, anno 1680, by three several quadrants, in the presence of a curious gentleman, to whom I am obliged for this communication.

By the same observation a much greater error is detected in the latitude of Aleppo, in the Rudolphine tables of Kepler, who supposes Aleppo to have been the ancient Antiochia ad Taurum, and accordingly places it in lat. 37° 20′, in which he is followed by Bulliald and others; and several maps have copied the mistake. But a much greater use of it is, that thereby we are assured, that the city of Aracta, where Albatâni made the observations we have published in N° 204, was doubtless the same which is now called Racca on the Euphrates; of which town an account may be seen in Rauwolf's Voyages, and which was not many miles below the place where our travellers first touched on the river: and if Arecca, in the language of this country, relates to victory, it was doubtless anciently the city Nicephorion, built by Alexander the Great; with which the situation exactly agrees. Its latitude was observed by Albatâni with great accurateness, about 800 years since; and therefore I recommend it to all that are curious in such matters, to endeavour to get some good observation made at this place, to determine the height of the pole there, to decide the controversy, whether there has really been any change in the axis of the earth, in so long an interval; which some great authors of late have been willing to suppose. And if any curious traveller, or merchant residing there, would please to observe, with due care, the phases of the moon's eclipses at Bagdat, Aleppo, and Alexandria, thereby to determine their longitudes, they could not do the science of astronomy a greater service: for in and near these places were made all the observations by which the mean motions of the sun and moon are limited: and I could then pronounce in what proportion the moon's motion does accelerate; which that it does, I think I can demonstrate.

On the Cure of a Horse that was staked into his Stomach; communicated by Dr. Wallis, D.D. R. S. Soc. N° 219, p. 178.

A horse, leaping over a hedge, staked himself very dangerously. The farrier searched the wound with his finger, as far as he could reach, and brought out with it some grass, newly chewed; by which he found that the stake had pierced the coats of the ventricle, into the cavity of the maw: and was about giving it over as desperate, thinking it was useless to proceed. But afterwards he resolved to try what could be done. Throwing the horse on his back, he first enlarged the wound in the outer skin and rim of the belly, by cutting it wider, that he might come at the maw; where he found the wound to be at least 3 inches long; he then removed the maw outward, and while preparing his needle and thread, he ordered his servant to cleanse the maw from what was in it, as being less likely to gangrene when empty. The servant thrusting in three fingers and his thumb, he pulled out the chewed grass, and what he found there. The maw being thus cleansed, the farrier sewed up the wound in it, then thrust the maw back into the body ; and sewed up the wound in the rim of the belly. The wound in the outward skin he did not sow up, but only tacked it closely together about the middle, leaving room on both sides for healing applications. The horse after this continued for some time much indisposed ; but in a month or six weeks, with careful attendance, the wounds were closed and perfectly cured : and the horse worked as before ; and has ever since continued sound and well. An account is then added of two cases in the human subject, when a knife was swallowed down into the stomach : in the one case, the side was opened, an incision made into the stomach, the knife taken out, and the wounds sewed up again. In the other, after 20 months, the knife made its way through, a little below the pit of the stomach; after which, the patient did well.

Account of La vana Speculatione disingannata dal Senso : Lettera Risponsiva circa i Corpi Marini, che Petrificati si trovano in varii Luoghi Terrestri. Di Agostino Scilla, Pittore Academico della Fucina, in Napoli, 1670. 4to. N° 219, p. 181.

This author endeavours to prove, which is now no longer doubted, that the shells, or stones in likeness of shells, which are found in many places on the surface, and in hills and quarries of the earth, were once real coverings of inclosed fishes, or have been formed in those shells, which were instead of moulds to the liquid matter that got in after the fishes were consumed. Signior Scilla has brought more arguments in proof of this than had before appeared. His way of writing shows little art, and less learning, which he owns himself a stranger to, being by profession a painter at Messina. It is considered useless to reprint any more of the account of this book, except the following explanation of the figures which are engraved in Plate II. of this volume, and some observations on them by a Fellow of the Royal Society.

Fig. 1, the head of the pesce vacca, drawn from the life, with the teeth in both jaws. It seems to be of the long cartilaginous kind, a-kin to the dog or hound fishes.—Fig. 2, 3, 4, 5, 6, the teeth of the same out of their sockets. These are found petrified in beds up and down the island of Malta, with those of dog-fishes, sharks, pesce aquila, &c.

Fig. 7, a jaw of a fish called dentex, with the round grinders : the like dentes molares are observed and drawn by the author in the jaws of other fishes, as the aurata and sargus, with several bufonitæ lying by them. These convex osseous tubercles are found commonly petrified in Malta, and are called there serpents' eyes. They are of the same kind with our English bufonites or toadstones, which Dr. Merret first declared to be the round jaw teeth of the lupus marinus, or wolf fish of Schonfeld. See Mr. Ray's Travels, p. 321. These bufonitæ are properly called by Mr. Lhwyd, Ichthyodontes Scutellati. Philosoph. Transact. N° 200.

Fig. 8, the petrified teeth of dog-fishes and sharks, called glossopetræ, lying in several postures and situations in their beds of earth. These, with all the foregoing, may be reduced to Mr. Lhwyd's Classis of Ichthyodontes.—Fig. 9, a sea urchin, with long prickles, hystrix spinis longissimis imperati. The fishermen of Sicily often brought it alive to the author. The spines break off, and are easily disjointed. Of the echinites the author has drawn above 18 species.—Fig. 10, a sea urchin found petrified (echinites) in white stone, on the rocks and hills near Messina, with some stony spines or prickles lying by it: the teats or pivots, on which they have been inserted, lie naked and broken off. See Mr. Ray's three Physico Theological Discourses, Tab. 3, p. 162, 163.

Fig. 11, a mass of petrified sea urchins, one entire, another bruised, with the stony prickles broken off, and lying by in the same bed; there may be as many species of this sort of figured stones, or petrified spines, as there are of the echini marini themselves; some short, thick, roundish, and cannulated (as the lapis judaicus), others long, slender, tuberculated, and ragged, as St. Paul's batoons in Malta, all belonging to the several Echinitæ and Ombriæ. See the Riccio Marino in Pietra, Imperati Istor. Natural. Venet. edit. 1672, p. 586, and his Chapter delle Pietre Giudaiche, p. 575, 576. These may come within the class of the Spondylites.

Fig. 12, 13, pertrified vertebræ, with their articulations and insertions, and the ribs; see fig. 13. These may be reduced to Mr. Lhwyd's tribe of Ichthyospondyli; for stones resembling vertebræ, and other bones of fishes. See Mr. Ray's Travels, in the Preface, and p. 116, 294. The Entrochi and Asteriæ come under this division. Fig. 14, petrified dentalia and cochlites, found lying in the same bed, in the rocky mountains of Calabria.

N. B. Dr. Robert Hook published some observations on this subject in his Micrographia, p. 109, 110, 111, 112; and afterwards discoursed of it at large in several of his public lectures in Gresham College, before Steno, Scilla, and Boccone, communicated their curious observations to the world. See Philosoph. Transact. N° 32, 72. See also M. Denis's Memoirs and Conferences, printed with the Journaux des Sçavans, An. 1672, Mem. I. Also the Italian Giornale de Literati Ephem. 5 of the same year. See Dr. Hook's Lecture on Springs, p. 48, 49, 50. But above all, justice is to be done to that noble natural philosopher, Fabius Columna, who has two admirable discourses on the several parts of aquatic and terrestrial animals, as also of plants, which he himself observed to be dug in the mountains of Andria, Apulia, and other places; and thence he remarks how they were left there by the general flood; why in some places they remain uncorrupted, in others wasted and mouldered, in others only by their impressed figures, and exact forms. That they all answer in every delineation, and every part the very bodies they resemble, and are truly the very same species. See Columna in his Observ. Aquat. et Terrestr. Chap. 21, p. 43 to 55. Also de Purpura, Dissertat. de Glossopetris, p. 31 to 39; 4to. Romæ impress. 1616.

An easy Demonstration of the Analogy of the Logarithmic Tangents, to the Meridian Line, or Sum of the Secants: with various Methods for computing the same to the utmost Exactness. By E. Halley. N° 219, p. 202.

It is now near 100 years since our worthy countryman, Mr. Edward Wright, published his Correction of Errors in Navigation, a book well deserving the perusal of all such as design to use the sea. Therein he considers the course of a ship on the globe steering obliquely to the meridian; and having shown, that the departure from the meridian, is in all cases less then the difference of longitude, in the ratio of radius to the secant of the latitude, he concludes, that the sum of the secants of each point in the quadrant, being added successively, would exhibit a line divided into spaces, such as the intervals of the parallels of latitude ought to be in a true sea chart, where the meridians are made parallel lines, and the rhumbs or oblique courses are represented by right lines. This is commonly known by the name of the meridian line; which, though it generally be called Mercator's, was yet undoubtedly Mr. Wright's invention, as he has made it appear in his preface. And the table of it is to be met with in most books treating of navigation, computed with sufficient exactness for the purpose.

It was first discovered by chance, and as far as I can learn, first published by Mr. Henry Bond, as an addition to Norwood's Epitome of Navigation, about 50 years since, that the meridian line was analogous to a scale of logarithmic tangents of half the complements of the latitude. The difficulty to prove the truth of this proposition seemed such to Mr. Mercator, the author of Logarithmotechnia, that he proposed to wager a good sum of money, against whoever would fairly undertake it, that he should not demonstrate, either that it was true or false: and about that time Mr. John Collins, holding a correspondence with all the eminent mathematicians of the age, excited them to this inquiry.

The first that demonstrated the said analogy was Mr. James Gregory, in his Exercitationes Geometricæ, published anno 1668, which he did, not without a long train of consequences and complication of proportions, by which the evidence of the demonstration is in a great measure lost, and the reader wearied before he attain it. Nor with less labour and apparatus has Dr. Barrow, in his Geometrical Lectures, lect. xi, app. i, proved, that the sum of all the secants of any arch is analogous to the logarithm of the ratio of radius + sine to radius — sine, or, which is all one, that the meridional parts answering to any degree of latitude, are as the logarithms of the rationes of the versed sines of the distances from both the poles. Since which, Dr. Wallis, on occasion of a paralogism committed by one Mr. Norris in this matter, has more fully and clearly handled this argument, as may be seen in N° 176 of these Transactions. But neither Dr. Wallis nor Dr. Barrow, in their said treatises, have any where touched on the aforesaid relation of the meridian line to the logarithmic tangent; nor has any one, that I know of, yet discovered the rule for computing, independently, the interval of the meridional parts answering to any two given latitudes.

Wherefore, having attained, as I conceive, a very easy and natural demonstration of the said analogy, and having found out the rule for exhibiting the difference of meridional parts, between any two parallels of latitude, without finding both the numbers of which they are the difference; I hope I may be entitled to a share in the improvements of this useful part of geometry. Desiring no other favour of some mathematical pretenders, than that they think fit to be so just, as neither to attribute my desire to please the honourable the Royal Society in these exercises to any kind of vanity or love of applause in me, (who too well know how very few these things oblige, and how small reward they procure,) nor yet to complain coram non judice, that I arrogate to myself the inventions of others, and on that pretext to depreciate what I do, unless at the same time they can produce the author I wrong, to prove their assertions. Such disingenuity, as I have always most carefully avoided, so I wish I had not too much experience of it in the very same persons, who make it their business to detract from that little share of reputation I have in these things. But to return to the matter in hand, let us demonstrate the following proposition.

The meridian line is a scale of logarithmic tangents of the half complements of the latitudes.—For this demonstration, it is requisite to premise these four lemmata.

Lemma I.—In the stereographic projection of the sphere on the plane of the equinoctial, the distances from the centre, which in this case is the pole, are laid down by the tangents of half those distances, that is, of half the complements of the latitudes. This is evident from Eucl. 3, 20.

Lemma II.—In the stereographic projection, the angles, under which the circles intersect each other, are in all cases equal to the spherical angles they represent; which is perhaps as valuable a property of this projection as that of all the circles of the sphere on it appearing circles; but this, not being commonly known, must not be assumed without a demonstration.

Let EPBL be any great circle of the sphere, (fig. 11, pl. 1;) E the eye placed in its circumference, C its centre, P any point in it, and let FCO be supposed a plane erected at right angles to the circle EPBL, on which FCO we design the sphere to be projected. Draw EP crossing the plane FCO in *p*, and *p* shall be the point P projected. To the point P draw the tangent APG, and on any point of it, as A, erect a perpendicular AD, at right angles to the plane EPBL, and draw the lines PD, AC, DC; then the angle APD will be equal to the spherical angle contained between the planes APC, DPC. Draw also AE, DE, intersecting the plane FCO in the points *a* and *d*; and join *ad*, *pd*: I say the triangle *adp* is similar to the triangle ADP, and the angle *apd* equal to the angle APD. Draw PL, AK parallel to FO; then by reason of the parallels, *ap* will be to *ad* as AK to AD; but, by Eucl. 3, 32, in the triangle AKP, the angle AKP = LPE is also equal to APK = EPG, therefore the sides AK, AP are equal, and it will be, as *ap* to *ad* so AP to AD. Whence the angles DAP, *dap* being right, the angle APD will be equal to the angle *apd*, that is, the spherical angle is equal to that on the projection, and that in all cases. Which was to be proved.

This lemma I lately received from Mr. Ab. de Moivre, though I since understand from Dr. Hook that he long ago produced the same thing before the society. However the demonstration and the rest of the discourse is my own.

Lemma III.—On the globe, the rhumb lines make equal angles with every meridian, and by the foregoing lemma, they must likewise make equal angles with the meridians in the stereographic projection on the plane of the equator: they are therefore, in that projection, proportional spirals about the pole point.

Lemma IV.—In the proportional spiral, it is a known property that the angles BPC, or the arches BD, are exponents of the rationes of BP to PC, (fig. 12, pl. 1,) for if the arch BD be divided into innumerable equal parts, right lines drawn from them to the centre P, will divide the curve B*ccc* into an infinity of proportionals; and all the lines P*c* will be an infinity of proportionals between PB and PC, whose number is equal to all the points *d*, *d*, in the arch BD; whence, and by what I have delivered in N° 216, it follows, that as BD to B*d*, or as the angle BPC to the angle BP*c*, so is the logarithm of the ratio of PB to PC, to the logarithm of the ratio of PB to P*c*.

From these lemmata our proposition is very clearly demonstrated; for, by the first, PB, PC, P*c* are the tangents of half the complements of the latitudes in the stereographic projection; and, by the last of them, the differences of longitude, or angles at the pole between them, are logarithms of the rationes of those tangents to each other. But the nautical meridian line is no other than a table of the longitudes, answering to each minute of latitude, on the rhumb line making an angle of 45 degrees with the meridian. Therefore the meridian line is no other than a scale of logarithmic tangents of the half complements of the latitudes. Quod erat demonstrandum.

Corol. 1.—Because that, in every point of any rhumb line, the difference of latitude is to the departure, as the radius to the tangent of the angle that rhumb makes with the meridian: and those equal departures are every where to the differences of longitude, as the radius to the secant of the latitude; it follows, that the differences of longitude are, on any rhumb, logarithms of the same tangents, but of a different species, being proportioned to one another as are the tangents of the angles made with the meridian.

Corol. 2.—Hence any scale of logarithm tangents, (as those of the common tables made after Briggs's form, or those made to Napier's, or any other form whatever,) is a table of the differences of longitude, to the several latitudes, upon some determinate rhumb or other; and therefore, as the tangent of the angle of such rhumb to the tangent of any other rhumb: so the difference of the logarithms, of any two tangents, to the difference of longitude, on the proposed rhumb, intercepted between the two latitudes, of whose half complements the logarithm tangents were taken.

And since we have a very complete table of logarithm tangents of Briggs's form, published by Vlacq, Anno 1633, in his Canon Magnus Triangulorum Logarithmicus, computed to 10 decimal places of the logarithm, and to every 10 seconds of the quadrant which seems to be more than sufficient for the nicest calculator, I thought fit to inquire the oblique angle, with which that rhumb line crosses the meridian, on which the said canon of Vlacq precisely answers to the differences of longitude, putting unity for one minute of it, as in the common meridian line. Now the momentary augment or fluxion of the tangent line, at 45 degrees, is exactly double to the fluxion of the arch of the circle, as may easily be proved; and the tangent of 45 being equal to radius, the fluxion also of the logarithm tangent will be double to that of the arch, if the logarithm be of Napier's form; but for Briggs's form, it will be as the same doubled arc multiplied into 0.43429 &c. or divided by 2.30258 &c. Yet this must be understood only of the addition of an indivisible arc; for it ceases to be true if the arc have any determinate magnitude.

Hence it appears, that if one minute be supposed unity, the length of the arc of one minute being .000290888208665721596154 &c. in parts of the radius, the proportion will be, as unity to 2.908882 &c. so radius to the tangent of 71° 1′ 42″, whose logarithm is 10.46372611720718325204 &c. and under that angle is the meridian intersected by that rhumb line, on which the differences of Napier's logarithm tangents of the half complements of the latitudes are the true differences of longitude, estimated in minutes and parts, taking the first four figures for integers. But, for Vlacq's tables, we must say,

As .2302585 &c. to .2908882 &c. So radius to 1.26331143874244569212 &c. which is the tangent of 51° 38′ 9″, and its logarithm 10.1015104285077 20941162 &c. wherefore in the rhumb line, which makes an angle of 51° 38′ 9″ with the meridian, Vlacq's logarithm tangents are the true differences of longitude. And this, compared with our second corollary, may suffice for the use of the tables already computed.

But if a table of logarithm tangents be made by extraction of the root of the infiniteth power, whose index is the length of the arc you put for unity, as for minutes the .0002908882th &c. power, which we will call a; such a scale of tangents will be the true meridian line, or sum of all the secants, taken infinitely many. Here the reader is desired to have recourse to my little Treatise of Logarithms, published in N° 216, that I may not need to repeat it. By what is there delivered, it will follow, that putting t for the excess or defect of any tangent above or under the radius, or tangent of 45; the logarithm of the ratio of radius to such tangent will be

$\frac{1}{m}$ into $t - \frac{1}{2}tt + \frac{1}{3}ttt - \frac{1}{4}tttt + \frac{1}{5}t^5$, &c. when the arc is greater than 45°, or $\frac{1}{m}$ into $t + \frac{1}{2}tt + \frac{1}{3}t^3 + \frac{1}{4}t^4 + \frac{1}{5}t^5$, &c. when it is less than 45°. And by the same doctrine, putting T for the tangent of any arc, and t for its difference from the tangent of another arc, the logarithm of their ratio will be

$$\frac{1}{m} \text{ into } \frac{t}{\mathrm{T}} + \frac{tt}{2\mathrm{TT}} + \frac{t^3}{3\mathrm{T}^3} + \frac{t^4}{4\mathrm{T}^4} + \frac{t}{5\mathrm{T}^5} \text{ \&c. when T is the greater term, or}$$

$$\frac{1}{m} \text{ into } \frac{t}{\mathrm{T}} - \frac{tt}{2\mathrm{TT}} + \frac{t^3}{3\mathrm{T}^3} - \frac{t^4}{4\mathrm{T}^4} + \frac{t^5}{5\mathrm{T}^5} \text{ \&c. when T is the less term:}$$

And if m be supposed .0002998882 &c. $= a$, its reciprocal $\frac{r}{a}$ will be, 3437.7467707849392526 &c. which multiplied into the aforesaid series, will give precisely the difference of meridional parts between the two latitudes, to whose half complements the assumed tangents belong. Nor is it material from whether pole you estimate the complements, whether the elevated or depressed; the tangents being to one another in the same ratio as their complements, but inverted.

In the same discourse I also showed that the series might be made to converge twice as swift, all the even powers being omitted: and that putting τ for the sum of the two tangents the same logarithm would be

$$\frac{2}{m} \text{ or } \frac{2r}{a} \text{ into } \frac{t}{\tau} + \frac{t^3}{3\tau^3} + \frac{t^5}{5\tau^5} + \frac{t^7}{7\tau^7} + \frac{t^9}{9\tau^9} \text{ \&c.}$$

but the ratio of τ to t, or of the sum of two tangents to their difference, is the same as that of the sine of the sum of the arcs, to the sine of their difference. Therefore, if s be put for the sine complement of the middle latitude, and s for the sine of half the difference of latitudes, the same series will be

$$\frac{2r}{a} \text{ into } \frac{s}{\text{s}} + \frac{s^3}{3\text{s}^3} + \frac{s^5}{5\text{s}^5} + \frac{s^7}{7\text{s}^7} + \frac{s^9}{9\text{s}^9} \text{ \&c.}$$

where, as the differences of latitude are smaller, fewer steps will suffice. And if the equator be put for the middle latitude, and consequently s = R, and s = the sine of the latitude, the meridional parts reckoned from the equator will be

$$\frac{s}{a} + \frac{s^3}{3rra} + \frac{s^5}{5r^4a} + \frac{s^7}{7r^6a} \text{ \&c.}$$

which coincides with Dr. Wallis's solution in N° 176. And this same series, being half the logarithm of the ratio of R + s to R − s, that is, of the versed sines of the distances from both poles, agrees with what Dr Barrow had shown in his 11th lecture.

The same ratio, of τ to t, may be also expressed by that of the sum of the co-sines of the two latitudes, to the sine of their difference: as also by that of the sine of the sum of the two latitudes, to the difference of their co-sines: or by that of the versed-sine of the sum of the co-latitudes, to the difference of the sines of the latitudes; or as the same difference of the sines of the latitudes, to the versed-sine of the difference of the latitudes; all which are in the same ratio of the co-sine of the middle latitude, to the sine of half the difference of the latitudes. As it would be easy to demonstrate, if the reader were not supposed capable to do it himself, on a bare inspection of a scheme duly representing these lines.

This variety of expression of the same ratio, I thought not fit to be omitted, because by help of the rationality of the sine of 30°, in all cases where the sum or difference of the latitudes is 30°, 60°, 90°, 120° or 150°, some one of them will exhibit a simple series, in which great part of the labour will be saved: and besides, I am willing to give the reader his choice, which of these equipollent methods to make use of; but for his exercise shall leave the prosecution of them, and the compendia thence arising, to his own industry. Contenting myself to consider only the former, which for all uses seems the most convenient, whether we design to make the whole meridian line, or any part of it, viz.

$$\frac{2r}{a} \text{ into } \frac{s}{\text{s}} + \frac{s^3}{3\text{s}^3} + \frac{s^5}{5\text{s}^5} + \frac{s^7}{7\text{s}^7} + \frac{s^9}{9\text{s}^9} \text{ \&c.}$$

Where a is the length of any arc, which you design shall be the integer or unity in the meridional parts, whether it be a minute, league, or degree, or any other, s the co-sine of the middle latitude, and s the sine of half the difference of latitudes; but the secants being the reciprocals of the co-sines, $\frac{s}{\text{s}}$ will be equal to $\frac{\sigma s}{rr}$ putting σ for the secant of the middle latitude; and $\frac{2r}{a}$ into $\frac{s}{\text{s}}$ will be $= \frac{2\sigma s}{ar}$. This multiplied by $\frac{ss}{3\text{ss}}$, that is by $\frac{\sigma\sigma ss}{3rrrr}$, will give the second step: and that again by $\frac{3\sigma\sigma ss}{5rrrr}$, the third step; and so forward till you have completed as many places as you desire. But the squares of the sines being in the same ratio with the versed-sines of the double arcs, we may, instead of $\frac{ss}{3\text{ss}}$, assume for our multiplicator $\frac{v}{3\text{v}}$, or the versed-sine of the difference of the latitudes divided by thrice the versed-sine of the sum of the co-latitudes, &c. which is the utmost compendium I can think of for this purpose, and the same series will become

$$\frac{2sr}{as} \text{ into } 1 + \frac{v}{3\text{v}} + \frac{v^2}{5\text{v}^2} + \frac{v^3}{7\text{v}^3} + \frac{v^4}{9\text{v}^4} \text{ \&c.}$$

Hence we are enabled to estimate the default of the method of making the meridian line by the continual addition of the secants of equidifferent arcs, which, as the differences of those arcs are smaller, still nearer and nearer approaches the truth. If we assume, as Mr. Wright did, the arc of one minute to be unity, and one minute to be the common difference of a rank of arcs: it will be in all cases, as the arc of one minute, to its chord :: the secant of the middle latitude, to the first step of our series. This by reason of the near equality between a and $2s$, which are to each other in the ratio of unity to 1 — 0.0000000035256604457713 &c. will only differ from the secant σ in the ninth figure; being less than it in that proportion. The next step being $+ \frac{2\sigma^3 s^3}{3ar^5}$, will be equal to the cube of the secant of the middle latitude multiplied into $\frac{2sss}{3arr} = 0.000000007051329087 15$: which therefore, unless the secant exceed ten times radius, can never amount to 1 in the fifth place. These two steps suffice to make the meridian line, or logarithm tangent, to far more places than any tables of natural secants yet extant are computed to; but if the third step be required, it will be found to be $+ \sigma s$ into $\frac{2s^5}{5ar^4} =$ 0.0000000000000000089498. By all which it appears, that Mr. Wright's table no where exceeds the true meridian parts by full half a minute; which small difference arises by his having added continually the secants of 1′, 2′, 3′, &c.

instead of $0\frac{1}{2}'$, $1\frac{1}{2}'$, $2\frac{1}{2}'$, $3\frac{1}{2}'$, &c. But as it is, it is abundantly sufficient for nautical uses. That in Sir Jonas Moor's New System of the mathematics is much nearer the truth, but the difference from Wright is scarcely sensible, till you exceed those latitudes where navigation ceases to be practicable, the one exceeding the truth by about half a minute, the other being a very small matter deficient.

For an example, easy to be imitated by any person, I have added the true meridional parts to the first and last minutes of the quadrant; not so much that there is any occasion for such accuracy, as to show that I have obtained, and here laid down, the full doctrine of these spiral rhumbs, which are of so great concern in the art of navigation.

The first minute is	1.000000014102658 62178
The second	2.0000000564106380 6707
The last, or 89° 59′, is	30374.9634311414228643

and not 32348.5279, as Mr. Wright has it, by the addition of the secants of every whole minute: nor 30249.8, as Mr. Oughtred's rule makes it, by adding the secants of every other half minute. Nor 30364.3, as Sir Jonas Moor had concluded it, by I know not what method, though in the rest of his table he follows Oughtred.

And this may suffice to show how to derive the true meridian line from the sines, tangents, or secants, supposed ready made; but we are not destitute of a method for deducing the same independently, from the arc itself. If the latitude from the equator be estimated by the length of its arc A, radius being unity, and the arc put for an integer be *a*, as before; the meridional parts answering to that latitude will be

$$\frac{1}{a} \text{ into } A + \frac{1}{6}A^3 + \frac{1}{24}A^5 + \frac{\frac{61}{84}}{60}A^7 \text{ or } \frac{61}{5040}A^7 + \frac{\frac{11}{2880}}{1386}A^9 \text{ or } \frac{1385}{362880}A^9, \text{ \&c.}$$

which converges much swifter than any of the former series, and besides has the advantage of A increasing in arithmetical progression, which would be of great ease if any should undertake de novo to make the logarithm tangents, or the meridian line, to many more places than now we have them. The logarithm tangent to the arc of $45 + \frac{1}{2}A$ being no other than the aforesaid series $A + \frac{1}{6}A^3 + \frac{1}{24}A^5$ &c. in Napier's form, or the same multiplied into 0.43429 &c. for Briggs's.

But because all these series, towards the latter end of the quadrant, converge exceeding slowly, so as to render this method almost useless, or at least very tedious; it will be convenient to apply some other artifice, as by assuming the secants of some intermediate latitudes; and you may for *s*, or the sine of α, the arc of half the difference of latitudes, substitute $\alpha - \frac{1}{6}\alpha^3 + \frac{1}{120}\alpha^5 -$

$\frac{1}{5040}\alpha^7 + \frac{1}{362880}\alpha^9$ &c. according to Mr. Newton's rule for given the sine from the arc; and if α be no more than a degree, a very few steps will suffice for all the accuracy that can be desired.

And if α be commensurable to a, this is, if it be a certain number of those arcs which you make the integer, then will $\frac{\alpha}{a}$ be that number; which if we call n, the parts of the meridional line will be found to be

$$\frac{\sigma n}{r} \text{ into } 1 + \frac{\sigma\sigma\alpha\alpha}{3r^4} + \frac{\sigma^4\alpha^4}{5r^8} + \frac{\sigma^6\alpha^6}{7r^{12}}, \text{ \&c.}$$
$$- \frac{\alpha\alpha}{6rr} - \frac{\sigma\sigma\alpha^4}{6r^6} - \frac{\sigma^4\alpha^6}{6r^{10}}, \text{ \&c.}$$
$$+ \frac{1\alpha^4}{120r^4} + \frac{13\sigma^2\alpha^6}{360r^8}, \text{ \&c.}$$
$$- \frac{1\alpha^6}{5040r^6}, \text{ \&c.}$$

In this, the first two steps are generally sufficient for nautical uses, especially when neither of the latitudes exceed 60 degrees, and the difference of latitudes does not pass 30 degrees.

But I am sensible I have already said too much for the learned, though too little for the learner; to such I can recommend no better treatise, than that of Dr. Wallis, in N° 176, where he has, with his usual brevity, and that perspicuity peculiar to himself, handled this subject from the first principles, which here for the most part we suppose known.

I need not show how, by regressive work, to find the latitudes from the meridional parts, the methods being sufficiently obvious. I shall only conclude with the proposal of a problem which remains to make this doctrine complete, and that is this. A ship sails from a given latitude, and having run a certain number of leagues, has altered her longitude by a given angle. It is required to find the course she steered. The solution of this would be very acceptable, if not to the public, at least to the author of this tract, being likely to open some further light into the mysteries of geometry.

To conclude, I shall only add, that, unity being radius, the cosine of the arc A, according to the same rules of Mr. Newton, will be

$$1 - \frac{1}{2}A^2 + \frac{1}{24}A^4 - \frac{1}{720}A^6 + \frac{1}{40320}A^8 - \frac{1}{3628800}A^{10} \text{ \&c.}$$

from which and the former series, exhibiting the sine by the arc, by division it is easy to conclude, that the natural tangent to the arc A is

$$A + \frac{1}{3}A^3 + \frac{2}{15}A^5 + \frac{17}{315}A^7 + \frac{62}{2835}A^9 \text{ \&c.}$$

and the natural secant to the same arc

$$1 + \frac{1}{2}A^2 + \frac{5}{24}A^4 + \frac{61}{720}A^6 + \frac{277}{8064}A^8 \text{ \&c.}$$

and from the arithmetic of infinites, the number of these secants being the arc A, it follows, that the sum total of all the infinite secants on that arc is

$$A + \frac{1}{6}A^3 + \frac{1}{24}A^5 + \frac{61}{5040}A^7 + \frac{277}{72576}A^9 \text{ \&c.}$$

which, by what goes before, is the logarithm tangent, of Napier's form, for the arc of $45° + \frac{1}{2}A$, as before. And collecting the infinite sum of all the natural tangents on the said arc A, there will arise

$$\frac{1}{2}AA + \frac{1}{12}A^4 + \frac{1}{45}A^6 + \frac{17}{2520}A^8 + \frac{31}{14175}A^{10} \text{ \&c.}$$

which will be found to be the logarithm of the secant of the same arc A.

Account of Books.—1. *Catoptricæ et Dioptricæ Elementa, Auctore Davide Gregorio, D. M. Astronomiæ Professore Saviliano Oxoniæ, et Soc. Reg. Socio,* 8vo. *è Theatro Oxon.* 1695. N° 219, p. 214.

In this treatise the learned author demonstrates the principal laws of reflection and refraction, without restraining himself to any sect of philosophers; as also the properties of plain and spherical surfaces in reflecting and refracting of rays: also how it happens that spherical surfaces produce the same effects with those of certain spheroids and conoids, viz. because they have the same degree of curvature. In the catoptrics, he determines the place of the image, when the object and the eye are not in the same axis of the reflecting sphere: an inconvenience that dioptrical machines are not subject to. He then proceeds to determine the situation and size of the images of sensibly large objects, with the quantity of the angles under which they appear, from the speculum or lens: and shows where to place an object in respect of any spherical speculum or lens, so that its image may be of any assigned magnitude.

He afterwards shows how to make a microscope or telescope of any two or more given specula or lenses, or of a speculum and lens, which shall magnify in any given ratio, and be fitted to any given eye: where also all the possible combinations of specula and lenses are universally considered, and the way of reckoning the power of catoptrical or dioptrical or cata-dioptrical machines is explained; with the way how to make a single lens, which shall produce the beforementioned effects.

Lastly, he shows how to make a concave speculum of glass, such that the images of a remote object made by its two surfaces may be in the same plane, which therefore, cæteris paribus, must burn more violently than any other.

2. *Dissertationes Medico-Physicæ de Antris Lethiferis; de Montis Vesuvei Incendio; de stupendo Ossium Coalitu; de immani Hypogastrii Sarcomate; à Bernardo Connor, M. D. Poloniarum Regis Medico, Regiæ Societatis Londinensis et Cameræ Regiæ Parisiensis Socio. Ox.* 1695. N° 219, p. 215.

After many vague inquiries concerning damps or vapours, the author proceeds to give an account of Mount Vesuvius and its late eruption; telling us that the hill is obtuse, and has at top a large cavity 2 miles around, which in the middle has another mountain, and in it a cavity: out of this come the smoke and flame, which in April 1694 it began to throw out, with a noise more than usual, and affrighted the people near it; so that they removed themselves and goods. On the 5th day after, a river of melted metal ran down the mountain by a slow pace: to prevent the ravage of which, the viceroy ordered a great ditch to be dug to receive it, where after 8 days space it rested, a mile from the sea. Then the whole river of metalline matter was from 20 to 150 paces broad, and the depth was from 15 to 80 paces, and its length 4 miles; the recrementitious and lighter parts of which were at top, the more metalline at bottom.

The account of the very extraordinary skeleton here treated of, has been already printed in these Transactions, N° 215.

The last part of this book is an account of a very large sarcoma, or excrescence of the uterus, which befel a woman on being frighted and kicked on the belly. It was 25 years growing in the cavity of the uterus, and came at last to be 22 inches long, 12 broad, and 10 deep, weighing 42lb. and a quarter, being fleshy and uniform. The doctor gives the figure of it, and concludes it to be no mole, but the inward glandulous coat of the womb grown to that size, after the manner of the bronchocele in the Alps, or the polypus in the nose; and has a great many reasonable conjectures on the probable causes of it and other tumours.

On a Substance like Butter, falling from the Air; in a Letter from Mr. Robert Vans of Kilkenny in Ireland. Dated Nov. 15, 1695, to Mr. Henry Million. N° 220, p. 223.

We have had of late, in the county of Limerick and Tipperary, showers of a matter, like butter or grease. If this be rubbed on one's hand, it will melt, but laid by the fire, it dries and grows hard, having a very stinking smell. This last night some fell at this place, which I saw this morning. It is gathered into pots and other vessels, by some of the inhabitants of this place.

On the same Butter-like Substance; from the Bishop of Cloyne's Letter, near Youghall, April 2, 1696. N° 220, p. 223.

Having very diligently inquired concerning a very odd phenomenon, which was observed in many parts of Munster and Leinster, the best account I can collect of it is as follows; for a good part of last winter and spring, there fell in several places, a kind of thick dew, which the country people called butter from the consistency and colour of it, being soft, clammy, and of a dark yellow; it fell always in the night, and chiefly in moorish low grounds, on the top of the grass, and often on the thatch of cabins. It was seldom observed in the same places twice: it commonly lay on the earth for near a fortnight, without changing its colour; but then dried and turned black. Cattle fed in the fields where it lay indifferently, as in other fields. It fell in lumps, often as large as the end of one's finger, very thin and scatteringly; it had a strong ill scent, somewhat like the smell of church-yards or graves: and indeed we had during most of that season very stinking fogs, some sediment of which might possibly occasion this stinking dew, though I will by no means pretend to offer that as a reason of it: I cannot find that it was kept long, or that it bred any worms or insects; yet the superstitious country people, who had scald or sore heads, rubbed them with this substance, and said, it healed them.

Abstract of a Letter from Sir William Beeston, Governor of Jamaica, to Mr. Charles Bernard, containing some Observations about the Barometer, and of a Hot Bath in that Island. Dated April 8, 1696. N° 220, p. 225.

I diligently observed my barometer every day, and found that in the mornings before the sun arose, it would stand at changeable; and as the heat increased with the day, it sunk to within one degree above rain; there it continued several days, and never altered above 3 degrees, though sometimes fair, sometimes rain, and sometimes cloudy; and one morning leaving open my window, and the sun having south declination, it shone in on the visible part of the tube, and in half an hour it sunk 3 degrees; which I never observed it to do with heat in England. I presently shut the window, and in one hour it rose again to within one degree of changeable. After it had kept this course in several weathers, for 6 weeks together, I began to doubt if it were well adjusted, and therefore took it down, new filled the tube, turned it three or four times up and down, to let out the air, and put it up with great care; and ever since it continues the same, never by one degree to changeable, nor down by one degree to rain; so that the whole progress of the mercury is but $\frac{3}{10}$ of an inch.

Here is a very hot spring of mineral water; but being an uncouth way for about 6 miles, from any usual roads, and among hills, woods, and rocks, it has not been frequented, but accidentally by hunters. Ever since I came hither, I have been urging people to try it; but the distance and trouble has hindered them, till this last month; when two, the one very much afflicted with the belly-ach, and another with the pox, as is supposed, went to it, carried clothes, built a hut, to keep them from the rain and sun; and both presently, by drinking and bathing, found such ease, that in about 10 days they returned perfectly cured. It comes out of a rock, in a fresh current, near a fine rivulet of good cool water; but is so hot, they affirm it soon boils eggs; some say craw-fish and fowls. However it is certain, that near where it comes forth, there is no enduring any part of the body but it takes off the skin. It cures ulcers, and contracted nerves and sinews in a few days. Col. Beckford, who was given over by the physicians, with very acute pains in his bowels, that had worn him out, and another for the venereal disease, and one for the belly-ach, are now gone up. It has been tried with galls in my sight; but it makes the water in 24 hours look only like canary, or old hock.

Sir, it is now the 18th of April, since that above; Col. Beckford is finely recovered, and the other almost cured of his ulcers, so that the water is beyond doubt, and many are resorting to it. And since that time I have tried several water-springs, and rivers hereabouts, and find them all tinged with some metal, more or less.

On the Soap-Earth, near Smyrna. Communicated by Dr. Edward Smith, F. R. S.* N° 220, p. 228.

There is a considerable natural curiosity in the neighbourhood of Smyrna, called by the Franks soap-earth, and has no other proper distinguishing name among the Turks or Greeks. It is found only in two places near Duraclea, a large open village, about 6 leagues to the eastward of Smyrna; and in a very flat plain, about a league westward of the river Hermus, and several leagues from the sea. It is a fine soap, and at the first gathering a whitish earth, which boils or shoots up out of the earth. It is gathered always before sun rise, and in mornings when there falls no dew; so that a stock must be laid in for the whole year in the summer months. It comes up in some places an inch or two above the surface of the ground. But the sun rising upon it, makes it fall down again. Every morning there is a new crop, though all be taken away which the preceding day afforded. The earth producing it lies low in both places, and is in the winter washy; it is covered, though but thinly, with grass.

To discover what quantity of salt this earth contains, I had the following experiments made. 300 drams put into a retort in balneo arenæ, for 12 hours, in a violent fire, gave between 5 and 6 oz. of an insipid phlegm. Finding therefore no volatile salt, as that must have come over by the foregoing experiment; 200 drams calcined at a bagnio-fire, in a German crucible, were dissolved in water. The composition of earth and water boiled into a lixivium, made 500 drams. It was boiled for 3 hours, always skimming off the froth, then filtrated, after that evaporated over a gentle fire; it was kept to crystallize, and appeared

* The term *soap-earth* is commonly applied to steatitic and talcky earths; but the substance here described appears to be natron (carbonate of soda). It is improperly called an earth, being an alkaline salt.

like a fixed salt.—At the soap houses they mix $\frac{3}{4}$ of earth with $\frac{1}{4}$ of lime, and dissolve the composition in boiling water; when stirring it often with a stick there floats at top a thick brownish substance, which they preserve in basins apart; and this scum is much richer than the liquor underneath, yet both are used in making the soap. Into a large copper caldron they put 50 quintals of oil, applying a very hot fire, which burns continually until the soap is made. When the oil has boiled, they begin to throw in some of the scum, and some of the liquor from which the scum was taken. They often repeat this, throwing in the scum and liquor for 13 or 14 days, in which time the soap is usually perfected. The brownish scum, and what is useful of the liquor, incorporating with the oil; what is useless sinks to the bottom of the caldron, where it is let out to make room for throwing in more. The water, thus let out, is again thrown upon a new composition of earth and lime; but when the liquor becomes wholly insipid, it is then judged to be exhausted: after 13 or 14 days, when the soap is finished, it is laded out of the boiler, and laid upon a lime floor to dry.

The proportion is 2 load of earth, of 5 quintals each, to 50 quintals of oil. The produce is between 70 and 80 quintals of soap. The earth is bought at a dollar a load; and the soap, when this account was made, at $6\frac{3}{4}$ a quintal. There is employed in making soap yearly at Smyrna 10,000 quintals of oil. Bringing soap earth employs 1000 camels every day throughout the year, or rather 1500 daily for 8 months; the 4 summer months being too hot for camels to travel. An ordinary soap house produces 1000 dollars a year clear profit, on an average.

On Chylification. By Mr. Willam Cowper. N° 220, p. 231.

The dentes incisorii, or cutting-teeth, are first employed in dividing the food. When a proportionable piece is thus taken into the mouth, the lower jaw is variously moved by its proper muscles, and mastication is begun, and carried on by the assistance of the tongue, cheeks, and lips; the first two still applying the less divided parts of the aliment to the dentes molares, till there is an equal comminution of all its parts. At the same time several of the muscles, employed in the motion of the lower jaw, are also serviceable in promoting the saliva or spittle, separated from the blood by the parotid glands; those of the lower jaw, and under the tongue into the mouth; the salival glands of the cheeks and lips also contributing their juices, do altogether join with the masticated aliment, before or at the same time it is made fit to be swallowed; which action is called deglutition.

Deglutition is thus performed; the aliment, as well what is fluid as that masticated, being lodged on the tongue, which somewhat hollows itself, by means of its own proper muscular fibres, for the more commodious entertaining the larger quantity, its tip and sides are applied to the insides of all the teeth of the upper jaw, the tongue is suddenly drawn up by the musculi styloglossi and myloglossus, together with those muscles which pull the os hyoides upwards, at the same time the fauces are also drawn up, and their cavity enlarged by the musculi stylopharyngei: and about two thirds of the superior surface of the tongue is adequately applied to the roof of the mouth; the epiglottis, from its position being consequently depressed, thereby covers the glottis or rimula of the larynx, and prevents any part of the aliment from descending into the windpipe. In this part of the action of deglutition, the glands under the tongue, and excretory ducts of those of the lower jaw, are compressed, and their separated liquors or spittle discharged by their papillæ, situated at the lower part of the frænum or ligament of the tongue; and this is done by the musculus mylohyoideus. When the aliment is thus forced into the fauces, or upper part of the gula, at the same time the gargareon, with the uvula, are drawn upwards and backwards by the musculi sphænostaphyli, by which means any part of the aliment is hindered from ascending into the foramina narium; the fauces by the musculus pterygopharyngeus and œsophageus are contracted: by which the aliment is not only compressed into the gula, but the matter separated from the blood by the glands of the fauces, especially of those large ones called tonsillæ, is forced out of their cells or excretory ducts, to join with it in its descent to the stomach by the gula, through which latter it passes, by the action of its muscular fibres.

The aliment, thus impregnated with saliva in mastication and deglutition, being received into the stomach, there meets with a juice separated from the blood by the glands of that part, whose excretory ducts open into the cavity of the stomach: by the commixture of these liquors, whether of the saliva or juice of the stomach, a proper menstruum is composed, by which the parts of the aliment are still more and more divided, by its insinuating into their pores, by which the air, before imprisoned in their less divided parts, is not only more disentangled, but by the natural heat, it must necessarily suffer such a rarefaction, as that the whole stomach becomes still more and more distended: hence it is we have less appetite some time after eating, then we had immediately after; hence also arise those frequent eructations from divers aliments, as old pease, cabbage, and other vegetables which we frequently eat; all which become very much disturbing in depraved appetites and weak stomachs. Though we have not used the word fermentation, yet we do not suppose the dissolution of the aliment within the stomach can be done, at least without an intestine motion of its particles with the menstruum : but we have omitted that term, because it may be apt to lead us into an idea of a greater conflict than in truth there really is.

At the same time, when this intumescence and agitation of the matter is made in the stomach, the contents of the neighbouring excretory ducts, viz. the bile in the gall-bladder, the liver ducts, and the pancreatic juice in the ductus pancreaticus, are compressed into the duodenum, through the extension of the stomach itself: the refluent blood of the stomach at that instant being, in some measure, retarded, whence the muscular fibres are more liable to be contracted.

Nor can we conceive how the liquor of the stomach, after uniting with the saliva and aliment, should be still so plentifully excreted from the glands of that part, as to irritate its internal membrane, and excite its muscular fibres to contract, since the muscles of the abdomen would in like manner as in vomiting, be drawn into a consent of co-operating, and the aliment would be forcibly rejected by the mouth: besides, should the liquor of the stomach prove so prejudicial in chylification, what would the case be, immediately on the discharge of all its contents. The irritation the stomach undergoes in hunger, appears only to arise from an accumulation of the saliva in the stomach, in conjunction with the liquor of the glands of that part; hence it is we rather discharge the spittle at that time by the mouth, than to suffer any more of it to descend into the stomach ; hence proceeds what is called the watering of the mouth ; hence also, when the saliva is vitiated, the appetite is depraved.

The stomach, by means of its muscular fibres, contracting itself, gradually discharges its contents by the pylorus into the duodenum, in which gut, after a small semicircular descent, it meets with the pancreatic juice and bile ; both which joining with it, renders some parts of the aliment more fluid, by still disuniting the grosser parts from the more pure ; and here chylification is made perfect. The bile which abounds with lixivial salts, and is apt to mix with the grosser parts of the concocted aliment, stimulates the guts, and deterges or cleanses their cavities ; of the mucous matter, separated from the blood by glands of the guts, and lodged in their cavities ; which not only moistens the insides of the guts, but defends the mouths of the lacteals from being injured by foreign bodies, which often pass that way.

The contents of the intestines moving still on by means of the peristaltic, or wormlike motion of the guts, whilst those thinner parts fitted for the pores of the lacteal vessels, called chyle, is absorbed by them ; the thicker parts move still more slowly on, and by the many stops they continually meet with by the connivent valves, all the chyle or thinner parts are at length entirely absorbed, the remains, being merely excrementitious, are only fit to be excluded by stool.

The analogous white appearance of the chyle, whether in the stomach, or intestines, and always in the lacteals, and thoracic duct, may be seen in the commixtures of divers liquids, which apart exhibit no such appearance: nor is this phenomenon any otherwise than a transposition of particles; whether by a menstruum insinuating into them, and dividing them into gross globules, as an acid into a sulphur, or vinegar with oil, &c. or else by precipitation, as when a gummous or resinous body is dissolved in a spirituous menstruum, and mixed with a phlegm; so tincture of myrrh and benjamin, &c. make a milky appearance in common water.*

The longitudinal and transverse orders of fibres of the guts are the instruments by which their peristaltic motion is performed: which motion is not only necessary for propelling their contents; but by the reciprocal contraction of those muscular fibres of the guts, and apposition of their connivent valves, the mouths of the lacteals are disposed to receive what is prepared for them: hence it is, that we can by no means make any fluid whatever pass from the cavity of the guts into those lacteals, in a dead animal. A further use of this contraction of the muscular fibres of the intestines, is to accelerate the chyle in its progress in the lacteals, till the lympha derived from the extremities of the arteries of the guts mixes with it; which conjunction is made in the lacteals, before they leave the external surface of the intestines. By this means the progression of the chyle is made towards the mesenteric glands, into whose cells it is received, and where it again mixes with a juice conveyed by the arteries of each gland; which juice, or lymphatic liquor, not only further dilutes the chyle, like that from the arteries of the intestines, but adds a fresh impetus, by which its motion is further promoted through the lactea secundi generis, arising out of each mesenteric gland, and discharging their contents into the receptaculum chyli. Here the chyle mixes with the lympha, sent through the lymphæducts from the inferior limbs and neighbouring parts; by which the chyle is not only further elaborated, but its ascent into the thoracic ducts is promoted, whose several divisions and inosculations, like the veins of the testicles, with its many valves, looking from below upwards, and its advantageous situation between the great artery and vertebræ of the back, together with the lymphæducts, discharging their lympha derived from the lungs and neighbouring parts of the thorax, demonstrate the utmost art, in order to promote its

* This chyemical view of chylification coincides, in some respects, with that given by the late Dr. G. Fordyce, in his excellent Treatise on Digestion.

ascent towards the left subclavian vein. Before the thoracic duct, thus charged with the chyle and lympha, empties itself into the subclavian vein, it receives the lympha brought from the superior parts, all which, mixing together, are soon discharged into the left subclavian vein, where meeting with the refluent blood of the superior parts, passes with it through the descending trunk of the vena cava, and joins with the refluent blood of the inferior parts in the right auricle of the heart; whence it is expelled by its contraction into the right ventricle, when the heart is in diastole; but by the systole, or contraction of the heart, it is thence propelled into the arteria pulmonalis, through whose extremities, in conjunction with those of the vena pulmonalis, it passes to the left auricle and ventricle of the heart, from whence it is again discharged in the systole into the aorta, by whose branches it is conveyed all over the body: the three tricuspid valves in the right, and two mitral valves in the left ventricle of the heart, opposing its return into the veins, and the semilunar valves, of the arteria pulmonalis and aorta, preventing its ingress into the ventricles, are sufficient to demonstrate the necessity of a circulation of this grand fluid of the blood.

A Catalogue of Plants growing within the Fortifications of Tangier, in 1673. *By Mr. Spottswood, a Surgeon, who lived there; and given by the Author to Dr. Love Morley, who communicated it.* N° 220, p. 239.

Phytologia Tingitana, vel Catalogus Plantarum Tingitanarum. 1673.*

* To occupy as little space as possible, it has been judged proper to subjoin this catalogue, which is retained as a specimen of the vegetable productiveness of this part of Africa, in the form of a note. —Absinthium, 2 species; angelica; anethum; atriplex, 3 species; althæa; aristolochia, 2 species; alkekengi; acetosa, 3 species; arum; arisarum; anagallis, 3 species; aloes; adianthum, 2 species; avena; avena sterilis, v. bromos; apium, 2 species; arbutus; acus pastoris; allium vulgare; asparagus, 3 species; asperula fl. albo; aster, 2 species; aurantia malus; acanthus, 2 species; armeria, 2 species; arundo, 2 species; anagyris fœtida; alopecuros; alsine, 2 species; amaranthus, 2 species; amygdalus dulcis; anemones, variæ species; antirrhinum, 2 species; apparine; asphodelus albus racemosus; acacia Ægyptiaca; ammi.—Behen. alb. v. ocymastrum; bellis, 2 species; beta, 2 species; borago, 2 species; buglossa, 2 species; branca ursina, v. acanthus; brassica florida; brassica, 2 species; bromos sterilis; blitum, 2 species; beccabunga, v. portulaca mar.; battata, 2 species; blattaria, 2 species; bryonia nigra.—Centino; calamintha; carduus, various species; carlina, 2 species; carthamus, v. cnicus verus; cnicus perennis; cupressus; cynoglossum; crocus, 4 species; crithmum, v. fænicul. marin.; chærifolium; chamæriphes, v. palma humil.; cerinthe, 2 species; chrysanthemu , 3 species; caulis, v. brassica sativa; campanula, 3 species; capsicum, 2 species; clematis daphnoides, v. vinca pervinca; clematis, v. periclymenum; corallina, 2 species; costus hortensis; cœpa; cucumer; cucumis asininus; cucurbita; cydonia malus; calendula, 2 species; chamomilla; cannabis aquatica; caltha palustris; capillus veneris; cardamine fl. albo; caryophylli variæ species; cattaria, v. nepeta; cauda equina; cauda equina nuda; centaurium, 3 species; cauda muris; ceterach, v. asplenium, chamæpitys; cichoreum, 2 species; cicutaria; cochlearia, 2 species; colchicum, 2 species; conso-

A Letter from Mr. Charles Bernard, giving an Account of two large Stones, which for twenty Years past had lodged in the Meatus Urinarius, and were thence cut out by him the 28th of September last. N° 220, p. 250.

About a fortnight since, I was taken by Dr. Beaufort to a Mr. Blondle,

lida regalis; convolvulus major et minor; conyza, 2 species; cornu cervi. maj. v. coronop.; cotula, 2 species; cracca major, v. vicia silvest.; cracca minima; cotyledon, v. umbilicus veneris; crista galli, 2 species; cytisus, v. trifol. arborescens; capnos, v. fumaria; caprifolium, v. periclymenum majus; coriandrum; cynara, 2 species; citrullus; chamædrys fl. purpur.; chondrilla hispanica; cerasus vulg.; centaurium majus; caryophyllus marinus; cistus, 3 species.—Dens leonis; dipsacus; dracontium, 2 species; dryopteris; draco herba, v. taragon; delphinium, v. consolida regalis; daucus, 2 species; daucoides tingitana; dactylus arbor; draba alba siliquosa minor; draba lutea; dulcamara, v. amara dulcis.—Ebulus vulg. v. chameacte; echium, 3 species; creticum; endivia, 2 species; equisetum; erigerum senecio; erigerum murale; eruca; eringium, 2 species; erysimum; esula, 2 species; euphrasia altera Dodonei; elatine, v. veronica fæmina.—Faba, 2 species; suilla, v. hyoscyamus; ferula; ficus; filix mas et fæmina; filius ante patrem, vel lysimachia siliquosa; fæniculum, 2 species; ferrum equinum semine reflexo; frumentum, 2 species; fungus, 2 species; fragaria; fragaria arbor, v. arbutus; fuga dæmonum, v. hypericon; fumaria, v. capnos; ficus indica, v. opuntia min.—Galeopsis, 2 species; gallitricum, v. horminum sat.; genista, 2 species; geranium, 2 species; robertianum, 2 species; gnaphalium, 2 species; gramen, various species; grossularia.—Halymus, v. portulaca marina; halicacabum, v. alkekengi; hastula regia, v. asphodelus; hedera corimbosa; hedysarum clypeatum; hepatica, 3 species; heliotropium minus, v. herba cancri; helxine, v. parietaria; helxine cissampelos, v. volubilis minor; henricus bonus, v. mercurialis anglic.; heraclea Plinii, v. lithospermum; herba cattaria, v. nepeta; cancri, v. heliotropium; Sancti Jacobi, v. Jacobea; impia, v. gnaphalium; margarita, v. bellis min.; muralis, v. parietaria; perforata, v. hypericon; regina, v. tabacco; stella, v. coronopus; tunica, v. caryophyllus; hieracium angustifol. et latifol.; hippolapathum, v. patientia; hippolapathum rotundifol. afric.; hordeum distichon; holosteum petræum; horminum, 3 species; hyacinthus, 3 species; hydropiper, 2 species; hyoscyamus albus; hypericon, v. millepeforata; hortus veneris, v. umbilicus veneris; hyssopus fl. cæruleo.—Jacea, 3 species; jacobea, 2 species; jasminum, 2 species; illecebra minor acris, v. vermicularis; juncus, 2 species; iris vulgaris fl. cœruleo; ibiscus, v. althæa; jecoraria, v. hepatica; irio, v. erysimum; iva arthritica, v. chamæpitys; jusquiamus, v. hyoscyamus.—Kali, 2 species; kik, v. kikaion johæ, v. ricinus.—Laburnum, v. anagyris; lactuca, 3 species; lagopus, v. pes leporinus; lactaria gazæ, v. tithymalus; lamium, 3 species; lapathum, 2 species; lapathiolum, v. acetosella; laureola semper virens; laurus, 2 species; laser, v. sium aquatic.; lichen, v. hepatica; lilium album; lilium inter spinas, v. periclymenum; limonia malus; linaria, 2 species; lingua canis, v. cynoglossum passerina, v. centinodium; linum vulgare fl. cæruleo, fl. luteo; lithospermon anchusæ facie; lupinus, 2 species; lychnis, 2 species; lysimachia, 2 species; lens palustris; leucoium vulgare; lathyrus major latifol.; limonium, 2 species; lolium album.—Majorana hortensis; malva, 4 species; malus cotonea, aurantia, persica, granata, medica; malus præcocia, limonia, amatoria, peruviana, v. stramonium; mandragora; marrubium album, v. prassium; matricaria fl. simplic.; medica, numerous species; melilotus vulgaris; melissa sativa; melo; mentha, 2 species; mentastrum; mercurialis, 3 species; mezereon, v. chamælea germ.; milium solis, v. lithospermon; millefolium, 2 species; mirabile, 3 species; moli latifol.; moli angustifol. fl. odorato; morus rubra; muscipula fl. albo; muscus, several species; malvaviscus, v. althæa vulg.; matrisilva, v. periclymenum; millemorbia, v. scrophularia maj.; morsus gallinæ, v. anagallis; myrtus, 2 species; meum athamanticum; melongena, v. mala insana.—Narcissus, vulg. fl. albo; nasturtium hortens. aquatic.; nepeta, v. mentha cattaria; nummularia; napus; nicotiana; nasturtium hyemale, v.

whom he had lately recovered from a feverish indisposition, and who afterwards complained of a very hard swelling behind the scrotum, which had remained there many years, and created great uneasiness to him. As the doctor advised him to send for me, we went together the next morning, and on examining it only with my fingers, I immediately declared it to be a stone of a very odd and irregular figure; and that there was no way of removing it, or relieving him, but by cutting it out. He was very much dejected with the apprehension of another operation; having about 20 years before, while a lad, been cut by Mr. Hollier for the stone in the bladder, and in great danger from it: but considering the misery of his life, and on my assuring him that it would not be at-

barbarea; nidus avis; nigella bœtica.—Ocymastrum, v. lychnis silvestr. fl. albo; ocymastrum valerianthos; oculus Christi, v. horminum silv.; olea sativa; olus album, v. lactuca agnina; onopordon Gesneri, v. acanthus vulg. onopteris nigra Dodonei, v. adianthum nigrum vulgare; opuntia, v. ficus Indica spin; orchis palmata; origanum; orobus fl. purpureo flor. cæruleo; os leonis, v. antirrhinum; oxylapathum majus et minus; oxalis, v. acetosa; onobrychis major et minor; orobanche; ocymum vulgare; orchis melittias; ornithogallum, 2 species; ornithopodium majus et minus; oxyacantha; œnanthe apii foliis.—Palma arbor, humilis, v. palmita; palatum leporis, v. sonchus levis; papaver alb. sativ.; and other species; parietaria, v. helxine; paronychia Mathioli, v. ruta muraria; parthenium, v. matricaria; pastinaca, 3 species; pastorum bursa, v. bursa pastoris; pecten veneris; pedes galli, v. ranunculus pentaphyllus; perforata, v. hypericon; periclymenum, v. lilium inter spinas; persica arbor; persicaria maculata et non; pes anserinus, v. atriplex lat.; petroselinum hort. phalangium; philanthropos, v. anserina; pilosella, 3 species; pimpinella agrimonoides; piper indicum, v. capsicum; pisa, 3 species; plantago, 3 species; polygonum, 3 species; polypodium; polytrichum; porrum; portulaca; potamogiton; prasium album; prunus arbor; pulicaria, v. conyza; pyrus arbor; pepo maximus oblongus; phaseolus, 2 species; pomum amoris; pulegium; pseudocostus; panax, 2 species.—Quercula major, v. teucrium; quercus, 2 species; quercus marina (alga); quinquenervium, v. plantag. min.; quinquefolium, v. pentaphyll.—Ranunculus, 4 species; raphanus, 2 species; rapistrum majus et minus; rapum; ricinus major, v. palma Christ.; rosa alba et rubra multip.; rosmarinus; rostrum porcinum, v. dens leonis; rubia tinctorum; rubus idæus; rubus saxatilis; ruta, 2 species; raphanus rusticanus; reseda Plinii; rosa silvestr. alb. odorat.—Sacra herba, v. verbena; salicaria, v. lysimachia maj.; salvia, 2 species; sanguisorba, v. pimpinella: satureia hyemalis; satyrion maculata et non; saxifraga, 2 species; scabiosa, 5 species; scolymus Theophrasti; scorpoides bupleuri foliis; scrophularia vulg.; scrophularia sambuci foliis; sedum, 2 species; senecio, v. erigerum; septifolium, v. heptaphyllon; serpentaria major, minor, v. arum; serpillum; seseli peleponense cicutæ facie; sideritis fl. cærul. et luteo; silybum, v. carduus mariæ, vulg.; smilax, 2 species; sinapi, 2 species; sium aquat. v. sisymbrium aq.; solanum, 3 species; solsequinum, v. heliotropium minus; sonchus, 3 species; spartium hispanicum; sagina, 2 species; stœche salamantic.; stœchas, 2 species; sambucus arbor; scilla, v. squilla; sicla, v. beta; spinachia; sanamunda 3ia Clusii.—Tamariscus; tabaco, v. petum vulg.; taraxacum, v. dens leonis; testiculus canis; teucrium, v. chamædrys silvestr.; thapsia turbith; thlaspi fl. alb. supinum; thymum hortens.; tithymalus, 4 species; tota bona, v. bonus henricus; trifolium pratense; trifolium arborescens; v. Cytisus; triticum; teucrium bœticum.—Valeriana Dodonei; verbena; vesicaria, v. alkekengi; vinca pervinca major et min.; vitis, 2 species; umbilicus veneris; volubilis nigra; vermicularis; urtica, 2 species; vulvaria, v. atriplex olida; vicia vulg. et sativ.—Xanthium, v. lappa min.; xiris, v. spatula fœtida.—Zizania, v. lolium album; zoopthalmium, v. sedum majus.

tended with the danger and difficulty which are dreaded on the extraction of a stone out of the bladder, and that there was no prospect of relief by any other method, he determined to submit to the operation.

The patient had not long recovered from under Mr. Hollier's care, before he began to complain of pain, which resembled his old pain of the stone, and this continued upon him for 4 or 5 years before he was sensible of any fulness or swelling in perinæo. Probably Mr. Hollier left either a couple of little stones or pieces of stone at the time of extraction, which were by degrees protruded into the urethra; but being too large to be voided, lodged themselves there, and so by perpetual accretion arrived to their present magnitude. He constantly complained of pain in making water, which usually came away by drops, and involuntarily for several years past. Nor was he longer at ease than while his bladder was full and distended with urine; which distension was continued all along the neck and the urethra, as far as where the stones were bedded: for his only way of procuring himself ease was by frequent drinking large quantities of small beer or water; and as soon as the separation could be made of the urine into the bladder, and while that continued full, he was sensible of some ease. He has been likewise exceedingly liable to vomiting of late, and generally molested with a diarrhœa for some years past; both which had lately so increased upon him, as very much to have impaired his health, and weakened his constitution.

Having prepared him with such evacuations as are proper to precede such an operation, on Monday the 28th of September last, I performed it, by cutting upon the most protuberant part of the stones, and making my incision pretty large, the upper part, which proved a distinct stone, and had formed itself a socket in the lowermost, slipped out with little or no difficulty; the other, which was forked, and was as it were bound in, as if it had adhered to the urethra, was removed with more trouble, and broke in the taking out, being neither of them very hard. There was not an ounce of blood lost in the operation; the stones, having lodged long there, had made a very great distention of the urethra, so that it was become so callous, that I seemed to cut through a cartilage. The stones being thus taken out, the wound was dressed, and continues in a very good condition. I had almost forgot to tell you, that to facilitate my removal of that stone which was locked in, I put two of my fingers up the anus, to secure it from retiring towards his bladder, and to my surprise I found that one of the angles of it had perforated into the anus.

The figure and position of the stones, fig. 13, pl. 1.—A the point which tended towards the glands: B that part which lay in the acetabulum; C the part upon which the incision was made; D the acetabulum; E the point which lay towards the neck of the bladder; F that which had perforated into the anus.

Microscopical Observations of vast Numbers of Animalcules seen in Water. By John Harris, M.A. Rector of Winchelsea, Sussex, and F.R.S. N° 220, p. 254.

July the 7th, 1694, I examined a small drop of some rain-water which had stood in a gallipot in my window for about 2 months. I took it with the head of a small pin from the discoloured surface of the water, and observed in it 4 sorts of animals. In the clear part of the drop were 2 kinds, and both very small. Some were of the figure of ants' eggs; these were in continual and swift motion; and I find that this kind of oval figure is the most common to the animalcules found in liquors. The other species, that were in the clear part of the drop, were much more oblong; about 3 times as long as broad; these were exceedingly numerous, but their motion was slow in comparison of the former.

In the thick part of the drop, for the water had contracted a thickish scum, I found also 2 species of animals: as, a kind of eels, like those in vinegar, but much smaller, and with their extremities sharper; these would wriggle out into the clear part, and then suddenly return back again, and hide in the thick and muddy part of the drop, much like common eels in the water. I saw here also an animal like a large maggot, which would contract itself up into a spherical figure, and then stretch itself out again; the end of its tail appeared with a forceps, like that of an ear-wig, and I could plainly see it open and shut its mouth, from whence air-bubbles would frequently be discharged. Of these I could number about 4 or 5, and they seemed to be busy with their mouths, as if in feeding.

These 4 kinds of living creatures I found afterwards also in many other drops of the same corrupted water, viz. in its film or scum, which was on the surface; for under that, in the lower parts of the water, I could never find any animals at all, unless when the water was disturbed, and the surface shaken down into, and mingled with the lower parts.

April 27th, 1696. With a much better microscope I examined some rain-water, which had stood uncovered a pretty while, but had not contracted any such thick and discoloured scum as that before mentioned had. In this, where it was clear, I could not find any animals at all; but a little thin white scum, which like grease began to appear on the surface, I found to be a congeries of exceedingly small animalcules of different shapes and sizes, much like those produced by steeping barley in water.

At the same time I looked on a small drop of the green surface of some puddle water: this I found to be altogether composed of animals of several shapes and magnitudes; but the most remarkable were those which I found gave the water that green colour, and were oval creatures, whose middle part was of a grass green, but each end clear and transparent. They would contract and dilate themselves, tumble over and over many times together, and then shoot away like fishes; their head was at their broadest end, for they still moved that way. They were very numerous, but yet so large, that I could distinguish them very plainly with a glass that did not magnify very much. Among these were interspersed many other smaller and transparent animals, like those just mentioned, as found in the whitish scum that was on some rain-water, which had stood a while uncovered.

April the 29th, 1696, I found another sort of creatures in the water, some of which I had kept in a window in an open glass. They were as large as 3 of the others, with the green border about their middles, but these were perfectly clear and colourless.

I then also examined more accurately the belts or girdles of green which were about the above animals, and found them to be composed of globules so like the rows or spawn of fishes, that I could not but fancy they served for the same use in these little animals; for I found now, since April 27, many of them without any thing at all of that green belt or girdle: others with it very much, and that unequally diminished, and the water filled with a vast number of small animals, which before I saw not there, and which I now considered as the young animated fry, which the old ones had shed. I continued looking on them at times, for 2 days, during which time the number of the old ones, with the green girdles, decreased more and more; and at last I could not see one of them so encompassed, but they were all clear and colourless from end to end.

May the 18th, 1696, I looked on some of the surface of puddle water, which was blueish, or rather of a changeable colour, between blue and red. In a large quantity of it I found prodigious numbers of animals, and of such various sizes, that I could not but admire their great number and variety; but among those were none with those girdles before-mentioned, either of green, or any other colour.

I then also examined the surface of some other puddle water, that looked a little greenish and this I found stocked with such infinite numbers of animals as I never yet saw, except in the genitura masculinâ of some creatures. Among these there were many of a greenish colour, but they all moved about so swiftly, and were so near to each other, that I could not distinguish whether the green colour were all over their bodies, or whether it were only round their middles in girdles, as before; but from the roundness of their figure and their smallness, I judged that they chiefly consisted of the young animated spawn of the above-mentioned kind of animals. I found that the point of a pin dipped in spittle would presently kill them all.

In the surface of some mineral chalybeate water, which had stood in a phial unstopped for about 3 weeks, I saw two kinds of animals, one exceedingly small, and the other very large; which latter sort had on the tail something like fins; there were but very few of either sort. The compounded salt or vitriol of the water was shot into pretty figures, but all irregular. They looked like a small heap of little sticks, laid across each other at all angles and positions, only they were transparent, and a little greenish, as crystals of a chalybeate nature use to be.

I have infused whole pepper-corns, bay-berries, oats, barley, and wheat, in water, whose scum, after 2 or 3 days, has afforded animals, as has been often already found by others, at least as to some of them; but I found the greatest numbers and variety in wheat and barley-water, and the fewest in that wherein bay-berries had been steeped.

How such vast numbers of animals can be thus, as it were at pleasure, produced, without having recourse to equivocal generation, seems a very great difficulty to account for. But though the solving of it that way makes short work of the matter, for it is easy enough to to say they are bred there by putrefaction, yet the asserting equivocal generation seems to me to imply more absurdities and difficulties than perhaps may appear at first sight; I wish therefore, that this matter would awhile employ the thought of some ingenious and inquisitive man. In the mean time I have conjectured, that these animalcula may be produced by one or both of the following ways.

1. I have thought that the eggs of some exceedingly small insects, which are very numerous, may have been laid or lodged in the plicæ or rugæ of the coats of the grain, by some kinds that inhabit those seeds, as their proper places. For that insects of the larger kinds do frequently thus deposit their eggs on the flowers and leaves of plants, is often experienced, and it is very probable, that the smaller or microscopical insects do the same. Now these being washed out of the seeds, by their immersion in water, may rise to the surface, and there be hatched into those animals which we see so plentifully to abound there.

2. Or the surface of the water may arrest the straggling eggs of some microscopical insects, that perhaps were floating in the air: and being fitted and prepared for this purpose by the infusion of proper grain, or a proportionable degree of heat, may compose so proper a nidus for them, that they may, by the warmth of the sun, be easily hatched into living creatures, which it is probable may afterwards turn into flies, or winged insects of the same species with the

animal parent. And perhaps sometimes both these circumstances, and others of the like nature, concur for their production.

Account of a Book, viz.—Parochial Antiquities, attempted in the History of Ambrosden, Burcester, and other adjacent Parts in the Counties of Oxford and Bucks. By White Kennet, Vicar of Ambrosden, Oxford, 1695, 4to. N° 220, p. 259.

This book is the first of the kind that has been published. The author has pursued the following method.

1. He has given an account of what traces he could discover of the several inhabitants of this island, before the Norman conquest, within the bounds of those parishes, which he proposed to treat of. As of the Britains, Romans, garrisons, coins, highways, customs, Saxons, Danes, Saxons restored. 2. From the Norman conquest, he has proceeded by way of annals, giving an exact account, under the several years, of the descent of families, the conveyance of estates, and other occurrences, which seemed material towards the full illustration of the history of those parts. 3. He has given the history of the Roman city Alchester, near Bister, composed in the year 1622, by a learned antiquary, who had both judgment and opportunities, to make proper observations on these remains of antiquity. 4. We have the prospects of the most considerable seats in those parts. 5. To these is added a general index of the names of persons and places. 6. A glossary, explaining the obsolete words and phrases which occur in the original charters and records, set down in their proper places; some hundreds of which were never mentioned in any glossary.

This, in short, is the substance of the work; which, upon reading of the title page, seemed only to concern the inhabitants of the several parishes described. But on a farther examination of the book, it is so managed by the learned author, as to be of great use to the lovers of antiquity in general.

On the great Age of Henry Jenkins; in a Letter from Mrs. Ann Savile to Dr. Tancred Robinson, F. R. S. with his Remarks on it. N° 221, p. 266.

When I came first to live at Bolton, it was told me, there lived in that parish a man near 150 years old; that he had sworn as witness in a cause at York to 120 years, which the judge reproving him for, he said he was butler at that time to Lord Conyers, and they told me, that it was reported his name was found in some old register of the Lord Conyer's menial servants. Being one day in my sister's kitchen, Henry Jenkins coming in to beg an alms, I had a mind to examine him: I told him he was an old man who must soon expect to give an account to God of all he did or said; and I desired him to tell me very truly how old he was; on which he paused a little, and then said, that to the best of his remembrance he was about 162 or 163. I asked him what kings he remembered: he said Henry VIII; I asked what public thing he could longest remember? he said Flodden-field. I asked whether the king was there? he said No, he was in France, and the Earl of Surry was general. I asked him how old he might be then? he said, he believed between 10 and 12; "for," says he, "I was sent to Northallerton with a horse load of arrows, but they sent a bigger boy from thence to the army with them." I thought by these marks I might find something in histories, and looking in an old chronicle, I found that Flodden-field was about 152 years before; so that if he was 10 or 11 years old, he must be 162 or 163, as he said, when I examined him. I found by the book, that bows and arrows were then used, and that the earl he named was then general, and that King Henry VIII was then at Tournay; so that I don't know what to answer to the consistencies of these things, for Henry Jenkins was a poor man, and could neither write nor read. There were also 4 or 5 in the same parish, that were reputed all of them to be 100 years old, or within 2 or 3 years of it, and they all said he was an elderly man ever since they knew him; for he was born in another parish, and before any register was in churches, as it is said; he told me then too, that he was butler to the Lord Conyers, and remembered the abbot of Fountains-abbey very well, who used to drink a glass with his lord heartily, and that the dissolution of the monasteries he said he well remembered. Ann Savile.

This Henry Jenkins died Dec. 8, 1670, at Ellerton, on Swale. The battle of Flodden-field was fought on the 9th of Sep. 1513. Henry Jenkins was 12 years old when Flodden-field was fought, so that he lived 169 years. Old Parr lived 152 years 9 months,* so that Henry Jenkins outlived him by computation 16 years, and was the oldest man born on the ruins of this postdiluvian world.

This Henry Jenkins, in the last century of his life, was a fisherman, and used to wade in the streams; his diet was coarse and sour; but towards the latter end of his days he begged up and down; he has sworn in chancery and other courts, to above 140 years' memory, and was often at the assizes at York, whither he generally went a-foot; and I have heard some of the country gentlemen affirm, that he frequently swam in the rivers after he was past the age of 100 years.

* See Vol. 1, p. 819, of this Abridgment.

Microscopical Observations on Eels, Mites, the Seeds of Figs, Strawberries, &c. By Mr. Leuwenhoeck. N° 221, p. 269.

In a letter to Mr. L. the celebrated Mr. Huygens writes thus:

"I am very much pleased, that the longer you labour, the plainer you prove the generation of animals by seed, and not corruption, and I am also of the same opinion. Concerning the generation of eels,* it seems to me very strange, that you find their young ones in the womb without any sign of life; and that you make no mention of any male fishes, which perhaps may by microscopes be found to be living seed. But it would be long to ask you every particular, there being still left innumerable discoveries behind. We ought highly to commend and admire your labour and diligence in these you communicate, by which natural knowledge is daily augmented. I remain yours, &c.

"Chr. Huygens."

It is very true, that when I was anatomizing eels, as well as palingers or silver eels, and to this very day, I never found a male eel nor palinger, or silver eel, that I could call so: for all that I dissected were provided with a womb. Now if there be no male kind among the eels, so the little animals of different kinds, that are found in great numbers on the leaves of currants, cherries, plums and roses, which some call lice, after they are found on the trees, have their bodies all over beset with young ones, and each of them produce their kind, although I could not discern any males of them, neither could I find the least sign of copulation among them.

Now whether this engendering also takes place in the eels, ought to be inquired into; or whether all eels are provided with masculine seed, and so are hermaphrodites, as we fancy; as by copulation, which we sometimes see, for some fœtuses are thus provided: that I have not said heretofore, that I have discovered in all eels their womb, that I concealed on purpose, that in time I might inform and satisfy myself better.

I have now in the winter again dissected some palingers or silver eels, none of those which were locked up all the winter, that they might be sold the dearer in Lent; but such as I have been very well satisfied of, that they were fresh caught: and now again, in the latter end of April, I have examined several of them, that I might, if possible, the better to be satisfied; yet notwithstanding all these observations, I learned no more than before.

On the 10th day of June, when some little boys went down into the town

* Eels are viviparous, the ova first hatching internally.

ditch, and were busy in taking up some green herbs, to find small eels among them, I desired them to bring me a pot full of the smallest of them to my house, which they did accordingly, that I might search them very narrowly, to try whether I could see any more concerning the circulation of the blood than I had discovered before in greater ones. These were from $2\frac{1}{2}$ to 5 inches in length. I put several of the least sort into my small tube, partly filled with water, so that they could but just go into it. When I placed these small eels before the glass, and fixed my eye on the fin near the tail, I saw, with greater admiration than ever I did in my life before, the circulation of the blood in many different parts. And when I contemplated the end of the bone, I saw that very near to the jointing of the last joint, many small veins there met together, and formed a large one, when I took it for granted, that there was a valvula, for there was a strange and quick pushing forwards after such a manner, as if we saw our blood pushed forwards in an artery before our eyes. In short, this contemplation far exceeded all the strange and pleasant ones, that ever mine eyes beheld before. When I turned my eyes towards the fins near the head, it was also very pleasant to see the blood run in many sorts of vessels, and also underneath the head between the jaw-bones. After this I observed the place of the heart; when I saw, with no less admiration, the quick motion of the heart, as well in the systole as diastole, whereby the heart was pushed forward.

I wrote, in my letter of the 10th of July, 1696, of my discovery concerning the procreation or engendering of mites, which are very small and despicable animals, and yet do a great deal of mischief; for by their numberless procreation they consume flowers, seeds, flesh and bacon, and chiefly that which is smoked and dried; and all sorts of dried fruit, as figs, raisins, prunes, &c. Lately examining the mites among some barley,* I saw, with admiration, that some of these mites were of a quite different make from what I had seen before; for they had on their back some brownness, and their bodies had not so long hairs on them as the common ones, and the hind part of their body was of different shape; they had also 8 paws, and before, near their head, were two tools, much thicker than their paws, but not half so long, which were divided towards their ends, into finger-like joints, and furnished with nails like claws; one joint of which, that was the thickest, had on one side extremely small teeth like a saw. I saw also a second kind of mites, different from the former, which at first seemed to be like these; but if you compared them with the former, you would see that they were of another kind, that were sprung forth by mixing

* Several species of mites are occasionally observed among substances of this kind.

with a peculiar sort of mites. But yet of these two sorts of mites, there was but a small number in comparison to our common mites, which I came to find in the flour-like stuff.

I have said before that I have taken a great deal of pains, to see the plant in the seed of a fig, yet that I could never accomplish it, for it seemed to me that the figs were not perfectly ripe, when they were pulled off and tunned up, to be sent beyond seas. But having some lately which seemed to have been gathered ripe, I therefore took many seeds of these figs to dissect them; and after I had cut or broke their hard husk, I brought out their kernel or pith perfect; and after taking off their film, and had separated the stuff wherein the young plant was laid, I saw the perfect plant, consisting of two leaves, and of that part that is to make the roots and stem.

When eating some strawberries, and fixing my eyes on the little apices we see on a strawberry, I concluded that every one of them was a seed; and to confirm my opinion I took a strawberry, one of the largest and ripest, and there I found a great many seeds, after I had taken off the film wherein they were wrapt up, and found that every seed had also a string by which they were nourished. I opened several of them, by taking off their hard husk, and saw, that every one of them had the stuff we call a pith: having separated this pith from its ancient film, I took out the plant, which I also caused to be delineated, that we might see how many seeds we send together into our stomach, when we eat but one spoonful of strawberries; for when I divided one of the largest into four equal parts; I found in one of these parts about 50 seeds; according to this, the strawberry contained 200 seeds, and another that was much less I guessed to contain 120. Now if we consider that a young plant of strawberries shoots in a year (for I never heard that they sow strawberries) into several shoots over the ground, which take root, and grow all up into plants, and bear the next year; and that besides this, each plant produces many strawberries, each whereof has as many seeds as is before said: we must lay our hand on our mouth, and be astonished at the increasing and great multiplicity of seeds of this plant.

When I observe any remarkable things on small creatures, then I make it my business to consider of the greater ones, which entirely agree with the lesser ones. When some years ago I fancied to see that subtle hair, which the flies have in great abundance about the end of their feet, which are delineated by several; by the help of which hair the flies can run up on any smooth body or glass; that every one of these hairs had a hook-like part on their end, with which they could hold themselves more firm to the glass, which hook fashioned parts on each little hair I could never see, although they were mentioned by others. When I pursued this inquiry, I came to think of the great lobsters (although there is no similarity between them and flies in their shape) which, as I am informed, are caught on rocks near the seas in Norway, and are now and then brought to us for sale, their feet are also surrounded with many hairs, to see how these hairs, and chiefly those on the hindermost feet were constituted, because these feet have no claws or nippers to take hold of any thing, as the other feet have, and each of them is only furnished with a small claw standing exactly or straight forwards, and with many small and short hairs. When I brought these hairs before the magnifying glass, I saw, with great admiration, that many hairs were furnished with two rows of many teeth-like parts, which stood in very neat order one by the other, just as if we imagine that the back of a knife was on each side wrought out into a row of small teeth. Hereupon I imagine, that when this lobster runs up against the rocks, his feet cannot slip out, being firmed by the multiplicity of these teeth-like parts.

Microscopical Observations and Experiments. By Mr. Stephen Gray. N° 221, p. 280.

Those congruous properties, known to be in small drops of water, viz. transparency, refraction, and sphericity, led me to conjecture that they might, if aptly disposed, be not unfit for microscopes, since they have the proper requisites that make the glass globules excellent ones; and accordingly experience informs me, that though the latter are to be preferred, yet the water, on a necessity, may be very well used, as a succedaneum to glass microscopes, which I have sometimes made trial of in the following manner.

I take a thin piece of brass, filing it into the form AB, fig. 1, pl. 3, making a small hole at A, which serves for an aperture; then, holding it by the other end B, I pour a few drops of water on the table, taking up a small globule thereof with a pin, which I lay on the hole A; then, removing the pin, the water will remain on the aperture, in form of a hemisphere, or to speak with opticians, a plano-convex lens. But if I have a mind to make a double convex of water, I thrust the pin, which must be less than the hole, through the hole, till the water be entered therein; then by drawing the pin perpendicularly to the plane of the aperture, the water remains there in form of an aqueous double convex lens. Then whatever I have a mind to view I take upon a pin, or a piece of glass, according to the nature of the object; and taking up this natural microscope by the end B, I move the object to and fro, till it be in its focus; by which means I can see objects little less distinctly, than by glass microscopes, especially by candle, which I find much better than day-light.

But I observed that those irregular particles, which are inherent in the globules of glass, were seen distinctly and prodigiously magnified, as was easy to imagine, both from their nearness to the eye, and because they did not hinder the globules, either by day or candle-light, from appearing throughout transparent, being so minute as not to be discernible, except held close to the eye, as in time of observation, and not then neither, if too near the light, but at a competent distance, they appeared as above. I knew not well how at that time to account for this strange phenomenon, that an object should be placed so far within the focus of a spherule, as to be within the glass, and yet seen distinctly to the eye so near it; but since by matter of fact, I found it was so, I made this inference, and concluded, that if I conveyed a small globule of water to my eye, and that there were any opacous or less transparent particles than the water therein, I might see them distinctly.

Having by me a small bottle of water, which I knew to have in it some of those minute insects which Mr. Leuwenhoeck discovered, by the help of excellent microscopes: having seen them with the common glass microscopes, and with the first aqueous, as abovementioned, I poured a few drops of this water on the table, and taking a small portion of it on a pin, I laid it on the end of a small piece of brass wire; I continued to lay on two or three portions of water, till there was formed somewhat more than a hemispherule of water; then keeping the wire erect, I applied it to my eye, and standing at a proper distance from the light, I saw them and some other irregular particles, most enormously magnified; for whereas they are scarcely discernible by the glass microscopes, or the first aqueous one, within the globule, they appeared not much different both in their form, nor less in magnitude than ordinary peas. They cannot well be seen by day-light, except the room be darkened, after the manner of the famous dioptrical experiment, but most distinctly by candle-light; they may be very well seen by the full moon light. The pin sometimes takes up the water round enough to show its objects distinct.

The insects I have as yet this way observed, are of two sorts, globular and elliptical; I shall first describe the former. They are of a globular form, and are but a little less transparent than the water they swim in; they have sometimes two dark spots diametrically opposite, but these are rarely seen; there are sometimes two of these globular insects sticking together; where they are joined it is opaque; they have a twofold motion, a swift progressive irregular one; and at the same time a rotation on their axes at right angles to the diameter that has the dark spots; but this is seen only when they move slowly. They are almost of an incredible minuteness. Mr. Leuwenhoeck is moderate enough in his computation, when he tells us (Philosophical Transactions, N° 213,) he saw insects in water, so small, that 30000 could not more than equal a coarse sand; but I believe it will seem a paradox to him, when told that they can be seen only by applying the bare eye to a portion of water wherein they are contained.

I have examined many transparent fluids, as water, wine, brandy, vinegar, beer, spittle, urine, &c. and do not remember to have found any of these, without more or less of the bodies of these insects; but I have not seen any in motion, except in common water, that has stood for some time, as has been observed by Mr. Leuwenhoeck; though I do not remember he has observed that they are existent in the water before they revive. In the river, after the water has been thickened by rain, there are such infinite numbers of them, that the water seems in great part to owe its opacity and whiteness to these globules. Rain-water, as soon as fallen, has many, and snow-water has more of these globules: the dew that stands on glass-windows has them; and forasmuch as rains and dews are continually ascending or descending, I believe we may say the air is full of them; they seem to be of the same specific gravity with the water they swim in, the dead remaining in all parts of the water; of many thousands that I have seen, I could discern no sensible difference in their diameters, appearing of equal size in water that has been boiled; they retain their shapes, and will sometimes revive.

There is another sort of insects which I have this way seen; but these are not so frequently (at least this winter season) to be found; they are much longer than the former; they can transform themselves into many shapes; they are for the most part elliptical, but sometimes they contract themselves so as to be almost globular; and sometimes they extend themselves, so as to be twice or three times longer than broad; these sometimes turn themselves round on their axes and diameters as they go; they consist of transparent and opaque parts.

The first of these natural microscopes performs its effects by the same laws, viz. by the refraction of the rays of light, as the glass ones, and differs from them in nothing but its material, water: but when I began to attempt to satisfy myself how objects are distinctly seen in a spherule of water, I found it at first somewhat difficult to explain; for whereas objects being placed in the focus of a convex glass, and consequently of water, are seen distinctly to the eye on the other side the glass, and so the reason of the former is obvious enough; but it is as certain, that if an object be placed so much nearer to the eye than the focus of a sphere, as to be within its surface, the rays of light must come too much diverging, to show the objects they come from distinctly.

But at length, that other known property, if I may so call it, of light falling on different mediums, coming into my thought, viz. reflection, I found there might be a very easy and natural reason given of its performance, which I shall now endeavour to demonstrate, on supposition that the inferior surface of the sphere is reflective. Let the circle in fig. 2, pl. 3, represent a sphere of water; A an object placed in its focus, sending forth a cone of rays, two of which are AB, AB, which coming into the water at B and B, will be refracted from their direct course, and become BD. At D they will, at their passing into the air, be again refracted into DE, DE, and so run parallel to each other, and to the axis of the sphere AECG. Now it is a known and fundamental principle in optics, that the angle of reflection is equal to the angle of incidence; therefore let the rays BD, BD be imagined to come from some point of an object placed within a sphere of water, by being reflected from the interior surface of the sphere at B, B; CBD is the angle of reflection, to which making CBF equal; so will F be the place where an object sending forth a cone of rays, two of which are FB, FB, which are reflected into the rays BD, BD, and then coming to the other side of the sphere at D and D, they are refracted into DE, DE, as before, and consequently be as fit for distinct vision, whether the object be placed in F within, or in A without the sphere, if its interior surface be considered as a concave reflecting speculum.

That the interior surface of glass, and consequently of water, is reflecting, common experience shows; but whether any one has before observed, that the air is specular, is to me unknown: but I have a very few days since, as I was endeavouring to improve this natural catadioptric microscope, stumbled on an aërial concave speculum, which I shall now describe.

A darkened room being somewhat troublesome to make, I thought it proper to try, if this inconvenience might not be remedied; so I took a stiff piece of brown paper, pricking a small hole in it, then applied the drop of water to my eye, and holding the paper with the hole at a little distance before me, I could see the globules therein little less distinctly than in a darkened room. But before I had removed the water, there appeared to me a very strange and surprising appearance: I saw the needle's point, together with the water, inverted: I could scarcely at first believe my eyes; to be further satisfied, I removed the water, and found that whether I held the needle perpendicular, horizontal, or inclined, to all these positions it was inverted. I then made many holes, and in every one I saw the inverted picture of the needle; the nearer the needle was to the holes, it was so much the more magnified, but less distinct: if the needle's point was so held, as that its image was near the edge of the hole, its point seemed crooked. So that it seems these small holes, or somewhat in them, performs the effects of a concave speculum; whence I take leave to call them aërial speculums. But how the rays of light can be reflected, before they come to a medium of a different density; or how, or by what means the air remains in small holes, in a concave spherical form, I must leave to the learned to determine.

On the Use of Opium among the Turks. By Dr. Edward Smyth, F. R. S. N° 221, p. 288.

My residence in Turkey having given me an opportunity of informing myself, how far the Turks are gone into the use of opium, and what are the common effects of it; I presume to offer an account of my observations to the Society.

I made inquiry for the most famous opium eater in the country about Smyrna, and had recommended to me one Mustapha Shatoor, an inhabitant of Sediqui, a village 6 miles from that city, by trade a coffee-man, and 45 years old when I discoursed with him. He told me his constant eating, was three drams a day of crude opium, one half of which was his dose in the morning, and the other half in the afternoon, but that he could safely take double this quantity.

Resolving therefore to be an eye-witness of what he could do; I provided the best opium I could get, and weighed it nicely into drams; I desired him to come to me before he had taken any part of his dose, and that I would entertain him the next morning; he took the invitation thankfully, and came to me the next day, at 9 in the morning, but excused his having taken half a dram before, because he wanted strength to rise out of his bed without it. I laid before him my opium made up in pills, each weighing a dram, and desired him to eat what he pleased; he took one dram and a half, making it up in three pills, and chewing it with a little water; he commended the opium, but was not willing to eat more at that time, and I would not press him, for fear of accidents. He stayed with me about half an hour after he had eaten the opium; the visible effects it had upon him were to make his eyes sparkle, and to give a new air of life and brightness to his face. He told me, that he was extremely refreshed, and made very cheerful by my entertainment, and that it gave him his keph, as the Turks express it.

He went from me to his coffee-house, and being desirous to observe him that day, I found him in half an hour labouring heartily at cleaving wood to burn. I desired his company again, when he was prepared for a 2d dose; he came to me at 3 in the afternoon, and took the same quantity as in the morning, and appeared after it with the same symptoms. He told me he would be again ready for the same quantity, at the same distance of time, but I pursued the experiment no further. He says it has always the same effects, giving him vigour and spirit, and is now become as necessary to him, as any other part of his sustenance; that it makes him fitter for procreation, for he has many wives and children; that it never affects him with sleep and drowsiness, but rather hinders his reposing, when he happens to take too much of it; that he entered upon this practice 25 years ago, beginning with the quantity of a grain, and so training up nature gradually to larger quantities; that the want of it, and the desire of taking more, grows daily upon him; that his common expence for living, is 3 parahs a day in opium, 1 in tobacco, 2 in coffee, and 2 in bread; a parah is about a penny farthing in our money.

The alteration and impairment which this custom has produced in him are, weakness, his legs being small, his gums eaten away, so that the teeth stand bare to the roots, his complexion very yellow, and appearing older by 20 years, than he really is. I asked him if he knew any body who could take opium in larger quantities; his answer was, he believed there was none in that country that could outdo him, but that he was informed of some in Arabia and about Damascus, where this custom of eating opium obtained more universally.

Opium is commonly taken by the messengers in Turkey, who are employed in making quick dispatches; it is generally part of their provision; they take it when they find themselves tired, and it gives them strength and spirits to proceed. The Turks use opium, made up with something that renders it palatable, at their feast called Biram, to make them cheerful; which may be one reason of its prevailing so much; for finding it then entertains them with pleasing fancies, they are tempted to continue it, and so the use of it becomes necessary and grows upon them.

Part of a Letter from Dr. Cyprianus to Dr. Sylvester, giving an Account of a Child born with a large Wound in the Breast, supposed to proceed from the Force of Imagination. N° 221, p. 291.

A lady was delivered of a girl, with a wound in her breast, above 4 fingers long, extended obliquely downwards, over the whole breast. I found not only the wound outwardly in the skin, but after a nearer examination, I perceived that it not only penetrated to the musculi intercostales, but that it was at least an inch broad, hollow under the flesh round about the wound: besides, that there was a contusion with a little swelling, red and blue as usual in contusions, at the lower part of the wound in the inside.

This lady had an easy and natural delivery, and it was a natural birth, as the child came into the world without any force, so that consequently it got not this wound in its birth, but was occasioned by strength of imagination, about 2 months before: when the mother being gone to bed, by chance she heard a report that a man had murdered his wife, and with a knife had given her a great wound in her breast, at which relation she changed, but not excessively.

Now my opinion is, that the child at the very moment that the mother was frighted, received the wound in its mother's body, as the wound was very sordid; and the inside as well as the outside beset with slime, proceeding from the water wherein the child is used to lie in its mother's womb, and it was also very like an old wound. But what is most worthy of reflection is, that the wound after three or four days' dressing, beginning to come to suppuration and mundification, began to bleed very fast with streams when dressed and wiped; and it plainly, in all its circumstances, was very like a fresh cut wound; only that the ends of the cut vessels were so covered with slime, that the circulation could not force the blood through it.

Account of a Book, viz.—Catalogus Plantarum, quæ in Insula Jamaica sponte proveniunt vel vulgo coluntur, cum earundem Synonymis et Locis Natalibus, &c. &c. Autore Hans Sloane, M. D. Lond. 1696. *8vo.* N° 221, p. 293.

A catalogue of plants which grow naturally or are cultivated in Jamaica and other parts of the West Indies.

An Account of 4 sorts of strange Beans frequently cast on Shore on the Orkney Isles, with some Conjectures on the Manner of their being brought thither from Jamaica. By Hans Sloane, S. R. S. N° 222, p. 298.

I had several times heard of strange beans frequently thrown up by the sea on the islands, on the north-west parts of Scotland, especially on those most exposed to the waves of the great ocean; they are no otherwise regarded than as they serve to make snuff-boxes. Four sorts of them have been sent me, very fresh, being little injured by the sea: three of these beans grow in Jamaica, where I have gathered them, and have mentioned them in my catalogue of the plants of that island.

The first is what is there commonly called cocoons, by me phaseolus maximus perennis, folio decomposito, lobo maximo contorto.* It grows in both the hot East and West Indies; and it is said to be cast up on the coast of Kerry in Ireland.

The second sort of bean sent from Scotland, is what in Jamaica we call commonly horse-eye bean,† from its resemblance to the eye of that beast, by means of a hilus or welt, almost surrounding it. This bean also is common to the

* Mimosa scandens. Lin. † Dolichos pruriens. Lin.

hot parts of the East and West-Indies. The third kind, from the same place, was what in Jamaica is called ash-coloured nickar,* from its being perfectly round and very like a nickar, such as boys use to play with. This is likewise common in the hot parts of the East and West Indies. The fourth sort I never saw grow, but have seen several of them in collections of rare fruits. It is well described but ill figured by Clusius, Exot. lib. 2, cap. 16, p. 41, with the title to it, Fructus Exot. 9, à Jac. Gareto acceptus, and is the Fructus exot. orbicularis, sulcis nervisque distinctus 4us seu fructus alter splendens quatuor sulcis distinctus. C.B. Authors are silent as to the place of its growth.

How these several beans should come to the Scotch isles, and one of them to Ireland, seems very hard to determine. It is very easy to conceive, that, growing in the woods in Jamaica, they may either fall from the trees into the rivers, or be any other way conveyed by them into the sea. It is likewise easy to believe, that being got to sea, and floating in it in the neighbourhood of that island, they may be carried from thence by the wind and current, which being obstructed by the main continent of America, is forced through the gulph of Florida, or canal of Bahama, going there constantly E. and into the N. American sea; for the lenticula marina serratis foliis, Lob. or sargasso grows on the rocks about Jamaica, and is carried by the winds and current towards the coast of Florida, and thence into the northern American ocean, where it lies very thick on the surface of the sea. But how they should come the rest of their way I cannot tell, unless it be thought reasonable, that as ships when they go south expect a trade-easterly-wind, so when they come north, they expect and generally find a westerly wind, for at least two parts of three of the whole year; so that the beans being brought north by the current from the gulph of Florida, they may be supposed by this means at last to arrive in Scotland.

By the same means that these beans come to Scotland, it is reasonable to believe, that the winds and currents brought from America those several things towards the Azores and Porto Santo, which are recorded by Fernand. Columb. in the Life of his father Christopher, to be some of the reasons which moved the said Christopher Columbus to attempt the discovery of the West Indies. The things mentioned by them, are 1, a piece of wood ingeniously wrought, but not with iron, taken up by Martin Vicenzo, a Portuguese pilot, 450 leagues at sea, off Cape St. Vincent, after a west wind of many days. 2dly. Another piece of wood, like the former, taken up by Pietro Correa, on the island of Porto Santo, after the like winds. 3dly, Very large canes, much beyond any growing in those parts. 4thly, Some of the inhabitants of the Azores observed,

* Guillandina Bonduc. Lin.

and told him, that W. winds brought pines to these islands, especially Fayal and Graciosa, which are not found growing in those parts; and that on another of those islands, viz. Flores, was cast on shore two men's bodies, with larger faces, and different aspects from Christians: and that at Capo della Verga were once seen two canoes or barks with cabins, which were believed to be forced to sea, when accidentally they had been going from one island to another.

On a large diseased Kidney. By Mr. Wm. Cowper. N° 222, p. 301.

The subject of the present observations was a young gentlewoman, not married, who, about 8 years before her death, found some small pains in the lumbar regions, and sometimes made blackish urine. If at any time she used any motion, the pain would increase; commonly finding most ease when her body was sedate. In this indisposition her physicians in the country prescribed astringent medicines. About 2 years after, the lumbar pain increased on the left side, followed by a great weakness, loss of appetite, and ill digestion. Of these indispositions she recovered again, and was in all appearance healthful, and so continued near 2 years and a half: about which time they returned again, together with black urine, and frequent incitations to vomit: but of these disorders she had some intermissions, and so she continued about 2 years. About Christmas last (1695) she began to be afflicted with violent pains, and her urine appeared very black: of these successive pains she was much eased by the use of common clysters, but yet she continued much debilitated. The beginning of May last the pains increased about the regions of the loins and pubes, and she was once or twice surprised with the falling down of a weight within her, as she expressed it. When thus tormented, she took large doses of opium, which somewhat alleviated the extraordinary pain. The usual position of the trunk of her body was more inclining to be erect, than bending forwards, contrary to what we find in those troubled with the stone in their kidneys or ureters, except those in whom the kidneys are tumefied. She complained of a stupor or numbness in the left region of the loins, whilst very acute pains affected the viscera of the lower belly, especially those placed in the hypochondria. The pains in her pubes increased near the time of her death, and a great stupor affected the left thigh, which she was scarcely able to draw after her, much less to put forwards in walking.

On dissection, a large tumor appeared in the left ilia, extending itself to the left part of the epigastrium, even to the hypochondrium of that side. The omentum appeared very thin and membranous, adhering to the left kidney which was very much tumefied, and caused that appearance of a large tumor above-mentioned before dissection; this kidney had taken place of the spleen, and touched the bottom of the stomach, and in such manner pressed on part of the colon, as very much lessened the diameter of that gut. The stomach and small guts were somewhat distended with wind: the former appeared very loose, as if its proper tone was much relaxed. The pancreas appeared a little indurated, the left spermatic vein very much distended, between the kidney and the ovarium; the upper part of that vein being compressed by the superincumbency of the lower part of that kidney; insomuch that the trunk of this spermatic vein was very much lessened, immediately before it enters into the left emulgent vein. In freeing this diseased kidney from its many adhesions to the neighbouring parts, its external membrane happened to burst in two or three places, whence issued a large quantity of grumous blood. This kidney weighed 5 lb. and the other but 5 oz. which was of a common size, and no ways disordered. By the distension of the membranous parts of the kidney itself its veins were in a great measure compressed. Its ureter was become large by the intumescence or thickening of its sides, by which its cavity was straightened. In a division made, by cutting into the body of this swelled kidney, its inside appeared like that of a scirrhus or boiled liver. I found two or three large cells, filled with grumous blood, which proceeded from a rupture of some blood vessels before death, which I am apt to think might alarm the patient with the apprehensions of some weight falling down, as she expressed it. The rest of the viscera of the lower belly appeared in no ill state, except the vagina uteri, in which, near the meatus urinarius, was an ulcerous appearance, attended with a mortification. The left psoas muscle was very much lessened by the compression of the lower part of that kidney; and the nerves distributed to some parts of the thigh, which pass through that muscle, were exposed to view.

Nothing disordered appeared in the thorax, but what is commonly observed after death in all chronical diseases, viz. a polypus in each ventricle of the heart, and great blood-vessels, of which I have commonly observed the right ventricle and the veins to be furnished with the largest polypuses, especially the vena cava and right auricle; the latter of which I lately found completely distended with a polypus, or coagulation of serum, in the body of a boy who died with a hydrops thoracis; in which case the symptoms of sighing and difficulty in inspiration I have always found remarkable. I cannot but think the slow return of the blood by the veins is the immediate cause of the coagulation of the serous part of the blood which frames these bodies, which, from the figure they acquire from the parts they are lodged in, are called polypi; hence it is the systole of the heart prevents their being framed so large in the left ventricle and arteries as in the right and the veins; the blood being carried through the former with much greater force than the latter; though in the left ventricle of the heart and arteries too I have sometimes met with polypuses very large: but I always found the right auricle and ventricle to be furnished with the largest.

Blackish urine I believe is commonly observed in many feverish indispositions, where the blood is either partially obstructed in its return by the veins of the kidneys, or through its great velocity in passing the kidneys, when some parts of the globules of the blood also pass out at the urinary pores in the sides of the blood-vessels, and those globules being broken exhibit those blackish bodies which appear in the sediment of the urine. In these cases, the serum of the blood passes off with the urine; for by evaporating such urine by heat, as in a spoon over the candle, it will become thick, like the true serum of the blood.

Obstructions commonly begin in the most capillary vessels first, as I have frequently observed in viewing the transparent fins of divers living fishes with a microscope; and though it has been hitherto commonly supposed, that veins and arteries are all equally lessened at their extremities, yet I am of opinion, that the extremities of divers blood-vessels are much larger than their fellows; hence an account may be given of the partial circulation of the blood, and yet mortifications not necessarily succeed, as in the present case. For the kidney here being vastly distended, which proceeded from a retardation of the refluent blood and lympha, it is conceivable that the obstructions began in the membranes, which compose the parietes of the trunks of the veins and lymphæducts, whence an intumescence necessarily follows, and the cavities of those vessels are lessened; consequently the refluent blood or lympha not being duly discharged, those larger vessels are necessarily distended between their tumefied sides with compressed cavities, and their extremities at the arteries. Thus we may apprehend how a part remains tumefied under a partial circulation, and may (when no bad juices taint the blood and lympha) continue so for some months, nay years, as in the present case, without any disorder to the patient; but on such motions of the body, as accelerate the motions of the blood, at the extremities of the vessels when there is a greater quantity of blood imported than can be discharged by the veins; whence a sudden intumescence arises, and pains necessarily follow. What astringent medicines avail in such like cases is difficult to conceive; but aperitives might be serviceable. Loss of appetite, bad digestion, &c. attend nephritic cases, by the nervous communications of those of the kidney with the stomach, &c. whence the tone of that part, as well as the intestines, especially the colon, becomes vitiated, and subject to frequent disorders, especially vomiting and colic pains. By the tone of that part, I mean that proper distribution of the nervous ramifications within the part when distended, as in this case, and intestinal ruptures, as they are called, and the like; or when the nervous ramifications are relaxed, as in paralytic cases, &c. The tone of the part necessarily becomes vitiated, inasmuch as its nervous distributions are disordered. The contents of the stomach and guts, not being duly carried on, are apt to ferment; the contained air being rarefied by the natural heat, the intestines become very much distended; whence colic pains and disturbances in those parts sometimes arise; hence by procuring the evacuation of this contained wind, the patent is relieved, as by the injection of clysters, &c. Concerning the operation of opium, and how it procures ease in this and similar cases, I shall only relate what occurred when an ingenious person and myself examined a solution of opium with the microscope; the particles of the dissolved opium appeared like fringed globules; these particles, if so conveyed to the mass of blood, might so entangle in its serum and thicken it,* as to retard the globules of the blood, and prevent their progressive motion at the extremities of the blood-vessels: hence the blood, not passing with its wonted velocity, does not so suddenly distend those enlarged vessels, which have a considerable share in the intumescence of the part; but by making the globules of the blood pass more calmly, may prevent their sudden efforts, or intrusions into those distended vessels. The tumefied kidney not only compressed the left spermatic vein, by which the refluent blood of the uterus, vagina, and parts adjacent, was in some measure retarded, but some of the nerves of the vagina, and those of the pudendum, were also compressed by it; hence arises pain from inflammation, through a retardation of the blood, at the extremities of the vast number of blood-vessels, about the meatus urinarius, at its egress in the vagina; whence exulceration and mortification ensued. The magnitude of this kidney prevented the bending forwards of the body, whence she was obliged to keep it erect. The lower part of the left kidney had so compressed the left musculus psoas, as scarcely a third part of its proper bulk remained; whence necessarily followed a great weakness in drawing the thigh forwards; she had a great stupor in that thigh, through a compression of the lumbar nerves, which lay exposed immediately under the tumefied kidney.

I am apt to think, that cases not unlike this are often taken to proceed from stones in the kidneys or ureters; but I conceive that unusual posture in keeping the body erect, may distinguish it: together with a weakness of drawing the thigh and leg forwards. If these symptoms do not conjunctly occur, yet by this we may perceive, that nephritic disorders are not, as is commonly throught, owing to stones, whether in the kidneys or ureters.

Ballonius Epidem, p. 220, mentions a case not unlike this, of a tumefied kidney 4 times as large as natural.

* This mechanical hypothesis concerning the action of opium is inadmissible.

Cabrolius Observ. 28, at the latter end of his Alphabetum Anatomicum, notices a kidney he found imposthumated in a dead body, which weighed 14 lb. occasioning symptoms that were supposed by several of the medical persons who were consulted, to proceed from a stone.

Account of a Stone of the Bladder, which weighed 51 *Ounces, and a Stone out of the Bladder which adhered to it. By Dr. Charles Preston.* N° 222, p. 310.

In the Hospital of Charity at Paris, is preserved, among a great number of stones extracted from the bladder by the operation of lithotomy, one of a prodigious size, weighing about 51 oz. or 3 lb. 3 oz.; it was taken from one of the religious brothers in the house, who attends the sick, in the month of June, 1690; but he died in the operation; for the stone being so large, it could not be extracted till after his death. It is kept as a great curiosity.

In the month of June, 1696, while I was at Ghent attending his majesty's hospital, a very singular case happened in the operation of lithotomy, viz. a stone adherent to the bottom of the bladder: this was found by M. Parfaim, lithotomist of the place, who, when he made the operation, could not extract the stone, but was obliged to leave his patient in that case: there ensued an imposthume, so that 8 days after he extracted it with great ease. The next day he showed me the stone, to which the fibres by which it was tied were yet attached, and could be easily observed by the naked eye, without the help of a microscope; so that I could not question any thing as to the matter of fact. All those that I had occasion to converse with of lithotomy, while at Paris, deny that the stone is adherent to the bottom of the bladder, and that they never observed the same; and I do not remember of any author that writes of it, so that it seems to be a case altogether new.

Effects of a very extraordinary Thunder near Aberdeen in Scotland. In a Letter to Dr. Geo. Garden. N° 222, p. 311.

This happened July 24, 1695. The day was clear and pleasant, till about half past 3 afternoon; when some rain fell; then two claps of thunder, rather moderate; then fell a heavy shower of hail, accompanied with a third clap of thunder, very tremendous, attended with great damage to the houses and people. In a school were the master and 15 boys; the building was perforated and shattered in several places, illuminated as with a strong and sudden fire, attended with a suffocating and sulphureous smell and dark smoke. The persons were all either struck down, or badly wounded and bruised. Four were killed outright, the rest recovered in due time. In the parts where they were struck, which was chiefly about the shoulders, the flesh was much discoloured, and the clothes there cut or perforated, to appearance as if eaten by rats.

Of a Fœtus lying without the Uterus, in the Belly. By M. Savard, Surgeon at Paris. N° 222, p. 314.

A woman big with child came to l'Hotel-Dieu, to lie-in of her 3d or 4th child; and after excessive pains about the navel and the lower part of the belly, by the different motions of the child, she died there.

On opening her, the child was found dead, not in the matrix, which they found entire, but near it. Having examined the body with attention; all the parts of the matrix, both inward and outward, as also the vagina, were very sound. The uterus was as large as it uses to be in women 10 or 12 days after they are brought to bed. The internal orifice was of a livid colour, occasioned by the several touchings of it, both before and after death. There was no mark of a cicatrice or hole, but those of the processes, called tubæ fallopianæ, which yet were hardly wide enough to admit of a hog's bristle. All the company agreed, that the child was never conceived in the matrix, and that it never had staid there. The right testicle or ovarium was very sound, but the tuba and its fringe were rotten in the place where it is fastened to the membranes of the peritonæum, which formed the bag in which the child was wrapped. The left testicle was of the size of a hen's egg, full of a fetid serum, and the ligaments large; the tuba and its fringe were putrid. This bag was placed between the matrix and the straight gut, in the cavity formed by the bending of the os sacrum; the child was on its knees, lying towards the right side, and seemed to have been dead 7 or 8 days. The child had left its placenta, though still fastened to it by the umbilical vessels; and the placenta, being out of the bag, was on the left side, whence was voided a great quantity of blood into the capacity: its edges being brought near to each other, represented a bowl, such as they play at nine pins with: all the membranes that formed this bag, and those that encompassed it, were gangrened.

Part of a Letter from Mr. Halley, at Chester, Oct. 26, 1696; giving an Account of an Animal resembling a Whelp voided per Anum by a Male Greyhound; also of a Roman Altar found there, &c. N° 222, p. 316.

The account the Society had from Dr. Wallis, about a year since, of a greyhound dog that voided an animal resembling a whelp per anum, as strange and incredible as it may seem, is yet here stedfastly believed; and the creature was kept for some time in spirit of wine, having lived for some short time after it came into the world: and it was seen alive by Mr. Roberts of the society, then in Chester.

I this morning was shown an altar-piece, dug up here about 3 years since, and took its inscription, which is pretty entire, but roughly cut in the stone of the place, which is soft and mouldering, nor capable of long continuance when exposed to the air.

It appears that this inscription was of the Bas Empire, not before Dioclesian, nor yet so late as Theodosius, it being Pagan. The stone itself is about 32 inches high, 16 in breadth, and 9 thick. On the one end is engraven, not very well, the resemblance of a genius, holding a cornucopia; on the other is a flower-pot, somewhat better executed, but a little damaged by the softness of the stone. The backside, opposite to the inscription, is adorned with a pretty sort of foliage, designed to fill up the vacant space. On the top, in a pretty deep cavity, is a full face of a man, almost such as they paint the sun or full moon with, with a cap on his head, of which as yet I cannot comprehend the design.

Account of a Roman Pottery, near Leeds in Yorkshire. By Mr. Ra. Thoresby, in a Letter to Dr. Lister. N° 222, p. 319.

I wish your opinion concerning a Roman pottery, that I have lately discovered in this parish: it is upon Blackmoor, about 2 miles from Leeds, the old Leogeolium. The name Hawcaster rig gave me the first occasion to hope for some Roman ruins there; but instead of the remains of a regular camp or fortification, I was surprised to find several circular heaps of rubbish, far too small for any military use; one was 16 perches round, another in walking 76 paces; and these I take to be ruins of some of the furnaces. The ground is sandy, yet plenty of clay is at no great distance; the country people tell me of heaps of slag and cinders. I fancy these might be for their bricks, because of the great plenty of clay in the neighbourhood, and the great number of those Roman bricks yet to be seen in the ruins of Kirkstall-Abbey; and that it belonged to the Romans, I conclude, partly because the inhabitants have no tradition of any modern pottery, but chiefly because it is seated on a branch of the Roman way, or one of their viæ vicinnales, that leads from the great military road upon Bramham moor, by Thorner, Shadwell, and Kirkstall, to Cambodunum; besides the very name seems to import some Roman castrum. The village that succeeded the old pottery is called Potter-Newton.

Account of several Shells observed in Scotland. By Sir Rob. Sibbald, in a Letter to Dr. Lister, with some Shells. N° 222, p. 321.

Of Univalves.—The rarest are, 1. The nautilus falconeri.* The structure

* Nautilus Pompilius.

where the animal lies is marvellous: there are two decks visible, one above another, of a pearl colour; there is a hole in the upper deck naturally, through which may be seen the other deck at some distance from the upper, and such another hole in it; the higher part of the shell, which resembles a helmet, where it is broken, shows several vaulted divisions, between which passes a tube that is hollow: they are of the colour of pearl too. The outermost coat of the shell is of a dark grey colour, which is much worn off in this specimen, and there appears a smooth coat, with brown and white streaks.

The next is that which Boccone calls the pediculus ceti. It is of one valve; but what is singular, it is open at both ends; the structure of it is throughout very curious; the animal was so dried, that I could not distingush its parts; but it must be of an odd shape, if it fit the sinuous caverns in the inner part of the shell.

The testudo marina squamosa* is sometimes cast on the Orkney isles; the shell of one sent to me, was 2 feet in length, and of a proportionable breadth. There is a great variety of the patellæ or limpets found in the isle of Sky. Besides the common patella, there is one of a middle size, of a dark grey colour, which is much flatter than the common patella; the circle about the peak is of a lighter colour; many striæ run from the peak to the border, and it has another larger circle near the border. There is another flat one, also of a grey colour.

There is a conical limpet, raised, with the peak white, and a circle below it of an orange colour; the rest below that of the same colour, variegated with black spots. There is a conical one too of a middle size, smooth and brownish, with a white peak. There is an oval limpet,† of a fucal size, thin and transparent, the peak of a dark colour; in the convex part below the middle, there are some blue and very beautiful lines.

There is a great variety of the trochi likewise. The trochus albidus maculis rubentibus distinctus, a large and a lesser sort of them. A trochus of a middle size, of the colour of pearl all over; which was taken up out of the sands. A trochus of a reddish colour, marked with dark spots. A trochus of a colour between blue and grey, marked with dark spots; this had a cancellus in it. I have been told too, that there is in the isle of Sky a trochus of a gold colour.

Cochlea Umbilicata.—There is a small sort of the cochlea umbilicata, with waves of a brown colour on a white ground. There is a lesser cochlea umbilicata, with darker waves on a white ground.

* Testudo imbricata. Lin. † Patella pellucida. Lin.

Cochlea Fasciata.—There is a small cochlea fasciata, with the fasciæ brown, on a white ground. Another of that sort, with the fasciæ darker, on a pale ground. A small cochlea, yellow all over. A small cochlea of an orange colour. A small one of a brown colour, smooth, with waved lines of a dark colour.

Nerita.—There is a small nerita of an orange colour. One of the cochlea convins of a smaller sort, of an ochre colour.

Of the Bivalves.—There is great variety of the pectines we call here clams. One of the middle size, with two ears, very white. One of a dark colour, variegated with white streaks and spots. Of the least sort, about the size of the Roman silver medals, and some less. One with two ears, with orange spots, on a white ground. One entirely of an orange colour. One of a purplish colour. One variegated like a gilliflower, with broad purplish and white spots. The lines of this run transverse. As do these, one with reddish and white streaks. One with white spots on an orange ground. One with a white ground and dark spots.

With the Lines Perpendicular.—One with two ears, with a dark ground, and the lines white and straight. One of an ear of a purplish colour. One of a brownish ear, the upper part of the shell raised somewhat above the edge, and the edge is more striated.

Of the Tellinæ.—One with white and blue fasciæ. One with the fasciæ yellowish and obscure.

Of the Conchæ Læves.—One large, with the fasciæ dark, and some white lines running from the peak to the border. One of a middle size, with the fasciæ bluish, on white perpendicular striæ. A third, least of all, with white fasciæ on a reddish ground. A pectunculus, with a fasciæ of a greyish colour, and three straight lines. A pecten of a small size, consisting as it were of 4 shells, each of them raised somewhat above another, of a greyish blue colour.

Of the Quinquevalve.—We have one sort of the pholas best described by you. And the barnacle, which I call concha quinquevalvis,* animal sui generis continens, variis cirrhis, et caudâ rotundâ rugosa instructum. Dr. Balflour found eggs in the cauda of it.

Account of a Book; viz. Julius Celsus de Vita et Rebus Gestis Julii Cæsaris ex Musæo Joan. Georgii Grævii. Iterata Editio, cum Indice Rerum uberrimo. Londini. 1697. N° 222, p. 327.

These commentaries being very rare, and not to be found in any public or

* Lepas anatifera. Lin.

private libraries of France and other countries, have given occasion to many learned critics to publish their different sentiments upon them. The great Isaac Casaubon did not know them; quoting some fragments of this Julius Celsus, as select obscure MSS. sent him by Bongarsius, though the author had been frequently mentioned above 300 years before, by Vincentius, Walter Burleigh, Eybbius, Johannes Magnus, and printed in a black letter, with abbreviations, in the year 1473. Gerard Vossius was the first who cleared this point, and said, that many things in Cæsar's Commentaries might be illustrated by this history of Celsus, whose name occurred very frequently in the fronts and ends of the ancient manuscripts of Cæsar's works; it being the custom of those times to affix the testimony and approbation of critics, and other learned men, to most of the old manuscripts, in order to show they were authentic, being read and examined by such and such scholars of known integrity and abilities: this caused the more barbarous ages to think those names to be the true authors, and to cite them as such; so Julius Celsus is much honoured by the many quotations made in this manner, and is taken by some modern critics for Cæsar himself.

The Commentaries here published, have been much sought after, though in vain, by some of the greatest men in matters of literature; as Gesner, Nicholas Heinsius, M. Bigot, M. Godin, Dr. Francis Bernard, and others; so that a single copy of them has been sold for 100l. sterling: yet we must confess, that we are ignorant of the time in which the author of these Commentaries flourished; though it is probable he is much more ancient than 4 or 500 years, in which Grævius thinks fit to place him, from the manner of his style, which seems to be above the common vein of the cloister, or the genius of that age. Some passages may have been added by readers or copyists, who frequently used to interpolate and corrupt the purest and best authors.

The 1st edit. was in 1473; but, by what fate I know not, it soon vanished, and became unknown, and even lost to the most industrious searches, till Vossius, in his Instit. Orator. and De Histor. Lat. illustrated its history, and set it in its true light; which incited the curiosity of several great men in vain, till the generosity of Grævius brought it forth in a better form.

An Anatomical Account of some remarkable Things, found on the Dissection of a Woman, who died of the Dropsy, after the Paracentesis was performed; with some Reflections on the Causes of Dropsy. By Dr. Charles Preston. N° 223, p. 330.

In the dissection of Mad. Vaillant, by M. Du Linier, the liver was found very white without, but red within; the epiploon extremely dried, the stomach much larger than ordinary, the winding of the colon, which passes under the stomach, strongly drawn together by three threads. In the umbilical region the intestines jejunum and ileum, much inflamed, and their tunics thicker than ordinary. In the hypogastric region, all the inferior part of the ileum, on that side near the bladder, and all the bottom of the matrix, as also the lower part of the rectum, much inflamed and ulcerated. In the bottom of the matrix there was an abscess, and the internal orifice extremely dilated, about the size of a crown; the extremity of the lower part of the ureter was cartilaginous; the extremity of the tuba fallopiana went so high, as the second vertebra of the lumbar region; in the interior part it was dilated 6 lines, and near the bottom of the matrix about 2 inches, and it was fastened to all the inferior part of the kidney; that of the left side was dilated about 4 lines in the upper part, and 6 in the lower.

The right ovarium, which commonly does not exceed the size of a pigeon's egg, was here 3 inches long, and 2 broad; and in the inferior part, there was found an egg, hanging by its ligament, out of the tuba fallopiana, about the size of the yolk of a common hen's egg; which, for experiment, was boiled, and it hardened like an ordinary egg.

The right kidney was of a considerable size, and went up as high as the last of the true ribs, and descended below the umbilical region; the pelvis was dilated about 3 inches in breadth, and 7 in length. The lungs were of a livid colour, as in all chronic diseases; on the right side they adhered to the pleura; and on the left side was an adhesion of the inferior lobe to the diaphragm: in the pericardium was little or no serum; and what we found was of a bloody colour: in dissecting the heart, there was a great polypus in the right ventricle, taking up almost all the cavity, about 5 or 6 lines in thickness, and half a foot in length.

Then follow some reflections on the causes of dropsy; by some attributed (says Dr. Preston,) to affections of the liver, the spleen, &c. And since the discovery of the lymphatics, to a rupture of them; but upon the dissection of hydropic bodies, these vessels (he observes) are never found broken. The true cause he deduces from the mechanical structure of the parts, and the disposition of the blood; which are 1st, the relaxation of the fibres and pores of the vessels, between the arteries and the veins, or 2dly, a compression of the vessels; for the lymphatics take their origin from the membranes, which cover the muscles, viscera, and glands; therefore, when the vesiculæ are too much straitened with serosity, their fibres lose their natural force, and become incapable of expelling the too great quantity of water; but the vesiculæ are enlarged from day to day, until their fibres suffer so great an extension even as to break, from hence is the source of those waters. It happens also sometimes, that the pores of the said vesiculæ are so widened, that the lymph runs into the cavity of the belly, or the interstices of the muscles: And from the disposition of the blood, either being too thin or too viscid; too thin whereby it easily passes through the pores of the vesicles; too viscid, so as not to be able to pass through the capillary vessels, and by consequence compressing the adjacent parts, so as to cause obstructions.

Account of a Gentleman's being cut for the Stone in the Kidney, with a brief Inquiry into the Antiquity and Practice of Nephrotomy. N° 223, p. 333.

After stating the opinions of various medical and chirurgical writers, ancient as well as modern, respecting the operation of nephrotomy; the author of this communication proceeds to give the history of a case, wherein it was successfully performed; as certified to him by the person himself, Mr. Hobson, upon whom the experiment was made.

This gentleman, who was consul for the English at Venice, having been long afflicted with the stone in the kidney, was at length attacked with a fit of such duration and violence, that it reduced him almost to desperation; and finding no relief from any means that had been used, he determined to apply himself to Dominic de Marchetti, a famed and experienced practitioner at Padua, intreating him to cut the stone out of his kidney, being fully persuaded that no other method remained capable of relieving him. Marchetti represented not only the extreme hazard, but as he feared the impracticability of the operation; that it was what he had never attempted, and it was in effect to destroy him. But Mr. Hobson persisting, Marchetti was at length prevailed on to undertake it. He began with his knife, cutting gradually upon the region of the kidney affected, till the blood disturbed the operation, so that he could not finish it at that attempt: wherefore dressing the wound 'till the next day, he then repeated and accomplished it, by cutting into the body of the kidney, and taking thence two or three small stones, he dressed it up again. From this instant he was freed from the severity of the pain, and in a reasonable time was able to walk about his chamber, having been in no danger, either from flux of blood or fever. Marchetti continued to dress the wound for a considerable time, but was not able to close it up, it soon becoming fistulous from the continual flowing of the urine through the sinus; but being in all other respects restored to his former health and vigour, and the matter discharged being little in quantity, he took leave of the professor, and returned to Venice, under the care and management of his wife; who, one morning, as she was dressing the sore, fancied she felt something hard and rugged, as she wiped it; on which, examining a little more carefully with her bodkin, she found it to be a stone, of the figure and magnitude of a date stone; which being removed, he never after complained of the least uneasiness in the part. About 10 years after this he returned to London, where the learned Dr. Tyson and myself were invited to see him; and after we had received this account from himself, he let us view the sore, which continued open; and permitted me without any complaint, the callosity being great, to pass my probe so far into the sinus, that we concluded it reached into the kidney: the matter it then discharged was but little in quantity, but always diluted with and smelt strong of urine. The orifice would sometimes close for 3 or 4 days together, and then the matter made its way through the common passages with the urine, yet without any difficulty or pain. There is no question, but that there was a coalition of the kidney, and the psoas muscle. When we saw it he applied nothing to the orifice but a clean linen rag, which had a strong urinous scent. He was then as able in appearance, to perform all the functions of life, and to undergo any fatigue, as any man of his years; being, as I conceive, upwards of 50, and was the next day to ride post 40 or 50 miles. I have heard that he is since dead, but could not be informed of what disease.*

On several Observables in Lincolnshire, not noticed by Camden, or any other Author. By Mr. Christopher Merret, Surveyor of the Port of Boston.

That part of the county of Lincoln, that lies towards the sea, is a level about 50 miles in length, viz. from Grimsby to Crowland; and 10 miles in breadth, from the sea to the wolds, or high lands. It may be divided:

1st. Into marshes, extending from Grimsby to about Wainfleet, abounding in store of large sheep, of a large staple, three or four fleeces usually making a tod, of 28lb. Several hundred loads are yearly carried out of it into Norfolk, Suffolk, the north and west countries, in great packs, called pockets, of about 2500 lb. weight, and there manufactured.

* This single instance, wherein an incision appears to have been made into one of the kidneys and several stones taken thereout, ought not to embolden other surgeons to venture upon an operation so difficult to perform, and so uncertain in its consequences. Where, indeed, a calculus generated in either of the organs destined to the secretion of urine, makes its way wholly or partially out of them by producing an abscess that points externally; the opening of that abscess, and the extraction of the renal calculus thereout, may be safely undertaken; but such an operation cannot properly be termed nephrotomy.

2. Fens. The east begins about Wainfleet, and ends at Sibsye, yielding great plenty and variety of fowl and fish, particularly duck, mallard, and teal, which are usually taken in decoys and sent to London. About Midsummer, at moulting time, several persons go in small boats among the reeds, and knock them down with long poles, being then unable to swim or fly. A little before Michaelmas, great flights arrive in these parts, which soon grow fat; when the decoys are frozen, the fowl resort to the sea for their food. As for fish there are great quantities, especially pike, some being of a very large size; the water is deep in some places, 8, 9, or 10 feet. Through these fens run great cuts or drains, which abound in fish; there are also vast numbers of geese, which live on the grass, but taste both rank and muddy; but when fed with corn are as good as others. But they make an amends in the vast quantities of feathers and quills they yield; the owners pluck them 4, 5, nay some 6 times a-year for their feathers, and thrice for their quills. Some persons have 1000, and some more: they are kept at little or no charge, except in deep snowy weather, when they feed them with corn. Between Spalding and Crowland grow large crops of oats, and also large quantities of rapum sylvestre, called cole-seed, of which they make oil, by breaking it between two large black marble stones of near a ton weight, in oil mills; some go with sails, and serve also to drain the fens, and are called engines, and discharge great quantities of water. After pressing out the oil, the remainder is called cakes, with which they heat ovens, and burn for fuel: they are exported to Holland, where the cows are fed with them.

3. Pasture grounds, lying between the sea and the fens, feeding a great number of fat oxen and sheep, which are weekly sent to London in droves.

Near the fens stands Boston, remarkable for the church, steeple, and river. The church is very lofty, and ceiled with Irish oak, neatly wrought; the body is 100 feet wide; the steeple is a tower of 285 feet high, octangular towards the top; of curious carved stone work, standing not above 12 yards from the river Witham: it is only 32 feet wide, and 40 in length; at each angle is a large buttress.

Our marshes doubtless have been gained from the sea, there being near them, at Wainfleet, such banks and salt-hills as Camden mentions at Sutterton. They are fenced chiefly by large dykes, filled with fresh water in the winter, and salt in the summer. The sea loses and gains considerably in this county; for, about Holbeach, Sutton, and Wainfleet, great marshes have lately been taken in; but northward of Ingold-Meals, it has lost much more. I have seen the roots of trees that have been dug out of the sands at low water, near a mile from the shore, which I take to belong to fir, the bark smelling aromatic, and somewhat like that of fir-timber in piles that have been long in salt water, but not near so strong; and at Mawplethorp they are often in danger of being drowned, their defence being only banks or hills of a small sand, called meals, the former church having been destroyed by it.

The country people gather up the dung of oxen and cows, which they temper with water, and spread on the ground about 5 inches thick; then cut it out in oblong pieces of about a foot, and call them dithes, which they use for fuel; in some places they make walls of them for fencing. They also gather up hogs' dung, and steep it in water, and having well stirred it, strain it, and so use it to wash clothes, which, when bleached in the summer, will become white and sweet. Besides the fowl mentioned by Mr. Camden, of mud-suckers, which are esteemed the best, we have ruff and reve, the former being the cock, the other the hen, in Latin aves pugnaces, because they are continually fighting; rarely two in a hundred are of a colour, they are usually mewed.

As to fish, here are turbots in great plenty, called brets, and taken in nets trailed on the ground by two horses; here are also plenty of large seals, taken in troul-nets, trailing by smacks under sail: also plenty of skate, which are taken by hooks lying near the shore; as are also cod and thornback.

As to insects, gnats, here midges, are in some places very troublesome; some have silk-nets to secure them from being bitten, and disturbing their rest. Frogs are very numerous, called Holland waites. As for vegetables, great quantities of hemp are sown in several places, of which ropes are made, both for sea and land; the female is called femble; as also flax; the seed is broken and oil made of it, as of cole-seed. The salt marshes yield a great deal of kali geniculacum, which, when pickled, is their samphire. Carum grows plentifully in the pastures; the seed they call saxifrage, which they gather and send to London.

These parts afford but little variety of metals, gums, or stones. Amber is picked up sometimes on the sands in pretty large pieces. The astroites, found at Belvoir castle, will not only move in vinegar, but also dulcify it. Here coals are charked, and then called coke, with which they dry malt, giving little colour or taste to the drink made of it.

Agues, here called Holland bailiffs, are very rife, few strangers escaping them. As also, that at Spalding there is lately a vast tunnel, laid under the river Welland, carrying another under it, for draining the fens. And that between Dunnington and Brig-end, which is about 3 miles, a good causeway is carried through the fen, having in several places bridges for the water to run under them, whence the name of Brig-end causeway. It is after great rains under water, and passengers take guides, the bridges directing them; it was built at the county's charge, who also purchased near 100 pounds per annum to maintain it. A great many hills are thrown up, called barrows, supposed to be sepulchral monuments.

A further Account of the Water Microscope. *By Mr. Stephen Gray.* N° 223, p. 353.

My water-microscope consists of five parts or pieces of brass, as follow: AB, fig. 3, pl. 3, is the frame of the microscope, which may be about the 16th part of an inch in thickness. At A is a small hole, near the 30th of an inch in diameter, which serves for the aperture of the water, in the centre of a large spherical cavity, about 1·8th of an inch diameter, and in depth, somewhat more than half the thickness of the brass; opposite to this, at the other side, is another concave, only half the breadth of the former, which is so deep, as to reduce the circumference of the small hole, in the centre, to almost a sharp edge; in these cavities the water is to be placed, being taken upon a pin or large needle and conveyed into them, till there be formed a double convex lens of water which, by the concaves being of different diameters, will be equivalent to a double convex, of unequal convexities. By this means the object is rendered more distinct than by a plano convex of water, or by a double one, formed on the plain surface of the metal; besides the water is now better secured in its spherical form. CDE is the supporter on which to place the object; if it be water, in the hole G; if a solid object, on the point F; this is fixed to the frame of the microscope by the screw E, where it is bent upwards, that its upper part may stand at a distance from the frame; it is moveable on the screw, as a centre, to the end that either the hole C, or the point F, may be exposed before the microscope, and that the object may be brought to, and fixed in its focus. There is another screw, about half an inch in length, which goes through the round plate into the frame of the microscope AE, the screw and plate taking hold of the supporter about D, where there is a slit, somewhat larger than the diameter of the screw, which is requisite for the admission of the hole C, or point F, according to the nature of the object, into the focus of the glass: for by turning the screw G, the supporter is carried to or from the same, which may be sooner done, if whilst we turn the screw with one hand, the other hold the microscope by the end B, and we continue looking through the water till the object be seen most distinctly.

The supporter must be made of a thin piece of brass, well hammered, that by its spring it may the better follow the motion of the screw. I chuse rather to fix the supporter by the screw E than by a rivet: because it may now by means of a knife, be unscrewed, and by the other screw G be brought close to the frame of the microscope, without weakening its spring, and so become more conveniently portable.

At B is a hole, about 1-10th of an inch diameter, which serves to convey the water in, when we have a mind to see the minute objects or animals contained in it, by having their images reflected from the opposite interior surface of the drop, the frame of the microscope being held by the other end A, during the observation; for I find, that if the plate be of some thickness, the objects are seen more distinctly than by only taking the water on a pin or wire, or the like; besides, the water is now better secured, and one may with more ease give it to others to observe, without so much danger of spoiling the spherical form on which the distinctness of its objects depend.

The best proportion for the hole at B is, to be somewhat less then half the thickness of the metal in its diameter; and to be so filled with water, till there remain near a hemisphere of the water on each side the hole, and it will not be amiss to have this end somewhat thicker than the other.

An Account of the Quantities of Rain fallen in one Year in Gresham College, London, per Month. N° 223, p. 357.

This was begun Monday morning, August 12, 1695, and the water weighed every Monday morning till August 12, 1696, by pounds, ounces, and grains, Troy Weight, the diameter of the vessel which receives the rain being $11\frac{4}{10}$ inches, or $\frac{114}{10}$ part of an inch, and the area $102\frac{1}{10}$ inches.

Months	Days	℔	℥	Gr.	Months	Days	℔	℥	Gr.	Months	Days	℔	℥	Gr.
August	19,	2	6	216	December	23,	0	1	60	April	27,	0	7	390
	26,	4	6	246		30,	5	8	93	May	4,	4	10	45
September	2,	9	4	96	January	6,	4	10	105		11,	7	6	0
	9,	3	10	397		13,	0	1	12		18,	6	2	105
	16,	0	1	204		20,	1	10	450		25,	1	7	60
	23,	0	6	336		27,	1	5	82	June	1,	0	0	99
	30,	4	1	444	February	3,	6	11	372		8,	6	6	150
October	7,	2	3	96		10,	4	9	242		15,	0	2	120
	14,	0	2	60		17,	0	6	291		22,	7	5	285
	21,	0	1	234		24,	0	2	180		29,	1	5	84
	28,	0	0	45	March	2,	0	9	12	July	6,	0	1	120
November	4,	0	0	207		9,	0	2	459		13,	16	1	0
	11,	1	11	65		16,	0	0	396		20,	1	7	240
	18,	1	1	309		23,	4	4	263		27,	6	1	256
	25,	0	9	285		30,	1	5	285	August	3,	1	10	120
December	2,	0	8	126	April	6,	2	3	375		10,	1	11	90
	9,	3	7	324		13,	1	0	294		12,	0	0	0
	16,	1	3	435		20,	2	1	0	The sum		131	7	113

The sum 131 7 113 = to $29\frac{11}{100}$ inches in a cylinder of the aforesaid diameter, viz. $11\frac{4}{10}$ inches.

Account of a Book, viz.—The Antiquities of Palmyra, or Tadmor, built by King Solomon in the Desert of Arabia; containing the History of that City and its Emperors, from its Foundation to this present Time. By Ab. Seller, 8vo. N° 223, p. 358.

The preface accounts for the rites and customs of the East, which are still continued by the Arabs, who are very tenacious of ancient customs, of which the author gives several instances, particularly the mourning for Thammur or Adonis.

The history shows that the city was founded by Solomon, as a frontier to his large territories; that it was probably taken by the kings of Syria from the Jews, when their kingdom was divided and impaired, till the kings of Babylon seized it; that on the ruin of the Persian empire it submitted to Alexander; that it was probably repaired and beautified by Seleucus, one of his successors, in gratitude to whom they used the common computation of most of the Eastern cities, the æra Seleucidarum; that Pompey, when he made Syria a province, reduced Tadmor, constituting it an appendage to that province; that Mark Antony designed to pillage the city, to gratify his discontented army, after his ill success in Persia, but was disappointed; from which time to the reign of Trajan, history is silent concerning the city, and so are all the inscriptions found there, none of which is older than that emperor. Adrian visited, rebuilt, and called it by his own name; Antoninus Caracallus made it a colony Juris Italici, and it continued firm to the Roman interests under the succeeding emperors, assisting Alexander Severus and the youngest Gordian, in their expedition against the Persians, with their forces; and when the emperor Valerian was conquered and made prisoner, Odenathus, the governor of Palmyra, asserted the rights of injured majesty, baffled the Persians, and was declared by Gallienus his co-partner in the empire, which authority continued in his family for more than 10 years; under Aurelian the city was ruined; after which it made a poor figure in story, till Justinian repaired and fortified it: in which condition it continued till the Mahometans made themselves masters of that country, and suffered the fortifications to go to ruin, since which time it has been a nest of Arabian banditti.

Account of the opening of the Body of a Boy, who died suddenly. By Dr. Charles Preston. N° 224, p. 362.

Being called to the dissection of a boy, about 9 years of age, who died suddenly, after a fit of vomiting, a little before his death; Dr. P. observed in the lower belly, after having laid open the common integuments, that the left testicle was out of its natural place, drawn up above the aponeurosis or hole of the 3 muscles of the abdomen, which gives passage to the spermatic vessels that go to the testicles in men, and to the round ligament of the matrix in women. The bladder was extremely distended, and full of urine. In the stomach was a worm of about 9 inches in length, and a line and half broad, as also a kind of slimy matter: the liquor contained in the stomach was black; but whether it had its colour from some remedies prescribed against his vomiting, or was the effect of some disease, cannot be determined. In the 2d cavity, the lungs were united to the pleura on the right side, but were free on the left; in the left there was an inflammation of the pleura, with some matter, as also an inflammation of the external tunic of the lungs. In the heart was a large polypus, in the left ventricle, which filled the vena pulmonaris, and entered the left auricle, about 8 inches in length, and 2 fingers broad. In the right ventricle, there was also a polypus, of about an inch in length, and so large that it almost stopped the entrance of the blood into the vena cava ascendens. In dissecting the brain, we found also a considerable polypus in the sinus longitudinalis; all other things were according to nature. From what is here observed, it is easy to conjecture the cause, both of his vomiting and of his sudden death.

On the Nature and Differences of the Juices of Plants. By Dr. Martin Lister, F.R.S. N° 224, p. 365.

An abstract of the only useful parts of this long paper, comprises the following observations.

Dr. Lister observes, that mostly juices coagulate, whether they be such as are drawn from the wounds of a plant, or such as spontaneously exude; and yet even that exudation seems to be often accidental, that is, by canker, or some similar chance.

That among those juices which coagulate and are clammy, there are some which readily break with a whey. In the middle of July, he drew and gathered the milk of lactuca sylv. costa spinosa, C.B. and of all our English plants, that he has yet met with, this most freely and plentifully affords it. It springs out of the wound thick as cream, and ropes, and is white, and yet the milk which came out of the wounds, made towards the top of the plant, was plainly streaked or mixed with a purple juice, as though one had dashed or sprinkled cream with a few drops of claret. And indeed, the skin of the plant thereabouts was purplish also, perhaps with veins. Again, when drawn into the shell, it turned still yellower and thicker, and by and by curdled, that is, the white and thick caseous parts separated from a thin purple whey. So the blood also of animals, while warm, remains liquid and alike; but as soon as cold, it cakes and has a serum or whey separated from it; the cake is made of glutinous fibres, and therefore if the hot or new drawn blood be well stirred or beaten, it will not break. Perhaps also stirring the aforesaid milky juice, in drawing it into the shell, will hinder its coagulating or parting with a serum or whey. Also, the caseous part of the milk of animals is glutinous and stringy. Further, this serum came freely from the other, by squeezing between the fingers: and the curds being washed in spring water, became immediately like rags, and tough, and remained still white and dry. As for the purple whey, after a day's insolation, it stiffened and became hard, and was easily formed into cakes, which were yet very brittle, and would easily crumble into powder. About December following, having broken one of the cakes, made of the caseous part of the milk of this plant; it then proved very brittle, and shone upon breaking, like rosin; it was then of a dark brown colour; it burned also with a lasting flame like rosin or wax; and that being melted by heat, it would draw out into long tough strings, like bird-lime. On the contrary, the purplish powder, which was the whey, if put into the flame of a candle, would scarcely burn with a flame at all, but soon be turned into a coal. Lastly, the purple powder tasted very bitter: whereas the caseous part was as insipid as wax. Qu. Whether the artifice of bees does not much consist in a way that nature has taught them, to coagulate the juice of plants, or rather to separate and make choice of the caseous part of the juices of plants, already coagulated, for their wax, and the whey for honey.

Similar instances of such breaking and separating are also added of the milky juices of some other plants.

There are other clammy juices, which do not let go a whey when they coagulate, but cake altogether. And for this purpose, we are to examine the natures of the juices of the hieracium kind, thistles and burdock, clematis daphnoides minor, J.B. onions and garlic, ficus, aceris turiones. He made cakes of the sole or unmixed juice of sonchus lævis et asper, without any addition, and it parted not with any whey. Papaver rhœas Ger. bleeds freely a white juice; and the heads or seed vessels, when the flower is gone, do yet bleed. He observed, that in gathering it into shells, it presently turned its white colour into a yellow one, inclining to an orange. At first springing it roped, or was but little clammy, and seemed to be very liquid and dilute; yet it did not part with any whey, but soon grew stiff, and is very resinous and oily.

The milks or juices of plants seem to be compounded and mixed of liquors of different, and perhaps contrary qualities; so that it is probable, if the caseous part be narcotic, for example, the whey may not be so; or the one may be hurtful, and the other a good and useful medicament.

Tragopogon flore luteo, J. B. yields a juice, which on the first springing from the wound is white and thick, but immediately it turns yellow, and then redder and redder; it is of no unpleasant taste: it is something glutinous and very oily, and parts not with much, if any whey, and therefore it is easily formed into cakes alone. Convolvulus major, J. B. bleeds freely a white and very sharp juice; not only the stalk and leaves, but the white flowers also in proportion, bleed as plentifully as any other part.

There is another very clammy juice, which is of a golden or yellow colour, upon drawing; this is from the seed vessels of centaurium luteum perfoliatum, C. B. in July, and after; even when the seeds therein contained are turned black and ripe, they yield plentifully and freely enough. It is liquid on first drawing, and after a while it thickens, parting with no whey; and this is of the colour of amber: it sticks to one's fingers, and draws out into threads like bird-lime; it would never become harder than very soft wax, and that by being dried in the shade only; for if ever so little exposed to the heat of the sun and fire, it soon became exceedingly soft. But as for the cakes made up of it and wheat flour, in winter they became very hard and firm, but the unmixed cakes still soft. These burn with no unpleasant smell; they emit a lasting flame; they still keep their amber colour; and draw out in threads in burning, like wax. To this last coagulate and clammy juice, and which will not much harden, may be added the yellow juice, which the wounds of Angelica sativa Park. yield; it will not harden by insolation or long keeping; yet it stiffens, and will draw into threads.

The next sort of coagulate and clammy juices noticed, are gums; and some of them seem to remain long liquid: he has not tried if they are inflammable: there are others which grow hard, and are certainly not to be kindled into a flame. They are easily dissolved in water, and sparkle when put into a flame; which two natures argue a serous or waterish part in them: again, put into a flame, they melt, and become as it were liquid and ductile; which shows the caseous part in them; and because they will not flame, it is an argument of their leanness and scarcity of oil. All three put together plainly evince gums to be coagulate juices.

The next instances are of gums which grow hard in time, readily dissolved in water, and are not to be kindled into a flame, though they become thereby soft and ductile.

The American or Indian rhubarb sown in our gardens is the only plant that he has met with, or ever saw, which yielded a gum; and yet, because it is of the very kind with the common sorrels and lapathums, he believes it not impossible, even from our own store, but herb-gums might in some way be had. It exudes from all parts of the stalk and ribs, on the underside of the leaf itself. He gathered some in the form of good large drops; others, as though the stalk had been besmeared with it; others, shot into long and twisted wires or icicles. He observed, that the cankered orifices, or places where the gum had burst out, might be followed into the stalk with a knife, and that through the skin: in certain places it could be seen that the juice within the plant was turned gummy, and looked clear like ice.

The juice extracted from the roots of our English rhubarb, by a tincture of fair water steamed away, is nothing else but a lean uninflammable gum; and though it differ in colour from the exuding gum; yet in other natures, as this of being uninflammable, ductile in the flame of a candle, &c. it agrees with it.

We may here give a probable reason, why a gentle infusion or maceration of rhubarb, is a very sure purge, but the substance or powder, or a decoction of it, will have a quite contrary effect, and bind. We may, I say, think, that the sharp and tart juice in rhubarb, wherein its purging faculty lies, is by a gentle infusion so extracted, that it turns not to gum in the stomach. For it cannot be thought that the sour juice of rhubarb is a distinct liquor from the gum, which seems to be only an accidental coagulation.

Lauro-cerasus, a beautiful winter green, which we have adopted to adorn our court walls with, yields a clear gum very plentifully: it is very white, and very clear.

There are other sorts of juices, which will not of themselves exude out of the wounds of their respective plants; and of this sort of plants is the holly. He wounded the holly the latter end of March; and yet after some days of warm and open weather, he could not perceive the least stirring of juice. The latter end of May, the bark begins to be full of lime, which may be tried by pressing a piece of it between the fingers; when you would take them off, the juice or lime draws out into hairs, and follows the fingers, cleaving to them like small threads. This lime or juice is separated from the bark thus: peel off the bark in the months of May, June, or July; for it then comes easily away, and most abounds with juice: boil the bark in fair water, until it be so tender, that the outmost thin grey bark or membrane peels easily off; lay it so peeled, and cover it over with green nettles or fern, or such like, in a cellar for about ten days, where it will ferment or rot, and become mouldy. Take them out, and beat them well in a mortar to a paste, and roll them up into small hand-balls, and in a running spring wash them clean, from all the woody or sticky parts; which is effected by drawing and teazing them. But great care is to be taken in the washing of the balls; for besides that they must, if possible, be forth-with washed, the lime will all run from you, unless you so order the matter, by engaging with your fingers that it entangle. You would imagine, upon breaking one of the balls, that there was little or no lime in them, so freely do they moulder and crumble. After it is once engaged thoroughly, it will endure washing: and the clearer you take away the woody parts, the better it is.

In cutting the tender tops of elder, the latter end of May, there will a stringy juice follow the knife, and draw out in threads, somewhat like bird-lime, or the juice of holly: it seems to be in certain veins just within the circle of teeth or wood.

We are to examine, for this stringy juice, the roots of the hyacinthus kind, also viscus, viburnum, asphodelus Lancastriæ, Ger. narcissus sylv. pallidus calice luteo, C. B. bryonia tum alba tum nigra, filix fæmina, &c.

The dissected veins of many plants afford us oil, that is, such a juice, which being rubbed between the fingers, is not at all clammy, but makes them greasy and glib. Some of it stiffens not, yet it seems to be coagulate and mixed. For instance, the juice of helenium sive enula campana, J. B. taken off with a clean knife, it looks like oil mixed with water, that is, the thin or dilute juice of the plant, springing up out of the wound, together with the oil. Also the fruits of many plants afford oils, as olivæ, baccæ lauri, hederæ, juniperi, cornus fæminæ, &c. V. C. P. A. The pulp of most seeds seems to abound with this oily juice, and at some time before their maturity, it is liquid and visible in them, in the form of a milk. For instance, in heleborus niger sylv. adulterinus etiam hyeme virens, J. B. The seeds of this plant, the latter end of May, are very milky, and by insolation are easily formed into cakes, which are yet very oily, and being long kept, and exposed to the flame of a candle they burnt freely, sparkling not very much, and not even then being at all clammy. This milk or juice of the seeds is of a very fiery and stinging nature; for on cutting the seeds out of the green pods, they strike the eyes as onion is wont to do. Even the tops of the fingers, which are wetted with this juice, will throb and ache, as after extreme cold; and that pain continues in them for several days; and at length the skin of the fingers' ends peels off.

There are yet other oily juices which, after coagulation, harden, and are called rosin; and such our ivy yields abundantly. Hither also may be referred the juice of juniperus vulgaris baccis parvis purpureis, J. B. which is a hard fat juice, and not much gummy. In the chops of ivy made in March, there exuded a thick matter like yest, yellowish and greasy: it melts like oil between the fingers, not having the least clamminess then perceivable. In process of time it hardens and crusts on the wounds, like coarse brown sugar; it burns with a lasting flame, and smells very strong. Also on the topmost leaves of lactuca sylv. costa spinosa, C. B. in July, many small drops or pearls of an oily juice, coagulated and hardened like rosin, are plainly to be discerned, especially with a single microscope: they are of an amber colour and transparent, easily to be wiped off, being only oily juice exuded: and probably even the blue flower of ripe plumbs is nothing else but a fine resinous coagulation of the transuded juice. On the underside of the leaves, and all over the stalk of bonus henricus, J. B. stick infinite small transparent pearls: those clear drops are hard to the touch, and feel like greasy sand, not clammy, and therefore it was well called unctuous by C. B.

And thus far concerning the juices of plants, as they are different, principally by that accident of coagulation, and other natures. He next proceeds to observations on the same juices of plants, as they are varied and distinguished by that other accident, fermentation. And not only the juices of fruits are to be wrought, or set a working, as of the apple, pear, briar, grape, &c. as is well known; but there is an artificial change, viz. malting, to be made even in the seeds of plants, so as to make them spend freely, or let go their juices, and communicate them to common water, and receive a ferment: also the juice of the roots glycyrrhiza will ferment, and the juice of the cane, as sugar. Again, the tapped juices of vegetables are susceptible of a ferment. As for instance: the 21st of April 1665, about 8 in the morning, he bored a hole in the body of a fair and large birch, and put in a cork with a quill in the middle; after a moment or two it began to drop, but yet very slowly: about 3 hours after it had filled a pint glass, and then it dropped exceedingly fast, viz. every pulse a drop: this liquor is not unpleasant to the taste, and not thick or troubled: yet it looks as if some few drops of milk were spilt in a basin of fair water. There are many ways of fermenting or setting this juice a working, that is, of keeping it from coagulating. And here it may be observed what great change the juice, particularly of this tree, undergoes, by being long buried under ground. Pimco is one of the highest mountains in Craven, lying on the south side of that country, about 2 miles above Carleton. On the south side the Pike, as they call the very top of that mountain, is a place where the water stands; this is called a moss, and is some fathoms perhaps deep in black mud. Here are dug up not only roots, but whole trees, of fir, as they think; but upon due examination of the grain and bark, Dr. Lister found them to be the roots of birch. These roots split easily, and soon dry, and when dried, they burn with a lasting flame; and for this purpose they use them on any sudden occasion about their houses: and although the flame be great, yet it is without any resinous smell. However, it seems, that their having lain so long under ground, has prepared the juice for burning.

The maple, both that which is miscalled the sycamore, and the lesser, bleed a fermentable juice copiously, on the breaking up of hard frosts. Also the willow, walnut, poplar, whicking, are all said to bleed in their seasons a vinous juice. To extract the juice of vegetables, as opium for example, (as is usual in the best preparations and methods of making laudanum) with spirit of wine, is not, probably, to separate any one part of that coagulate juice from the other, as the serum or whey, for example, from the caseous part of the juice, but only to depurate or defecate the opium.

The whey of lactuca sylv. can be only dissolved in cold water, the curds wholly refusing to mix with it. And the same probably in other juices, so as to make good that simple adage, water is the best menstruum, and that it really separates, what spirit of wine only depurates.

Solution to two Problems, proposed by Mr. John Bernouilli, in a Letter to Sir Charles Mountague, Pres. of the R. S. from Mr. ——.†* N° 224, p. 384. *Translated from the Latin.*

Sir, I yesterday received copies of two problems, proposed by that most acute mathematician, Mr. John Bernouilli, printed at Groningen, Cal. Jan. 1697, of which the following are solutions.

* John Bernouilli, the younger brother of James, by whom he was initiated into the mathematical sciences, was born at Basil in 1667. John soon became equally eminent with his brother in those sciences; after which, their mutual communications, and even violent contestations, contributed at once to their own improvement, and that of their favourite study; as by their emulous struggles for superiority, many valuable discoveries were made. John B. was professor of mathematics at Groningen, while his brother James held the same office at Basil, and where he succeeded him also, on the death of James in 1705; after which, it was held by John till his death, in 1748, in the 81st year of his age. This long life, spent in a continual study and improvement of his favourite science, gave occasion to this latter to make many and important discoveries in it, and to produce voluminous writings on it; though his genius seems to have been rather less brilliant than that of his brother James. In the more early part of his career, John B. adopted the notion of the vortices of Descartes, and endeavoured to explain the celestial phænomena by them; but he was afterwards obliged reluctantly to adopt the powerful principles of Newton's philosophy. Our author first explained the principles of Leibnitz's integral calculus; the catenarian curve; the curve of swiftest descent; and isoperimetrical problems; he discovered the mercurial phosphorus, or luminous barometer; with many other ingenious discoveries; as may be seen in the collection of his works, published 1742, in 4 vols. 4to.

Of five sons, which he had, three pursued the same science with himself: one of these died before him; the two others, Nicolas and Daniel, he lived to see become eminent professors of it, in different universities, like himself; and to this day some of their descendants still adorn the mathematical and astronomical sciences; like the family of the Gregorys in this country, to whom in several respects they have a very near resemblance.

† This letter, containing these solutions, is here anonymous; but tradition has justly ascribed it

Prob. 1.—The first problem is a mechanico-geometrical one, concerning the line of swiftest descent, and is in these words: "To determine the curve-line connecting two given points, which are at different distances from the horizon, and not in the same vertical line, along which a body passing by its own gravity, and beginning to move at the upper point, shall descend to the lower point in the shortest time possible."

"The sense of the problem is this: of the infinite number of lines that may be drawn between those points, from one to the other, to make choice of that according to which if a plate be bent, having the form of a tube or a canal, so that a ball being laid upon it, and suffered to descend freely, it may perform its passage from one point to the other in the shortest time possible."

Solution.—From the one given point A, (fig. 4, pl. 3,) let there be drawn an indefinite right line APCZ parallel to the horizon, and on the same right line let there be described any cycloid AQB, meeting in Q with the right line AB, drawn and produced if necessary, through the other given point B; as also another cycloid ABC, whose base and altitude may be to the base and altitude of the former respectively, as AB to AQ. Then this last cycloid will pass through the point B, and will be that curve line in which a body, falling by the force of gravity, will pass soonest from the point A to the point B. Q. E. I.

Prob. 2.—"To find a curve line of this property, that the two segments (of a right line drawn from a given point through the curve), being raised to any given power, and taken together, may make everywhere the same sum."

This problem, if I rightly understand its meaning, (for I have not yet seen the part of the Leipsic Acts concerning it, cited by the author), may be thus proposed: required a curve-line KIL (fig. 5, pl. 3) under this condition, that if a right-line PKL be any how drawn from some given point or pole P, and meeting that curve in two points K and L, the powers of its two segments PK and PL, intercepted between the given point P and the two points of intersection, if they be raised to an equal height (that is, both squares, or cubes, or biquadrats, &c.), in every position of the right-line, may make the same sum, $PK^2 + PL^2$, or $PK^3 + PL^3$, &c.

to the celebrated Newton, who solved them as soon as he received the paper containing their proposal; although for the solution of the former of them, viz. to find the curve of swiftest descent, Bernouilli had proposed, in the Leipsic Acts, to allow all mathematicians the term of 6 months to give in their solutions; and even at the request of M. Leibnitz, extended the term for that purpose to the end of 12 months. The history of this celebrated problem, and of various solutions that were given to it, may be seen in Montucla's History of Mathematics, vol. ii. p. 437, 2d edition. Although Newton's solution was anonymous, the masterly manner of it readily detected the author, and Bernouilli said he perceived the lion through his disguise.

Solution.—Through any given point A draw any indefinite right-line ADB in a given position, meeting the moveable right-line PKL in the point D; then calling AD, x; and PK or PL, y; and let q and r be quantities any how composed of any given quantities and the quantity x; and let the relation between x and y be defined by the equation $yy + qy + r = 0$. Then, if r be a given quantity, the rectangle of the segments PK and PL will be given. If q be a given quantity, the sum of those segments, connected by their proper signs will be given. If $qq - 2r$ be given, the sum of the squares, $PK^2 + PL^2$, will be given. If $q^3 - 3qr$ be a given quantity, the sum of the cubes, $PK^3 + PL^3$, will be given. If $q^4 - 4qqr + 2rr$ be a given quantity, then the sum of the biquadrats, $PK^4 + PL^4$, will be given. And so on in infinitum. Let there be made therefore r, q, $qq - 2r$, $q^3 - 3qr$, &c. given quantities, and the problem is solved.

In the same manner curves may be found, which shall cut off three or more segments having the like properties. Let there be the equation $y^3 + qyy + ry + s = 0$, where q, r, s denote quantities composed of any given constant quantities and the quantity x; then the curve will cut off three segments. And if s be a given quantity, then the solid contained by those three segments will be given. If q be a given quantity, the sum of the three will be given. If $qq - 2r$ be a given quantity, the sum of the squares of those three will be given.

Of a strange Symptom which attended an Hydrops Pectoris. By Mr. Samuel Doudy, F.R.S. N° 224, p. 390.

Mr. Cowper, in his letter printed in the late Transactions, of an extraordinary large kidney, occasionally mentioning, that sighing and difficulty of respiration are always remarkable symptoms in an hydrops pectoris, put me in mind of the case of a noble peer. His shortness of breathing was very extraordinary; for he was always better in bed or lying, than sitting or standing; quite contrary to other asthmas, in which the patient is not able to lie down: the muscles of the breast having a freer motion, when in an erect posture. On opening the body, both the cavities of the breast were found full of water, which, when standing or sitting pressed so upon the diaphragm, that respiration was performed with difficulty; but when lying, the floating load was so disposed, that that office of nature was better performed. This seems to be so natural a symptom, that it may be almost an infallible diagnostic, to distinguish an hydrops pectoris from other more frequent diseases of the breast, that cause a shortness of breathing. Perhaps it may not be impracticable to use the paracentesis in the like case, when the disease is certainly known, and without it, death is most likely to ensue.

Account of a Book, viz. Musei Petiveriani * *Centuria Prima, Rariora Naturæ continens: viz. Animalia, Fossilia, Plantas, ex variis Mundi Plagis advecta, Ordine digesta, Nominibus propriis signata, et Iconibus æneis eleganter illustrata. Lond.* 1696. 8vo. N° 224, p. 393.

The History of a Tumor in the lower Part of the Belly, related by Mr. Giles, sworn Surgeon at St. Come; from Brunet's Progrés de la Medicine. N° 225, p. 402.

A Lady about 64 years old, had a tumor in the lower region of the belly, hard, round, and as large as a ball, such as the boys play with. This globe could be moved in the same manner as the matrix, when with a child, of 6 or 7 months old; no accidents like a fever, pain, vomiting, loss of blood, fluor albus, &c. accompanied this tumor, but a constant discharge of urine; many physicians were consulted at different times; they searched the patient, and agreed at length that it was a scirrhus, some placed it in the epiploon, others in the mesentery, and others in the matrix. All possible means were employed to soften and discuss it; as emetics, strong purgatives, diuretics, emollients and resolvents; but all to no purpose. Being wearied with so many remedies, she went in her coach to take the air at Vincennes; after her return she had an inclination to go to stool, and filled a basin with gross excrements, a little black, and not very stinking; this she did a second time, and the lady found herself

* James Petiver, a zealous cultivator of the science of natural history, was an eminent London apothecary. He collected specimens from all countries, and his Museum became so considerable, that Sir Hans Sloane offered to purchase it for the sum of four thousand pounds. Mr. Petiver was a Fellow of the Royal Society, and was the correspondent of Ray, Sloane, and most other eminent naturalists. His first publication was "*Musei Petiveriani* Centuriæ decem:" containing the names and synonyms of various rare animals, fossils, and plants, among which latter are some of the rarer cryptogamic plants of England. He next published "*Gazophylacii Naturæ et Artis* Decades Decem." A work of great importance at the period of its publication, consisting of engravings, with short descriptions, of all the orders of animals, vegetables, and fossils. He was also the author of many other publications relative to Natural History; and after having arrived at a very considerable age, died at his house in Aldersgate-street, on the 20th of April 1718. His funeral was splendid, and the pall was supported by Sir Hans Sloane, Dr. Levit, physician to the Charter-house, and four other physicians. Many of Petiver's works having become scarce, the whole, exclusive of his papers in the Philosophical Transactions, were collected and published in 2 vols. folio, in the year 1764, with the addition of some plates which had not appeared in the former edition.

immediately relieved, her swelling disappeared, her urine stopped; and in a few hours she was perfectly well.

A year after, she fell into an apoplexy, out of which she recovered by emetics and purgations, and nothing as yet appeared in the lower region of her belly; but in 1691, the tumor showed itself in the same place, of the same consistence, size, and roundness, with an involuntary efflux of her urine; and with all the same circumstances as before. All possible means of relief were again used, but to no purpose, as she died 2 years after its first appearance.

On opening the abdomen, the great round tumor was found to be the cæcum dilated; its membranes were outwardly smooth, and of the same colour with the intestines, without alteration, and full of vessels of all sorts. Before I cut it, I followed the intestines, and remarked that the ileum lay along the tumor, being flat against it, and returned to join the colon as is usual; so the excrements had the liberty to pass from the ileum to the colon, without entering into the tumor, which after this I opened; I found about 3 quarts of greyish matter without smell, and of a consistence rather liquid than thick; after that I searched for a communication it might have with the guts, but discovered neither hole, nor any appearance it might have; the interior membranes were very beautiful, and all the parts of the swelling, as well as of the neighbouring organs, appeared very sound.

Though I perceived no communication this tumor had with the ileum, yet some must have been in the beginning of this tumor, by which it discharged its gross excrements; but after this evacuation I believe that this opening was stopped. The compression which the tumor made on the bladder, caused the urine to run out as fast as it came in; its sphincter not being able to resist the violence of the load.

Of an undescribed Scolopendra Marina. By Thomas Molyneux, M. D. S. R. S. N° 225, p. 405.

I have lately met with a remarkable marine animal,* which I take to be one of the many non-descripts, which the sea, by reason of its vast extent and profound depth, has hitherto reserved undiscovered, notwithstanding the diligent researches of naturalists.

* This animal is the *aphrodita aculeata* of Linnæus, and is a native of the European seas, generally frequenting the coasts, and feeding principally on the smaller kind of marine worms and testacea: it is remarkable for the beautiful colour of the stiff, shining hairs with which the sides of the body are beset, and which exhibit the varying lustre of a peacock's feather

Dec. 1696, two of them were found in the stomach of a common cod-fish, sold in the fish-market at Dublin. One of them, by lying long in the stomach, was partly digested; but the other was intire and unaltered. It was larger at one end, and went tapering or gradually lessening towards the other. It was 4 inches, and $\frac{6}{10}$ of an inch long, and where largest it was an inch and $\frac{6}{10}$ broad; so that it was about 3 inches and $\frac{1}{2}$ in circumference; at the smaller end not above $\frac{4}{10}$ of an inch broad. It had neither shell, crust, scales, or bone for its covering, but was soft; yet not flabby or fleshy, as the mollia described by the naturalists, but rather membranous. The back, or upper side, was roundish, especially towards the sides; in the middle it was rather flattened, the belly was perfectly plain; along the middle of the back ran a large stripe from one extremity to the other, about $\frac{8}{10}$ of an inch broad, towards the upper end, but still narrower as it came towards the tail. This stripe was all covered with a short soft kind of down, not unlike, in texture, colour, and substance, to that which grows on the back of the leaf of tussilago or colts'-foot. Joining to the edge of this stripe, there ran, from one end to the other, a list about $\frac{4}{10}$ of an inch broad, that covered both sides of the animal, and part of his back. This list or verge was thickly shagged, with a fine soft hair, that grew very thick, and about a quarter of an inch long, of a most delicate changeable red and green colour; and of so sparkling a vivid lustre, that nothing of this kind could show more beautiful. Among this soft hair were thickly interspersed, without order, an abundance of black, sharp, hard prickles, about the same length as the hair, and the thickness of a hog's bristle, but much harder, and very sharp at the points. The mouth was a very large patulous opening, for the bulk of the animal; not placed at the end, but somewhat underneath, as forming part of the belly, and could not be seen when the back was turned uppermost.

After having well observed its outward shape, I opened it, but found here little variety of parts; that which first offered, was a thin membranous gullet, that led from the mouth to the stomach, about an inch long: from this was continued straight-downwards the stomach, not lying transverse, as is its most usual posture, but lengthwise; it was of a whitish colour, and of a tough thick texture, consisting of an external and internal membrane, with a sort of carneous substance between, resembling somewhat in make, though not in figure, the gizzard in some fowl; it was as large as the upper joint of a man's little finger; to this was annexed the intestine, of a very different colour and substance from the stomach, being reddish, soft, and tender, and of a much smaller cavity; it was continued almost directly, or with little circumvolution, to the anus;

and besides these parts serving for nutrition, I could not distinguish any other viscera.

But that it had no brain, heart, gills, liver, or parts for generation, or something analogous to these, I dare not affirm; yet this is certain, that nature has carefully supplied some imperfect animals, such as the leech, a water reptile as this, with large and conspicuous organs for nutrition, while other principal parts, if they have any, are hardly, if at all, to be distinguished.

But what was most remarkable in its inward structure, was the curious contrivance of the muscular parts, for the performance of its several motions; these were very apparent, being both large and distinct: one long continued stripe of red fleshy fibres, about the 6th part of an inch broad, ran directly along the middle of the back, from the head down to the tail: this fleshy stripe sent out from each side, like so many rays, 36 several pair of smaller lateral muscles, which, by the considerable interstice between, I could easily distinguish from each other, making so regular a figure altogether, that they might very aptly be resembled to the spine, or back bone of the passer marinus, or common plaice fish, when it is entire with all its ribs or transverse processes, issuing by pairs from both sides of each vertebra, from the head down to the tail: in this manner every particular foot and fin were supplied with their correspondent muscles, to give them motion, either together or apart, as the necessity or design of the animal required. And besides, considering this sort of muscular mechanism, with the taper shape of the body, and the position and use of the many prickles interspersed among the hairy shag that covered the sides; it seems very evident to me, that, besides its progressive motion, it had also the power (as have most of the many footed land-reptiles, and some water insects I have observed) of contracting its body in such a manner, that bending its head inward, it rolled the rest of the body round it as a centre, making a figure like a rope coiled into a helix, and in this posture guarded itself from violences that might annoy it. So we may often see the large hairy caterpillars, that have not a little resemblance to this creature, when molested by any offensive object, straight secure themselves from the violence, by gathering up their body in this manner, and making their hairy bristles start out directly forward.

An Explanation of the Figures, drawn half the Size of Life.

Fig. 6, pl. 3, aaaaa the downy list running along the back; bb the two triangular scales that cover the anus; ccccccc the verge of fine changeable green red hair that covered the sides and part of the back; ddddddd the hard and sharp prickles interspersed among the hair.

Fig. 7, eeeee the skin of the belly; ffff several incisures resembling joints towards the tail; ggggg darker spots in the skin of the belly; hhhhh the feet on each side the belly; iiiii the fins with their hairy fringe behind the feet; kk the large mouth opened wide.

On several Plants which may be usefully cultivated for producing Grass for Hay. By Dr. Martin Lister. N° 225, p. 412.

For the improvement of sandy light ground, or any clay well sanded, I recommend upon experience vicia multiflora nemorensis perennis sive dumetorum, J. B. It has these qualifications, besides those mentioned in the title of J. Bauhine, (viz. of its being perennial, thriving even in woods and among bushes, and being of the pulse or pea-kind,) that it shoots 1000 roots, far and wide, and spreads itself under ground like quick grass; above ground it is so rampant, that it will climb 3 yards, and will preserve itself in spite of weeds or drought. It may be either sown or planted.

A recommendation is next given of improving sandy land, by mixing clay with the sand. This sandy ground, unless clayed, will bear nothing but rye, whatever other manure or lime your compost be: but once clayed, it will bear oats, barley, peas, &c.

Agriculture may be considerably advanced by the great choice of plants, even of those of our own growth of the pulse kind, of which besides what I mentioned before, this list I recommend to industrious gentlemen who have leisure in the country.

Lathyrus major latifolius. Ger.—Lathyrus luteus sylvestris dumetorum. J. B. —Astragalus sylvaticus. Ger.—Vicia sylvestris semine rotundo nigro. C. B. —Orobus sylvaticus nostras. C. B. P. in Append.—Vicia sylvatica multiflora maxima. P. B.

I also recommend, as substitutes for hemp and flax, of our English growth, viz. perennial plants: linum sylvestre angustifolium. J. B.—Linum sylvestre floribus cœruleis. Ger.—Corona fratrum, of the thistle kind. This plant is generally a yard tall; its fibres are exceedingly tough and strong, beyond any I ever tried; it puts forth many of these tall and very thick stalks yearly; it naturally grows to this bulk in most barren soils, as the dry wolds and high pastures in Yorkshire and Lincolnshire.

It is probable, that by tillage, even harsh plants may be improved and brought to kinder food: the same asparagus which we eat, grows wild in the marshes of Lincolnshire, very fair, and not to be distinguished by the eye from that in our gardens, but is intolerably bitter; which garden culture alone has made pleasant to the taste.

For this purpose, the liming of pasture ground is not so much to fertilize and make the grass grow ranker, but also to make it palatable to cattle, to make it eat short and tender, and sweet, which it does by a kind of blanching it. Throw lime over the half of a pasture, and the cattle will not bite any where else willingly, but will eat here to the bare ground, neglecting the other half.

I used to lime my asparagus and lettuce beds; and this so far meliorated them, that they far exceeded in tenderness and pleasant taste; covering the asparagus in winter with clean wheat straw, instead of nasty litter, and sowing the bed thick with the powder of burnt oyster-shells.

On the long Worm, which is troublesome to the Inhabitants of the East Indies. In a Letter from thence to Dr. Martin Lister.* N° 225, p. 417.

These worms are bred in the water, between Gomroon and Schiraz, especially that about Laur. They come out in any part of the body, and are very troublesome and dangerous; some losing their legs, sometimes their lives by them; they come out sometimes to the length of 6 or 7 yards; when they first come out they are small like a thread, and afterwards grow larger and stronger by degrees. They roll them up on a little bit of stick or cotton, and lay upon them onions and flour of rice boiled in milk. The chief care is to be taken not to break them, for then it is that they do mischief. When mine first came out, for about 40 or 50 days it came out every day by little and little, without putting me to much pain, but that I could go up and down till it was come out a yard and a quarter; but afterwards, one day stirring too much, I hurt the worm and enraged him, so that he broke off of himself, and going in, caused my foot and leg, up to the calf, to swell till the skin was ready to burst, which kept me sleepless, and threw me into a fever. I had a surgeon, and kept my bed for about 20 days, having several fits of the fever. The worm was broke to pieces, and came out in several parts of my foot; but the surgeon applied such things as killed the worm, and turned it to matter: he then lanced my leg a little above the ankle, and another place in my foot, and so with drawing plaisters drew it all out.

* Gordius Medinensis, Linn. The affection itself is the vena medinensis of medical writers.

On the Structure of the Internal Parts of Fish. By Dr. Charles Preston. N° 225, p. 419.

The principal difference between fish and other animals, is their want of lungs and respiration; whereas all other animals have lungs, both terrestrial, volant, and amphibious; and in insects, the several tracheæ, that are spread throughout the whole body, serve them instead of lungs. And yet it is necessary that something should supply this in fishes, which may have the same effect on their blood, as the air has upon ours, by entering into our lungs; viz. to divide and dissolve it, and render it fit for circulation. Now we find no part in fish more proper to produce this effect than the bronchia, that lie like so many leaves over each other under their gills; for they receive the water in by the mouth, and return it by the gills; or receiving it in by the gills, they throw it out by the mouth.

Now it is agreed upon by all, that the water contains something that produces this effect: and this seems most probably to be the air contained in the water, that dissolves the blood in the bronchia of fish, as well as it does that in the lungs of all other animals. That there is air in all water, cannot be doubted, after the experiment of M. Marolle. He set a vessel of water over the fire, so as to drive out the air from it; This water he put into the air pump, to extract the air from it; and after that filled a phial with it, within two or three fingers of the top, which space he left only full of air, and stopped the phial well: and by shaking it, the water imbibed the air, so as to rise up and quite fill the phial.

It may be objected, that if the air in the water were the cause of this effect, the fish would live in the open air. I shall only reply to this, that fish have their blood naturally less hot than ours, so that the natural heat of our blood would in them be a fever and mortal; hence we need not wonder they cannot live in the air; for the nitre* of the pure air is in too great a quantity, and too subtle, so as it dissolves their blood too much, and makes it too fluid: whereas the nitre* in the water is more gross, and in less proportion: whence it gives their blood only a fluidity requisite to keep it in its natural state. To prove that it is in the bronchia that this division is performed, we need only observe their extraordinary redness above any other part of the body, a proof that the blood is there more divided:† fish are also found to die in water frozen over, which happens plainly from their communication with the external air being hindered by the ice.

* Oxygen.

† Or, as physiologists now say, more oxygenized.

The heart of a fish is different from that of other animals in its having only one ventricle; for it has only the vena cava and the aorta that open into it, having no lungs; so that by the aorta the blood comes out of the heart which is branched into a thousand capillaries over the bronchia, and is afterwards reunited; which reunion is made under the basis of the cranium; and because the blood, when once there, has no need of being forced higher upwards, they have no occasion for a second ventricle for that purpose, as terrestrial animals have. The reunion of these capillaries of the bronchia being made, they form two large trunks, of which one proceeds towards the head, and the other towards the lower parts.

Fish have a diaphragm, but not for the same purpose as in other animals that breathe; it is always straight and tense, and perpendicular on the vertebræ. Their stomach is membranous: for fish swallow down other small fish whole, and sometimes earth; therefore it is necessary to have a power of contracting itself forcibly to break in pieces its contents.* Their intestines make several great windings, a sign the fermentation is but slow in them, which is made up by their great length.

The liver has much the same situation as in other animals, as also the spleen: they are provided with a gall bladder, a ductus choledochus, and pancreas, or rather two little bags fastened to the ventricle for the same use; they have indeed usually many pancreases, so that in some there have been found 44; they have kidneys, bladder, &c. They have the ovary near the vertebræ of the loins; the eggs come out at a passage below the anus, and the male has a like ductus or hole, by which they eject their seed upon that of the female, to impregnate the eggs, of which the male sometimes changes the colour as he passes over them, when he casts his seed upon them after they are laid.

Fish have on the vertebræ of the loins a bladder, very large in proportion to their bulk, which serves, by dilating or compressing itself, to render the fish lighter or heavier, as occasion requires, for swimming. And if this be by any means burst, so that it cannot be extended, the fish can no more raise itself in the water, but keeps continually at the bottom. The fins and tail assist them in their passage through the water: but it is this dilatation of the air in the bladder that makes them capable of swimming, after the same manner as the dilating of the lungs and thorax of a man bears him up in the water. Flat fish, such as soles, have none of this bladder: for they are able, by reason of their breadth, to sustain themselves in the water. Craw-fish and other shell-fish

* Their digestion is performed, not by trituration, or mechanical force, but by chemical solution, viz. by the dissolving action of the gastric juice.

want it likewise, for the most part, for they creep only at the bottom of the water, but there are many fish that have them double.

*On the Ratio of the Time, in which a heavy Body passes over a Right Line, joining two given Points, to the shortest Time which, by the Force of Gravity, it passes from the one of these Points to the other by the Arc of a Cycloid.** N° 225, p. 424. *Translated from the Latin.*

Theorem. In the cycloid AVD, (fig. 8, p. 3) whose base AD is parallel to the horizon, and vertex V is downwards, if from A there be any how drawn the right line AB meeting the cycloid in B, from whence draw the right line BC perpendicular to the cycloid at B, to which from A there is drawn the perpendicular AC. I say that the time in which a body from rest falling from A, by the force of its gravity, describes the right line AB, is to the time in which it runs along the curve AVB, as the right line AB is to the right line AC.

Through B draw BL parallel to the axis VE of the cycloid, and BK parallel to the base AD, meeting the axis in G, and a circle described on the diameter EV in F and H, and lastly meeting the cycloid in K. Draw the right line EF, which from the nature of the cycloid, will be parallel to the right line BC. Whence BM is equal to EF, and EM to BF, which by the cycloid, is equal to the arc VF; and therefore AM is equal to the arc EHVF.

By prop. 25, part 2, of Huygens's Horologium Oscillatorium, the time in which a body falling from rest passes over AV, is to the time falling through EV, as a semicircumference is to its diameter, and by the last prop. of the same, the time in which a body runs over VB, after having passed over AV, (viz. equal to the time in which a body passes over KV after running over AK) is to the time of sliding along AV, as the arc VF is to the semicircumference; and therefore to the time of the fall through EV as the arc FV to the diameter. Therefore the time in which a body runs over the curve AVB is to the time of the fall through EV, as the arc EHVF to the diameter EV. But the time of the fall through EV is to the time of the fall through LB, or EG, as EV to EF; therefore, by equality, the time of a body's running along AVB is to the time of the fall through LB, as the arc EHVF to the subtense EF: that is, as the right line AM to the right line MB. Again, the time of the fall through LB, is to the time of sliding along AB, as LB to AB; therefore the ratio of the time in which the body passes along AVB, to the time of running over AB, is composed of the ratio of AM to MB, and of the ratio of LB to BA; and therefore is equal to the ratio of AM × LB to MB × BA. But AM × LB is equal to MB × AC, because each is equal to double the triangle ABM: and therefore the time in

* This anonymous paper has very much the character of a production of Sir Isaac Newton's.

which a body falling from rest runs through the curve of the cycloid AVB, is to the time in which it passes along the line AB, as MB × AC to MB × BA, that is, as AC to AB. Q. E. D. And in the same manner the demonstration proceeds when the point B is between A and V.

*Account of Books, viz.—I. An Account of a new Voyage round the World, by William Dampier,** 1697, *in 8vo.* N° 225, p. 426.

In this vol. the author, in 20 chapters, gives an account of the voyages he made during near 12 years, i. e. from the beginning of 1679, when he left England, to the middle of Sept. 1691, when he returned. First he relates his passage to Jamaica; thence to Porto Bello; thence across the Isthmus of Darien, passing in sight of Panama into the South Sea; thence coasting southward, as far as the island of John Fernando, and his stay there some time; and then his return to cross back again the said isthmus into the North Sea.

In the 4th chapter, the author begins the account of the first part of his new voyage towards the South Sea, which proved afterwards to be a circumnavigation of the whole globe of the earth. He began it in August 1683, from Virginia, and continues the account of it in the 16 following chapters, till Sept. 16, 1691, when he arrived in the Downs.

II. Almagestum Botanicum s. Phytographiæ Plucnetianæ Onomasticon, &c. fol. London. edit. 1696. N° 225, p. 434.

In this work Dr. Leonard Plukenet presents the world with the names of about 6000 plants, a part of his Herbarium Vivum, digested into an order as well alphabetical as classical, 500 of them no where else to be found; which may very well serve instead of a pinax or general index plantarum.

To which 70 copper plates, with various sculpts of the more rare, exotic, new plants are annexed, for the satisfaction of the lovers of botany. Here it is indeed our author seems to lead us into the delights of both the Indies, and

* William Dampier was a celebrated navigator in his time, who performed the circumnavigation of the terraqueous globe. He was born in Somersetshire 1652, and went to sea early in life. He sailed with a Captain Cook, who commanded a Bristol ship sent out against the Spaniards. After cruising a considerable time on the American coast, and taking several prizes, Captain Cook died, and was succeeded by Mr. Davis, whom Dampier quitted, and entered another buccaneering ship, commanded by Captain Swan. Meeting with little success, they sailed for the East Indies, where Dampier left Captain Swan, and proceeded to the English factory at Achin. He then engaged with a Captain Weldon, and afterwards became gunner to the factory at Bencoolen. In 1691 he embarked by stealth for England, where he arrived the same year. He afterwards sailed from Bristol with Captain Woodes Rogers, for the South Sea, and returned in 1711. When Dampier died is not known. His voyages are thought to possess much accuracy.

by an artful adumbration entertains the curious eye with another world of vegetables.

An Account of the Map of France, according to the Observations of MM. Picard and de la Hire; taken from the Recueil d'Observations, &c. Paris, 1693, fol. N° 226, p. 443.

Here is contained a short account of the circumstances in which this new and more accurate map of France, drawn from the observations of the Royal Academy, differs from the former maps, particularly that of M. Sanson, as the best of them; which particulars are chiefly the following: both the old and new boundary line of the coast are laid down in a differently shaded line, at once to distinguish them, and to exhibit to the eye the nature and quantity of the correction. In general the corrected west coast of France is brought much more towards the east; and the south, or Mediterranean coast, much further to the north. The degrees of latitude are marked on both sides of the border, or on both the right and left hand sides; and the degrees of longitude are marked both along the top and bottom, counting both eastward and westward, and from the meridian of Paris, instead of from the Ferro island, as formerly.

The true Theory of the Tides, extracted from Mr. Isaac Newton's Treatise, intitled, Philosophiæ Naturalis Principia Mathematica; being a Discourse presented with that Book to the late King James, by Mr. Edmund Halley. N° 226, p. 445.

The sole principle on which this author (Mr. Newton) proceeds to explain most of the great and surprising appearances of nature, is no other than that of gravity, by which all bodies in the earth have a tendency towards its centre; as is most evident; and from undoubted arguments it is proved, that there is such a gravitation towards the centre of the sun, moon, and all the planets. From this principle, as a necessary consequence, follows the spherical figure of the earth and sea, and of all the other celestial bodies; and though the tenacity and firmness of the solid parts support the inequalities of the land above the level, yet the fluids, pressing equally, and easily yielding to each other, soon restore the equilibrium, if disturbed, and maintain the exact figure of the globe.

Now this force, of the descent of bodies towards the centre, is not in all places alike, but is still less and less, as the distance of the centre increases, and in this book it is demonstrated, that this force decreases as the square of the distance increases, that is, the weight of bodies and the force of their fall is less, in parts more removed from the centre, in the proportion of the squares of the distance. Thus a ton weight on the surface of the earth, if it were raised to the height of 4000 miles, which I suppose the semidiameter of the earth, would weigh but $\frac{1}{4}$ of a ton, or 500 weight; if to 12000 miles, or 3 semidiameters from the surface, that is 4 from the centre, it would weigh but $\frac{1}{16}$ part of the weight on the surface, or 100 and $\frac{1}{4}$; so that it would be as easy for the strength of a man at that height to carry a ton weight as here on the surface a $1\frac{1}{4}$ cwt. And in the same proportion does the velocities of the fall of bodies decrease; for whereas on the surface of the earth all things fall 16 feet in a second, at 1 semidiameter above the surface this fall is but 4 feet, and at 3 semidiameters, or 4 from the centre, it is but $\frac{1}{16}$ of the fall at the surface, or but one foot in a second; and at greater distances, both the weight and fall become very small; yet at all given distances they are still something, though the effect become insensible. At the distance of the moon, which I will suppose 60 semidiameters of the earth, 3600 pounds weigh only 1 pound, and the fall of bodies is but $\frac{16}{3600}$ of a foot in a second, or 16 feet in a minute; that is, a body so far off would descend in a minute no more than the same at the surface of the earth descends in a second of time.*

As was said above, the same force decreasing after the same manner is evidently found in the sun, moon, and all the planets, but more especially in the sun, whose force is prodigious, becoming sensible even at the immense distance of Saturn; this gives room to suspect, that the force of gravity is in the celestial globes, proportional to the quantity of matter in each of them; and the sun being at least 10000 times larger than the earth, its gravitation, or attracting force, is found to be at least 10000 times as much as that of the earth, acting on bodies at the same distance.

This law of the decrease of gravity being demonstratively proved, the author inquires into the necessary consequences of this supposition; by which he finds the genuine cause of the several appearances in the theory of the moon and planets, and discovers the hitherto unknown laws of the motion of comets, and of the ebbing and flowing of the sea.

Now, the theory of the motion of the primary planets is here shown to be nothing but the contemplation of the curve lines, which bodies projected with a given velocity, in a given direction, and at the same time drawn towards the sun by its gravitating power, would describe. Or, which is the same, that the orbits of the planets are such curve lines as a shot from a gun describes in the air, being thrown according to the direction of the piece, but bent into a

* That is, 3600 times the space fallen in a second, because the spaces descended are in proportion as the square of the times.

crooked line by the supervening tendency towards the earth's centre; and the planets being supposed to be projected with a given force, and attracted towards the sun, after the aforesaid manner, are here proved to describe such figures as answer exactly to all that the industry of this and the last age has observed in the planetary motions. So that it appears, that there is no need of solid orbs and intelligences, as the ancients imagined; nor yet of vortices or whirlpools of the celestial matter, as Descartes supposes; but the whole affair is simply and mechanically performed, on the sole supposition of a gravitation towards the sun, which cannot be denied.

The motion of comets is here shown to be compounded of the same elements, and not to differ from planets, but in their greater swiftness, by which overpowering the gravity that should hold them to the sun, as it does the planets, they fly off again to such a distance from the sun and earth, that they are soon out of our sight. And the imperfect accounts and observations antiquity has left us, are not sufficient to determine whether the same comet ever return again. But this author has shown how geometrically to determine the orbit of a comet from observations, and to find his distance from the earth and sun, which was never done before. The third thing here accomplished, is the theory of the moon, all the inequalities of whose motion are proved to arise from the same principles, only here the effect of two centres operating on, or attracting a projected body, comes to be considered; for the moon, though principally attracted by the earth, and moving round it, does, together with the earth, move round the sun once a year, and is, according as she is nearer or farther from the sun, drawn by him more or less than the centre of the earth, about which she moves; whence arise several irregularities in her motion, of all which, the author in this book has given a full account. And though by reason of the great complication of the problem, he has not yet been able to make it purely geometrical, it is to be hoped, that in some further essay he may surmount that difficulty; and having perfected the theory of the moon, the long desired discovery of the longitude, which at sea is only practicable this way, may at length be brought to light.

All the surprising phænomena of the flux and reflux of the sea are, in like manner, shown to proceed from the same principle. If the earth were alone, that is to say, not affected by the actions of the sun and moon, it is not to be doubted but the ocean, being equally pressed by the force of gravity towards the centre, would continue in a perfect stagnation, always at the same height, without ever ebbing or flowing; but it being here demonstrated, that the sun and moon have a like principle of gravitation towards their centres, and that the earth is within the activity of their attractions, it will plainly follow, that the equality of the pressure of gravity towards the centre will thereby be disturbed; and though the smallness of these forces, in respect of the gravitation towards the earth's centre, renders them altogether imperceptible by any experiments we can devise, yet the ocean, being fluid and yielding to the least force, by its rising shows where it is less pressed, and where it is more pressed by its sinking. Now if we suppose the force of the moon's attraction to decrease, as the square of the distance from its centre increases, as in the earth and other celestial bodies, we shall find that where the moon is perpendicularly either above or below the horizon, in zenith or nadir, there the force of gravity is most of all diminished, and consequently that there the ocean must necessarily swell by the coming in of the water from those parts where the pressure is greatest, viz. in those places where the moon is near the horizon. Thus, let M, fig. 9, pl. 3, be the moon, E the earth, C its centre, and Z the place where the moon is in the zenith, N where in the nadir. Now, by the hypothesis, it is evident that the water in Z, being nearer, is more drawn by the moon than the centre of the earth C, and that again more than the water at N; therefore the water in Z has a tendency towards the moon, contrary to that of gravity, being equal to the excess of the gravitation in Z, above that in C: and in the other case, the water at N, tending less towards the moon than the centre C, will be less pressed, by as much as is the difference of the gravitations towards the moon in C and N. This rightly understood, it plainly follows, that the sea, which otherwise would be spherical, by the pressure of the moon must form itself into a spheroidal or oval figure, whose longest diameter is where the moon is vertical, and shortest where she is in the horizon; and that the moon shifting her position as she turns round the earth once a day, this oval of water shifts with her, occasioning thereby the two floods and ebbs observable in each 25 hours.

And this may suffice as to the general cause of the tides. It remains now to show how naturally this motion accounts for all the particulars that have been observed about them; so that there can be no room left to doubt but that this is the true cause of them. The spring tides at the new and full moons, and neap tides at the quarters, are occasioned by the attractive force of the sun in the new and full, conspiring with the attraction of the moon, and producing a tide by their united forces: whereas in the quarters, the sun raises the water where the moon depresses it, and the contrary; so as the tides are made only by the difference of their attractions. That the force of the sun is no greater in this case, proceeds from the very small proportion the semidiameter of the earth bears to the vast distance of the sun.

It is also observed that, cæteris paribus, the equinoctial spring tides in

March and September, or near them, are the highest, and the neap tides the lowest; which proceeds from the greater agitation of the waters, when the fluid spheroid revolves about a greater circle of the earth than when it turns about in a smaller circle; it being plain, that if the moon were constituted in the pole, and stood there, that the spheroid would have a fixed position, and that it would be always high water under the poles, and low water every where under the equinoctial; and therefore, the nearer the moon approaches to the poles, the less is the agitation of the ocean, which is the greatest of all, when the moon is in the equinoctial, or farthest distant from the poles. Whence the sun and moon, being either conjoined or opposite in the equinoctial, produce the greatest spring tides; and the subsequent neap tides, being produced by the tropical moon in the quarters, are always the least tides; whereas in June and December, the spring tides are made by the tropical sun and moon, and therefore less vigorous; and the neap tides by the equinoctial moon, which therefore are the stronger: hence it happens, that the difference between the spring and neap tides in these months, is much less considerable than in March and September. And the reason why the very highest spring tides are found to be rather before the vernal, and after the autumnal equinox, viz. in February and October, than precisely upon them, is, because the sun is nearer the earth in the winter months, and so comes to have a greater effect in producing the tides.

Hitherto we have considered such affections of the tides as are universal, without regard to particular cases; what follows from the different latitudes of places, will be easily understood by fig. 10, pl. 3. Let APEP be the earth, covered over with very deep waters, C its centre, P, p, its poles, AE the equinoctial, Ff the parallel of latitude of a place, Dd another parallel at equal distance on the other side of the equinoctial, Hh the two points where the moon is vertical, and let Kk be the great circle, wherein the moon appears horizontal. It is evident, that a spheroid described on Hh, and Kk shall nearly represent the figure of the sea, and cf, CD, CF, cd will be the heights of the sea in the places f, D, F, d, in all which it is high-water: and seeing that in 12 hours' time, by the diurnal rotation of the earth, the point F is transferred to f, and d to D; the height of the sea CF will be that of the high-water when the moon is present, and cf that of the other high-water, when the moon is under the earth: which in the case of this figure is less than the former CF. And in the opposite parallel Dd the contrary happens. The rising of the water being always alternately greater and less in each place, when it is produced by the moon declining sensibly from the equinoctial; that being the greater of the two high-waters in each diurnal revolution of the moon, when she approaches nearest either to the zenith or nadir of the place: whence it is that the moon in the northern signs, in this part of the world, makes the greatest tides when above the earth, and in southern signs, when under the earth; the effect being always the greatest where the moon is farthest from the horizon, either above or below it. And this alternate increase and decrease of the tides has been observed to hold true on the coast of England, at Bristol by Capt. Sturmy, and at Plymouth by Mr. Colepresse.

But the motions hitherto mentioned are somewhat altered by the libration of the water, by which, though the action of the luminaries should cease, the flux and reflux of the sea would for some time continue: this conservation of the impressed motion diminishes the differences that otherwise would be between two consequent tides, and is the reason why the highest spring tides are not precisely on the new and full moons, nor the neaps on the quarters; but generally they are the third tides after them, and sometimes later.

All these things would regularly happen, if the whole earth were covered with sea very deep; but by reason of the shoalness of some places, and the narrowness of the straits, by which the tides are in many cases propagated, there arises a great diversity in the effect, and not to be accounted for, without an exact knowledge of all the circumstances of the places; as of the position of the land, and the breadth and depth of the channels by which the tide flows: for a very slow and imperceptible motion of the whole body of the water, where it is, for instance, 2 miles deep, will suffice to raise its surface 10 or 12 feet in a tide's time; whereas, if the same quantity of water were to be conveyed on a channel of 40 fathoms deep, it would require a very great stream to effect it, in so large inlets as are the channel of England and the German ocean; whence the tide is found to set strongest in those places where the sea grows narrowest; the same quantity of water being to pass through a smaller passage: this is most evident in the straits between Portland and Cape de Hogue in Normandy, where the tide runs like a sluice; and would be yet more between Dover and Calais, if the tide coming about the island from the north did not check it. And this force, being once impressed on the water, continues to carry it above the level of the ordinary height in the ocean, particularly where the water meets a direct obstacle, as it is at St. Malo's; and where it enters into a long channel, which running far into the land, grows very strait at its extremity; as it is in the Severn Sea, at Chepstow and Bristol.

From this shoalness of the sea, and the intercurrent continents, it is, that in the open ocean the time of high-water is not at the moon's appulse to the meridian, but always some hours after it; as it is observed on all the west-coast of Europe and Africa, from Ireland to the Cape of Good-Hope: in all which a

S. W. moon makes high-water, and the same is reported to be on the west side of America. But it would be endless to recount all the particular solutions, which are easy corollaries of this hypothesis; as, why the lakes, such as the Caspian Sea, and Mediterranean Seas, the Black Sea, the Straits, and Baltic, have no sensible tides: for lakes, having no communication with the ocean, can neither increase nor diminish their water, by which to rise and fall; and seas that communicate by such narrow inlets, and are of so immense an extent, cannot in a few hours' time receive or empty water enough to raise or sink their surface any thing sensibly.

Lastly, to demonstrate the excellency of this doctrine, the example of the tides in the port of Tonquin in China, which are so extraordinary, and differing from all others we have yet heard of, may suffice. In this port, there is but one flood and ebb in 24 hours: and twice in each month, viz. when the moon is near the equinoctial there is no tide at all, but the water is stagnant; but with the moon's declination there begins a tide, which is greatest when she is in the tropical signs: only with this difference, that when the moon is to the northward of the equinoctial, it flows when she is above the earth, and ebbs when she is under, so as to make high-water at the moon's setting, and low-water at the moon's rising: but on the contrary, the moon being to the southward, makes high-water at rising, and low-water at setting; it ebbing all the time she is above the horizon. As may be seen more at large in N° 162, of the Philos. Trans.

The cause of this odd appearance is proposed by Mr. Newton to be from the concurrence of two tides; the one propagated in 6 hours out of the great South Sea along the coast of China; the other out of the Indian Sea, from between the islands in 12 hours, along the coast of Malacca and Cambodia. The one of these tides being produced in north-latitude, is, as has been said, greater when the moon, being to the north of the equator, is above the earth, and less when she is under the earth. The other, which is propagated from the Indian Sea, being raised in south-latitude, is greater when the moon, declining to the south, is above the earth, and less when she is under the earth; so that of these tides, alternately greater and less, there come always successively two of the greater and two of the less together, every day; and the high-water falls always between the times of the arrival of the two greater floods; and the low-water between the arrival of the two less floods. And the moon coming to the equinoctial, and the alternate floods becoming equal, the tide ceases, and the water stagnates: but when she has passed to the other side of the equator, those floods, which in the former order were the least, now becoming the greatest, that which before was the time of high-water, now becomes that of the low-water, and the converse. So that the whole appearance of these strange tides is naturally deduced from these principles, and is a great argument of the certainty of the whole theory.

Account of a Child born alive without a Brain. By Dr. Charles Preston. N° 226, p. 457.

The account of this extraordinary birth (which Dr. Preston had an opportunity of examining) is taken from the Journal des Progres de la Medecine; and is related as follows, by Mons. Le Duc, sworn surgeon of Paris.

All the parts of this child were well proportioned, except the head, the hinder part whereof was flat, as if it had been taken off with the stroke of some weapon, even to the os sphenoides; there was neither brain, cerebellum, nor medulla oblongata; the cavity which ought to contain these was very superficial; I found in their place, a black and livid substance, covered with a membrane, which may be the dura and pia mater joined together; this substance had coloured the os petrosum and other bones of a deep red colour. I thrust a probe into the cavity of the vertebræ, where the medulla spinalis ought to be placed, but found no opposition; for it was filled with a red stinking liquor, contained in the membranes of the medulla spinalis; the visage was a little deformed; it had eyes and ears like a monkey, and all over the body was uncommonly hairy. Instead of the brain, there was nothing but a substance like congealed blood, covered with a membrane; and instead of the optic nerves, there were only some small filaments.

Mons. Du Verny, Prof. of Anatomy in the Royal Garden at Paris, traced the 8th and 9th pairs of nerves and intercostal: and having cut up the canal of the vertebræ, discovered the medulla spinalis all along the cavity, and traced all the vertebral nerves, proceeding from it; as also the sciatic nerve, which was considerable enough: it is true, the medulla spinalis was not here of that consistence as in adult persons: but one could with some pains observe all the four tunics, and the two substances, as in the brain; viz. the cortical or glandulous substance, and the fibrous or white, but with this difference, that the brown substance is exterior in the brain, but interior in the medulla spinalis, for it is as it were a third brain contained in the canal of the vertebræ, so framed for its defence; it has meninges, as in the brain, and cavities which may pass for ventricles: but it appears to be more sensible and necessary to life, than the brain itself; for you can take away the brain or cerebellum from an animal, and yet the animal shall live for some time after; but a wound or compression of the medulla spinalis causes sudden death; as is confirmed by several anatomical experiments. 1. Mons. Du Verny took away the brain and cerebellum from a pigeon, and filled the cranium with flax: notwithstanding which it lived some time, searched for aliment, did the ordinary functions of life, and had the use of its senses. 2. Mons. Chirac, Professor of Anatomy at Montpellier, took away the brain from a dog, yet he lived some time; but when the cerebellum was taken out, he died immediately: but he has observed, that by blowing into the lungs, the animal has lived an hour, although wanting the cerebellum. 3. He took away from another dog half the cerebellum, but he died immediately. 4. After taking away half the brain from a third dog, he continued to have the motion of all the parts, and could walk about; he then took all the brain from the same dog, and he yet had sense and respiration. 5. He separated the medulla oblongata of a fourth dog from the medulla spinalis, by introducing a pair of scissars between the first vertebra and the os occipitis; the animal had died immediately, but by blowing into the lungs the motion of the heart continued, and the animal could move its body. 6. He took the cerebellum from a fifth dog, but he lived 24 hours, and his heart beat well.

All these experiments show that an animal may live for some time, though imperfectly, wanting the brain, and even the cerebellum; but there is no experiment where they ever lived wanting all; therefore I conceive, that the medulla spinalis was not here wanting, for it has supplied the defect of the brain and cerebellum, and the animal spirits have been separated and disturbed for continuing the circulation of the blood: for it is to be considered, that although the intercostal nerve and 8th pair have their origin in the medulla oblongata, yet after their entry into the cavity of the breast, they are united with branches from almost all the vertebral nerves, and with them make up several plexuses, from whence several branches are emitted to the heart and other parts, sufficient for continuing the circulation of the blood; which has occasioned some to fall into a mistake, thinking the circulation might be explained some other way, than by the influx of the animal spirits into the nerves, which they endeavour to prove by an experiment on a dog, of tying up the intercostal and 8th pair of nerves, before they enter the cavity of the breast, and yet the dog shall live for two or three days after. But unless they can tie up all the vertebral nerves, or at least tie up the nerves at their entrance into the heart, the experiment is not so convincing; and the symptoms that usually happen, even upon tying the intercostal and 8th pair, afford an evident proof of the contrary, for the animal is immediately taken with convulsions.

Extract of a Letter from Jean Marie Lancisi, Prof. Anat. Rom., to Mr. Bourdelot, giving an Account of Mr. Malpighi, the Circumstances of his Death, and what was found remarkable on opening his Body. From Brunet's Journal des Progres de la Medecine.* N° 226, p. 467.

Malpighi was very studious, and lived to 66 years. He had frequent sicknesses, and had troublesome vomitings for 20 years; he was also afflicted with the gravel, a hæmorrhage in the kidneys, a rheumatism.

Scarcely had these evils given him some respite, when a cruel palpitation of the heart, with an unequal pulse, afflicted him: and for 4 years before his death a severe sweat all the summer troubled him every night.

* John Maria Lancisi holds a distinguished rank among the medical writers of Italy. He was born at Rome in 1654; was professor of anatomy in one of the colleges there; and physician to Popes Innocent XII. and Clement XI. He died in his native city in 1720. Notwithstanding his constant engagements at the papal court, and the extensive correspondence he kept up with the most learned men, foreigners as well as natives, of his days, he found time to write and publish several considerable works on medical and anatomical subjects; such as Anatomicæ Corp. Humani Synopsis, 1684; De Mortibus Subitaneis, 1707; De Triplici Intestin. Polypo, 1710; De Nativis et Adventitiis Aëris Romani Qualitatibus, 1711; De Ratione Stud. Med. 1715; De Noxiis Paludum Effluviis, 1716; an excellent and truly original treatise on marsh exhalations, showing their injurious effects upon the human body (more especially their influence in the production of intermittents,) and suggesting the means of preventing the mischief they occasion; an Account of Five Epidemic Fevers; some Tracts on Epizootic Diseases; an Epistle de Humor. Secretionibus; another De Vena sine pari; another De Gangliis Nervor. Besides these, several other treatises were published from his MSS. after his death; among which may be mentioned as the most entitled to notice his dissertation de Motu Cordis et Aneurismatibus, and his collect. of Cases and Consultations. His Opera Omnia (but not complete) were published at Geneva, in 2 vols. 4to, 1718, and afterwards at Venice (with the insertion of some treatises omitted in the Geneva edition) in folio, 1739.

Lancisi is entitled to great praise for the pains he took to enforce the necessity of a strict attention to the removal of all kind of filth and stagnant waters, lying close or near to the habitations of men; showing that at all times they contaminate the air in a greater or less degree, so as to impair the health in various ways; and that not unfrequently they prove the source of epidemic diseases. In these respects he rendered the most important services to the inhabitants of Rome. These, however, are but a part of his meritorious exertions in his medical character. He threw much light on some organic diseases, such as apoplexy and aneurisms; and he contributed greatly to the progress of anatomy not only by his lectures and some separate tracts thereon, but more especially by editing and explaining the plates of his countryman Eustachius, recovered and presented to the world after having been concealed or mislaid for more than a century and a half. These plates have been since re-edited with further elucidations, by Albinus.—While we record the instances of Lancisi's industry, erudition, and science, we must not omit doing him the justice to mention some other acts which serve to throw additional lustre on his character; we mean his liberality and beneficence; as testified by the donation of his valuable library during his life time to the Hospital dello Spirito Santo, for the use of the medical pupils; and by his legacy of a considerable sum of money to the same charitable institution for the maintenance of 60 poor women.

Pope Innocent XII. having called him to Rome, to make him his chief physician, he began the 1st year to lose his fresh colour; in the 2d he voided many stones without much pain; and in the third, which was the last of his life, he was oppressed, during the winter, with a difficulty of breathing. His health being thus insensibly undermined, and a bilious looseness returning frequently, he was at length seized with a vertigo, a loss of speech, and a contortion of the mouth, with a palsy of half the right side. Bleedings, purges, diuretics, and antapoplectic medicines, gave some temporary relief; but perceiving his end drawing near, he set his affairs and his writings in order, bequeathing his posthumous works to the Royal Society; soon after which, another stroke of apoplexy, in 4 hours, put a period to his life, Nov. 29.

The abdomen being opened, the ventricle, the guts, the sweet-bread, the spleen and liver were quite sound, both as to colour and size, only the gall bladder abounded with a black gall. The left kidney had nothing amiss; but the right was only half the size, and had its pelvis thrice as large: which discovered the cause of the easy descent of the stones. In the bladder was a little stone, that seemed to have fallen into it a few days before. On removing the sternum, the lungs appeared withered, with some mark of corruption on the back-side. The heart was larger than ordinary, and the sides of the left ventricle felt harder and thicker in some places than others; yet there was no polypus found in either of the ventricles, though there was ground to suspect it. At last the skull being cut asunder, the true cause of his death was discovered, for the right ventricle of the brain contained almost 2 ounces of extravasated blood, and the left ventricle was swelled with a thick and yellow sort of phlegm, which weighed more than an ounce. The dura mater stuck closer to the skull than is usual.

This proves that the conglobate glands in the whole body, had thrown into the mass of blood an acid lymph; and that the conglomerate glands of the hypochondria, especially those of the liver, had thrown into it a melancholy humour; and that these two sorts of humours being carried into the vessels of the brain, had disposed the blood to coagulate there; and that having there corroded and broken the tunicles, they had run into the cavities, where they caused death.*

The Origin of a Polypus discovered. By Mr. Giles, sworn Surgeon at St. Come, translated from Brunet's Progres de la Medecine. N° 226, p. 472.

In June 1684, being called to see a lady, who had a polypus in the right

* This mode of accounting for the morbid appearances, on the principles of the humoral pathology, is by no means satisfactory.

nostril; I examined it, and found it soft, white, and without pain; I presently pulled it out, which was done without pain or any bad accident. But after this extraction, she still felt some trouble in her nose, and moisture passed with difficulty from the nose to the throat. This induced me, seeing no more in the nostrils, to look into the mouth, where I perceived behind the uvula, a strange body of the size of half a nut, which I judged to be a portion of the same polypus. Having pulled this out also, it was of an extraordinary shape; the piece by which I laid hold of it was hard, and of a dark brown: it was fastened by two branches, which seemed to have taken their shape in the nose, being each of them as large as a sweet almond; their substance was softer and whiter. Besides these three parts it had a little stalk, something red, of the size of a cherry-stalk: there was not a drop of blood spilt, and the patient felt no pain in the operation; all trouble was removed, and the liquor passed easily.

After 2 years the patient died of a malignant fever; and as she had some time before her death complained of a new trouble in her nose, I earnestly desired leave of the family to open this organ, to search out the origin of this polypus, which was granted me. After opening the organ, and the adjacent bones, we found nothing in all the nose, but a little piece of very soft flesh, which came out of a cleft of the processus pterygoides; following it exactly, it brought us into the sinus of the upper jaw, where we perceived a ropy and clear humour, in the middle of which was a body, like in figure, consistence, and colour, to a greater one, which we had before taken out; there was also a little red speck, which seemed to be the root of this polypus.

Polypuses are spongy excrescencies, which, according to authors, are formed on the membrane that covers the nose within, by some alteration made there; some are formed also in other parts, as in the cavities of the great veins. But this membrane is more disposed to the production of them than others, because it is the most spongy of the whole body, and most full of blood vessels.

The discovery of Mr. Giles gives us to understand, that it may be produced in the sinus, over which this membrane is extended, and into which it filters the mucus which is spread over this organ, and for this reason probably it is that it is so difficult radically to cure these polypuses. Also the extirpation of them is not always so successful as it has been in this; when they appear very red and full of blood, the extirpation of them is dangerous, for fear of an hemorrhage, which is not easily stopped.

Account of Books.—1. *An Account of the Nature, Causes, Symptoms, and Cure of the Distempers that are incident to Seafaring People; with Observations on the Diet of the Seamen in His Majesty's Navy. By Wm. Cockburn. Lond.* 1696, *8vo.** N° 226, p. 475.

2. *A Continuation of the Account of the Distempers incident to Seafaring People. By Wm. Cockburn of the Coll. of Physicians, &c. Lond.* 1697, *8vo.* N° 226, p. 478.

3. *Recueil de diverses Pieces touchant quelques nouvelles Machines, &c. Par Mr. D. Papin, Dr. en Med. &c. A Cassel,* 1695, *in 8vo.* N° 226, p. 481.

This treatise contains several discourses and letters, with the descriptions of several engines and machines, with their uses. The first is what the author names the Hessian pump. The contrivance consists in a cylindrical hollow vessel, in the centre of which is an axis, that carries 2 or 4 flies or sails; which, being swiftly moved, force the air, or any other fluid contained in the cylinder, from the centre towards the circumference of the cylinder or barrel; in which circumference is a hole for the fluid to issue out, and likewise another near the centre for a new supply of air or water to come into the cylinder; by which means a constant motion or stream of the fluid is continued, and may be applied to several uses, both for pleasure and profit; as, for jet d'eaux, and other raising of water to considerable heights, and is applicable to extinguish fires, &c. Another use is by the air thus forcibly driven out, to give very strong and lasting blasts for iron forges, &c.

The next letter treats of the several ways of sparing fuel in all works, where the quantity of the fuel much increases the expense; and this chiefly by a contrivance to burn the smoke, by causing a draught of air to come, or be forced down the tunnel of the chimney to the fire-place; which is done by applying the above described engine to the top of the tunnel, which must be closed all but the place where the engine is applied, and a continual stream of air forced down on the fuel by the swift motion of the engine. This he applies to glass works, iron works, brewing, &c. and says $\frac{5}{6}$ of the wood or other fuel may be saved.

The third letter treats of several inventions to draw the water out of mines,

* So many better accounts of the diseases of seamen, and of the method of treating them, have been published since the date of this book; that a detail of its contents would, at this time, be whelly uninteresting.

by means of some river not far distant from them. And this is performed by the pressure of the air to cylindrical vessels, being alternately evacuated, whose plugs alternately descending again, turn a wheel, which raises two buckets that discharge the water.

The fourth letter shows a method of draining mines, where you have not the conveniency of a near river to play the aforesaid engine: where having touched on the inconveniency of making a vacuum in the cylinder for this purpose with gunpowder, he proposes the alternately turning a small surface of water into vapour, by fire applied to the bottom of the cylinder that contains it, which vapour forces up the plug in the cylinder to a considerable height, and which (as the vapour condenses as the water cools when taken from the fire) descends again by the air's pressure, and is applied to raise the water out of the mine.*

The fifth is concerning a dispute between M. D. Gulielmini and Mr. Papin, concerning running waters, the decision of which he refers to M. Huygens.

The sixth is an abridgment of a dispute between himself and the same person, concerning the true estimate of powers or moving forces.

The seventh treats of instruments to conserve flame under water, against the objections of Mr. Scarlet. He ends with the description of a plunging-boat, or parallepipide vessel made of tin, $5\frac{3}{4}$ feet high, $5\frac{1}{2}$ long, and $2\frac{1}{2}$ broad, strengthened with cross-bars of iron; which vessel, by means of a pump (which has communication with the external air above the water) is to be continually supplied with fresh air, by drawing down the sucker of the pump.

The whole treatise concludes with an harangue, which the author made when he was admitted professor of mathematics at Marburgh.

A Letter from Dr. Charles Morley to Dr. Bernard Connor, F.R.S. giving an Account of the Bones of a Fœtus voided per Anum, some Years after Conception. An abridged Translation from the Latin. N° 227, p. 486.

In this letter it is stated that Mary Kid, about 30 years of age, who had borne children before, and who lived at Swasy, became pregnant in the year 1658. She grew large, and had all the symptoms common in such cases. Towards the completion of the usual period of gestation, she sent for a midwife, and was seized with labour-pains; but no parturition ensued, and the pains ceased, although the enlargement of the abdomen continued. Things remained in this state for a year and a half afterwards. She then heard of a certain country quack, to whom she applied; and who undertook to cure her, not by medicine,

* The principle of the steam-engine; but much inferior in the contrivances to that described by the Marquis of Worcester, in his Century of Inventions, published in 1663.

but by stroking and pressing the abdomen with his hands: an operation to which she submitted in the presence of several women from among her neighbours and acquaintance. This being done, she was ordered to provide herself with a box, to receive whatever should come away from the uterus, and to preserve the same therein. In about a fortnight a small bone came away, not by the uterine passages, but by the anus; and a great many other small bones were voided at intervals in the same manner; and this continued for as long a time as the woman had gone beyond the natural period of gestation. They were all carefully preserved in the box; and from their number and appearance (especially those of the cranium which were very distinct) it was thought that there must have been three dead fœtuses retained all that length of time in the womb. After the tedious and painful expulsion of the fœtal bones in the manner abovementioned, the patient got well by the efforts of nature, who healed up the abcess she (nature) had made for the evacuation of the dead offspring. But this woman about 2 years afterwards riding, very imprudently, upon a jolting horse to Stirbitch fair, near Cambridge, a fresh ulceration was thereby occasioned, and she died.

A Discourse concerning the Large Horns frequently found under Ground in Ireland, concluding from them that the great American Deer, called a Moose, was formerly common in that Island: with Remarks on some other Things natural to that Country. By Thomas Molyneux, M.D. F.R.S.* N° 227, p. 489.

By the remains we have of this animal, it appears to have been of the genus cervinum or deer kind, and of that sort that carries broad or palmed horns, bearing a greater affinity with the buck or fallow deer, than with the stag or red deer, that has horns round and branched without a palm: this I lately observed, having an opportunity of particularly examining a complete head, with both its horns entirely perfect, not long since dug up, given to my brother William Molyneux, as a natural curiosity, by Mr. Henry Osborn, of Dardistown, in the county of Meath, about 2 miles from Drogheda, who wrote him the following account of the manner and place they were found in.

"I have by the bearer sent the head and horns I promised you; this is the third head I have found by casual trenching in my orchard; they were all dug up within the compass of an acre of land, and lay about 4 or 5 feet under

* These horns (says Mr. Pennant,) differ very much from those of the European or American elk; the beam, or part between the base and the palm, is vastly longer: each is furnished with a large and palmated brow antler, and the snags on the upper palms are longer.

ground, in a sort of boggy soil. The first pitch was of earth, the next two or three of turf, and then followed a sort of white marl, where they were found: they must have lain there several ages, to be so deeply interred."

I took their dimensions carefully as follows: from the extreme tip of the right horn to that of the left, expressed in the line AB, fig. 11, pl. 3, was 10 feet 10 inches; from the tip of the right horn to the root where it was fastened to the head, CD, 5 feet 2 inches; from the tip of the highest branch, measuring one of the horns transverse, or directly across the palm, to the tip of the lowest branch, EF, 3 feet $7\frac{1}{2}$ inches. The length of one of the palms, within the branches GH, 2 feet 6 inches: the breadth of the same palm, still within the branches, IK, 1 foot $10\frac{1}{2}$ inches: the branches that shot forth round the edge of each palm were 9 in number, besides the brow-antlers, of which the right antler DL, was a foot and 2 inches in length, the other was much shorter: the beam of each horn at some distance from the head, where it is marked M, was about 2 inches and 6 tenths of an inch in diameter, or about 8 inches in circumference; at the root, where it was fastened to the head, about 11 inches in circumference. The length NO of the head, from the back of the skull to the tip of the nose, or rather the extremity of the upper jaw-bone, 2 feet, the breadth of the skull PQ, where largest, was a foot.

The two holes near the roots of the horns, that look like eyes were not so, (for these were placed on each side the head in two ample cavities, that could not be well expressed in the figure) but were large open passages, near an inch in diameter in the forehead-bone, to give way to great blood-vessels that here issue forth from the head, and pass between the surface of the horn and the smooth hairy skin that covers them whilst they are growing, (which is commonly called the velvet,) to supply the horns with sufficient nourishment, while they are soft, and till they arrive at their full magnitude, so as to become perfectly hard and solid.

It is not to be questioned, but these spacious horns, like others of the deer kind, were naturally cast every year, and grew again to their full size in about the space of 4 months: for all species of deer, yet known, certainly drop their horns yearly, and with us it is about March, and about July following they are full grown again. And this probably owing to the same cause, that trees annually cast their right fruit, or drop their withering leaves in autumn; that is, because the nourishing juice is stopped, and flows no longer; either on the account that it is now deficient, being all spent, or that the hollow passages, which convey it, dry up, so that the part having no longer any communication with them must of necessity by degrees sever from the whole.

Another such head, with both the horns entire, was found some years since by one Mr. Van Delure in the county of Clare, buried 10 feet under ground in a sort of marl. And in the year 1691, Major Folliot told me, that digging for marl near the town Ballymackward, not far from Ballyshannon in the county of Fermanagh, he found buried, 10 feet under plain solid ground, a pair of this sort of horns, which he keeps still in his possession. In the year 1684, two of these heads were dug up near Turvy, within 8 miles of Dublin. Not long since, a head of this kind, with its horns, was found near Portumny, the house of the Earls of Clanricard, seated on the river Shannon, in the county of Gallway. And to my knowledge, within less than 20 years, above 20, I might safely say 30, pair of such horns have been dug up in several places of this country, all found by accident; and we may well suppose vast numbers still remain undiscovered; so that doubtless this creature was formerly common in Ireland, and an indigenous animal, not peculiar to any territory or province, but universally met with in all parts of the kingdom. We may also reasonably gather, that they were not only common in this country, but that they were a gregarious animal, or such a sort of creature as affect naturally keeping together in herds; several of these heads being found within a small compass.

That these heads should be constantly found buried in a sort of marl, seems to intimate, as if marl was only a soil that had been formerly the outward surface of the earth, but in process of time, being covered by degrees with many layers of adventitious earth, has by lying under ground a certain number of ages, acquired a peculiar texture, consistence, richness, or maturity, that gives it the name of marl; for we must needs allow that the place where these heads are now found, was certainly once the external superficies of the ground; otherwise it is hardly possible to conceive how they should come there. And that they should be so deep buried, as we at present find them, appears to have happened by their accidentally falling where it was soft low ground; so that the horns, by their own considerable gravity, might easily make a bed, where they settled in the yielding earth; and in a very long course of time, the higher lands being by degrees dissolved by repeated rains, and washed and brought down by floods, covered those places that were situated lower with many layers of earth: for all high grounds and hills, unless they consist of rock, by this means naturally lose a little every year of their height; and sometimes sensibly become lower even in one age.

How this kind of animals, formerly so common and numerous in this country, should now become utterly lost and extinct, deserves our consideration. Some have been apt to imagine that they were destroyed by the deluge in Noah's time. But it is not probable that such a slight and porous substance as these horns could be preserved entire from the time of that flood. It is indeed more likely that this animal might be destroyed here by some epidemic distemper, or pestilential murrain.

It remains that we inquire, what species of animal it was to which these enormous horns belonged. It is an opinion generally received that they belonged to the alche, elche, or elenda, and therefore they are usually called elks' horns. But they are quite different from these, both in shape and in size, and cannot by any means belong to the same animal. Indeed the description of that majestic horned animal in America, called the moose, or moose-deer, agrees sufficiently well with it; having the same sort of palmed horns, of similar length and breadth, as well as figure, and the bulk of their bodies corresponding exactly in proportion to the wide spreading of their horns. So that it may be concluded that the moose-deer were formerly as frequent in Ireland as they are still in the northern parts of the West-Indies, New-England, Virginia, Maryland, and Canada.

This animal I find described by Mr. John Josselyn among his New-England rarities, in these words: "The moose-deer, common in these parts, is a very goodly creature, some of them 12 feet high, (in height, says another author more particularly, from the toe of the fore-foot to the pitch of the shoulder 12 feet: in its full growth much larger than an ox,) with exceedingly fair horns with broad palms, some of them 2 fathom or 12 feet from the tip of one horn to the other." That is, 14 inches wider than ours was.

Another thus describes the manner of the Indians hunting this creature: They commonly hunt the moose, which is a kind of deer, in the winter, and run him down sometimes in half, or a whole day, when the ground is covered with snow, which usually lies here 4 feet deep; the beast, very heavy, sinks every step as he runs, breaking down trees as thick as a man's thigh with his horns; at length they get up with it, and darting their lances, wound it so that the creature walks heavily on, till tired and spent with loss of blood it sinks and falls like a ruined building, making the earth shake under it."

There are several things in which Ireland and the West-Indies partake in common. For as on the coast of New-England and the island Bermudas considerable quantities of ambergris are gathered; so on the western coast of Ireland, along the counties of Sligo, Mayo, Kerry, and the isles of Arran, they frequently meet with large parcels of that precious substance, so highly valued for its perfume. Near Sligo there was found one piece that weighed 52 ounces. On the outside it was of a close compact substance, blackish and shining like pitch; but when it was cut, the inside was more porous, and something of a yellowish colour, not so grey, close, and smooth as the cleanest and best sort of amber, but, like it, speckled with whitish grains, and of a most fragrant scent. Many other pieces have been there found.

What sort of substance spermaceti is, and in what part of the whale it is found, physicians and naturalists are not agreed; but it is truly nothing else but part of the oil or liquid fat of this particular sort of whale; which oil, at first when confused and mixed, shows like a whitish liquor of the consistence and colour of whey, but laid by in vessels to settle, its parts by degrees separate: that which is lighter and swims at top, becomes a clear oil, pellucid like water, answering all the uses of common train oil got out of the blubber of other whales; that which subsides, because it is heavier and of a closer consistence, candies together at the bottom, and is what is sold for spermaceti. Of this substance several hundred pounds weight may be procured out of one whale; but the cleansing and curing of it is troublesome, and requires no small art, time, and charge: the fat of the whole body affords it, but that of the head yields the greatest quantity, and purest spermaceti.

Again, the arbutus, sive unedo, or the strawberry tree, is not to be found any where of spontaneous growth nearer than the most southern parts of France, Italy, and Sicily; and there too it is never known but as a frutex or shrub: whereas in the rocky parts of the country of Kerry, about Loughlane, and in the islands of the same lough, where the people of the country call it the cane apple, it flourishes naturally to that degree as to become a large tall tree; the trunks of these are frequently 4½ feet in circumference, or 18 inches in diameter, and the trees grow to about 9 or 10 yards in height; and in such plenty that they now cut them down as the chief fuel to melt and refine the ore of the silver and lead mine, lately discovered near the castle of Ross, in the county of Kerry.

Another plant I shall notice is cotyledon, sive sedum serratum latifolium montanum guttato flore Parkinsoni et Raii, commonly called by the gardeners London Pride. Ray rightly conjectures it is a mountainous plant, for it grows plentifully here with us in Ireland on a mountain called the Mangerton, in Kerry, 6 or 7 miles over, and reputed the highest in Ireland, 2 miles from the town of Killarny, and 4 miles from the castle of Ross: here it spreads itself so abundantly as to cover the greater part of the mountain, and I understand is peculiar to this country.

Whether both the foregoing plants are truly American I cannot at present determine; but this I know, that sabina vulgaris, or common savin, is mentioned by Mr. Josselyn as a plant common on the hills of New England; and I have been assured by an apothecary of this town, that he has gathered savin growing wild as a native shrub in one of the islands of Loughlane, in the county of Kerry: and if so, I have reason to believe, that hereafter farther inquiry may add to those I have given, several other examples of things natural and common to that and this country.

*Account of several Magnetical Experiments; and of a Person who pretended to cure or cause Diseases at a Distance, by applying a Sympathetic Powder to the Urine.** N° 227, p. 512.

These magnetical experiments are to be considered now as rather trifling, or of very little consequence. They consist chiefly in trying whether pieces of magnet would act as in open air when inclosed in sealed glass vessels, or immersed in water, &c.

Account of a Book; viz. ΛΥΚΟΦΡΟΝΟΣ ΤΟΥ ΧΑΛΚΙΔΕΩΣ ΑΛΕΞΑΝΔΡΑ, Καὶ εἰς αὐτὸ τοῦτο ΙΣΑΚΙΟΥ τοῦ ΤΖΕΤΖΟΥ ΕΞΗΓΗΜΑ. *Lycophronis Chalcidensis Alexandra, cum Græcis Isacii Tzetzis Commentariis. Accedunt Versiones, Variantes Lectiones, Emendationes, Annotationes et Indices Necessarii. Curâ et Operâ Johannis Potteri,† A. M. et Collegii Lincolniensis Socii. Oxonii, è Theatro Sheldoniano, An. Dom.* 1697. N° 227, p. 522.

Lycophron's Cassandra is the only work that remains to us, out of the many volumes of that author: it is a poem the most intricate and obscure of any, that has ever appeared in the Greek, or other languages: but its usefulness sufficiently compensates for its obscurity. The design is thus; Cassandra, the daughter of Priam king of Troy, seeing her brother Paris put to sea, with an intent to fetch Helena from Greece, and being before instructed by Apollo in the art of divination, foretels the manifold calamities which that voyage brought upon her native country; and having premised an account of the former taking of Troy by Hercules, she enumerates all the miseries which the Grecians and Trojans underwent during the long ten years' siege of that city, and at the destruction of it, with the various fortunes that befel them after-

* The concluding part of this communication relates to a German quack, who pretended to cure sick and wounded people by what he called a sympathetic powder, which operated, (as he asserted) at his house, upon the urine of persons brought to him.

† The Rev. John Potter, archbishop of Canterbury, was born at Wakefield in Yorkshire, in 1674. At 19 he published his Variantes Lectiones et Notæ ad Plutarch. libr. de Aud. Poet. and the year after he was chosen fellow of Lincoln coll. At 23 (1697) he published the above learned edition of Lycophron; and the same year also the first volume of his Antiquities of Greece; literary pursuits which engaged him in a correspondence with Grævius and other learned men abroad. In 1715 he was made bishop of Oxford; and in 1737 archbishop of Canterbury. He died suddenly in 1747, at 73 years of age.

wards, and the numerous colonies planted by them in Italy, Sicily, and other parts of the world. Then having related from their first original the causes of the continual quarrels between Europe and Asia, and described the memorable occurrences in Xerxes's famous invasion of Greece, she draws out the thread of her discourse as far as the successors of Alexander the Great, in a most natural, yet artful method. All these narrations are embellished with many pleasant episodes, and so great variety of poetical histories, that by a thorough understanding of this single poem, the reader will be furnished with a competent knowledge of the greatest part of the ancient mythology: and the words and phrases, in which all these are expressed, are such, that whoever has made himself master of them, can scarcely be at a loss in any the most obscure passages of other authors, especially the poets: so that a careful perusal of this book will be a considerable step to a perfect understanding of the Greek language.

On Fossil Wood dug up at Youle in Yorkshire. By Richard Richardson, M. D. N° 128, p. 526.

At Youle, about 12 miles below York, near the place where the Dun runs into the Humber, there are several persons, called tryers, who, with a long piece of iron, search in the soft and boggy ground for subterraneous trees; and by this means they can in a great measure discover the length and thickness of these trees, and get a livelihood by it. Some are so large, that they are used for timber in building houses, which is said to be more durable than oak itself; others are split into laths; others again are cut into long splinters, and tied up in bundles, and sent to the market towns, several miles off, to light tobacco. These trees, when found, are all broken off from the roots; I suppose by violence of storm or water, or both. The tryers affirm, that at 3 or 4 yards depth they find stumps of trees broken off; some 2, 3, or 4 feet from the ground, and to be exactly the same wood with the subterraneous trees. The bate or texture of this wood is the same with fir, splitting easily; when burnt, it emits the same resinous smell, and it affords the same coal. The branches generally grow in circles, as appears by the knots, which easily part from the rest of the wood, as is usual in fir-wood. The straightness and length of these trees are also a presumption, that they must be such; if one consider that some of these are near 100 feet long; and at the bottom, not much above a foot in diameter. It is affirmed, that their tops lie all one way, viz. with the current of the water. Oaks are also found there, though not in so great quantity. The vitriolic parts of the earth, in which they have lain, has given them a black tincture quite through, which, when wrought and polished fine, is but little inferior to ebony: this does not emit the same smell when burnt, with that called fir-wood; so that the smell of that wood cannot be attributed to the bituminous parts of the earth in which it has lain. About 60 or 70 years ago, several Dutchmen undertook to drain a large marsh in that place; and in cutting a channel in the dry ground between the fen and the river; at the first they threw up a rich and firm soil, afterwards they met with a stratum of sand, under that a stratum of boggy ground, in which they found some of these subterraneous trees, and under that firm ground again. The place, where these trees are found, is a long flat on the one side, bounded by the raging river Humber, which often breaks its banks.

Extract from some Letters from Mr. Nicholas Witsen, of Amsterdam; giving a farther Account of the horrible Burning of some Mountains of the Molucco Islands. N° 228, p. 529, &c.

The mountain Kemas or Brothers, in the territory of Manado, is blown up with a most dreadful noise, as of the loudest thunder, which caused darkness and an earthquake, and other dismal signs at Ternata: which noise has also been heard at Amboyna. The mountain of brimstone upon Amboyna, called Wawany, also burns dreadfully. From all which it seems evident that in those parts and seas, there are subterraneous fires, having a mutual communication with one another. When a hole is made any where in the ground, 10 or 12 feet deep, the ground is warm.

Nov. 20, 1694, about the evening was seen a very thick smoke about the top of the mount Gounong Apy, in the island of Banda, which was much augmented on the 21st and 22d, and that night the flame broke out: on the 23d, 24th, and some following days, the fire was continually increasing on the west side, and with such noises, as if the greatest pieces of cannon had been discharged: and afterwards followed the stones on the west-side as far as the sea, which was a horrible spectacle. The fishermen say that so many stones have been cast out already, that the place where they used to fish with lines at 40 fathom water, is now dry, and the fire comes out of the water so vehemently that it is dreadful to see, and the water is so hot that we cannot come near it. And now the mountain burns most towards the side of the Loutoir. The trees on the east and west-side are altogether spoiled, and the west-side is covered with stones to a great height. The smell of brimstone, during the westerly monsoon, is so intolerable, that one could scarcely endure it in the strees of Neira.

It causes also a great sickness on Neira: the water which rains down is, by reason of the brimstone and saltpetre, become sour, and without a natural taste.

We are in fear because of the mount Gounong Apy, which burning continually, throws out so great a quantity of fire and ashes, that the trees of the country Neira, and part of those on the high country of Loutoir, are so much covered with ashes, that no fruit is to be expected from them.

At Neira there is neither leaf nor herb. The ground is covered with stones and ashes; and many houses crushed down to the ground by their weight, and buried under them.

Observations on an Infant, where the Brain was depressed into the hollow of the Vertebræ of the Neck. By Dr. Edward Tyson, F.R.S. N° 228, p. 533.

The midwife informed me, that she was very sensible that this child was alive at first, and that it died in the birth, or a little before. I found it well grown, all the limbs and body well proportioned, and plump; the face well featured, only from the eye-brows; the scull was perfectly depressed down to the os sphenoides, or basis of the calvaria: so that it had no forehead. I opened the cranium in several places, before I could find any brain at all; the cranium being every where so depressed and touching the calvaria: but at length I observed, near the passing out of the medulla oblongata to the medulla spinalis, a small quantity of the brain, the whole might be included in a walnut-shell. It was covered over with a bloody matter; but thrusting down my little finger through the foramen, where the medulla spinalis passes, I observed a very large cavity in the hollow of the vertebræ of the neck; which I found to be filled with a substance like the brain, or medulla spinalis, or both; but far larger than the medulla spinalis itself could be in so small an infant.

How far the medulla spinalis may answer the office of the brain, especially in embryos, where there is no exercise of the senses, nor the imaginative faculty, will be no great difficulty to comprehend; since for the functions of life in them, the spirits generated even in the medulla spinalis may suffice, especially in this instance, where I suppose a great part of the brain to be detruded (by a bruise the mother received) into the cavity of the vertebræ; and I query, whether in those instances that are given of births of infants without brains, there might not be the like accident of the brain, or the principal parts of it being depressed into the vertebræ, which in embryos are parts capable of distension. But the brain being confined in so narrow an inclosure, it stints its growth and enlargement, yet it may be sufficient to supply spirits for maintaining those offices of life the fœtus enjoys whilst in the womb.

But somewhat to confirm these instances given in the same Transaction, of life continuing after the loss of a great part of the brain, I shall add the following observation.

An Observation of one Hemisphere of the Brain sphacelated, and of a Stone found in the Substance of the Brain itself. By Edward Tyson, F. R. S. N° 228, p. 535.

Dec. 12, 1688, I was desired to be present at the opening of Mr. A. About 2 months before, he had received, in a quarrel at the tavern, a great bruise on his head by a quart pot. But at first neglected the use of means, till at last he was forced to betake himself to his bed. Dr. Morton was sent for. He found him to complain of a most violent pain in his head. He sometimes vomited, sometimes was in convulsions, sometimes in the day he would have a great stupor upon him; and when he awaked would be delirious. His swallowing was difficult, and he would grind his teeth; his eye-sight afterwards failed him, and he lost his memory: and on the least motion of his body would faint away; and in the whole course of his distemper was feverish.

On opening his head, I observed the blood-vessels of the meninges very much extended; but what surprized me more was, to find the greatest part of the left hemisphere or side of the cerebrum, or brain, to be perfectly rotten or sphacelated, not having the least consistency, but purulent and soft; nor could I distinguish the medullary substance from the cineritious, but all of a dark reddish colour; so that I wondered not at the symptoms he complained of, but rather that he lived so long; there being so considerable a part of the substance of the brain itself wholly corrupted.

In the ventricles of the brain I observed a great deal of water; but the greatest surprise of all was the protuberantia orbicularis, called the testis, on the left side; which was as large as a nutmeg; for, on dissecting, I found in a purulent matter there a chalky stone, about the size of a cherry-stone, but flat, and not very thick, and in taking it out I found it friable.

There are frequent observations of stones found in the glandula pinealis, and I have seen the glands of the tunica choroides petrified; but to find stones in the substance of the brain itself, I think is very rare.

Part of a Letter from Mr. Octavian Pulleyn, dated Rome, March 16, 1696, giving an Account of an Inscription found there in the Language of the Palmyreni; and another in the Etruscan Language, found on an old Urn. N° 228, p. 537.

Some rude and unintelligible characters, without description or explanation.

On an Optic Lens of Water, for viewing both near and distant Objects, with the Description of a Natural Reflecting Microscope. By Mr. Stephen Gray. N° 228, p. 539.

I send you here a short account of what has been the success of my attempts, to make small portions of water subservient to the viewing both near and distant objects, together with the description of a natural reflecting microscope.

Drops of fair water being let fall on a piece of plain glass, form themselves into plano convexes, having a convexity proportionable to the height, from which they descend, viz. from a greater height a less, and from a less height a greater degree of convexity. I applied some of these as reading glasses for single words of small letters, as on the globes and maps, and found no other inconveniency, than that the fluidity of the water obliges one to keep the glass horizontal, which I remedied thus: I took a sufficient quantity of isinglass, and dissolved it in water over the fire; and whilst it was warm I dipped a stick into the solution, and let some drops of it fall on the glass as before, and in a quarter of an hour they acquire a consistency that permits them to be held in any position; and though they are not quite so transparent, yet this is little or no impediment to their use. The drops of this solution are more exactly defined than those of common water, having their edges exactly circular, and one may make them of a much longer focus.

A thin flat ring of brass, not exceeding $\frac{4}{10}$ths of an inch diameter in its interior circle, being cemented to a plain piece of glass, and filled with water, or the solution above-mentioned; then by pressing the finger into it, till what is superfluous be taken off, there will be formed a plano concave, which may serve as an eye-glass to a prospective, or to any other optical use concave glasses are applicable to.

I have tried what would be the success of combining portions of water by the help of brass rings, and plain pieces of glass, to give them their true figure and requisite apertures, and inserted them at the ends of tubes of several lengths, and find, that though these natural lenses may serve as eye-glasses, yet when used as object ones, either to telescopes or double microscopes, their effects will not compensate the trouble there is in using them.

For the reflecting microscope, A, fig. 1, pl. 4, represents a small flat ring of brass, whose interior circle must not much exceed $\frac{4}{10}$ths of an inch diameter, and about $\frac{1}{30}$th of an inch thick; this we may call the frame or cell of the glass; it must be prepared for use after the following manner: Take a small globule of quicksilver, and dissolve it in a few drops of aquafortis, to which you may add ten parts of common water; dip the end of a stick in this liquor, and rub the inward circle of the ring with it, so as to give it a mercurial tincture, and being wiped dry, be fit for use. Then let it be laid on the table, and pour a drop of quicksilver within it, which press gently with the ball of the finger, and it will adhere to the ring; then cleanse it with a hare's foot, and you will have a convex speculum. Take up the ring and speculum, carrying it horizontal, and lay it on the brims of the hollow cylinder B; so will the mercury become a concave reflecting speculum, which, from the smallness of the sphere of which it seems to be a section, may be used as a microscope. The cylindric vessel B has a screw hole at bottom, by which it is screwed to the top of the pedestal C D; C E F G is the supporter of the object plate, which may be raised higher or let lower, as there is occasion, by the screw on the pedestal; the object plate must be of glass, cemented to the ring G.

This instrument, with a little variation, may be made a reflecting microscope of water, if, instead of the ring G, there be only a small arm with a hole in it, to receive a drop of water, and the cylindric vessel B be either taken away, or screwed on with its bottom upwards, so as to make an object plate. And this will be found more convenient for viewing the textures of opaque objects, than that described in N° 223 of the Transactions, which is fitter for fluid and transparent ones.

Of a Red Colour produced by a Mixture of a Sulphureous Spirit with a Volatile Alcali. By Mr. Edw. Coles. N° 228, p. 542.

In making several chemical experiments, I found a sulphureous spirit, which being mixed with a volatile alcali, such as spirit of sal ammoniac, or urine, &c. gives it a red colour in a moment, and that without any effervescence, though both the liquors be clear before. And as this experiment may be serviceable in demonstrating sanguification, it is humbly offered to your consideration, &c.

I made the spirit by distilling 2 or 3 pounds of benzoin, with a little sand in a retort, ad siccitatem, and putting the oil, spirit, and flowers altogether into a paper filtre: the spirit comes first through. You may put two parts of the spirit to one of spirit of sal ammoniac, or urine, &c. then shake the glass or bottle, and it will be red in a moment: though the more the glass is shaken, the deeper or blacker red it will be.

*A Note, communicated by Mr. Hill, confirming the great Age of Henry Jenkins.** N° 228, p. 543.

In the king's remembrancer's office, in the exchequer, is a record of a depo-

* See N° 221, p. 92, of this vol.

sition in a cause by English bill, between Ant. Clark and Smirkson, taken April 1665, at Kettering in Yorkshire, where Henry Jenkins of Ellerton upon Swale, labourer, aged 157 years, was produced, and he deposed as a witness. Several very ancient witnesses swore to his being a very old man when they first knew him.

On making Pitch, Tar, and Oil, out of a blackish Stone in Shropshire. By Mr. Martin Ele, the Inventor of it. N° 228, p. 544.

In Brosely, Bently, Pitchford, and other adjacent places in Shropshire, there lies over most of the coal-pits or mines, a stratum or layer of a blackish rock, or stone, of some thickness, which is porous, and contains in it great quantities of bituminous matter. This stone being brought to the workhouse, is ground small by horse-mills, such as are used for grinding flints to make glass of. The powder is thrown into great coppers of water, where, by boiling, the bituminous matter is separated from the stony or gritty part; this last sinking to the bottom, the other swimming at the top of the water. This bituminous substance being gathered together, and evaporated, comes to the consistence of pitch; and this by means of an oil, distilled from the same stone, and mixed with the pitch, becomes thinner, or like tar. These substances are found to exceed common pitch and tar, as they do not crack, but always keep black and soft, by which they may prevent the worm from getting into the ships pitched with it. The oil may be used for oil of petre, or turpentine, and has been tried in aches or pains.

Account of a Book, viz.—Marcelli Malpighii Philosophi et Medici Bononiensis e Regia Soc. Lond. Opera Posthuma Fig. æneis illustrata quibus præfixa est ejusdem Vita a seipso scripta. Lond. 1697, fol. N° 228, p. 545.

This work of Malpighius was delivered when he found himself near the period of his life, with orders to send it to the Royal Society after his death, by whose care it was published, being the last remains of the illustrious Malpighi, giving an account of his whole studies, and some remarkable passages of his life.*

The subjects contained in this vol. besides the author's memoirs of himself, relate principally to physiology and comparative anatomy. At the end are reprinted his observations on the structure of the glands.

* Of this life an abstract has already been given at p. 171, vol. 1, of these Abridgments.

Abstract of the Number of Marriages, Baptisms, and Deaths, at Frankfort on the Maine, in the Year 1695. *Communicated by Dr. Fred. Slare, F. R. S.* N° 229, p. 559.

Months.	Marriages.	Baptisms.	Deaths.	Months.	Marriages.	Baptisms.	Deaths.
January	23	79	72	July	21	69	56
February	17	67	76	August	28	78	63
March	0	65	62	September	15	73	63
April	35	78	58	October	31	86	45
May	25	89	77	November	25	69	45
June	20	75	74	December	8	88	57
				Sum	248	916	748*

248 couples were married, and among them 2 couples that lived before 50 years in matrimony.

Of the baptisms in Frankfort there were—Citizens' children 534, foreigners 234, males 420, females 348.—And among them were, twins 11, posthumous 11, Jews 2, bastards 13 ; sum of all 768.

Of the baptisms at Sachfenhousen were—Citizens' children 94, foreigners 54, males 84, females 64.—And among them were, twins 4, posthumous 1, bastards 2 ; sum of all christened 916.

Of the deaths in Frankfort were—Citizens 63, women 39, widows 24, sons 153, daughters 123, not christened 7, foreigners 194, out of the hospital 30, out of the alms, orphans, and workhouse 9 ; sum of all 240.

At Sachfenhousen.—Citizens 8, women 3, widows 3, sons 20, daughters 14, not christened 3, foreigners 55 ; the sum of all deceased 748.

Abstract of a Letter from Dr. Wallis, of May 4, 1697, *concerning the Cycloid being known to Cardinal Cusani, about the Year* 1450; *and to Charles Bouilli, about the Year* 1500. N° 229, p. 561. *Abstracted and translated from the Latin.*

Dr. Wallis finds among the mathematical works of Charles Bouilli, or Bovilli, published at several times between the years 1501 and 1510, that the curve now called the cycloid was then considered. And he also finds that Bouilli was not the first who considered it: for that Cardinal Cusani had considered the same curve some time before; as appears by an old manuscript of his works, transcribed by J. Scoblant in the year 1451. The figure of the curve, indeed, through the unskilfulness of the transcriber, both in the manuscript and the

* There is some mistake in this column : in what follows the number is 768.

Basil edition of 1565, is very ill drawn; but being corrected according to the true meaning of the Cardinal's own words, it evidently represents the modern cycloid. From hence it is manifest, that this curve was not first taken into consideration either by Mersenne or Galileo, but some ages before; though it was not well understood before the then present time.

The Dissection of the Scallop. By Dr. Martin Lister, F.R.S. N° 229, p. 567. *Translated from the Latin.*

Dr. Lister observed that the hinge was slightly incurvated from the hollow valve or shell, and carried over the other or flat valve, in such a manner as to be firmly connected with both by a lateral cartilage; also that another very strong and black cartilage was placed in the middle part of the hinge; hence the wonderful power of constriction possessed by the animal, as well as perhaps of moving the flat valve somewhat in the manner of an oar, and of springing or leaping, which property the ancients have often mentioned as peculiar to this shell-fish. On laying open the shells he observed the following particulars, viz. towards the right, and under the hinge, lies the hooded mouth, as in the oyster; the coverings of the mouth are formed by the meetings of the exterior branchiæ, or gills, which are muscular, and surround the whole animal from the head to the opening of the vent, running from the region of the mouth to the left. Of these exterior branchiæ, that which lies on the flat shell adheres by its upper centre to the border of a very large round muscle, which is inserted at right angles into the middle of the shells; in like manner is connected the other exterior branchiæ to the other head of the same central muscle. Both these exterior or spurious branchiæ consist of a very fine and pellucid membrane, and being expanded or dilated towards the middle of the shells, adhere slightly to them, so as not to be moved from their situation, and guard the animal's back from any injury from water received into the shells; from this place of adhesion a thick and extraordinary muscle, like a kind of border, commences; it is represented in its state of contraction, but in the living animal it is wonderfully extensile, even a great way beyond the edge of the shells, and is formed into segments, and variegated with most elegant rufous lines: this part evidently moved many days after being taken; its use I conceive to be that of holding, as in a net, whatever is caught by it, when both the branchiated muscles are stretched out beyond the shells in order to obtain food; and the laciniæ or marginal divisions serve to separate or drain off the sea-water, while the food is retained. This border may serve not only for catching the prey as in a net, when extended beyond the shells, but even for killing any small animal or fish by strong pressure, and also by its undulating-power, which is very remarkable, may convey the food round, from whatever part it be in, to the mouth; thus supplying the place of a hand. As for the real, or properly so called, branchiæ, they are four in number, of a slightly yellowish colour, and elegantly striated in a pectinated manner; they surround the large central muscle, and comprehend or lie upon the uterus and ovarium, or parts of generation. Near the mouth or opening is a process with a double orifice; one of which must be considered as the termination of the female organ, and (if the animal be, as I suspect, androgynous) the other must be supposed to afford a passage for the male organ. To proceed to the head of the animal: it is surrounded by reddish lips, in the manner of the internal branchiæ, but they are very short. The head lies inbedded in a large black meconium tending towards the left. Beneath which is concealed the heart, which may be seen through the pellucid pericardium, and is of a light reddish colour; the aorta is distributed over the branchiæ; from the meconium or black part before-mentioned proceeds the rectum, and going over the pericardium is stretched towards the internal branchiæ, and is connected to the central muscle; this central muscle is orbicular, white, and smooth for a great part of its surface, where it adheres to the shell, but on the left side is distinguished by another, whiter and lacerated muscle, and is still more strongly attached to the shell.

aaa, the mouth and head, fig. 2, pl. 4; bb, the deep black meconium; c, the heart, as it lies beneath its membrane; dd, the pericardium, or (perhaps) rhomboid urinary bladder; eeeee, the rectum, running over the pericardium; fffff, the large central muscle; gg, the other lacerated muscle, strongly adhering to the shells; hhhh, the internal branchiæ; ii, the exit of the lengthened uterus, with its two foramina; kk, the upper whitish part of the uterus; lll, the lower saffron-coloured part of the uterus; mmmmm, the variegated border, or second reticular muscle.

A Letter from Mr. Halley at Chester, giving an Account of an extraordinary Hail in those Parts, on the 29th of April last. N° 229, p. 570.

The vapour that disposed the aqueous parts thus to congeal, came with a south-west wind out of Carnarvonshire, passing near Snowdon with a horrid black cloud, attended with frequent lightnings and thunder. I hear no further of it westward than out of Denbighshire, where it left St. Asaph to the right, and did much damage between it and the sea, breaking all the windows on the weather side, killing poultry, lambs, and a stout dog; and in the north part of Flintshire several people had their heads broken, and were grievously bruised in their bodies. From Flintshire it crossed over the arm of the sea that comes up to Chester, and was only felt in Cheshire, at the very N. W. corner of the

Peninsula, called Wirall, between the Æstuaria of Chester and Liverpool, at a town called W. Kirkby, where it hailed only for 3 minutes, it being on the extreme point of it on the right hand, but it thundered dreadfully, and was here about 3 in the afternoon; but the main body of it fell upon Lancashire, in a right line from Ormskirk to Blackburn, on the borders of Yorkshire; the breadth of the cloud was about 2 miles, within which compass it did incredible damage, killing all sorts of fowl and small creatures, and scarcely leaving any whole panes in any of the windows where it passed; but, which is worse, it ploughed up the earth, and cut off the blade of the green corn, so as utterly to destroy it, the hail-stones burying themselves in the ground; and the bowling-greens, where the earth was any thing soft, were quite defaced, so as to be rendered unserviceable for a time. The hail-stones, some of which weighed 5 ounces, were of different forms, some round, some half-round, some smooth, others embossed and crenulated, like the foot of a drinking-glass, the ice very transparent and hard, but a snowy kernel was in the middle of most of them, if not all; the force of their fall showed they fell from a great height. What I take to be most extraordinary in this phenomenon is, that such a sort of vapour should continue undispersed for so long a tract, as above 60 miles together, and in all the way of its passage occasion so extraordinary a coagulation and congelation of the watery clouds, as to increase the hail-stones to so vast a bulk in so short a space as that of their fall.

Another Account of the same Hail Storm. N° 229, p. 572.

We had only the extreme skirt of the shower here, and there fell not above 100 hail-stones in our court, but they were much larger and harder than we had ever seen. Some measured about 5 inches round. Scarcely any of them were so little as a musket bullet, but most of them far larger, and of that figure. Some indeed as large as hens' eggs, and of half a pound weight. Many sea-fowl and land-fowl were killed.

Account of a great Hail Storm in Hertfordshire. By Mr. Rob. Taylor. N° 229, p. 577.

At Hitchin, on Tuesday May 4, 1697, about 9 in the morning, it began to lighten and thunder extremely, with some great showers between. It continued till about 2 in the afternoon, when on a sudden a black cloud arose in the S. W. the wind being E. and blew hard; then fell a sharp shower, with some hail-stones, which measured 7 or 8 inches about. But the extremity of the storm fell about Offley, where a young man was killed, and one of his eyes struck out of his head; his body was all over black with the bruises; another person nearer to Offley escaped with his life, but much bruised. In the house of Sir John Spencer, 7000 quarries of glass were broken, and great damage done to all the neighbouring houses thereabouts. The hail fell in such vast quantities, and so great, that it tore up the ground, split great oaks and other trees, in great numbers; it cut down great fields of rye, as with a scythe, and has destroyed several hundred acres of wheat, barley, &c. insomuch that they plough it up, and sow it with oats: the tempest was such when it fell, that in four poles of land, from the hills near us, it carried away all the staple of the land, leaving nothing but chalk. I was walking in my garden, which is very small, about 30 yards square, and before I could get out, it took me to my knees, and was through my house before I could get in, which was in the space of a minute, and went through all like a sea, carrying all wooden things like boats on the water, the greatest part of the town being under this misfortune. The size of the hail-stones is almost incredible; they have been measured from 1, to 13 and 14 inches about. Their figures various, some oval, others round, others pointed, some flat.

Of the Effects of a great Hail Storm in Herefordshire, June 1697. N° 229, p. 579.

In the parish of Westhide, not far from Hereford, so great a quantity fell, as destroyed all the poultry, garden stuff, corn, grass, and most of the fruit trees in the parish; but killed no men nor cattle, though it hurt several, and broke most of the windows: many of the stones were measured above 9 inches in compass.

A Note concerning an Extraordinary Hail in Monmouthshire, extracted out of a Letter sent from Mr. Edward Lhwyd to Dr. Tancred Robinson, F.R.S. N° 229, p. 579.

We had at Pont y Pool in Monmouthshire, on the 6th of June last, an extraordinary shower of hail, which extended about a mile, and lasted near half an hour. It broke the stalks of all the beans and wheat within that circumference, and broke as much glass at Major Hanbury's house, as cost 4 pounds repairing: some of the stones were 8 inches about; their figure very irregular and unconstant, several of them being compounded.

Account of a Fœtus, voided by the ulcerated Navel of a Negro, in Nevis. By Mr. James Brodie. Communicated by Dr. Preston. N° 229, p. 580.

In the island of Nevis, in the West Indies, there was a negro woman belonging to one Capt. Mead, who after 1½ year being with child, was at the last relieved by the navel, in this manner. About the 17th month, the woman being thought hydropical, her navel began to swell and imposthumate. It swelled and grew livid of itself, and then broke and voided some quantity of ichorous matter; by which the woman had some ease. In about a month more it imposthumated again, to a far greater degree than before; on which the surgeon opened it, where it seemed most jetting out, which was the navel itself; and then after voiding a great deal of thin ichor and matter, there appeared some bones, which startled him, not having seen the like before. It proved to be a child, the flesh of which was decayed. After the extraction of the bones, the woman was easy, and in a little time began to recover, she being very low, by reason of the great burden she had carried for a long time. She is now recovered, and was alive about 6 months ago, when I was in Nevis; and she has had a child since.

Concerning the Torricellian Experiment tried on the Top of Snowdon-hill. By Mr. Halley. N° 229, p. 582.

Wednesday, May 26, I was on the top of Snowdon, where I tried the Torricellian experiment with all the satisfaction I could wish for; the air continued, both before and after, in the same state, as I got it verified by Mr. Davis's standing barometer at Llanerch in Denbyshire, about 25 miles east from Snowdon where it was observed during 4 days, to stand from 29.7$\frac{1}{4}$ to 29.8$\frac{1}{2}$ inches.

Llanerch is about a mile and a half above the town of St. Asaph, about 6 miles from the mouth of the river Lluyd, which falls with a rapid stream into the Irish sea; and, consequently, is several feet above its surface.

May 26, between one and two in the afternoon, on the top of Snowdon, I thrice repeated the experiment, and as often found the height of the mercury 26 inches 1. And being come down to Llanberris, at the foot of the hill, about 6 that evening, I as often found it 29.4 inches. A little above this place are the principal fountains of the river, that falls into the channel of Anglesey, at Carnarvon, called anciently Segontium, whither we went the next day; and about 8 at evening, found the mercury, by a triple experiment, to stand at 29.9 inches, very near the surface of the sea: when, at the same time, at Llanerch, it was not above 29.7$\frac{1}{4}$; whence I conclude, that the difference of the air's pressure on the sea and on the top of Snowdon, is rather more than 3 inches, 8 tenths. I could have wished for one of Mr. Hunt's portable-barometers; which will certainly be accurate enough for taking the levels, for bringing of water from distant places, and certainly much less subject to error; there being a tenth of an inch for each 30 yards, which may be divided into many parts evidently. Snowdon was measured by Mr. Caswel, with Adams's instruments, and found to be 1240 yards high; which abating the height of the mercury 3 inches, 8 tenths, may serve for a standard, until a better be obtained on a higher place.* From hence the sea dipt everywhere above a degree below us, the visible horizon being a lesser circle, and we saw Ireland plainly from the W. b. S. to S. W. b. W. and the mountains of Cumberland or Westmoreland very faintly, but evidently in the north; and I think we saw as far as St. David's Head into the south; Carnarvonshire and Anglesey lay under us, like a map, affording a very pleasant prospect, were it not for the horrors of the neighbouring precipices. Hence we counted 15 or 16 lakes, great and small, where the cavities of the rocks are filled up with the rills that gleet from the hills; all these are said to abound with trouts, some of which we found to be very good fish: and in one of these lakes I was on board a floating island, as it may be called; the lake is scarcely half a mile about, environed with a boggy turfy soil, a piece of which, about 6 yards long and 4 broad, floats on the water, being about 5 or 6 inches raised above it, but I believe about 18 inches deep within the water, having broad spreading fungous roots on its sides, the lightness of which buoys it up. It was driven on the lee-shore, but I launched it off and swam it, to be satisfied it floated: this I take the more notice of, because it is denied to be true, by the author of the additions to Cambden, lately published: but I myself saw it as described, and was told it had formerly been larger, there being a lesser spot, which they told us had been heretofore a part of it, which floated likewise.

Account of a Book, viz.—Nouveaux Memoires sur l'Etat present de la Chine, par le R. P. Louis le Comte, de la Campagnie de Jesus, Mathematicien du Roy, enrichi de Figures. Amsterd. 1697, *in* 12*mo*, 2 *Vols. and since translated into English, and printed in* 8*vo*. N° 229, p. 585.

This book contains a great number of curious particulars relating to the empire of China, with the travels of the missionaries in that wonderful country. Its extent is from Canton to Pekin, N. and S. 18°, or 450 leagues; as much from E. to W. and nearly round in figure; so that it is near 1400 leagues about: 55° are the limits settled between Muscovy and Tartary, by the treaty of peace between those kingdoms; so that there are 900 leagues counting 25 to a degree, of extent from the S. point of the isle Haynan to the extremity of Tartary, ubject to China. In the journey to Pekin they met ice in the canals, and the rivers were frozen. Here is an account of Father Verbiest, and his death in

* This comparison cannot be very accurate, owing to the want of regulation and correction by the thermometer. We shall find occasions hereafter of more accurate comparisons.

China. It is remarked that none of these cruel diseases, the gravel, stone, gout, or sciatica, are known in China.

Account of a Person who had horny Excrescences, or extraordinary large Nails, on his Fingers and Toes. By Mr. Locke. N° 230, p. 594.

Mr. Locke saw this young man at Paris, in May, 1678. He was then between 19 and 20. Those horny excrescences, like ill-shaped claws, grew on most of his fingers and toes, instead of nails; some of them 4 inches in length. There were some also on the back of his hands, but shorter and broad. This disease began about 3 years before, after having had the small-pox, to which he attributes its origin.

Journal of a Voyage from England to Constantinople, made in the Year 1668. *By T. Smith, D. D. et F. R. S.* N° 230, p. 597.

This journal contains nothing either useful or curious, not differing from that of a common seaman. It was kept by Dr. Smith, in accompanying Sir Daniel Harvey, his Majesty's ambassador to the port of the Ottoman emperor at Constantinople.

A Method of raising an Infinite Multinomial to any given Power, or extracting any given Root of the same. By Mr. Ab. De Moivre. N° 230, p. 619.

About two years since, considering Mr. Newton's theorem for raising a binomial to any given power, or extracting any root of the same; I inquired whether, what he had done for a binomial could not be done for an infinite multinomial. I soon found the thing was possible, and effected it, as in the following paper; and I design in a little time to show the uses it may be applied to: in the mean while, those that are already versed in the doctrine of infinite series, and have seen what applications Mr. Newton has made of his theorem, may of themselves derive several uses from this.

I suppose that the infinite multinomial number is $az + bzz + cz^3 + dz^4 + ez^5$ &c. m is the index of the power, to which this multinomial ought to be raised, or the index of the root which is to be extracted: I say that this power or root of the multinomial is such a series as I have here expressed, viz.

$$\begin{aligned}
&\overline{az + bz^2 + cz^3 + dz^4 + ez^5 + fz^6 + gz^7 + hz^8 + iz^9 \text{ \&c.}}\,\Big|^{m} = a^m z^m \\
&+ \tfrac{m}{1} a^{m-1} b z^{m+1} + \tfrac{m}{1} + \tfrac{m-1}{2} a^{m-2} b^2 z^{m+2} + \tfrac{m}{1} + \tfrac{m-1}{2} + \tfrac{m-2}{3} a^{m-3} b^3 z^{m+3} \\
&\qquad\qquad + \tfrac{m}{1} a^{m-1} c \qquad\qquad\qquad + \tfrac{m}{1} + \tfrac{m-1}{1} a^{m-2} bc \\
&\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad + \tfrac{m}{1} a^{m-1} d
\end{aligned}$$

$$+\frac{m}{1}\times\frac{m-1}{2}\times\frac{m-2}{3}\times\frac{m-3}{4}a^{m-4}b^4z^{m+4}$$
$$+\frac{m}{1}\times\frac{m-1}{2}\times\frac{m-2}{1}a^{m-3}b^2c$$
$$+\frac{m}{1}\times\frac{m-1}{1}a^{m-2}bd$$
$$+\frac{m}{1}\times\frac{m-1}{2}a^{m-2}c^2$$
$$+\frac{m}{1}a^{m-1}e$$

$$+\frac{m}{1}\times\frac{m-1}{2}\times\frac{m-2}{3}\times\frac{m-3}{4}\times\frac{m-4}{5}a^{m-5}b^5z^{m+5}\ \&c.$$
$$+\frac{m}{1}\times\frac{m-1}{2}\times\frac{m-2}{3}\times\frac{m-3}{1}a^{m-4}b^3c$$
$$+\frac{m}{1}\times\frac{m-1}{2}\times\frac{m-2}{1}a^{m-3}b^2d$$
$$+\frac{m}{1}\times\frac{m-1}{1}\times\frac{m-2}{2}a^{m-3}bc^2$$
$$+\frac{m}{1}\times\frac{m-1}{1}a^{m-2}be$$
$$+\frac{m}{1}\times\frac{m-1}{1}a^{m-2}cd$$
$$+\frac{m}{1}a^{m-1}f$$

For the understanding of it, it is only necessary to consider all the terms by which the same power of z is multiplied; in order to which, I distinguish two things in each of these terms: 1. The product of certain powers of the quantities, a, b, c, d, &c. 2. The unciæ, as Oughtred calls them, prefixed to these products. To find all the products belonging to the same power of z, to that product, for instance, whose index is $m + r$, where r may denote any integer number, I divide these products into several classes; those which immediately after some certain power of a (by which all these products begin) have b, I call products of the first class; for example $a^{m-4}b^3e$ is a product of the first class, because b immediately follows a^{m-4}; those which immediately after some power of a have c, I call products of the second class, so $a^{m-3}ccd$ is a product of the second class; those which immediately after some power of a have d, I call products of the third class, and so of the rest.

This done, I multiply all the products belonging to z^{m+r-1}, which precedes immediately z^{m+r}, by b, and divide them all by a; 2. I multiply by c

and divide by a, all the products belonging to z^{m+r-2}, except those of the first class; 3. I multiply by d and divide by a all the products belonging to z^{m+r-3}, except those of the first and second class; 4. I multiply by e and divide by a all the terms belonging to z^{m+r-4}, except those of the first, second and third class, and so on, till I meet twice with the same term. Lastly, I add to all these terms the product of a^{m-1} into the letter whose exponent is $r+1$. And here I must take notice that by the exponent of a letter, I mean the number which expresses what place the letter has in the alphabet; so 3 is the exponent of the letter c, because the letter c is the third in the alphabet. It is evident that by this rule, you may easily find all the products belonging to the several powers of z, if you have but the product belonging to z^m, viz. a^m.

To find the unciæ which ought to be prefixed to every product, I consider the sum of units contained in the indices of the letters which compose it, the index of a excepted. I write as many terms of the series $m \times m-1 \times m-2 \times m-3$, &c. as there are units in the sum of these indices, this series is to be the numerator of a fraction, whose denominator is the product of the several series $1 \times 2 \times 3 \times 4$, &c. $1 \times 2 \times 3 \times 4 \times 5$, &c. $1 \times 2 \times 3 \times 4 \times 5 \times 6$, &c. the first of which contains as many terms as there are units in the index of b, the second as many as there are units in the index of c, the third as many as there are units in the index of d, the fourth as many as there are units in the index of e, &c.

Demonstration.—To raise the series $az + bzz + cz^3 + dz^4$, &c. to any power whatever, write so many series equal to it as there are units in the index of the power required: Now it is evident that when these series are so multiplied, there are several products in which there is the same power of z; thus, if the series $az + bzz + cz^3 + dz^4$ &c. be raised to its cube, you have the products b^3z^6, $abcz^6$, $aadz^6$, in which you find the same power z^6. Therefore let us consider what is the condition that can make some products to contain the same power of z: the first thing that will appear in relation to it, is that in any product whatever, the index of z is the sum of the particular indices of z in the multiplying terms; this follows from the nature of indices; thus b^3z^6 is the product of bz^2, bz^2, bz^2, and the sum of the indices in the multiplying terms, is $2+2+2=6$; $abcz^6$ is the product of az, bzz, cz^3, and the sum of the indices of z in the multiplying terms is $1+2+3=6$; $aadz^6$ is the product of az, az, dz^4, and the sum of the indices of z in the multiplying terms is $1+1+4=6$; the next thing that appears is, that the index of z in the multiplying terms is the same with the exponent of the letter to which z is joined; from which two considerations it follows that, to have all the products belonging to a certain power of z, you must find all the products where the sum of the exponents of the letters which compose them, shall always be the same with the index of that power. Now this is the method I use to find easily all the products belonging to the same power of z: let $m + r$ be the index of that power; I consider that the sum of the exponents of the letters which compose these products, must exceed by 1 those which belong to z^{m+r-1}; now because the excess of the exponent of the letter b, above the exponent of the letter a, is 1, it follows that if each of the products belonging to z^{m+r-1} be multiplied by b, and divided by a, you will have products, the sum of whose exponents will be $m + r$; likewise the sum of the exponents of the letters which compose the products belonging to z^{m+r}, exceeds by 2 the sum of the exponents of the letters which compose the products belonging to z^{m+r-2}; now because the exponent of the letter a is less by 2, than the exponent of the letter c, it follows, that if each product belonging to z^{m+r-2} be multiplied by c and divided by a, you will have other products, the sum of whose exponents is still $m + r$; now if all the products belonging to z^{m+r-2} were multiplied by c and divided by a, you would have some products that would be the same as some of those found before, therefore you must except out of them those that I have called products of the first class. What has been said shows why all the products belonging to z^{m+r-3}, except those of the first and second class, must be multiplied by d and divided by a: lastly, you see the reason why to all these products is added the product of a^{m+1} by the letter whose exponent is $r + 1$; which is because the sum of the exponents is still $m + r$.

As for what relates to the unciæ; observe that when you multiply $az + bzz + cz^3 + dz^4$ &c. by $az + bzz + cz^3 + dz^4$ &c. each letter a, b, c, d, &c. of the second series, is multiplied by each of the letters a, b, c, d, &c. of the first series; thus the letter a of the second series is multiplied by the letter b of the first, and the letter b of the second series is multiplied by the letter a of the first; therefore you have the 2 planes, ab, ab or $2ab$; for the same reason you have $2ac$, $2ad$, &c. Therefore you must prefix to each plane of those that compose the square of the infinite series $az + bzz + cz^3$ &c. the number which expresses how many ways the letters of each plane may be changed; likewise if you multiply the product of the two preceding series by $az + bzz + cz^3$ &c. each letter a, b, c, d, of the third series is multiplied by each of the planes formed by the product of the first and second series; thus the letter a is multiplied by the planes bc and cb; the letter b is multiplied by ac and ca; the letter c is multiplied by ab and ba; therefore you have the 6 solids, abc, acb, bac, bca, cab, cba, or 6 abc; therefore you must prefix to each solid whereof the cube of the infinite series is composed, the number which expresses how many ways the letters of each solid may be changed. And generally, you must prefix to any product whereof any power of the infinite series $az + bzz + cz^3$ &c. is composed, the number which expresses how many ways the letters of each product may be changed.

Now to find how many ways the letters of any product, for instance $a^{m-n}b^hc^pd^r$, may be changed; this is the rule which is commonly given: write as many terms of the series $1 \times 2 \times 3 \times 4 \times 5$ &c. as there are units in the sum of the indices, viz. $m - n + h + p + r$; let this series be the numerator of a fraction, whose denominator shall be the product of the series $1 \times 2 \times 3 \times 4$ &c. $1 \times 2 \times 3 \times 4 \times 5$ &c. $1 \times 2 \times 3 \times 4 \times 5 \times 6$, &c. whereof the first is to contain as many terms, as there are units in the first index $m - n$; the second as many as there are units in the second index h; the third as many as there are units in the third index p; the fourth as many as there are units in the 4th index r. But the numerator and denominator of this fraction have a common divisor, viz. the series $1 \times 2 \times 3 \times 4 \times 5$ &c. continued to so many terms as there are units in the first index $m - n$; therefore let both this numerator and denominator be divided by this common divisor, then this new numerator will begin with $m - n + 1$, whereas the other began with 1, and will contain so many terms as there are units in $h + p + r$, that is as many as there are units in the sum of all the indices, excepting the first. As for the new denominator, it will be the product of 3 series only, that is of so many as there are indices, excepting the first. But if it happen that n is equal to $h + p + r$, as it always happens in our theorem, then the numerator beginning by $m - n + 1$, and being continued to as many terms as there are units in $h + p + r$ or n, the last term will necessarily be m; so if you invert the series, and make that the first term which was the last, the numerator will be $m \times m - 1 \times m - 2 \times m - 3$, &c. continued to so many terms as there are units in the sum of the indices of each product, excepting the first index. There remains but one thing to demonstrate, which is, that what I have said of powers whose index is an integer, may be adapted to roots, or powers whose index is a fraction; but it appears at first sight why it should be so: for the same reason which makes me consider roots under the notion of powers, will make me conclude, that whatever is said of one may be said of the other. However I think to give some time a more formal demonstration of it.

Of an Error committed by common Surveyors, in comparing of Surveys taken at long Intervals of Time, arising from the Variation of the Magnetic Needle. By William Molyneux, Esq. F. R. S. N° 230, p. 625.

The variation of the magnetic needle is so commonly known, that I need not insist much on its explication. It is certain that the true solar meridian, and the meridian shown by a needle, agree but in very few places of the world; and this too, but for a little time together. The difference between the true and the magnetic meridians perpetually varying, and changing in all places, and at all times; sometimes to the eastward, and sometimes to the westward.

On which account it is impossible to compare two surveys of the same place, taken at distant times, by magnetic instruments, (such as the circumferentor, by which the Down survey, or Sir William Petty's Survey of Ireland was taken,) without due allowance be made for this variation. But this is not to be understood, as if a map of the same place, taken by magnetic instruments at never so distant times, should not at one time give the same figure and contents as at another time. This certainly it will do most exactly, the variation of the needle having nothing to do either in the shape or contents of the survey. All that is affected by it, is, the bearings of the lines run by the chain, and the boundaries between neighbours. And how this may cause a considerable error, unless due allowance be made for it, is fully proved thus.

Let AB, fig. 3, pl. 4, represent the survey of two lands, one in the possession of A, and the other in the possession of B, taken for instance, An. 1657, when there was no variation. Let the line NS, running through the point P, be the true meridian, and consequently the magnetic meridian also at that time; and let this line NS be also the boundary between the two lands A and B. In 1695, when the variation is supposed to be 7° from the north to the westward, B having a map of the former survey, and suspecting that his neighbour A had incroached on him, by a ditch PQ, employs a surveyor to enquire into the matter: the surveyor finds by his map, that the boundary between B and his neighbour A ran from the point P through a meadow directly according to the magnetic meridian SPN; but observing the ditch PQ cast up much to the eastward of the present magnetic meridian, he concludes that A has encroached on B, and that the ditch ought to have been cast up along the line Pq, the angle QPq being an angle of 7°, that is the present variation of the needle; and the line Pq the present magnetic meridian: for which variation, not making any allowance, he positively determines that B has all the land in the triangle QPq, more than he ought to have; and that his ditch ought to run along the line Pq.

It is true indeed, if the surveyor go the whole round of the lands A and B, he will find their figure and contents exactly agreeable to the map. But then the bearings of the lines are all 7° different from the bearings in the map, and they will run in and out upon the adjacent neighbouring lands, and cause endless disputes between their possessors; as is manifest from the figure, wherein the pricked lines represent the disagreement in the bearings of the lines, protracted from the point P: and we see A encroaching on his neighbours on the westward, as he is encroached on by B, and B's eastward neighbours encroaching on him, and so forward and clear round. Whereas, by a due allowance for the variation of the needle, all this confusion and disagreement is avoided, and every thing fits right.

What is here said, on supposition that the magnet had no variation at the time of the first survey taken, and that it had 7° variation westward at the time of the second survey, may easily be accommodated to any other variations at the first and second surveys, mutatis mutandis; for knowing the variations, we know their difference; and if we know their difference, this gives us the angle QPQ, by which we reduce them to each other. The best way therefore to make maps invariable would be, for the surveyors who use magnetic instruments, to make always allowance for the magnetic variation, and to protract and plot by the true meridian.

Perhaps it may be objected, that surveys may be taken without magnetic instruments, and that therefore this error, arising from the magnetic variation, and change in the bearing of lines, may be avoided. To which I answer, first, that granting a survey may be taken without magnetic instruments, this is nothing against what we have laid down relating to surveys that are taken with magnetic instruments, as the Down survey actually was, and as most surveys at present actually are taken. Secondly, Though a survey may be taken truly without magnetic instruments, so as to show the exact angles and lines of the plot, and consequently the true contents, yet this will not give the true bearings of the lines, or show my position in relation to my neighbours, or the other parts of the country. This must be supplied by the magnet, or something equivalent, as finding a true meridian line on your land by celestial observations. And I doubt not but the ancient Egyptians, before the discovery of the magnet, were forced to employ some such expedient in their surveys, and applotments of lands, after the inundations of the Nile; which, we are told, gave the first original to geometry and surveying.

And this leads to another objection, which may be made against the instance before laid down: it may be said, that certainly the surveyor which B employed was very ignorant, who would choose to judge of the line PQ, rather by its bearing than by determining the point Q, by measuring from H and G. To this I answer, what if both the points H and G were vanished since the Down survey was taken? What if the whole face of the country were changed, except only the point P, and the line PQ? How shall the surveyor then judge of the line PQ, but by its bearing? That this is no extravagant supposition, we have an example in Egypt abovementioned, where the Nile lays all flat before it, and so uniformly covers all with mud, that there is no distinction. In such a case, the bearing must certainly help you out; there is no other way. But, 2dly, to say that the surveyor might have determined the point Q by admeasurement from G and H, or any other adjoining noted points, as from F, K, I, &c. is very true; but then it is against our supposition. We are showing an error, that arises from judging of the line PQ by magnetic bearing, and to say that this might be avoided by another way, is to say nothing. I have shown how it may be avoided, by allowing for the variation; but still it is an error, till it be avoided. But, 3dly, If B's surveyor do not allow for the variation of the needle, he will never exactly determine even the points G, F, H, K, &c. or any other points in the plot; but instead of them, he will fall on the points g, h, f, k.

From what has been said, we may see the absolute necessity of allowing for the variation of the magnet, in comparing old surveys with new ones; for want of which, great disputes may arise between neighbouring proprietors of lands: and it were to be wished, that our honourable and learned judges would take this matter into their consideration, whenever any business of this kind comes before them.

Extract of a Letter from Mr. de Vallemont, &c. concerning a small Egg being found within an ordinary one; from the Journal des Sçavans of the 7th of Jan. 1696. N° 230, p. 632.

In the Journal des Sçavans of the 7th of Jan. 1696, is an account of a small egg, of about 7 lines from end to end, and 4½ of thickness, which was included in a hen's egg, which appeared to have nothing extraordinary on its outside, and which they were breaking to make an omelet of. The small egg-shell was fastened to the shell of the greater, by one of its extremities.

Part of a Letter from Mr. John Ray, F. R. S. to Dr. Sloane, June 30, 1697, *concerning the Effects of a poisonous Root, and concerning the Virtues of the Leaves of Hemlock.* N° 231, p. 634.

A woman eating by mistake some roots, or common hemlock (it is supposed) among parsnips, was immediately seized with raving and madness, talked obscenely, and could not forbear dancing. Thus she continued for some time, till at length she was taken with epileptic fits, of which distemper, being committed to my charge, she was soon cured by the common method, and has now for several years lived in perfect health. However, I am in some doubt, whether it was really the root of hemlock which this woman eat, and which had this effect upon her, and not some other; because 1. Jo. Bauhine, relating two parallel stories of two families in Montbelgard, during his abode there, who were in like manner intoxicated by eating of roots, which they took to be parsnips, and which he himself cured; is of opinion, that they were the roots of wild cicely, commonly called hereabouts cow weed, because kine in the spring time willingly eat it, by Herbalists in Latin, cicutaria vulgaris, or myrrhis sylvestris; because the roots of it are more like to parsnips, than those of cicuta or hemlock, and because this plant was abundantly more frequent in the gardens there than hemlock. 2. Mr. James Petiver assured me, that being in company with one Mr. Henley, a friend of his, he saw him eat 3 or 4 ounces of hemlock-root, without the least harm, on which he himself was encouraged to do the like, eating about half an ounce. They tasted somewhat like the root of celery, and he perceived no ill effect or inconvenience from the eating of them. 3. The common people generally believe that the roots which cause these symptoms, are no other than old parsnips, which have continued some years in the ground, and therefore call them madnips. For my part, I am not yet satisfied what roots they are, and should be glad to receive satisfaction from others.

The other observation I shall give you in his own words, without making any reflections upon it. A gentlemen of my acquaintance, having a horse, which he highly valued, troubled with that stubborn disease they call the farcy, employed several usually efficacious medicines in vain. At length, one day riding abroad on this horse to take the air, and being in discourse with a gentlemen he met in a place where grew a great quantity of hemlock, he observed that the horse began to feed on them, but checked him at present, and was returning home; when calling to mind, that some animals are sometimes directed by what they call instinct to proper remedies, he rode back to the same place, where the horse again refused the grass, and fell on the hemlock, greedily eating it up. On which within 3 or 4 days his sores dried up, and he recovered very fast. From whence it appears that the leaves at least of hemlock are not noxious to some animals, but rather salutary. The seeds also some birds, as in our observations bustards, will greedily eat.

The Properties of the Catenaria, or Curve Line, formed by a heavy and flexible Chain, hanging freely from two Points of Suspension. By David Gregory, M.D. Savilian Professor of Astronomy, and F.R.S. N° 231, p. 637. *Translated from the Latin.*

Prop. I. Prob.—In the catenarian curve, to find the relation between the fluxion of the axis and the fluxion of the ordinate.——Let FAD (fig. 4, pl. 4.) be a chain hanging by its ends F and D; the lowest point, or vertex of the curve, being A, its axis AB perpendicular to the horizon, and its ordinate BD parallel to the same. There is to be found the relation between Bb or Dδ and $d\delta$; supposing the point b to be infinitely near to B, and bd parallel to BD, also Dδ parallel to AB.

It appears from mechanics, that three powers are in equilibrio, when they have the same ratio as three intersecting right lines that are parallel to their directions, or which are inclined to them in a given angle, being terminated by their mutual concourse. Therefore, if Dd denote the absolute gravity of the particle Dd, as it must be in a chain of uniform thickness; then $d\delta$ will represent that part of the gravity that acts perpendicularly on Dd, by which it happens, (because of the flexibility of the chain moving about d,) that dD endeavours to reduce itself to a vertical situation. Therefore if δd, or the fluxion of the ordinate BD, be supposed constant, the action of gravity exerted perpendicularly on the corresponding parts of the chain dD, will also be constant, or every where the same.

Let this be expounded by the right line a. Again, by mechanics before cited, Dδ the fluxion of the axis AB, will denote the force, which is exerted according to the direction of dD, which is equivalent to the aforesaid endeavour of the heavy line dD to reduce itself into a vertical situation, and which prevents its doing so.

Now this force arises from the heavy line DA drawing according to the direction dD, and therefore cæteris paribus is proportional to the line DA. Therefore δd, the fluxion of the ordinate, is to δD, the fluxion of the absciss, as the constant right line a is to the curve DA. Q. E. F.

Corol.—If the right line TD touch the catenaria, and meet the axis BA produced in T, it will be BD : BT :: ($d\delta$: δD ::) a : curve DA.

Prop. II. *Theor.*—If to the perpendicular AB as an axis, with vertex A, an equilateral hyperbola AH be described, whose semiaxis AC is equal to a; and to the same axis and vertex, a parabola AP be drawn, whose parameter is equal to four times the axis of the hyperbola; and if the ordinate HB of the hyperbola be continually produced, till HF be equal to the curve AP; I say the curve FAD, in which the points F and D are found, (supposing BD = BF) will be the catenaria.

Make AB $= x$; then B$b = \dot{x}$, and BH $= \sqrt{2ax + xx}$. Whence, by the method of fluxions, the fluxion of BH $= \frac{a\dot{x} + x\dot{x}}{\sqrt{2ax+xx}} = mh$. Again, because the parameter of the parabola AP is $= 8a$, it is BP $= \sqrt{8ax}$. Whence np, the fluxion of BP, will be $\frac{2a\dot{x}}{\sqrt{2ax}}$. So that the fluxion of the curve AP $=$ Pp $= \sqrt{np \times np + \text{P}n \times \text{P}n} = \sqrt{\frac{4a^2\dot{x}^2}{2ax} + \dot{x}^2} = \sqrt{\frac{2a\dot{x}^2 + x\dot{x}^2}{x}}$, which by multiplying both numerator and denominator into $\sqrt{2a+x}$, becomes $\frac{2a\dot{x}+x\dot{x}}{\sqrt{2ax+xx}}$. And since HE is every where equal to AP, the fluxion of the right line HF, that is $mh+sf$, will be equal to $\frac{2a\dot{x}+x\dot{x}}{\sqrt{2ax+xx}}$. But it is already found that $mh=\frac{a\dot{x}+x\dot{x}}{\sqrt{2ax+xx}}$. Whence $sf=\frac{a\dot{x}}{\sqrt{2ax+xx}}$, which is the fluxion of BF the ordinate to the axis of the catenaria. Therefore the fluxion of the curve AF, or $Ff = \sqrt{sf^2+Fs^2} = \sqrt{\frac{a^2\dot{x}^2}{2ax+xx}+\dot{x}^2} = \frac{a\dot{x}+x\dot{x}}{\sqrt{2ax+xx}}$, of which the fluent is $\sqrt{2ax+xx}$, as just now found. Therefore $AF=\sqrt{2ax+xx}$. And it appears that the fluxion of the ordinate BF, or $\frac{a\dot{x}}{\sqrt{2ax+xx}}$, is to $\dot{x}$ the fluxion of the absciss AB, as the given line a to the curve AF; which is the property of the catenaria found above. Therefore the points of the catenaria are rightly determined, by the foregoing construction. Q. E. D.

Corol. 1.—From the construction it appears, that BF, the ordinate of the catenaria, is equal to the parabolic curve AP, taking away BH the correspondent ordinate of the conterminate hyperbola AH.

Corol. 2.—From the demonstration it appears, that the curve of the catenaria AF is equal to BH the correspondent ordinate of the conterminate equilateral hyperbola. For since the fluxions of these lines are equal, and the lines themselves are nascent at the same time, it is plain they must be always equal. Whence the chain being given, AC or a will be given also, being equal to the semiaxis of the equilateral hyperbola whose vertex is A, and ordinate equal to the absciss AB of the chain AD.

Corol. 3.—All catenaria are similar to one another; since they are generated by a like construction of like figures similarly posited. Whence two right lines alike inclined to the horizon, drawn through the vertices of the chains, will cut off similar figures, and portions of the chains which are proportional to the right lines so cutting them off.

Corol. 4.—If the chain QAD is suspended at the points Q and D, which are at unequal heights, the part of the curve FAD continues the same as if it had been suspended at the points F and D, which are equally high; because it is all one whether the point F be fixed to the horizontal plane or not.

Corol. 5.—If the force of the chain, drawing according to the direction dD, be denoted by Dd; let it be divided, as is commonly known, into the force $d\delta$ according to a horizontal direction, and a force δD according to a vertical direction. Therefore in the extremity of the chain, the force of approaching directly to the axis, is to the force of perpendicular descent in the same; or the part of the sustaining force acting according to the direction BD, is to a part of the same acting according to the direction Dδ, as the semiaxis of the conterminate hyperbola AH, is to DA the length of the chain to the vertex of the curve. Whence, when the chain is given, this ratio is given. And in the same chain suspended more or less loosely, that horizontal force is as the axis of the conterminate hyperbola, since DA remains the same, when the extremes of the chain are equally high.

Corol. 6.—In a vertical plane, but in an inverted situation, the chain will preserve its figure without falling, and therefore will constitute a very thin arch or fornix: that is, infinitely small, rigid, and polished spheres, disposed in an inverted curve of a catenaria, will form an arch, no part of which will be thrust outwards or inwards by other parts, but, the lowest parts remaining firm, it will support itself by means of its figure. For since the situation of the points of the catenaria is the same, and the inclination of the parts to the horizon, whether in the situation FAD, or in an inverted situation, so that the curve may be in a plane which is perpendicular to the horizon; it is plain, that it must keep its figure unchanged as well in one situation as the other. And on the contrary, none but the catenaria is the figure of a true and legitimate arch or fornix. And when arches of other figures are supported, it is because in their thickness some catenaria is included. Neither would it be sustained, if it were very thin, and composed of slippery parts. From Corol. 5, before, it may be collected, by what force an arch or buttress presses a wall outwardly, to which it is applied. For this is the same with that part of the force sustaining the chain, which draws according to a horizontal direction. For the force which in the chain draws inwards, in an arch equal to the chain drives outwards. All other circumstances, concerning the strength of walls to which arches are applied, may be geometrically determined from this theory, which are the chief things in the construction of edifices.

Corol. 7.—Instead of gravity, if any other power exerts its force, acting in like manner on a flexible line, the same curve will be produced. For example, if the wind be supposed equable, and should blow according to right lines parallel to a given line; the line thus inflated by the wind would be the same as the catenaria. For since all things obtain in this other force, as we have supposed in gravity, it is evident, the same line must be produced.

Prop. III. *Theor.*—The hyperbola aforesaid AH remaining, (fig. 5, pl. 4,) if through A, a right line GAL be drawn perpendicular to the axis AB, and a curve KR be described of such a nature, that BK may be a third proportional to the right lines BA and AC, and to AC be applied a rectangle AV equal to the interminate space ABKRLA; the concourse F of the right lines HB, VG, will be at a catenaria.

For by the construction it is BK $= \frac{aa}{\sqrt{2ax+xx}}$. Therefore the fluxion of the space ABKRLA is BKhb = BK × Bb $= \frac{a\dot{x}}{\sqrt{2ax+xx}}$. And since BF $= \frac{\text{ABKRLA}}{\text{AC}}$, and AC is given; its fluxion will be BF $= \frac{a\dot{x}}{\sqrt{2ax+xx}}$. But in the construction of the foregoing proposition, the fluxion of the ordinate BF $= \frac{a\dot{x}}{\sqrt{2ax+xx}}$. Wherefore this construction comes to the same as the construction of the foregoing proposition, and consequently the point F is at a catenaria. Q. E. D.

Corol.—As in the foregoing proposition, the catenaria is described from the given length of the parabolic curve; so in this its description depends on the quadrature of the space, in which $xxyy = a^4 - 2axyy$. For BK or $y = \frac{aa}{\sqrt{2ax+xx}}$.

Prop. IV. *Theor.*—The space AGF (fig. 4) contained by the catenaria AF, and the right lines FG, AG, parallel to AB, BF, is equal to the rectangle under the semiaxis AC, and DH the distance of the ordinates in the hyperbola and catenaria.

For $\dot{\text{D}}\text{H} = \text{B}\dot{\text{H}} - \text{B}\dot{\text{D}}$ = (by Prop. 2 of this) $\frac{a\dot{x}+x\dot{x}}{\sqrt{2ax+xx}} - \frac{a\dot{x}}{\sqrt{2ax+xx}} = \frac{x\dot{x}}{\sqrt{2ax+xx}}$. Wherefore the fluxion of the rectangle under the given line AC and HD is $\frac{ax\dot{x}}{\sqrt{2ax+xx}} = x \times \frac{a\dot{x}}{\sqrt{2ax+xx}} = sf \times$ FG = the fluxion of the space AGF. And since these figures are nascent together, it follows that the rectangle under AC and DH is equal to the space AGF. Q. E. D.

Corol. Hence it follows that the space FAD, comprehended by the chain FAD and the horizontal right line FD, is equal to the rectangle under FD and BA, subtracting the rectangle under either axis of the hyperbola AH, and DH the excess of the right line BH, or of the curve AD, above the ordinate BD.

Prop. V. Theor.—If the rectangle LE, equal to the hyperbolic space ALH, be applied to the right line AL, the point E will be the centre of equilibrium of the catenarian curve AFD.

Let a heavy curve FA be conceived to be poised on the axis GL. From the doctrine of the centre of gravity it follows, that the moment of the weight FA is expounded by the surface of an upright cylinder erected on FA, and cut off by a plane passing through GL, making half a right angle with the plane of the curve. And the fluxion of this surface, or FA × FG, is equal to the fluxion of the space ALH, or BH × HL: because FA and BH, as also FG and

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HL, are equal. And therefore, since they are nascent at the same time, the said superficies of the erect cylinder is equal to the hyperbolic space AHL. Therefore this applied to the heavy line itself AF, or to the right line AL, which is equal to it, it produces a breadth AE equal to the distance of the centre of gravity from the axis of libration GL. Hence E will be the centre of equilibrium of the curve FAD, lying equally on each side of the axis AB. Q. E. D.

Corol. 1.—The spaces ABHL, BAH, and AGF, are in arithmetical proportion. For the fluxion of the space ALH $= \frac{ax + x\dot{x}}{\sqrt{2ax + xx}} \times x = \frac{\overline{ax + xx} \times \dot{x}}{\sqrt{2ax + xx}} = \frac{\overline{2ax + xx - ax} \times \dot{x}}{\sqrt{2ax + xx}} = \dot{x}\sqrt{2ax + xx} - \frac{ax\dot{x}}{\sqrt{2ax + xx}} =$ fluxion of the space BAH, lessened by the fluxion of the space AGF, by prop. 4 of this. And as these three figures are nascent at the same time, it will be BAH — AGF = (ALH =) BL — BAH. So that 2 BAH = BL + AGF. Whence it follows that the spaces BL, BAH, and AGF, are in arithmetical proportion.

Corol. 2.—The centre of gravity of the catenaria descends lower than that of any other line of the same length, and having the same extremities. For every heavy body descends as low as it can. And since a figure descends just so much as its centre of gravity descends, a heavy flexible line will so dispose itself, as that its centre of gravity will be lower than if it assumes any other figure. And from this property of a heavy flexible line all its other properties might be easily deduced.

Corol. 3.—If upon any curves, having the same length and the same limits D and F as the catenaria FAD, upright cylinders were cut by a plane passing through DF; of the cylindrical superficies so cut off, the greatest is that which insists on the catenaria. For these superficies, if the angle made by the planes be half a right angle, applied to the curves themselves, which in the present case are of the same length, produce breadths equal to the distances of the centre of gravity of the curves from the right line DF. Now as in the catenaria this distance is the greatest, because of the greatest descent of the centre of gravity, the cylindric surface to be applied, will also be the greatest. And because there is the same ratio of cylindrical surfaces cut off by a plane, containing any angle with the plane of the base, as when the said angle is half a right angle, the proposition obtains universally.

Lemma.—If upon any ordinate FB (fig. 4) perpendicular to the axis AB of any curve AFQ, that is described by the evolution of another curve KV, from the corresponding point V in KV a perpendicular VR be let fall, meeting the ordinate in R; if the fluxion of the axis AB remains the same, the fluxion of the fluxion of the ordinate BF, the fluxion of the curve AF, and the right line FR, will be continual proportionals.

Let the little right line Ff be produced, till it meets the next ordinate wϕ in o. And because by the hypothesis FS$=f$w, it will be o$f=$Ff, and therefore oϕ will be the fluxion of fs, that is, the fluxion of the fluxion of the ordinate. Moreover the triangles oϕf and fFR are equiangular, because oϕf is equal to the alternate ϕfr, and foϕ = Ffr = FfR, because their difference Rfr vanishes in respect of either of them, since Rr is nothing in comparison of fr. Therefore it is oϕ : ϕf :: fF : FR. But ϕf and fF are equal, since they only differ by the fluxion of each. Therefore oϕ : fF :: fF : FR. Q. E. D.

Prop. 6. *Prob.*—To find the curve KV, by the evolution of which the catenaria AFQ is described.

Make AB $= x$, and BF $= y$, as before. Then by Prop. 2 of this, it is $\dot{y} = \frac{a\dot{x}}{\sqrt{2ax+xx}}$, or $2ax\dot{y}\dot{y} + xx\dot{y}\dot{y} = aa\dot{x}\dot{x}$. Then, by Newton's method now in common use, it is $2a\dot{x}\dot{y}^2 + 4ax\dot{y}\ddot{y} + 2x\dot{x}\dot{y}^2 + 2x^2\dot{y}\ddot{y} = 2a^2\dot{x}\ddot{x} = 0$; for $\ddot{x} = 0$, because $\dot{x}$ is a constant quantity. Therefore $\ddot{y} = \frac{-a\dot{x}\dot{y} - x\dot{x}\dot{y}}{2ax+xx} = \frac{\overline{a+x} \times a\dot{x}^2}{\overline{2ax+xx} \times \sqrt{2ax+xx}}$, by substituting instead of $\dot{y}$ its value $\frac{a\dot{x}}{\sqrt{2ax+xx}}$; for the sign $-$ prefixed to the quantity $\ddot{y}$ only shows, that the place of the point R in respect of F, is opposite to the place of the point F in respect of B, since the curve AFQ is concave towards the axis AB. And by the second prop. of this, F$f = \frac{\overline{a+x} \times \dot{x}}{\sqrt{2ax+xx}}$. Wherefore by the foregoing lemma, FR $= \frac{Ffq}{\ddot{y}} = \frac{\overline{a+x}|^2 \times \dot{x}^2}{2ax+xx} \times \frac{\overline{2ax+xx} \times \sqrt{2ax+xx}}{\overline{a+x} \times a\dot{x}^2} = \frac{\overline{a+x} \times \sqrt{2ax+xx}}{a}$. Again, because of the right-angled triangles FSf and FRV, having equal angles fFS and VFR, because VFS is the complement of each to a right angle, it is FS : Sf :: FR : VR, or $\dot{x} : \frac{a\dot{x}}{\sqrt{2ax+xx}} :: \frac{\overline{a+x} \times \sqrt{2ax+xx}}{a}$: VR, which therefore is equal to $a+x$. Therefore this is the nature of the curve KV, that if AB be called x, it will be FR $= \frac{\overline{a+x} \times \sqrt{2ax+xx}}{a}$, and VR$=a+x$. Q. E. I.

Corol. 1.—AC : CB :: BH : FR. For this is the property of the right line FR found above.

Corol. 2.—The right line CB is equal to BI or VR : for each of them is equal to $a+x$.

Corol. 3.—The evolving right line VE is a third proportional to the lines AC and CB. For because of the equiangled triangles fFS and VFR, it is SF : Ff :: FR : VF. Or $\dot{x} : \frac{a\dot{x}+x\dot{x}}{\sqrt{2ax+xx}} :: \frac{\overline{a+x} \times \sqrt{2ax+xx}}{a}$: VF, which therefore is equal to $\frac{\overline{a+x}|^2}{a}$. Whence it is $a : a+x :: a+x$: VF, which also is the radius of a circle equicurved with the catenaria in the point F.

Corol. 4.—When the point F falls in A, or when the vertex is described by evolution, that is, when $x = 0$, the value of the evolving right line VF, which in this case is KA, becomes $\frac{\overline{a+x}|^2}{a} = a$. That is, the point K, where the curve VK meets the axis, is as much above the vertex A of the chain, as C is depressed below the same. Whence the diameter of a circle, equicurved with the chain at its vertex, is equal to the axis of the conterminate hyperbola AH. Therefore the chain AD and the hyperbola AH have the same degree of curvature at the vertex A: for it is generally known that the aforesaid circle is equicurved with the equilateral hyperbola AH in the vertex A. Also this appears from the nature of the chain itself, by what is demonstrated Prop. 2 of this. For the nascent line FH, = AP = the nascent BP = $\sqrt{8ax}$, is double the nascent line BH or $\sqrt{2ax+xx}$ = (when x vanishes) $\sqrt{2ax}$. And therefore the same point is both in the nascent hyperbola and the nascent catenaria. That is, the nascent hyperbola AH coincides with the nascent catenaria AD, and therefore these lines are equicurved at the vertex A.

Corol. 5.—The curve KV is a third proportional to the right line AC, and the curve AF, or the right line AL. For, from the nature of evolution, KV=VKA — KA = VF — KA = $\frac{\overline{a+x}^2}{a} - a = \frac{a^2+2ax+x^2}{a} - a = \frac{2ax+xx}{a}$. And therefore $a : \sqrt{2ax+xx} :: \sqrt{2ax+xx}$: KV. But $\sqrt{2ax+xx}$ = AF, by Cor. 2, Prop. 2. Whence AC : AF :: AF : KV.

Corol. 6.—The right line KI is double of AB. For since BI=BC=CA+AB, it will be AI = CA + 2AB. But AK = CA, by Corol. 4 of this. Whence KI = 2AB.

Corol. 7.—The rectangle of AC and BR is equal to double the hyperbolic space BAH. For FR + AC = $\frac{\overline{a+x} \times \sqrt{2ax+xx}}{a} \times a = \overline{a+x} \times \sqrt{2ax+xx} = x \times \sqrt{2ax+xx} + a \times \sqrt{2ax+xx}$ = AB × BH + AC × BH = AB × BH + AC × BD + AC × DH. Therefore FR × AC — BD × AC = BR × AC = AB × BH + AC × DH. But by Prop. 4 of this, it is AC × DH = space AGF. And therefore BR × AC=ABHL+AGF=2BAH, by Cor. 1, Prop. 5.

Prop. 7. *Theor.*—If in the logarithmic curve LAG, fig. 6, pl. 4, whose given subtangent HS is equal to the right line a, (determined by Cor. 2, Prop. 2 of this) a point A be taken, whose distance AC from the asymptote HP is equal to the subtangent HS; and from the points H and B, any how taken in the asymptote, equally distant from the point C, if ordinates HL, PG are erected to the logarithmic curve, to half the sum of which HD or PF are made equal; the points D and F will be in the catenaria corresponding to the right line AC.

Make AB $= x$, and therefore CB or DH, the half sum of the ordinates HL, PG, will be $a + x$; let the half difference of the same be called y. Then HL $= a + x + y$, and PG $= a + x - y$. And since, from the nature of the logarithmic curve, CA is a mean proportional between these, it will be $aa + 2ax + xx - yy = aa$, and therefore $y = \sqrt{2ax + xx}$. So that HL $= a + x + \sqrt{2ax + xx}$, and PG $= a + x - \sqrt{2ax + xx}$. Therefore the fluxion of HL, or lm, is $\frac{a\dot{x} + x\dot{x} + \dot{x}\sqrt{2ax + xx}}{\sqrt{2ax + xx}}$. And because of similar triangles lmL and LHS, it is LH : HS :: lm : mL. Whence mL or $d\delta$, the fluxion of BD, is equal to $\frac{a\dot{x}}{\sqrt{2ax + xx}}$. That is, the curve AD, derived from the logarithmic curve in the foregoing manner, is of such a nature, that if its axis be called x, and its fluxion $\dot{x}$, the fluxion of the ordinate BD will be $\frac{a\dot{x}}{\sqrt{2ax + xx}}$. But this is the very property of the catenaria to which a belongs, as demonstrated in Prop. 1 of this. Therefore the curve FAD, above described, is no other than the catenaria. Q. E. D.

Corol. 1.—As by the help of the logarithms the catenaria may be described; so, on the contrary, by means of the catenaria, which is constructed by nature herself, the logarithm of a given number, or rather of a given ratio, may be found. As supposing CA to be unity, whose logarithm is equal to 0, let us find the logarithm of the number CQ, or of the ratio between CA and CQ. To the right lines CQ and CA let the third proportional be CV, and let half the sum of CQ and CV be CB. The ordinate to the catenaria from B, that is BD, is the logarithm required. The reason is plain from the proposition.

Corol. 2.—On the contrary, if from the logarithm given, CH or CP, the correspondent number HL or PG were required, or the ratio HL to CA, or PG to CA; from H or P let a perpendicular be raised, meeting the catenaria in D or F; and let CR be made equal to HD or PF, that is, to CB, and let it be terminated at the horizontal line AR. Then will AR be the semidifference of the lines required, LH, GP, as HD or CR is their semisum, by what is demonstrated above about the nature of the catenaria. For in three quantities that are geometrically proportional, such as HL, CA, PG, the square of the half sum of the extremes, lessened by the square of the mean, is equal to the square of the half difference of the extremes. And therefore CR + AR and CR — AR are the numbers HL or GP, belonging to the given logarithm CH or CP.

Corol. 3.—From the demonstration it is evident, that as HD the half sum of the ordinates HL, PG, of the logarithmic curve, applied perpendicularly to CH in H, is the ordinate of the catenaria; so the half difference of the same HL, PG, applied perpendicularly to CA in B, is the ordinate of the equilateral hyperbola, described with centre C and vertex A; and therefore by Cor. 2, Prop. 2, of this, is equal to the catenaria AD; for $y = \sqrt{2ax + xx}$. And since it is shown in the foregoing corollary, that AR also is the half difference of the right lines HL, PG, it is plain that AR is equal to the portion of the catenaria AD. Whence, by the way, a method is discovered, from the chain AD being given, to find C the centre of the conterminate hyperbola, or that point in the asymptote of the logarithmic curve GL. For if AR be taken equal to the chain AD, and from the middle point of the right line BR, a perpendicular to it be raised, this will meet BA the axis of the chain in the point required C, as very plainly appears. For thus CR will be equal to CB.

Corol. 4.—Hence also it follows, that if the angle BDT be made equal to ACR, the right line DT will touch the catenaria in D. For thus, in the similar triangles DBT and CAR, it will be DB : BT :: CA : AR, or the curve AD, which is equal to it. And therefore by Corol. Prop. 1 of this, DT touches the catenaria.

Corol. 5.—It also follows, that the space ACHD is equal to the rectangle of CA and AR. For because AYD, by Prop. 4, is equal to the triangle under CA and AD — BD = (by Corol. 3 of this Prop.) AR — AY = YR, the proposition is plain. And because CA is given, it is evident that the space ACHD is as the curve AD, or its fluxion H*d* is as the fluxion of this D*d*.

Corol. 6.—If through the point K, where CR meets HD, a line KZ be drawn parallel to PH, meeting the right line AC in Z, and CE be taken equal to half the sum of BC, CZ; the point E will be the centre of equilibrium of the curve FAD. Upon FAD let it be conceived, that the upright superficies of a cylinder is erected, and cut by a plane through PH, at half a right angle with the plane of the curve FAD. This superficies will expound the moment of the curve FAD, when librated on the axis PH; and its fluxion is DH × D*d* + PF × F*f* = 2BC × $\dot{\text{AD}}$ = $2 \times \overline{a + x} \times \frac{a\dot{x} + x\dot{x}}{\sqrt{2ax + xx}} = \frac{2aa\dot{x} + 4ax\dot{x} + 2xx\dot{x}}{\sqrt{2ax + xx}} = \frac{aa\dot{x}}{\sqrt{2ax + xx}} + \frac{aa\dot{x} + ax\dot{x}}{\sqrt{2ax + xx}} + \frac{3ax\dot{x} + 2xx\dot{x}}{\sqrt{2ax + xx}}$, of which the fluent is $a \times$ BD $+ a\sqrt{2ax + xx} + x\sqrt{2ax + xx}$ = CA × BD + CB × AD. Wherefore CA × BD + CB × AD is equal to the aforesaid cylindrical superficies, (for they are nascent together,) which is equal to the moment of the curve FAD, when poised on the axis PH.

Whence the distance of the centre of gravity of the curve FAD, from the point C, is $\frac{CA \times BD + CB \times AD}{2AD}$, or $\frac{1}{2}\frac{CA \times BD}{AD} + \frac{1}{2}CB$. Moreover, because of ZK parallel to AR, it is AD : BD :: AR : ZK :: CA : CZ; whence $CZ = \frac{CA \times BD}{AD}$, and therefore CE, which by construction is equal to $\frac{1}{2}BC + \frac{1}{2}CZ$, will be equal to $\frac{1}{2}\frac{CA \times BD}{AD} + \frac{1}{2}BC$. That is, the centre of gravity of the curve FAD, and the point E, determined by the construction, will be equally distant from C; but being in the same right line, and situate the same way, they must necessarily coincide.

The coincidence of the point E, as above determined, with the centre of equilibrium determined Prop. 5 of this, may be thus shown synthetically. By Corol. 1, Prop. 5, it is $2BAX = AYD + BA \times AR$. Whence $AH + 2BAX = ACHD + BA \times AR =$ (by the foregoing corol.) $AR \times CA + BA \times AR$. That is, $BD \times AC + 2BAX = AR \times CB$, or $BD \times AC = AR \times CB - 2BAX$. Whence $BD \times AC + AD \times BC = AD \times BC + AR \times CB - 2BAX = 2AD \times BC - 2BAX = 2AD \times AC + 2AD \times AB - 2BAX$. And by applying it to 2AD, it will be $\frac{1}{2}\frac{BD \times AC}{AD} + \frac{1}{2}BC = AC + \frac{AB \times AD - BAX}{AD} = CA + \frac{ARX}{AR}$. But $\frac{ARX}{AR}$ is the distance of the centre of equilibrium of the chain from the vertex A, by Prop. 5, and therefore by the same $CA + \frac{ARX}{AR}$ is the distance of the point E from C, and $\frac{1}{2}\frac{BD \times AC}{AD} + \frac{1}{2}BC$ is the distance of the same E, from the same C, by this corol. Whence it appears that these two determinations of the point E come to the same, because $CA + \frac{ARX}{AR} = \frac{1}{2}\frac{BD \times AC}{AD} + \frac{1}{2}BC$.

Corol. 7.—The centre of gravity of the space PFADH is in I, the middle point of the right line CE. For since the centre of gravity of the fluxion of AD, or D*d* and F*f*, is distant as far again from PH, as the centre of gravity of the fluxion of ACHD, or DH*hd* and FP*pf*, and $\overline{Dd + Ff} \times AC$ is given, equal to D*dh*H + F*fp*P; it is plain that the centre of gravity E of the fluent FAD is as far again distant from PH, as the centre I of the fluent PFADH. But I shall prove this otherwise, after the manner of the foregoing.

Let an erect cylinder be supposed to be raised upon the figure PFADH, and cut off by a plane passing through PH, making half a right angle with the plane of the base; that solid will represent the moment of the figure PFADH, when poised upon the axis PH. The fluxion of this solid, or of the aforesaid moment, (that is, the solids erected upon PF*fp* and HD*dh*) is produced, if the moment of the fluxion, or the fluxion of the moment of AD, is drawn into the given line $\frac{1}{2}AC$. For by Corol. 5 of this proposition, HD*dh* = D*d* × AC. Wherefore the flowing moment itself is produced by multiplying the moment of the curve FAD in respect of the axis PH, determined by the foregoing corollary, that is, CA $\times$ BD + CB $\times$ AD into $\frac{1}{2}$AC; and therefore it will be $\frac{1}{2}$ AC $\times$ AC $\times$ BD + $\frac{1}{2}$AC $\times$ CB $\times$ AD. Now if this be applied to the librated figure PFADH, or 2CA $\times$ AD, by Cor. 5 of this Prop. there will arise the distance of the centre of gravity of the figure PFADH from the axis PH, equal to $\frac{1}{2}\frac{CA \times BD}{AD} + \frac{1}{2}CB$, which is equal to half the right line CE, as above determined.

Corol. 8.—If through the point N, where DT the tangent to the catenaria in D meets the line AR, a right line be drawn parallel to BC, meeting a right line through E parallel to AR in the point O; this point O will be the centre of gravity of the curve AD. For, by Corol. 6, the centre of gravity of the curve AD is in the right line EO. But it will be also demonstrated, that it is in the right line NO, and therefore will be in the point O. Let DA be conceived to be librated about the axis HL; the moment of this is the curve DA, drawn into the distance of the centre of gravity from HL, and therefore its fluxion is DA $\times$ Hh, (Hh is the fluxion of the distance of the axis of libration, from the centre of gravity, which is equal to $\sqrt{2ax+xx} \times \frac{a\dot{x}}{\sqrt{2ax+xx}} = a\dot{x}$. And therefore the moment of the weighty curve DA, librated about the axis HL, is $a\dot{x}$. Therefore the distance of the centre of gravity from the same axis is ax applied to AD, or $\frac{AC \times DY}{AR}$. But because DT touches the catenaria, by Cor. 4 of this Prop. the angle BDT or DNY will be equal to ACR. And the angles at A and Y are right; therefore in the equiangular triangles RAC and DYN, it is RA : AC :: DY : YN. Whence YN $= \frac{AC \times DY}{AR}$, that is, YN is the distance of the centre of gravity of the chain AD from the axis HL; or the said centre is in the right line NO.

Corol. 9.—If upon I a right line be drawn parallel to AR, meeting ON produced in W; the point W will be the centre of gravity of the space ACHD. For, by Corol. 7, this centre is in the right line IW; and it will be shown presently, that it is in NW, and therefore is the very point W. For in the same manner as in the foregoing, the fluxion of the moment of the space ACHD, librated about HL, is shown to be ACHD $\times$ Hh = AC $\times$ AD $\times$ Hh $= ax\sqrt{2ax+xx} \times \frac{a\dot{x}}{\sqrt{2ax+xx}} = aa\dot{x}$. And therefore the moment of the space ACHD, librated about HL, is equal to the fluent of the fluxion $aa\dot{x}$, that is to aax. This therefore applied to the space itself ACHD, or $a\sqrt{2ax+xx}$, gives the distance of the centre of gravity of the space ACHD from HL, that is $\frac{ax}{\sqrt{2ax+xx}} = \frac{AC \times DY}{RA}$. But in the foregoing corollary it is shown that $YN = \frac{AC \times DY}{RA}$. Therefore the centre of gravity of the space ACHD is in NW. And by these last two corollaries, the centre of gravity is found, of any portion of a catena that does not reach to the vertex A, or of any space of a catenaria, comprehended by any portion together with right lines.

Corol. 10.—Hence are measured the superficies and solids produced by the rotation of a catenaria, or of any space comprehended by that and right lines, revolving about a given axis. For the figure generated by rotation, as is commonly known, is equal to the evolving figure drawn into the periphery that is described by the centre of gravity in the rotation; which periphery is given, since its radius is given, or the distance of the centre of gravity from the given axis. Thus if the catenaria AD revolves about the axis AB, the periphery described by the centre of gravity O will be $\frac{\pi}{\varrho} \times AN$, if $\frac{\pi}{\varrho}$ denotes the ratio of the periphery of a circle to its semidiameter; and therefore the superficies produced by the rotation of the catena AD, will be $\frac{\pi}{\varrho} \times AN \times AD = \frac{\pi}{\varrho} \times AN \times AR$. That is, a circle whose radius is equal in power to the double of the rectangle RAN, will be equal to the superficies produced by the rotation of the chain AD about the axis AB. In like manner it may be shown, that a solid generated by the rotation of the space ACHD about AC, is equal to a cylinder whose base is the aforesaid circle, and its height equal to AC. And so may the superficies and solids be measured, that are produced by the rotation of these figures about any other given axis. For when the centres of gravity are known, the rest will easily follow.

On the Production and Effects of Hail, Thunder, and Lightning. By Dr. Wallis. N° 231, p. 653.

Thunder and lightning are so very like the effects of fired gunpowder, that we may reasonably judge them to proceed from like causes.* The violent explosion of gunpowder, attended with the noise and flash, is so like that of thunder and lightning, as if they differed only as natural from artificial: as if thunder and lightning were a kind of natural gunpowder, and this a kind of artificial thunder and lightning. Now the principal ingredients in gunpowder are, nitre and sulphur, the admixture of charcoal being chiefly to keep the parts

* It is curious to observe the reasonings and conjectures of ingenious and learned men. These of Dr. Wallis in the present instance, though very specious and plausible, and which were probably satisfactory to the philosophers of his time, are now pretty generally known to be erroneous; since it has been found that lightning and electricity are the same or similar phænomena. As will abundantly appear in some future volumes of this work.

separate, for the better kindling of it. So that if we suppose in the air, a convenient mixture of nitrous and sulphureous vapours, and those by accident to take fire; such explosion may well follow, as in the firing of gunpowder. And being once kindled, it will run on from place to place, as the vapour leads it, as in a train of gunpowder.

This explosion, if high in the air, and far from us, will do no mischief, or not considerable; like a parcel of gunpowder fired in the open air; but if near us, or among us, it may kill men or cattle, tear trees, fire gunpowder, break houses, or the like, as gunpowder would do in the like circumstances.

Now this distance may be estimated by the interval of time between seeing the flash of lightning and hearing the noise of the thunder. For though in their generation they be simultaneous, yet, light moving faster than sound, they come to us successively. I have observed that, commonly, the noise is about 7 or 8 seconds after the flash, that is, about half a quarter of a minute; but sometimes much sooner, in a second or two, or less, and almost immediately on the flash. And at such times, the explosion must needs be very near us, or even among us. And, in such cases, I have more than once presaged the mischievous consequences, which happened accordingly.

Now, that there is in lightning a sulphureous vapour, is manifest from the smell which attends it, especially when mischief is done, and even when there is none, from the lightning itself, which is more or less discernible. And a sultry heat in the air is commonly a forerunner of lightning, soon after to ensue. And that there is also a nitrous vapour with it, we may reasonably judge, because we know not of any body so liable to a sudden and violent explosion.

Now as to the kindling of these materials, in order to such explosion, chemists observe, that a mixture of sulphur, filings of steel, and a little water, will not only cause a great effervescence, but will of itself break out into an actual flame. So that there wants only some chalybeate or vitriolic vapour, or something equivalent, to produce the whole effect, there being no want of aqueous matter in the clouds. And there is no doubt, but that among the various effluvia from the earth, there may be copious supplies of matter for such mixtures. And it is known that hay, if laid up too green, will not only heat, but take fire of itself.

The same account may also be given of Ætna, and other burning mountains, where the admixture of steel and sulphur may give a flame, which is often attended with prodigious explosions and earthquakes, from the great quantities of nitre, as in springing a mine.

This may also suggest something as to the generation of hail, which is very often an attendant on thunder and lightning. It is well known, in our artificial congelations, that a mixture of snow and nitre, or even common salt, will cause a present and very sudden congelation of water. And the same in clouds may cause that of hail-stones. And the rather, because not only in those prodigiously great, but in common hail-stones, there seems something like snow, rather than ice, in the middle of them. And, as to those in particular so very large as to weigh half a pound, or three quarters of a pound, supposing them to fall from a great height; it is very possible, that though their first concretion, upon their sudden congelation, might be but moderately great, as in other hail; yet in their long descent, if the medium through which they fall were alike inclined to congelation, they might receive a great accession to their bulk, and divers of them incorporate into one, like as in those icicles before mentioned.

Effects of a violent Storm on the Rivers of North America. By Mr. Scarburgh, of Acomack. N° 231, p. 659.

Oct. 19, 1693, in the North-American provinces, there happened a most violent storm, which stopped the course of ancient channels, and made other new ones; so that between the bounds of Virginia and Newcastle, in Pennsylvania, are made many new navigable rivers for sloops and small vessels.

On the Damage that happened in the Isle of Portland, Feb. 3, 1695-6. Communicated by the Hon. Sir Robert Southwell, F.R.S. N° 231, p. 659.

The great pier is quite demolished, and filled up with rubbish; and the rocks that lay about 40 yards off in the sea, at the pier head, are raised above water, so that there are no hopes of making good that pier again. And the roads leading to that pier from the quarry, are turned upside down, and sunk at several places about 30 feet. Also the way leading to the north or little pier, is under the same circumstances, and the pier cracked in several places. The earth is slid into the sea between the two piers, near 100 yards, and is still working off into the sea. It is conjectured that this proceeded from a great quantity of rubbish thrown over the cliff, upon a clayey foundation, which the violence of rain softened, and made it give way; and not by earthquake, as some report.

Part of a Letter from Mr. Thoresby, (Leeds, July 10, 1697,) to Dr. Martin Lister, F.R.S. concerning Two Roman Altars lately found in the North of England: with Notes on the same, by Tho. Gale, D. D. and F. R. S. N° 231, p. 663.

One of these altars was taken out of the Roman-wall, not far from Chollarton, and may tempt us to believe that the old Procolitia, which was the station of the Cohors prima Batavorum, was rather there, which is an important place, (where the river Tyne interrupting the course of the wall it was but necessary that the ford should be secured by making one of the cohorts keep that station, and it is but 2 miles and a half from Carrow, where the altar now is in the possession of Mr. Forster,) than at Prudhoe, which is at least 10 miles distance from where Mr. Camden seemed to fancy it. The other is at Blenkinsop Castle in Northumberland, which I take to have been dedicated by Lucius Annius to the goddess nymphs old and young, and particularly to the Debonair (if Urbana be taken appellatively) Mansueta Claudia; for thus I read it, Deabus Nymphis veteribus et junioribus Mansuetæ Claudiæ Urbanæ, nuncupavit Hoc Lucius Annius; and hereby the defects in the stone seem to be supplied with a right number of letters in each vacuity, and this I the rather apprehend to be right, because it is now a year since I communicated the same to an ingenious gentleman, Dr. Cay, of Newcastle, without its being disputed by any one there.

On the Generation of Eels. By Mr. Benjamin Allen. N° 231, p. 664.

The manner of the generation of eels, has been a question unresolved ever since Aristotle, and reputed spontaneous: and the reason of the difficulty of discovering it, is the different way of generation, and that they breed in February, a time when few are taken but what are preserved in trunks or ponds, where they breed not. This I examined two years since, in some taken at a mill, in which holes they breed, especially near gravelly shallows, and found one with egg, another with six young ones in the great intestine, which I call the straight bowel, that descends immediately from the pylorus until the winding begins; they were fastened each to a very small placenta, which was fixed to the intestine, the meseraics at that time being very turgid: the eggs were on the outside of the intestine. They are certainly viviparous, and feed not, at least gross, in the winter, during all which they lie still, till they have discharged their young.

The parts distinguishing the sex are discoverable, those of the male affixed to the extremity of the kidney; the females had a slender gland, lying transversely near the bowel; but of this I dare not say much, till fresh subjects allow further examination. In salt-water eels, I have not found the like, though sought for; because I am of opinion, they do not breed, but are the same with the fresh-water ones, since such multitudes of fresh-water eels go down to sea, and cannot return, yet are never taken at sea, among the many brought hither; and there are vestiges of their beards in the fresh-water ones.

Account of a Book, viz. Philippi Cluverii Introductio in Universam Geographiam, tam Veterem quam Novam, &c. in 4to, 1697. N° 231, p. 666.

This celebrated geographer, Ph. Cluverius, was born at Dantzic, in the year 1580, where his father, who was master of the mint, took great care to educate him in the best manner; at fifteen years of age he sent him into Poland; afterwards to Leyden, to study the civil law, for which he had no taste, his mind running wholly upon geographical studies, being a master in the art of drawing and surveying. Joseph Scaliger, then a professor in that university, seeing his natural genius bent upon geography, advised him to pursue it, and make it his chief business; on which he resolved, first to visit Lipsius, and view all the Netherlands; after that he spent 2 years in Hungary and Bohemia, and viewed all Germany, Italy, Sicily, France, and England, with a curious and observing eye; having ten languages at his command, he was highly courted in all places, especially at Rome; but retaining an old love for the city of Leyden, he returned thither, and fixed under a generous pension from the curators, who appointed him to read and teach geography, of which he there published several specimens, as his Com. de 3 Rheni Alveis ac Ostiis, et de 5 Populis quondam Accolis cum Tab. Geograph.; his Germania Antiqua; his Descriptio Italiæ Antiquæ; as also the Sicilia, Sardinia, and Corsica; all illustrated with charts, &c. After his death, in the year 1623, Joseph Vorstius published his Introduction to Geography, which Cluverius had drawn up before his death, as an abridgment of his labours; this geographical epitomy was often translated and printed in many places, where several learned men have thought it worth their time to comment upon it; as Joh. Frid. Hekelius, Joh. Reiskius, and Joh. Buno, to whose excellent notes the new maps contained in this volume are very well adjusted; so that the present edition may be considered as much the most useful and exact, whether we regard the gravings of the charts, the elegance of the types, or the fulness of the annotations.

On the Tongue of a Pastinaca Marina, frequent in the Seas about Jamaica, and lately dug up in Maryland and England. By Hans Sloane, M. D. N° 232, p. 674.

Dr. Tancred Robinson, some time since, showed me a considerable number of fossil bones and shells of several sorts, which had lately come to his hands from Maryland. Some of them had received little alteration in the earth, others more, and some were so changed as to be stony; but all of them retained their ancient shape so well, that it was easy for any person, who remembered the figures of the parts of those animals, to conclude these fossils must have come from the same original.

One of these fossils I carried home with me, to compare with the tongue of a fish I had observed in Jamaica; and on setting it and the fossil together, and comparing them with another of the same tongues in pieces, which I saw in Mr. Charleton's most useful and admirable collection of natural curiosities, we found a perfect agreement of the tongue that was dug up in Maryland, and that taken from the fish in our collections. It was the opinion of some, that these bones were the pieces of a petrified mushroom, the lamellæ of which this fossil in some manner resembled. A part of one of the joints of this tongue was dug up in England, and given to Mr. Charleton, by Mr. Lhwid of Oxford, by the name of siliquastrum subnigrum pectinatum maximum.

A Catalogue of some Guinea-Plants, with their Native Names and Virtues; sent to James Petiver, Apothecary, and F. R. S.; with his Remarks on them. Communicated in a Letter to Dr. Hans Sloane. N° 232, p. 677.

These plants, with their names and virtues, Dr. Sloane received from the Rev. Mr. John Smyth, while he was minister to the Royal African Company in the English factory at Cape Corse, in Guinea. But there is nothing in this catalogue sufficiently interesting to be reprinted.

Observations at Cape Corse. By Mr. J. Hillier. N° 232, p. 687.

I thought the custom of destroying slaves at the death of great people had been abolished, and I was so informed; but we have lately seen that it is not; for Oct. 3, 1687, died Ahen Penin Ashrive, King of Fetou, here at Cape Corse, where he had been long sick; the fetishers had done all they could to save his life, but to no purpose, their physic scarcely extending to any thing but the flux, and what we call the French disease; his disorder was a consumption and an asthma of a long continuance: so they had recourse to their religion, and according to the rules of that, they made several pellets of clay, which they ranged in order in his room, all besprinkled with blood; besides they eat several muttons to his good health. But all was of no efficacy, so the man died, having delivered his sword to the Dey, who in the interregnum was to be the principal man, for the kingdom is elective: he also appointed one of his wives, whom he thought worthy of that fatal honour, to accompany him to the other world, who was accordingly buried with him the next day. Presently after, the more considerable people sent in such persons as they had a mind to murder in honour of the king: how many there were is not easy to say, the highest account gives 90, the lowest 50, the middle 70; the blacks do not understand arithmetic, so the numbers they give in all cases are very uncertain.

The shore lies almost east and west, exposed to the sea wholly on the south. The country is hilly; the hills not very high, but thick, clustering together; the valleys between extremely narrow; the whole in a manner covered with certain low but very thick shrubs. Not the tenth part of the ground is tilled; and where they do till, within half a year the ground is overgrown as before; for they do not root up the shrubs, but only cut, or sometimes burn them somewhat close to the earth; so they spring again in a very little time; this is sufficient for planting their corn, which they do by making small holes in the earth, at a competent distance, and putting seeds into them.

The water, which they have in pits, rain water for the most part, has a mixed taste of sweet and subacid. At Whiddah, which is one of the most unhealthy places in Guinea, he that opens the ground, though it be but to dig a grave, runs the hazard of his life; so noxious are the steams arising from it.

The age of the inhabitants is very uncertain, because none of them keep an account of it; there are some of them very grey, but if the country be to them unhealthy, grey hairs may come early. Much of the mortality among strangers is the effect of their irregular diet, and drinking to excess very hot and spirituous liquors; and if any chuse the cold rather, his stomach is chilled, and he is in danger of an immediate flux.

The Quadrature of Figures Geometrically-Irrational. By John Craig. N° 232, p. 708. *Translated from the Latin.*

Let ACF, fig. 1, plate 5, be a semicircle, and ADE a curve geometrically irrational, whose ordinate BD cuts the semicircle in C. Also let the quantities be thus represented, viz. the diameter AF $= 2a$, the absciss AB $= y$, the arc AC $= v$, the ordinate BD $= z$. And let $z = rvy^n$ be a general equation, expressing the natures of the geometrically-irrational curves ADE, in which r denotes any given and determinate quantity, and n the indefinite exponent of the indeterminate quantity y. Then I say the area of the curve will be, ABD $= \frac{rvy^{n+1}}{n+1} - qv + \sqrt{2ay - yy}$ into $\frac{ra}{\overline{n+1}|^2}y^n + \frac{2nra^2 + ra^2}{n \times \overline{n+1}|^2}y^{n-1} + \frac{a\text{A} \times \overline{2n-1}}{n-1}y^{n-2} + \frac{a\text{B} \times \overline{2n-3}}{n-2}y^{n-3} + \frac{a\text{C} \times \overline{2n-5}}{n-3}y^{n-4} + \frac{a\text{D} \times \overline{2n-7}}{n-4}y^{n-5}$ &c. Where it is to be observed, 1. That the capitals, A, B, C, D, &c. denote the coefficients of the terms immediately preceding; viz. $\text{A} = \frac{ra^2 \times \overline{2n+1}}{n \times \overline{n+1}|^2}$, $\text{B} = \frac{a\text{A} \times \overline{2n-1}}{n-1}$, C =

$\frac{\text{AB} \times 2n - 3}{n - 2}$, and so on. 2. That if the exponent n be any positive integer number, or $= 0$, or if $2n$ be an odd number, then the quadrature of the space ABD is expressed by a finite quantity, because of the series breaking off in these cases. 3. That q denotes the last term so breaking off. 4. That all those figures, in which the series breaks off, have a portion geometrically quadrable, easily assignable from the series itself: for if there be taken the absciss $y = \overline{r^{-n+1}}^{\,1} \times \overline{nq + q}|^{n+1}$, the arc belonging to this absciss will be geometrically quadrable. 5. That only the irrational term $\sqrt{2ay - yy}$ is to be multiplied into the terms that follow it.

Example 1.—Let $z = v$. Now because in this case it is $r = 1$, $n = 0$, therefore $\frac{ra}{\overline{n + 1}|^2}y^n$ is the last term breaking off. Hence $q = a$, and ABD $= vy - av + a\sqrt{2ay - y^2}$. Therefore if, by note 4, there be taken the absciss $y = a$, that is, if the ordinate pass through the centre of the circle, the portion belonging to it will be geometrically quadrable: for then the area $= aa$, the square of the radius.

Example 2.—Let $z = \frac{vy}{a}$. Because in this case $r = \frac{1}{a}$, $n = 1$, therefore $\frac{2nraa + raa}{n \times \overline{n + 1}|^2}y^{n-1}$ is the last term breaking off, so that $q = \frac{3}{4}a$; hence ABD $= \frac{vy^2}{2a} - \frac{3av}{4} + \frac{y + 3a}{4}\sqrt{2ay - yy}$; and therefore if, by note 4, there be taken $y = \sqrt{\frac{3}{2}aa}$, the area belonging to the absciss will be geometrically quadrable, and equal to $\sqrt{\sqrt{6a^4} - \frac{3}{2}a^2} \times \sqrt{\frac{3}{2}a^2} + \frac{3}{4}a$.

Example 3.—Let $z = \frac{vy^2}{aa}$. In this case $r = \frac{1}{aa}$, $n = 2$, and therefore $\frac{\text{QA} \times 2n - 1}{n - 1}y^{n-2}$ is the last term breaking off; therefore $q = \frac{5}{6}a$. Hence the infinite series will be ABD $= \frac{6vy^3 - 15a^3v + \overline{2ay^2 + 5a^2y + 15a^3} \times \sqrt{2ay - yy}}{18aa}$. Therefore if, by note 4, there be taken $y = \sqrt[3]{\frac{5}{2}a^3}$, the area belonging to this absciss will be geometrically quadrable, and equal to $\frac{2ay^2 + 5a^2y + 15a^2}{18a} \times \sqrt{ay - yy}$

Secondly, let ACF, fig. 2, pl. 5, be a parabola, its axis AE, vertex A, and parameter $= 8a$. And let ADG be a curve geometrically irrational, whose ordinate BD cuts the parabola in C. Call the absciss AB $= y$, the ordinate BD $= z$, and the parabolic arc AC $= v$. Then let the general equation expressing the natures of an infinity of irrational curves, be $z = rvy^n$, in which r denotes a given determinate quantity, and n the indefinite exponent of the indeterminate quantity y. I say the area ABD $= \frac{rvy^{n+1}}{n+1} - qv + \sqrt{2ay + yy}$ into $\frac{r}{n+2 \times n+1} y^{n+1} - \frac{ra}{n+2 \times \overline{n+1}|^2} y^n + \frac{raa \times 2n+1}{n \times n+2 \times \overline{n+1}|^2} y^{n-1} - \frac{aA \times 2n-1}{n-1} y^{n-3} + \frac{aB \times 2n-3}{n-2} y^{n-3}$ — &c. Where it is to be observed, 1st. That the great letters, A, B, C, &c. denote the coefficients of the respective preceding terms. 2. That if n be a positive integer, or equal to nothing, or if $2n$ be an odd number, then the quadrature may be exhibited by a finite number of terms, by the series in these cases breaking off. 3. That $+ q$ is equal to the last term breaking off. 4. That, of the terms multiplying the quantity $\sqrt{2ay + yy}$, the last term breaking off is to be doubled. 5. That all those figures in which n is a positive integer and odd number, or more generally, all the figures in which the last term breaking off has the affirmative sign $+$, have a portion geometrically quadrable, and which is easily assignable by the series, by taking the absciss as in note 4 of the preceding series.

Example 1.—Let $z = v$. Because in this case $r = 1$, $n = 0$, therefore the term last breaking off is $- \frac{ra}{n+2 \times \overline{n+1}|^2} y^n$, whence $+ q = \frac{1}{2}a$ by note 3. And because in this case $- \frac{1}{2}a$ is the last term breaking off, therefore $- a$ is the last term to be multiplied into $\sqrt{2ay + yy}$, by note 4, and therefore ABD $= vy + \frac{1}{2}av + \sqrt{2ay + yy} \times \overline{-\frac{1}{2}y - a}$.

Example 2.—Let $z = \frac{vy}{a}$. Because in this case $r = \frac{1}{a}$, $n = 1$, therefore the last term breaking off is $\frac{raa \times 2n+1}{n \times n+2 \times \overline{n+1}|^2} y^{n-1} = \frac{1}{4}a$. Hence $q = \frac{1}{4}a$, and so $\frac{1}{2}a$, is the last term to be multiplied into $\sqrt{2ay + yy}$. Therefore ABD $= \frac{vyy}{2a} - \frac{av}{4} + \sqrt{2ay + yy} \times \overline{- \frac{y^2}{6a} - \frac{y}{12} + \frac{a}{2}}$. And if we take $y = \sqrt{\frac{1}{2}aa}$, the area belonging to this absciss will be quadrable, and $= \frac{1}{12}\sqrt{\sqrt{2a^4} + \frac{1}{2}a^2} \times \overline{5a - \sqrt{\frac{1}{2}aa}}$.

The following Part is added from N° 235, p. 785.

Thirdly, let ACF, fig. 1, be a semicircle, ADE a curve geometrically irrational, of which the ordinate BD cuts the semicircle in C. Let the quantities be denoted as before, viz. the diameter AF $= 2a$, the absciss AB $= y$, the arc AC $= v$, the ordinate BD $= z$; and let the equation expressing the natures of the curves be $z = rv^2y^n$, in which r denotes any given determinate quantity, and n the indefinite exponent of the indeterminate quantity y. I say the area is ABD $=$ $\frac{rv^2y^{n+1}}{n+1} - qv^2 + v\sqrt{2ay - yy}$ into $\frac{2ra}{\overline{n+1}|^2}y^n + \frac{2ra^2 \times \overline{2n+1}}{n \times \overline{n+1}|^2}y^{n-1} + \frac{aA \times \overline{2n-1}}{n-1}y^{n+2} + \frac{aB \times \overline{2n-3}}{n-2}y^{n-3} + \frac{aC \times \overline{2n-5}}{n-3}y^{n-4}$ &c. $- \frac{2raa}{\overline{n+1}|^2}y^{n+1} - \frac{2ra^3 \times \overline{2n+1}}{n^2 \times \overline{n+1}|^2}y^n - \frac{a^2A \times \overline{2n-1}}{\overline{n-1}|^2}y^{n-1} - \frac{a^2B \times \overline{2n-3}}{\overline{n-1}|^2}y^{n-1}$ &c. Of which theorem it is to be noted, 1st. That it consists of two infinite series; of which the first, connected by the sign $+$, is multiplied into $v\sqrt{2ay - yy}$; but the terms of the latter, affected by the sign $-$, are absolute. 2. That, in the former, the capitals, A, B, C, &c. denote the coefficients of the terms which precede them; also in the latter the same values obtain as in the former. 3. That the quadrature is exhibited by a finite quantity, when n is a positive integral number, or equal to nothing, or when $2n$ is an odd number; for in these cases both the series break off. 4. That $2q$ is equal to the last term breaking off in the former series.

Example 1.—Let $z = \frac{v^2}{a}$. Because in this case $n = 0$, $r = \frac{1}{a}$; therefore it will be the area ABD $= \frac{yv^2}{a} - v^2 + 2v\sqrt{2ay - yy} - 2ay$.

Corol.—The whole figure AFE is equal to a double square, the side of which is ACF, taking away the square of the diameter.

Example 2.—Let $z = \frac{yv^2}{a^2}$. Because in this case $n = 1$, $r = \frac{1}{a^2}$; therefore the area will be ABD $= \frac{y^2v^2}{2a^2} - \frac{3}{4}v^2 + v\sqrt{2ay - yy} \times \overline{\frac{y}{2a} + \frac{3}{2}} - \frac{1}{4}y^2 - \frac{3}{2}ay$.

Example 3.—Let $z = \frac{y^2v^2}{3a^3}$. Because in this case $n = 2$, $r = \frac{1}{a^3}$, the area will be ABD $= \frac{y^3v^2}{3a^3} - \frac{5}{6}v^2 + v\sqrt{2ay - yy} \times \overline{\frac{2y^2}{9aa} + \frac{5y}{9a} + \frac{5}{3}}$ $\frac{2y^3}{27a} - \frac{5y^2}{18} - \frac{5ay}{3}$.

On a large Piece of Ambergris thrown on the Shore at Jamaica. By Mr. Rob. Tredwey. N° 232, p. 711.

Two years ago, a man found 150lb. weight, dashed on the shore, at a place in these parts called Ambergris Point, where the Spaniards usually come once a year to look for it. This vast quantity was divided in 2 parts; supposed by rolling and tumbling in the sea. But what I have chiefly to inform you of, is the way in which it is produced; viz. from a creature, as honey or silk; for I saw in sundry places of this mass, the beaks, wings, and part of the body of the creature, and this ignorant fellow has seen the creature alive; and he adds, that he believes they swarm as bees, on the sea-shore or in the sea.*

Account of a moving Bog in Ireland. N° 233, p. 714.

June 7, 1697, near Charleville, in the county of Limerick, in Ireland, a great rumbling, or faint noise, was heard in the earth, much like the sound of thunder nearly spent. For a little time the air was somewhat troubled with little whisking winds, seeming to meet contrary ways: and soon after that, to the greater terror of a great number of spectators, a more wonderful thing happened; for in a bog the earth began to move, viz. meadow and pasture land that lay on the side of the bog, and separated by an extraordinary large ditch, and other land on the further side adjoining to it; and a rising, or little hill, in the middle of the bog, hereupon sunk flat. This motion began about 7 o'clock in the evening, fluctuating in its motion like waves, the pasture-land rising very high, so that it over-ran the ground beneath it, and moved upon its surface, rolling on with great pushing violence, till it had covered the meadow, and remains upon it 16 feet deep. In the motion of this earth, it drew after it the body of the bog, part of it lying on the place where the pasture-land, that moved out of its place, had before stood; leaving great breaches behind it, and spewings of water that cast up noisome vapours: and so it continues at present, to the amazement of all that come to view it.

A true description of the Bog of Kapanihane, on the Estate of Brook Bridges, Esq. in the County of Limerick, near Charleville, with an Account of its Motion, June the 7th, 1697, which lasted about half an Hour. Communicated by W. Molyneux, Esq. N° 233, p. 714.

The quantity of this bog is about 40 acres. Adjoining to it is a piece of

* It has been mentioned in a former vol. of these Trans. that ambergris is now generally believed to be an excrementitious substance voided from the spermaceti whale, the physeter macrocephalus. Linn.

firm pasture-land, of 4¾ acres: and adjoining to this, a piece of meadow land, of 3¼ acres. The meadow was lower by a descent of 5 feet than the pasture, and the pasture was lower by 6 feet than the surface of the bog: and there was yet a considerable rising and hill, near the middle of the bog, the height of which was 10 feet above the surface of the bog; so that there was a descent from it to the meadow.

A more than ordinary wet spring occasioned a prodigious swelling of the height of the bog at the said elevation, and at length moistened the whole, but chiefly its under part, the water soaking to the bottom. By this means the turfy hill being as it were undermined, naturally sunk down, and consequently pressed the bog on all sides, chiefly towards the descent; till the pasture was forced on the meadow, overturning the intermediate hedge.

Observations on different Maladies; by Mons Gaillard the Son, M. D. of Toulouse. From the Journal des Sçavans. N° 233, p. 717.

There was seen 12 years ago, an infant with 2 heads; one was a sort of a bag, resembling the hood of a benedictine monk, and was fastened to a neck of the same length with the neck of the other head. Being opened, the waters ran out, and the swelling vanished. The neck did not so, that part of it which was next to its original, and which had about the length of 2½ inches, was made up of flesh. The child lived 15 days.

Having opened the corpse of a young woman, dead of the king's evil, the glands of the mesentery were found petrified; most of them were about the size of a walnut, and others of a small nut; in some of them, being opened, were found about a dozen of stones.

Having opened the corpse of a man in Toulouse, who died of a continual fever, and a spitting of blood, accompanied with a difficulty of breathing, there were found in the right kidney 3 little stones, and some gravel. Going down the ureter, which was much enlarged, the operator found a tough stone of the size of a bean, lodged towards the lower orifice of the same passage: the lungs stuck to the pleura, to the mediastinum, the diaphragm, and pericardium: the wind pipe was full of blood. There was seen in the left lobe, and the back part of the lungs, a bony substance 2 inches long, and ½ inch broad: there were 2 polypuses in the heart, one in each ventricle, of the size of a pigeon's egg, whose roots were 10 inches long: the vena cava, both ascending and descending, was covered at its entry into the left ventricle of the heart, with a bony matter.

Having opened the vena basilica of the right arm of a woman, the operator observed a little black blood that stopped the orifice he had made: and drawing it away, to open the passage, he found that it was a polypus, 10 inches in length.

Having opened a young woman between 25 and 26 years of age, who had been from time to time seized with a bloody flux, the surgeon found the colon and part of the mesentery ulcerated. The mouth of this ulcer was so great, that one might easily thrust a hand into it. It was stopped with a clue of worms, larger than itself.

Having stopped suddenly a flux of blood in a nun, who had her catamenia (though she had a continual fever and a bleeding at the nose) before he had used general medicines; she fell all on a sudden into an apoplexy, and died quickly after. On opening her, there was found in the lateral sinus, which divides the brain from the cerebellum, a clot of blood as large as a hazel nut. All the vessels of the brain were very much swelled, and full of clotted blood; and the ventricles were full of a serous humour.

A maiden of 18 years old was subject to great head-achs, and almost continual faintings, and convulsive fits; and for the last 2 years of her life, so strongly seized with them, that she became blind, and continued in that condition 2 or 3 months. After death she was opened: when the surgeon came to the grey substance of the brain, he found above the ventricles, between the cortical substance and the callous body, a lump of flesh, resembling the stomach of a goose. Immediately after the callous body in the foremost ventricles appeared an ulcer, from whence issued out about a setier of matter.

Opening the gall bladder of a widow of 19 years old, there was found a stone, like a hen's egg. That part of the liver which was near, was hurt; and the matrix scirrhous. She had for 2 years the yellow jaundice.—In the ventricles of the brain of a child was found a setier of water.—In another child, about 2 years old, was found in the right ventricle of the heart, a polypus as large as a pigeon's egg, and in the left auricle coagulated blood of the size of a walnut. There was found also in the little lobe of the lungs 2 ulcers very distinct, from each of which there issued a setier of matter. The ureter of the left kidney was distended an inch, and its passage stopped by phlegm so hardened, that a knife could scarcely cut it.—In a woman, about 26 years of age, and subject to great diseases; the vessels that brought the blood to the membranes of the brain, were greatly swelled, and full of polypuses; 12 were drawn out, some 4 inches long, and some 3.

There was observed in a child newly born, and in due time, that it had nothing of the bone in the hinder part of the head, the temporal bones, nor of the frontal bone as far as the eyes, so that the eyes made an appearance of 2 horns, which the calves have when they come into the world, which standing much out, made the child's face very monstrous. In the temporal bones there was nothing seen but what inclosed the organ of hearing; on laying the hand upon it the beating of the arteries was felt; and the vessels which watered the pia and dura mater, were seen distinctly, as if the bone had been taken off. The child lived in this state 4 or 5 days.

A surgeon having opened a young girl, found her matrix so scirrhous, that it seemed to be made but of one piece.—Such a thing was observed in a girl 2 years old, that died of an apoplexy; there were also 4 glands in the mesentery of this maid, each as large as a walnut. Also the mesentery of a child 7 or 8 years old, was made of 2 glands, each of the same size.—A surgeon found in a girl of 11 or 12 years old, instead of a matrix, a very thin membrane, placed where the matrix is. The vagina in the outward orifice was shut up hermetically, i. e. the cover was of the same piece with the matrix.

*The Anatomical History of the Leech. By M. Poûpart.** N° 233, p. 722.

The upper lip is stretched out into a point, and falls on the under, which is round like a crescent, and shorter. Its throat on the inside is covered with a great many white muscles, about 5 or 6 lines along, as thick as a small thread, and lying parallel to each other, along its body. When the leech applies its mouth to the flesh of any animal, all these muscles contract themselves, and she sucks with so great violence and greediness, that the part enters in form of a small nipple into its throat. So that all the effect of suction terminating in a very little space, of necessity the flesh must break in that part.

There is seen at the extremity of its tail, a little flat part, exactly round, the border of which is elevated far above the tail, and all round it; and this it applies so uniformly to the bodies on which it fastens, that it touches them in all their parts; and then drawing up a little the middle of this flat part, without taking off the edges, she makes of it, as it were, a little balm, and leaves a cavity in the middle. This excellent glue fastens so strongly the tail of the leech, that it is a hard matter to pull it away, without making some rent, especially if drawn perpendicularly from the surface on which the animal is fastened. It has always recourse to this little instrument for fastening its body, that it may not be suspended in the air, while it draws its nourishment by suction, or else that it be not carried away with the current of water, while it carries its head to and fro in search of food.

Its gut goes in a straight line from the mouth to the anus: it is as large as a

* Francis Poûpart was originally a French sailor, and afterwards capitain de vaisseau; but being of a studious turn, he quitted the navy and devoted himself to philosophy and medicine. He was a member of the Parisian Academy of Sciences, in whose memoirs are inserted several papers by him on natural history and comparative anatomy.

goose quill, and all along beset with a great number of little valves; some of which make a perfect circle with a hole in the middle, and others a half moon; some are shaped spiral-wise, and of these there is a great one near the tail, fashioned like a heart, which leaves only a very little hole, near which is found much yellow fat, which fills all the cavity of the intestine to half an inch. Two small intestines or appendices, each half an inch in length, and as thick as the feather of a little bird's wing, open into the great gut, and are shut at the other end; all this structure shows why the intestine, which makes no convolutions, and yet reserves usually only liquid aliments, does yet retain them to a perfect concoction.

There is a nerve, the size of a horse hair, all black, hard to break, having knots at intervals, which begins at the mouth of the animal, and passes over the parts that serve for generation in the male. It is fastened in a straight line all along the gut above, terminates at the little circle in the end of the tail, and in its way sends out branches to the right and left side, from every knot. It is very probable, that by this canal, the animal spirits run abundantly, which give so great briskness to this reptile, which cause it to swim so swiftly, and suck with such greediness.

The leech is hermaphrodite; the parts of the male destined for generation, are placed where the neck ought to be. The yard, which is about 2 inches long, is white, round, hollow, and gristly; a part of the yard, which is always in the body, is a sheath about 15 lines of an inch in length, as thick as a little bird's quill, covered with a fine membrane, which fastens it strongly to the belly, round about a small hole given the leech for exerting its penis at pleasure, and not for breathing, as the ancients thought. The other part of the yard, which comes out 9 or 10 lines of an inch, is the size of a sewing thread, and its extremity, for the length of 2 lines, is thicker than the rest. All the yard is hollow, and has in its cavity a white muscle as thick as a hair, fastened only to the root and head, all the rest being at liberty. It is with this muscle that the animal draws the yard into its sheath, which may be tried by cutting it at the root, and drawing out this muscle.

On every side of the root of the yard there is a little white web, flat, oval, about 2 or 3 lines long, resembling small guts twisted about, with a cartilaginous body, as large as a double thread, and 2 lines long, which fastens to the root of the yard, in which it is probable it carries the prolific matter. A little above the root of the yard, between these two webs, there is a little gristly globule, 2 lines long, white, hard, hollow, round, oval, sharp, inwardly covered with a membrane wrinkled and full of a milky liquor. At the head of this globule is a small web, like an epididymis, whose little canal, of the same piece with it, creeps over the globule, and is fastened at the point of it, and above the epididymis are 2 glands exactly round, each as large as a grain of millet. I am much inclined to think this little globule is a testicle.

Along every side of the intestine is a white canal, or ovarium, of the size of a small twisted thread, and variously folded, to which are fastened with a tail, many little globules exactly round, as large as a small pea, full of a milky juice, and some little white eggs, gristly and perfectly round, as large as a grain of millet, hard, which are with difficulty broken, making a noise, and full of a white matter.

There is in the intestine towards the end, a great valve fashioned like a heart, with 2 little bags, where begin 1000 small channels made of fine yellow fat, which fill the cavity of the intestine for half an inch. It is probable that these passages of fat receive the prolific liquor, to conduct it into the ovarium, by ways unknown.

Of a venomous Scratch with the Tooth of a Porpus, its Symptoms and Cure. By Dr. Martin Lister, F. of the Coll. of Physicians, and R. S. Translated from the Latin. N° 233, p. 726.

In dissecting a porpus, that had been dead at least 3 days, I accidentally scratched the inside of my finger, so slightly as not to fetch blood, against one of the teeth. I left no inconvenience from this accident until 4 days afterwards; when the finger put on a livid appearance, and was somewhat swoln at the joint. This affection spread daily, so that in the space of 4 more days 2 fingers were diseased; and at length, 3. I tried various applications by the advice of surgeons but without relief; till at length the disorder extended to the hand, and the wrist began to be painful. Its further progress, however, was now arrested by a fomentation composed of aq. sperm. ran. ℥vj. bol. armen. ℥iss. vitriol. alb. ℥iv. applied warm twice a day. Sometimes the application was varied in the following manner: ℞ vitriol. alb. combust. bol. armen. an ℥iv. camph. ℨj. ap. commun. lbviij. Afterwards by applying the ung. nutritum, and over that an emplastr. ex bolo et diapalm. I recovered from this extraordinary accident. Besides the livid appearance, a proof of something poisonous, I was affected with a most troublesome and distressing itching, or rather a hot smarting sensation, both day and night. The whole of the cuticle belonging to the diseased parts peeled off; and it was not till after some months that the use of my fingers was completely restored.

On a medicated Spring in Glamorganshire. By Mr. Aubry, F. R. S. N° 233, p. 727.

In Lancarim is a medicated spring, long frequented from several counties, for the king's evil. There is a rill, of about an ell broad, between 2 collines, covered with wood; about 12 yards from this spring, the rill falls from a rock 8 or 9 feet high, which makes a grateful noise. The spring is very clear, and comes out of a pure white marl. I thought there had been no white marl in Wales, for the earth is red. A graduate doctor here imputes the virtue of this spring to the lime stone, and says one of the chief remedies of the doctors, for the king's evil, is lime-water.

Observations on the Western Islands of Scotland. By Mr. Martin. N° 233, p. 727.

All the tribes of fowls are observed to have their sentinels, especially in the night: the watchfulness of the scart is true to a proverb. The want of rain at the usual time of laying eggs, hinders the sea fowls from laying for some time. If the April moon go far in May, it hinders the sea fowls from laying 10 or 12 days longer than is ordinary. A poor man of Rowdil, in the Isle Harries, known by the name of St. Clement's Blind, though his sight served him to travel alone through all Harries, Skie, &c. yet he was struck blind 2 days before the new moon, but at that instant he recovers his sight; in this he never erred once in his life time, whence he was called the infallible almanac. The children of Ferintosh in Ross, are taught from their infancy to drink aqua-vitæ, and are never observed to be troubled with worms. There are many in the highlands, who pretend not to any skill in surgery, and yet venture to cut off the uvula when they are troubled with it, and prescribe with success for a remedy after it a piece of bread and cheese. In many of the isles, the common people apply spearwort for pains in the head: being bruised and applied, it raises a blister, from which issues much matter, and this they find very effectual for pains in eyes, head, arms or legs. They also beat the juice out of it, which they drink for a looseness, frequently with good success: and to prevent excoriation of the throat, they drink a little melted fresh butter. A boy of 16, in the Isle of Skie, has a faculty of erecting his ears at his pleasure. The inhabitants of St. Kilda are every summer afflicted with a cough, which lasts for 10 or 12 days; and the usual remedy for it is giben, drank on brochan of meal and water. This giben is the fat of sea fowls preserved in the stomach, a sovereign remedy for coughs and green wounds.

Some Additions to a former Letter on Thunder and Lightning. By Dr. Wallis. N° 233, p. 729.

When I said, in my former letter, "A mixture of sulphur and filings of steel, with the admission of a little water, will not only cause a great effervescence, but will of itself break forth into an actual fire:" I said expressly, a little water;

because too much water will hinder the operation, or quench the fire. Which I take to be the case of the Bath waters, where steel and sulphur cause a great effervescence, but no flame. And the like of other hot springs. And I do not confine it to this particular mixture, for the chemists, I presume, may furnish us with divers others. And therefore I said, "or somewhat equivalent." But I gave instance of this for one. I would have added also, that the same account may be given of Ætna, and other burning mountains, where the mixture of steel and sulphur may give a flame; which is often attended with prodigious explosions and earthquakes, from great quantities of nitre, as in springing a mine.

Account of Books.—I. Refractio Solis Inoccidui in Septentrionalibus Oris, Jussu Serenissimi ac Potentissimi Principis Caroli II. Suecorum, Gothorum, Vandalorum, &c. Monarchæ Clementissimi, circa Solstitium Æstivum, 1695, *aliquot Observationibus Astronomicis detecta. Holmiæ in 4to. Swedish and Latin, and now translated into English, in* 8*vo.* N° 233, p. 731.

This work is chiefly about the refraction of the atmosphere, and a journey made by the Swedish astronomers to the northward, to a place where they could see the sun above the horizon at midnight, on account of the great refraction there.

The author, J. Bilbery, treats of the figure of the earth, the variation of the needle, and the difference of refractions under the pole and equator. He observes that the places where they travelled are all laid down too northerly in the maps, and discourses of the figure of the globe, which he believes is not spherical; also of the variation of the needle.

II. De Fontium Mutinensium admirandâ Scaturigine Tractatus Physico Hydrostaticus, Bernardini Ramazzini, in Mutinensi Lycæo Medicinæ Professoris. Mutinæ* 1691, *in 4to. Translated into English, and illustrated with many curious Remarks and Experiments, by the Author and Translator, Dr. Rob. St. Clair. London,* 1697, 8*vo.* N° 233, p. 734.

The author Ramazzini begins his treatise with a description of the wells,

* Bernardin Ramazzini was born at Carpi in 1633. He studied at Parma, and practised for several years at Modena, where he experienced much unfair dealing from some rival practitioners. In 1700 he removed to Padua, being appointed professor of the practice of physic in that university. He was afflicted with blindness for some years previous to his death, which happened in 1714, at the age of 81. He wrote on epidemic constitutions, after the example of Sydenham; but his Diatribe de Morbis Artificum, (with a supplement de Morbis Literatorum) is the work by which he acquired most celebrity. The novelty and variety of the subject soon brought this publication into general notice, and it has been translated into most of the European languages. It cannot be denied that the

observing that in any part of the plain of Modena, and 63 feet deep, it is certain to have an excellent spring of most pure water. That in digging the first 14 feet, they met with the traces of an old city, causeways of flint, tradesmen's shops, the pavements of houses; which he says, cannot be attributed to the city's being ruined and rebuilt, for all the plain is of the same height with the city.

Below that is fenny or marshy ground, full of reeds, which continues till they come to the depth of 28 feet; where they meet with a bed of clay 11 feet thick. Then appears a marshy ground, not unlike the former; and next a bed of clay, but not so thick as the former. Then a bed of marshy ground. Lastly, a bed of clay and sand, mixed with sea products. This last bed they pierce with an auger, on the pulling up of which, the water flows up with so great violence, that it throws up sand and pebbles, sometimes weighing 4 or 5 ounces. Before they bore this last bed, they hear a remarkable murmur and noise; which, on the author's stamping on the ground with his foot, increased to such a degree that fearing all would suddenly fall about his ears, he ordered himself quickly to be drawn up. Upon the first rising of the water in one of these wells, the water settles in the next wells. The number of these is such, as to make a canal large enough for swimming vessels in which they go to Venice.

He says that these are running waters, which he proves by the noise they make before boring, and by their sudden rising after the auger is drawn out. He derives them from a cistern in the Appenine mountains, which runs through a bed of sand lying under the last bed of clay.

In chap. 3, he proves, that this source cannot be from a subterraneous river. Chap. 4, treats of the ancient state of the country, on this and the other side of the river Po. Chap. 5, treats of the nature and condition of this hidden spring. Chap. 6, the progress and end of the waters is inquired into, and a reason is given of the use of things, which are observed in the digging of the wells. Chap. 7, contains very curious experiments about the motions of fluids,

author has taken a very extended view of his subject, and composed a curious, and in several respects a useful book; yet it is a work in which the extracts inserted from other writers greatly out-number the facts derived from his own observation; and in which the descriptions of some of the disorders are by no means so accurate as could be desired, nor the prescribed remedies (in general) the best that might have been recommended. Ramazzini wrote also de Principum Valetudine Tuenda, a treatise which contains observations on regimen and diet; concerning both which he published some further remarks in his annotations upon Cornaro's Discourse on the Advantages of Temperance. He was strongly prejudiced against the Peruvian bark, condemning its employment for the cure of fevers, in a tract De Abusu Chinæ Chinæ. Besides the works already enumerated, and that above-noticed, De Font. Mutinens., he wrote several Latin orations and other treatises on medical subjects; for which we refer to his Opera Omnia, printed at London in 1716.

tending highly to illustrate the subject in hand. Chap. 8, contains many remarks about the excellency and goodness of the wells of Modena.

With the book translated, are published several observations and experiments by the translator, Dr. Rob. St. Clair, who formerly was operator, and used to try experiments for the Hon. Mr. Boyle.

On some Roman Antiquities found in Yorkshire. By Mr. Thoresby. N° 234, p. 738.

Leeds, Oct. 30, 1697.—I have added to my Roman curiosities two entire urns, both of the blueish grey clay, but different forms, with some of the burnt bones, and two other vessels of the red clay. The lesser of them is almost in the form of the Roman simpulum or guttus, and by the narrowness of the neck seems rather to have been a kind of lacrymatory, or vessel for some kind of liquid matter than for ashes. The other was part of an aqueduct, and is turned in the form of a screw on the inside, and has a narrow neck at one end to put into the open end of the next, and several of these, each a foot long and four inches broad, were found thus placed in the Roman burying place at York, by the river side, out of Boutham bar, which our learned dean, Dr. Gale, tells me, signifies burning in the British language. And it was doubtless the place the Romans made use of to that end, as appears by the great number of urns frequently found there, when they dig the clay for bricks; and that it continued the place of their sepulture, after that custom of burning, introduced in the tyrannous dictatorship of Sylla, was abolished, is evident by a remarkable hypogæum without any urns in it, discovered the last winter; it was large enough to contain two or three corpses, and was paved with bricks near 2 inches thick, 8 in breadth and length; on which was a second pavement, of the same Roman bricks, to cover the seams of the lower, and to prevent the working up of vermin. But those that covered the vault were the most remarkable, being above 2 feet square, and of a proportionable thickness. I have also a third sort of Roman bricks, which I discovered in my survey of this parish, in the ruins of Kirkstall abbey, 2 miles from Leeds, which come the nearest to those mentioned by Vitruvius, being 8 inches broad, and almost double that length. I have also two sorts of chequered pavements, one of about 3 inches square, the other (of those found at Aldbrough) not above half or one-fourth of an inch, and of different colours, &c. I took the inscription below the statue, which is of the standard-bearer of the 9th legion.

On Swarms of Insects, that infested some Parts of the Province of Connought in Ireland. By Dr. Thomas Molyneux, F. R. S.* N° 234, p. 741.

These insects were first noticed in this kingdom in 1688. They appeared on the south-west coast of the county of Gallway, brought thither by a south-west wind, one of the common, I might almost say trade-winds, of this country. From hence they penetrated into the more inland parts towards Heddford, about 12 miles north from the town of Gallway; here and in the adjacent country multitudes of them appeared among the trees and hedges in the day-time, hanging by the boughs in clusters, sticking to the back of each other, like bees when they swarm. In this clinging posture they continued, with little or no motion, during the heat of the sun; but towards evening or sunset, they would all rise, disperse, and fly about, with a strange humming noise, like the beating of drums at some distance, and in such vast numbers, that they darkened the air for the space of 2 or 3 miles square. Persons travelling on the roads, or abroad in the fields, found it very uneasy to make their way through them, they would so beat and knock themselves against their faces in their flight, and with such a force, as to make the place smart, and leave a slight mark behind them.

In a short time after their coming, they had so entirely eat up and destroyed all the leaves of the trees for some miles round about, that the whole country, though it was in the middle of summer, was left as bare and naked as if it had been in the depth of winter; and the noise they made, in gnawing the leaves, made a sound much resembling the sawing of timber. They also came into the gardens, and destroyed the buds, blossoms, and leaves of all the fruit-trees, so that they were left perfectly naked; nay, many of them that were more delicate and tender than the rest, lost their sap as well as leaves, and quite withered away, so as they never recovered it again.

Their multitudes spread so exceedingly, that they infested houses, and became extremely offensive and troublesome. Their numerous creeping spawn, which they had lodged under ground, next the upper sod of the earth, did still more harm, in that close retirement, than all the flying swarms of their parents had done abroad; for this young destructive brood, lying under ground, devoured the roots of the corn and grass, and thus destroyed both the support of man and beast. This spawn, when first it gave signs of life, appeared like a large maggot, and by taking food, and increasing every day, became a larger worm, till

* The insect whose ravages are here described is the ***scarabæus melolontha*** of Linnæus, or common cockchafer.

at length it grew as big as a large white caterpillar; and from this, according to the usual transformation natural to these smaller animals, came forth this flying insect.

This plague was happily checked several ways. High winds, wet and misling weather, destroyed many millions of them in a day; whence we may conclude, that though we have them in these northern moist climates, yet they are more natural, and peculiar to warm and dry countries. Whenever this bad constitution of the air prevailed, their bodies were so enfeebled, that they would let go their hold, and drop to the ground from the branches, and so little a fall as this was sufficient quite to disable, and sometimes perfectly kill them. Nay, it was observable, that even when they were most vigorous, a slight blow would for some time stun them, if not deprive them of life. During these unfavourable seasons of weather, the swine and poultry of the country would watch under the trees for their falling, and feed and fatten upon them; and even the poorer sort of the native Irish, the country then labouring under a scarcity of provision, had a way of dressing them, and lived upon them as food.

In a little time it was found, that smoke was another thing very offensive to these flies, and by burning heath, fern, and such like weeds, they secured their gardens, and prevented their incursions; or if they had already entered, by this means they were effectually driven out again.

Towards the latter end of the summer, they constantly retired of themselves, and so wholly disappeared, that in a few days you could not see one left. Some thought they took their flight, like swallows and other birds of passage, to a more distant country and warmer climate. But I believe the true reason of their disappearing is, that after their coition is over, for it is about this time they are observed to couple, they retire under ground, in order to lay their spawn there, for a succeeding generation, and likewise to compose themselves to sleep for the rest of the ensuing year, as several other animals are known to do; for instance, snails among insects, the hedge-hog among the beasts, and as I have good reason to think, the ortygometra or rail among the birds. What further confirms this opinion is, that in the spring time, on digging or ploughing up the ground, great hollows or nests of them are frequently discovered and broken up, where whole bushels are found together in one heap, but in such a quiet condition, that they seem to have but little life and motion. These large caverns to which they retire, are often met with under a firm solid surface of earth, that has not been stirred or ploughed in many years before, and no manifest passage can be discovered by which they could get in.

A year or two ago, all along the south-west coast of the county of Gallway, for some miles together, there were found dead on the shore such infinite multitudes of them, and in such vast heaps, that by a moderate estimate, it was computed there could not be less than 40 or 50 horse loads in all; which was a new colony, or supernumerary swarm from the same place, whence the first stock came in 1688, driven by the wind to sea from their native land, which I conclude to be Normandy or Britany in France, it being a country much infested with this insect, and from whence England heretofore has been pestered in the same manner with swarms of this vermin. But these meeting with a contrary wind, before they could reach land, their progress was stopped, and tired with their voyage, they were all driven into the sea, which by the motion of its waves and tides, cast their floating bodies in heaps on the shore.

It is observed that they seldom keep above a year together in a place, and their usual stages or marches are computed to be about 6 miles in a year. Hitherto their progress has been westerly, following the course of that wind which blows most commonly in this country.

These insects have been erroneously called locusts, but the true locust, much resembling in shape a common grashopper, though larger, is quite a different species of insect from this, which belongs to that tribe called by the naturalists κολεοπτέρος, or vaginipennis, the scarabæus or beetle kind, that has strong thick cases, to defend and cover their tender thin wings, that lie out of sight, and next the body. And this species is certainly that particular beetle, called by Aristotle, in his History of Animals, μελολάνθες, from its devouring the blossoms of apple-trees, and is the scarabæus arboreus of Moufet and Charleton, called by the English, dorrs, or hedge-chaffers, and by the French, les hannetons. They are much of the size of the common black beetle, but of a brownish colour, something near that of cinnamon; they are thick set with a fine short downy hair, that shows as if they were powdered all over with a fine sort of dust; the cases of their wings do not entirely cover all the back, for their long peaked tails, where lie the organs for generation, reach a good way beyond them; and the indentures or joints on each side of their belly appear much whiter than the rest; they are exactly figured by Dr. Lister, Scarab. Tab. Mut.

A Letter from Ernest Tentzel, Historiographer to the Duke of Saxe Gotha, to Anthony Magliabechi, Librarian to the Grand Duke of Tuscany, concerning the Skeleton of an Elephant dug up at Tonna [Tonne]. An Extract from the Latin.* N° 234, p. 757.

As some persons, in Dec. 1695, were digging sand at the bottom of a hill

* Although Magliabechi could not boast of making useful or ingenious discoveries and improvements in science, or of being the author of any great or important work; yet his astonishing memory,

(famous for its fine white sand) near Tonne (a village not far from Erfurt in Thuringia) they met with some remarkably large bones, one of which weighed 19lb.; they afterwards found a globular extremity, or head of a bone inserted in its acetabulum; it was larger than a man's head, and weighed 9lb.: afterwards a bone resembling a thigh-bone, and weighing 32lb. Renewing their researches, after a thaw at the beginning of the year, they met with a spina dorsi with the ribs joined to it, and still deeper in the sand they found two larger balls or globular extremities, with the bones belonging to them, viz. the bones of the fore feet; they next met with an os humeri, 4 feet long, and 2½ spans round; afterwards the vertebræ of the neck; and last of all the prodigious head itself, having 4 dentes molares, each weighing 12lb. and 2 large tusks,* measuring 1½ spans in circumference, and projecting 8 feet from the head.†

and the use he made of it to assist those who sought for information concerning the writings of others, induce us not to let his name occur without subjoining to it some biographical notice.

He was born at Florence in 1663, and was apprenticed to a goldsmith, an occupation which ill-accorded with his love of learning. He therefore quitted it on the death of his parents, and devoted himself entirely to study, expending the whole of his small finances in the purchase of books. Although he did not confine his attention to any one class of writers, but took a most varied and extensive range, yet he never forgot what he had once read. He would remember not only the leading facts, arguments, and dates, but (as his biographers assert) the very words of an author, even when there was no very striking peculiarity or beauty of style. The following anecdote, which indeed, as the editors of the General Biographical Dictionary have remarked, is hardly credible, is told of him by Mr. Spence in his Parallel between him and Rob. Hill. "A gentleman to make trial of the force of his memory lent him a MS. he was going to print. Some time after it was returned, the gentleman came to him with a melancholy face and pretended it was lost. Magaliabechi being requested to recollect what he remembered of it, wrote the whole, without missing a word or varying the spelling." The Grand Duke of Florence, Cosmo III. made him his librarian, a situation of all others the best adapted to a person of his studious turn. In this situation he had full opportunity of gratifying his passion for reading, and at the same time of rendering considerable services to many literary characters then living, who frequently consulted him (for his judgment is said to have been scarcely inferior to his memory) respecting the best writers on the several subjects which engaged their attention. Magliabechi died at the age of 81. In his mode of living he was so extremely penurious, that he saved out of his salary, as librarian, enough to purchase a large collection of books, which was further augmented by presents of works from various authors. This library he left by his will for the use of the public, together with a sum of money for a commodious building, &c. By the munificence of the Medicis, considerable additions were made to this endowment; so that the Magliabechian library, not only in regard to the number and value of the books it contained, but also in regard to the spaciousness and elegance of the building wherein it was deposited, might bear a comparison with any in Florence. A collection of letters, amounting to 5 vols. was published, under his name, at Florence, in 1745. They consist of letters, for the most part complimentary, addressed to him by some of the most learned men of his time.

* In a subsequent part of this letter it is mentioned that each of these tusks weighed 100lb. and upwards.

† An enumeration of the rest of the bones that were found is afterwards given, together with the dimensions of such as were not too much decayed to be measured.

To give a better view of this enormous head, an excavation of nearly 12 cubits, or 24 feet, was made in the mountain; after which the Prince of Saxe Gotha (among whose attendants was the author of this letter) went to see it. They were all astonished at the prodigious magnitude of the head, but were much vexed to find the greater part of the bones in a very decayed state.

Two opinions were formed respecting this production; one of which made it to be the skeleton of an elephant; the other, a fossil unicorn or a mineral production of sportive nature. Mr. Tentzel adopts the first of these opinions, and shows by the description of the several parts of the skeleton, and the comparison thereof with Moulin's Anatomy of the Elephant,* and with the descriptions given by Ray and other naturalists, that in all respects these bones resemble those of an elephant.

In consequence of the imperfect and decayed state of the greater part of this skeleton Mr. Tentzel was unable to compare the dimensions of all its parts with the skeleton described by Moulin; but from a comparison of some of the bones whose measurement he had an opportunity of taking,† he infers that the skeleton of Tonne is twice as large as that described by Moulin; now if to the height (viz. 6 feet) of the bony fabric of the latter 2 feet more be added for the soles of the feet, for the curvature of the back, for the flesh and the skin, the height of that elephant (when alive) would be 8 feet; consequently (by the same mode of calculation) the height of this must have been about 16 feet; this, however great and surprising it may appear, the author shows from various authorities, to be by no means the utmost possible growth of this stupendous quadruped.

After refuting the idea of its being a fossil unicorn or mineral production, Mr. Tentzel concludes with an inquiry, how the elephant came to be in the place where it was found imbedded in the sand of the aforesaid mountain to the depth of 24 feet. And, after showing the improbability of its having ever been brought alive into this part of Europe and buried, when dead, at so great a depth in the earth: he concludes that it must have been deposited there at the time of the universal deluge, an opinion which he thinks is corroborated by the nature and disposition of the strata of which the before-mentioned hill is composed.‡

* Published at Dublin in 1681.

† The distance between the maxillæ of the Tonna skeleton was 3½ feet, or 42 inches, while in the Irish elephant the distance between the zygomatic bones was only 21 inches. In like manner the measurement of the cranium from one extremity to the other was only 20½ inches in the Irish specimen; whereas in this of Tonna, it was 3½ feet, or 42 inches.

‡ The author of this letter has favoured the Royal Society with some pieces of the bones of the skeleton of this elephant, viz. part of the scull, wherein appear its cells, some of the teeth both of those that grind, and such as are called elephant's teeth or ivory, with some other pieces of bones,

Two Observations. One on the Death of a Dog on firing some Vollies of small Shot [Arms]: the other on the Polypus of the Lungs. By Mr. Robert Clarke. N° 235, p. 779.

On proclaiming the peace in Nov. 1697, two troops of horse dismounted and were drawn up in a line, in order to fire their vollies; the centre of their line faced a butcher's door, who kept a very large mastiff dog, a dog of great courage for fighting; this dog was laid by the fire asleep; but on the first volley he immediately started up, ran into a chamber, and hid himself under the bed; on a second volley the dog rose, run several times about the chamber, with violent tremblings and strange seeming agonies; but on the third volley, he ran about once or twice violently, and fell down dead immediately, throwing out blood from his mouth and nose.

A poor man for three years past has frequently coughed up shapeless lumps, like clotted blood, some larger and some smaller. They came up after a continued coughing of almost half a day or night, and he knows when they come by first feeling great pains round his chest; he has voided hundreds of them in these three years, and all alike, though of different sizes. They do not seem, he says, to have life; but he has pressed a sliminess out of the body, and also through that part which seems to be the head. He is now very meagre, and complains of great pains about his chest and back part answerable to it.

Dr. Lister's opinion of these substances is, that they are shaped in the remoter and deeper branches of the aspera arteria, and therefore so difficult to get up. They are nothing else but the viscous excretions of the small glands, hard baked in those moulds, whose form they receive, and may, if we strain a metaphor, be called polypuses of the lungs.

Account of a Negro Boy dappled in several Places of his Body with White Spots. By Will. Byrd, Esq. F.R.S. N° 235, p. 781.

This negro boy, of about 11 years of age, was born in the upper parts of Rappahanock river, in Virginia; his father and mother were both perfect negroes, and the boy himself, till he came to be three years old, was in all respects like other black children; and then, without any distemper, he began to have several little white specks on his neck and breast, which increased with his age, both in number and size; so that now from the upper part of the neck,

all which they found agreeable to his description, and ordered they should be carefully preserved in their repository.—Orig.

From the description of the dentes molares in the original paper, the skeleton appears clearly to have been that of an elephant.

where some of his wool is become white, down to his knees, he is every where dappled with white spots, some of which are broader than the palm of a man's hand. They are very white, at least equal to the skin of the fairest lady. But of a paler white, and do not show flesh and blood so lively through them as the skin of white people; the reason of which may be, that the skin of a negro is much thicker. His face, arms, and legs, are perfectly black.

Surprising Effects of a terrible Clap of Thunder with Lightning, that fell on the Trumbull Galley, on Thursday the 26th Day of November, 1696. *Communicated by Mr. Robert Mawgridge, Surgeon of the said Galley.* N° 235, p. 782.

The vessel was violently struck, and greatly damaged, but none of the people killed. Some of the masts and yards shivered to pieces, and many parts of the hull blown out.

Part of a Letter from Mr. Halley, dated Chester, Oct. 25, 1697; *giving an Account of his Observations there of the Eclipse of the Moon, Oct.* 19. N° 235, p. 784.

I observed the eclipse with all the satisfaction I could desire, the air was all the while very still and clear: so that I think the observation may be very much depended on, and will, with sufficient exactness, give the longitude of this place.

The beginning 6 h. $8\frac{1}{2}$ m. the end 8 h. $49\frac{1}{2}$ m.

About the middle there remained $9' \ 26''$ of the luminous part, and consequently the digit eclipsed, $8\frac{2}{3}$.

Experiments about making Concave Specula nearly of a Parabolic Figure. By Mr. Stephen Gray. N° 235, p. 787.

A linen cloth being first wet in fair water, and then laid on a concave cylinder, as the verge of a sieve, or the like, its central parts will descend, so as to form a very regular concave superficies, which I suspected to be a parabolical, well known to be the best of figures, could it be obtained for burning glasses, in which I was not greatly deceived. A thread, being first wet in common water, and then suspended with its two ends, or any two points nearer than their utmost extent; so as to touch the centre of the suspended cloth, and its two opposite points on the ring, was found to have the same curvature: as indeed could scarcely be doubted, since the cloth is but a number of threads suspended in the position of this single one. To discover the figure of the thread, thus suspended, I described parabolas of several species, whose axes were perpendicular, and parameter horizontal, to which the line being applied so as to touch the vertex, it passed very nearly through all the intermediate points of the parabola, much nearer than the portion of a circle, which passed through the extremity of the parameter and latus rectum, would do.

Hence I conclude, that a ponderous and pliable substance, being suspended on a ring or hollow cylinder, so that its central parts may descend, will form itself into a figure that is more commodious for burning-glasses than the spherical, of which they are now made, being much nearer their most absolute figure, the parabola.

Now, if a way could be found to give the cloth, or leather, a metalline surface, or a varnish that may bear a good polish; or if this be found impracticable, perhaps plates of metal may be beat out so thin, as being suspended on a large ring, will by their own gravity receive their true figure; speculums may be made of any size. And there will be another convenient property in them, that one and the same speculum will be changeable into all degrees of concavity, and so have its focal length increased or diminished, according to the purpose it is designed for. On this idea I devised the following experiment.

There was taken a sufficient quantity of potters-clay, of which there was formed a plain circular plate, by help of an iron ring about 13 inches diameter. This was laid on a lesser ring, supported by 4 feet, and it immediately became a very regular concave on its upper, and convex on its under surface: but notwithstanding it was set to dry in the shade, yet before it was dry enough its central parts extended so as to become almost plane, not without some defects; if it had continued in its regularity, I designed to have burned and glazed it in a potter's furnace. I have since had a concave plate of clay which I formed by hand, and glazed, but found the glass to flow more unequally than I expected; which the potter tells me is caused by the foulness of the earth I used.

Concerning the Eggs of Snails. By Mr. Anth. van Leuwenhoeck. N° 235, p. 790.

Having procured some small, white, round eggs, supposed to be those of snails, mixed in moist earth, Mr. L. separated the eggs from the earth, and kept them apart in a dry place. The consequence was, the eggs soon dried up, and nothing came of them. Convinced of his mistake in separating the eggs from the earth, he procured some more, and inclosed both eggs and earth in a glass tube, open only at one end, which he also close corked, to prevent the evaporation of the moisture. After two months, viz. the beginning of August, the eggs began to hatch, and two or three young snails daily appeared.

I looked (says M. L.) several times on a snail, as it sat inwards, against the glass, and to my great satisfaction, I could see through the shell and part of the snail, which seemed not larger than an ordinary grain of sand, having the figure of a common egg. The body of the snail was partly retracted and extended again, which motion happened in as little time as we may easily pronounce a word of 4 syllables.

I have often wondered in the spring, to see those little snails so early on the tops and branches of the vine, because I could not imagine that the snails should have brought forth their young so early in the year. But now we see, that they come forth out of eggs; and thus we can easily comprehend that these eggs lay in the earth all the winter, and by the first warm weather are hatched.

Having afterwards procured a very large snail, I put it up in a glass tube, being so large that the snail could turn itself in it, and about 10 inches long. The snail had not been there half an hour, before it had brought forth on the glass 7 eggs, and about 2 hours after, 7 eggs more; and when I looked on it again, I found that the snail by creeping up and down had broken all the eggs in the glass; so that there could be nothing discerned, except the membrane of the eggs. This great snail died on the 2d day, probably for want of food, without producing any more eggs. The young snails, which were come out of the eggs, did not live above 2 or 3 days; after which, I took them out of the glass, and observed, that the membrane out of which the snails had come, was very white; and the rest of the eggs, which were fruitless, and out of which no snail had come, had a dark watery colour.

END OF VOLUME NINETEENTH OF THE ORIGINAL.

Account of some Experiments about the Height of the Mercury in the Barometer, at the Top and Bottom of the Monument: and about portable Barometers. By Mr. William Derham, Rector of Upminster.* N° 236, p. 2. *Vol. XX.*

In Sept. 1696, I made observations on the monument, with 2 of Mr. Quare's

* Dr. Wm. Derham, an eminent philosopher and divine, as well as a most useful member of the Royal Society, was born at Stowton, near Worcester, Nov. 26, 1657. He became a student at Oxford, where he was soon distinguished for his learning in the languages, and his genius in philosophical inquiries. From the vicarage of Wargrave in Berkshire, which he held 7 years, he was

best portable barometers. By the best of the two, I found the mercury descended $\frac{1}{10}$ of an inch at the height of 80 feet, and $\frac{2}{10}$ at 160 feet. But since that, finding my observations a little different from Mr. Halley's on Snowden-Hill, I thought it necessary to renew my experiments more nicely; and accordingly last Nov. tried again with other portable barometers; which erred intolerably. I therefore contrived to carry up the Torricellian experiment to the top of the monument, thus: I provided a pretty large glass tube, well cleaned, this I cased in wire, and filled with well strained mercury; which being cleared of air, I plunged the bottom of the tube into a broad cistern of mercury, and then fixed both the tube and cistern together, in the wire case, or frame. On the top I left an eye in the wire, to suspend the whole barometer on a string, that it might hang pendulously, which is absolutely necessary; because if the cistern be deeper on one side than another, or if the tube hang more towards one side than the other, it will cause a great and erroneous variation in the mercury above, according as the tube stands perpendicularly, or not.

My instrument being thus very nicely prepared, I marked exactly the height of the quicksilver, on two narrow labels of paper, pasted on each side the tube, both at the bottom, and in my ascent up the monument. The differences of the mercury's height I measured with a decimal inch scale on thin brass; and the quantity of my ascent I measured with a Gunter's chain, because a string would stretch. By the nicest observation I could make, I found that at the

removed to the rectory of Upminster in Essex, where he continued till his death, which happened in 1735, in the 78th year of his age. This situation, in the vicinity of London, gave him convenient opportunities of conversing with learned men in the metropolis, and particularly with the members of the Royal Society, to which he communicated a multitude of useful papers, several of which were inserted in almost every volume of the Transactions, from the 20th, in 1698, to the 39th vol. in 1735. Besides these, which exhibit strong indications of an active and philosophical mind, he was author of several other ingenious works, as "Physico-Theology; or A Demonstration of the Being and Attributes of God; from his Works of Creation;" being the substance of 16 sermons at Mr. Boyle's lecture, preached in 1711. And, in pursuance of the same design, in 1714, he published "Astro-Theology; or, A Demonstration of the Being and Attributes of God, from a Survey of the Heavens;" works which are still highly valued, and have passed through several editions. The last thing he published of his own composition, was entitled, "Christo-Theology; or, A Demonstration of the Divine Authority of the Christian Religion." But besides his own, he was useful also in perfecting or publishing some works of others. Thus, when Albin published his natural history of birds and insects, it was accompanied with curious notes and observations by our learned author. He also revised the Miscellanea Curiosa, published by Dr. Halley, in 3 vols. 8vo. He published also some pieces of the celebrated Mr. Ray, revising and correcting that author's manuscripts. To Dr. D. the world is likewise indebted for the publication of the Philosophical Experiments of the ingenious Dr. Hook, and other learned men of his time.

height of 82 feet the mercury fell $\frac{1}{10}$ of an inch, and at about 164 feet $\frac{2}{10}$. I also repeated my experiment, by ascending and descending quicker. At both which times, my observations agreed exactly with the first trial. From whence I conclude that at every 82 feet height, or thereabouts, the mercury will descend $\frac{1}{10}$ of an inch.

Considering that there is a difference of 8 feet between Mr. Halley's observations and mine, I am inclined to think, that a higher ascent than 82 feet is necessary to cause the mercury to descend $\frac{1}{10}$*, the higher we are in the atmosphere.

To make a portable barometer, provide a strong glass tube; let its head be pinched at about an inch from the top, so as to make a narrow neck, whose orifice shall be almost as wide as a straw. This will check much the blow of the mercury against the top. The bottom of the tube is to be ground aslant near half an inch, that the bottom of the tube touching the bottom of the cistern, its orifice may lie about the middle of the mercury in the cistern; which will prevent the air getting into the tube, because the mercury is always about the mouth of the tube. The cistern must be made wide, either of glass, or close-grained wood; round the brim of which, on the outside, must be a notch to tie on the leather that is to cover it. When the tube is filled, cleared of air, and plunged into the cistern nearly full of mercury, inclose the mercury with soft leather, tied very fast round the tube near the bottom; which being spread over the cistern, tie it round that also: the tube and cistern, thus conjoined with leather, must be lodged in a case, made very fit to receive both, where they must lie very firm. Through the case let 3 or 4 holes be bored, to let the air in freely to the leather that covers the cistern, which, lying close against the holes, will firmly enough keep the mercury from running out at them. The whole instrument, thus prepared, must be suspended by the top: for which purpose a tripos may be best, whose legs open and shut by joints at the top. The weather-plates are to be put upon the frame, by setting them to the same height, at which the mercury stands in a common barometer.

On the Effects of a great Storm of Thunder and Lightning at Everdon in Northamptonshire. By Dr. Wallis. N° 236, p. 5.

In harvest time, on the 27th of July, 1691, in Everdon-Field, near Daventry in Northamptonshire, several persons were at work reaping corn. The

* The altitude answering to the first tenth of an inch is found to be various, according to the temperature of the air: in the mean temperature of 65°, that altitude is 93 feet, or 31 yards. And for greater altitudes, it is still more.

morning was fair and clear, but before noon there came a violent storm of thunder, lightning, and rain; which caused the dry reapers to retreat for shelter to a quick-set hedge, with a ditch by the side of it, of about 20 yards in length, about 20 persons in all; of whom 4 were killed, 8 others dangerously hurt, of whom 1 was a woman great with child; whereof 6 were in the ditch, and 2 out of it, the rest not much hurt.

The persons that were hurt, but not killed, were grievously wounded in many parts of their body, as if with small shot, in great quantities; the wounds of which were very difficult to be cured. Their clothes were also perforated in many places.

Some additional Remarks on extracting the Stone of the Bladder from the Female Sex. By Thomas Molyneux, M.D. S.R.S. N° 236, p. 11.

About 6 years since, a paper of mine was read before our Philosophical Society here in Dublin, and afterwards published in the Philos. Trans. N° 202, wherein I gave an account of a stone, of an extraordinary size, spontaneously voided through the urethra, by a woman here in Dublin: and as a corollary or deduction from this history, I there proposed the extraction of the stone, by the gradual dilatation of the urethra, or neck of the bladder, without any manner of section, as the most safe and easy way, and of most general use, for freeing the female sex from the stone in the bladder.

I then alleged two instances of fact, to prove not only the reasonableness, but the real success of this practice; and I have been since still more confirmed in that opinion by several other successful operations I have seen of the like kind: but more particularly, by one lately performed in this town on a girl, between 11 and 12 years of age, who for 6 years past has been severely afflicted with all the painful and usual symptoms of the stone, but on the 16th of October, was happily relieved, by only dilating gently the neck of the bladder, and then extracting a stone of a very considerable bulk, without making any incision at all. The whole operation was performed in 6 or 7 minutes; and it was the more remarkable from the extraordinary magnitude of the stone, the shape and size of which are exactly represented in fig. 3, pl. 5. It may seem almost incredible that a solid of this bulk should be forced through the urethra of so small and so young a child, without any manner of section: and that the child should recover so as to be perfectly well, without the least ill accident succeeding the operation. But we may gather hence, of what vast extension this urinary passage, though naturally strait, is capable; and how much still wider it may be dilated, in persons of mature age; who may yet more easily and safely be relieved after this same manner, even of stones of a much larger size.

*A Lunar Eclipse observed at Rotterdam, Oct. 29. N. S. 1697. By M. Jas. Cassini.** N° 236, p. 15.

The beginning of this eclipse could not be seen for clouds.

At 6^h 32^m 34^s, the moon, seen among the clouds, seemed as yet entire.

At 6 41 23 beginning of mare crisium eclipsed.

9 14 39 the end of mare crisium.

9 21 34 end of the eclipse.

Account of a Book, entitled, Hortus Medicus Amstelodamensis, sive Plantarum tam Orientalis quam Occidentalis Indiæ aliarumque Peregrinarum Descriptio et Icones. Autore Joanne Commelino† Urbis Amstelod. (dum viverit) Senatore. Opus Latinitate donatum, Notis et Observationibus illustratum a Frederico

* James Cassini, a celebrated French astronomer, was born at Paris, Feb. 18, 1677, being the younger son of John Dominic Cassini, whom he succeeded as astronomer at the Royal Observatory, the elder son having lost his life at the battle of La Hogue. At the early age of 17 he was admitted a member of the Academy of Sciences; and in 1696 he visited England, where he was chosen a Fellow of the Royal Society. From time to time he enriched the stock of science with many valuable discoveries and works, both published separately, and in different literary journals. In 1740 he published his Astronomical Tables, and elements of Astronomy; very extensive and accurate works. Cassini did not confine himself entirely to astronomy, but made some curious experiments in electricity and other parts of natural philosophy; as, experiments on the recoil of fire-arms; on the rise of the barometer at different heights above the level of the sea; on the perfecting of burning-glasses, &c. In 1700 he assisted his father in continuing and producing the meridian of Paris to the southward; and the part of it to the northward he finished in 1718, assisted by Maraldi, and De la Hire the younger. From these measures, as also from the measure of a perpendicular to the meridian, he concluded, in opposition to Newton, that the figure of the earth was an oblong spheroid, or resembled a lemon. In consequence of these assertions of James Cassini, the French government sent out two different sets of measurers, the one to measure a degree at the equator, and the other at the polar circle. The comparison of these measures gave a figure of the earth the reverse of that assigned by Cassini, or the form of the oblate spheroid.

Cassini was however a very great and learned cultivator of science, and published several other works; as, a Treatise on the Magnitude and Figure of the Earth; also Elements or Theory of the Planets with Tables, besides an immense number of papers in the Memoirs of the Academy, between the years 1698 and 1756. But after a long and laborious career, he lost his life by a fall in 1756, in the 80th year of his age; and he was succeeded in the Academy and in the Observatory, by his second son Cæsar-Francois Cassini de Thury, the third of that illustrious name, ever dear to science.

† John Commelinus was a celebrated botanist of the 17th century. He was a native of Amsterdam, and was a burgomaster of that city. Besides the abovementioned work published after his

Ruyschio, M. D. Botan. Profess. &c. et Francisco Kiggelario, Amst.* 1697. N° 236, p. 29.

This work is none of the least specimens of modern magnificence and im-

death by Ruysch, he was author of the following: The Hesperides of the Netherlands, written in the Dutch language, folio, 1676; and Catalogus Plant. Indigen Hollandiæ, 12mo. 1683. He also bore a principal part of the labour of arranging, annotating, and editing the Hortus Malabaricus.

* Frederic Ruysch was born at the Hague in 1638, and studied at Leyden under Van Horne. After he had taken his degree of M. D. he practised for some time at the Hague; but in 1666 he removed to Amsterdam, having accepted the offer of the anatomical professorship there. He was afterwards appointed to the botanical chair; and he moreover gave lectures on midwifery. Here he formed that fine collection of anatomical preparations and of curiosities in natural history, which attracted the notice of all foreigners who visited Amsterdam. That enlightened Prince, the Czar Peter the Great, who left no source of information untried, and whose object in seeking information was his country's good, took a particular interest in examining this museum during his first travels (1698) into Holland, and even honoured its possessor (whose diet was as simple as his manners) by dining at his board; and on his second visit in 1717, the Czar purchased this celebrated collection, and had it conveyed to Petersburgh for the use of the Medical College there. Although Ruysch was now in his 79th year, he resolved to collect another Museum, to supply the place of that which he had sold; and this he actually accomplished during the 13 remaining years of his life, with the assistance of his son (who died 4 years before him) and daughter; whom the father had rendered very expert in the use of the dissecting-knife and injecting apparatus. Ruysch died in 1731, at the advanced age of 92. He was a member of the Parisian Academy of Sciences and of the Royal Society of London. A biographical account of him, in Latin, was published by Schreiber in 1732, and he is among the number of those who have been eulogized by Fontenelle. His 2d anatomical collection was sold by auction after his death, and the best part of it was bought by the king of Poland, for the use of the University of Wittenberg.

Among the principal of Ruysch's works should be mentioned his dissertation De Vasis lymphaticis, 1665; his Epist. Anatom. 1696; his Thesaur. Anat. exhibiting representations of the most remarkable preparations in his Museum, and consisting of 11 parts or fasciculi, published successively between the years 1701 and 1728, and his Adversaria Anat. in 3 decades, published in 1717, 1720, and 1723. These and some other writings make 4 vols, 4to. enriched with a vast number of plates.

Ruysch excelled in the art of injecting the blood-vessels; an art which he learned from his countrymen and contemporaries de Graaf and Swammerdam, upon whose methods, however, he greatly improved; filling the vessels, through all their minute ramifications more completely than any preceding anatomists had done; and inventing a varnish which, while it heightened the beauty of their appearance, defended them from moisture and other injurious impressions of the atmosphere. We are indebted to Ruysch for the discovery of some parts in the animal structure that were before unknown, and for a more complete investigation of other parts. Thus he discovered the inner lamina of the tunica choroidea, called after him membrana Ruyschiana; he traced the ciliary nerves and ciliary processes with remarkable accuracy; he demonstrated with great perspicuity the valvular structure of the lymphatics; and he showed that certain visceral parts, which Malpighi had represented as being of a folliculo-glandular structure, consist wholly of minute vessels or tubes, without any intervening cells or follicles. He moreover thought he had discovered an orbicular muscle in the fundus uteri; but this has eluded the research of succeeding anatomists. It is not, however, so provement in the history of nature; which, though she opens daily such mines and treasures, yet is never like to be exhausted. The art of calcography has given to these studies a new sort of life and perspicuity; its beauty and graces have drawn many illustrious persons abroad, into a kind of emulation who should excel in this noble and most useful ornament; what the English want in this part, they have made up in the critical methods in their discoveries of non-descript species, and in their judicious references to the synonomous names of various writers, by which confusion and multiplicity have been very much corrected. The authors of this garden have here described and elegantly figured above 100 several plants, with the illustrations of many additional synonyma, not mentioned by the curious publishers.

On preserving Specimens of Flowers, Fruit, &c. By Sir Rob. Southwell, F.R.S. N° 237, p. 42.

1. *To preserve Flowers in a Book that may retain their Colours.*—Prepare two plates of iron, as large or larger than the specimens. These plates must be so thick as not to bend, be very smooth on one side, and have holes for screws in each corner, to screw them close. Take the flowers, leaves, &c. when perfectly ripe, and in their true colours; spread them on a brown paper, with the leaves as distinct as you can; and if the flowers be large, more paper must be laid under them; and if thick, you may pare away the one half, as also of the stalk, so as to make it lie almost flat; and some distinct leaves may be separated and taken out, as a by store, to be afterwards stuck in, and complete the flower. Then lay over the whole more brown paper, and put these between the iron-plates, then screw them close, and put the whole into an oven for two hours, just as the bread is drawn. After which, take out the flowers; then take aqua-fortis, and aquavitæ, or brandy, in equal quantity, mixed together, and with a brush pass over the leaves of the flowers. Then lay them to dry on fresh brown paper, and press them a little with a handkerchief, or with your fingers. Then take the size of a walnut of gum dragon, which in less than 24 hours will be dissolved in a pint of fair water, and with a fine brush rub the back sides of the flowers and leaves, to make them stick; then lay them into your paper-book, where they will lie fast, and always look fresh. And if you would add any smell to these flowers, which will have none, touch them with any essence you please.

much on account of his new discoveries (by no means so numerous as he himself imagined, for he had no leisure for a thorough examination of the works of others), as for his excellent injected preparations, and his equally excellent plates, that Ruysch is entitled to be ranked in the number of those, who contributed largely to the progress of anatomical knowledge at the beginning of the 18th century.

2. *To preserve Fruit or Flowers the whole Year without spoiling.*—Take saltpetre 1 pound, bole ammoniac 2 pounds, common clean sand 3 pounds; mix all together; and observe this proportion in greater quantities. Then, in dry weather, take fruit of any sort, which is not fully ripe, each with its stalk; put them, one by one, into an open glass, till it be full; then cover it with oiled cloth, close tied down. Then put each of these glasses 4 fingers deep under ground in a dry cellar, and so as that quite round each glass, and both above and below, there may remain two fingers thick of the said mixture. Flowers may also be managed in the same manner.

3. *To make Fruit and Flowers grow in the Winter.*—Take up trees by the roots in the spring, just as they put forth their buds, preserving some of their own earth about the roots. Set them standing upright in a cellar till Michaelmas; then fit them into vessels, with an addition of more earth, and bring them into a stove, taking care to moisten the earth every morning with rain-water, in a quart of which you must dissolve the size of a walnut of sal ammoniac, and about Lent the fruit will appear.

As to flowers, take good earthen pots, and therein sow the seeds at Michaelmas, watering it in the same manner with the like water, and by Christmas you will have flowers, as tulips, lilies, &c. This and the other may be performed in a good warm kitchen; and on such days as the sun shines you may set them out for some hours.

A Contrivance for Measuring the Height of the Mercury in the Barometer, by a Circle on one of the Weather Plates. By Mr. Wm. Derham. N° 237, p. 45.

This circle, on one of the weather-plates, may be of any convenient diameter. Divide this into 100 parts, which are to answer the 100 parts of an inch. The index which points to these parts must be driven round by a small wheel, like the dial-wheel of a watch. This wheel must be driven round by a straight piece, like a small ruler, with teeth on one edge; every inch of which must contain just the same number of teeth as are in the dial-wheel before mentioned; so that by the thrusting up and down this toothed ruler, you may at every inch turn round the index once. About the middle of this toothed ruler a fine finger must be fixed, to point exactly to the height of the mercury. And consequently by raising or depressing this finger to the height of the mercury, you very exactly see, on the circle, the parts of an inch which the mercury rises or falls in the tube.

This description in words may perhaps be sufficient; but to prevent obscurity I have added a figure, see fig. 4, pl. 5, which represents the circle and toothed ruler, without the interposition of the weather-plate; that the contrivance may be the better seen. AA, the ruler with teeth, made to slide up and down. b, the little finger, that points to the mercury's height (which is placed higher on the toothed ruler than it ought to be, that it may be seen). cccc, the index or dial-wheel. DDDD, the circle. ee, the index.

On the Cure of the Bitings of mad Creatures. By Mr. Geo. Dampier. With a Remark on the same by Hans Sloane, M. D. N° 237, p. 49.

The herb used for this purpose is a sort of Jew's ear, and I know no other name for it but aures judaicæ, or fungus sambucinus, which is properly the Jew's ear that grows on the alder; this grows on the ground, as close as may be to it, being flat on it, the moss and grass grow up about and among it. To use it, you must dry it, then powder it, and pass it through a fine sieve; this mixed with the like quantity of pepper finely ground, is the composition. When given to a dog, he must first be blooded in the ear, or elsewhere, and then washed well all over; then mix it well in a convenient quantity of warm milk or broth; if it be for any cattle, they must be also blooded, and well washed, then given with a drenching horn; and the dose may be proportioned to the size or strength of the animal. To a man or woman it must be given after blood-letting, and well washing the face and hands, or the place bitten, or all the cloths that the person wore, when bitten, to wash away the drivel that comes from the mouth of a dog. The patient may take it in warm milk, beer, ale, broth, &c. fasting, for 2 or 3 several mornings. This remedy, when given in time, prevents all signs of madness, and is a noble and infallible medicine.

Dr. Sloane's Remark on the foregoing Account.—The simple or herb mentioned in this letter is not Jew's ear, but is the lichen cinereus terrestris,* described by Mr. Ray in his History of Plants, p. 117, and grows commonly in most barren places about London, and all over England.

The weight of one single dose of this simple, and the pepper mixed, communicated to me by Mr. Southwell, with Mr. Dampier's leave, is near ℈iv. †

* The Lichen caninus, Linn.

† This pretended antidote against the bite of a mad-dog is, we fear, not to be relied on. Mr. Dampier seems to have persuaded himself, that a proof of its efficacy was afforded in his own person; although he has not stated any particulars respecting his wound, and does not appear to have had any symptoms precursory of hydrophobia. It may further be remarked, that the pepper is by far the most powerful of the two ingredients. Even the recommendation of Dr. Mead, some years afterwards, could not long support the fame of this medicine.

Some Chinese Astronomical Observations. Communicated by M. James Cassini. N° 237, p. 53.

These are observations made at Pekin, by which M. Cassini determines the latitude and longitude of that place, the former by observed altitudes of the pole-star, which corrected for refraction, &c. give 39° 55′ 30″ for the latitude of Pekin; and the latter by the observed eclipses of Jupiter's satellites, which give, for its longitude, 7h. 35½ min. or 113° 52½′ east of Paris.

On the Origin of Caterpillars that infest Fruit Trees. By Dr. Geo. Garden, of Aberdeen. N° 237, p. 54.

I had occasion some years ago to discover the true origin of the small caterpillar, which infests the blossoms of pears and apples, and destroys the fruit. The vulgar conceit was, their being bred of mists and dews, which Goedartius assents to, but Dr. Lister rightly conjectures their original to be from the butterfly, into which they are transformed, though he seems not to have taken notice of the particular manner of their propagation, as may be seen in his edition of Goedartius. The bearers of these trees are full of asperities, and not so smooth in their bark as the other parts of the tree. If, after the harvest, and any time during winter, you look upon these bearers through an ordinary microscope, you will find the cavities full of eggs of an oblong figure, and citron colour, especially in those years and trees wherein the caterpillars have been numerous; out of these they are hatched in the spring. The seasons which usually destroy them, are, when there comes an early heat, such as is sufficient to hatch them before the coming forth of the buds and blossoms, and when immediately there succeeds a nipping frosty air, which soon kills them.

The discovery of this manner of their propagation, seems to give light to these conjectures. 1. That we ought not to conclude that any insects are bred of corruption, and not ex ovo, because we cannot discern the particular manner of their propagation; for the discovery of this is by accident; and not discernible by the naked eye. 2. That the female insects of all kinds of flies, and butterflies, probably put their spawn near those places where the erucas which are hatched of them are to have their food, so that they are to be searched for in such places. 3. They seem to be fixed into the cavities of the bearers by a gluten, so as that rains do not wash them off. The greatest frosts, it seems, do no hurt to the small eggs of insects; for I have seen the caterpillars hatch, after most cold and frosty winters, from those eggs which I have observed on the bearers all the winter over.

Observatio de Fœmina, quæ, non obstante Vaginæ Uteri Coalescentiâ, Infantem peperit. N° 237, p. 56.

Ad fæminam ruri habitantem in puerperio enitentem, ante aliquot septimanas accersitus eram, quæ parturientis doloribus per biduum laboraverat, absque ullo tamen effectu, nam ne guttula quidem sanguinis aut aquæ adhuc effluxerat. Vetula obstetrix quæ prius aderat mihi venienti retulit, se nunquam quampiam visitasse, cujus uterus tam clausus erat, quod cum exploraveram ita se habere sensi; nam vagina uteri (paulo supra ductum urinæ) firmiter coaluerat et latera ejus tam arcte unita erant, ac si semper unica essent membrana; nam specillo non daretur transitus versus uterum (nisi membrana prius perforata.) Ab ejus marito interrogabam quam diu vulva tam clausa esset, respondit per quinquennium, viz. a tempore prioris puerperii, quo in difficili partu huic obstetricaveram; quod coalescentia tam arcta erat non tactu solum, sed visu deprehendi. Rebus sic habentibus, puerperii ejus spem penitus abjeci, fefellit me tamen conjectura; nam post integram fere diem, multos fortesque enixus, una cum auxilio manus obstetricis aliquantulum aperta (et ni fallor lacerata) erat membrana, adeo ut digito minori daretur ingressus: hanc apertionem (ut ad partum conduceret) per speculum matricis dilatare visum est; hoc facto magna hæmorrhagia statim sequebatur, unde infelix fæmina ita debilitata erat, ut sex vel septem horis a partu infantis mortuæ expiravit.

In animo etiam atque etiam volutanti, quomodo fieri posset ut in utero conciperet hæc mulier, ad quem membrum semenve viril nunquam accederat, mihi in mentem venit opinio doctissimi Harvæi nostri in libro de generatione divulgata (cui ob hanc demonstrationem assentire cogor) viz. quod fœtus non formatur ex semine masculino in uterum ejecto, sed tota massa sanguinis (quasi per contagium) vim plasticam à semine virili accipiens ovis uterinis communicat, unde fiunt fertilia, et eo magis cum illo sentio, quoniam scio hanc fæminam infantulum vehementer appetiisse, unde procul dubio eo majori desiderio cum viro rem habuit; et maxime probabile videtur quot inflatis muliebribus instante coitus, spiritus eo tunc temporis affatim affluentes effluvia aliquot a semine virili attraxerunt, sanguinisque massæ et deinceps ovis uterinis fæcunditatem communicarunt.

Nota quod non obstante hac clausura frequenter per menses purgata erat antequam utero concepit.

Account of Books. 1. *Numismata, a Discourse of Medals, Ancient and Modern; with some Account of Heads and Effigies of illustrious Persons, in Sculps, &c. and a Digression on Physiognomy. By J. Evelin, Esq. S.R.S.* 1697, *in Fol.* N° 237, p. 57.

The ingenious author of this treatise, who has so often obliged the world with many useful pieces, cultivating and advancing as well natural philosophy as other parts of learning and arts, has in this discourse given a learned account of ancient and modern medals. He states, that having begun this work about five years since, he desisted from prosecuting it, on the publishing of Mr. Walker's treatise on the same subject; but finding some particulars that admitted of a further improvement, he resumed his design; and, after a short introduction, bewailing the failure of marbles, statues, trophies, &c. in perpetuating memorable actions, he begins his first chapter with the use of medals, either made for money, or to preserve the memory of worthy actions; observing their very early use in the world, and that the first Roman money was brass, without any marks at all; he then shows the origin of stamping, which was for a testimonial of the weight. The first silver stamped at Rome, was a little before the first Punic war; and gold not till about 62 years after, at which time the worth of gold to silver was as $12\frac{1}{2}$ to one, though in the earliest times it bore but a decuple value among the Romans and Greeks. Next, speaking more particularly of medals, he is of opinion, that they did not, when first made, pass for money, but were stamped in memory of celebrated actions or persons. But on the inundation of the Goths, the lustre of medals ended, with all the more polite arts. Next he treats of the materials used for money, whether leather, paper, earth, porcelain, coral, shells, linen, or the like. He next speaks of the time when the several metals were first used, and thinks iron and copper were the first, of which he gives several instances. Then he proceeds to consider the impressions and sizes, of which latter there were three.

The second chapter treats of the medals of several nations, and concludes with a proposal of designing in dead life what medals of undoubted truth can be procured; and these to be well and exactly engraven on copper-plates. The third chapter treats of ancient and modern reverses, as they relate to history, chronology, and other parts of learning, the use and benefit whereof he shows in several particulars. The fourth chapter treats of persons and things deserving the honour of medals, though most of them never obtained it; and in this he finds our nation too deficient. The fifth chapter is of incriptions on medals, and their several forms and differences. In the 6th chapter he gives instructions for procuring antique and rare medals, with directions to distinguish the true from counterfeits, presenting a catalogue of some alphabetically; and in this place he shows the several tricks used in making the cheats and false ones, and sets down some ways to take off medals by a sort of glue, and the like. In the seventh chapter our author discourses of mints, and the most skilful artists, with directions to collect and dispose medals for the cabinet, and gives his opinion and reasons against either debasing the coin, or enhancing the value. The eighth chapter gives an account of heads and effigies in taille douce, with particular directions for such a collection.

The ninth chapter, which concludes the work, contains a digression concerning physiognomy, giving his opinions and conjectures of the natural dispositions, wit, and qualifications to be gathered from the observation of each part and member particularly.

II. *Caspari Bartholini Thom. F. Specimen Phil. Nat. Accedit de Fontium, Fluviorumque Origine Dissertatio Physica. Amstelodam.* 1697, 12mo. N° 237, p. 62.

The design of this piece is to instruct the youth of Copenhagen in the rudiments of natural philosophy, therefore the author delivers his elements in a compendious method; in which he treats of hypotheses, of the understanding in general, then proceeds to principles, as matter, form, motion, extension, divisibility, space, time, &c. Afterwards he handles particular qualities, as heat, cold, fluidity, solidity, rarity, density, light, colours, sound, taste, smell, gravity, magnetism, &c. He examines the several elements and systems of the world, the earth with all its strata, inequalities, and fossils; the air and heavens with the meteors and celestial bodies. After which he descends to the functions of animal, and vegetable bodies, as sensation in general, and all the senses in particular: digestion, nutrition, secretion, excretion, respiration, generation, muscular motion, vegetation, &c.

Among the many opinions concerning the origin of springs, our author only examines 3 or 4, and then he delivers his own opinion, which makes rain-water, stopped by the strata of the earth, to be sufficient for the feeding of fountains; and this may be calculated from the observations of M. Perault, and Mariotte, to which Mr. Ray adds many illustrations in his Three Physico-Theological Discourses, 2d edit. 1693.

III. *Historia et Explicatio Figurarum, Embryon. quatuor Septimanarum, et Placentam cotyledoniformem exhibentium, Autore P. J. Hartmanno, Phil. et Med. D.* N° 238, p. 66.

On the Use of Ipecacuanha, for Loosenesses, translated from a French Paper: with Notes. By Hans Sloane, M.D.* N° 238, p. 69.

Most persons sick of a dysentery need but to observe the following rules, and they will be cured easily: first, they must take for three days together, morning and evening, one of the papers of powder marked with A, diluted with half a glass of wine, and as much water, to dispose them by degrees for purging, and to sweeten and correct the sharp corrosive humours, which eat away the tunicles of the intestines, and the mouths of the vessels.

A. ℞ Antim. diaph. crabs' eyes of each gr. x, croc. martis, gr. viii. mace, gr. iv. They must drink weak broth 2 hours after, or with a crust of bread dipped in it, or take a fresh egg as an omelet, and dine lightly; if they want nourishment, after dinner they may eat a toast with wine and sugar, or a little biscuit steeped in water or wine. At night they may take another paper marked A, as before, and sup lightly.

The fourth day they must take the dose marked B. ℞ Of good ipecacuanha, well pulverised, ʒi. with ʒvi. of cinnamon diluted in weak broth, or in half a glass of wine, to clear the stomach of a viscid bile, that weakens the natural heat, and hinders the digestion of the food. They may take 4 hours after some broth, and the remainder of the day eat sparingly; the day after they should take two papers marked A, as before.

The seventh day they should take the medicine marked C. ℞ Good rhubarb, ℈ii. ipecacuanha gr. xv. pulverise them well, and mix them in a glass of ptisan, D, described hereafter. This medicine will remove part of the obstructions; they should take two hours after, broth. The ninth day they must take the dose marked B 2, ℞ Good ipecacuanha ℈ii, with cinnamon gr. vi. well pulverised, and mixed with broth or wine. The eleventh day they must take a second medicine marked C; and observe the same regimen as at first. On the thirteenth they must take the dose marked B. 3. ℞ Good ipecacuanha ℈i. half a ʒ cinnamon with vi. gr. of nutmeg, and observe the same diet as on the two others. On the fifteenth they must take the dose marked B. 4. ℞ Good ipecacuanha ℈i. with nutmeg gr. x. well pulverised. They must keep themselves as on the three former days.

Though by this time they find themselves cured, yet they must take care that they suffer not cold in their feet, nor elsewhere, while the distemper continues; and they must yet observe as strict a diet as if they were sick, without feasting or

* The French account here mentioned was probably that drawn up by Helvetius, for the publication of which a large sum of money was given him by Lewis XIV.

drinking iced drinks. They must purge once in fifteen days with the medicine marked c, to prevent a relapse. The days that are not marked before for taking any remedy, as the 8th, 10th, 12th, they must take in the morning and evening one of the packets, marked A, as before. If the sick has no rest in the night because of great pains, or too frequent stools, it is convenient to take a spoonful, or one and a half, of the syrup of coral, according to the violence of the distemper, mixed with a glass of ptisan.

Children, delicate persons, and women with child, may use it in the following manner:

For children that are yet sucking, or are under 3 years old, they must take but the 8th part of the doses of the remedies. Children from 3 years old to 10 may take a 4th part; from 10 to 15, a 3d; from 15 to 20, the half: the same dose will serve for tender persons, and such as are aged, and women with child.

After all these remedies are used, the patient may take for 15 days, a spoonful of the stomachic elixir, pure, or in 4 spoonfuls of water. It is made after the following method:

The Stomachic Elixir.—℞ Of red saunders, of lignum aloes, each half an ounce, cinnamon two ounces, of little cardamoms, galangal, cloves, zedoary, each an ounce; of anniseed, fennel, and kermes, each two drachms; of liquorice, two ounces; of cashu, of crystal mineral, of each one ounce; of raisins 4 ounces; dates, 10 or twelve, cut the dates and the raisins into little bits, and having beaten that which ought to be beaten, put all into a matras, and pour upon them a quart of brandy, in which the crystal mineral shall be dissolved; infuse them a whole night, and the next day add two pounds of aquavitæ, and let all infuse in the cold for four days, shaking the glass four or five times a day; then filter the liquor, and dissolve a pound of fine sugar in it.

During the course of the disease, the patient must eat little, and shun what is of hard digestion, and hardly distributed, or easily corrupted, as pastry, beef a la mode, pork, either salt or fresh meats: and eat things of good nourishment, such as are broth made of beef, or of the scrag end of a neck of mutton, or a partridge, or an old cock, whose bones have been broken, and that without herbs; instead of which, may be taken two or three white onions, with as many cloves in them, avoiding boiled meats.

It is usual for the diseased to believe that their dysenteries come from heat: to allay which they use water, chicken broth, or whey, which often prove mortal to them. But it is very necessary for them to forbear much drinking, for the heat and thirst which they feel, are only symptoms and accidents of their distempers, and not the cause. Some are much enfeebled and emaciated by the length of the disease; and it will be convenient in the intervals to give them clysters made of broth, which will serve to sustain them, and to bring them more quickly to their strength. After the remedies, they may, to keep themselves in a good habit of body, take milk, with a little chocolate.

The Ordinary Ptisan.—℞ Of red saunders, the rind of the pomegranate ā ℥i. tormentil roots ℥s. wild succory and dandelion ā ℥ii. choice sumach ℥ii. leaves of agrimony, two handfuls. Make all boil over a clear fire, in 6 pints of water, which ought to be boiled to one half; at the end of the decoction, as you take it off the fire, add to it two drachms of cinnamon, and as much powder of liquorice.

For Clysters.—℞ Shepherd's purse two handfuls, linseed ℥s. red roses two drachms, salt a handful. Make all boil in a decoction of barley; strain it, and mix it with the yolk of a fresh egg, and two ounces of honey of roses. These clysters will, in a great measure, take off the pains in the intestines. If the pains be very violent, two heads of white poppy may be added.

Some Notes on this Paper, by Hans Sloane, M. D.

Although I am of opinion that the root mentioned in the foregoing paper is not so infallible a remedy for fluxes, as is pretended ; yet considering that sometimes those distempers yield not to ordinary means, and that this has a great reputation in our neighbour nations, and may be had in this, I thought it might be beneficial to the public, to have it printed in English, that it may be considered of, and brought into use, if by proper judges of the circumstances of the sick, it may be thought harmless and helpful.

In order to a fuller understanding of it, I think it necessary to take notice that Piso, in his edit. 1648, p. 101, 1658, p. 231, Pomet. p. 46, Marcgrave, p. 16, and an author at the end of Dr. Lister's Exercitations lately printed abroad, have treated of this herb. It seems to have been first noticed by an anonymous Portuguese, who lived in Brasil, (supposed to be one Manoel Tristaon,) whose book falling into the hands of the English, is translated and published by Purchas, in the year 1625. In whose Pilgrims, vol. 4, lib. 7, cap. 1, § 5, p. 1311, he speaks of an herb called in Brasil, igpecaya, or pigaya, which I believe to be this.

Igpecaya, or pigaya, says he, is profitable for the bloody flux, the stalk is a quarter long, and the roots of another, or more; it has only 4 or five leaves; the smell is strong and terrible. This root beaten, and put in water all night at the dew, and in the morning, if this water with the same root beaten and strained be drunk, (only the water,) it causes presently to purge so that the looseness ceases altogether.

Most of this is translated into Latin from Purchas, by Jo. de Laet, Amer.

lib. 15, cap. 10, p. 566, from whose hint I suppose, Piso and Marcgrave inquired more after it in Brasil; from whose inquiries we may have as good an account as they give us.

Account of a Monstrous Calf with two Heads. Communicated by the Right Hon. Sir Robert Southwell, V. P. R. S. N° 238, p. 79.

This monstrous calf had a perfect large head, and on the right side of that another almost as large; from the roof of which hung down a piece of flesh with the shape of a tongue upon it, and a row of teeth, as on an under-jaw, which occasioned the man, who showed it, to say it had 3 heads.

On the Division of the Monochord, or Section of the Musical Canon. By Dr. Wallis. N° 238, p. 80.

Any string or cord of a musical instrument open, or at its full length, will sound what is called an octave, or diapason, to that of the same string stopped in the middle, or at half its length. Hence it is that we commonly assign to an octave the duple ratio, or that of 2 to 1; because such is the proportion of lengths, taken in the same string, which gives those sounds. And on a like account we assign to a fifth, or diapente, the sesquialter ratio, or that of 3 to 2; and to a fourth, or diatesseron, the sesquitertian, or that of 4 to 3; and to a tone, which is the difference of a fourth and fifth, the sesquioctave, or that of 9 to 8; because lengths, taken in the same string, in these ratios, give such sounds. And universally, whatever ratio of lengths, taken in the same string, equally stretched, gives such and such sounds, just such ratios of gravity we assign to the sounds so given.

But when an eighth or octave is said, in common speech, to consist of 12 hemitones, or 6 tones, this is not to be understood according to the utmost rigour of mathematical exactness, of such 6 tones as called the diazeuctic tones, or that of la mi, which is the difference of a fourth and fifth; but is exact enough for common use. For 6 such tones, that is, the ratio of 9 to 8, repeated 6 times, is somewhat more than that of an octave, or the ratio of 2 to 1; and consequently such a hemitone is somewhat more than the 12th part of an eight or octave, or diapason. But the difference is so small that the ear can hardly distinguish it; and therefore in common speech it is usual so to speak. And accordingly, when we are directed to take the lengths for what are called the 12 hemitones in geometrical proportion, it is to be understood not to be so in the utmost strictness, but to be accurate enough for common use; as for placing the frets on the neck of a viol, or other musical instrument, wherein a greater exactness is not thought necessary. And this is very convenient, because thus the change of the key, upon altering the place of mi, gives no new trouble; for this indifferently serves any key, and the difference is so small as not to offend the ear.

But those who choose to treat of it with more exactness, proceed thus: presupposing the ratio for an octave, or diapason, to be that of 2 to 1; they divide this into two proportions; not just equal, for that would fall on surd numbers, as of $\sqrt{2}$ to 1; but nearly equal, so as to be expressed in small numbers. In order to which, instead of taking 2 to 1, they take the double of these numbers 4 to 2; which is the same ratio as before, and interpose the middle number 3. And of these three numbers 4, 3, 2, that of 4 to 3 is the ratio of a fourth, or diatesseron; and that of 3 to 2, the ratio of a fifth, or diapente; and these two put together make up that of an octave, or diapason, that of 4 to 2, or 2 to 1. And the difference of those two that of a tone or 9 to 8; as will plainly appear in the ordinary method of multiplying and dividing fractions. That is, $\frac{4}{8} \times \frac{3}{2} = \frac{4}{2} = \frac{2}{1}$. And $\frac{4}{3}$) $\frac{3}{2}$ ($\frac{9}{8}$.

Thus, in the common scale, or gamut, taking an octave in these notes, la, fa, sol la, mi, fa, sol, la; (placing mi in b fa ♮ mi, which is called the natural scale) the lengths for the extremes la, la, an octave, are as 2 to 1, or 12 to 6; those for la, la, (in la fa sol la) or mi la, (in mi fa sol la) a fourth, as 4 to 3, or 12 to 9, or 8 to 6; those for la mi (in la fa sol la mi) or la la (in la mi fa sol la) a fifth, as 3 to 2, or 12 to 8, or 9 to 6; those for là mi, the diazeuctic tone or difference of a fourth and fifth, as 9 to 8. Thus we have for these four notes, la, la, mi, la, their proportional lengths in the numbers 12, 9, 8, 6.

Then if we proceed in like manner to divide a fifth, or diapente, la, fa, sol, la, mi, or la, mi, fa, sol, la, or the ratio of 3 to 2, into near equals, taking double numbers in the same ratio, 6 to 4, and interposing the middle number 5; of these three numbers 6, 5, 4, that of 6 to 5 is the ratio of a lesser third, called a trihemitone, or tone and half, as la, fa, (in la, mi, fa,) ; and that of 5 to 4, is the ratio of the greater third, commonly called a ditone, or two tones, as fa, la, (in fa sol la) which two put together make a fifth, as 3 to 2; that is $\frac{6}{5} \times \frac{5}{4} = \frac{6}{4} = \frac{3}{2}$; and their difference is as 25 to 24, that is $\frac{6}{5}$) $\frac{5}{4}$ ($\frac{25}{24}$. So have we for these 3 notes la, fa, la, their proportionate lengths in numbers, as 6, 5, 4.

In like manner if we divide a ditone or greater third, as fa, la, (in fa, sol, la) whose ratio is as 5 to 4, or 10 to 8, into two near equals, by help of a middle number 9; then we have in these three numbers 10, 9, 8, that of 10 to 9, for what is called the lesser tone, and that of 9 to 8 for the greater tone. But whether fa sol shall be made the lesser, as 10 to 9, and sol la the greater, as

9 to 8; or this the lesser, as 10 to 9, and that the greater, as 9 to 8, or sometimes this and sometimes that, as there is occasion, to avoid what is called a schism, is somewhat indifferent; for either way the compound will be as 5 to 4, and the difference, which is called a comma, as 81 to 80. That is, $\frac{9}{8} \times \frac{10}{9} = \frac{10}{9} \times \frac{9}{8} = \frac{10}{8} = \frac{5}{4}$. And $\frac{10}{9}$) $\frac{9}{8}$ ($\frac{81}{80}$.

Lastly, if from that of the trihemitone, or lesser third, la, mi, fa, whose ratio is as 6 to 5, we take that of the tone la, mi, which is the difference of a fourth and fifth, as 9 to 8, there remains for the hemitone mi, fa, or la, fa, that of 16 to 15. That is $\frac{9}{8}$) $\frac{6}{5}$ ($\frac{48}{45} = \frac{16}{15}$. Or, the trihemitone, or lesser third, whose ratio is as 6 to 5, may be divided into three near equals, by taking triple numbers in the same ratio, 18, 15, and interposing the two intermediates 17, 16, which will therefore be as 18 to 17, and as 17 to 16, and as 16 to 15; that is, $\frac{18}{17} \times \frac{17}{16} \times \frac{16}{15} = \frac{18}{15} = \frac{6}{5}$. Where also the greater tone, whose ratio is as 9 to 8, or 18 to 16, is divided into its two near equals, commonly called hemitones, that of 18 to 17, and that of 17 to 16; that is, $\frac{18}{17} \times \frac{17}{16} = \frac{18}{16} = \frac{9}{8}$.

And the lesser tone, that of 10 to 9, or 20 to 18, may be in like manner divided into that of 20 to 12, and that of 19 to 18; that is, $\frac{20}{19} \times \frac{19}{18} = \frac{20}{18} = \frac{10}{9}$. Which divisions of the greater and lesser tone answer to what is wont to be designed by flats and sharps.

So that by this computation of these eight notes, la, fa, sol, la, mi, fa, sol, la, their ratios stand thus; that of la, fa, or mi, fa, is as 16 to 15; that of fa, sol, as 10 to 9, and that of sol, la, as 9 to 8, (or else that of fa, sol, as 9 to 8, and that of sol, la, as 10 to 9) that of la, mi, as 9 to 8, And if either of the tones, greater or less, chance to be divided (by flats or sharps) into what they call hemitones, their ratios are to be such as is already mentioned.

There may be a like division of a fourth, or diatesseron into two near equals: and of some others of these into three near equals. Which might be of use for what they were wont to call the chromatic and enarmonic music. But these species having been long since laid aside, there is now no need of these divisions in the modern music.

On the Poisonous Qualities of Hemlock water-drop-wort. By Dr. Vaughan. Communicated by Mr. Ray.* N° 238, p. 84.

Eight young lads one afternoon went a fishing to a brook in Ireland, and there meeting with a great parcel of œnanthe aquatica succo viroso, they mistook the

* Œnanthe crocata, Linn. Other instances of the deleterious effects of this vegetable are recorded in the 44th and 50th vols. of these Transactions. The medical reader is further referred to the 7th vol. of Dr. Foart Simmons's Medical Facts and Observations, for other proofs of the poisonous operation of this plant.

roots of it for sium aquaticum roots, and ate a great deal of them. About 4 or 5 hours after going home, the eldest of them, who was almost of man's stature, without the least previously appearing disorder or complaint, on a sudden fell down backwards, and lay kicking and sprawling on the ground; his countenance soon turned very ghastly, and he foamed at the mouth. Soon after, 4 more were seized the same way, and they all died before morning, not one of them having spoken a word from the moment in which the venenate particles surprised the genus nervosum. Of the other 3, one ran quite mad, but came to his right reason again the next morning. Another had his hair and nails fallen off, and the 3d alone escaped without receiving any harm; whether he ate less of this fatal root, or whether his constitution, which is to this day very athletic, occasioned it, I cannot tell. Though I am of opinion, that his speedy running above two miles home, after seeing the first young man fall, together with his drinking a very large draught of milk, warm from the cow, in his way, were of singular use to him; for his violent sweating doubtless expelled and carried off many of the venenose particles, and had a better effect than perhaps the best of our alexipharmics might have produced in this case. Besides, the draught of warm milk might act its part, by involving the acid or acrimonious poisonous particles, and rendering them inactive, and preventing them from seizing the genus nervosum, till they were expelled per diaphoresin. This happened about 30 years ago, but there are many yet living who assert the truth of it, having been eye witnesses of this dreadful tragedy. There was also a Dutchman about 2 years since, within 8 miles of Clonmel in Ireland, poisoned by boiling and eating the tops of this plant, shred into his pottage; he was soon after found dead in his boat, and his little Irish boy said the cause of his death was eating this herb, which he forewarned his master against, but in vain, the Dutchman asserting that it was good sallad in his country; so that probably he took it for apium palustre, which its leaves much resemble. Thus far Dr. Vaughan.

Several parallel, and no less tragical histories of later date, of the miserable destruction of divers persons from eating the roots of this pernicious and deleterious plant, I find recorded by Jacobus Wepferus, in his book de Noxis Cicutæ Aquaticæ, and in the Miscellanea Curiosa or Ephemerides German. Dec. 2, An. 6, Observ. 116.

Experiments about giving a Variety of Tinctures to Water, &c. By the Right Hon. Sir Rob. Southwell, V. P. R. S. N° 238, p. 87.

For red, tinctura rosarum 6 spoonfuls. For a higher red, syrupus florum punicorum, 1 spoonful; either of these to be mixed with 5 of ordinary water. For violet, 1 spoonful of syrup of violets to 5 spoonfuls of water. Then to change the rose colour into high green. ℞ Oleum tartari per deliquium, wash herewith the inside of the glass, leaving a few drops at the bottom, and then pour in the said rose tincture, and it will change. To make the high red black: Dissolve half the size of a walnut of sal ammoniac in a glass of water, pour all out but 3 or 4 drops in the bottom; if the said red be put to this, it turns as black as ink. To make the violet red: Wash the glass with spirit of vitriol in manner aforesaid, and pour therein the violet water. To make red wine yellow as sack: Steep in white wine Brasil wood 24 hours, or else in ordinary water, till it looks red, pour it at the same time into a glass, washed with vinegar, and it grows presently yellow. To make this yellow white: Take styrax calamita and benjamin ½ an oz. of each, pulverize it and steep it in 4 oz. of aquavitæ, of which a few drops will turn the liquor white. Note, This makes the lac virginis for the common wash. Washing with clear water, to make the hands and face black: Beat galls into very fine powder, and strew it very well, and roll it up and down into a towel; then into a basin of water throw some Roman vitriol, which will soon dissolve, and after the party has washed therein, it being clear and without smell, as soon as they wipe with the towel, all the skin grows black. But in some days, washing it with soap, it will come off.

On the Generation of Eels. By Mr. Dale, N° 238, p. 90.

Two very large eels have been lately caught on the coast of Essex. These both had all the characteristic marks of the eel, and wanted those barbles which the eel sometimes has not, but the conger is never without. The first was taken somewhere about Cricksea; its length from the tip of the nose to the tail's end was 5 feet 8 inches, and in circumference it was 22 inches, but as for the weight no person could inform me what it was; though perhaps it might not exceed 20 pounds, of which Aldrovandus says, that in Italy they come up to, but never exceed it; and for length it agrees with those mentioned by Rondeletius to be sometimes caught in the lake of Latera, which were 3 or 4 cubits long.

But those were far exceeded by one lately caught in Maldon channel, about a mile below the town, the length of which was 7 feet, the circumference 27 inches, the weight 36 pounds, and out of its belly were taken 5 pounds of fat; its skin was black, and being stuffed, is still preserved at Maldon for the inspection of the curious. This fish was supposed to have been brought down thither by the great floods at the breaking of the last frost, because of a hurt it had on its back, which the fisherman who caught it told me he conjectured might be from some mill it passed through.

Had I known of this monstrous eel soon enough, I would have gone to Maldon to have seen it opened, it being a fit subject in which to have examined the parts of generation, so much controverted, not only by the ancients but also by modern authors, and thereby been in some measure capacitated to have satisfied myself concerning that no less controverted point, the manner of their generation.

There are many who, with Aristotle, will have the generation of eels to be spontaneous or equivocal, and will not allow them the distinction of sex, from the difficulty how eels should come to be in any pool, pond, moat, or ditch, in which never any were put.

But that the generation of any animal cannot be equivocal or spontaneous, but from animal parents, has been so well made out by many undeniable arguments, and confirmed by multiplied experiments, by those celebrated naturalists Malpighi, Redi, Swammerdam, Leuwenhoeck, Ray, and others, that I think there is not the least doubt that eels have the same original. And if we may credit what Dr. Plot, in his Natural History of Staffordshire, p. 243, writes concerning the night travels of eels observed near Bilson in that county, by Mr. Mosely, the way of their stocking ponds, &c. may not be so improbable as at first it may be thought to be, if we but consider how long they will live out of water; and though I cannot with Pliny, in his Natural History, lib. 9, cap. 21, allow the time to be 6 days, yet I am sure it may be long enough to travel over a few short meadows, or from one ditch or pond to another, which may be performed in much less time than one night; and if we may believe what Gesner, in his Book of Fishes, lib. 4, cap. De Anguilla, quotes from Albertus, of a parcel of eels, which in a very cold winter, anno 1125, not only left their natural element, but were found in a dry meadow, bedded together in a hay-stack, the thing will seem more probable; to which let me add the form of their bodies, which by their serpentine motion is adapted to travel in arido. Neither are eels the only fish which are affirmed to live in sicco, but the exocœtus, also mentioned by Rondeletius, with others so numerous, that Theophrastus Eresius wrote a book of them, which was afterwards commented upon by Aurelius Severinus, in a work entitled De Piscibus in sicco viventibus, printed at Naples, anno 1655. Not to mention the Carian and Paphlagonian fishes, affirmed by Aristotle to wander up and down on the dry sands, and then return back to sea again; the like is also asserted of those of the river Cherati, in Judea, by Geo. Pictorius. All which Rondeletius thinks, eels, as well as the aforesaid fishes, perform by the rima of their gills, being narrow and thereby capacitated to oppose the free, and too sudden appulses of the air.

But the controversy does not terminate here, for even among those learned persons who oppose an equivocal or spontaneous generation, the dispute is, whether eels have distinct sex, or are hemaphrodites. By some a distinct sex is allowed them, for Mr. Allen in his Account of the Generation of Eels, published in the Philosophical Transactions, N° 231, affirms that the parts distinguishing the sex are discoverable, and in this Rondeletius is positive, when he affirms, Anguillas mutuo corporum complexu coeuntes se vidisse; neque putare se partibus ad gignendum necessariis prorsus destitutas esse, inferiore enim ventris parte, et vulva in fœminis et semen in maribus reperitur; sed pinguedine multa circumfusa hæ partes non apparent: and from hence, I mean from the parts of generation being hid in fat, might arise that mistake in Aristotle, which occasioned him so posivively to affirm, anguillam neque marem esse neque fœminam. And though it cannot but be granted, that that ingenious inspector of nature, Mr. Leuwenhoeck, has, by the help of his glasses, made many curious discoveries in animals and their parts of generation, yet never had he found a male eel that he could call so; for all those that he dissected, as in his letter in the Philosophical Transactions, N° 221, he declares were provided with a uterus, from whence he conjectures eels to be hermaphrodites, and besides the uterus to be furnished with masculine seed.

Another great controversy about the generation of eels is, whether they are oviparous or viviparous;* and many ingenious persons, who cannot consent to an equivocal or spontaneous generation, yet firmly believe them to be oviparous, whose sentiments are contrary to the observations of Walter Chetwynd, Esq. who, in the month of May, found them to be viviparous, by cutting open the red fundaments of the females, from whence the young eels would issue forth alive; and although Mr. Allen affirms them to be certainly viviparous, yet his observations concerning the place of their conception I cannot conceive to be consonant to that care and industry of nature, in providing convenient receptacles for preserving the fœtus; neither is it agreeable to reason to believe that when nature has provided a uterus in all animals, not only the viviparous, and such as only cherish the embryo in utero, but in the oviparous also, and insects, the eel and xiphia, or sword fish, mentioned by Bartholinus Cent. 2, H. 16, anno 1654, should be the only animals without it; much less that the guts, appointed by nature for the secretion of nourishment, and the expulsion of the fæces, and which are always in motion, should be the place of generation in any animal; though we may allow eels not to feed gross in the winter. On the contrary, that the eel has a uterus is asserted by Mr. Leuwenhoeck, who never found them without, which perhaps is that part which Mr. Allen names a slender gland transversely lying near the bowel.

Besides, nature having in all animals, oviparous as well as viviparous, hitherto

* Eels are viviparous, see a note annexed to a preceding article on this subject, at p. 94 of this vol. of these Abridgments.

dissected, provided not only a uterus, but also tubes for conveying the ovum from the ovaria to the uterus, there is another great difficulty and objection that lies against Mr. Allen's observations, and in which indeed he seems to contradict himself; it is this: whereas he says, that in one eel he found eggs, and those on the outside of the intestine; but in the other, six young ones, each fastened to a small placenta, and those within the great intestine, called the straight bowel, which adjoins immediately to the pylorus; how and by what passages those eggs came into the intestine, to be formed and invigorated, unless we may suppose they do like the embryos of some sorts of insects, which for the conveniency of food eat their own way into their heterogeneous or assumed matrices.

Account of a Book, viz.—The History of Poland, giving an Account of the ancient and present State of that Kingdom, Historical, Geographical, Physical, Political, and Ecclesiastical, &c. with several Letters relating to Physic. Vol. I. With a new Map. By Bern. Connor, M. D. F. R. S. Member of the College of Physicians, &c. Lond. 1697, *8vo.* N° 238, p. 98.

In this history of Poland, the author gives an account first of its origin; that about the middle of the 6th century it came to be a distinct nation, when as yet it had no cities, nor money, nor written laws; the first city was then built by Lechus near the state of Brandenburgh, naming it Guesna. Then treating of their policy and princes, which at first were called dukes, he gives a particular history of all their dukes and kings, down to the present king Frederic Augustus. These he divides into 4 classes, the first beginning anno 550, ending anno 830, when the government came into the families of Pirstus and Jagello, to the year 1574, when the Jagellonic race ended, which make the 2d and 3d classes. The time of the Teutonic knights' establishment in Prussia; how the Latin tongue came to be so frequent in use, when the Lutheran religion came to be there propagated; the jocular common-wealth of Babina, when and how instituted. The 4th class consists of mixed families, from the year 1574 to 1674; and here he observes when courts of judicature were first erected, with the original of the Cossacks, and extent of their dominions, their country, character, customs, religion, &c.

Next he gives a geographical description of Poland, its extent, provinces, towns, products, &c. Next he speaks of the origin and extent of the great duchy of Lithuania, with the description of its towns, and succession of its dukes. In Vilna, the chief city thereof, is a bell, which requires above 24 strong men to ring it, &c.

At the end of this treatise the doctor gives a compendious plan of the body of physic, or his Corpus Rationale Medicum, being his chemical and anatomical method for understanding the œconomia animalis, the nature of diseases, and the materia medica, as it was by him demonstrated at Oxford, London, and Cambridge; first of the elements, fabric, and system of the world; then of the elements of terrestrial bodies, next the structure and parts of the human body, in all its particulars; and lastly, of the union of the soul and body. Speaking of the materia medica, he affirms, all inward diseases have their first seat in the mass of blood; that there are no specific medicines for any particular part of the body, and that outward applications cannot avail much for inward distempers. He divides all the materia medica into 2 classes, evacuating and altering medicines; where he explains the chemistry and reason, the nature and operations of medicines, &c.

The last letter gives an account of a Latin Treatise lately published by the author, called Evangelium Medici, seu Medicina Mystica de Suspensis Naturæ Legibus; in which he compares supernatural effects philosophically with natural ones; and endeavours to explain them by the principles of physics.

Carigueya, seu Marsupiale Americanum; *or, The Anatomy of an Opossum, dissected at Gresham-College. By Edw. Tyson, M. D. F. R. S. &c. at the Surgeons'-hall, in London.* N° 239, p. 105.

This animal, which was brought alive from Virginia, has several names given it by different authors. Georg. Margravius, (Nat. Hist. Brasil.) and Gul Piso, (Hist. Nat.) tell us, that it is called in Brasil, and on the sea coasts, carigueya; by some, and in the inland countries, impatiima; in Paraguay, tai-ibi. Franc. Hernandez, (Hist. Mexican.) says it is called tlaquatzin by the Indians. Antonius Herera calls it taquatzin; and the modern Spaniards, by a corruption, tlaquacum; as Joh. Euseb. Nierembergius, (Hist. Nat.) informs us. Joh. Pet. Maffeius, (Hist. Ind.) and Caspar Barlæus, (Res Gest. in Brasilia,) call it cerigo. Joh. Lerius, (Hist. Navig. in Brasiliam,) calls it sarigoy or carigoy. Joh. Stadenius, (Hist. Brasil.) or Stadius, as he is printed in Theodore de Bry, writes it, servoy or serwoy. By Cardan and Oviedo, (Summar. Ind. Occid.) it is called chiurca et alibi chucia. In Virginia, and generally by the English, it is called opossum, as by Ralph. Hamor, (Descript. Virginiæ) and others. Joh. de Laet, (Descript. Indiæ Occidentalis) and Captain John Smith, (Voy. and Disc. in Virginia) writes it, opossum. Mr. Ray, (Synops. Animal.) calls it, the possum; as do also our common seamen.

But since it is an animal sui generis, and in several parts has a great resemblance to those of different species, I think a denomination might be best given to it, from that particular in which it is most distinguished from all others; which is that remarkable pouch or marsupium it has in the belly; into which, on any occasion of danger, it can receive its young: whence it may properly be denominated Marsupiale Americanum;* and it seems best referable to the vermine kind, as far as may be judged from this specimen, which is a female.

As to its dimensions, from the extremity of the nose to the tip of the tail, it measured 31 inches; the length of the head 6 inches; the tail 1 foot long; the compass of the body, $15\frac{1}{2}$ inches; when alive and well, it seemed much thicker: the fore-legs were 6 inches long; the hinder-legs but $4\frac{1}{2}$ inches; the compass of the tail, near the root, was 3 inches; near the tip but 1 inch: about the ears, the head was largest; measuring on the forehead, from one ear to the other, 3 inches; thence gradually tapering towards the nose, and more resembling that of a pig than a fox: the aperture of the eyelids not horizontal, but lying in a straight line from the ears to the nose, and not large: the ears were about $1\frac{1}{2}$ inch long; not sharp, but of a roundish figure, the rictus of his mouth, from the corner on one side, to the end of the nose, measured $2\frac{1}{2}$ inches. The fore-feet have 5 long claws or fingers, equally ranging with one another, and a hooked nail at the end of each finger; but the hinder-legs are formed differently, having but 4 fingers armed with hooked nails, and a perfect thumb set off at a distance from the range of the other fingers. This thumb had not a hooked or curved prominent nail, but a tender flat one, as in a human body. This contrivance of the legs, feet, and the nails, seems very advantageous to this animal in climbing up trees, which it does very nimbly in quest of birds, a prey it is very fond of, though it also feeds on other things.

These fingers, toes, or claws were naked, without hair; the skin here showing of a reddish colour. They were about an inch long, and the thumbs almost as long, but set lower. The palms, especially when dilated, as in climbing, were large; but so contrived as to be capable of contraction, as in walking; but that they might be better defended from injury, at the setting on of each toe there is in the palms a protuberant, fleshy, and almost cartilaginous body. In feeding, it makes use of the fore-feet to bring the food to its mouth, as the monkey and squirrel do. The tail was without hair, except for a little way near the setting on; tapering from the root towards the tip, and covered with a regular order of small whitish scales, which were mostly oblong hexagons; and between each was observable a little skin or membrane in which they are fixed. The colour of the scales makes the tail appear whitish, though the skin seems darker. The ears were also bare, and without hair; and though soft and slender, and in colour and substance almost resembling the membrane of a bat's wing, yet they were erect, and of a circular or oval figure: they were so

* Didelphis Marsupialis. Linn.

slender and soft, that I could not perceive that cartilaginous body, which is usually met with in the structure of this part, in most other animals; but as if it was formed only by a duplication of this tender membrane or skin; or if it had a cartilage, as is likely, it was much finer than in most other animals. The concha, or passage to the porus auditorius, was very capacious; but it was observed, that when our subject began to grow ill, the verge or rim of the external ear seemed to be crimped; and when it died, it was so shrivelled as if burnt up; not making a smooth, but jagged edge. The upper-jaw was somewhat longer than the under; the nostrils were large; the eyes black, small, vivid, and exerted, when alive; now dead, very much sunk: the neck was short; the breast was broad. It had mustaches like a cat; the fur on the face is shorter and whiter than the rest of the body. On the back and sides it was of an ash colour, or dappled with black hair in spots, intermixed with white, especially on the back; on the belly it was more of an umber colour, but darker on the legs. The longest hairs, which were stronger and coarser than the rest, measured 3 inches, and were white towards the ends.

At the bottom of the belly, in the middle, between the two hinder-legs is observed a slit or aperture, moderately extended about 2 inches long: but capable of a larger extension, by dilating it with the fingers, even when alive. The animal can so exactly close and contract it, that the eye does not readily discover it. There is, on each side of this aperture, a reduplication of the skin inwards, forming a hairy bag; but the hairs are so thinly set, that almost every where the skin is seen through them. The use of this bag, pouch, or marsupium, is to preserve the young, and secure them on any occasion of danger; and the contrivance is admirable in forming and adapting this part so suitably to that end. For there are two remarkably strong bones, not to be met with in any skeleton, of great use, which, from their office, I shall call ossa marsupialia, or janitores marsupii.

These bones are so fastened to the upper and inner edge of the ossa pubis, that at their basis here they touch each other, just at the coalition of the bones that form the ossa pubis. The other extremities of these bones were at a distance from one another, that measured $2\frac{1}{2}$ inches. The basis of these bones where joined to the ossa pubis was half an inch broad, having 2 heads; the larger lying near the coalition of the ossa pubis, and the lesser towards the os coxendicis; having in the middle a sinus, into which was received a protuberance of the ossa pubis: by which contrivance it appears, there can be no motion of these bones, nearer or farther from one another, but that they must stand always at an equal distance; but they were capable of a small motion inwards towards the spine, and outwards from it. These bones, as they ascended from the os pubis, grew slender, being about the middle but $\frac{1}{4}$ inch broad; and they were each 2 inches long. These bones were furnished with 4 pair of muscles: and another pair ran over them, to which they performed the office of a trochlea, or pulley. The first pair of muscles (i. e. which first came to be dissected, on the pronation of the animal, and from its figure I call triangularis) arises fleshy from the whole length of the internal side of these bones, and inserted their opposite tendons on each side of the rima, or aperture of the marsupium. Under part of the muscles, lay another, or a 2d pair, flat and thin, having their origin from the upper part of the internal side of the ossa marsupialia, and inserting their opposite tendons a little above the tendons of the former muscles: the tendency or direction of the muscular fibres of this pair, in respect of the first, made a decussation. The 3d pair of muscles had their rise from the fore-part of the basis of these bones, where they were joined to the os pubis; and were afterwards inserted into the linera aspera of the thigh-bone. The 4th pair arose from the external side of these bones near the basis, and are inserted into the fore-part of the thigh-bone near the middle. The last pair of muscles arises more immediately from the marsupium or pouch itself; for spreading their muscular fibres all over this bag, as they issue from it, by joining their fibres together, they more remarkably form a solid muscle; which passing on each side over the middle of these bones, i. e. in the prone posture of dissecting the animal, they at length were inserted into the spine of the os ileum.

By considering the structure of these muscles, and what must be the effect of their action or contraction; one cannot but think the first 2 must serve towards the dilatation or opening the marsupium or pouch: for these bones are a fulciment or basis, their articulation not admitting of a contraction inwards, or nearer to each other; wherefore, when the 1st and 2d pair of muscles act, or contract, they must necessarily open or dilate the mouth of the marsupium or pouch. The 3d and 4th pair may serve to extend these bones outwards; so that when this animal hangs by its tail, as it frequently does, the weight of the fœtus in this pouch by this means will not press so much on the internal viscera. The 5th and last pair, as they may serve to dilate the capacity of the pouch itself, so likewise may serve the better to suspend its weight, when the animal is prono capite, and if it gravitates too much, they may retract it upwards, and this the easier, as passing over these bones like a pulley, their force is more augmented. The antagonist to these muscles is the sphincter marsupii, an oval series of strong, fleshy fibres, which serve to constringe and close the orifice of the pouch; which it does so perfectly, that one would think the skin here not to be slit; nor can the orifice be observed till it is dilated with the fingers.

The pouch, or marsupium itself, was a membranous body, not very thick, though consisting of several coats, and is reducible to the class of the vesicular parts of the body; which seem to be partly muscles, partly glands, and to perform the office of both motion and secretion: for the cavity of this pouch was somewhat hairy, and at several places I could observe them matted together by a yellowish substance, which ouzed out of the cutaneous glands. This liquor discharged into the pouch from the glandulous coat, was strong scented, and had more of the peculiar fœtor of this animal, than any part besides. But after the skin, with the pouch, had been kept for some days, and was grown dry, there was so great an alteration in the smell, that what before was so disagreeable, was now become a perfect perfume, and smelled altogether like musk; though the general consent of all authors had branded it with the note of a fœtid stinking animal. But the same is to be observed in the richest perfumes we have, as musk, civet, and ambergris.

This marsupium had likewise a muscular coat, besides the several other muscles bestowed on it, to give it motion. It had also a vascular coat, being plentifully irrigated by blood vessels, especially by 2 large branches, that came from the upper part of the thorax, and might be reckoned the mammaria, as they are styled in other animals. This pouch was fastened by several membranes to the muscles of the abdomen and the skin; but so as to be easily separated for the most part with my fingers.

In this marsupium, or pouch, many writers on the natural history of this animal place the mammæ or teats; and they tell very odd stories about it: I will only relate what they say of it; and what I at present observed, or rather, did not observe.

I did not find any teats here, nor even on the outward skin, as is usual in other multiparous animals. Possibly this subject never had a litter; and for want of drawing, the teats might be less, so as to escape notice. The male also, if we may believe Piso, has such another purse under his belly, and takes his turn to carry the young, in order to ease the female.

This contrivance of nature for securing the young from any danger, till they are able to shift for themselves, is perhaps not to be paralleled in any other species of animals, at least of the quadruped kind.* Not that she is wanting in abundantly providing for their preservation; but she pleases herself in using infinite variety in attaining the same end. Nor are there wanting instances to evince it: what comes nearest to our subject is recorded in Oppianus, (Halieu-

* The kanguroo of New Holland, whch by some naturalists is referred to the opossum-tribe, by others is made a distinct genus, is provided with a similar pouch.

tic. lib. 1. ver. 132) in his excellent poem of fishes: for in his Halieutics, describing the philostorgia of fishes, he comes to the dog-fish, and says, that on any storm or danger, if pursued, the young ones run into the mother's belly; and when the fright or danger is over, they come out again. His verses were so admired by Antoninus, at that time Emperor of Rome, to whom he made the dedication, that he not only revoked the banishment of his father, but presented him likewise with a golden statera for each verse; whence they are called golden verses: which, according to Suidas's computation, came to 20,000.

I would not expect in a poet, that exactness of natural history, as in a philosopher, who is truly to relate matter of fact. But this particular of the dog-fish bears the more resemblance of truth, as formerly dissecting a fish of this kind, which was a female, I was surprised to observe the gradual formation of several fœtus, some just beginning to be formed, others an inch or 2 long; others 4 or 5; some 9 or 10, and fit for birth; but what nearest concerns us was, that near the exit of the pudendum on each side, I observed a foramen or hole, capable of distension, and readily enough would admit my finger, which led into the cavity of the abdomen or belly itself; and not in any bag, or the uterus, or any other part. Besides, in the abdomen I found a quantity of water, which I could not but think was let in this way. So that if upon observation at any time, there should be found loose in the cavity of the belly of this fish a young one, there would be no reason to mistrust the relation, since here are 2 doors to let them in and out.

Ælian (Hist. Animal. l. 1, c. 18) relates the same story of the dog-fish; his words, as they are translated by P. Gillius, are these; si quis eorum (speaking of the young ones) timeat, ingreditur rursus per genitalia in ventrem matris; ubi timor abierit, is prodit tanquam rursus editus. And in the preceding chapter he tells the same (as our poet does) of the Glaucus. Nay, Aristotle (Hist. Animal. l. 6, c. 8) himself acknowledges the same thing of the galeus, which is of the dog kind. And the like he (l. 6, c. 10) affirms of the dolphin and porpus. But if what is thus related of these fishes should prove but a vulgar error, it is a very ancient one, and it is high time it was removed: and if there should be any truth in these stories, it is requisite that it be supported by some more evident proof, and confirmed by later observation.

Concerning the parts in the thorax, I only observed, that the lungs had 3 lobes on one side; and but 1 on the other: but this 1 was as large as the other 3. They were soft and spongy, and easily dilated, and large in proportion to the animal. The heart was included in a pericardium, as usual, but larger in respect to the bulk of the body, than is common; nor was its cone so sharp, but rather more obtuse; it had 2 auricles, and 2 ventricles. About the throat there were large glandulæ maxillares. The tongue was a little above 3 inches long, about $\frac{3}{4}$ inch broad; it was rough, having several protuberances, whose points looked inwards. The voice or noise it made, was a little growling.

The abdomen or belly was divided from the thorax, by a large, strong, fleshy diaphragm; for the thorax near the throat was small, then gradually as it descends it enlarges its capacity; so that here, where the diaphragm was fastened, its compass was very large; which might be rendered the more so, because the animal often hangs by its tail, by which the viscera in the abdomen must press upon it. But that they might not too much, we shall see what provision nature has made for it, by her great contrivance in suspending the intestines. The ventricle or stomach somewhat resembled the usual make, inclining to that of a half moon; but the two orifices of the gula, and the pylorus, were both placed so near each other, that they seemed to touch or meet; and when the stomach was opened, there was only a very slender isthmus, or wall, that parted them. These orifices were not at the extremities of the stomach, as usual, but inserted almost in the middle of the upper part, but more inclining towards that which respects the duodenum. The stomach appeared but small, being much contracted, for it had not eaten any thing for some days; it measured about $3\frac{1}{2}$ inches in length, and about 2 inches in depth: the gula, which conveys the food into the stomach, consisted of strong muscular fibres, and was about 9 inches in length: the pylorus, that carries out, seemed to have its passage free and open, without that annular constriction of valve, as in most other animals; though here was observed a larger body of muscular fibres than in the other intestines.

I observed at one side a perforation or hole through, and round, about the size of a pea. That it was occasioned by an ulcer there, I plainly perceived by the lips or edges, which were not fresh, but had an ulcerated matter about them; and this was doubtless the occasion of the animal's death; for it had fallen from its food, and had pined away for some time before, and by its uneasy motion, made its keeper suspect it had swallowed something that stuck in its throat, or injured its stomach. A like accident as this (a perforation of the stomach) I have three times met with in dissecting human bodies. What appears to me most likely to be the cause of this perforation, is, that some of the glands in the stomach, such as Peyerus (De Glandulis Intestin.) and Dr. Grew (Comparative Anatomy of Stomachs and Guts) describe in the intestines, being become scrophulous or steatomatous, might imposthumate, and so corrode the coats of the stomach, and cause a perforation. And I am the rather of this opinion, because in those instances I mentioned of human bodies, I found in other places of the stomach these glands very large and steatomatous; though naturally they are but small, and often not observed. Where there is a perforation of the stomach upon an inflammation, and upon that an imposthumation; there the foramen is larger and not regular: as I once remarkably met with it in a child, where a large part of one side of the stomach was sphacelated. So likewise upon a corrosive poison taken, its effects are not confined to so narrow a compass; as I observed once in one who had taken ratsbane.

There was nothing contained in the stomach but a body of clotted hair, formed into the shape and figure of the stomach, somewhat like a half-moon; covered with a slimy viscid substance, which served the better to glue these hairs together. These hairy tophi are frequently to be met with in the stomach of brutes, as oxen; and the butchers say that they chiefly meet with them in the winter season, after the hair begins to shed, and the cattle feed upon hay and dry meat: but after the spring, and in summer, they more seldom find them; as if the new grass, which purges them, contributed to dissolve these tophi likewise. Georg. Hieron. Velscius has written 2 medico-philosophical dissertations (viz. De Ægagropilis) about these tophi, found in goats; and others have made distinct treatises on them; and Gul. Piso (Hist. Nat. et Med.) gives a figure and description of one. But our animal is carnivorous, and most rapacious of the vermine kind; and where it cannot find its prey on the land, it will hunt for it in the trees; climbing up very nimbly; and, if the tender bough cannot bear the weight of its body on its feet, by twisting its tail about the twig, it can hang by it, and stretch itself the farther, to obtain its desired food, or rob a nest. Nay, by this means it is said to fly, or pass from one tree to another, without descending down; for thus hanging by its tail, and waving and swinging its body like a pendulum, it can fling itself into the boughs of a neighbouring tree; where his tail is sure to take fast hold of the first bough it lights on, if otherwise it misses his footing; and his hinder feet being made like hands, with a thumb, it can more readily raise its body up by them. When driven by hunger, they can take up with other food besides animal, not refusing fruit, bread, &c.

The mesentery is that membranous part which connects the intestines together, fixes their situation, and gives them the order of their figure. The intestines are not just fastened to the periphery or outward circumference of the mesentery; but its external membrane, on both sides, is entirely projected, and continued over the whole canal or duct of the guts, and forms their external or common membrane: so that often, by separating this outward membrane from the muscular that lies under it, the whole length of the guts may be extracted, leaving only the common membrane, as it is continued from that of the mesentery, which could be inflated, as if the whole of the guts remained.

Now here is observed that remarkable difference from many other animals, that we cannot but make two mesenteries; one peculiar to the small guts, the other to the great ones; and for distinction sake, I shall call the former mesenterium minorum, and the latter mesenterium majorum, sc. intestinorum. For as the duodenum descended from the stomach, it ran under the colon, just where it is joined to the cæcum, towards the middle of the spine. Hence I found a projection of the first mesentery into a spiral line, like a cochlea, or winding pair of stairs; so that on inflation, these intestines made several convolutions, though not exactly spiral. The second mesentery, or mesenterium majorum, was projected more in a plane, and made almost a circular figure at its periphery; so that the cæcum and colon almost entirely encircled the small guts.

The small guts, when inflated, measured about 6½ feet in length. The cæcum was about 6 inches long; and the colon and rectum 2 feet long. The compass of the duodenum was 3 inches; the ileum 2½ inches; that of the cæcum, in the largest place, was 6 inches; of the colon 4 inches; and the rectum was 3 inches about. From the spine to the utmost projection of the small guts, under the same circumstance of inflation, measured about 6 inches; the greatest diameter that the colon in this circular figure made, was somewhat above 7 inches. In the whole duct or canal of the intestines, I could not observe any valves, not even in the cæcum itself. It is true, that the foramen into the cæcum was a great deal less than the capacity of the gut itself; however, the passage into it was so open and wide, as readily to receive or emit its contents. But the length, and frequent gyrations and windings, supply this want of valves; they prevent the danger of a too hasty descent of the fæces, and give more opportunity for the separation of chyle into the vasa chylifera. And the cochlea, or spiral figure of the first mesentery, easily prevents a regurgitation of the contents of the intestines again into the stomach, on a declining posture of the body of this animal, as it is frequently in, when it hangs by the tail. For though the passage from the stomach by the pylorus, into the duodenum, is large and open, yet in that posture of the body, there must be a reduplication, or folding over of the duodenum; since the great bulk of the intestines must incline towards the diaphragm; by which reduplication, the passage at the pylorus must, in a great measure, be obstructed; and the ascent of the contents now be as difficult and great, as when the animal stands upon its four feet. The reverse of this structure of the intestines I found and have described in my anatomy of the tajacu, or the Mexico musk hog: for here the colon made a spiral figure, and the small guts made a plane. In our possum the small guts make a spiral, and the colon and great guts a plane. But a spiral convolution of the intestines is to be met with in several animals, though their structure be different; as in the goat and deer kind, and very remarkably in a woodcock.

The pancreas was large, with one part running towards the spleen, and the other down by the duodenum. The spleen was $2\frac{1}{2}$ inches long, and one inch in the broadest part, and was of a dark red colour. The liver was very large, of a bright red colour, consisting of 3 lobes; 2 of them much larger than the third, which was not to be seen, but upon inverting the liver: and here were found not only at the edges of one of the larger lobes, deep incisures, which rendered it jagged; but also in the middle of the concave part of the same lobe, several deep fissures: possibly for this reason, that so it might yield and give way the better when inverted, as it always is, when this animal hangs by its tail. The gall bladder was very large.

The kidneys on each side were a little above $1\frac{1}{2}$ inch long, about $\frac{3}{4}$ inch broad, and of the figure almost of a kidney-bean. The emulgent veins and arteries were very plainly seen: but on the inside of the kidneys, towards the upper part, were placed the glandulæ renales, which were very large, and of the same colour with the kidneys themselves, which was a deep red; whereas these glandulæ renales in men and other animals are usually of a white yellowish colour. The ureters were about $5\frac{1}{2}$ inches long, and were inserted into the neck of the bladder of urine, first running under, then ascending by the two extremities of each uterus, as they lie duplicated. The bladder of urine, being inflated, was about the size of a hen's egg, and of that figure. The neck of the bladder, or urethra, which was about an inch long, lay over the vagina uteri; and here the urethra and the vagina uteri emptied themselves into one common canal, which measured about $1\frac{1}{2}$ inch in length.

In most animals, about the kidneys there is usually observed a large body of fat covering them, being contained in the membrana adiposa: but here we found four large protuberances of fat, two on each side; two of them lying in the pelvis of the abdomen, near the bladder of urine, and the uterine parts; and the two others, between them and the kidneys. They consisted of large regular laminæ, which were easily separable from each other, in broad flakes, in an uncommon manner.

We shall proceed now to the examination of the uterine parts: for it is so far from true, as some assert, that it has no uterus within, that here we find not only one, but two uteri; and these too most wonderfully contrived, and far different from the common structure and make of this part in other animals. There were also two ovaria, two tubæ fallopianæ, two cornua uteri, and two vaginæ uteri. The ovaria were placed one on each side, near the extremities of the cornua uteri, being fastened to the alæ uteri, and were about the size of a vetch. The vasa præparantia were very plain; though the greater part of these vessels was bestowed on the cornua uteri. Near the ovaria were observed the fimbriæ foliaceæ, and from thence a passage into the tubæ fallopianæ, which were two fine slender canals or ducts, supported by the alæ uteri, and running waving, and leading into the extremities of the cornua uteri. The cornua uteri, being inflated, were about the size of a goose quill, about 1½ inch long, and were fastened to the alæ uteri, towards both ends a little bent; but where they pass into the uteri, they were reflected inwards; at the other extremity reflected outwards. Their substance seemed rather thicker than the uteri themselves, and not so transparent, by reason of the numerous blood-vessels which irrigated them almost all over; for in the inside, both above and under, there ran, the whole length of the cornua, large trunks of blood-vessels, sending from the side all along numerous branches; which is very requisite in animals that are multiparous, as is our subject, as the litter lie, and are formed in the cornua uteri. And I here observed some little risings of the internal membrane of the cornua, by which they were somewhat divided into cells, but very imperfectly. These 2 cornua empty themselves into the 2 uteri, just in the middle, where they are conjoined together; and so outwardly seem to form, as it were, but one continued body; from this conjunction, near the neck of the bladder, extending themselves on each side, and afterwards being reflected to the neck of the bladder again, where they pass into the vaginæ uteri. But having extended this part by inflation, and so letting it dry, and then dissecting it; I observed a membrane like a diaphragm, to run perfectly across, and entirely to divide them, near the insertion of the cornua, into two distinct bodies; so that what is contained in the uterus on the right side, cannot pass into the uterus on the left side, on account of this partition; though outwardly they both seemed but as one continued body. The fabric of this part seemed very surprising; and such as I have not met with the like, in any animal besides; at least of the quadruped kind.* It is true, in lobsters and crabs, in the female there are two uteri, as in the male there are two penes, but more distinct and separated from each other. So two penes, and each forked too, I have observed in the rattle-snake (Phil. Trans. N° 144, Abridg. vol. ii. p. 570); but how the male possum is provided, I cannot tell: but this I think is the only instance of a land quadruped that has two uteri; and each of these too seemingly double, by that reflection they make, and by an imperfect diaphragm, which divides the

* It was scarcely possible for Dr. Tyson, though a most expert anatomist, to determine with exactness the structure and uses of all the parts of that complicated viscus, the uterus, in the opossum-tribe from a single specimen, and that too in the unimpregnated state. It is therefore recommended to the reader, to compare this description of the uterus of the opossum with the description and figures of the uterus of the kanguroo (so nearly allied to it) by Mr. Home, in the Phil. Trans. for 1795. Such a comparison will throw much light on the present subject.

cavity of each uterus a considerable way. These uteri are not fastened to the alæ, as the ovaria, tubæ, and cornua are; but where they are conjoined near the insertion of the cornua, they adhere very firmly to the neck of the bladder, not easily to be separated from it; and by membranes to the rectum, where they are more separable. So that the neck of the bladder lies over that diaphragm or membrane which parts them into two distinct uteri. Here the body of the uteri seemed to be about the size of the end of my finger; or in compass, thus inflated, it measured about $1\frac{1}{2}$ inch: hence they were projected towards each side, and not according to the length of the spine, gradually enlarging the internal cavity, as it is extended. For here, about the angle of reflection, it measured in compass $2\frac{1}{2}$ inches. The uteri being thus extended towards each side, about the space of $1\frac{3}{4}$ inch, are then reflected back again, towards the neck of the bladder; and so pass into the two vaginæ which lie under the urethra. From this angle of reflection, the cavity of each uterus gradually lessens, and is much smaller than the other part of the uterus. The capacity of each uterus being the largest at the external elbow, where it begins to be reflected; for here it made, as it were, one common cavity for almost the length of an inch: but on the inside, I observed a membrane projected from the internal side of the uteri, just from the corner where the sides of the uteri are doubled, by which this cavity is in part divided; and for this reason I shall call this membrane, the second, or an imperfect diaphragm of the uteri.

In these uteri, I observed 4 large trunks of blood-vessels, which ran their whole length, sending from their sides numerous branches, and ramifications all along. These trunks were propagated from the hypogastric and spermatic vessels. I also observed here in these uteri, thus by inflation extended and dried, several fasciculi of muscular fibres, placed at a regular distance from each other, and which also ran the whole length of the uteri, by whose contraction the fœtus may be more easily protruded.

The 2 uteri empty themselves into the 2 vaginæ; for at this extremity, the uteri, making a turn at the neck of the bladder, are continued thence into the 2 vaginæ, which lie just under the urethra, and are much of the same length with it, which was about an inch. Their capacity was about the size of a wheat-straw. Both these vaginæ and urethra emptied themselves into a common passage, which was as large as all the other 3; and about $1\frac{1}{2}$ inch long; it showed reddish, by means of its numerous blood-vessels, and at last had its exit so near the fundament, that when alive, there was not observed any other foramen outwardly, but that which led into the rectum. But on dissection, by elevating the skin here, which seemed to cover it like a valve, I observed the foramen that led into this common passage, and putting a blow-pipe into it, at the same time, by inflation I distended the bladder of urine, and the uterine parts too; viz. The vaginæ, the uteri, and the cornua. So that in the skin here, there was only one foramen for the exit of the fæces, the urine, and the fœtus.

I have had no opportunity of dissecting a male possum; and, indeed, of any other than this single subject: for had I, I might have been more exact in some particulars; nor is it scarcely possible, to observe all in one.

The Skeleton.—The head, from the end of the occiput to the extremity of the nares, was $4\frac{3}{4}$ inches long; of which the rostrum or snout measured 3 inches; and just where the snout and the cranium met, the bones were so pinched in at the sides, that here it was very narrow; and indeed, in proportion to the bulk of the animal, this was the least cranium that ever I met with in a quadruped. On the forehead, the snout was an inch broad, having on each side, a protuberance jetting out. There was a large suture just in the middle, which divided the upper bones of the nares lengthwise, and though they ran slender towards the extremity of the nares; yet these bones, towards the forehead, spread into a triangular figure, and as they are joined together, form a rhomboid, or a lozenge. There was a remarkable ridge, like a crest, that ran the length of the cranium, from the forehead to the occiput, just in the middle; where the sutura sagittalis is in other skulls. This ridge, for distinction sake, I shall call protuberantia ossea longitudinalis; and it jetted out from the cranium above $\frac{1}{4}$ of an inch: just at its upper edge was a seam like a suture; so that, though these bones are so well united together, as to appear but one entire body, yet in the fœtus they are doubtless separable, and are two. And this I rather think, because in the upper part of the cranium I could not find any sutures at all. So likewise, those other ridges in the extremity of the occiput, which I shall call protuberantiæ osseæ laterales, which rising on each side from the processus styloides, ascend obliquely up the hinder part of the occiput, and just in the middle at the top are joined with the longitudinal ridge, I have described. These ridges, though as deep as the first, yet were not standing so upright but projected rather like a pent-house over this hinder part of the cranium; by both which ridges, the cranium is so well guarded and defended, that it is almost impossible the skull should be any ways cracked or broken. Something like these ridges, but not nearly so large, I have observed in the skull of a weazel.

And not only the brain, but the eyes likewise are very well guarded and defended, by the os zygomaticum; which is very broad and strong; being in the broadest place above $\frac{3}{4}$ of an inch, and in the narrowest $\frac{1}{2}$ inch, and very thick on its under edge; but at its upper, growing thin and sharp. But for the greater strengthening this bone, which is formed by a process from the os temporum, and another from the maxilla superior, where they meet, they over-lap each other, and so become the stronger. This os zygomaticum was 2¼ inches long, and projecting from the cranium an inch. In the orbit of the eye, at the internal canthus, there was a large foramen, which led into the cavity of the nose, and by a duct placed here, the tears are conveyed into the nostrils. In the upper jaw-bone, there was also a large foramen, for the passage of some vessels from the internal orbit of the eye.

The cranium, which encompassed the brain, in the largest place, was about an inch over; and about 1½ in length; but its cavity jetted out somewhat farther towards the nares, forming as it were a particular cell here, and pretty capacious, for receiving the processus mammillares, and the fore part of the brain. The os cribriforme was very remarkably perforated with holes, like a sieve; and indeed, in forming this organ of smelling, nature seems very careful and solicitous, the snout making so great a part of the head, that the cranium itself seemed very inconsiderable in respect of it, its internal capacity containing not above the quantity of a walnut. The os spongiosum, in each nostril, seemed very curiously contrived, by the abundance of its laminæ; so that the membrane, that covers them, is by this means rendered more capacious, and capable of receiving more plentifully the effluvia of those animals it would either catch or avoid; and in this sensory it is known, that brutes excel even man himself, and their organ more adapted to it.

The under-jaw consists of two strong bones, joined together only at the mentum or chin; each measured 4 inches in length. The head of this bone, which is half an inch broad, is received into a sinus of the os temporum, and very firmly articulated there. It has two processus: the anterior or superior is large and thin, into which the temporal muscle is inserted. The inferior process is smaller, and runs to a sharp point: here at this process, the edge of the mandible is so dilated, that it measures above ½ an inch. On the inside of the jaw is a large sinus, which leads to a foramen, that goes into the body of the jaw-bone, and affords a passage for the vessels thither. The use of these bones is for mastication; which leads me to consider the teeth. And here we find all the 3 sorts of them; for in the upper-jaw before, are 8 small dentes incisores, 4 on each side; then a void space, almost ¼ of an inch; then 2 large prominent dentes canini, one on each side; which jut out of the jaw about ½ an inch: these are succeeded on each side by 3 dentes incisores; which are much stronger and larger than the fore-teeth, and resemble the dentes molares, in that they were inserted into the jaw-bone with two fangs: but the heads of these incisores are acuminated, whereas the heads of the molares are flat, and almost of a triangular figure. There were 4 dentes molares, on each side: in all, 24 teeth in the upper-jaw. But the double fangs of the molares, and the incisores majores seemed at first sight two distinct teeth; each fang being inserted into a distinct alveolus, or socket in the jaw, and remaining separated some way above the jaw-bone, and only joined at the head. In the under jaw-bone, there were likewise on each side, 4 smaller incisores before; then a little void space; after that the dens caninus: then 3 larger incisores; and lastly, 4 dentes molares, answerable to those in the upper-jaw, but somewhat smaller: in all, 48 teeth, in both jaws.

There were 7 vertebræ of the neck; 13 of the back or thorax; 6 of the loins: 3 of the os sacrum; and 22 of the tail; in all 51, and all extraordinarily contrived. The first vertebra of the neck, to which the head is fastened, and therefore called the atlas, has two broad transverse processes, but no spine. The 2d vertebra of the neck has a very large and thick spine of a triangular figure; and in it a large semi-circular sinus, so deep, as to receive into its bosom a great part of the first vertebra; by which means, the articulation is very much strengthened. This vertebra is called dentata, from the tooth-like protuberance, and which is received into the hollow of the first vertebra, where the medulla spinalis passes. This vertebra has backwards two processus obliqui superiores, and two obliqui inferiores. The 3d vertebra of the neck has the same processes, both before and behind; but the spine here was about $\frac{3}{4}$ of an inch in height; about the 3d part of an inch thick; and just at the top seemed to be a little cleft. The 4th and the 5th vertebræ had the same processes, as the 3d vertebra; and the spine here, likewise very thick, and cleft at the top; but gradually lessening in height, as also thickness. The 6th vertebra, besides the former processes, had likewise an acute transverse one, on each side; and its spine much shorter, and more acuminated than the former. The 7th vertebra of the neck had only two oblique processes before, and none behind; and two acute transverse processes, and a very short and sharp spine: so that, on holding up the head, the spine of the first vertebra of the thorax would touch the top of the 5th vertebra of the neck. These vertebræ are so strongly and closely locked into one another, that though each of them are large in itself, yet thus articulated, they do not make full two inches in length. This thickness and strength of the vertebræ of the neck, and also of several of the vertebræ of the thorax and loins, and the prominent bony ridge in the cranium, do so well secure its neck, back, and head, that should it happen to fall to the ground, there would be no danger of breaking any of them.

The first 7 vertebræ of the thorax have 2 oblique processes forwards, which run under the hinder oblique processes of the preceding vertebra, and have two oblique processes backwards, which ride over those of the succeeding vertebra; as likewise two transverse processes, which at their ends have small acetabulas or sinuses, for receiving the heads of the ribs, which are fastened to them. The spines of these vertebræ, are slender, thin, and sharp; about $\frac{3}{4}$ of an inch long. The 6 following vertebræ of the thorax have short, thick, and flat spines: the oblique processes being continued on each side of the spine, make as it were a gutter; and the transverse processes here are somewhat different from the former. The spines of the vertebræ of the back, or loins, as they approach the os sacrum, lessen gradually in their thickness on the edge: but here were double oblique processes, viz. four at each end of the vertebra, and the undermost spreading themselves out in breadth. The three vertebræ of the os sacrum are firmly fastened to the os ilium; but the last not so entirely as the two former, which at each side had a broad transverse process, and the spines of these were thin. The first two vertebræ of the tail had only one small acute spine; but in all the other vertebræ of the tail, both at the head and tail of each vertebra, there were two spines; but those at the head of the joint, the larger. In the first 6 vertebræ of the tail, there was on each side a broad transverse process, the length of the joint: in the other vertebræ only at the head and tail a jetting out at the sides. The vertebræ about the middle of the tail, were the longest; being there about an inch long; nearer the root of the tail, and at the end not so long.

But there is a wonderful piece of nature's mechanism, in those spines or hooks, placed in a line in the middle of the under side of the vertebræ of the tail. It is true the first three vertebræ had none of these spines, nor were they necessary here, since they lay within the compass of the ossa coxendicis; but in all the other vertebræ, to the end of the tail, they were to be observed; and as they approached the extremity of the tail, they grew less and shorter. These spines, where longest, were about $\frac{1}{4}$ of an inch, or somewhat more: they were placed just at the articulation of each joint, and in the middle from the sides, and seemed to be articulated, both to the preceding and following vertebra; not being an entire solid bone, but rising from the vertebræ with the crura or legs, become afterwards perfectly united at the ends. By this means, these bones are rendered more firm and strong, and this hollow serves for transmitting the blood-vessels through them; and one may here observe a stria, or furrow, all the length of the vertebræ, for receiving them; by which they are the better secured from compression, when the animal hangs by its tail: and for performing this office, nothing could be more advantageously contrived: for when the tail is twisted or wound about a stick, this hook of the spine easily sustains the weight, and there is but little labour of the muscles required, only sufficient for bending the tail; for then, as by a hook, the weight of the whole body is here suspended. And for performing this, it was observed, that in each preceding vertebra, there arose a muscle, which was inserted on each side of the succeeding vertebra; which acting or contracting, must necessarily bend and curve that joint. But for the strengthening the whole, there was observed four muscles to arise from the os sacrum, which ran the whole length of the tail; two on the upper side, and two on the under; sending each a tendon to each internode or vertebra. So that when the skin was stripped off, the external parts of these muscles seemed to have tendinous expansions over them, the whole length of the tail, and to be almost covered by them; which must needs very much contribute to add strength to the tail; besides what may be the effect of their insertion of tendons into each joint, or vertebra, in curling and unbending the tail.

To the vertebræ of the thorax are fastened the ribs, and there are 13 on each side. The 7 foremost are more perfectly articulated with the sternum; the 6 succeeding may be reckoned, in some sense, costæ nothæ: for though they are long, and, as they proceed from the vertebræ, are inclined backwards, towards the hinder legs; yet afterwards they are reflected forwards towards the sternum, or cartilago scutiformis. And though in man, and other animals, that part of the ribs that is fastened to the os pectoris, or sternum, be usually cartilaginous, yet, in this subject, it is all bony throughout. There was however this difference, that the ribs looked redder, by reason of their blood-vessels, and this part was whiter; so that it may well pass for a bony cartilage, as often cartilages become bony. The first rib was only an inch in length, and its bony cartilage $\frac{1}{4}$ of an inch: hence gradually the ribs increase in length; for the 7th rib was 3 inches long; and its cartilage $1\frac{1}{2}$ inch. The last 4 of the costæ nothæ gradually lessen again in length; for the last rib of all was only $1\frac{1}{2}$ inch long; and its cartilage did not run home to the os pectoris, or sternum, though the 1st, 2d, and 3d of the costæ nothæ did. The sternum consisted of 7 bones, according to the number of the fore-ribs, that are fastened to them. At the beginning of the sternum, there jetted out a sharp bony cartilage, which, from its figure, I call cartilago ensiformis; and here was fastened one extremity of the claviculæ; at the end of the sternum, towards the belly, there was a broad, round cartilage, which therefore I call cartilago scutiformis.

There were two claviculæ, or collar-bones, each $1\frac{1}{2}$ inch, having one extremity fastened to the first bone of the sternum, or the cartilago ensiformis; and the other to the spine of the scapula, near its conjunction to the os humeri. By means of this bone, it can more advantageously bring its fore-feet to its mouth, as it must do when it feeds itself, like the monkey-kind, which have claviculæ as men have. The scapula, or shoulder-blade, was about 2 inches long, about $1\frac{1}{2}$ inch broad; its spine, though thin, yet the nearer it approached the shoulder, it grew larger and flatter. Into the sinus of the neck of the scapula, was received the head of the shoulder-bone, or fore-thigh-bone; as to that protuberance called the acromium, was fastened the end of the clavicula.

This thigh-bone of the fore-legs was about $2\frac{3}{4}$ inches long; it was thick and strong, having a large rough spine jetting forward, and running half its length. The lower extremity of this thigh-bone, to which were fastened the tibia and fibula, grew almost an inch in breadth. Above, where this bone began to grow broad, on the outside there was a large protuberance; and on the inside a great oblong foramen, or hollow passage, formed by a small bone, arising from the internal fore-part of the thigh-bone, where it begins to grow larger, and is afterwards united to that part of the basis of this bone where the fibula, or minus focile, is joined. Just in the middle of the basis of this bone, there is a large sinus, which backwards appears deeper, locking into another deep sinus of the tibia; by which means these bones are so firmly articulated together, as not easily, if possibly, to be put out of joint.

The tibia or focile majus, was a strong bone, about 3 inches long; which was extended upwards about $\frac{1}{4}$ of an inch above its articulation with the thigh-bone; and at the other end, was fastened to the outward bone of the tarsus. The fibula, or focile minus, is a smaller bone, placed more inward and forwarder, and not so long as the tibia; being articulated above, but not so firmly, with the thigh-bone, and below, with the inner bone of the tarsus. For there are but two bones of the tarsus, having each a small sinus, for receiving the heads of the two fociles. The bones of the metatarsus were 4, or perhaps 5, to which were joined the 5 fingers or toes of the fore-feet. The innermost toe had but two articulations, or joints, but at the end had a large hooked strong nail: the other 4 fingers had each 3 joints, armed with hooked nails, as the first.

The hinder-legs were fastened to the trunk of the body by the os innominatum; which, in a straight line, was 3 inches long. In the head of the hinder thigh-bone, and deeper in, there was a space for the fastening the ligament, from which space there was a sinus which led outward; so that the brims of the acetabulum were not an entire circle, but broken off here. Here also are the ossa marsupialia, or janitores marsupii. The hinder-thigh-bone was a little above 3 inches long; it was a roundish strong bone. But the tibia, or focile majus of the hinder-leg, was somewhat longer, and a little curved. The fibula, or focile minus, was about the same length, but straighter and slenderer: this towards the foot was articulated to the os calcis, as the tibia to the talus or astragalus; and these two bones I make the tarsus; and joining to them were the bones of the metatarsus, and to these the phalanges of the fingers or toes. In the innermost, or the thumb, there were only two joints; in the other 4 toes, or digiti, in each there were three. The end of the thumb was more flatted than the ends of the other toes, with a flat nail, like a human thumb; in the others the nails were long and curved. At the articulation of each joint of the toes, on the under side, there were two small bones, called ossa sesamoidea, and these both in the fore and hinder feet.

This being an animal so very remarkable, and a distinct species from all others, Dr. Tyson was induced to be thus particular in the description of it. And he adds that he is the more confirmed in what he formerly wished, (Preliminary Discourse to his Natural History of the Phocæna,) that for perfecting the natural history of animals we had a distinct account and anatomy of some one of a species, which with a little variation might serve for all of that family; since he finds so great a master of natural history as Mr. Ray (Synops. Animal. p. 324) is of the same opinion.

Explanation of the Figures.

Fig. 1, pl. 6, represents the outward shape and figure of the possum, drawn from the life. Fig. 2, the slit or aperture in the belly, opening to the marsupium or pouch, where the young ones lodge, till they can shift for themselves.—Fig. 3, a the marsupium turned inside outward, where may be observed the hair or fur that covers it, which may help to keep the young ones warm; bb the two hinder legs cut off; c the foramen of the anus, which is also the common outward vent or exit to the rectum, the bladder of urine, and the uteri also; d the beginning of the tail.—Fig 4, the skeleton or bones of this animal; aa the rostrum or snout; bb the cranium or skull; ccc a bony ridge, or the protuberantia ossea longitudinalis, which ran the length of the cranium, and over a part of the snout; d the lateral ridge, which like a penthouse, jutted over the hinder part of the cranium; ef the os zygomaticum; e its process from the os temporum, and f that from the maxilla superior, or upper jaw; g a foramen or hole in the inner canthus of the orbit of the eye, that leads into the nostrils and by a duct conveys the tears or moisture of the eyes into them; h a foramen or hole in the upper jaw, for a passage to the vessels; i a protuberance of the os frontis; k a suture of the os narium; ll the lower mandible or jaw-bone; m the superior process of the under-jaw; n the inferior process of the under-jaw; o the clavicula of one side; p the cartilago ensiformis of the first bone of the sternum; q the scapula or shoulder-blade bone; r the spine of the scapula; ssss the thigh bones; tttt the tibia, or focile majus of all the legs; uu part of the tibia in the fore-legs, extended beyond the articulation; wwww the fibula or focile minus; xxxx the bones of the tarsus; yyyy the bones of the metatarsus; zzzz the toes; αα the thumbs in the hinder feet; N° 1, the first vertebra of the neck, called the atlas; 2, 3, 4, 5, 6, 7, the second, third, fourth, fifth, sixth, and seventh vertebræ of the neck; 8, the first vertebra of the thorax; 9, the first vertebra of the loins; 10, the first vertebra of the os sacrum; 11, the first vertebra of the os coccygis, or tail; 12, 12, 12, 12, the spines or hooks on the inside of the tail; 13, 14, the os innominatum, where 13 is the os ilium, 14 the os ischii or coxendicis; 15, 15, the ossa marsupialia, seu janitores marsupii; **** the ribs, thirteen in ll; ⊙ the cartilago scutiformis.—Fig. 5, the situation of the ossa marsupialia, &c., aa the ossa pubis; b the coalition or joining of the ossa pubis; cc the two ossa marsupialia, or janitores marsupii; de the basis of the ossa marsupialia, where joined to the ossa pubis, d the inner head of the basis, e the outer; ff the acetabulum, or socket, for receiving the head of the thigh bone; gg the os ilium; hh the vertebræ of the os sacrum; ii the os ischii or coxendicis.—Fig. 6, exhibits the fore side of the thigh bone of the fore leg; a the head of the thigh bone, where it is fastened to the scapula; b a large rough spine, which runs above half the length of this thigh bone; c a protuberance of this bone on the outside; d a large foramen or hollow passage; e a sinus for receiving the head of the tibia; fg the basis, or lower extremity of the thigh bone.—Fig. 7, the stomach and guts. a the gula or gullet; b the stomach; c a perforation of the stomach, caused by an ulcer there; dd the two pouching out of the stomach at the two ends; e the pylorus; f the beginning of the duodenum; ghiklmnopq the small guts and their convolutions, some of which lie hid and out of sight; but the order how they follow one another, is signified by the order of the letters of the alphabet: so that g follows f, and g is succeeded by i, and i by k, and so on to q, where the ilion is discharged and empted into the cæcum, or if that is full, into the colon at the first letter s; rr the cæcum; sss the colon; t the rectum; u the first mesentery, or mesenterium minorum intestinorum; w the second mesentery, or mesenterium majorum intestinorum.—Fig. 8, the urinary and the uterine parts. aa the two kidneys; bb the emulgent veins; cc the emulgent arteries; dd the glandulæ renales; ee the two ureters; f the insertion of the left ureter into the neck of the bladder; g the bladder of urine turned aside; h the urethra; ii the two vaginæ uteri; k the common passage from the urethra and the two vaginæ; l the arteria aorta, or great artery; m the vena cava; nnn the spermatic arteries; oooo the spermatic veins; ppp the hypogastric arteries and veins; rrr the alæ uteri, or cornuum; ss the ovaria; tt the tubæ fallopianæ; uu the cornu uteri of the left side opened; w the cornu uteri of the right side, not opened; xx the two uteri opened; y the diaphragm, that divides the two uteri; zz the imperfect diaphragm, which partly divides each uterus, and lies over the passage of that part of the uterus which is doubled, and tends to the vaginæ.—Fig. 9, the uterine parts more particularly. aa the two ovaria; bb the fimbria foliacea; cc the tubæ fallopianæ; dd the two cornua uteri; ee the two uteri reduplicated; f a slit in the neck of the left uterus, to show its passage into the vagina on that side; g the left vagina opened; h the ostium or mouth of the right vagina; i the common passage from the urethra and vagina; k the urethra; ll the bladder of urine cut off.—Fig. 10, the hairy tophus, or ball of hair that was taken out of the stomach.—Fig. 11, the liver. a the vena cava; bbb the three lobes of the liver; c the bladder of gall; ddd the fissures in the body of the liver; eee the incisures at the edges of the liver.—Fig. 12: a the spine of the second vertebra of the neck; b its thickness; c a large sinus for receiving the first vertebra; d the dens or tooth of this vertebra; e the processus obliquus superior of one side; f the processus obliquus inferior of the same side. Fig. 13, a represents the spine of the third vertebra of the neck, where is shown its natural thickness; b the hole through which the medulla spinalis passes; cc two small foramina for the passage of vessels; d the cleft at the top of the spine; ee the two processus obliqui superiores before; ff the two processus obliqui inferiores before.—Fig. 14, the first vertebra of the thorax. a the spine, which is long and acute; bb the oblique processes before; cc the oblique processes behind; dd the transverse processes; ee where the ribs are fastened; f the hollow where the medulla spinalis passes.—Fig. 15, the fourth vertebra of the loins. aa the two upper oblique processes behind; b the spine; cc the two under oblique processes behind.—Fig. 16, the second and third vertebra of the tail. aa two vertebræ of the tail; bbb the spines or hooks on the inside, by means of which it can better hang by its tail; cc a hollow or foramen in the middle of these spines, through which blood-vessels pass.

Observations on Natural History made in New England. By Mr. Benj. Bullivant, in a Letter to Mr. Petiver, F.R.S. N° 240, p. 167.

I made the same remark you do about the plague of the back, that it is greatly distant from an empyema. I have experienced it more than once, it seems more of a cholick, yet is undoubtedly a nervous dolour. The country people have learned of the Indians to steep castoreum in rum, and so cure it.—The fire-flies seem to be a flying glow-worm, the lustre is placed as in a glow-worm. Kill the fly, and you find the scintilla a small jelly-like substance, which, separated into atoms, gives still in the dark a lustre proportionable to the magnitude of each atom. I saw butterflies' eggs that were testaceous, and near as large as a wren's, most gloriously bestudded with gold and silver; at Rhode Island the mowers find them in the grass, and they hatch in the windows, and are a sport for children.—Tortoises are amphibious, I have found their eggs by the sides of ponds in great quantities; they are without shells, like those in a hen's belly; our dames scruple not to use them as hens' eggs in puddings.—Grashoppers, in dry years, are a plague to the husbandman; so that on some islands they have put multitudes of turkeys to destroy them; they are prodigious in quantity, of a grey colour, and about 3 inches long; in July become flying animals, and have a kind of regimental discipline, and as it were, some commanders, which show greater and more splendid wings than the commoners, and rise first when they are pursued by the fowls, or by the foot of the traveller, which I have often seriously remarked.—The hum-bird I have shot with sand, and had one some weeks in my keeping. I put a straw for a perch into a Venice glass tumbler, tied over the mouth with a paper, in which I cut holes for the bird's bill, which is about as long and as small as a taylor's needle, and laying the glass on one side, set a dram of honey by it, which it soon scented, and with its long tongue put forth beyond its bill, fed daily; it muted the honey pure; it flew away at last.—We have a frog as large as a penny loaf; its cry is exactly like a bull.—I have examined the clam; he has a plain pipe or proboscis, from whence he ejects water if compressed.

Concerning the Eyes of Beetles, &c. By Mr. Anthony Van Leuwenhoeck. N° 240, p. 169.

I have formerly spoke of the multiplicity of eyes, wherewith the smaller sort of insects are endued, as flies are: which eyes I have several times shown to different persons, to their great satisfaction; and that in such a manner, that they could clearly discern the apperarance of some hundreds of eyes at once. Among the rest, I have last summer shown to several English gentlemen the multiplicity of eyes that are to be seen in the tunica cornea of a beetle, called the eye.* This sight was very strange to the English gentlemen, because if one reproaches a man there with blindness, or dimness of sight, they use to say in English, you are as blind as a beetle. I have cut that part of a beetle which is reckoned to be his eye, from the head, and after I had made it clean, fixed it before the magnifying glass, and observed, that it could not make up half the bulk of a globe, it being broader than it was long. I have however counted, to the best of my power the eyes that were in one row, in the greatest semicircle, and found that there were at least 60. Now let us suppose, that in the small semicircle of the tunica cornea there are but 40 eyes in one row, and then add these 60 to the 40, and it makes 100, the half whereof is 50, which I imagine, if we take the tunica cornea for half a globe, they stand

* A similar structure takes place in the cornea of by far the major part of insects.

in the greater half circuit of the same. Whence Mr. L. computes that 3181 is the number of these eyes that are in both the tunica cornea of a beetle; if they both make up a whole globe.

On enlarging the Divisions of the Barometer, in order to measure the Height of the Mercury more exactly. By Mr. Stephen Gray. N° 240, p. 176.

A, fig. 5, pl. 5, is a long square table, towards one end is erected a square column BB, on which there slides a square socket C, from one side of which proceeds a crooked arm DE. At D is a screw hole to receive the screw, and at E a ring to support the tube of the microscope F. From the other side of the socket comes a short arm G, having a screw-hole to receive the long screw II, whose length may be about 6 or 7 inches; its lower end, by a small hole in its centre, rests on the end of a small screw, that comes through the screw-hole, in the arm H, which is fixed on the back side of the column; the upper end of the screw is filed less than the body of the screw, and goes through the centre of the round plate without shaking, and to prevent its doing so, either upwards or downwards, there is added a springing plate N, which keeps the shoulder of the screw close to the under side of the plate K; over this plate goes an index O, and over that a handle L, on the end of the screw which comes through the centre of the plate, which is riveted to the top of the column BB. The teeth of the screw must be of that size as to have just 10 in an inch. The fore side of the column must be divided into inches and tenths, beginning about the height of the socket H, where the lower end of the screw rests, and so continuing to the top of the column. The limb of the round plate must be divided into 100 parts. In the focus of the eye-glass of the microscope is fixed a hair, or very fine silver wire, in a horizontal position.

To use this instrument, take hold of the handle, and, looking through the microscope, turn the screw till you have brought the hair to touch, as it were, the surface of the mercury M: then observe what divisions are cut on the column by the upper or under edge of the socket, which are tenths of an inch. Observe likewise to what parts the index points on the limb of the round plate, which are hundreds of a tenth, or thousand parts of an inch; when you perceive the mercury varied, raise or depress the microscope, till the hair be brought to its surface, as before; then by subtracting the less from the greater of the two observed numbers, you will have the variation in inches and thousandth parts.

This instrument becomes a micrometer on the same principles; the thermometer is also capable of the like improvement.

On the Cause and Use of Respiration. By Dr. Musgrave, F.R.S. dated Exeter, May 9, 1698. N° 240, p. 178.

Nothing is more evident than that breathing is, from the very moment of our birth, perpetually necessary to life; yet nothing is more in the dark than the true cause and reason of that necessity. Dr. Thruston asserts that the chief use of respiration consists in maintaining a due motion of the blood. And to make out his assertion he urges, that this opinion easily explains the manner of sudden death, by strangling, by drowning, and by violent catarrhs, supposing death, and the stagnation of the blood in the lungs, right ventricle of the heart, &c. to arise, in all these cases, from the stoppage of the breath. Etmuller embraces the same opinion.

Though I think the opinion is very rational, I cannot say it appears such from the argument now produced, which, on examination, will be found too liable and obnoxious to bear so great a proportion of the proof. By Dr. Thruston's own concession, men that are hanged may, with good reason, be supposed to die partly from the mutual commerce between the head and heart being intercepted. The remarkable lividness of their faces, with the extraordinary distension of the jugulars, in their several branches above the ligature, argue that they die in a great measure apoplectical. Now, whatever share the interruption of this mutual commerce has in killing the man; so much the less reason have we to impute his death, and the stagnation of blood in his lungs, &c. to the stoppage of his breath. Nor is the second case, that of sudden death by drowning, without exception: for here the water rushing, after an unusual manner, into the lungs,* may be suspected so to affect them as to occasion death, though not by stopping the circulation. And as to suffocation from a catarrh, instances of this kind, with anatomical observations on them, have not occurred sufficient to prove what was intended by this argument. Wherefore that a noble proposition may not want evidence, I pitched on the following experiment, as clear and decisive of the matter.

I took a large middle aged healthy dog, and having freed the trachea from the adjacent parts, cut it off just beneath the pomum adami, and turned the loose end outward. After some time allowed him to recover the present concern, with a cork got ready on purpose, I stopped up the trachea, binding it

* Very little water is found in the lungs of drowned animals. Their death is not occasioned (as Dr. Musgrave supposed) by the rushing of the fluid in which they are submerged into the trachea and bronchia, (see Goodwyn on the Connexion of Life with Respiration,) but to the discontinuance of the oxygenizement and other chemical changes of the blood, in consequence of the necessary supply of atmospherical air being cut off.

close to the stopple. A few violent struggles succeeded, in which the sternum was raised, as in the deepest inspiration; and thus he died. From the stoppage of his breath to the last motion in any part of his body, was the space of 2 minutes. I then immediately threw open the thorax; where I saw the blood stagnating in the lungs, the arteria pulmonaris, the right ventricle of the heart, with its appending auricle, and the 2 great trunks of the cava, distended with blood, to an excessive degree; the vena pulmonaris, left auricle and ventricle of the heart, in a manner empty, not containing more than one spoonful of blood.

This experiment proves, that the respiration promotes the passage of the blood through the lungs, and that in bodies full of vigorous blood, it is on this account of perpetual necessity. This acceleration of the blood in that passage seems to be the principal use of respiration; no other is of such consequence to life, or stands in competition with it.*

Experiment of syringing warm Water into the Thorax of a Bitch: By Dr. William Musgrave, Fell. of the Coll. of Phys. and R. S. N° 240, p. 181.

On June 21, 1683, I syringed ℥iv of warm water into the right side of a greyhound bitch, which caused a great rigor, especially in the hinder parts, a shortness of breath, a heat or burning in the flesh; she looked heavy, was unwilling to rise or stand long on her feet; those symptoms wore off by degrees, so that in a week's time she appeared as well as ever.

July 2, following, that is 11 days after the former experiment, I injected ℥xvj of warm water into the left side of the thorax of the same greyhound; after which she was extremely hot and short breathed: I felt a violent throbbing in her heart, but the rigor was not so great as in the first experiment; she recovered this also in the space of a week.

About the 15th ditto, I injected ℔jss of warm water into one side of the thorax, and ℔ss into the other side of the same bitch; the symptoms attend-

* It is certain that the free transmission of the blood through the lungs depends upon their due dilatation by the inspired air, and subsequent contraction, constituting the *mechanical part* of the function of respiration. But the mere progression of the blood by the alternate expansion and contraction of the pulmonary organs is not "the principal use of respiration," is not "of such consequence to life," that no other "stands in competition with it," for if so, animals would live in atmospheres of azotic gas, carbonic acid gas, (fixed air,) and hydrogen gas, by the inhalation of which the lungs may be distended as effectually as by common air, and consequently the movement or transmission of the blood continued. But man and other animals die when confined in such gases; a proof that there is some other purpose answered besides this mechanical one, by respiration. Now this other purpose is a *chemical one*, viz. a portion of the common atmospheric air is absorbed and combined with the blood, imparting to it its florid colour, besides other chemical changes, and furnishing at the same time a supply of animal heat.

ing it were, as in the former experiments, a burning in the flesh, and shortness of breath; they all went off, and in 5 days time she seemed perfectly recovered.

Thus we see a quantity of ℔iij¼ of warm water has been injected into the middle venter of the same greyhound within the space of one month; and if we may be allowed to judge of the recovery, by a perfect cessation of all symptoms as to outward appearance, we must then grant, that this water was carried off thence in the time. But to give an account which way it was discharged, whether by expiration, perspiration, stool, or urine, seems very difficult, and is beyond my anatomy to explain; only thus much I must say, as to the latter, that having ordered the greyhound to be tied up, after one of the last two experiments, within two or three days, I observed the boards of the floor where she lay to be very wet, which I then imagined to be the effects of the injection come off by urine. If I may conjecture in so uncertain a matter it is, that as nature has furnished us with vessels to bring off that humour which is thrown into the ventricles of the brain, which by tarrying there would prove fatal to us, so likewise possibly there may be some ductus yet unknown, which, belonging to the thorax, may convey off thence what liquor arises, either from the condensation of vapours, or from the rupture of lymphatics, or any other way, in the cavity, mediately or immediately into the blood; certainly these experiments, as also the many histories of empyemas and dropsies of the breast, mentioned by physicians, as cured by large evacuations by urine, do, in some measure, argue the possibility of this thing; but whether there really be any such passage may shortly be determined by further anatomical experiments.*

Observations on the Substance commonly called Black Lead. By the late Dr. Robert Plot, F.R.S. N° 240, p. 183.

The mineral substance, called black lead, found only at Keswick in Cumberland, and there called wadt, or kellow, by Dr. Merret, nigrica fabrilis, is certainly so far from having any thing of metal in it,† that it has nothing of fusion, much less ductility; nor can it be reckoned among the stones, for want of hardness; it remains therefore that it be classed among the earths, though it dissolve not in water, as most earths will, except stiff clays and ochres, among the

* The water in these experiments would be taken up by the absorbents with which the pleura, investing the cavity of the thorax, is furnished; and after entering the circulation would be carried to the kidneys; where it would be separated from the sanguineous mass, and descending to the bladder would by its outlet the urethra, be discharged from the body.

† This is erroneous. It has been shown by the analyses of modern chemists that this mineral substance contains a portion of iron, though its chief constituent part is carbon. It is the plumbago of Kirwan, the Graphit of Werner, and the carburetted iron of the new chemical nomenclature.

latter of which I think it may be reckoned, it seeming to be a species of close earth, of very fine and loose parts, so burnt that it is become black and shining, discolouring the hands, as all the ochres do; whence the most proper name that can be given it perhaps, is ochra nigra, or black ochre, being a stony sort, as there are stony sorts of the red and yellow ochres as well as clay.

Account of one Edmund Melloon, (or Malone,) born at Port Leicester in Ireland, who was of an extraordinary Size. Communicated by Dr. William Musgrave, Fel. of the Coll. of Physicians, and R. S. N° 240, p. 184.

The measures of some of the parts of this Irishman, 19 years of age, shown at Oxford, were communicated to me by Dr. Plot. He was 7 feet 6 inches high; his finger $6\frac{3}{4}$ inches long, the length of his span 14 inches, of his cubit 2 feet 2 inches, of his arm 3 feet $2\frac{1}{2}$ inches, from the shoulder to the crown of his head $11\frac{3}{4}$ inches.

On the Dissection of a Dog that had Mercury injected into one of the Jugulars. By Dr. Christopher Pitt. N° 240, p. 184.

The mercury was thrown out of the blood into the cavity of the abdomen, also some appearance of it in the other cavities of the body. All the glandules were very turgid, and full of liquor, especially in the ventricles of the brain, and all round there was a great quantity of serum. This may be called a true hydrocephalus. It being a chance dog, and having no notice of what had been done on him, I could not so well observe whether it would work on him by salivation, whether it made him duller than ordinary, or how long the quicksilver had been in his body.

Explanation of the Rubricks for the Seat of Easter, according to the Julian Account. By Dr. Wallis. N° 240, p. 185.

The fundamental rule of the Nicene council, which we pretend to follow, for the keeping of Easter, is to this purpose. "Easter-day is to be that Sunday which falls upon or next after, the first full moon which happens next after the vernal equinox." This vernal equinox was then observed to fall on the 21st of March; though it now falls on the 11th of March, or sometimes the 10th of March. And therefore instead of "next after the vernal equinox," we say, "next after the 21st of March." But then it is said, by a mistake I suppose, "after the first full moon," instead of "upon, or next after the first full moon," (for so it is to be understood,) and added, "and if the full moon happens upon a Sunday, Easter-day is the Sunday after;" which must needs be a mistake.

For in such case it is to be that Sunday, not the Sunday after. And so the tables agree, contrary to this note, both that "for forty years," and that "to find Easter for ever." And so it was observed in the years 1668, 1678, and 1682. And so whenever the case happens that the ecclesiastical full moon falls on a Sunday.

The question only remains, on what day we must reckon the ecclesiastical full moon to fall? for we are not to judge either the equinox or the full moon according as they happen in the heavens, or in our almanacs, but according to the paschal tables, fitted to the time of the Nicene council. And accordingly we reckon the equinox to be now, as it was then, on March 21. And as to the full moon, next after that equinox, we are to account it thus: The golden number, adapted to the cycle of 19 years, after the end of which it begins again, at 1, 2, 3, &c. is placed in the first column of our calendar, to inform us, of what day, of such year, the new moon is supposed to happen in each month, and the 15th day of that moon is reputed the full moon.

Now the golden number for the year 1698 is 8, that is, this is the 8th year of such decem-novenal cycle, or circle of 19 years, commonly called cyclus lunaris, or the circle of the moon, as the other circle of 28 years is called cyclus solaris, the circle of the sun, or rather of the Sunday letter. And this number 8 stands in the calendar at March 6, which we must therefore suppose to be new moon; though the new moon was indeed March 2. Now March 6 being the new moon or first day of the reputed lunar month for such year, March 20 will be the 15th day, or the reputed full moon for the month of March this year. Which happens this year to be Sunday, the dominical letter for this year being B. But this happening before March 21, the supposed equinox cannot be the paschal full moon; but we must wait for another. And we shall then find the golden number 8 standing at April 5, for the new moon of April the same year. And therefore the full moon or 15th day of that reputed lunar month, is to be April 19. Which being Tuesday, the Sunday next following is April 24, where stands B, the Sunday letter for this year, which is therefore to be Easter-day, according to the intent of these tables. And it was so observed accordingly.

But it is to be wished there had been somewhere a rubrick to direct how we are to find this reputed full moon; and what is the use of the golden number. The difference of the ecclesiastical account in the paschal tables, from that of the heavens arises from hence; 1. The common Julian year, by which we reckon, of 365 days and 6 hours, is somewhat too long; being about 11 minutes of an hour longer than the true solar year. By reason whereof the equinox, and other annual seasons, go backwards about 11 minutes every year;

which, from the time of the Nicene council, till now, amounts to about 11 days. So that the equinox which then happened March 21, is now come back to our March 11, or rather March 10. Which, upon Pope Gregory's reforming the Roman calendar, above 100 years since, causes the difference of 10 days, between what we call the New Style and the Old. Which, 2 years hence, in the year 1700, and thenceforth for 100 years, will be 11 days. 2. It was then supposed, that in 19 years, which is the compass of the golden number, the lunations of new and full moon returned to the same day and hour, as they were 19 years before. This is pretty near the truth, but comes short by about an hour and a half. Which hour and a half, in every 19 years since that time, amount to about 4 or 5 days. Whence it happens, that the reputed full moon is later, by 4 or 5 days, than that of the heavens. But our Easter is reckoned according to the reputed full moons, derived from the golden number, and not according to those of the heavens.

A Method of extracting the Root of an Infinite Equation. By A. De Moivre, F. R. S. N° 240, p. 190.

If $az + bzz + cz^3 + dz^4 + ez^5$ &c. $= gy + hyy + iy^3 + ky^4 + ly^5$ &c. then will z be $= \frac{g}{a}y + \frac{h - b\text{AA}}{a}y^2 + \frac{i - 2b\text{AB} - c\text{A}^3}{a}y^3 + \frac{k - b\text{BB} - 2b\text{AC} - 3c\text{AAB} - d\text{A}^4}{a}y^4 + \frac{l - 2b\text{BC} - 2b\text{AD} - 3c\text{ABB} - 3c\text{AAC} - 4d\text{A}^3\text{B} - e\text{A}^5}{a}y^5$ &c.

For the understanding of this series, and in order to continue it as far as we please, it is to be observed, 1. That every capital letter is equal to the coefficient of each preceding term; thus the letter B is equal to the coefficient $\frac{h - b\text{AA}}{a}$. 2. That the denominator of each coefficient is always a. 3. That the first member of each numerator is always a coefficient of the series $gy + hyy + iy^3$ &c. viz. the first numerator begins with the first coefficient g, the second numerator with the second coefficient h, and so on. 4. That in every member after the first, the sum of the exponents of the capital letters, is always equal to the index of the power to which this member belongs: thus considering the coefficient $\frac{k - b\text{BB} - 2b\text{AC} - 3c\text{AAB} - d\text{A}^4}{a}$, which belongs to the power y^4, we shall see that in every member $b\text{BB}$, $2b\text{AC}$, $3c\text{AAB}$, $d\text{A}^4$, the sum of the exponents of the capital letters is 4; where I must take notice, that by the exponent of a letter, I mean the number which expresses what place it has in the alphabet; thus 4 is the exponent of the letter D. Hence I derive this rule for finding the capital letters of all the members that belong to any power;

combine the capital letters as often as you can make the sum of their exponents equal to the index of the power to which they belong. 5. That the exponents of the small letters, which are written before the capitals, express how many capitals there is in each member. 6. That the numerical figures or unciæ that occur in these members, express the number of permutations which the capital letters of every member are capable of.

For the demonstration of this; suppose $z = \text{A}y + \text{B}yy + \text{C}y^3 + \text{D}y^4$ &c. Substitute this series instead of z, and the powers of this series instead of the powers of z; there will arise a new series; then take the coefficients which belong to the several powers of y, in this new series, and make them equal to the corresponding coefficients of the series $gy + hyy + iy^3$ &c. and the coefficients A, B, C, D, &c. will be found such as I have determined them.

But if any one desires to be satisfied, that the law by which the coefficients are formed, will always hold, they may have recourse to the theorem I have given for raising an infinite series to any power, or extracting any root of the same; for if they make use of it, for taking successively the powers of $\text{A}y + \text{B}yy + \text{C}y^3$ &c. they will see that it must of necessity be so.

I might have made the theorem I give here, much more general than it is; for I might have supposed, $az^m + bz^{m+1} + cz^{m+2}$ &c. $= gy^m + hy^{m+1} + iy^{m+2}$ &c. then all the powers of the series $\text{A}y + \text{B}yy + \text{C}y^3$ &c. designed by the universal indices, must have been taken successively; but those who will please to try this, may easily do it, by means of the theorem for raising an infinite series to any power, &c.

This theorem may be applied to what is called the reversion of series; such as finding the number from its logarithm given; the sine from the arc; the ordinate of an ellipse from an area given to be cut from any point in the axis: but to make a particular application of it, I will suppose we have this problem to solve; viz. The chord of an arc being given, to find the chord of another arc, that shall be to the first as n to 1. Let y be the chord given, z the chord required; now the arc belonging to the chord y is, $y + \frac{y^3}{6dd} + \frac{3y^5}{40d^4} + \frac{5y^7}{112d^6}$ &c. and the arc belonging to the chord z is $z + \frac{z^3}{6dd} + \frac{3z^5}{40d^4} + \frac{5z^7}{112d^6}$ &c. the first of these arcs is to the second as 1 to n; therefore multiplying the extremes and means together, we shall have this equation:

$$z + \frac{z^3}{6dd} + \frac{3z^5}{40d^4} + \frac{5z^7}{112d^6} \text{ \&c.} = ny + \frac{ny^3}{6dd} + \frac{3ny^5}{40d^4} + \frac{5ny^7}{112d^6} \text{ \&c.}$$

Compare these two series with the two series of the theorem, and you will find $a = 1$, $b = 0$, $c = \frac{1}{6dd}$, $d = 0$, $e = \frac{3}{40d^4}$ $f = 0$, &c. $g = n$, $h = 0$,

$i = \frac{n}{6dd}$, $k = 0$, $l = \frac{3n}{40d^4}$, $m = 0$, &c. hence z will be $= ny + \frac{n-n^3}{6dd}y^3$ &c. or $ny + \frac{1-nn}{2 \times 3dd}yy$A, &c. Supposing A to denote the whole preceding term, which will be the same series as Mr. Newton has first found.

By the same method, this general problem may be solved; the absciss corresponding to a certain area in any curve being given, to find the absciss, whose corresponding area shall be to the first in a given ratio.

The logarithmic series might also be found without borrowing any other idea, than that logarithms are the indices of powers: let the number, whose logarithm we inquire, be $1 + z$, suppose its log. to be $az + bzz + cz^3$ &c. Let there be another number $1 + y$; its logarithm will be $ay + byy + cy^3$, &c. Now if $1 + z = \overline{1 + y}|^n$, it follows, that $az + bzz + cz^3$ &c : $ay + byy + cy^3$ &c :: n : 1, that is, $az + bzz + cz^3$ &c. $= nay + nbyy + ncy^3$ &c. Therefore we may find a value of z expressed by the powers of y; again, since $1 + z = \overline{1 + y}|^n$, therefore $z = \overline{1 + y}|^n - 1$, that is $z = ny + \frac{n}{1} + \frac{n-1}{2}yy + \frac{n}{1} \times \frac{n-1}{2} \times \frac{n-2}{3}y^3$ &c. Therefore z is doubly expressed by the powers of y. Compare these two values together, and the coefficients a, b, c, &c. will be determined, except the first a which may be taken at pleasure, and gives accordingly all the different species of logarithms.

Account of an extraordinary Iris, or Rainbow, seen at Chester. By E. Halley. N° 240, p. 193.

August 6, 1698, in the evening, between 6 and 7 o'clock, walking on the walls of Chester, I was surprised by a sudden shower, which forced me to take shelter in a nich in the wall, I soon observed an iris, exceedingly vivid, as to its colours, at first on the south side only, but in a little time with an entire arch; and soon after, the beams of the sun being very strong, there appeared a secondary iris, whose colours were more than ordinary bright; but inverted, as usually: that is, the red was inwards, which in the primary iris is outward, and é contra for the blues. But what appeared most remarkable was, that with these two concentric arches, there appeared a third arch, nearly as bright as the secondary iris, but coloured in the order of the primary, which took its rise from the intersection of the horizon and primary iris, and went across the space between the two, and intersected the secondary, as in fig. 6, pl. 5, AFCG intersects the secondary iris EFGD, dividing the arch ED nearly into three equal parts: but at first the arch AF did not appear, which afterwards became as bright as the former. I observed the points F and G to arise, and the arch FG gradually to contract, till at length the two arches FHG, and FG became coincident; when for a great space, the secondary iris lost its colours, and appeared like a white arch at the top. I observed also, that at the points F and G, the intersection of the interior red of the secondary iris, and the exterior red of the arch, was much more intensely red than the outward limb of the primary iris; and that during the whole appearance, the upper part of the third iris was not at all visible, beyond the intersections, F, G. This uncommon sight entertained me for about 20 minutes, when the clouds blowing away, the whole vanished. I was at first amazed with the sight, but afterwards recollecting that the sun shone along the river Dee, which from thence empties itself W. N. W. where the sun then was, I concluded this secondary arch AFHGC was produced by the beams of the sun reflected from that water, which at the time was very calm; and it had been much more bright had it been at that time about high, as it was low water, when all the sands were bare. I was soon confirmed that my supposition was right, and that it answered all the appearance without any scruple, and that the arch AFHGC, was no other than that part of the circle of the Iris, that would have been under the earth, bent upwards by reflection.

Account of Books.—1. *Voyages and Discoveries in South America: The First up the River of Amazons to Quito in Peru, and back again to Brazil, performed at the Command of the King of Spain, by Christopher D'Acugna. The Second, up the River of Plata, and thence by Land to the Mines of Potosi, by M. Acarete. The Third, from Cayenne into Guiana, in search of the Lake of Parima, by M. Grillet, and Bechamel. Done into English from the Originals, being the only Accounts of those Parts hitherto extant, with Maps. Lond.* N° 240, p. 196.

Father D'Acugna begins with a short account of some remarkable attempts that had been made unsuccessfully at several times by the Spaniards, to discover the river Amazons; and then proceeds to the perfect discovery of it, by Don Pedro de Texeira, who in the year 1637, set out from Para in Brazil, with 70 Portugueze, and 1200 Indians, in 47 canoes, and passing up the river with much difficulty, got to Quito in Peru.

By the account which Father D'Acugna gives of this river, it takes its rise 8 leagues from Quito, within 20 minutes of the equinoctial line, runs from east to west, coasting along the south side of the equinoctial line, and is not distant from it above 5 degrees, in the greatest of its windings; the narrowest part of it is a quarter of a league broad, in some places it is one, in others 2, 3, and 4 leagues wide; and after a course of above 1200 leagues, discharges itself into the sea, by a mouth 84 leagues broad, and is so deep, that a ship of the largest size may go up almost to its source.

2. *Traité du Cancer, ou l'on explique sa Nature, et ou l'on propose les Moyens les plus surs pour le guerir methodiquement. Avec un Examen du Systeme et de la Pratique de Mr. Helvetius. Par. Mr. J. B. Alliot, Conseillier du Roi, Medecin Ordinaire de sa Majesté, et de la Bastille. Paris.* 1698, 8vo. N° 240, p. 199.

This author thinks that cancers come from acidity and are to be cured by alkalies and absorbing medicines. He recommends for their cure, a preparation of red arsenic which is put into a very strong lixivium, the solution is poured off by inclination, it is filtrated, and to this liquor is put vinegar of lead, till nothing precipitates. This powder precipitated is sweetened by 12 or 15 times pouring warm water on it. The last water ought to come off insipid; then burn either pure spirit of wine, 5 or 6 times on it, or such to which is put a tincture of opium; then powder it, and it is ready for [external] use.

Concerning a Roman Shield. By Mr. Ralph Thoresby, F. R. S. N° 241, p. 205.

Having procured an old Roman shield, of a different form from that I had before, and observing them both to be of different materials from the usual descriptions of them, I resolved to make a more particular inspection into their texture, and whereas they are generally said to be è ligno corio superinducto, upon a strict survey, there is nothing of wood, but the handle, in either of them. The ancient Romans had three words, scutum, parma, et clypeus, for that defensive weapon we generally English by a shield, which notwithstanding their different forms or matter, their authors frequently confound, as probably we now do shield, buckler, and target. This shield or buckler is of the parma kind, and rightly so called, being quite round; whereas the scutum was mostly oval. It is 15 inches diameter, of which a little more than a third part is taken up with the umbo, or protuberant boss at the centre, which is made of an iron convex plate, wrought hollow on the inside, to receive the gladiator's hand; on the centre of this is a smaller boss, in which there seems to have been fixed some kind of cuspis, or sharp offensive weapon, to be used when they came to fight hand to hand. From the umbo, the shield is 4 inches and a half broad on each side, in which are 11 circular equidistant rows of brass studs of that size, that 222 are set in the outmost circle, which is 45 inches, that being the circumference of the buckler and so proportionably in the lesser circles to the centre of these 11 rows of brass studs; the inmost circle is placed on the umbo itself, the next 8 upon as many circular plates of iron, each a third of an inch broad. The two outermost upon one thicker plate, an inch broad: in the little intervals between these circular plates are plainly discovered certain cross laminæ, that pass on the back of the other, from the umbo to the exterior circle; and these iron plates are also about the third part of an inch at the broader end towards the circumference, but gradually contracted into a narrower breadth, that they may be brought into the compass of the umbo at the centre. The inner coat next to those iron plates is made of very thick hard strong leather, which cuts bright, somewhat like parchment. Upon that is a second cover of the same, and on the outside of this are plaited the iron pins that run through the brass studs; for the abovementioned brass studs are cast purely for ornament on the heads of the said iron pins the sixth part of an inch long, that none of the iron appears. The next cover to the plaiting of the said nails (which pass through the circular and cross iron plates, and both the leather covers) is a pure linen cloth, but discoloured, though perhaps not with age only, but sour wine and salt, or some other liquid wherein it seems to have been steeped. And lastly, upon the said linen is the outer cover, which is of softer leather, all which coats are bound together by two circular plates of iron, a thin and narrow one towards the centre, and a thicker and large one, an inch broad at the circumference which is curiously nailed with two rows of very small tacks, above 400 in number, the vacant holes whence some of the nails are dropped out, are little larger than to admit the point of a pair of small compasses, both which rims do likewise fasten the handle (the only part of wood) which has also 6 other iron plates, about 3 or 4 inches long, to secure it.

That shield which I lately procured, differs not so much in size, though it is completely a foot larger in the circumference, as in the form; for whereas that already described is almost flat, except the swelling umbo, this is absolutely concave, and from the skirts of the protuberant boss in the middle, it rises gradually to the circumference, which is near 3 inches perpendicular from the centre; this has 14 rows of the like brass studs, but the circular plates of iron they are fixed in, do not lie upon other cross plates, as the former do, but each from the centre, on the outer edge of the other, which occasions its rising in that concave manner.

That these were part of the accoutrements of the Roman equites, rather than either the velites or hastati, I conclude, because though all in general had shields, yet those of the velites, who were as the forlorn hope, seem more slight, and are expressly said to be, è ligno corio superinducto, those of the hastati are not only said, è pluribus lignis et asserculis constitut. &c. but were also 4 feet long to cover the whole body, when stooping; of which kind were likewise those of the Principes and Triarii. Whereas the description that the anonymous author of Roma Illustrata with Fabricius's Notes, gives in his Armatura Equitum, comes the nearest to this, Scutum sive Parmam habebant ex bovillo corio, arte leviter durato, but then he adds, eoque mero, nulla materie subjecta, omitting not only the ornamental studs, but the iron work, which Camillus first contrived as a defence against the immense swords of the Gauls.

Some additional Observations on the Giant's Causeway, in Ireland. By Dr. Tho. Molyneux. N° 241, p. 209.

The few circumstances, that are any way material, contained in this paper, above what were in the former accounts of this phenomenon, are as follow.

The figures of the columns, better examined, show that there was a mistake committed as well in answering one of the queries relating to this causeway, as in the account that is given of it; where it is said, that among the columns "there are none square, but almost all pentagonals or hexagonals, only a few are observed that have seven sides, but more pentagons than hexagons;" whereas it is certain, there are not only in this pile quadrangular, but also triangular and octangular pillars, though no notice was taken at that time of any such, by reason they are much fewer in number than those other figured columns. But this sort of stone is not more remarkable for being cut thus naturally into regular geometrical figures, than for being found in such plenty and vast abundance in many parts of this country, for 4 or 5 miles about. Other curiously shaped stones, as the trochites, the astroites, the lapides judaici, the echinitæ pellucidi, and such like, wheresoever discovered in the world, are always but few in number, and only met with in small parcels, dispersed up and down: but nature has framed such an immense quantity of this prodigious stone here altogether, that she seems more than ordinarily profuse of her elaborate workmanship.

For besides what goes under the vulgar name of the Giant's Causeway, which itself alone is of a great extent, at least 75 feet longer than what it was first said to be, and how much farther it may run into the sea, none can tell; there are many other collections of the same kind of pillars, situated in and about this place; as two smaller, but more imperfect causeways, as we may call them, that both lie at some distance on the left hand of the great one, facing the north: and a little farther into the sea, some rocks show themselves above water, when the tide is low, that seem all made still of the same stone. And if you ascend towards the land in the hill above the Causeway, next and immediately adjoining to it, you meet with more of the same sort of pillars, but in a different situation, not perpendicular and erect, but lying as it were on their sides, in a slanting position.

Beyond this hill eastward, at several distances, stand many sets of straight and upright columns, ranged in curious order along the sides of the hills; that parcel of them which is most conspicuous and nearest the Causeway, the country people call the looms or organs, from its formal shape; which is so very regular, that all its several pillars may be distinctly counted, and they are just 50 in number; the largest and tallest, at least 40 feet high, consist of 44 distinct joints, and stand directly in the middle of all the rest, which gradually decrease in length on both sides of it, like organ pipes.

At 4 miles westward of the Giant's Causeway, 1 mile and ½ distant from the sea, 3 miles from the town of Coleraine, and about 2 from Dunluce, an old seat of the Marquisses of Antrim, several ranges of tall pillars show themselves along the side of a rock for about 300 paces together: a church within a quarter of a mile of them, called, Ballywillan-church, was built for the most part with stone taken from the pillars, which are all of the same sort of stone with the columns of the Giant's Causeway, and like those too, consist of regularly cut, loose, and distinct joints, placed one upon the top of the other. But in the following respects they differ: 1. That some of these inland pillars are of a much larger size than any in the Causeway, being 2½ feet in diameter: 2. That there are only found among these such as have 3, 4, 5, and 6 sides; none that have 7 or 8, like some of the Giant's Causeway: 3. That the joints of these do not observe that kind of articulation, by cavities and convexities, as those of the Causeway do; but their upper and lower surfaces touch only in planes, and they stand united by means of their weight and pressure alone, so that a small force will sever them.

As to the internal substance of this stone, it is of an extraordinary hard, close, and compact texture: its grain so very even and fine, that it hardly appears, unless viewed near the eye, and when the stone is newly broke; then it shows itself on its surface like a very minute small glistening sand, thickly interspersed with the rest of the solid; which, as its parts are so firmly combined together, has something more of gravity in proportion to its bulk, than most other sorts of stone, unless such as partake of the marchasite or pyrites, and are more ponderous than usual from a metalline principle being an ingredient in their composition: of which this does not at all participate, or at least not in any considerable quantity that I can discover. It seems as if it were one plain homogeneous body, without any mixture of cochlite, belemnite, veins of spar, or such like extraneous matter, so commonly met with in most other stony concretes: nor can there be observed rays, furrows, striæ, or any manner of lines running along its superficies; so that it is capable of a good polish, and I find has in perfection that quality of the lapis-lydius, basanus or touch-stone, so much celebrated of old, for showing the various impressions different metals make upon it, when rubbed or drawn along its surface; but being a stone naturally divided into small pieces or joints, and of so hard a body, that it turns or breaks the edges of the best tools, when they offer to cut it, it seems unfit for the embellishing of houses, and all the other greater uses of architecture and statuary.

Its rough and natural outside that is exposed to the weather, is of a whitish colour, much the same with that we see on common rocks and lime stone; but the inside, when you sever one piece fresh from another, is of a blackish iron-grey, like that of the best black marble before it is polished, but somewhat of a darker shade. And indeed I can discover but little, if any, difference between the substance of this stone and that of marble. And indeed the stone of our Giant's Causeway agreeing so well in hardness, colour, and substance with the Æthiopic marble described by Pliny, and Kentmann reducing a sort of pillared stone in Misnia, near Dresden in Germany, that nearly resembles ours in many of its properties, to the basaltes; I thought I could not more aptly refer it to any species of fossil yet known, than to that, and therefore gave it the name of lapis basaltes, vel basanus hibernicus, but not being so well informed then, I ran into a mistake, when I said, angulis minimum quinque plurimum septem constans; whereas I should have said, angulis minimum tribus plurimum octo constans; and this shows it to partake still more of the nature of the Misnian Basaltes, though it comprehends two sorts of pillars which that has not, those of three and those of eight sides.

But I shall forbear making any more of this kind of remarks or raising deductions from them, considering that I write to one whose accurate observations, vast reading, and ample experience in fossils, can, if he please, furnish me with those that are so much more instructive and judicious: and shall therefore only intreat you to let me know your particular sense of this wonderful product of nature, and your impartial censure of what I have said concerning it; and then I shall quite accomplish all that I proposed to myself by troubling you with this, the acquiring knowledge, and showing you that I am, your's, &c.

A Letter from Raymund Vieussens, M. D. of Montpellier, to the Royal Society, concerning the Human Blood. Dated Montpellier, June 6th, 1698. *An Extract from the Latin.* N° 241, p. 224.

In this letter, addressed to the members of the Royal Society, the author gives an account of some experiments which he made, after the example of Mr. Boyle, upon the human blood; experiments wherein he extracted from that vital fluid not only an alkaline salt, but (what no chemists before him had conceived to be possible) an acid salt also; and by these experiments he, moreover, thinks he has been able to determine the relative proportions of the constituent parts of the blood.

From 50lb. of blood exsiccated in a copper vessel, and afterwards calcined for 24 hours in a potter's furnace, were obtained ℥iij ʒvij of grey ashes, which effervesced with acids, turned syrup of violets and other blue vegetable colours green, and precipitated a solution of corrosive sublimate. These ashes being lixiviated, yielded ℥j of a fixed salt (possessing all the alkaline properties just mentioned) almost as white as snow. Of this purified salt ʒvij 42grs. were mixed with ℥iij of well dried bolar earth; the mixture being put into a retort (with the receiver luted to it) and subjected to a strong heat, there was distilled from it ℥ss. 18grs. of a spirit, which in colour resembled spirit of sulphur, and was sharper to the taste than distilled vinegar. This spirit effervesced strongly with salt of tartar, with vol. salts, &c.; and it reddened syrup of violets, tincture of turnsole, &c. so that it was evidently of an acid nature.* The matter which remained at the bottom of the retort after the extraction of this spirit, being lixiviated, gave ʒij. 31grs. of a light grey fixed salt; which produced no sensible effervescence with any acid except oil of vitriol, although it turned syrup of violets green, and precipitated a solution of corrosive sublimate, &c.

To satisfy himself that nothing extraneous was derived from the copper vessel in which the blood, in this instance, was exsiccated, the author repeated the experiment upon blood exsiccated in earthen vessels. The results were the same.

In order to ascertain the proportion of vol. salt in the phlegm of blood, Mr. Vieussens made what he terms an artificial phlegm, by adding different quantities of the vol. salt extracted from blood, to a given quantity of distilled water; until, by comparing the changes produced upon syrup of violets, and a solution of corrosive sublimate, by equal quantities of his artificial phlegm and of the real phlegm of the blood, he arrived at what appeared to be the true proportions. After a number of unsuccessful trials in this way, he at length found that by adding 1gr. and a quarter to 12 ounces of distilled water he obtained a liquor, which in colour, taste, smell, and consistence resembled the natural phlegm of blood, and which, in equal quantities, produced the same phænomena with the beforementioned chemical tests, as the natural phlegm;

* The acid thus obtained was probably the phosphoric acid. The prussic acid would be dissipated and destroyed by the previous torrefaction of the blood in the open fire.

whence he infers that the quantity of vol. salt contained in 12 ounces of the natural phlegm of blood is exactly 1 gr. and a quarter.

By a similar train of experiments he infers, that the reddish spirit of blood consists of 27 grains of the vol. salt and ʒj of phlegm, being nothing more than phlegm strongly impregnated with this salt, and containing moreover a little sulphur.

In order to ascertain the relative proportions of the component parts of the fœtid oil obtained from blood by distillation, Mr. V. proceeded in the following manner: he took ℥j of this oil, and having mixed it with ℥iij of bolar earth well exsiccated and reduced to a very fine powder, he put the whole into a retort with a proper receiver adapted to it, and subjected it to distillation in a reverberatory furnace. There came over first of all with a gentle heat, 40 grs. of a limpid phlegm derived from the bolar earth; this receiver being taken away, and another fitted on, in its place, there was obtained by increasing the fire ℥ss 42 grs. of reddish spirit; and afterwards under a still stronger degree of heat, ʒij 51 grs. of oil, resembling in colour and consistence the bile naturally contained in the gall bladder. The residuum at the bottom of the retort yielded by lixiviation 8 grs. of a black saline matter, which readily deliquesced in the air, was pungent to the taste, effervesced with acids, &c. Hence it is inferred that ℥j of the fœtid oil of blood contains only 19 grs. of earthy matter, which remained mixed with the bolar additament.*

In the concluding part of this communication the author takes notice of some experiments, which he made upon bile in the year 1696; wherein he obtained from this fluid a limpid phlegm and a liquor as white as milk, besides some other products which on this occasion he omits mentioning. One drachm of bile was taken from the gall bladder of a sheep just killed; it was put into a glass vessel and diluted with 8 ounces of water; to this was added a small quantity of spirit of vitriol; whereupon the liquor immediately acquired a milky appearance; which milkiness Mr. V. remarks would have been increased, if he

* The products obtained in this distillation were as follow:

	℥	ʒ	Grs.
Phlegm, supposed to be derived from the bolar earth, ʒss 10 grs. or	0	0	40
Red spirit, ℥ss ʒss 12 grs. or	0	4	42
Oil, resembling bile, ʒiiss 21 grs. or	0	2	51
Alkaline salt	0	0	8
Earthy or insoluble matter	0	0	19
	1	0	40
Deduct for phlegm supposed to come from the bolar additament	0	0	40
	1	0	0

had added 4 grs. of the vegetable alkali (salt of wormwood). A similar effect (he remarks) is produced by mixing with the bile the acid phlegm distilled from bread.*

Account of a Book, viz. La Meridiana del Tempio de S. Petronio, &c. i. e. The Meridian Line of the Church of St. Petronio, drawn and fitted for Astronomical Observations in the Year 1655, *revised and restored in the Year* 1695. *By Signior John Dominico Cassini, F. R. S. &c. Bononia,* 1695, *fol.* N° 241, p. 240.

In this book (written in part by Signior Cassini, whilst in Italy, but augmented and published by Signior Dominico Guglielmini after his departure thence) there is an account of the occasion of the making of this meridian line by S. Cassini, in the year 1655, of the method of doing it, and of the exactness with which it was performed by him: then of the uses that have been made of it, and of the alterations that have happened to this church since, and of the restoration and verification of it in the year 1695, by the said Signior Cassini himself; and lastly, of the uses that may be made of it for the future.

To this discourse, which was written by Signior Cassini himself, is adjoined a discourse of Signior Dominico Guglielmini, mathematician and public lecturer of Bononia, giving an account of the operations made, and of the instruments employed in this last restoration of the said meridian line.

Of two Boys bit by a Mad Dog. Communicated by Dr. Martin Lister, Fellow of the Coll. of Phys. and R. S. N° 242, p. 246.

In October, 1679, 2 boys, of 9 and 10 years old, of a sanguine and choleric complexion, touched and handled the head of a dog which had been wounded by a mad dog, but by the handling and washing of his wound by the children, the wounded dog was healed, and did not become mad. But about May, 1680, the children became very unwell, and were seized with a pain towards the bottom of their bellies, which tormented them grievously, and ascended gradually towards their navel. About the 1st of July, they were also taken with a slow flux, and with fainting fits by times, when the pains

* The milky appearance would be owing to the precipitation of the albuminous part of the bile, coagulated by the acid liquors here mentioned.

By these experiments Mr. V. ascertained a fact doubted of until then, viz. the existence of an acid in the blood. Nevertheless the knowledge which philosophers had at this period of time, respecting the composition of the blood and other animal fluids, was (as remarked at p. 685, Vol. II. of this Abridgment) extremely imperfect and obscure; as will appear by comparing these experiments with the accurate and luminous analyses of the chemists of these days.

attacked them. After they had continued thus for some time, the pain ascended towards and above the stomach, and very violent motions ensued, especially about the stomach and belly; by which they were convulsed in the whole body, with some foaming at the mouth, in the interim of their fits; these symptoms continued increasing until the latter end of August, when they were taken with the dread of water, and could not endure to look on any thing liquid, but would have fallen into a fainting fit, and have so lain some time; and then would have tossed about in the most violent motions, groaning very much; and usually, the eldest especially, snarled, barked, and endeavoured to bite like a dog. They continued in this fit sometimes for an hour, at other times less, and then came out of the convulsive-like motions, lying as in a swoon; but a little after they would appear as well as ever. The symptoms continued until the middle of September, the fits coming on every day, during which they could not speak; but, in their intermissions, were as towardly and well as ever.

About the middle of September, at which time, especially, their barking and snarling like a dog came on, they became more wild; so as for some days, even while out of their torturing fits, they would, every now and then, not endure company, not so much as come near each other; this disposition continued for a week; and then the eldest drew near his father, saying, as one surprized, father, I am well; and they both became so well, as not only to converse with their friends, but also to look into the water without any dread; and were as well in their senses as ever, and so continued for 3 or 4 days; but after that they fell ill again, and remained ill 6 or 7 days; after which, they recovered again, saying, as before, suddenly to their father, father, I am well; this was about the end of September, and they continued both as well as ever they were to appearance, till the end of January, when the eldest had some fits like the former; but the youngest remained as well ever since.

We should observe that in August, when the symptoms were first supposed to proceed from the poison of a mad dog, doses of antimony and merc. vitæ was prescribed, which accordingly were administered; with antidotes of venice treacle, powder of crabs' eyes, and other things.

On the Imperfections in an Organ. By Dr. Wallis. N° 242, p. 249.

It seems evident, that each pipe in the organ is intended to express a distinct sound at such a pitch; that is, in such a determinate degree of gravity or acuteness; or (as it is now called) flatness or sharpness. And the relative or comparative consideration of two or more such sounds or degrees of flatness and sharpness, is the ground of what we call concord and discord; that is, a soft or harsh coincidence.

Now, concerning this, there were among the ancient Greeks, two of the most considerable sects of musicians: the Aristoxenians, and the Pythagoreans. They both agreed thus far; that Diatessaron and Diapente do together make up Diapason; that is, as we now speak, a fourth and fifth do together make an eighth or octave: and the difference of those two, viz. of a fourth and fifth, they agreed to call a tone; which is now called a whole note.

Such is that, in our present music, of la-mi, or as it was wont to be called, re-mi; for la-fa-sol-la, or mi-fa-sol-la, is a perfect fourth: and la-fa-sol-la-mi, or la-mi-fa-sol-la, is a perfect fifth: the difference of which, is la-mi. Which is, what the Greeks call the diazeuctic tone; which disjoins two fourths, on each side of it; and, being added to either of them, makes a fifth. Which was, in their music, that from mese to paramese; that is, in our music, from A to B: supposing mi to stand in B fa b mi, which is accounted its natural position.

Now, in order to this, Aristoxenus and his followers took that of a fourth, as a known interval, by the judgment of the ear; and, that of a fifth, likewise; and consequently, that of an octave, as the aggregate of both; and of that a tone, as the difference of those two.

And this of a tone, as a known interval, they took as a common measure, by which they estimated other intervals. And accordingly they accounted a fourth to contain two tones and a half; a fifth to contain three tones and a half; and consequently an eighth to contain six tones, or five tones and two half-tones. And it is very near the matter, though not exactly so. And at this rate we commonly speak at this day; supposing an octave to consist of 12 hemitones, or half-notes, meaning thereby somewhat near so many half-notes: but when we would speak more nicely, we do not take those supposed half-notes to be exactly equal, or each of them just the half of a full-note, such as la-mi.

Pythagoras, and those who follow him, not taking the ear alone to be a competent judge in a case so nice, chose to distinguish these, not by intervals, but by proportions. And accordingly they accounted that of an octave, to be, when the degree of gravity or acuteness of the one sound to that of the other is double, or as 2 to 1; that of a fifth, when it is sesqui-alter, or as 3 to 2; that of a fourth when sesqui-tertian, or as 4 to 3. Accounting that the sweetest proportion, which is expressed in the smallest numbers; and therefore, next to the unison, that of an octave, 2 to 1; then that of a fifth, 3 to 2; and then that of a fourth, 4 to 3. And thus, that of a fourth and fifth, together make an eighth; for $\frac{4}{3} \times \frac{3}{2} = \frac{4}{2} = \frac{2}{1} = 2$. That is, four-thirds of three halves, is the same as four halves, that is 2. Or the proportion of 4 to 3, compounded with that of 3 to 2, is the same with that of 4 to 2, or 2 to 1. And, consequently, the difference of those two, which is that of a tone or full-note, is that of 9 to 8. For $\frac{4}{3}) \frac{3}{2} (\frac{9}{8}$; that is, three halves divided by four-thirds, is mine eighths; or, if out of the proportion of 3 to 2, we take that of 4 to 3, the result is that of 9 to 8.

Now, according to this computation, it is manifest, that an octave is somewhat less than 6 full-notes. For the proportion of 9 to 8, being 6 times compounded, is somewhat more than that of 2 to 1. For $\frac{9}{8} + \frac{9}{8} + \frac{9}{8} + \frac{9}{8} + \frac{9}{8} + \frac{9}{8} = \frac{531441}{262144}$, is more than $\frac{524288}{262144} = \frac{2}{1}$. This being the case; they allowed indisputably to that of the diazeuctic tone, la-mi, the full proportion of 9 to 8; as a thing not to be altered; being the difference of diapente and diatessaron, or the fifth and fourth. All the difficulty was, how the remaining fourth, mi-fa-sol-la, should be divided into three parts, so as to answer pretty near the Aristoxenians two tones and a half; and might altogether make up the proportion of 4 to 3; which is that of a fourth or diatessaron.

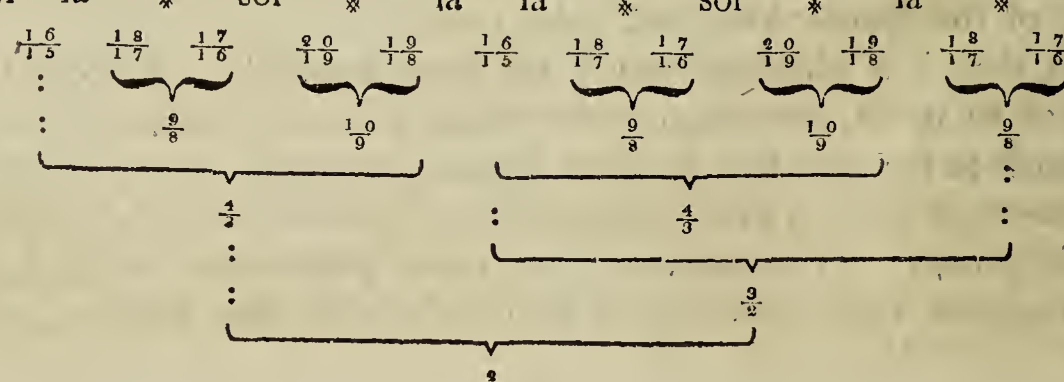
Many attempts were made to this purpose; and according to those, they gave names to the different genera or kinds of music, the diatonic, chromatic, and enarmonic kinds, with the several species, or lesser distinctions under those generals. The first was that of Euclid, which most generally obtained for many ages: it allows to fa-sol, and to sol-la, the full proportion of 9 to 8; and therefore to fa-sol-la, called the greater third, that of 81 to 64. For $\frac{9}{8} \times \frac{9}{8} = \frac{81}{64}$. And, consequently, to that of mi-fa, which is the remainder to a fourth, that of 256 to 243. For $\frac{81}{64}) \frac{4}{3} (\frac{256}{243}$; that is, if out of the proportion of 4 to 3, we take that of 81 to 64, the result is that of 256 to 243. To this they gave the name of limma (λεῖμμα), that is, the remainder, viz. over and above 2 tones. But in common discourse, when we do not pretend to speak nicely, nor intend to be so understood, it is usual to call it a hemitone or half-note, being very near it, and the other, whole notes. And this is what Ptolemy calls diatonum ditonum, of the diatonic kind with 2 full tones.

Against this, it is objected, as not the most convenient division, that the numbers of 81 to 64, are too great for that of a ditone or greater third; which is not harsh to the ear; but is rather sweeter than that of a single tone, the proportion of which is 9 to 8. And in that of 256 to 243, the numbers are yet much greater. Whereas there are many proportions, as $\frac{5}{4}, \frac{6}{5}, \frac{7}{6}, \frac{8}{7}$, in smaller numbers than that of 9 to 8; of which, in this division, no notice is taken.

To rectify this, there is another division thought more convenient; which is Ptolemy's diatonum intensum, of the diatonic kind, more intense or acute than that other. Which, instead of two full tones for fa-sol-la, assigns what is now called a greater and a less tone; which, by the more nice musicians of this and the last age, seems to be more embraced; assigning to fa-sol, that of 9 to 8, which they call the greater tone, and to sol-la, that of 10 to 9, which they call the lesser tone: and therefore to fa-la, the ditone or greater third, that of 5 to 4. For $\frac{10}{9} \times \frac{9}{8} = \frac{10}{8} = \frac{5}{4}$. And consequently, to mi-fa, which is remaining of the fourth, that of 16 to 15. For $\frac{5}{4}) \frac{4}{3} (\frac{16}{15}$. That is, if out of that of 4 to 3, we take that of 5 to 4, there remains that of 16 to 15. There are many other ways of dividing the fourth or diatessaron, or the proportion of 4 to 3, into three parts, answering to what, in a looser way of expression, we call a half-note, and 2 whole-notes. But this of $\frac{16}{15} \times \frac{9}{8} \times \frac{10}{9} = \frac{4}{3}$, is that which is now received as the most proper. To which therefore I shall apply my discourse. Where $\frac{16}{15}$ is what we call the hemitone, or half-note, in mi-fa; $\frac{9}{8}$ that of the greater-tone, in fa-sol; and $\frac{10}{9}$ the lesser-tone, in sol-la. Only with this addition; that each of those tones is, upon occasion, by flats and sharps divided into 2 hemitones or half-notes: which answer to what the Greeks called mutatio quoad modos, the change of mood; and what is now done by removing mi to another key. Namely $\frac{9}{8} = \frac{18}{16} = \frac{18}{17} \times \frac{17}{16}$; and $\frac{10}{9} = \frac{20}{18} = \frac{20}{19} \times \frac{19}{18}$.

Thus, by the help of flats and sharps, dividing each whole-note, be it the greater or the less, into 2 half-notes, or what we call so, the whole octave is divided into 12 parts or intervals, contained between 13 pipes, which are commonly called hemitones or half-notes. Not that each is precisely half a note, but somewhat near it, and so called. As for instance, a flat in D, or a sharp in C, do either of them denote a middling sound, though not precisely in the middle, between C and D; sharper than C, and flatter than D. Accordingly; supposing mi to stand in B fa b mi, which is accounted its natural seat, the sounds of each pipe are to bear these proportions to each other, viz.

B	C	✻	D	✻	E	F	✻	G	✻	a	✻	b
mi	fa	✻	sol	✻	la	fa	✻	sol	✻	la	✻	mi



And so in each octave successively following. And if the pipes in each octave be fitted to sounds in these proportions of gravity and acuteness, it will be supposed, according to this hypothesis, to be perfectly proportioned.

But, instead of these successive proportions for each hemitone, it is found necessary so to order the 13 pipes, containing 12 intervals called hemitones, as that their sounds, as to gravity and acuteness, be in continual proportion, each to its next following, in one and the same proportion: which, all together, shall complete that of an octave or diapason, as 2 to 1. Whence it happens, that each pipe does not express its proper sound, but very near it, yet somewhat varying from it; called bearing. Which is somewhat of imperfection in this noble instrument, the chief of all.

It may be asked, Why may not the pipes be so ordered, as to have their sounds in just proportion, as well as thus bearing? I answer, it might very well be so, if all music were composed to the same key, or, as the Greeks call it, the same mode. As for instance, if, in all compositions, mi were always placed in b fa b mi. For then the pipes might be ordered in such proportions as I have now designed. But musical compositions are made in great variety of modes, or with great diversity in the pitch. Mi is not always placed in B fa b mi; but sometimes in E la-mi; sometimes in A la-mi-re, &c. And in some there is none of these 12 or 13 pipes, but may be made the seat of mi. And if they were exactly fitted to any one of these cases, they would be quite out of order for all the rest. As for instance; if mi be removed from B fa b mi, by a flat in B, to E la-mi: instead of the proportions before designed, they must be thus ordered;

B	*	C	*	D	*	E	F	*	G	*	a	b
fa	*	sol	*	la	*	mi	fa	*	sol	*	la	fa

$\frac{18}{17}$ $\frac{17}{16}$ $\frac{20}{19}$ $\frac{19}{18}$ $\frac{18}{17}$ $\frac{17}{16}$ $\frac{16}{15}$ $\frac{18}{17}$ $\frac{17}{16}$ $\frac{20}{19}$ $\frac{19}{18}$ $\frac{16}{15}$

Where it is manifest, that the removal of mi quite disorders the whole series of proportions. And the same would again happen, if mi be removed from E to A, by another flat in E. And again, if removed from A to D. And so perpetually. But the hemitones being made all equal; they indifferently answer all the positions of mi, though not exactly to any: yet nearer to some than to others. Whence it is, that the same tune sounds better at one key, than at another.

It is asked, Whether this may not be remedied, by interposing more pipes; and thereby dividing a note, not only into half notes but into quarter notes or half quarter notes, &c. I answer: it may be thus remedied in part; the imperfection might be somewhat less, and the sounds somewhat nearer to the just proportions; but it can never be exactly true, so long as their sounds, be they ever so many, are in continual proportion, that is, each to the next following in the same proportion.

For it has been long demonstrated, that there is no such thing as a just hemitone practicable in music. For, supposing the proportion of a tone or full note to be $\frac{9}{8}$, or as 9 to 8; that of the half note must be as $\sqrt{9}$ to $\sqrt{8}$, as the square-root of 9 to the square-root of 8, that is, as 3 to $\sqrt{8}$, or 3 to $2\sqrt{2}$, which are incommensurable quantities. And that of a quarter note, as $\sqrt[4]{9}$ to $\sqrt[4]{8}$, as the biquadrate root of 9 to the biquadrate root of 8, which is yet more incommensurate. And the like for any other number of equal parts. Which will therefore never fall in with the proportions of number to number. So that this can never be perfectly adjusted for all keys, without somewhat of bearing, by multiplying of pipes, unless we would for every key, or every different seat of mi, have a different set of pipes, of which this or that is to be used, according as, in the composition, mi is supposed to stand in this or that seat. Which vast number of pipes for every octave would vastly increase the charge. And, when all is done, make the whole impracticable. Those who desire to know more of it, may see my thoughts more at large in the appendix to my edition of Ptolemy's Harmonics, in Greek and Latin.

The two eminent sects among the ancients, the Aristoxenian and the Pythagorean, differ much in the same way as the language of our ordinary practical musicians, and that of those who treat of it in a more speculative way. Our practical musicians talk of notes and half notes, just as the Aristoxenians did, as if the whole notes were all equal, and the half notes likewise each the just half of a whole note. But Pythagoras, and those who follow him, found, by the ear, that this equality of intervals would not exactly answer the musical appearances in concords and discords, just as our organists and organ-makers are now aware, that their pipes at equal intervals do not give the just desired harmony, without somewhat of bearing, that is, of some little variation from the just sound. The Pythagoreans, to help this, changed the notion of equal intervals into that of due proportions; and this is followed by Zarline, Kepler, Cartes, and others who treat of speculative music in this and the last age. And though they speak of notes and half notes, in a more gross way, much as others do, yet they declare themselves to be understood more nicely.

And though our present gamut take no notice of this little diversity, yet, in vocal music, the ear directs the voice to a more just proportion. And, in string music, it may in like manner be helped by straining and slackening the strings, or moving the frets. But, in wind music, the pipes are not capable of such correction; and therefore we must be content with some little irregularity therein; that so they may tolerably answer, though not exactly, the different compositions according to the different placing of mi in the gamut.

Concerning a Periodical Palsy. By Dr. Wm. Musgrave, F. R. S. N°242, p. 257.

A periodical palsy is a very unusual distemper; I do not remember either from books or men to have met with more than two instances of it. The one was in a young man in the Duchy of Wirtemberg, who, for the space of 12 years, spoke only 1 hour in the 24, and that always at the same time, viz. between 12 and 1 of the day. The other instance has fallen within my own observation, and is as follows:

The patient was a young woman about 21, of a sanguine complexion. She had been for several days less active than usual; and after that lost her speech, and the use of her legs. She had little or no sense of feeling in them, and the left leg was drawn up as in a violent cramp. Her ruddy sanguine look directed bleeding, but that did not relieve her. I then gave her spirit of sal ammoniac succinated, steel with gentian, amber, castor, and other warm cephalics; a blister was laid on her neck; a bath of wormwood, and other hot herbs, prepared for her legs; ung. martiatum used to anoint them after bathing. By these means she was, in the space of 3 days, able to speak again, and in a little time, by the help of crutches, able to go. But then omitting the medicines, though but one day, lost her speech again; and returning to them, especially the spirit, recovered it as soon. When not able to speak, she had a manifest alteration in her face; the strength and tonic vigour of it abated, her eyes grew dull, and her lips pale. I have in this juncture given her 30 drops of the spirit, in the space of 2 hours the change has been surprising, her eye has quickened, a colour come over her face, her speech returned.

In July, 1688, I was again at Astrop; whither the mother, encouraged by the success of the last year's physic, brought her daughter to me, and gave me the following account of her, viz. that after the physic I had prescribed her was all gone, her speech and the use of her legs left her, first on a Tuesday about noon, that it returned the Saturday following, near the same hour; and that for 10 months her speech and strength of legs observed the same period, of going off on Tuesdays every week, and returning on Saturdays, with only 2 exceptions, viz. that once they returned on a Friday, another time not before Sunday. Her menses were regular as to period, but unequal as to quantity, with this farther observable, that when they were most the patient was worst. Before her speech used to go off she constantly lost for an hour's space the use of her left arm, and when her speech was leaving her, she would stammer out some few words, and after this on a sudden become mute; when not able to speak she often moaned and made a melancholy complaining noise; her speech used to return as it went off, on a sudden. She always had as her speech ceased, and 2 hours after it was gone, a pain in her left side, including arm and leg; her left foot was then drawn up, as before-mentioned; her face was high-coloured when she lost her speech, pale when it returned; no part of her body withered, but she was generally cold. Some time before she was first struck speechless, her hands used to tremble, but have been of late more steady; nor was she now so dull and heavy as formerly, but generally more brisk and cheerful. When she has her speech she is best, but is always forced to use a stick, being never able to go steadily; she speaks by intervals as distinctly as ever, and as loud; can sing when capable of speaking, but at no other time. I repeated the former course of medicines, furnishing her with large quantities, and desired her to let me hear again from her when the physic should be all spent. The same being repeated again she recovered, and by the 10th of Nov. following was grown strong, and to all appearance as well as ever. For 2 months past she has walked and spoke every day, but not at all times of the week, for her speech left her, as formerly, on Tuesdays; but now returned the next day after noon. Thus she continued to the summer following, not speaking in more than 20 months on any one Wednesday morning. In the summer of 1689, hoping to complete the cure, I procured for her a large stock of medicines for the winter following, but since then have heard nothing more of her.

Of the Posture Master, or a Man having an absolute Command of his Joints and Muscles. N° 242, p. 262.

In Pall Mall, London, lived one Clark, called the posture master, who had such an absolute command of all his muscles and joints, that he could disjoint almost his whole body; so that he imposed on the famous Mullens, who looked on him in so miserable a condition, that he would not undertake his cure; though he was a well-grown fellow, yet he would appear in all the deformities that can be imagined, as hunch-backed, pot-bellied, sharp-breasted; he disjointed his arms, shoulders, legs, and thighs, that he appeared as great an object of pity as can be: and he has often imposed on the same company, where he has been just before, to give him money as a cripple; looking so much unlike himself that they could not know him. I have seen him make his hips stand out a considerable way from his loins, and so high that they seemed to invade the place of his back, in which posture he had so large a belly, that though one of our company had one of a considerable size, yet it seemed lank compared with his; he turned his face into all shapes, so that by himself he acted all the uncouth, demure, odd faces of a quaker's meeting; I could not have conceived it possible to have done what he did, unless I had seen it; and I am sensible how short of a full description I have given of him. He began young to bring his body to it, and there are several instances of persons that can move several of their bones out of their joints, using themselves to it from children.

On the strange Effects of the Papaver Corniculatum Luteum, &c. By Mr. Jas. Newton.* N° 242, p. 263.

In my journey from London to Margaret Island, and thence by the sea-shore to the Land's End in Cornwall, to observe what plants were produced between Penzance and Marketjew, on the sandy shore I found abundance of papaver corniculatum luteum, or horned poppy, with a yellow flower, vulgarly called in Hampshire and Dorsetshire squatmore, or bruiseroot, where they use it against bruises external and internal. Mr. John Hancock, an apothecary in Penzance, gave me the following account of its effects on Charles Worth, and others of his family, at the halfway-house between Penzance and Marketjew, viz. that Charles Worth causing a pie to be made of the roots of the poppy, supposing them to be sea holly or eryngo roots, of which by order of a physician, they had made pies, which were very pleasant; that eating of the poppy pie, while hot, he was presently taken with a delirium, which made him fancy that most things he saw were gold, such as white earthen ware and pewter, &c. being purged at the same time very much. The man and maid servants having also eaten of the same pie, stripped themselves quite naked, and so danced against one another a long time, being also purged. A child in the cradle having also tasted of the pie was much purged. And thus they continued for some days, and then became well.

Concerning several Stones voided by a Boy, &c. By Sir Robert Sibbald. N° 242, p. 264.

A rare case has occurred to me in the person of a boy, in the 13th year of his age. The boy had the misfortune 4 weeks ago to fall backwards upon a stone, against which the hinder part of his head was struck with such force, that he lay for a quarter of an hour without sense, and the next day vomited

* Chelidonium Glaucium. Linn.

some blood; he felt a pain and weight in the hinder part of his head and neck, and lost his appetite, but concealing his case, nothing was done for more than a fortnight. After the fall he went into the country, where he staid a few days, and as he was coming back he had a frequent desire to make water, and alighted from the horse several times, but could make no urine; he vomited in this time; the suppression had continued more than 24 hours when I came to visit him. He had a great pain in his head, a pain in his back and groins, and in the region of the bladder, which was swelled, and he could not suffer it to be touched. I caused some mild diuretics to be given to him presently, anointed his groins and the regio pubis with the usual ointment, and caused a clyster to be injected; upon which, that night he passed first some sand, and then some urine by spoonfuls. I caused him afterwards to be put in a half bath of appropriate simples. He was on the following days let blood and purged; and the pain in his head being very troublesome, a large vesicatory was applied to the nucha, which discharged much humour from it. While this was doing much sand was passed of a greyish and whitish colour, and after the first purge, he began to pass stones by the yard, of a considerable size, with pain in the back some time before they fell down, then in the groins or along the ureters, and most in the right side, yet sometimes in the left. He found the yard much dilated while they passed it, and he had a smarting pain then and while the urine flowed, the stones came in with the first of the urine; he took several emulsions which had a good effect. Some of the stones were round, some oval, some angular. Some of a pyramidal form, some cubical. The colours were different, some whitish, some brown, some bluish, some black, or of a dark colour, the consistence of a sandy stone, and some looked like bricks, some in thickness the 10th part of an inch, some the 12th part of it, some $\frac{1}{2}$ an inch long; most of them approached to a triangular form. He found a weight in the bladder when they fell down, and he told me, he was sensible they came down the ureters. He leaped and ran sometimes to hasten their descent. I was present when he passed one, and I heard it fall into the urinal, and saw it there; his relations saw most of them when they were passed. These stones are not made up of several coats over each other, but look like bricks, and may easily be reduced to powder. In a fortnight's time he has passed above 60 of them by the yard.

Since writing this, the boy has passed several triangular stones, some thicker than the 6th part of an inch, and upon the 20th and 21st instant he has passed 3 by the fundament, 2 of them triangular, pretty large, and 1 as large as a little plum, but of the shape of a pear, of the same sandy consistence as the former, and of a greyish colour. He has passed none by the yard since he passed these the other way.

Inquiring about his diet, I was told by his parents, that for some years when they lived near the shore of the Firth of Forth, the boy frequently got a number of sand eels, (ammodites,) which he often boiled without taking pains to free them of the sand that stuck to them. This, with the glutinous juice of that fish, has furnished abundant matter for these stones. He continues passing daily several of them with great quantities of sand, notwithstanding the usual remedies are continued. This is a specimen of the art of nature and her mechanism, in giving such various shapes to these stones, by directing the matter so regularly to such forms. I shall give you some cases, which show her power in dissolving stones, when coated, and of a more united texture.

The first occurred in a reverend divine, now above the 70th year of his age. After having for 10 years suffered much from a confirmed stone in the bladder; since the beginning of this last winter he has passed, but with pain, a vast number of slices, of several figures, many of them cornered and pointed, about the thickness of a shilling, white within and smooth, but without of a dark colour; suppression of urine for several hours sometimes precedes them; he uses the ordinary remedies; in the intervals he has tolerable good health. I was told by an expert physician of 2 patients of his, the one yet living, who after passing an incredible number of these slices, is now in perfect health, and free from that disease. The other, who died long ago, after passing for a long time such slices, became free of the disease, and when his body was opened at his death, no stone nor slices were found in his bladder. So, even in this obstinate disease nature is sometimes the doctor.

Concerning an extraordinary Inundation in the Island of Mauritius. Communicated by Mr. Witsen, Burgo-Master of Amsterdam, F. R. S. N° 242, p. 268.

On the 22d March, 1696, at half an hour after 12 o'clock, being calm but a little rainy, the river which passes by the plain ground of Noardwyck, in the space of a quarter of an hour, swelled to such a height, that the sugar-mill, the sugar-work, and almost all the said ground was ruined, the most part of the sugar-canes being rooted or torn out of the ground by the violence of the torrent. It cannot be imagined what had caused so sudden a swelling of this river, for the rain was not very hard, and could not have produced that effect; for about 12 o'clock, when the company's servants assembled for dinner, the water of the river was at its ordinary height, and before they had half dined all the country was flooded a foot higher than 2 years since, when there was a hurricane and a most violent storm. It is very remarkable, that at 1 o'clock all the extraordinary water was gone, and the river again at its ordinary height. There has been no earthquake that could cause it, neither was there any such thing in other rivers.

Concerning Irish Slate. Extracted from the Minutes of the Philosophical Society at Oxford, March 18, 1683-4. N° 243, p. 271.

It having been hinted that the Irish slate pulverized, and infused in water for a night or less, would impart its vitriolic quality so far to it, that it would strike of a faint reddish colour with powder of galls, as the vitriolic waters of Tunbridge, Astrop, and dives others do; it not only led me to believe that some of these waters might as well issue from slate as an iron ore; unless it should appear, that this sort of slate were an iron ore too; which induced me to calcine it for 3 or 4 hours after the manner of Dr. Lister, to try whether it would then, like the other iron ore, apply to the magnet; but although the magnet did not take the least notice of it, yet it afforded me another discovery altogether satisfactory, viz. That upon torrefaction it became a yellow ochre, and would mark like it; which further persuades me, that the yellow, or rather orange-coloured sediment found at the bottom of these fountains, proceeds rather from this sort of slate than from an iron ore; for I much question whether some of the yellow ochres, though the red ones plainly do, proceed from, or are iron ores.

Some Observations in the East Indies, in answer to some Queries. N° 243, p. 273.

It does not appear that the Maldiva islands were ever joined to the main land, there being no soundings between the islands and the main, and the earth, sand, and shells of the one much differing from the other: the small shells, called cowries, which pass for money in Bengal and other places, are chiefly found there. The north and south poles are not visible under the line, for in the clearest night the horizon is so overcast with a thick darkness, that no star can be seen. The poles are seldom visible till they have 5 or 6 degrees latitude, though the night be ever so clear. Gum lac is the house of a large kind of ants, which they make on the boughs of trees, to keep them from the weather. It is certain that cloves will attract water at some distance, which is daily experienced among the Dutch in this country, who make a considerable advantage of it. I have known a bag of cloves laid over water 1 or 2 feet distant, a considerable quantity of which has been imbibed during a night; and the cloves have become so moist that the water might be pressed from them. There has been seen an oyster-shell in Bantam, that has been about 18 inches diameter, and several in Maccao that have been 18 inches long, and 5 or 6 broad, and the fish within proportionable to the shell. At Batavia a whole duck was taken out of the belly of a snake; and in Achin they killed a snake that had a whole deer in its belly.

They draw their wire in moulds of several sizes, gradually, as in England. The Chinese gild paper with leaf-gold and silver, laid on with a very good sort of varnish, the same with which they varnish their lacquered wares; all which, after it is thoroughly dry, they put in a screw-press, and with an instrument like our plane, shave it as fine as they please; and so they cut their tobacco, which is as fine as a hair. Ambergris is found more or less in most parts; great quantities are found at Japan, and to the eastward of Java, and at the Maldiva-islands; which, they say, they find generally fastened to the roots of trees that grow in the sea near the shore; and that while it is kept under water it is soft and pliable like wax, and sometimes like jelly: there is now a piece in India, which I have seen, that weighs above 2000 ounces.

The people of Java marry, and have children, at 9 or 10 years of age; and generally leave childbearing at or before 30. At Tonquin there are women common to any that will hire them, at 8 or 9 years of age.

The Japan and China varnish is made of turpentine and a curious sort of oil, which they mix and boil to a proper consistence, which never causes any swelling in the hands or face, &c. of such as make or work it. The swelling that often happens to those that work the lacquered ware, and sometimes to those that only pass by the shops and look on them at work, proceeds from the lac, and not the varnish; which lac is the sap or juice of a tree, which when cut, emits it slowly; it is catched by pots fastened to the tree; it is of the colour and consistence of cream, the top, that is exposed to the air, immediately turns black; and the way they make it black and fit for use, is to put a small quantity in a bowl, and stir it continually with a piece of smooth iron for 24 or 30 hours, which both thickens it and makes it black: they then add a quantity of very fine powder of any sort of burnt boughs, and mix the whole very well together, and then with a brush lay it smooth on any thing they design to lacquer; then let it dry very well in the sun, when it becomes harder than the board it is laid on. When it is thoroughly dry it is rubbed with a smooth stone and water till it is as smooth as glass, and on that lay the varnish made of turpentine and oil boiled to a due consistence, for black lac: but for red, or any other coloured lac, they mix the colour in fine powder with the varnish, taking care to lay the varnish on as smooth as possible; for therein lies the art of lacquering well. To print in gold or silver, &c. you must with a fine pencil, dipped in the varnish, draw what flowers, birds, &c. you please, and let it lie till it begins to be dry; then lay on the leaf-gold, or silver, or pin-dust, &c.

It is well known that there is among the Bramins a language called the

Sanscrit, written in a different character from that now in use; in which language are written in Porane or sacred history; the Shastram being to them what the Bible is to Christians; and the four Beads, one of which is lost, containing their divinity, law, physic, &c. and some other books; this language is not understood by all Bramins, but only by the studious and learned among them. It is evident that several of the languages now spoken in India are derived from the Sanscrit, and one of the Bramins wrote a book to show that the present Hindostan is derived from thence.

On the Motion of the Stomach and Guts. By Dr. Chr. Pitt. N° 243, p. 278.

In the dissection of a dog I observed that the peristaltic motion of the guts was continued throughout the stomach; the pylorus being in every waving brought below the very bottom of the stomach, I could manifestly observe a construction in the middle of the stomach, at every motion downward, passing it in so as to be able to compress what was contained in its cavity. And these motions were as regular and orderly as ever I saw it in the guts. I have seen the motion of the stomach in two or three that I have dissected since; so that we may safely conclude it holds true in all. The motion of the stomach being performed after this manner, may give us a clear account of the quickness of the distribution of the nourishment; the meat being no sooner opened by the spittle and liquor that we take in, than it has a free motion by the descent of the pylorus into the intestines, which is almost in a full stream from this compression in the middle of the stomach.

Concerning some regularly figured Stones lately found; and Observations on Ancient Languages. By Mr. Edward Lhwyd. N° 243, p. 279.

I should have troubled you with some sort of account of our travels, which have been tolerably successful, in discovering several fossil bodies. Several of these are modioli or vertebræ of sea stars; for I have been long since fully satisfied that all sorts of entrochi and asteriæ must be referred thither; not that I conclude that either these, or any other marine terrestrial bodies, were ever really either parts or exuviæ of animals; but that they bear the same relation to the sea-stars, that glossopetræ do to the teeth of sharks; the fossil shells to the marine ones, &c. You have done me an inexpressible kindness, by procuring a correspondence with Mr. Pezron. His notion of the Greek, Roman, and Celtic languages being of one common origin, agrees exactly with my observations: but I have not advanced so far, as to discover the Celtic to be the mother-tongue, though perhaps he may not want good grounds, at least plausible arguments, for such an assertion. The Irish comes in with us, (the Welsh,) and is a dialect of the old Latin, as the British is of the Greek: but the Gothic or Teutonic, though it has also much affinity with us, must needs make a band apart.

Remarks concerning Factitious Salts, drawn from a Discourse written by Sig. Francisco Redi. N° 243, p. 281.

The method of extracting the factitious salts here mentioned was by burning the vegetables experimented on to ashes, afterwards lixiviating the said ashes, then filtrating the lixivium, and lastly, evaporating and crystallizing. Of this paper it is only necessary to reprint the tables, showing the relative quantities of ashes and salts obtained from various vegetables.

Pounds.	Vegetables.	Ashes. ℔	℥	ʒ	Salts. ℥	ʒ
100	Of dried flowers of oranges	4	6	0	0	5
800	Of gourds new gathered which dried in the oven were 36℔	4	0	0	10	0
400	Red onions being (720) roasted, the coals turned to 16℔ to the coals new added 4℥ of sulphur	1	6	0	2	2
150	Eyebright fresh, and afterwards stilled and burnt	5	0	0	4	0
120	Distilled roses	4	0	1	0	0
100	Of maidenhair	9	0	0	0	4
150	Roots of black hellebore, which dried came to 50℔	6	0	0	1	0
150	Roots of white hellebore fresh, which dried came to 50℔	2	0	0	4	0
96	Roots dried and burnt of fresh esula	3	0	0	2	0
30	Roots of liquorice	2	0	0	1	4
20	Pellitory	1	0	0	0	6
100	Green endive	2	0	0	2	0
90	Green bindweed	1	0	0	2	0
2000	Leaves of laurel	33	0	4	0	0
500	Leaves of laurel	6	0	0	10	0
1000	Water melons well ripe, the seeds being taken	25	0	1	9	0
2400	Cucumbers	18	0	0	0	0
300	Wood of ivy	9	0	0	0	0
50	Scorzonera dried	8	0	0	0	0
300	Pine apples, the nuts taken out	3	0	0	0	0
150	Mugwort dried	8	0	0	0	0
130	Leaves of cyprus	6	0	0	0	0
10	Peel of pomegranates dried	0	8	0	0	0
2	Sassafras	0	0	0	0	0
12	Lignum sanctum	2	6	0	0	0
4	Yellow sanders	0	1	4	0	0
4	Black pepper	0	2	4	0	0
30	Ginger	1	7	0	0	0
12	Turbith	1	0	0	0	0
	Wood of fir	3	0	0	3	0
	Scopæ	16	0	1	4	0
	Scopæ	16	0	1	6	0

A Table of the Ashes which 100lb. *give.*

[This and the following table exhibit the differences between the ashes, after the rate of 100℔ of vegetables, and between the salts, after the rate of 1℔ of ashes, set down according to the order of the excesses.]

	℔	℥	ʒ	℈	gr.
Red onions	0	4	4	0	0
Gourds	0	6	0	0	0
Cucumbers	0	9	0	0	0
Pine nut-shells	1	0	0	0	0
Yellow sanders	1	0	4	0	0
Bindweeds	1	1	2	2	0
Laurel leaves	1	2	0	0	0
Roots of white hellebore	1	4	0	0	0
Other leaves of laurel	1	7	4	2	10
Endive	2	0	0	0	0
Wheat flour	2	2	5	1	0
Water melons	2	6	0	0	0

	℔	℥	ʒ	℈	gr.
Ivy	3	0	0	0	0
Roots of esula	3	1	4	0	0
Sassafras	3	1	4	0	0
Eyebright	3	4	0	0	0
Distilled roses	3	4	0	0	0
Roots of black hellebore	4	0	0	0	0
Orange flowers	4	6	0	0	0
Leaves of cyprus	4	7	3	5	0
Pellitory	5	0	0	0	0
Black pepper	5	2	4	0	0
Ginger	5	3	2	2	0
Mugwort	5	4	0	0	0
Pomegranate bark	6	8	0	0	0
Roots of liquorice	6	8	0	0	0
Turbith	8	4	0	0	0
Maiden-hair distilled	9	0	0	0	0
Scorzonera	16	0	0	0	0
Lignum sanctum	20	0	0	0	0

A Table of the Salts which are extracted from One Pound of Ashes.

	℥	ʒ	℈	gr.
Maiden-hair	0	0	1	8
Roots of black hellebore	0	0	4	0
Orange flowers	0	1	0	8
Laurel leaves	0	3	1	22
Root of esula				
Roots of liquorice	0	6	0	0
Pellitory	0	6	0	0
Water melons	0	6	1	11
Red onions	0	7	1	0
Endive	1	0	0	0
Fir	1	0	0	0
Roots of white hellebore	1	0	0	0
Scopæ	1	0	0	0
Another	1	1	0	0
Eyebright	1	1	1	9
Other leaves of laurel	1	5	1	6
Bindweed	2	0	0	0
Gourds	2	4	0	0
Roses	3	0	0	0

Concerning a Shower of Fishes. By Dr. Rob. Conny. N° 243, p. 289.

On Wednesday before Easter, Anno 1666, a pasture field at Cranstead, near Wrotham, in Kent, about 2 acres, which is far from any part of the sea, or branch of it, and a place where are no fish ponds, but a scarcity of water, was all overspread with little fishes, conceived to be rained down, there having been at that time a great tempest of thunder and rain; the fishes were about the length of a man's little finger, and judged by all that saw them to be young whitings. Many of them were taken up, and showed to several persons. The field belonged to one Ware, a yeoman, who was at that Easter-sessions one of the grand inquest, and carried some of them to the sessions at Maidstone in Kent, and he showed them, among others, to Mr. Lake, a bencher of the Middle Temple, who had one of them, and brought one to London. The truth of it was averred by many that saw the fishes lie scattered all over that field. There were none in the other fields adjoining: the quantity of them was estimated to be about a bushel.

The Way of making Pitch, Tar, Rosin, and Turpentine, near Marseilles. Communicated in a Letter from Nismes. By Mr. Thomas Bent. N° 243, p. 291.

Five leagues from Marseilles are very high mountains, for the most part covered with forests of pine trees. Half a league out of the road is seen the making of pitch, tar, rosin, and turpentine, which is thus: in the spring time, when the sap runs most, they pare off the bark of the pine, to make the sap run down into a hole, dug at the bottom to receive it: as it runs, it leaves a cream or crust behind it, which is tempered in water, and fraudulently sold for white bees-wax, to make flambeaux of. Then they take up the juice in scoops from the bottom, and having a good quantity, they strain it through a grocer's basket, such as they put up Malaga raisins in; that which runs easily through is the common turpentine; then they take that which remains above, and adding a sufficient quantity of water, distil it in an alembic; what is so distilled is oil of turpentine, and the residuum that is left is common rosin. Afterwards they cut the stock of the tree into large chips, and pile them hollow in a cave, covering it over the top with tiles, but so as to let some air come in to feed the fire; then burning them, there runs down a thick juice to the bottom, where they may make a small hole for it to run out at, for a large hole would set it all in a flame; and that which so runs out is tar; which tar being boiled gently over again, to consume more of the moisture, becomes pitch when cold.

Concerning a Woman who voided the Bones of a Fœtus above the Os Pubis, and by other extraordinary Ways. N° 243, p. 292.

Margaret Parry, of Kintbury in Berkshire, in 1668 was delivered of a child. She continued indifferently well two or three days after her delivery; then new pains came upon her, and for three weeks together there came from her daily some quantity of corruption, with pieces of flesh and skin; and she continued dangerously ill for about eight weeks, at the end of which time she was relieved, as is supposed, by taking a potion which was prescribed her. After two years she began to breed again, and had three children in the three years following, all which were drawn from her by violence. During her lying-in with the last of these three children, some bones of a fœtus came from her; after this several other bones came away with her catamenia, and several, among which were parts of the skull, and some of the larger bones of the body of a fœtus, worked their way by degrees through the flesh above the os pubis.

The woman is now living, October 1684, and in health; all the children were born perfect.

On the Barometer and other Observables. By Dr. Ashe, Lord Bishop of Cloyne. N° 243, p. 293.

On the evening of March 3, 1687, we had much thunder; and that and the next day the mercury in the barometer was much lower than ever I observed it, viz. only $\frac{4}{10}$ above 28 inches.—March 18th, I observed here the occultation of

Saturn by the moon, which happened at 12h. 13m. 55s.: it passed directly under the midst of the moon's disc: clouds hindered the emersion.—Dr. Mullen tried lately an experiment on the famous Irish herb mackenboy, or tithmalus hibernicus, which has been long reported to be so strong a purge, that even the carrying it about in one's clothes is sufficient to produce the effect; this fabulous story he proved false, by carrying its roots for three days in his pocket, without any effect. A quarry of white marble has been lately discovered in the county of Antrim, a specimen of which was brought to us; it is of an extremely fine grain; soft at first, but grows very hard afterwards, like Portland stone.

Concerning Rusma and Alcanna. N° 243, p. 295.

Dr. Plot showed us some of the Turkish rusma and alcanna, lately received from Mr. Smith, chaplain to the factory at Smyrna, who writes on the use of the rusma as follows: The black earth, which looks as if it were burnt, must be beaten in an iron or marble mortar to a fine powder, and carefully sifted. When you use it, take one part of the powder, and 2 parts of unslaked lime, put these mixed together into a linen rag, which infuse in warm water for the space of a quarter of an hour, or till it becomes of a black colour; then apply it to the place from whence you would take the hair; as soon as the hair begins to be loose, the part must be washed with warm water and soap.* The alcanna † is the leaf of a plant dried and powdered, which when steeped a night in wine, will dye the nails red, [yellow ?]

To give Iron a Copper Colour. By Sir Robert Southwell, F. R. S. N° 243, p. 296.

Take of small thin copper pieces, cleaned in the fire, ℥j, of aquafortis ℥iij; which being put together in a glass, the copper in 3 or 4 hours will be dissolved; when cold you may use it, by washing with a feather upon the iron, made clean and smooth, and it will presently take the colour of copper: when it comes off by much rubbing, you may renew it again; but if you do it twice together, the iron will look black.‡

* Rusma is said to be a composition of quicklime and orpiment. It is to the quicklime that its depilatory power is chiefly to be ascribed.

† The alcanna of the Turks is said to be prepared from the leaves of the lawsonia inermis, Linn. It must not be confounded with the European alkanet, which is the root of the anchusa tinctoria.—Linn.

‡ In this experiment, the copper is precipitated in its reguline state, from its solution in aquafortis (nitrous acid) in consequence of the greater affinity of that acid to the iron, a portion of which last metal is in consequence dissolved.

To Gild Gold upon Silver. By the same. N° 243, p. 296.

Beat a ducat thin, and dissolve it in 2 oz. of aqua regia; then dip a clean rag in it, and let the same dry: and do it again and again, till all the liquor be soaked up; then burn the rag, and with the tinder of it let silver be rubbed, using a little spittle with it, and if by chance the silver will not take, then hold it to the fire to take away all manner of grease, and it will not fail.

Concerning the strange Effects reported of Music in former Times, beyond what is to be found in later Ages. By Dr. Wallis. N° 243, p. 297.

I take it for granted, that much of the reports, concerning the great effects of music in ancient times, are highly hyperbolical, and next door to fabulous; so that great abatements must be made from their elogies. We must consider, that music to any tolerable degree was then, if not a new, at least a rare thing, which the rustics, on whom it is reported to have had such extraordinary effects, had never heard before: and on such, a little music will do great feats, as we find at this day a fiddle or a bagpipe at a country morrice-dance.

We are to consider, that their music, even after it came to some degree of perfection, was more plain and simple than ours now a-days. They had no concerts of two, three, four, or more parts or voices: but one single voice, or single instrument, which, to a rude ear, is much more pleasing than more compounded music. For that is at a pitch not above their capacity; whereas this other confounds them, as it were with a great and indistinct noise.

We are to consider, that music with the ancients was of a larger extent than what we call music now. For poetry, and dancing or a comely motion, were then accounted parts of music, when this arrived to some perfection. Now we know that verse of itself, if in good measure and affectionate language, and set to a musical tune, and sung by a good voice, and accompanied with soft instrumental music, such as not to drown the emphatic expressions, like what we call recitative-music, will work strangely on the ear, and move all the affections suitable to the tune and ditty; whether brisk and pleasant, or soft and pitiful, or fierce and angry, or moderate and sedate; especially if attended with a suitable gesture and action. Now all these together, which were all ingredients in what they called music, must needs operate strongly on the fancies and affections of ordinary people, unacquainted with such kind of entertainments. For, if the deliberate reading of a well written romance will produce mirth, tears, joy, grief, pity, wrath, or indignation, much more would it do so, if accompanied with all these circumstances.

It will perhaps be asked, why may not all this be now done as well as then? I answer, no doubt it may; if an address be made, in proper words with moving arguments, in just measures, with the emphatic words pronounced with a good voice, and a true accent, and attended with a becoming gesture; and all these suitably adjusted to the passion, affection, or temper of mind, particularly designed to be produced, will certainly now, as well as then, produce great effects, especially on a surprise, and where persons are not otherwise pre-engaged: and if so managed as that you be, or seem to be, in earnest: and, if not overacted by apparent affectation.

We are to consider, that the usual design of what we now call music, is very different from that of the ancients. What we call music, is only what they called harmonic; which was but one part of their music, consisting of words, verse, voice, tune, instrument, and acting, and we are not to expect the same effect from one part as from the whole. When music had arrived to a great perfection, it was applied to particular designs of exciting this or that particular affection, passion, or temper of mind; the tunes and measures being suitably adapted. But such designs seem almost quite neglected in our present music; for the chief design now, in our most accomplished music, is to please the ear; when, by a sweet mixture of different and parts voices, with just cadences and concords intermixed, a grateful sound is produced; which to a common ear is only a confused, though somewhat pleasing noise, of they know not what, while only the judicious musician can discern and distinguish the just effects.

It is true, that even this compound music admits of different characters; some are more brisk and airy; others more sedate and grave; others more languid; as the different subjects require. But that which is most proper to excite particular passions or dispositions, is such as is more simple and uncompounded: such as a nurse's languid tune, lulling her babe to sleep; or a continued reading in an even tone; or even the soft murmur of a little rivulet, running upon gravel or pebbles, inducing a quiet repose of the spirits: and on the contrary, the briskness of a jig, on a fiddle, exciting to dance. And these are more operative to such particular ends, than an elaborate composition of full music. To conclude; if we aim only at pleasing the ear, by a sweet concert, no doubt our modern compositions may equal, if not exceed those of the ancients: among whom I do not find any traces of what we call several parts or voices, as bass, treble, mean, &c. sung in concert, answering each other to complete the music. But if we would have our music so adjusted, as to excite particular passions, affections, or temper of mind, as that of the ancients is supposed to have done, we must apply more simple ingredients, fitted to the temper we would produce. For in the sweet mixture of compounded music, one thing so corrects another that it does not operate strongly any one way. But this no doubt a judicious composer may so manage that with the help of such hyperboles, as those with which the ancient music is wont to be set off, our music may be said to produce as extraordinary effects as theirs.

An Account of Books.—I. Basis Botanica; *seu, Brevis ad Rem Herbariam Manuductio, omnes Plantarum Partes, una cum earumdem Virtutibus secundum novissima Botanicorum Fundamenta generali quadam Methodo commonstrans, edita a D. Christiano Ludovico Welschio. Lips.* 1697, 12*mo*. N° 243, p. 304.

II. Juli Pflugh Equitis Saxonici Epistola ad Perillustrem atque Generosissimum Virum Ludovicum à Seckendorff, Virum de utraque Republica meritissimum, præter Fata Bibliothecæ Budensis, Librorum quoque in ultima Expugnatione repertorum Catalogum exhibens. Jen. 1688, *in 8vo*. N° 243, p. 305.

This letter (of about 112 pages) was intended to be published sooner, had not the author thought Tollius would have undertaken the task. This library was first collected by Matthias Corvinus (who died Anno 1490) from all parts of the world, consisting both of printed books and manuscripts; printing being then young, he kept writers in many places to enrich his library in what it wanted from Greek; he got many Hebrew, Greek, and Latin books from Constantinople and Greece, when those places were taken; 40, or 50,000 books were said to be in the library, either printed or manuscript. Bosmannus Cardinalis offered the Turks for them 200,000 nummi imperiales. When Buda was taken by the Turks, this library was pillaged by the soldiers. Busbeckius bought many of the books, and brought them to Vienna; Johannes Sambucus purchased many, which are now also the emperor's. Billibaldus Birckheimerus got some which now belong to the Royal Society. Of the remainder which were at Buda when it was taken, an account is here given in a catalogue taken by a missionary Jesuit. At the close of the book is a catalogue of some manuscripts, formerly belonging to this library, which are now in that of the Duke of Wolfenbuttel.

III. Dissertatione Epistolare del Fosforo Minerale o sia della Pietra illuminabile Bolognese, à Sapiente ed Eruditi Signori Collettori degli Acta Eruditorum di Lipsia, scritta da Luigi Ferdinando Conte Marsigli, &c. Lips.* 1698, *in 4to.* N° 243, p. 306.

This dissertation of 31 pages, was designed to be presented by the author

* Count Louis Ferdinand Marsigli was renowned both as a soldier and a philosopher. He was born at Bologna in 1658, and received an excellent education, attending the lectures of the most celebrated

to Mr. Boyle, but has been laid aside since his death, till now. This Bononian stone is found 3 miles from Bononia, in the mountain Paderno, or 8 miles westward from thence, in that hill called Predalbino.*

To make it shine, it is prepared by grating the stone smooth with a file, dipping it in brandy; after which it is rolled in some fine powder of the same stone, and calcined in an open furnace, being placed in the middle of live charcoal. When the stone is calcined the crust is taken off, and the surface of the stone, which is become yellowish, when exposed to the daylight imbibes the light, and shines like a coal in the dark. It will not be calcined into lime. The stone shines in water, and receives the light in oil of nuts, but will not emit it till it be out of it.

At the end of this treatise is an account of plaister or gesso, of the several

professors at that time in Italy, such as Montanari, Borelli, Malpighi, &c. After he had completed his course of academical studies, of which the mathematical sciences formed a principal part, he travelled to Constantinople, where he made those observations on the Ottoman empire, and on the Bosphorus, which formed the subject of two separate publications. On his return from Turkey he entered into the service of the emperor Leopold I. to whom his knowledge of fortifications proved highly serviceable, at a time when the Turks threatened an irruption into Hungary. In these campaigns, however, he was unfortunately wounded and taken prisoner by the Tartars, under whom he suffered extreme hardships, as well as under the Turks, to whom he was sold. Being at length redeemed, he entered a second time into the Imperial service, during the war between Austria and France respecting the Spanish succession, and was promoted to the rank of a general; but of this rank he was shortly after deprived, in consequence of the surrender of the fortress of Brisac in 1793, where he was second in command. Concerning this transaction he published a justificatory memorial, in which he makes it appear that the place was so badly garrisoned, and so ill provided with stores and ammunition, as to have been incapable of holding out longer. After this, as it would appear, unmerited disgrace, he devoted himself wholly to science, and became the founder of a college at Bologna, called the Institute of Sciences and Arts. To this institution he gave his numerous specimens in natural history, his cabinet of mathematical and philosophical instruments, his maps and plans of fortifications, his models of machines, his collection of antiquities, and last of all some thousand volumes of books, which he had purchased at a great expence during his travels in France, England, and Holland. He moreover established a printing-house and letter-foundry for Latin, Greek, Hebrew, and Arabic. This establishment was unconnected with the Institute, and placed in the hands of the Dominican friars. He died in his native city, to the celebrity of which as an university he had so largely contributed, of a stroke of apoplexy, in 1730, aged 72. His two principal works are 1, his Histoire Physique de la Mer, fol. 1715; and 2, his Danubius Pannonico-Mysicus in 6 vols. fol. 1726, or the history, geographical and natural, of the river Danube, especially in its course through Hungary. Of this costly, but in some parts not very accurate work, the 1st vol. treats of the course and navigation of the river, the force of its current, &c. &c.; the 2d, of the antiquities found on its banks and neighbourhood; the 3d of the Danubian fossils and metals; the 4th, of the fishes and crustacea; the 5th, of the Danubian or Hungarian birds; and the 6th and last, of the quadrupeds, insects, and vegetables, found upon or near the banks of this noble river.

* To what class of minerals this stone belongs, has already been noticed at p. 382, vol. ii. of this Abridgment.

kinds of it, and where they are dug. He tells us, that the workers in it, in some days time, are cured of the itch, either by means of its astringent quality or sulphur.

The whole treatise is illustrated with a variety of figures.

On a Roman Coffin, and other Antiquities lately found in Yorkshire. By Ralph Thoresby, Esq. F.R.S. N° 244, p. 310.

I have procured another curiosity relating to the plastics of the Romans: it is part of the bottom of an old Roman coffin, lately dug up in their burying place out of Boutham Bar at York. It is of the red clay, but not so fine as the urns; it is 14½ inches long, and about 11 broad at the narrower end, and near 12½ at the broader; this was the lowest part, for the rest was proportionably broader, till it came to the shoulders: it is an inch thick, besides the ledges, which are 1 broad and 2 thick, and extend from the bottom of either side to within 3 inches of the top, where it is wholly flat, and somewhat thinner for the next to lie upon it. The several parts were thus joined together by some pin, I presume, for at the end of each tile is a hole that would receive a common slate pin; these edges are wrought a little hollow, probably to receive the sides, and at the feet are 2 contrary notches, to fasten the end-piece. I procured some scars of broken urns of the finest clay, dug up in a garden, together with a Roman shuttle, about 3½ inches long, but not 1 inch broad in the very middle, the hollow for the licium being but ¼ of an inch in the broadest place. I have also a Roman pottle from Aldbrough, which is of the red clay, but coarser than the York urns: I was pleased to find it whole, that I might observe the difference between their congius, of which I take this to be exactly the half, and our gallon; and this comes the nearest to Mr. Graves's computation, containing 3½ pints, Winchester measure.

Last week I received a valuable present of 22 old Roman coins, from Mr. Townley of Townley, which were lately found in the parish of Burnley in Lancashire. Many of them are consular or family coins: one of them, viz. Q. Cassius, was 162 years A. C. That they were the ancient Roman Denarii, and coined before the emperors' times, I think is evident, because there is mostly, instead of the emperor's head, the antique form of the city's head, without an inscription: besides, Tacitus calls these bigati and quadrigati, pecuniam veterem ac diu notam, i. e. coins having the image of a chariot drawn by 2 and by 4 horses. Again, others have upon them ROMA, which I find not used by any of the emperors, except those small pieces on the translation of the empire to Constantinople again; the letters in these are often interwoven, as particularly VL, in one I have of L. Valerius Flaccus A. V. C. CDXCII, which according to Goltzius, is the 7th year after the Romans first stamped silver money; and, to mention no more, many are of the Serratos, filed in small notches round the edge, of which sort I have of Scipio Asiaticus, &c. and other consular pieces, but never saw any of a later date.

An Account of some Indian Plants, &c. with their Names, Descriptions, and Virtues. Communicated in a Letter to Mr. James Petiver, Apothecary and F.R.S. from Mr. Sam. Brown, Surgeon at Fort St. George. N° 244, p. 313.

Forty-six plants collected by Mr. Brown at Unanercoonda, were sent, with their Malabar names, to Mr. Petiver for his examination. Mr. P. gives the synonyms of these plants from the Hort. Malabar. from Pluckenet's Phytogr. Ray's Hist. Plant. &c. with their descriptions and uses.

Concerning Magnetical Sand. In a Letter from Mr. Butterfield to Dr. Lister. N° 244, p. 336.

I send you a little of that black sand which in Italy they use instead of dust to their letters; it is found 6 miles from Genes, near St. Piere d'Araine, on the sea-shore. It has the properties of the load-stone, and I believe that it is loadstone, or the powder of it, for it follows the loadstone; it also sticks to a knife that is touched with the loadstone: it draws a magnetic needle; does not ferment with aquafortis, like iron dust; does not rust with any acid that can be put to it; nor sparkle in the flame of a candle, like steel dust. It is commonly found on the sea-shore after great storms.

An Objection to the new Hypothesis of the Generation of Animals from Animalcula in Semine Masculino. By Dr. Martin Lister, Fel. Coll. Phys. and R. S. N° 244, p. 337.

Amongst the many arguments which I have used to confute the opinion of Mr. Leuwenhoeck about the generation of animals from innumerable little animals in semine masculino, one I omitted, which is as follows:*

Rursus quæro, si humanum corpus nascatur ab animalculo è semine masculino unde sint ista animalcula genita? et quidem generantur ad plurimos annos; scilicet ab adulto viro ad extremam usque senectutem; certe à coitu peracto longè maxima eorum pars ejicitur; unde nova soboles indies succrescat, necesse est. An vero hæc animalculorum proles ferè diurna à sui similibus animalculis gene-

* From the peculiar nature of this subject it has been deemed proper to reprint this short but cogent objection against the hypothesis of Leuwenhoeck in the original Latin.

rentur, vel sponte nascantur? Posterius te, Leuwenhoecke, existimare haud facilè credo, quia tu, si quis alius, automata mirificè confutasti; si prius verò putes ipsa etiam illa animalcula, dum in semine masculino sunt, adulta esse sequeter, quòd generare potes sunt. At quam absurdum hoc sit, tute cogita: scilicet eadem animalia bis adolescere, nempe semel in semine masculino, atque iterum in humano statu atque conditione.

Account of a Book, viz. An Abstract with some Reflections on a new Account of East-India and Persia, in Eight Letters, being Nine Years Travels, begun 1672, *and finished* 1681, *&c. By John Fryer, M. D. F. R. S.* 1698. N° 244, p. 338.

The Symptoms that attended the Bite of a Serpent. Communicated by Mr. Aaron Goodyear. N° 245, p. 351.

Mr. Robert Burdett, an English merchant at Aleppo, was bit by a serpent on the left wrist, near the pulse towards his hand; it seemed at first like 2 pricks of a pin; he immediately vomited, and his wrist and hand began to swell presently; he had some few days before a looseness, which this perhaps increased: he rode easily alone, after he was bit, above 2 miles off to Aleppo; he felt no pain, but a great desire to sleep; his arm continued swelling upwards, and grew black. Some remedies were used, till the rest of the factory returned, who then began to cup and scarify his arm; he having still no pain, but a great drowsiness. At last the swelling came up to his shoulder, and then he complained much; and within ¼ of an hour he died. He was bit about ten in the forenoon, and died about 3 in the afternoon. His body swelled much after death, and purged. The snake was in length like a common snake; his colour dark sandy, with black spots; his 2 teeth, or fangs, like those of a rattle-snake, on the upper jaw; the poison lies in the gums: and wherever they fetch blood of any creature they certainly kill; though in some parts sooner than in others. The oil of tobacco kills the serpent, if put in his mouth, as was experienced. The people of the country say, that if, as soon as any one is bit by a serpent, they shall suck immediately the wound, they may be saved; but they rub first their gums and teeth with oil, that none of the poison may touch any place; where the skin is broken, and spit out immediately what they suck, every time washing the mouth, and taking more oil. This serpent killed a dog, in about 8 minutes time, biting him at the end of his ear; and 2 young turkeys afterwards in 3 or 4 minutes each, biting them at the end of a claw; and then we poisoned him with the oil of tobacco out of a reed pipe (that had been much used, and not cleansed for a week or two) and he died in about 2 or

3 minutes, trembling as soon as the oil was dropped into his mouth. There are people who get their bread by showing these serpents: they find them in hot days near rocks, and putting a stick near the head, they take them up carefully by the neck, and put them into a leather bag.

A Method of instructing Persons Deaf and Dumb to speak, and understand a Language. By Dr. Wallis. N° 245, p. 353.

Teaching deaf persons to speak, or to speak plain, is to be done by directing them to apply their tongue, lips, and other organs of speech, to such postures and motions, as are proper for the formation of such and such sounds respectively, as are used in speech. And then the breath, emitted from the lungs, will form those sounds; whether the person speaking hear himself, or not. Of which respective formation, of all sounds commonly used in speech, I have given a full account, in my Treatise De Loquela; prefixed to my Grammar of the English tongue, published in the year 1653: in pursuance of which, I attempted the teaching of deaf persons to speak.

For the other part of the work, to teach a language, it is necessary in the first place, that the deaf person be taught to write: that there may be somewhat to express to the eye, what the sound of letters represents to the ear. It will next be right, as pen and ink is not always at hand, to teach him how to design each letter by some certain place, position, or motion, of a finger, hand, or other part of the body; which may serve instead of writing. As for instance, the five vowels, a, e, i, o, u, by pointing to the top of the five fingers; and the other letters, b, c, d, &c. by such other place or posture of a finger, or otherwise, as shall be agreed upon. After this, a language is to be taught the deaf person, by such methods as children are at first taught, except that the children learn sounds by the ear, but the deaf person is to learn the marks of those sounds by the eye. But both equally signify the same things or notions; and are equally of arbitrary signification. It is then most natural, to furnish him by degrees with a nomenclature, containing a competent number of names, of things common and obvious to the eye, that you may show the thing answering to each name; and these should be arranged under convenient titles, and placed under them in several columns, or other orderly situation in the paper, as by their position best to express to the eye their relation to each other. As, contraries or correlatives, one over against the other; subordinates or appurtenances, under their principals: which may serve as a kind of local memory. Thus, in one paper, under the title Mankind, may be regularly placed man, woman, child, boy, girl; and, if you please, the names of some known persons, with spaces left to be supplied with other like names or words, as afterwards there may be occasion.

Then in another paper, under the title Body, may be written in the like proper order, head, hair, skin, ear, face, forehead, eye, eye-lid, eye-brow, cheek, nose, mouth, lip, chin, neck, back, breast, side, belly, shoulder, arm, &c. With like spaces as before, that more may be added as there is occasion.

And when he has learned the import of the words in each paper, let him write them in the same manner in distinct leaves or pages of a book, prepared for that purpose, to confirm his memory, and to have recourse to it on occasion. In a third paper, you may give him the Inward Parts: as, scull, throat, stomach, heart, lungs, &c. In another paper, under the title Beast, may be placed, horse, cow, sheep, hog, dog, hare, rabbit, cat, &c. Under the title Bird or Fowl, put cock, hen, goose, duck, swan, crow, kite, lark, &c. Under the title Fish, put pike, eel, plaice, salmon, lobster, crab, oyster, cray-fish, &c. You may then put plants or vegetables, under several heads, or subdivisions of the same head; as, tree, fruit, flower, herb, corn, &c. And the like of Inanimates; as, heaven, sun, moon, stars, elements, earth, water, air, fire, stone, metal, glass, &c. Under the title Cloths, put the several sorts; as, woollen, linen, &c. Under the title House; put wall, roof, door, window, room, &c.

And under each of these, as distinct heads, the furniture or utensils belonging, with divisions and subdivisions, as there is occasion. And, in like manner, from time to time, may be added more collections or classes of names or words, properly digested under distinct heads, and suitable distributions, to be written in distinct leaves or pages of his book, in such order as may seem convenient.

When he is furnished with a competent number of names, it will be time to teach him, under the titles Singular and Plural, the formation of plurals from singulars, by adding s or es: as, hand, hands; face, faces; fish, fishes, &c. with some few Irregulars; as, man, men; woman, women; foot, feet, &c. Which will serve for Possessives, to be afterwards taught him, which are formed from their Primitives, by the like addition of s or es; except some few Irregulars, as, my, mine; thy, thine; our, ours; your, yours; his; her, hers; their, theirs, &c. And in these cases, it will be proper first to show him the particulars, and then the general title.

Then teach him (in another page, or paper) the Particles: a, an; the, this, that; these, those. And the Pronouns; I, thou, he, it, they, who, &c. Then under the titles Adjective, Substantive, teach him to connect these; as, my hand, your head, his foot, their shoes, &c. And to furnish him with more Adjectives, under the title Colours, you may place black, white, grey, &c. and having showed the particulars, let him know these are called Colours. The like for taste, smell, hearing, and touch or feeling. From whence you may furnish him with more examples of Adjectives with Substantives, as white bread, brown bread, soft cheese, hard cheese, black hat, &c. And then, inverting the order, Substantive and Adjective, with the verb Copulative between; as, silver is white, gold is yellow, lead is heavy, wood is light, snow is white, ink is black, &c. which will begin to give him some notion of Syntax. In like manner, when Substantive and Substantive are so connected; as, gold is a metal; a rose is a flower; horses are beasts; larks are birds, &c.

Then, as those before relate to quality, you may give him some other words relating to quantity; as, long, short, broad, narrow, thick, thin; much, many, few, full, empty, &c. Then words of figure; as, straight, crooked, concave, convex; round, square, &c. Of gesture; as stand, sit, &c. Of motion; as, move, rest, walk, run, fly, creep, &c.

Then, words relating to time, place, number, weight, measure, money, &c. are in proper time to be shewed him, distinctly. As likewise, the names and situations of places, and countries, which are convenient for him to know; and which may be written orderly in his book; and showed him in maps.

After the concord of Substantive and Adjective, he is to be showed, by proper examples, that of the Nominative and Verb; as for instance, I go, he sits, the fire burns, the sun shines, and the like: with the titles on the top, Nominative, Verb. Then, under the titles, Nominative, Verb, Accusative, give him Examples of Verbs Transitive; as, I see you, you see me, the fire burns the wood. Or even with a Double Accusative, as, you teach me writing, or to write, &c. After this, you may teach him the Flexion or Conjugation of a Verb; or what is equivalent to it: for in our English tongue, each Verb has only two Tenses, the Present and the Preter, and two Participles, the Active and the Passive: all the rest is performed by auxiliaries; which auxiliaries have no more tenses than the other verbs. Those auxiliaries are, do, did, will, would, shall, should, may, might, can, could, must, ought to, have, had, am, be, was: and if by examples you can insinuate the signification of these few words: you will then have taught him the whole flexion of the verb.

And here it will be proper once for all, to write him out a full specimen of some verb, as to see, through all those auxiliaries. The verb itself has only these four words to be learned; see, saw, seeing, seen; except that, after thou in the second person singular, in both tenses, we add est; and in the third person singular, in the present tense, eth or es: or, instead thereof, st, th, s. And so in all verbs. Then, to the auxiliaries, do, did, will, would, shall, should, may, might, can, could, must, ought to, we adjoin the Indefinite see: and after have, had, am, be, was, the Passive Participle seen. And so for all other verbs. But the auxiliary am or be, is somewhat irregular, in a double form; am, art, is, plural are; was, wast, was, plural were; be, beest, be, plural be; were, wert, were, plural were; be, am, was, being, been: which attended with the other auxiliaries make up the whole passive voice.

All verbs without exception in the Active Participle, are formed by adding ing; as, see, seeing, teach, teaching, &c. The Preter Tense, and the Passive Participle, are formed regularly by adding ed; but are often subject to contractions, and other irregularities, sometimes the same in both, sometimes different: and therefore it is proper here to give a table of Verbs, especially the most usual, for those three cases: which may at once teach their signification and their formation: as boil, boiled, boiled; bake, baked, baked, &c. teach, taught, taught; buy, bought, bought, &c. give, gave, given; take, took, taken; write, wrote, written, &c.

The Verbs being thus dispatched, he is then to learn the Prepositions, wherein lies the whole regimen of the noun; for diversity of cases we have none; the force of which is to be insinuated by proper examples, suited to their different significations: as for instance, of, a piece of bread; a glass of wine, &c. And in like manner for, off, on, to, from, at, in, by, &c. And, by this time, he will be pretty well enabled to understand a single sentence. In the last place, he is in like manner to be taught Conjunctions, as, and, also, or, if, but, &c. and these illustrated by examples; as, because I am cold; therefore I go to the fire; that I may be warm; for it is cold weather.

By this time, his book, if well furnished with plenty of words, and those well digested under several heads, and in good order, and well recruited from time to time as new words occur, will serve him in the nature of a Dictionary and Grammar. And in case the deaf person be otherwise of a good natural capacity, and the teacher of good sagacity, by this method proceeding gradually step by step, you may with diligence and due application, of teacher and learner, in a year's time, or thereabouts, perceive a greater progress than you would expect; and a good foundation laid for further instruction, in matters of religion, and other knowledge which may be taught by books.

It will be convenient all along to have pen, ink, and paper, ready at hand, to write down in words what you signify to him by signs; and cause him to write, or show him how to write, what he means by signs. Which way of signifying their mind by signs deaf persons are often very ready at. And we must endeavour to learn their language, if I may so call it, in order to teach them ours, by showing what words answer to their signs. It will be proper also, as you go along, after some convenient progress made, to express in as plain language as may be, the import of some of the tables: as for instance, the head is the highest part of the body; the feet the lowest part; the forehead is over the eyes, &c. And such plain discourse, put into writing, and particularly explained, will teach him by degrees to understand plain sentences: and such like advantages a sagacious teacher my take, as occasion offers.

Thus I have given a short account of my methods, used in such cases with good success: particularly in teaching Mr. Alexander Popham, who was born deaf, to speak distinctly, and to understand a language, so as to express his mind tolerably well in writing, and understand what was written to him by others, as likewise in another instance in the person of Mr. Daniel Whaley.

Observations in New Holland. By M. Witsen, F. R. S. N° 245, p. 361.

In a voyage to the south-land, called Hollandia Nova, it has been discovered that the soil of this country is very barren, and like a desert; no fresh-water rivers have been found, but some of salt water; no quadrupeds, except one as large as a dog, with long ears, that lives in the water as well as on the land. Black swans, parrots, and many sea-cows were found there. Our people had seen but 12 of the natives, all black and naked, but so terrified that it was impossible to bring them to a conversation, or a meeting: they lodge themselves as the Hottentots do, in pavilions made of small branches of trees. By night our people saw fires all over the country; but when they drew near, the natives were fled. The coast is very low, but the country far from the sea is high.

Upon the islands near the coast have been seen rats* as large as cats, in great numbers; all which had a kind of a bag or purse hanging from the throat upon the breast downwards. There were found many sweet scented trees, out of the wood of which is to be drawn oil smelling like a rose; but for the rest they are small mean trees. There were also found some birds-nests of a prodigious size, so that 6 men could not, by stretching out their arms, encompass one of them; but the fowls were not to be found. There was great store of oysters, lobsters, and crabs; as also of strange sorts of fish. There were also millions of flies, which were very troublesome. They saw a great many footsteps of men and children, but all of an ordinary size. The coast is very foul and full of rocks.

* Probably the smaller Kanguroo, or *Macropus minor*.

Some Philosophical Experiments, communicated by the Right Hon. Sir Robert Southwell. V. P. R. S. N° 245, p. 363.

1. *To make the Globe Looking-Glass.*—Take quicksilver, marcasite of silver, of each 3 ounces; tin and lead, each half an ounce; these first two throw on the marcasite, and last of all the quicksilver; stir them well together; but they must be taken from the fire, and almost cool before the quicksilver be added; let your glass be well warmed, then pour out the mixture, and roll it from side to side.

Note, this will do also when cold; though it is best when the glass is heated, and very dry.

Note also, That if at the glass-house, your ball be of yellow glass, then all will shine like gold.

2. *To paint Glass in Marble Colours.*—First grind well upon a stone some minium for red. 2. Radix curcumæ, or rather cerussa citrina for yellow. 3. Smalt for blue. 4. Verdigris for green. 5. Cerusse, or chalk, for white. Which being all separately wrought in oil, take a brush of hog's hair, dipped in any of the said colours, and it will, being rolled in your hand, scatter the same upon the glass; then with your pencil work them together as you think fit; and lastly, fling a little mead among them, which covers all.

3. *The Magic Lantern.*—In order to give variety of colours to these lanterns, which are generally made to represent dark figures, take oil of spike, and mix in it the several colours, with which you will have your glass stained, paint them finely on; they will dry presently, and penetrate any glass.

4. *Phosphorus Metallorum.*—Take lapis smaragdi mineralis, and beat it into a very fine powder. If you strew this very fine on any metal, and in any figure, and set the plate on hot coals, you will in a short time perceive a light shine which will last as long as you continue the hot coals; and if you beat out the fire, it may do again for once or twice; but then the virtue will fade.*

On some Mineral Waters at Eglingham in Northumberland. By Dr. Cay, of Newcastle. N° 245, p. 365.

A mineral water was sent me by Mr. Duncan, a skilful surgeon in Alnwick, which he desired me to examine, and give him an account of. Accordingly I

* Many other spars, besides this, become phosphorescent under similar treatment. See Mr. Tho. Wedgewood's experiments on the production of light from different bodies by heat and attrition in the 82d vol. of the Phil. Trans.

first tried it after the usual manner, with galls, and found it turned almost quite black, though it had been brought at least 30 miles by land-carriage from Eglingham in Northumberland. But I was much more surprised to find, after I had slowly in a glass evaporated more than one half of this water, that it still retained the same black quality, and struck yet as deep with galls as ever. The strangeness of this phenomenon made me hope to meet with somewhat new and uncommon in this water, and the event did not deceive me, for it yielded me at least a real and genuine vitriol. I say nothing of the ochre which this water let fall in very great plenty, that being a thing common to all atramentous waters.

Though greatly surprised at this phenomenon, I could not bring myself to think it possible that the pyrites lying constantly under water, should ever yield vitriol, and I knew of nothing else (at least in England) that I could expect it from. But having to visit this remarkable well, I found our vitriol water to be only an old drift made for the draining of a row of old wrought coal-pits a little above, and I informed myself from some old men, that had formerly wrought in these pits, that there was plenty of the pyrites there, by them called brass lumps: and that this drift was sometimes dry, and sometimes run with a plentiful stream; which is as fair and full an account how this water comes to have vitriol in it, as any one need to desire. Dr. Cay found soon after another similar instance, of a reputed fons vitriolaceus, near Haigh in Lancashire, which turned out to be nothing more than a like drift to drain the water from the coal works there.

On the Longitude of Canton. By M. Cassini, N° 245, p. 371.

From the transit of Mercury over the sun's disk, observed at Canton and Nuremberg; and again from the eclipses of the moon, observed at Nuremberg and Paris, M. Cassini has determined the difference of longitudes between Canton and Paris to be 7h. 23m. or 110° 45′.

The Quadrature of the Logarithmic Curve. By Mr. John Craig. N° 245, p. 373. *Translated from the Latin.*

Let ONF (fig. 7, pl. 5) be a logarithmic curve, whose asymptote is AR, in which let a point A be taken, such, that its first ordinate AO may be equal to the subtangent, or to unity: to determine the curvilineal space AONM, comprehended by the two ordinates AO, MN, the absciss AM, and the logarithmic curve ON. From O draw OE parallel to AM and cutting MN in E; then the rectangle of the segments ME, EN, will be equal to the required space.

Demonstration.—Call the ordinate MN, z; and the subtangent AO or ME, s; also to the axis AR let another curve HGQ be constructed, whose equation is $2\,sz = x^2$, where its ordinate GM is $= x$; then this will be the quadratrix of the logarithmic curve, according to the principle of my method; that is, its subnormal is equal to the respective ordinate of this: as will appear by a calculation according to that method. Therefore, by what I have elsewhere explained, if GC be drawn perpendicular and equal to GM, and HD parallel to GC, meeting the lines GM, CM in B and D; then there will be the trapezium GBDC = AONM, But GBDC = GMC − BMD $= \frac{1}{2}x^2 - \frac{1}{2}$ BM$^2 = sz - \frac{1}{2}$ HA^2; but HA = $\sqrt{2\,\text{AO}^2}$ from the nature of the curve HGQ, therefore GBDC $= sz -$ AO^2 = AO × $\overline{\text{MN} - \text{AO}}$ = ME × $\overline{\text{MN} - \text{ME}}$ = ME × EN. Therefore also AONM = ME × EN. Q.E.D.

On the Gall Bee. By Mr. Benj. Allen. N° 245, p. 375.

In some Aleppo galls which the insects* had not eaten their way out of, I found a sort of bee, resembling the same sort of our wild bees which earth: they have long wings; the belly thick and deep; and on the back near the commissure to the body, it is of a greenish black, the rest reddish, near a cinnamon colour. These galls were very gummy, some of them had a stem, and the cavity round them was so extremely so, that not the least entrance to it appeared, though the bee was beginning to make its way out; which may seem to show, that the atmospherical air is not necessary to the essence of life, before the organs of the body are employed; but that it is maintained by a more subtile air, that pervades the more minute pores, as it is conveyed to fish through the water, &c. But this is not the only insect that I have found in galls, for in the greyer sort, not so rich in gum, I have found a small ichneumon of a bright green.

On the Scarabæus Galeatus Pulsator, or the Death Watch.† *By Mr. Benjamin Allen.* N° 245, p. 376.

The second animal I observed is that which makes a noise resembling a watch; it lived 4 days with me, beating exactly. I took one some years since, which I then traced by the noise, as I did this, and they were both the same: from its noise it has obtained the name of a death watch. I found it in a copper; it resembled dry dirt in colour. I found another some years before on a rotten

* The insects which cause the galls, or globular swellings on the leaves of the oak, belong to the Linnæan genera of *cynips* and *ichneumon.*

† *Ptinus fatidicus,* see Naturalist's Miscellany, vol. 3. *Ptinus Pulsator,* Linn. Gmel. Syst. Nat. p. 1605. *Dermestes tessalatus,* Fabr. Syst. Ent. p. 56.

post, and made the noise like a watch, by beating its head on the subject that it finds fit for sound. This was answered by another in the same room, and after a minute's distinct beating, would forbear for the other to answer. The part it beats with is the extreme edge of the face, which I may call the upper lip; the mouth being protected by this bony part, and lying underneath, out of view.

It was $\frac{3}{10}$ of an inch long; the colour a dark brown, with spots somewhat lighter, irregularly placed, which would not rub off readily. They seemed to lie rather athwart the back, and direct on the head, as in the small figure, (fig. 8, pl. 5) which is much of the same size with it, and the maculæ are designed for the greyish spots. Under the vaginæ are pellucid wings, and the body is of a dark colour. The head appeared large, by reason of a large cap or helmet which covered it round, only turned up a little at the ear; from under this appeared the head, which was flat and thin; the eyes forwards: the lip hard and shining; the bars of the helmet greyish. Two antennæ proceeded from under the eyes, which, by their meeting on the breast, I conjectured to assist their feeding, and to be rather probosces; and the helmet to be turned up for the sake of hearing, and the belly plicated as other beetles. The other beetle that answered it was less, and the marks on the back not so distinct.

By the microscope I discovered the marks to be thickest spots of hair of a castor colour: the head all hairy, and face full of curled hair. On the belly was some hair thinly set. The eyes appeared large, as in fig. 9, drawn from the microscope. The superficies consisting of many small squares furrowed deep between, and these lay in lines transversely descending towards the nose; these eyes were not moveable, but contiguous to the face, without any cavity to receive them, and they were very opaque. The antennæ preceeded from under the eyes, the first large joint having a cavity, out of which it proceeds at the sides of the lip. Between the eyes the face rises in a little ridge, which is the nose, and is signified by the light part of the face; and just below, the nostrils are covered by straight pendulous hair proceeding from the lower ridge of the nose; under this hair the cavity is dark, below the nose the lip shades show the more depressed places; under this lip are forcipes, to lay hold on its food, two on each side.

On an Eruption of Fire out of a Spot in the Earth near Fierenzola in Italy. By Dr. Rob. St. Clair. N° 245, p. 378.

I lately received an account from my brother, that on the side of one of the Appenine mountains, half way between Bologna and Florence, near a place called Petra Mala, about 5 miles from Fierenzola, there is a spot of ground, about 3 or 4 miles diameter, which incessantly sends up a flame rising very high, without noise, smoke, or smell, yet it gives a very great heat, and it has been observed to be always thus, except at great rains, which put it out for a time, but when that is over, it burns with greater vigour and heat than before; the sand about it, when turned up, sends up a flame; but within 3 or 4 yards of it there grows corn all round about, for it continues always in the same spot. The flame seems to proceed from a vein of bitumen or naphtha, that cropes, as the miners call it, only here; which, when by ploughing or some other accident the upper crust has been turned up, was kindled into a flame by the heat and agitation of the air, as other salino-sulphureous bodies are, of which Mr. Boyle's phosphorus is a particular instance. The like spontaneous accension is seen in many mineral substances, but none that I know of so quick in its production or so lasting as this is. The whole woods and fields have been destroyed by it. The inhabitants there have been so little curious to observe it, that they believed that there was a great hole in the flame place, but he found it to be firm ground. Neither does any there remember, when, and upon what occasion it first began. The flaming well near Wigan seems to proceed from a similar cause; you may boil an egg in it, and upon the approaching of a lighted candle it takes fire; both seem to proceed from a naphtha or subtle bitumen, only that in a hotter country, and being in a drier soil, is more subtle and inflammable; just as the petroleum which is found in Italy is white like spirit of turpentine, and is more penetrating than the petroleum found in the northern countries; an instance of which we have in a well 2 miles from Edinburgh, called the Baume-well, of a black red colour, and very thick, but being distilled, in colour, taste, and smell, it resembles that of Italy. This spontaneous accension of the naphtha seems to be made out by the smell that our bitumen near Edinburgh yields, being most like coal smoke. There are three such fires on the same hills that are extinguished in the summer, but burn in the winter.

A new Lamp. By Dr. Rob. St. Clair. N° 245, p. 380.

As it is observed that the wick of a lamp or candle never wastes till the wick be exposed to the air by the flames falling downwards; hence it follows, that a way found out to keep the fuel, and consequently the flame at the same height upon the wick, would make it serve a long time; I have a good while since thought this might be effected by hydrostatics; thus: let a lamp, 2 or 3 inches deep, with a pipe coming from the bottom, almost as high as the top of the vessel, be first filled with water, so high as to cover the hole of the pipe at the bottom, that the oil may not get in at the pipe, and so be lost; then let the oil be poured in, so as to fill the vessel almost brim-full, which must have a cover pierced with as many holes as there are designed to be wicks. When the vessel is thus filled and the wicks are lighted, if water fall in by drops at the pipe, it will keep the oil always at the same height, or very near it, the weight of water to thát of oil being nearly as $20\frac{8}{11}$ to 19, which in 2 or 3 inches will make no considerable difference. If the water runs faster than the oil wastes, it will only run over at the top of the pipe, what does not run over will come under the oil, and keep it to the same height.

On an Extraordinary Eruption of Water. By R. P. Vicar of Kildwick in Yorkshire. N° 245, p. 382.

This most extraordinary eruption happened in June 1686, by which the towns of Kettlewell and Starbotton, in Craven, Yorkshire, have been nearly destroyed. The towns are situate under a great hill on the east and west: the country is very mountainous and rocky. The descent of the rain was after a thunder clap, and continued about an hour and half, with extraordinary violence, and by several eye-witnesses, the rock on the east side opened visibly, and water was seen ejected thence into the air, the height of a church steeple; so that the current of water came down the hill into the towns as in one entire body, and with a force as if it would have drowned all the inhabitants. Several houses were quite demolished, and not a stone left; others gravelled up to the chamber-windows; some inhabitants were driven from their habitations, the current of the water running through them; mighty rocks descended from the mountains into the valley, and there remain immoveable; many meadows were covered with sand and stones, that the worth of the soil will not recover them. Household goods were carried away and lost; besides much cattle. The whole loss was reputed to be many thousand pounds.

Experiments about Freezing. By Mr. Desmasters. Communicated by Dr. William Musgrave. N° 245, p. 384.

A tube of $\frac{1}{4}$ of an inch diameter being filled with water to the height of two inches, and set to freeze in a mixture of snow and salt; the water, when perfectly frozen, appeared $\frac{5}{16}$ of an inch above the mark it stood at before freezing. Another tube, of almost an inch diameter, being filled with water to the height of 6 inches, and set to freeze, as before, rose $\frac{7}{8}$ of an inch above the mark. It was observable, that when the water thus set in snow and salt began to freeze, a great many small bubbles continually rose from the bottom.

A Catalogue of Electrical Bodies. By the late Dr. Robert Plot, F. R. S. N° 245, p. 384. *Translated from the Latin.*

Not only do amber and the agate stone attract small bodies, but also the diamond, sapphire, carbuncle, the iris gem, the opal, amethyst, the false diamond, Bristol-stone, beryl, and crystal; also the hyacinth, the Bohemian-garnet, glass, and preparations of glass and crystal, false gems, glass of antimony, glass of lead, all the fluors of the mines, belemnites, sulphur, mastic, sealing-wax of gum-lac, hard rosin, arsenic, (but weakly,) and in dry weather sal-gem, talc, and roch-alum.

An Account of a Book.—Histoire des Plantes qui naissent aux Environs de Paris, avec leur Usage dans la Medecine par M. Pitton Tournefort * *de l'Academie Royale des Sciences, Docteur en Medecine de la Faculte de Paris et Professeur en Botanique au Jardin Royal des Plantes. A Paris de l'Imprimerie Royale.* 1698, 8vo. N° 245, p. 385.

The author of this book is already well known by his former works. In the present he gives an account of the plants growing wild about Paris. The pre-

* Joseph Pitton de Tournefort, the most celebrated of all the French botanists, was born in the year 1656, of a good family at Aix in Provence. He discovered in his early years an uncommon passion for botany. He was designed by his parents for the ecclesiastical profession, but the study of nature and medicine attracted him with such irresistible ardour that theology was abandoned, and the church obliged to yield her unjust acquisition. In 1677 he visited the mountains of Dauphiny and Savoy, where he collected many curious plants. In 1679 he went to Montpelier, where he greatly advanced his botanical knowledge, and in 1681 set out for Barcelona, and wandered about the province of Catalonia, accompanied by several students in the same science. The lofty Pyrenean mountains stood too near not to afford a powerful temptation: he well knew that in these vast solitudes he must lead the life of the most austere and rigid anchoret, and that the miserable inhabitants who were to furnish him with his slender subsistence scarcely exceeded in number the robbers he had to dread; and indeed it so happened that he was often stripped by the Spanish miquelets, but he at length contrived to hide some money in the small coarse loaves which he carried with him; by which means he occasionally eluded their rapacity; and once the tears which he shed on being robbed of his small stock had such an effect on his plunderers, that they restored him all they had taken. About the year 1681 he returned to Montpelier, and to Aix, his native town, where, having remained some time, he was induced to visit Paris, and being introduced to Mons. Fagon, was made professor of botany in the Royal Garden founded by Lewis XIII. In 1694 appeared his first work, entitled *Elemens de Botanique,* which was afterwards, in its enlarged state, published under the title of *Institutiones Rei Herbariæ,* a work of too great celebrity to need any particular description. In 1698 he took the degree of Doctor of Physic at Paris, and in 1700 was appointed by Lewis XIV. to undertake botanical travels. He visited Greece, and went to the frontiers of Persia, but the plague prevented him from pursuing his African researches, and he returned *spoliis orientis onustus,*

face relates the success of several experiments he made to discover the salts contained in the earth, wherein plants grow, many of these were done with great labour and nicety. He likewise gives his opinion of the several ways of the operation of medicines on human bodies, and of the causes of the same.

The book is divided into six herborisations, each of which contains the plants he met with in the course of a walk. To the names he gives each plant from the best and most common authors; he adds a critical account of the extant descriptions and figures of each, viz. where it is ill, and where well described and figured. He gives often an account of the chemical analysis of it, which he generally extracts from the registers of the Academie Royale; also an account of the virtues ascribed to each plant, from the most approved authors, or from information received from the inhabitants of several countries he lived in, or travelled through.

Account of a China Cabinet, filled with several Instruments, Fruits, &c. used in China: sent to the Royal Society by Mr. Buckly, chief Surgeon at Fort St. George. By Hans Sloane, M. D. N° 246, p. 390.

These instruments are chiefly those used by the Chinese surgeons, and are very clumsy and inconvenient. They consist of rasors of different sorts, knives, ear-pickers of several shapes, brushes, &c.

Remarks, by Mr. James Petiver, F. R. S. on some Animals, Plants, &c. sent to him from Maryland. By the Rev. Mr. Hugh Jones. N° 246, p. 393.

SECT. I. *Crustaceous Animals.*—1. Testudo terrestris Americana, dorso elato. Its shell an inch and a quarter long, and one broad, the scales about the edges are quadrangular, those above pentangular; he is guarded along the back with a round ridge; his head about the size of our horse-bean; the orbits of

having discovered a vast number of new and rare plants, &c. The fatigues of his official capacity and his professional engagements at length threw him into a declining state of health, which was soon rendered hopeless by an accident of a similar nature to that which caused the death of Morison; the pole of a coach running against his breast while he was crossing one of the streets of Paris. Tournefort however survived a few months, and died on the 20th of Dec. 1708.

The system of Tournefort, which is chiefly founded on the flower or corolla, is undoubtedly far superior to every preceding one; and though he did not invent a mode of systematically defining the genera of plants by words, (which was reserved for the great Linnæus,) yet, as has been well observed by Mons. Delamarck, he was no less sensible of the distinctions of his genera, and has caused them to be figured in so able a manner that they cannot easily be mistaken.*

* See Dr. Smith's introductory discourse on the Rise and Progress of Natural History, in the first volume of the Transactions of the Linnæan Society.

the eyes very large; his snout not very unlike a parrot's bill, his upper jaw including the under; each foot has four sharp claws like a mouse. His belly is made up of several thin scales; whose middle pair are long and quadrangular, that next the head and tail triangular, the rest irregular; his tail taper, and about half an inch long. His whole body exceeds not the half of a large walnut.

*The Molucca Crab.**—2. In Virginia and several parts of the continent of America they call it—The King Crab. Mus. Tradesc. 8.—A king crab of the Molucca Island. Hubert's Nat. Rarities, p. 21. Cancer Bont. Hist. Nat. p. 83. fig. malâ et descript. Cancer Moluccanus Clus. exot. 128. fig. opt. dorsi et ventris cum descriptione accuratâ. Mus. Worm. 249, bonâ dorsi et ventris ac descript. Cancer Moluccensis, Jonst. Hist. de Exang. Aquat. tab. 7, fig. 1 et 2 sine descript. Mus. Regal Societ. 120. Signoc seu Siquenoc Incolis Novæ Franciæ, Aragnée de Mer. nob. Laet. Ind. Occid. 60, fig. d. et v. opt. et desc. Gal. id. Lat.

The whole structure of this animal is very remarkable, and particularly his eyes, viz. Between the fourth and last pair of claws on each side, reckoning from his mouth, and excluding the small pair there placed, are inserted the rudiments of another pair, or a claw broken off on each side at the second joint or elbow; on these extremities are the eyes, like those on the horns of snails, but being under the covert of a very thick and opake shell, nature in that place has wonderfully contrived a transparent lantern, through which the light is conveyed, whose superficies very exactly resembles the great eyes of our large libellæ, or adderbolts, which to the naked sight are plainly perceived to be composed of innumerable globuli; these, like them, are oblong, and guarded with a testaceous supercilium.

Sect. II. *Testaceous Animals.*—3. Cochlea terrestris major striata, ore compresso. Cochlea Virginiana, List. Hist. Conchyl. lib. 1, fig. 45. 4. Cochlea terrestris Virginiana media umbilicata, striata, ore unidente compresso. Cochlea umbilicata, capillaceis striis per obliquum donata, unico dente ad fundum oris, List. Hist. Conch. lib. 1, fig. 91. 5. Cochlea terr. Virginiana insigniter striata, umbilico magno. Cochlea umbilicata, fusca, sive variegata, capillaribus striis leviter exasperata, List. H. C. lib. 1, fig. 69. 6. Cochlea terr. Virginiana minor, striata et umbilicata, ore tridentino. Cochlea parva umbilicata, tenuiter striata, tridens, scil. in triangulo positi nempe unus ad fundum oris, alter ad columellam, tertius ad labrum, List. H. C. lib. 1, fig. 92.

Sect. III. *Crustaceous Insects:* Being such whose membranaceous wings are wholly, or in part, covered with a hard or crusty sheath.—7. Scarabæus

* Monoculus polyphemus. Linn.

Marianus viridis rhinocerotos. An Nasicornis Virginianus, Mus. Trad. 15. 8. Scarabæus Marianus viridis acerotos. These two, I believe, are male and female. 9. Scarabæus Marianus minor fulvus, maculis nigricantibus aspersus. 10. Scarabæus verrucosus minor Marianus cænosi coloris. An Scarabæus instar Bufonis Virginianus, Mus. Tad. 16. 11. Scarabæus stramineus minor Marianus, maculis aterrimis diversimodè notatus. 12. Scarabæus oblongus niger Virginianus, vaginis sulcatis dorso plano nitente. 13. Scarabæus elasticus major Americanus capite bimaculato.* an Cocujas Mof. 111, fig. id. Angl. 977. —This is commonly about an inch and half long, of which the head takes up a third part, which is nearly as broad as long; the sides are grey or frosty; the middle black: what in this part are most remarkable, are, two very black oval spots, in texture, colour, and softness much resembling the finest black velvet, being encompassed with a whitish circle. These orbicular spots at first view seem to be their eyes, though they are ten times less, and placed at the setting on of the horns, which are about half an inch long, composed of 8 serræ, or teeth, notched on the under side only. The vaginæ, or wing-sheaths, are long, black, sulcated, and plentifully sprinkled with white specks, the under part and belly is frosted on the sides, and in the middle of a shining black. The structure of this insect is the same with a peculiar species I have seen in England, and called snap-beetles, from their elastic or springing faculty, by which they will easily force themselves out of your fingers: I have also frequently observed, that if you lay them on their backs, not being able to turn on their bellies, they will spring or raise themselves to a wonderful height, and that for several times, until they fall on their legs.

14. Scarabæus elasticus medius Marianus hirsutus. 15. Scarabæus elasticoides Marianus, vaginis ex nigro aurantioque mixtis. 16. Cicindela Mariana, the fire-fly, vaginis teneris fuscis marginibus fulvis. 17. Cantharis Anglica viridis, maculis aureis insignita. 18. Cantharis Mariana viridis, lituris marginalibus aureis insigniter notata. The spots in this are larger and finer marked than the last. 19. Cantharis Mariana fusca, meandris marginalibus pallidis incurvatis. 20. Capricornulus nigrescens Marianus, undis et circulis flavescentibus striatus.

SECT. IV. *Plants.*—Muscus Filicinus Marianus repens pinnis brevioribus. This differs from our common fern moss in having shorter wings set opposite from the middle rib, which creeps along the ground, and is not branched. 2. A. Branched coralline moss. This grows with us very plentifully on most heaths. 3. Trichomanes major Marianus longifolius, an trichomanes major foliis longis

* Elater oculatus. Linn.

auriculatis, Raii H. H. pl. 1928. 4. Cornutus or Canada maiden-hair. Adianthum Americanum Cornuti 7, fig. Virginianum Tradescanti Park. 1050. Fruticosum Americanum Ejusd. 1050. Fig. frut. Brasilianum CB. 355, et Prodr. 150, desc. frut. Amer. summis ramulis reflexis et in orbem expansis Pluk. tab. 124, fig. 2. 5. Filix Mariana pinnulis seminiferis angustissimis. 6. Ophioglossum Marianum linguâ dentatâ. 7. A. Gramen Panicum maximum, spicâ divisâ, aristis armatum. Cat. Pl. Jam. 30. Panicum Sylvestre cum aristis CB. Phyt. 20, N° 93. 8. Gramen exile hirsutum Ger. 16, fig. id. emac. 17, fig. Juncus villosus capitulis Psyllii Hist. des Plantes des Environ de Paris 105, Raii H. pl. 1291. Syn. 193 ed. 2, 263. 9. Gramen cyperoides minus spicâ parvâ. 10. A. Millet cyperus grass. Cyperus gramineus Miliaceus Ger. emac. 30, fig. Raii H. pl. 1171. Synops. 200, ed. 2, 271. 11. Cyperus gramineus paniculâ sparsâ subflavescente. This is found in most watery places in Germany, Italy, and Provence.

12. Gramen tomentosum Virginianum paniculâ magis compactâ, aureo colore perfusâ, Pluk. tab. 29, 9, fig. 4. 13. The least English rush. Juncellus Lobelii, Park. 1192. Raii H. pl. 1304, Syn. 203, ed. 2, 274. It flourishes with us in June and July in moist, sandy, and boggy places. 14. Parietaria foliis ex adverso nascentibus urticæ racemiferæ flore, Cat. pl. Jam. 50. This Dr. Sloane observed to grow plentifully on the moist and shady rocks in Jamaica.

15. Aster Americanus albus latifolius, caule ad summum brachiato, Pluk. tab. 79, fig. 1 et Alm. Bot. 56. Dr. Plukenet's figure very well resembles this plant, the leaves are somewhat hairy, and on the back side very full of veins; they are near 3 inches and half long, and somewhat more than an inch broad; are sharp at each end and stalkless: the flowers are white, standing on long footstalks, and branch towards the top. This I have observed for some years growing in our physic-garden at Chelsea.

16. Aster Marianus, foliis rigidis, floribus parvis umbelliferis. 17. Aster Americanus albus mezerei arabum exasperatis foliis, florum petalis reflexis, Pluk. tab. 79, fig. 2, Alm. Bot. 56. These flowers are very small, and stand many together, like an eupatorium; the scaly tips are green, the petala long, white, narrow, and seldom more than five or six in a flower.

18. Chrysanthemum Americanum laciniato folio majus, H. Bles. 251. Doronicum Americanum Hort. Oxon. H. Patav. et l. Bat. H. Gron. et Tradesc. Park. 321 et 2. Fig. Amer. laciniato foio, CB. app. 516. Descr. Amer. fol. dissecto, H. Hafn. Ray H. pl. 339. 19. Virga aurea Americana tarragonis facie et sapore, paniculâ speciocissimâ, Pluk. tab. 116, fig. 6 et Alm. Bot. 20. Eupatorium Marianum foliis Melissæ rigidioribus. An Eupatoria Valerianoides flore niveo, Teucrii foliis cum pediculis Americana, Pluk. tab. 58, fig. 3 et Alm.

Bot. 141. 21. Eupatorium Marianum Melissæ foliis tenuioribus, floribus purpurascentibus filamentosis. An Eupatorium Americanum Melissæ foliis magis acuminatis, Pluk. tab. 87, fig. 3, et Alm. Bot. 140. 22. Baccharis Mariana flore pulchrè rubente. 23. Flos solis Marianus foliis pyramidalibus scabris ex adverso sessilibus. 24. Flos solis Marianus foliis latioribus flore mixto. 25. Flos solis Marianus foliis angustioribus fl. mixto. 26. Chrysanthemum pilosissimum umbone purpurascente, petalis extus villosis. 27. Chrysanthemum Marianum foliis abrotani maris. 28. Nardus Americana procerior foliis cæsiis, Pluk. tab. 101, fig. 2, Alm. Bot. I have observed this stately plant for several years in our physic garden at Chelsea, growing more than two yards high, with leaves somewhat like our goosefoot, but much larger, and underneath of an ash colour.

Carolina Globe Tree.—29. Valerianoides Americana flore globoso, ... folio. Mus. Petiv. 293. Arbor Americana triphylla, fructu Platani quodammodo æmulante; lignum fibularium, i. e. button wood nostratibus dicta, Pluk. tab. 77, fig. 3, Alm. Bot. 47. Scabiosa dendroides Americana, ternis foliis circa caulem ambientibus, floribus ochroleucis, Alm. Bot. 336. This formerly grew at the physic garden at Chelsea.

30. Laserpitium Americanum fraxini folio Musei Petiv. 255. 31. Hipposelinum Marianum foliis integris et trifidis. The lower leaves are more or less round or pointed, and serrated like our caltha palustris, but much smaller, not exceeding those of the garden violet, which they much resemble; these stand on longer or shorter footstalks, sheathed at the base, those above are wholly vaginated or sheathed, and come trifoliate at every joint, its flowers are small and yellowish. A. 32. Our least water parsnip, with various leaves.

33. Symphytum Marianum foliis echii latioribus. These leaves are near an inch broad, and between 2 or 3 long, are set alternately close to the stalk; and taper at each end; in texture very much resembling our vipers bugloss, but broader.

34. Teucrium Marianum spicatum menthæ folio. 35. Mr. Ray's Virginia snake-weed. Pulegium Virginianum nonnullis, aliis serpentaria aut columbrina Virginiana Raii H. pl. 534. 36. Dr. Herman's Virginiana wild basil, with yellow flowers. 37. Horminum Marianum foliis pilis albis aspersis. 38. Scutellaria Virginiana hyssopi angustis foliis, flore cæruleo Alm. Bot. 338. 39. Mr. Banister's columbine leaved crow-foot. 40. Munting's yellow passion flower. 41. Cornutus's Canada herb christopher. A friend of mine brought me this root from Protuxen River in Maryland; and he tells me, they there call it richroot, and use it as a specific against the scurvy; they boil about a pound of it in two gallons of cyder, till only two quarts remain; and being strained, they

drink half a pint of it every morning, either alone or mixed with any other drink. He assured me it cured him, and several others in the same ship.

42. Spike-flowered meadow-sweet. 43. Gentiana major Virginiana, floribus amplis ochroleucis, Pluk. tab. 186, fig. 1 et Alm. Bot. 166. These leaves are very like those of sope-wort, and stand crosswise, or alternately opposite, convoluting the stalk, which is round. Its flowers one inch and three quarters long, and pale, growing towards the top of the stalk: its calyx half an inch deep, and then divides into five narrow greenish beards, three quarters of an inch long, reaching almost to the dents or lower angles of the flower.

44. Gentiana major Virginiana, flore cæruleo longiore, Morrison. tab. inedit. fig. These leaves stand also opposite, like the last, but are much narrower, and glaucous underneath. The flowers blue, and broader at the top than the last; and the segments or angles not so sharp nor deeply indented; the calyx like the other, but the foliaceous beards shorter.

45. Erinus Marianus ferè umbellatus, Majoranæ folio. 46. Perfoliate Venus looking-glass. Speculum Veneris perfoliatum seu viola pentagonia perfoliata, Raii H. pl. 743. Campanula pentagonia perfoliata, Morrison, H. Ox. 457. sect. 5, tab. 2, fig. 23. 47. American scarlet cardinal-flower. Flos Cardinalis Barberini Coll. in Hernand, 880, fig. Card. seu Trachelium Americanum, H. L. Bat. et H. Groning. 48. Morrison's Virginiana blue cardinal-flower. Ranunculus galeatus Virginianus, flore violaceo majore, Morrison. H. Ox. 466. Sect. 5, tab. fig. 55. 49. Digitalis Mariana Persicæ folio. This I take to be the humming bird tree, figured in Josselin's New-England Rarities. These leaves stand opposite, on half inch footstalks, above four inches long and three quarters broad.

50. Digitalis Mariana filipendulæ folio. The flowers of this elegant plant stand on naked footstalks, near an inch long; they generally grow by pairs, one against the other, each divided into five equal round segments, like those of yellow tobacco, but three times larger; these are set in a calyx, whose divisions are fimbriated like a lobe or wing of its leaves. Its style is thready, and about an inch long. 51. Alecto .... Marianus blattariæ folio. These leaves are deeply cut into 8 or 10 serrated lobes, which for the most part stand opposite; each leaf is about the length of the footstalk it stands on, viz. if full grown, 5 inches, or thereabout. Its seed vessels are oblong pointed husks, which open on the upper edge: they grow in a spike on each side the stalk, and are guarded, especially the upper side, with a hoary membranaceous calyx.

52. Crateogonon Marianum flore cæruleo. 53. Turritis Mariana siliquis dependentibus, uno versu dispositis. The pods are about 2 inches long, flat, somewhat crooked, and end as it were in a blunt spine, they stand on half inch

footstalks, and are thin set on all sides the stalks, but have a tendency only one way.

54. Cornutus's Canada Celandine. Chelidonium maximum Canadense ακαυλον, Corn. 212, fig. Park. 617. Morrison. H. Ox. 257. Sect. 3, tab. 3. fig. 1, Raii H. pl. 1887. Ranunculus Virginiensis albus, Park. 327, fig. an Virginianus, Mus. Trad. 160.

Captain Langford's Observations on his own Experience upon Hurricanes, and their Prognostics. Communicated by Mr. Bonavert. N° 246, p. 407.

It has been the custom of our English and French inhabitants of the Caribee islands to send about the month of June, to the native Caribees of Dominico and St. Vincent, to know whether there would be any hurricanes that year; and about 10 or 12 days before the hurricane came, they would constantly send them word; and it very rarely was erroneous, as I have observed in five hurricanes, in the years 1657, 1658, 1660, 1665, and 1667. From one of these Indians, I had the following prognostics:

1. All hurricanes come either on the day of the full, change, or quarters of the moon. 2. If it be to happen on the full moon, observe these signs, during the change: the skies will be turbulent, the sun redder than usual, a great calm, and the hills clear of clouds or fogs over them, which in the high lands are seldom so; likewise in hollows, or concaves of the earth, or wells, there will be a great noise, as of a storm, and at night the stars will look very large with burs about them, and the north west sky very black and foul, the sea smelling stronger than at other times: and sometimes for an hour or two of that day the wind blows very hard westerly out of its usual course. On the full of the moon you have the same signs, with a great bur about the moon, and frequently about the sun. The same signs must be observed on the quarter days of the moon, in July, August, and September; the months when the hurricanes are most prevalent; the earliest I ever heard of, was the 25th of July, and the latest the 8th of September; but the usual month is August.

The method of avoiding the danger is to keep the ship sailable, with good store of ballast, the ports well barred and calked, the top-masts and tops down, the yards laced a-port, keeping the doors and windows of the ship fast, and she will lie as well as in other storms; thus the ships being in readiness, they may stay in the road till the storm begins, which is always first at north, so to the north-west, till it comes round to the south-east, and then its fury is over. So with the north wind they may run away to the south, to get themselves sea-room, for the drift of the south-west wind, where it blows very fiercely. By these means, I have, by God's blessing, preserved myself in two hurricanes at sea, and in three at shore, greatly to my advantage, as I lost not a sail, yard, or mast in two great hurricanes.

The causes of these hurricanes, according to experimental observations of my time, are these:

1. It is known to men of experience, that to the southward of the tropics there is constantly a trade-wind, or easterly wind, which goes from the north to the south-east all the year round; except where there are reversions of breezes, and inlets near the land; so that when this hurricane, or rather whirl-wind, comes in opposition to the constant trade-wind, then it pours down with such violence as exceeds any storms of wind. In the hurricane at Nevis, I saw the high mountain that was covered with trees left in most places bare.

2. It is remarkable by all men, that have been in those parts where the sun comes to the zenith, that at his approach towards it, there is always fair weather; but at his return southwards, it occasions, off the north parts of the equinoctial, generally much rain and storms, as tornados, and the like; which makes the wind in the tornado come on several points. But before it comes, it calms the constant easterly winds: and when they are past, the easterly wind gathers force again, and then the weather clears up fair.

3. The wind being generally between the tropics and the equator easterly, unless at such times as before-mentioned; meeting with the opposition of these hurricanes, which come in a contrary course to that trade-wind, causes this violent whirl-wind, on the sun's leaving the zenith of Barbadoes, and these adjacent islands; by which the easterly wind loses much of its strength; and then the west wind, which is kept back by the power of the sun, with the greater violence and force pours down on those parts where it gets vent. And it is usual in sailing from Barbadoes, or those islands to the north, for a westerly wind, when we begin to lose our easterly wind, to have it calm, as it is before hurricanes: and then the wind springing up, till it comes to be well settled, causes the weather to be various; but after the settled westerly wind comes fresh, they have been constantly without those shufflings from point to point.

Here it is to be observed, that all hurricanes begin from the north to the westward, and on those points that the easterly wind blows most violently, the hurricane blows most fiercely against it; for from the N.N.E. to the E.S.E. the easterly blows freshest; so does the W.N.W. to the S.S.W. in the hurricane blow most violent; and when he comes back to the S.E. which is the common course of the trade-wind, then it ceases of its violence, and so breaks up. Thus I take the cause of hurricanes to be the sun's leaving the zenith of those parts towards the south: and secondly, the reverse or rebounding back of the wind, which is occasioned by the calming of the trade-wind.

But it will be objected, why should not this storm be all over those parts of the West Indies, as well as Barbadoes and the Leeward-islands ; To which I answer, that it has in about 25 years of my experience, taken its course from the Bermudas to the Caribees ; but seldom or never carries such a breadth as from the latitude of 16 to 32 degrees, which are the latitudes of the places; but it has been observed, that when hurricanes have been in Martinico, which is within 2 degrees of latitude, and 2 degrees of longitude, according to the miles of that circle, yet no hurricane has been in Barbadoes; nor could I ever call any of the former storms at Barbadoes hurricanes, till that last year in 1675. Again it has been noted, that hurricanes have done the like to the northwards: For when the hurricane has been in Antega and St. Christopher's, those ships that were only in the latitude of 20 degrees, had no hurricane, but constant westerly winds, reasonably fair, and then there were no hurricanes in Bermudas; and when the hurricanes were at Bermudas, the Leeward or Caribee Islands had no hurricane : nor had those islands the hurricane when Barbadoes had it.

It may be also objected, why the hurricane was never known to go farther to the westward than Porto Rico, which lies in or near the latitude of those islands of St. Christopher's ? To this I answer, that from Porto Rico, downwards, both that island and Hispaniola, as well as other adjacent islands, are of vast magnitude, and very high lands, that of themselves most commonly give reversal or westerly winds at night, through the year; for there, for the reasons aforesaid, the easterly wind, towards night, calms, and those lands afford a land wind, which the other islands cannot do, by reason of the smallness of those Caribee Islands; but very near the shore, the trade-wind having its full power till this general whirlwind comes, for the reasons aforesaid. I do imagine likewise, to the southwards of Barbadoes, where the tornadoes come frequently, there are no hurricanes; nor was there at Barbadoes, when these tornadoes commonly came there, which made some small reversal, though it was but for 2 or 3 hours; yet the easterly wind giving some way by the sun's declining from that zenith, prevents this furious reverse, where it has no vent till it is forced by the violence of the two winds.

On the Magnetism of Drills. By Mr. Ballard. N° 246, p. 417.

I caused 6 or 7 several drills to be made before my face, and the bit or point of every one become a north pole, only by hardening, before they ever came to be worked, either in iron or any other matter; so that I cannot suppose those found in a shop to have acquired their polarity so much from their after use, as from their first make.

That pieces of plain iron, in shape like drills, that is something long and small, always change their poles as they are inverted, the end downwards being always the north pole, I find not always true: for though it hold generally in such small pieces, and always in pieces of any bulk, as large hammers, anvils, andirons, bars of windows, &c. yet I found several small pieces of steel, such as the drills are made of, to have fixed poles, one end north, the other south, in whatever positions I held them: some of these very vigorous in the polarity; others showing plainly a tendency to such a pole, rather than the other; yet so faintly, that it applied contrary to their inclination; that is, at the upper end, if it affected to draw the south; or the lower end, if the north. They caused the needle to stand in æquilibrio east and west; the particular inclination of either one end seeming in some pieces quite to conquer; in others, quite to hinder that more general polarity they both acquire, by being either upward or downward. Yet this seems only to be found in small stems of iron; the being either upward or downward always prevailing in pieces of greater bulk.

As to the opinion of the magnetic philosophers, that nothing gives or receives a magnetism, but what is in itself truly magnetic, as is only iron; as to the last part, that is, only iron receiving a magnetism, I have nothing certain to say; but for giving the same, I suppose it very questionable, whether only iron or loadstone can bestow or impart such virtue, since not only the quenching in water will do it, but the heating also of an iron by violent motion, will do the same; as by quick and hard filing, which is the very same thing as brisk drilling in the iron; and therefore may be said to proceed from the file which is steel or iron. But to show it comes from the mere motion or heat, which is nothing else but the motion continued, this experiment may suffice, if it succeed to others as it seemed to do to me. I took my knife, which had been formerly touched a quarter of a year or more before, and profering it to the needle, it drew the north pole, which happened right for my purpose. I whetted it briskly on a dry dirty threshold, and being thin, it became very hot towards the point, the edge being whetted away to a wire, as it were, I struck the very top, and back towards the top, against the ground, as I had done the sides, to destroy and rub off, if I could, all its former polarity which was southward; then offering it again to the needle, it drew the south end, and was quite changed. To confirm the thing, I touched the same knife again with the north pole of my loadstone, and it drew vigorously the north end of the needle. I whetted it again strongly in the same manner, and it changed again. This I repeated five or six times, and it still changed by whetting, especially on the sides towards the top of the knife, the very top and back, which could not be whetted to so great a heat, retaining still some affection for that pole the loadstone had inclined them to. This I tried with a knife of a thicker blade; but I could not with my hand whet it to that heat as

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to have the same effect, as on my own; though I used such force as at last to break it in two. I intend therefore to try it at a cutler's wheel, laid with emery and oil; and likewise on a grindstone, both wet and dry; and I rather choose the grindstone, because the other wheel may be supposed to have much iron worn into it from the many knives that have been ground on it, and so the effect if produced will prove no more than that of filing with, or drilling in iron. And the wet grindstone, though it want heat to give a new polarity, yet probably it may wear off those parts of the iron in which the old did inhere, and so render it simple again.

As to the 4th, whether brass or copper will, as well as iron, give a north polarity to a drill; this cannot well be tried; since the very making, if it be well hardened, will certainly give it. Wherefore the drill Mr. Hunt made could not, if well hardened, according to what I can find, be indifferent to either pole.

As to the conclusions, first, that a drill is naturally a north pole, I suppose may be true, but it is contrary directly to what is just affirmed, viz. that the drill made by Mr. Hunt was indifferent to either pole, &c. And I suppose that bare drilling might be able to give a polarity to a drill, if it could be made indifferent, as well as filing does, if the drill be used so briskly as to be made as hot as the file makes the iron. Secondly, That though a south pole given by the magnet cannot be taken off by the heat of a brisk motion, as that of drilling; which yet the experiment of my knife seems to be contradicted; yet perhaps the heat may be great enough to produce a polarity in an indifferent piece of iron; as was before said to be done, in little indifferent drill-like pieces of steel, by filing.

On some Indian Manuscripts, lately sent to the University of Oxford. By the Rev. Geo. Lewis, from Fort St. George. N° 246, p. 421.

Herewith I send some Indian manuscripts, which are in several languages and different characters. There will arrive by the King William, 3 volumes of Chinese books, stamped on wood, which is their boasted way of printing; of such, you may have any quantity, books being very plenteous in China.

On comparison, it appeared, by a sample or specimen of the leaves and fruit of the Ampana Hort. Mal. Tom. 1, p. 13, fig. 10, or Palma Malabarica, flosculis stellatis, fructu longo squammato D. syen. ib. or Palma Coccifera folio plicatili flabelliformi major. Ampana H. M. Raii Hist. p. 1366, shown to the society by Mr. James Petiver, one of their members, that the several leaves of these books were made of the leaves of this palm, written on with a style.

Of a Child that swallowed two Copper Farthings. Communicated by Dr. Edw. Baynard, Fell. of the Coll. of Physicians. N° 246, p. 424.

A child, aged about 3 years, swallowed by accident 2 copper farthings, only half a year after each other. After the first farthing, he ate nothing for 10 days, and complained of a great pain at his stomach, and drivelled as if he had been salivated; and often said he had a nauseous venomous taste in his mouth, the farthing not coming from him in half a year. After the swallowing of the second farthing he began by degrees to lose his limbs, his breast growing narrow, and the child consumptive; but was afterwards perfectly cured by the Bath, and his breast dilated and grew broad as before.

Analytical Investigation of the Curve of Swiftest Descent. By Mr. R. Sault.* N° 246, p. 425. *Translated from the Latin.*

Let AP (fig. 10, pl. 5,) be a horizontal line, P the point from whence the heavy body descends through the curve line required PDE, C and D two points infinitely near, through which the body may fall, CD a right line connecting those points; also DC and SC, DF and SG, FS and GC or SH, moments of the curve, of the absciss, and of the ordinate respectively. Take DR = DS, and CT = CB.

Then because in small nascent lines, the time is as the path ran over directly and as the velocity inversely, that is, in this case, as the root of the altitude of the falling body, by the hypothesis it will be as $\frac{DS}{\sqrt{QD}} + \frac{SC}{\sqrt{QF}}$ = the least time. And the velocity in the points of equal altitude S and B along the curve DSC and the right line DBC is the same, the time through DC, which is a minimum, will be as $\frac{DB}{\sqrt{QD}} + \frac{BC}{\sqrt{QF}}$: put therefore these times equal, and it is $\frac{DS}{\sqrt{QD}} + \frac{SC}{\sqrt{QD}} = \frac{DB}{\sqrt{QD}} + \frac{BC}{\sqrt{QF}}$, that is, $\frac{DB-DS}{\sqrt{QD}} = \frac{SC-BC}{\sqrt{QF}}$, or $\frac{BR}{\sqrt{QD}} = \frac{TS}{\sqrt{QF}}$.

But the evanescent triangles BRS, BTS are equiangular to the triangles DSF, HSC; therefore $\frac{BS}{DS} = \frac{BR}{SF}$, and $\frac{TS}{HS} = \frac{BS}{ST}$. Compound these two ratios of equality, and then $\frac{BR}{DS \times HS} = \frac{TS}{SF \times ST}$. And ex æquo $\frac{\sqrt{QD}}{SF \times ST} = \frac{\sqrt{QF}}{DS \times HS}$. Now as any of the elements may be supposed to flow equably, put DS = SC, and the most simple expression of the curve becomes $\frac{\sqrt{QD}}{SF} = \frac{\sqrt{QF}}{DS}$ every where. That is, in the point of flexure the curve will always be in a ratio com-

* See N° 224, p. 129, of this volume.

pounded of the velocity directly, and of the moment of the ordinate inversely, Now let $\dot{x}$, $\dot{y}$, $\dot{z}$ be the fluxions of the absciss, of the ordinate, and of the curve respectively; then, as above, $\frac{\sqrt{x}}{\dot{y}}$ is constant; therefore $\frac{\sqrt{x}}{\dot{y}} = 1$; but we supposed $\dot{z}$ $(= \sqrt{\dot{x}^2 + \dot{y}^2})$ to be constant. Therefore that this may be constant unity, and may retain its due dimensions, there will be $\frac{\sqrt{x}}{\dot{y}} = \frac{\sqrt{a}}{\sqrt{\dot{x}^2 + \dot{y}^2}}$; and after reduction $\dot{y} = \frac{\dot{x}\sqrt{x}}{\sqrt{a - x}}$, which is a known expression of the cycloid PDE. Q.E.D.

*On the Mineral Waters at St. Amand near Tournay. By Mr. Geoffroy.** N° 247, p. 430.

A mineral water has been found, called St. Amand's water, which has been much used in all sorts of sickness, rather for its novelty, than for its extraordinary properties.

It is situated in a marshy ground; the basin of the spring is 450 feet square; in the bottom of the basin is mud of 20 feet deep; below that is sand, which is sometimes very moveable, and at others is very firm. It often casts up a great quantity of sand; and once in a little time more than 16 cart loads of it, by which all the basin was bordered. Three sorts of earth are met with; the uppermost is black, and burns like turf, and with the same smell; the second

* Stephen Francis Geoffroy was born at Paris in 1672. His father, who was an apothecary, intended him for his own profession; but young Geoffroy aimed at the dignity of a physician. After attending the lectures of the medical professors at Paris, he was sent to Montpellier for the completion of his studies. After the peace of Ryswick in 1698, although he had not yet taken his doctor's degree, he accompanied the French ambassador, Marshall Tallard, to England. Here he became acquainted with Sir Hans Sloane, and was elected a Fellow of the R. S. in whose transactions are inserted several communications of his, chiefly on chemical subjects. From England he went to Holland, and afterwards to Italy. He did not take his degree of M. D. until 1704. In 1709 he succeeded Tournefort, in the professorship of physic at the Royal Coll. at Paris, and in 1712 he was appointed chemical professor at the King's Garden. He died in 1731. Besides the papers inserted in the Phil. Trans. and in the Memoirs of the French Academy of Sciences, he wrote a Latin Treatise De Mat. Med. published from his MSS. ten years after his death, under the care of Anthony de Jussieu, in 3 vols. 8vo. It was afterwards translated into French in 7 vols. 12mo. 1744. The continuation or supplement is by other hands.

It has been remarked by a celebrated physician, that although Geoffroy's Mat. Med. is a work of some value both in regard to the extent and variety of matter; yet that in his accounts of the virtues of plants, he has yielded too readily to the authority of preceding writers, and in numerous instances has admitted, without the least judgment or selection, their extravagant commendations; and sometimes their mistakes. He was moreover too fond of explaining the medicinal powers of vegetables by the quantity of salts, oil, earth, &c. obtained from them by chemical analysis; a most fallacious mode (as the physician before quoted has remarked) of determining their action.

is white, and the third the same colour as slate. These last two sorts give by lixivium a salt like sal gemmæ. This water in its spring is clear and luke-warm. Its smell and taste like standing water. When exposed to the air, it soon loses both; whence one may judge that it has a very volatile sulphur; and on account of which it is almost impossible to make any experiments on it.

This mineral water has the same weight as the Seine river-water. It altered not the colour of syrup of violets, nor the tincture of tournesol, lime water, nor the oil of tartar; the volatile spirit of sal ammoniac and hartshorn whited the water, and made in it a light coagulum. This water, mixed with the dissolution of ammoniac salt, did not give any smell. It did not alter the infusion of galls. Mingled with the solution of vitriol, it was troubled a little, and gave a greenish colour, and at length it precipitated a yellow powder. Acid spirits did not ferment at first with the water, but afterwards it gave some small bubbles, which adhered to the side of the glasses, wherein the liquor was contained. Having distilled 5 pints of that water; the distilled water had not any taste or smell: and it did not change tincture of tournesol, nor lime-water. There remained from that 5 pints, or 160 ounces, 70 grains of residue; which by lixivium gave 54 grains of grey earth, and 15 grains of white salt, almost like sal gemmæ.

The residue of the evaporated water put upon the burning coals, did not cast any smoke, nor did it make any detonation; spirit of nitre being poured on it, it fermented very much; nor did spirit of wine extract any tincture from the residue.

From these experiments it may be concluded, that this water has no acidity; that it participates not of vitriol nor of alum: and that there is in it but a small quantity of the white earth, and less also of salt, which is very like sea-salt. That the parts which show themselves in the mixture of the lime-water, &c. are the earth, and salt of fixed or volatile alcalis. These are the same parts which begin the light fermentation in the mixture of acid spirits; but that fermentation is imperfect, because of the small quantity of the earth, which is drowned in so great a quantity of liquor; indeed, when the water is evaporated, the acid spirits ferment very much with the residue.

It appears by the smell of this water, that it contains a sulphur very subtle, which dissipates easily, and is not sensible in the experiments. However to that sulphur are to be attributed the principal effects which are produced by that mineral water; such as relieving the palsy, &c. in other sorts of distempers where the nervous system is attacked, in short-breath, and in all affections of the lungs; and relieving many other infirmities, which are caused by the sharp ferments, which are sweetened by this water. As to its other properties, such as purging, removing obstructions, tempering the hot intrails, &c. it may have the same effects with common water when drunk plentifully.

One may drink many glasses of this water, beginning with 4, 6, or 8 every morning, and augmenting to 12, 18, 20, or more, according as the stomach is able to support it. This water passes readily by urine, and many persons are purged by it. Sometimes one may mix with it some diuretic salt, to make it pass more freely, and remove the more obstructions. At other times one may put some manna, or such-like, for making it more purgative. One may wash also in the mud of the fountain, according to necessity.*

Some Experiments and Observations concerning Sounds. By Mr. Walker. N° 247, p. 433.

Intending to try the swiftness of sounds, I provided a pendulum, which had two vibrations in 1″ of time; this I carefully adjusted at a watch maker's; it was a piece of small virginal wire, with a pistol bullet at its end, the length was 9 $\frac{6}{10}$ inches to the middle of the bullet: I first made it about $\frac{2}{10}$ of an inch longer, viz. $\frac{1}{4}$ of the length of a pendulum that vibrates 2ds, but found it too slow, which I expected from the air's resistance.

I took this pendulum, and standing over against a high wall, I clapped two small pieces of boards together, and observed how long it was ere the echo returned; thus removing my station till I found the place to which the echo returned in about half a second. But that I might distinguish the time more nicely, I clapped every second of time 10 or 15 times together; so that by this means I could the better discover whether the distances between the claps and the echoes, and the following claps were equal. And though it be very difficult to be exact, yet I could come within some few yards of the place I sought for, thus: I observed the two places where I could but just discover that I was too near, and where I was too far off; and from the mid-way between them I measured to the wall, which measure doubled was the space that the sound moved in half a second.

Here follow the numbers of English feet which a sound moved in one second of time at several trials.

Trials.	Feet.	Trials.	Feet.	Trials.	Feet.
1	1256	5	1292	9	1278
2	1507	6	1378	10	1290
3	1526	7	1292	11	1200
4	1150	8	1185		†

* Further accounts of these mineral waters by Mons. Boulduc in 1699, and by Mons. Morand in 1743, are inserted in the Memoirs of the Royal Parisian Academy of Sciences for the aforesaid years.

† It will readily be perceived that, from the wide differences among the numbers, these experi-

Mersenne mentions an experiment, in which he found the motion of sound to be 1174 feet in a second. And the Academy del Cimento caused six harquebusses and six chambers to be fired, one after another, at the distance of 5739 English feet, and from the flash to the arrival of each report was 5″; and repeating the experiment at the mid-way, the motion was exactly in half the time, which gives 1148 feet per second. Mr. Boyle also mentions that he has more than once diligently observed, that the motion of sound passes above 400 yards, or 1200 feet in 1″.

Mersenne and the Academy del Cimento conclude, that sounds are all of the same quickness, whether they be great or small, and whatever temper the air is of, though Mersenne was once of another mind: but Kircher, from several experiments, infers, that loud sounds move quicker than small ones. Dr. Plot also tells us, the echo returned the sound of a pistol much quicker than a voice; and that it repeated more syllables in the night than in the day: whence it follows that the sound moved slower in the night than in the day. Kircher says, that an echo, which in the night repeated 14 syllables, repeated only 7 in the day. Because there seems to be so great affinity between the undulations of water, and the propagation of sound, therefore the Academy del Cimento tried some experiments about the first; and they tell us, that the larger the stone is, which is thrown into the water, and the greater the force, by so much is the undulation swifter: though Gassendus had before affirmed, that the undulations of water are all equally swift. And I have often observed, that when a stone has been thrown into the water, the further the undulations removed from the centre, the greater was the distance from one another, even of those that rolled the same way: so that the motion of each precedent undulation was quicker than that which followed it. If this may be allowed for any argument, it makes for Kircher's opinion. By some of those experiments which I tried, I am inclined to think that the sound moved quicker when it was calm, than in a wind, even when the sound moved half way with the wind. Some other experiments seemed to confirm an opinion of Kircher's, who says, that a sound moves swifter at first than afterward, as is usual in other violent motions.

In places where there are parallel walls, not above 6 or 8 yards asunder, as in Trinity Ball-court, and at the entrance into St. John's-Grove, &c. I have heard the echoes of a clap following one another distinctly enough; but there the echoes of a musical note, which was longer than a clap, were so confused,

ments have but little accuracy in them. And we shall find hereafter that the more accurate experiments of Dr. Derham, &c. give 1142 feet for the velocity of sound per minute, which has ever since been used as a standard number. The number 1148, found by the experiment of the Academy del Cimento, agrees very nearly with this.

that they seemed one continued long sound; which makes me think, that the echo in some vaults is nothing else but the sound tossed between the side walls, and between the top and bottom. This also makes me conjecture, that the reason why stringed musical instruments give a greater and longer sound to the strings than if the strings were fixed to a single board, may be, because the sound is tossed from side to side in the belly of the instrument.

Further Experiments about Freezing. By Mr. Desmasters. N° 247, p. 439.

In the account in N° 245, concerning the expansion of water by freezing, the water then used was a sort of rough pump water, which on the effusion of oil of tartar per deliquium immediately turns milky and turbid, and considering the ice made of this water was a sort of very rarefied white ice, I was inclined to try whether river water, which would readily mix with oil of tartar without the least precipitation, would upon freezing be expanded to the height of the pump-water above-mentioned. In order to which, I filled a glass tube, of almost an inch diameter, with river water to the height of 6 inches, as in the former trial, and putting it to freeze in a mixture of snow and salt, it gained but $\frac{5}{8}$ of an inch after it was frozen, whereas the pump water got $\frac{7}{8}$ of an inch. I observed that while the river-water was freezing, bubbles rose from the bottom of the tube, much the same as in the freezing of pump-water. I likewise took boiled pump-water and having filled the tube with it to the height of 6 inches, and set it to freeze as before, it rose hardly to $\frac{6}{8}$ of an inch above the mark, whereas the same water unboiled rose $\frac{7}{8}$.

Account of a Stone bred at the Root of the Tongue, and causing a Quinsey. By Mr. Bonavert. N° 247, p. 440.

Tho. Wood, of Wrotham, was so troubled with a quinsey that he could hardly swallow any liquid. I found the tumor tend to suppuration inwardly about the root of the tongue on the right side, though it was almost as large as an egg outwardly, but without any sign of suppuration there. I ordered him maturating gargles; and the next day sent my man, and bid him advise him to endeavour to break it with his finger, which the man effected, and brought out of his mouth near the quantity of a quarter of a pint of matter, and with it at last the stone: he had likewise a ranula, and before he had broken the tumour, and spit out the corruption, he could hardly speak. I believe this stone to be of the same nature as those generated in the kidneys and bladder. The weight of this stone in air is 7 gr. The weight of the same in water is $3\frac{3}{8}$, and its specific weight compared with water is near as $1\frac{21}{108}$ to 1.

Concerning a Piece of Antiquity lately found in Somersetshire. By Dr. Musgrave, F. R. S. N° 247, p. 441.

This piece of antiquity was lately found near Ashelney, in Somersetshire, the place where King Alfred built, as Milton affirms, a fortress, but according to William of Malmsbury, a monastery; in memory, it is supposed, of his deliverance, obscure retreat, and concealment in that place from the Danes.

The work is so very fine as to make some question its true age, but in all probability it belonged to that great king.

The edge is thin, as far as the letters, which are on a plane rising obliquely. All within the inner pyramidal line is on a plane equidistant from the reverse. The representation in that upper plane seems to be of some persons in a chair. It is in enamel, covered over with a crystal, which is secured in its place by the little leaves coming over its edges. In the reverse are flowers engraved. The whole piece may be of the weight of 3 guineas, and is of pure gold, except the crystal and enamel; and was perhaps an amulet of King Alfred's.

Account of the Catalogues of MSS. lately printed at Oxford. N° 247, p. 442.

The whole consists of two tomes, price 1l. 2s. The first vol. takes in the MSS. in the Bodleian, Savilian, and Ashmolean libraries, which belong to the university in general, in part I, and the MSS. in most of our college libraries in part II, with those of the libraries of the university of Cambridge in part III. The second tome gives, in part I, catalogues of the MSS. in the libraries of many of the cathedral churches, and of several of the nobility and gentry; and in part II, are some catalogues of the MSS. in some libraries of Ireland; each of which several parts has its peculiar index. At the beginning of the book is prefixed an epistle concerning its nature and use, which is followed by a preface, which acquaints us with the method taken in composing the indexes, with a list of all the catalogues comprehended in the whole. Then comes the life of Sir Thomas Bodley, the magnificent founder of our public library, with the history of it, and an account of its chief benefactors, the heads of whom are engraven on copper plates, here, and at the front of the book to be seen.

The first catalogue is that of those Greek MSS. which once belonged to Sig. Francesco Baroccio, a Venetian gentleman, which were highly valued in Italy, and brought over into England, and by the persuasion of Archbishop Laud, were bought by the old Earl of Pembroke, and presented to our university. These books have been often celebrated by authors of note, to whom they have been highly serviceable; containing a great number of excellent tracts of the Greek fathers, never yet published, besides divers ancient historians and geographers, and particularly a good deal of Chrysostom.

The MSS. of Sir Thomas Roe, which he brought over with him from the East, and those given by Oliver Cromwell, have as good a character, considering their numbers; those of Cromwell's being accounted the remaining part of the Baroccian library, which the Earl thought fit to detain, and were afterwards given by Cromwell.

After these is a catalogue of the MSS. of Archbishop Laud, 1300 in number, which he gave to the university at three or four donations, besides what he gave to St. John's college in Oxon. These MSS. are sufficient to make a large library of themselves, and are written in these languages, viz. Hebrew, Syriac, Chaldee, Ethiopic, Armenian, Arabic, (as well African as Asiatic,) Persian, Turkish, Chinese, Japonese, Malayan, Malabaric, Russian, Greek, (as well in the vulgar Greek as the scholastic,) Latin, Italian, German, Bohemian, Irish, Anglo-Saxon, English, and one book in the Hieroglyphics of Mexico, as there are several others in other parts of the library. What noble copies do we find here of the sacred books, fathers, historians, poets, orators, philosophers, physicians, mathematicians, &c. Besides those above-mentioned, there are in the library thousands of MSS. which are in the same languages with that Prelate's books; besides other books written in the Samaritan, Mendæan, Coptic or Egyptian, Siamese, Peguan, Indostan, Sanscrit, Tylingan, Ceylonian, Tartarian, Spanish, Portuguese, British, Francic, Frisian, Gothic, and Islandic, &c.

After these follow the MSS. of Sir Kenelm Digby, which are chiefly mathematical, though there are many other valuable books among them on other subjects. Then comes a great number of other MSS. given by many particular persons, and now ascribed to Sir Thomas Bodley; as also those of Mr. John Selden, in the Greek and Oriental languages, with some others of his ancient books. Next to these come in order the books which are said to be in Hyperoo Bodleiano; the chief of which are these: 1. Those given by Dr. Huntington. 2. Those bought by the university of Mr. Greaves. 3. The collections of Dr. Richard James, bought by the university after his death, which are more partilarly accounted for afterwards. 4 Those given by the Lord Fairfax; among which are the collections of Mr. Dodsworth. And 5, those bought by the university out of the library of the Lord Hatton, among all which are many books of very great value. Mr. Dodsworth's collections make 160 volumes, written with his own hand, and contain a vast treasure of antiquities of all sorts, relating to our English history. Next to these, in the catalogue, follows a more exact account of the collections of Mr. John Leland, all written with his own hand, in which his design was to set forth England in its true light.

The next parcel of books are those of an equally industrious foreigner, the late Mr. Francis Junius, the chief promoter of the Saxon learning whilst he lived. These books he bequeathed to the university at his death, all of them relating to the northern languages. Some of these are the old MSS. themselves, others are copies of the most considerable Saxon MSS. in the Cotton library, &c. accurately transcribed by himself; or else his own works, almost ready for the press, or lastly, some curious printed books, with his written notes and amendments. Then follow the papers of Isaac Casaubon, the adversaria of Dr. Langbain, both in their own hands. And afterwards a catalogue of part of the MSS. bequeathed to the university by Dr. Mareschal.

Next comes the titles of the Oriental MSS. of the learned Dr. Pocock, late regius professor of Hebrew in this university, which the university bought of his widow. And a catalogue of the MSS. of Dr. Huntington, which the university bought of him since his return from the east. As also those books which the university bought of Dr. Hyde; which three parcels containing in them many books of an extraordinary price and value, joined to what was in the library before, and has come in since, furnish any scholar with sufficient helps to pursue his own studies in most of the languages. After these, there is an account of the MSS. which Dr. Barlow bequeathed to the library; which is followed by the particulars of the MSS, left by Sir William Dugdale to the Ashmolean museum, mostly written with his own hand. These are followed by a catalogue of the MSS. given by Sir Henry Savil; an account of some mathematical instruments belonging to the geometry school, and a catalogue of the printed books there, being all mathematical, which catalogue was never before made public. Then comes a catalogue of the MSS. in the Ashmolean library, which are ranged under the following heads, as, grammatici, rhetorici, musici, geometræ, astrologici, poemata, de re antiquaria, de re heraldica, historici, vitæ, historia naturalis, chimici, medici, anatomici, chirurgici, juridici, politici, orationes, geographici, theologici, magici, prophetici, fatidici, miscellanei, mechanici, et epistolæ; with an appendix, and an account of the MSS. left to the university by the late famous antiquary Mr. Anthony à Wood, which are also laid up in the same Ashmolean museum.

Lastly, come the titles of those MSS. which the university bought of the same Mr. à Wood, and of those left to the public library by Dr. Fell, and some others. These being between 8 and 9000 in numbers, make up the first part of the first tome, which is shut up with every author's name, or tract, &c. in the foregoing catalogue. Since this catalogue was printed off, the university has bought all the papers, MSS. and books collated with MSS. &c. which were in the library of the late learned Dr. Edward Bernard, and some other MSS. have come in also by the generosity of late benefactors.

The second part of the first tome consists of the MSS. in most of the libraries of the Oxford colleges, in this order:

1 University college, in which are MSS. 165
2 Baliol college 319
3 Merton college. 348
4 Exeter college 52
5 Oriel college 72
6 Queen's college. 40
7 New college 323
8 Lincoln college. 113
9 All Souls college 50
10 Brasen-nose college 16
11 Corpus Christi college 271
12 St. John's college 199
13 Trinity college 82
14 Jesus college. 105
15 Magdalen college. 239
Omitted in Merton college . . 1
Omitted in Corpus Christi college 7
Given to Queen's college by Bishop Barlow 106
16 Magdalen hall 12
17 Wadham college 14
Omitted in University college 14
Omitted in All Souls college 16

2564

Given lately to Lincoln college by Sir G. Wheeler 76

In all 2640

And these, except the appendix, have their own index, like the first part.

In the third part of the first tome is an account of the Cambridge MSS. as, in

1 Emmanuel college 137
2 Trinity college 563
3 Sidney Sussex college 76
4 Gonvile and Caius college . . 580
5 Bennet's or Corpus Christi college 395
6 Peter-house college 168
7 Pembroke hall 231
8 Jesus college. 7
9 King's college 7
10 Trinity hall 7
11 The public library. 322

In all 2293

Which catalogues, with their index, make up the third and last part of the first tome.

The second tome comprehends the libraries of many of our cathedral churches, noblemen, gentlemen, &c. the chief of which I will reckon up, as they lie in the catalogue. The cathedral churches are those of York, Durham, Carlisle, Worcester, Salisbury, Winchester, Litchfield, Hereford, Exeter, Wells, and Canterbury. Other libraries belonging to public places, here decribed, are those of Westminster church, Winchester college, Coventry school, Bristol, Grays-inn, Eaton college, Grasham college, Shrewsbury, Lincoln's-inn, Sion college, Manchester library, with directions to the MSS. in the Herald's office, and to the records in the Tower. The MSS. of the nobility, are those of the Earl of Carlisle, the Earl of Denbigh, the Lord Viscount Longuevile, the Earl of Peterborough, the Earl of Derby, the Lord Bishop of Norwich, and the Earl of Kent.

The largest catalogues of the gentry, are those of Sir William Glynne, Dr. Plot, Sir Thomas Wagstaffe, Mr. Leneve, Dr. Francis Bernard, Mr. Evelyn, Mr. Seller, Sir John Hoby, Dr. Johnston, Mr. Bromley, Mr. Onsley, Mr. Chetwynd, Dr. Tyson, Dr. Browne, Sir Henry St. George, Dr. Gale, Mr. Theyer, Mr. Pepys, Mr. Worsley, Sir Edward Norwich, Sir Henry Langley, Mr. Jones, Dr. Todd, Dr. Edward Bernard, which last are now all in the Bodleian library; Mr. Thoresby, Mr. Burscough, Mr. Brotherton, Dr. Sloane, Mr. Cousin, Sir George Wheeler, which he has since generously given to Lincoln college; Mr. Farmer, and Sir Symonds D'Ewes. Besides which, and others of less note, here is exhibited a catalogue of the MSS. in his Majesty's library at St. James's, and one foreign catalogue, which is that of Isaac Vossius, whose MSS. are now at Leyden in Holland. The books being good ones, and the catalogue being hitherto often inquired for, I am well satisfied to see it here, though the books were suffered to go out of the kingdom. This part likewise has its index.

The last part of the book, that is, the second part of the second tome, gives the catalogues of Ireland, viz. of the Earl of Clarendon, who, though he be an English peer, yet the books are Irish, and were brought from Ireland. The next is that of the college of Dublin, then that of the Lord Archbishop of Dublin, with the titles of those oriental MSS. which he lately bought out of the library of Golius, and lastly of Dr. Madden; which last part, as all the rest, has its particular index; and by this means each part may be bound up by itself, and interleaved.

Lastly, as MSS. are usually valued either for the antiquity, the language they are written in, their beauty, or for their rarity; so on all these accounts our English libraries, and consequently these catalogues, are of very considerable value.

A further Account of the Contents of the China Cabinet mentioned in last Numb. By Hans Sloane, M. D. N° 247, p. 461.

One figure represents what is commonly but falsely called in India, the Tartarian lamb. This was more than a foot long, as thick as one's wrist, having several protuberances, and towards the end had some foot stalks, about 3 or 4 inches long, exactly like the footstalks of fern, both without and within. Most part of the outside was covered with a down, of a dark yellowish snuff-colour, shining like silk, some of it a quarter of an inch long. This down is what is commonly used in spitting of blood, about six grains of it being taken to a dose, and three doses supposed to cure such an hæmorrhage. In Jamaica are many scandent and tree-ferns, which grow on, or to the size of trees, and have such a kind of down on them, and some of our capillaries have something like it. It seems to be shaped by art to imitate a lamb, the roots or climbing part being made to resemble the body, and the extant footstalks the legs. This down is noticed by Dr. Merret, by the name of poco sempie, a golden moss, and is there said to be a cordial. I have been assured by Dr. Brown, who has made good observations in the East Indies, that he has been told there by those who have lived in China, that this down or hair is used by them for the stopping of blood in fresh wounds, as cobwebs are with us, and that they have it in so great esteem that few houses are without it. I have known it much used in spitting of blood; it being pretended that some of the small down may, by being swallowed, easily slip into the windpipe, and so stop the bleeding: but on trials, though I may believe it innocent, yet I am sure it is not infallible.

Other figures show eight several instruments made for paring the nails, at which the Chinese are very curious and dexterous. These instruments are each of them shaped like a chizzel. One represents a kind of instrument, called in China a champing instrument. Its use is to be rubbed or rolled all over the muscular flesh. It is like a horse's curry-comb, and is said to be used after the same manner, and for the same purposes that they are made use of for horses.

Account of a Book, viz.—Museo di Plante rare della Sicilia, Malta, Corsica, Italia, Piemonte e Germania, &c. di Don Paolo Boccone, &c. with additional Remarks. By Mr. John Ray, F. R. S. N° 247, p. 462.

Signior Paolo Boccone, a gentleman of Sicily, botanist to the Great Duke of Tuscany, and now a monk of the Cistertian Order, of the province of Sicily, having changed his prænomen into Sylvius, has made himself well known to the learned world, by his writings published many years since, viz. His Icones et Descriptiones Rariorum Plantarum Siciliæ, Melitæ, Galliæ et Italiæ, Oxford, 1674. And his Letters about several natural curiosities, written in French, and printed at Amsterdam.

In the present work he gives us a large collection of rare plants, most of which are new and nondescript, curiously delineated and engraven in 130 octavo plates, which he divides into decades, inscribing each decade to a Venetian nobleman. There are two defects in this work; the one, want of method; the other, of description. 1. As for method, there is none at all observed in it, the species being promiscuously and indiscreetly placed as they came to hand, without any order or connection. 2. Besides the names, the stature and magnitude, the places where he found them, or persons from whom he received them, he has to a great number of these plants added no descriptions of the principal parts, root, stalk, leaf, flower, fruit. He would also have obliged us, if he had given the synonyms of such as he took to have been described by others before him, together with the names of the authors of such synonyms and descriptions. Yet notwithstanding all this, we ought rather thankfully to accept what he has done, by enriching the history of plants with such a multitude of new species, than to censure or reprehend him for what he has not done.

END OF VOLUME TWENTIETH OF THE ORIGINAL.

A Description of the true Amomum, or Tugus, sent from the Reverend Father George Camelli, at the Phillipine Isles, to Mr. John Ray and Mr. James Petiver, Fellows of the Royal Society. N° 248, p. 2. *Vol. XXI.*

Camelli in this paper supposes the *tugus* to be the true *amomum* of Dioscorides. He says it sometimes rises to the height of nine cubits. The flowering stem rises to the height of a palm and half, and is covered with red flowers.

An Account of Amber. By M. Phil. Jack. Hartman. N° 248, p. 5. *An Abstract from the Latin.*

A history and description of amber, in 6 sections. Of which sections the 1st gives an account of the countries in which amber is met with; Sect. 2, of the matrix of amber (which the author represents to be a fossil wood) and of the manner in which amber is produced in the said matrix; Sect. 3, of the extraneous bodies adhering to and imbedded in amber; Sect. 4, of the class to which amber should be referred, and in what respects it differs from other minerals. [The author thinks that it belongs not to metallic, earthy, saline, bituminous, or sulphureous bodies; but that it should be referred to the class of gems or precious stones.*] In this section the author makes mention of the electrical property and medicinal virtues of amber; Sect. 5, of the chemical analysis of amber, and of certain of its pharmaceutical preparations; here we have an account of its oil and purified salt, which last the author shows to be of an acid nature, and is induced to regard it as a modification of the vitriolic acid; Sect. 6, and last, of the laws, regulations, fiscal dues, &c. relative to the digging of amber.

* A most erroneous notion.

On the Generation of Fleas. By Sig. D. Cestone. N° 249, p. 42.

Fleas bring forth eggs, or a sort of nits, from which are hatched worms; these make bags like silk-worms, and from these bags come fleas. They deposit their eggs on dogs, cats, men, and other animals infested with them, or in places where they sleep, which being round and smooth, slip commonly down to the ground, or fix themselves in the folds or other inequalities of the coverlets and clothes. From these are brought forth white worms, of a shining pearl colour, which feed on the branlike substance which sticks in the combs when puppies are combed to take out the fleas; or on a certain downy substance that is found in the folds of linen-drawers, or other similar things. In a fortnight's time they come to the size of fig. 1, pl. 7, and are very lively and active; if they have any fear, or be touched, they suddenly roll themselves up, and make as it were a ball. A little after they creep as silk-worms do that have no legs, with a brisk and swift motion. When they are come to their usual size, they hide themselves as much as they can, and bringing out of their mouths the silk, they make round themselves a small bag, white within as paper, but without always dirty and fouled with dust. The bags are to the natural eye of the size of fig. 2, without magnifying. In two weeks more in the summer-time, the flea is perfectly formed; then it soon leaves its exuviæ in its bag, as silk worms and all caterpillars do; which leave in the same their exuviæ. The flea so long as it is enclosed in the bag, is milk-white, and has legs, but two days before it comes out, it becomes coloured, grows hard, and gets strength, so that coming speedily out, it straight leaps away.

Fig. 3, represents the eggs; fig. 4 the worm; fig. 5 the bag; and fig. 6 the flea; but all magnified by the microscope.

To make Two clear Spirituous Inflammable Liquors, which being mixed together, give a fine Carnation Colour, without either sensible Fermentation or Alteration. By Mons. Geoffroy, F. R. S. N° 249, p. 43.

To make the first of these liquors, put a small handful of dried red roses into a glass bottle; pour on them rectified spirit of wine till it cover them an inch. Let them infuse in the cold altogether in the bottle for 4 or 5 hours; then pour off the spirit of wine, which will be clear and colourless.

The second liquor is made by putting some drops of good spirit of vitriol, or oil of sulphur, into some good spirit of wine, so that the acid taste can scarcely be discovered by the tongue. If you put a little of this last liquor into the first, it will give a fine reddish colour, without any effervescence, or other sensible alteration.

If instead of this wine mixed with acids, you put to the first some drops of any volatile alcalis, as of spirit of sal ammoniac, or such like, it will give a green colour to the infusion.

The two first-mentioned liquors were brought to a meeting of the Royal Society by Mons. Geoffroy, where the first experiment above recited being made, it succeeded according to expectation.

A further Account of the China Cabinet. By Hans Sloane, M. D. N° 249, p. 44.

Seeds to clarify water. These seeds come from the coast of Coromandel and Malabar, where they are used for elarifying water. They are about the size of a small pea, only broader and flatter, having striæ running from their centre, after the manner of the common nux vomica. In the East Indies they rub or grate them on the bottom of a small earthen basin, wherein is contained some water. This water and powder are put into a large quantity of muddy, or foul water, which is thus clarified.

Part of a Letter from Mr. William Derham, to Dr. Sloane; accompanying his Observations on the Height of the Mercury in the Barometer, Rains, Winds, &c. for the Year 1698. N° 249, p. 45.

The quantity of rain which fell through my tunnel last year, was 122,32 pounds: which exceeds the quantity of 1697, that being only 77,60 pounds. I find foggy weather makes the mercury rise, as well as the north-wind; as in the month of December, when the mercury was very high, though the wind was in the southerly points. I submit it, whether the cause be not the increase of the weight of the atmosphere, by an addition of those vapours of which the fog consists, which are manifestly as heavy as the air, because they swim in it without ascending? These filling up many of the vacuities of the air, without extruding much the parts of air, as I judge clouds do, yet add considerably to the weight of the atmosphere, and so cause the mercury to ascend. The greatest range I have ever observed the mercury to have, is no more than 2,12 inches; it being here never higher than 30,40, nor lower than 28,28 inches, the lowest it ever was, within my observations, was Jan. 24 last, about two o'clock in the afternoon; about which hour Mr. Townley observed his barometer fall to 27,80 inches, which, he says, was remarkably low.

Account of what rain fell at Townley in Lancashire, in the Years 1697 and 1698, with some other Observations on the Weather. By Richard Townley, Esq. N° 249, p. 47.

	An. 1697	An. 1698
January	5 13	6 47
February	7 17	5 88
March	49 3	20 16
April	4 12	20 95
May	11 88	8 95
June	8 92	6 45
Carried over	42 15	68 86

	An. 1697	An. 1698
Brought over	42 15	68 86
July	13 50	10 37
August	40 25	21 50
September	46 90	21 79
October	27 60	22 26
November	10 72	24 72
December	24 50	20 42
Sums	205 70	189 92
These doubled	41 040	37 984

In the table of the observations I have only set the quantity of rain in pounds and cestesimals, which if doubled, they will answer those numbers formerly printed in the Phil. Trans. giving the numbers of half pounds, and near enough the height of the water also. So the last year there fell 189.92 pounds Troy, which doubled make 37.984 inches, the inches the water would have filled any cylindrical vessel.

As far as I have learned, the mercury rises and falls much after the same measure in most parts of our island, and of this you may better judge by some observations I have here transcribed and sent you of the very low stations. Dec. 28, about 3 o'clock, the mercury 28,17 ; on the 29th, about $2\frac{1}{2}$ h. 28,18, and Jan. 2, about the same hour, 28,05 ; and on the 6th still about 3 h. 28,19.

Part of a Letter from Mr. Dale, to Dr. Martin Lister, concerning several Insects. N° 249, p. 50.

I send you a cervus volans* or two, which I take to be different from those described by Moufet in his Theat. Insect. pp. 148, 149. These are plentifully found about Colchester, especially towards the sea-coast. Besides these I have found several sorts of scarabs, which I cannot find figured in your curious tabulæ mutæ; a species or two of cantharides, three or four sorts of lady bugs, and others. Last summer being on our sea-coast at Harwich, I observed no less than five or six species of cochleæ marinæ, two of which I have since found to be already

* This insect, which is the *lucanus cervus* of Linnæus, varies much in size, and in its shades of colour.

noted by you in your Hist. Conchyl. as of English production. A third I have, which is figured by you, but is not marked as found in England. The fourth agrees with your n. 8, in figure, but having no name, I cannot be positive, I therefore desire your name of it. Among other things which the fishermen brought up, there were several of those marine animals, which by Dr. Molyneux, Phil. Trans. n. 225, are taken for nondescripts, and referred to the classes of scolopendræ marinæ; these our fishermen call sea-mice, and are described by Rondeletius, and by Moufet, and Johnson, figured under the title of physalus, but badly.

Account of a young Man killed by Thunder and Lightning, Dec. 22, 1698. *By Ralph Thoresby, Esq. F. R. S.* N° 249, p. 51.

Jeremiah Skelton, of Warley, near Halifax, Yorkshire, observing a storm coming, hastened to gather in some of the corn which was out at a farm of his father's in the Cold Edge, about a quarter of a mile from their own dwelling; while at this work, bringing in a burden and casting it upon the barn-floor, the tempest began as he came forth again; whereupon he stepped aside for shelter within the barn door, and while there, was struck with a dreadful flash of fire. The young man was a sad spectacle, being beaten down, quite dead, and many stones about him; he was laid upon his face, wholly naked, save a small part of his shirt about his neck, and a piece of a stocking on one foot, and so much of a coat-sleeve as covered the rist of one arm: his shoes driven from his feet, one not to be found, and the other split; his hat not to be found after search, and the rest of his garments torn into small shreds, and cast at considerable distances, one piece from another; the hair of his head and beard singed, as if with a candle, and a little hole below his left eye, which was probably made with the fall upon a stone, for there was a great breach made on the barn, the door tops, both of stone, broken, and the wall above them fallen, with the slate and water-tables.

Account of Books.—1. *Museo di Fisica et di Esperienze, &c. By Signior Boccone; with additional Remarks by Mr. John Ray, F. R. S.* N° 249, p. 53.

This book is made up of many curious observations, natural and medicinal, about various subjects, not digested into any certain method, but miscellaneously disposed: each observation dedicated to some noble or learned person.

The first 4 observations relate to the dreadful earthquake in Sicily in 1693. The 5th is concerning succinum or amber; the 6th about alkaline and medicinal earths: the 7th on the powder of Claramont; the 8th of the lapis bezoar mineralis of Sicily; the 9th of terra lemnia: the 10th on the same; the 11th on the aqua santa or di nocera, a mineral water of Sicily; the 12th a description of the fungus melitensis; the 13th on an urn found in Malta; the 14th and 15th on manna; 16th on the tarantula of Corsica; 17th on the tarantula of Apulia; 18th on a venomous spider of Sardinia; 19th on poisons and antidotes; 20th on the same; 21st on the effects of terror; 22d on diseases of the liver; 23d on agues; 24th on the actions of some animals; 25th on the effects of some plants; 26th on the effluvia of plants; 27th on various curious effects produced by nature; 29th on the pitch of Castro; 30th on the macaluli near Agrigentum in Sicily; 31st on the oil of juniper; 32d on the glossopetræ of Malta; on an ebbing and flowing well near Chamberry in Savoy, &c.

2. *An Account of Paradisus Batavus, continens plus centum Plantas, &c. with additional Remarks. By Mr. John Ray, F. R. S.* N° 249, p. 63.

Dr. Paul Hermans, author of this work, designed therein to give the history of such rare and nondescript plants, as well European as Indian, as were cultivated either in public physic-gardens, or those of private persons, in and about Holland. Of some of those he presents us with both descriptions and figures; of others with descriptions only; and of others, which had been before described, but not delineated with figures, referring for their descriptions to their first authors. Of the first kind, this work contains more than an 100 species, digested in an alphabetical order. The author intended a second and third century, for which he had prepared materials, having caused many more plants to be drawn by hand, which are not as yet engraven, a catalogue whereof the editor has added to the end of the book.

The descriptions are accurate, and sufficient to give us a knowledge of the plants described, without being incumbered with superfluous matter. The icons are answerable to the descriptions, and are very exactly delineated and well engraven.

A further Account of what was contained in the Chinese Cabinet. By Hans Sloane, M. D. N° 250, p. 70.

A sea-horse tooth. Cow-bezoar. A pair of brass tweezers. A round metallic speculum, used as a looking-glass, 2 inches diameter. A Malaya purse, made of straw, platted or woven as are straw-hats. Two bone probes. Four China pencils; with these the Chinese write their letters, as we do with pens. One wide toothed comb of one piece of wood. One straight toothed comb: its teeth are all distinct flat pieces of wood, sharp at both ends, set together and fastened to each other by two pieces of reed, laid over their middles.

An instrument to clean the combs, of three teeth. Nux vomica. Bamboo stone.

Books of China leaf gold, the leaves of some of which are an inch and half square, others four inches: the paper of the ordinary China sort, probably made of silk or cotton: the Chinese gild paper on one side with this leaf gold, then cut it in long pieces, and weave it into their silks, which makes them, with little or no cost, look very rich and fine. The same long pieces are twisted or turned about silk thread by them, so artificially, as to look finer than gold thread, though it be of no great value.—A sheet of brown paper from China. This sort of brown paper, which is smooth and thin, is made use of instead of linen cloth or rags, to spread ointments on, in the hospitals in Paris.—Two steel instruments for polishing razors, each of them crooked and two inches long.

Semen phaseoli zurattensis, or cowage, Raii Hist. Plant. used for curing dropsies.—A great black scararbæus, a scarlet butterfly, an ash-coloured capricorn, a locust, and a phalæna, all to pieces.—An Indian hone, a blackish colour. A China hone like ours. An Indian hone, to be used after the stone, to smooth the points of lancets, &c. this is made of a kind of white wood, as light as touchwood.—A painter's brush, made of the stalk of a plant, the fibres of which, at both ends, being fretted asunder and tied together again, serve for a brush.—A box of several kinds of China ink, with characters on them.

Of Coal-Borings, communicated by Dr. Martin Lister: which he received from Mr. Maleverer, of Arncliffe in Yorkshire. N° 250, p. 73.

Thomas Waike bored for coal at Mauston near Leeds, in the grounds hereafter named, May the 20th, 1639.

In the Rye-Close, or upper pig hill.

	Ft.	Inc.		Ft.	Inc.
In earth	3	0	Iron stone	0	6
Yellow clay	3	0	A cowshot coloured stone, with many iron girdles in it	28	6
Blue ramel	3	0	Black stone	7	6
Black slate	0	9	A mouse-coloured stone	3	0
Grey metal stone	7	6	Black metals	0	9
Black metal	1	6	Grey stone	6	9
Grey stone	6	0	A cowshot coloured stone with many iron girdles in it	24	0
A whinstone	0	9	A grey metal	1	6
Grey metal	1	6	Coal	1	0
A whinstone	1	0			
Grey metal	1	0			

	Ft.	Inc.
A dark grey stone	1	6
A whinstone	1	0
A dark grey stone	3	0
A cowshot coloured stone with catheads in it	3	0
Black metal mixed with coal	1	6
Cowshot coloured stone	10	6

In all 21 fathoms.

The charge 9l. 5s.

Bored 140 yards west from the former place, in the Taith-Garth.

	Ft.	Inc.
In yellow clay	9	0
Orange coloured stone	24	0
A cowshot coloured stone	6	0
Black metal	1	6
Cowshot coloured stone	3	9
Coal mixed with metal	0	9
A blue metal	1	6
Coal	2	9
Cowshot coloured stone	6	0

In all 9 fathoms.

The charge of boring, 2l. 1s. 3d.

Bored in the severals on the west side of the fish-ponds

	Ft.	Inc.
In yellow clay	9	0
Yellow stone	6	0
Cowshot coloured stone	4	6
Blue stone	15	0
Coal	5	3
Grey metal	1	4
Coal, under this coal a hard grey stone	3	0

In all

The charge 1l. 12s. 6d.

Bored at the west-end of the East-hall close

	Ft.	Inc.
In earth	3	0
Coal	1	9

Bored 40 yards by east on the dip.

	Ft.	Inc.
In earth	7	9
Coal	4	2

Bored 30 yards by east, further still on the dip.

	Ft.	Inc.
In earth	9	0
Grey metals	2	3
Coal	4	2
Earth	27	0

In all 4 fathoms.

The charge 3l. 3s. 9d.

Bored in the West Close adjoining to Win Moor.

	Ft.	Inc.
In yellow clay	9	0
Orange coloured stone	30	0
A whinstone	1	6
An orange coloured stone	7	6
A cowshot coloured stone	7	6

In all 9 fathoms.

The charge 2l. 1s. 3d.

A Comet observed at Paris in Feb. 1698-9. *By M. Cassini.* N° 250, p. 79. *Translated from the Latin.*

In the night following Feb. 19, 1699, at the Royal Observatory at Paris, there began to appear through the opening of the clouds, which for some days had obscured the heavens, a small comet, like a nebulus star of the 3d magnitude, like that which was observed Sept. 1698. It was situated among the unformed stars of the 6th magnitude near the north polar circle, over the head of Auriga. By repeated observations from that night to the next following, the comet appeared to have a proper motion, and to direct its course towards Capella, with little or no deviation from its circle of declination: so that had not the sky been obscured the preceding days, it might have been seen near the north pole. Its velocity was such, that in a day's time it had run through about 7° of a great circle; by which motion it might in less than 4 days nearly reach the pole, and be associated with the pole star.

By comparing this comet with a star of the 6th magnitude, which Tycho calls the second of those that are in a right line with the pole, it was found that in passing through the horary circle it had got before this star by 15′ 53″, by which the difference of right ascension ought to be 4° 43′, and it was 8′ more northerly then that star. Hence the longitude, from the latitude assigned to this star by Tycho, being computed to this time, the comet may be referred to 15° 51′ of Gemini, with 37° 25′ north latitude.

This comet moved in the region of the heavens opposite to that of the comet of the preceding year, when nearly at the same distance from the pole as this appeared in at first, and pretty near the same place. That comet of September went in the same track as that observed by Cassini at Bologna in 1652. This latter in the month of December came from the southern regions, through the constellations Lepus, Orion, and Taurus, where it crossed the ecliptic at an angle of 76°, and through Perseus and Cassiopeia, where it disappeared in January 1653. Hence it appears that this comet first appeared in the beginning of September, in the same part of Cassiopeia where the other disappeared, and from thence proceeding through the shoulders and arms of Cepheus, where it had its greatest latitude from the ecleptic, viz. 76°, it passed between Draco and Cygnus, through the lion's skin in Hercules, through Ophiucus, till it came to the constellation Scorpio, where according to the observations, it continued from the 24th to the 28th of September. From the same observations it was found that it came to its perigeum Sept. 7, in the evening, having a very great apparent velocity, viz. of nearly 10° in a day.

On the Virtues of the Ostracites. By Dr. Cay. N° 250, p. 81.

It is stated in this letter that the finely pulverised ostracites, mixed with a third part of chamomile flowers, is a good remedy in gravelly affections. Dose from ℥ss to ℥i.

An Account of the Virtues of Faba Sancti Ignatii; mentioned in last Numb. By Franciscus Joannes, the Jesuit. An Extract from the Latin.* N° 250, p. 87.

The bitter seed called the Faba Sancti Ignatii, and which grows in the Philippine Islands, is in this account said, 1. to be good against spasms, and particularly against that species of spasm which is termed sotan or soutan. 2. To be useful as an emetic where poisons have been swallowed, being grated and taken in cold water; also against the bites of venomous animals, being scraped and applied to the wound. 3. It is serviceable also where any limb is affected with spasm, when applied to the said limb in the manner just mentioned. 4. Further, the raspings when applied to any sort of wound, stop the bleeding; and being administered internally last year (1692) to a woman labouring under an obstinate hæmorrhage, she was thereby cured. 5. This bean (or seed) cures fevers; as was proved by the case of an infant who was ill of a violent fever, which speedily gave way to the exhibition of this remedy. 6. It promotes the birth, in lying in-women. 7. It is remarkably serviceable in surfeits and indigestion, and is a good remedy in disentery and diarrhœa.

Various modes of using this remedy are mentioned, viz. each nut or seed is directed to be cut into 3 pieces, one of which is to be held in the mouth for a $\frac{1}{4}$ or $\frac{1}{2}$ an hour, the patient swallowing his spittle, and afterwards drinking 2 or 3 oz. of cold water: or, the grated seed may be steeped in cold water,† and the infusion given: or, lastly, the seed cut into small portions may be fried in oil, and the oil either be taken internally or applied topically, in wounds and spasms.

A further and more exact Account of the Faba Sancti Ignatii, sent in a Letter from Father Camelli, to Mr. John Ray, and Mr. James Petiver, F. R. S. Extracted from the Latin. N° 250, p. 88.

Of the Igasur or true Nux Vomica of Serapion.

Catolongay, or as others call it cantara, is the plant which bears the true nuces vomicæ of Serapion. It is a climbing plant, and twines itself round the tallest trees. Its stem is woody, porous, and sometimes as thick as a person's arm; the bark is rough, thick, and of an ash-colour; the leaves are large, ribbed, and of a bitter taste; the flower resembles the balaustine or pomegranate flower, and is succeeded by a fruit larger than a melon, covered with a

* Ignatia amara, Linn. Ignatiana Philippinica. Loureiro.

† In the following paper on this subject it is said to be steeped in hot water.

thin, glossy cuticle or rind of a lurid green colour, under which lies another covering of a stony hardness. Within this shell is contained a fleshy pulp, of a yellow colour and bitter taste, in which are imbedded the nuts [seeds], the true nuces vomicæ of Serapion. These nuts when fresh have a shining silvery down upon them; they are not quite so large as a walnut, are of an unequal size and diversified shape, and upwards of 20 of them are frequently found packed together. They are called by the natives igasur and manaog (i. e. victorious); by the Spaniards nucleos or pepitas de bysayas, or catbalogan; by others, fabæ Sancti Ignatii. When dried they are rather larger than a filbert, knotty [wrinkled], very hard, transparent, of a horny compactness, of an intensely bitter taste, and of a colour inter album et glaucum.

After this description of the plant and its fruit, Father Camelli proceeds to give an account of its reputed virtues; noticing in the first place its employment as an amulet and antidote; then its use in dyspepsia, diarrhœa, and hypochondriacal affections; adding, that the common people of the Philippine islands give it indiscriminately in all sorts of disorders, esteeming it to be a true panacea. As in the preceding account, so here also, its power of stanching hæmorrhages and curing the bites of venomous animals, is mentioned. The common mode of using this nut, is to infuse it in hot water. Others administer a small quantity of it in powder. Others cut the nut into small pieces, and give one or two of those pieces for a dose. Others wear a whole nut hanging from the neck, as an amulet. It generally vomits, and sometimes purges; and in the instance of the Spaniards, almost always excites convulsive motions, but not in the natives. It is administered either in a morning upon an empty stomach, or an hour or two after taking food, where the object is to produce vomiting; in which case 10 grs. are given, along with other gentler emetics. In certain spasmodic affections, in apoplexy, palsy, lethargy, epilepsy, asthma, malignant and suffocating catarrh, toothach, &c. a small portion of the nut is put under the tongue and used as a sialagogue. They give the powder in infusion or oil in tertian and quartan fevers; they also employ this remedy in suppressions of urine and the menses; as well as in cases of difficult parturition, and to promote the expulsion of the secundines, and against worms. Likewise in surfeits, indigestion, diarrhœa, and tenesmus; and lastly, in obstructions of the liver, spleen, &c.

Account of Stones found in the Stomach, Kidney, and Gall-bladder. By Mr. William Clerk, Surgeon. N° 250, p. 95.

In 1690, a lady who had been drinking the waters at Moffet Wells, in Annandale, Scotland, for a continual vomiting, and for the dolor nephriticus, died there in a fit of vomiting. On dissecting the stomach, I found a stone of the size and form of fig. 7, pl. 7. The corner a was almost fixed in the pylorus, so that the passage from the stomach to the intestines was nearly quite shut up. The substance of this stone is a little spongy, weighing about 8½ drams. On dissecting the left kidney was found also a stone of the same substance and form as represented in fig. 8, weighing about 5 drams, and in the gall bladder were several stones, as represented in fig. 9, weighing 2 drams.

That stones are daily generated in the vesica urinaria, reins, and vesicula fellis, is very common, but not so that they should be bred in the stomach of a human body. However, it seems they have been produced by the same common cause and petrifying matter. But I am apt to believe some extraneous body has given origin to that of the stomach, as it happens frequently even in those extracted from the vesica urinaria. Thus, an iron tag, a leaden bullet, &c. have been found to be the kernels of several stones; and that various extraneous bodies are often found in the stomach, which have been swallowed down, either by design or accident, we have many instances and authorities.

A new Way of Cutting for the Stone by a Hermit in France; with Observations by M. Bussiere. N° 250, p. 100.

Brother James, a hermit in France, in extracting the stone out of the bladder, uses a steel staff, much thicker but shorter than usual; it is shorter from the top to the bending; it bends more than ours; his conductor is more slender and longer than ours; the point of it, which goes iuto the bladder, being of the figure of a lozenge, is wide and open in its extremity. His forceps has longer branches than ours, but their holds are shorter and wider, with many large teeth within. The scoop, with which he draws the sand or gravel which remain sometimes in the bladder after the stone is out, is shorter than ours. His knife is much longer and slenderer than ours.

He places the patient flat upon his back, either on his bed or on a table, having a soft quilt over it, in such a manner, that the fundament is 3 or 4 fingers over the table, some servants supporting his thighs and legs. He uses no ligature to fasten the patient, giving him more liberty than we do; only causes his legs to be bent against the thighs, but not the thighs against the belly, except the left, which in his operation he uses more or less as he thinks fit. Then he introduces the catheter or staff into the bladder, which though thick and shorter than ours, yet seems to run in easier; very often he holds it himself with his left hand, pressing it close towards the fundament, in order to dilate and extend the membranes of the bladder; then he feels with the fingers of his right hand, to find out the staff through the skin, and having felt it, he runs his incision knife at the bending of the left thigh, upon the fat protuberance below the ischium bone, directly upward by the rectum to the bladder, which he pierces by its neck, and sometimes a little above it.

When he cuts, the cutting parts of his knife are turned upward and downward: having thus pierced the bladder, which he knows by the urine running out, he turns his knife, and thrusts it a little further, in order to open the bladder wide enough that his finger may go in easily; then he withdraws his knife, and enlarges the wound in the outward parts, of the length of 2 or 3 inches; after which he thrusts his finger into the bladder, in order to know more precisely the size and situation of the stone, and make it loose, but chiefly to dilate the opening into the bladder, by tearing its membranes. Then he introduces his conductor into the bladder along this finger which is in it. When the conductor is in the bladder, he takes the staff out, and introduces the forceps by the conductor into it, with which he gets hold of the stone, and draws it out.

If he find any difficulty, either in getting hold of the stone or in drawing it out, he employs all the usual means, raising the left thigh more or less, putting his finger in the fundament, and sometimes into the bladder, in order to examine the situation of the stone, and loosen it, in case there might be any adhesion with the membranes of the bladder. Having found out and removed the cause of the difficulty, he thrusts the forceps again into the bladder, and gets hold of the stone, and so draws it out.

It is to be observed, that neither this second time, nor on any other, does he use any conductor, the forceps running in very easily. He never thrusts either his finger nor any instrument into the bladder without steeping them in oil of roses. He never uses any dilatatorium, nor canula, or tents in the wound, except sometimes small dossils in the lips of the outward wound, to keep them open for a little while. He uses no ointment at all for the wound, applying only a pledget steeped in oil of roses upon it.

In this way he operates as dexterously as any of our best operators. He often cuts the patient on the gripe, almost in the same manner as was used formerly, except that he makes the incision in the same place as for the former. This way he likes better than the other, and indeed it is surer, though the pressing on the belly, which he uses, is a very bad method.

He cuts women also on the staff, and in the same place as men; only that he cuts the internal neck of the urethra.

But in my opinion, that method either in men or women, is not so sure as the ancient plan, because the point of his knife not being directed by the staff, he is always in danger of piercing all the membranes of the bladder through and through; and besides, the place where he makes the incision, being full of considerable vessels, one can hardly avoid cutting some of them. He succeeds better when the stone is large than when it is small, because a large stone not only extends the bladder, but stops the point of the knife. When there is but a small stone, the bladder being empty, he must necessarily cut it throughout, and consequently some of its own vessels, which causes the hæmorrhage, and is the better avoided when the stone is very large.

Now, for my own opinion, though I cannot approve that way on all occasions. I took a body, in the bladder of which I put a stone, the staff being in the bladder, I pressed it downward, hard enough to be felt through the teguments, and made the incision upon it in the bent of the thigh, in order to know whether it would not be a surer way by securing the point of the knife; by that way I got the conductor and forceps into the bladder, and drew the stone very easily; but afterwards, by the dissection of the body, I found that the artery of the penis, and the vesiculæ seminales were cut through and through, which cannot be avoided, because the artery and vesiculæ lie immediately under that part of the bladder which the staff presses upon.

I took another body, and having put in the bladder a small stone, I made the incision much lower, and pierced the bladder under the staff, by which incision I drew the stone. Then dissecting the body, I found the bladder cut through, and its arteries, which can hardly be avoided, the bladder being then so much contracted, that both sides are cut, before the operator either feels the stone, or sees any urine running out.

I took a third body, in the bladder of which I put up a very large stone, the staff being in it, I made the incision upon the fat protuberance, under the ischium; and piercing the bladder below the staff, I found immediately the stone with the point of the knife, with which I cut the bladder, the length of an inch; through which having introduced the conductor, and then the forceps, I got hold of the stone and drew it out very easily. After dissecting the body I found that neither the vesiculæ seminales nor any artery had been cut, because the weight of the stone pressed the bottom of the bladder lower than the vesiculæ and arteries.

My opinion then is, that this method might be made use of when the stone is very large, and I would prefer it to the old way; for by this way we avoid that extraordinary and violent dilatation of the neck of the bladder, which the stone causes when large, and which is the cause of the inflammation and mortification of the bladder which kill the patient. But when the stone is small, or of but a moderate size, the old way is easier and surer.

Though I have not tried this way on women, yet I cannot approve it at all, since one cannot avoid cutting the neck of the uterus, the cicatrix of which might prove to be of some ill consequence, in case the woman should come to be with child. And therefore when the stone is but of a moderate size, the old way is preferable to any other; but when very large, then I had rather thrust my fingers into the vagina, and bring the stone as near the neck of the bladder as can be, and cut the membranes of the vagina and bladder upon the stone. I once cut a woman in Hamburgh that way, from whom I drew a stone, weighing 5½ ounces, who recovered very well. By this way we prevent the incontinence of urine, which always follows the extraction of large stones in women.

Neither can I approve the cutting on the gripe, as practised by some mountebanks, because in that way one cuts through the prostates, and so destroys the parts of generation. I have observed that all those which have been cut by that method were never fit for generation.

On some Parhelia seen at Sudbury in Suffolk. By Mr. Petto. N° 250, p. 107.

August 28, 1698, about 8 o'clock in the morning, there was seen the appearance of three suns, which were at the brightest then, or a little after. About half an hour after 8 I saw it, when there was in the east a dark, dusky, watery cloud, and below it towards the middle, was the true sun, shining with such strong beams, that persons could not look upon it; on each side were the reflections, with the true sun in the middle. Elsewhere much of the firmament was of an azure light blue colour. The circles which I saw were not of rainbow colours; but white; there was also higher in the firmament, more over our heads, and towards the south, at the same time, at a considerable distance from the other, the form of a half moon; but I think it was more than double the size of a half moon, with the horns turned upwards, and within of a fiery red colour, and more like a rainbow colour; these all faded gradually, after having continued about two hours.

On Sable Mice, which have lately come in Troops into Lapland, about Thorne, and other Places adjacent to the Mountains, in Multitudes. By Sir Paul Rycaut, F. R. S.* N° 251, p. 110.

In the year 1697 these sable mice were first observed, and are nearly as large as a small squirrel; their skin streaked, and spotted black and light brown; they have two very pointed teeth above, and two below; their feet like those of squirrels; they are so fierce and angry, that if a stick be held out at them they

* The lemming. *Mus lemmus.* Linn.

will bite it, and hold it so fast, that they may be swung about in the air; they are fat and thick, and without any tail. In their march they keep a direct line, generally from north-east to south-west, and are innumerable, thousands in each troop, which for the most part is of a square figure; they march by night and in the twilight, and lie still by day. The distance of the lines they go in is of some ells, all parallel to each other, so that the places they have gone over look like the furrows in a ploughed field. If they meet any thing that might stop them, they avoid it not, though it were a fire, a deep well, a torrent, lakes, or morass, but without any hesitation venture through, and by that means many thousands of them are destroyed and found dead in waters, and otherwise. If they be met swimming over lakes, and attacked with oars or boat-hooks, they neither retreat, nor offer to run up the oars, &c. but hold on their course, and if forced out of it they presently return to it again; when they are met in woods or fields and stopped, they set themselves on their hinder feet like a dog, and make a kind of barking or squeaking noise, leaping up as high as a man's knee, defending their line as long as they can; and if at last they be forced out of it, they creep into holes, and set up a cry sounding like biabb, biabb. They never come into any house, nor meddle with any thing that is food for man; if a house happen to be in their way, there they stop till they die; but through a stack of hay or corn they will eat their way; when they march through a meadow they injure it much by eating the roots of grass; but if they encamp there by day they quite spoil it, and make it look as if it were burnt, or strewed with ashes. The roots of grass, with rotten wood, and the insects in it, are their chief if not only food. These creatures are very fruitful, and bring forth 8 or 9 at a time; yet this does not hinder their march: for some of them have been observed to carry one young one in their mouth, and another on their back.

It is reported that some poor Laplanders, wanting other food, have killed and eat several of these creatures, and found their flesh like that of squirrels: dogs and cats, when they kill them, eat only the heads, and birds of prey only the heart; during the winter they lie under the snow, aud have their breathing holes upon the top of it, as hares and other creatures. The common people are very glad of these guests, as they foretell plenty of game, as fowl, squirrels, lo-cats, foxes, &c.

These mice are the same with those called mures Norwegici, Norway mice, described by Olaus Wormius in his museum.

On some Plants in Jamaica. By Dr. Hans Sloane. N° 251, p. 113.

In Jamaica, the neighbouring isles, and on the continent of America, there grow many sorts of misseltoe, parasitical plants, as they are called by some, or epidendra by others; which grow not on the ground, on rocks, or in waters, &c. but on the bodies or arms of trees, after the manner of misseltoe, similar to which they bring forth roots, leaves, stalks, flowers, and seed. There being none other but misseltoe in Europe so remarkable for these particulars, I was constrained, to convey the clearest idea of the thing to be described, to give the name viscum to all the several families of them, though they differed very much from it, and almost as much among themselves; by that name designing only a plant like it in growing on trees, and bringing forth roots, leaves, stalks, flowers, and seeds on them, as other plants do on the ground, or in the soils they grow.

The particular family of these I now intend to speak of is that kind I have called viscum caryophylloides, from having its seed vessel somewhat like that of clove-gillyflowers; and the one, which I shall here describe, is what I name in my catalogue of Jamaica plants, p. 76, viscum caryophylloides maximum flore tripetalo pallide luteo semine filamentoso,* and which is commonly in that island called, wild pine; a great many brown fibrils encompass the arms, or take firm hold of the bark of the trunk of the trees whereon they grow; not like misseltoe, which enters the bark or wood to suck nourishment, but only weaving and matting themselves together to afford the plant a firm and strong foundation, from hence rise several leaves on every side, as fig. 14, pl. 7, aa, after the manner of leeks or ananas, hence the name of wild pine, or aloes, being folded or enclosed one within another, each of which is 2½ feet long, and about 3 inches broad at the base, ending in a point, having a very hollow or concave inward side, and a round or convex outward one; so that by all of their hollow sides is made within a very large reservatory, or basin, b, fit to contain a quantity of water; which in the rainy season falls upon the uppermost parts of the spreading leaves, that have channels in them, conveying it down to the cistern, where it is kept, as in a bottle; the leaves, after they are swelled out like a bulbous root, to form the bottle bending inwards, or coming again close to the stalk, by that means hindering the evaporation of the water by the heat of the sun. They are of a light green colour below, and like leeks above; from the middle of these rises a round, smooth, straight green stalk, 3 or 4 feet long, c, having many branches, which when wounded yields a clear, white, mucilaginous gum; the flowers come out here and there on the branches; they consist of three long, yellowish, white, or herbaceous petals, and some purple ended stamina, standing in a long calix or tubulus, made up of three green viscid leaves, with purple edges, to which follows a long triangular capsule, d,

* *Tillandsia utriculata.* Linn.

of a greenish brown colour, being somewhat like those of the cariophylli, having under it three short capsular leaves, and within several long pappous seeds, the seed itself being oblong, pyramidal, and very small, having very soft hairs down, or tomentum, much longer in proportion to the seed than any tomentum I know, being as long as the pod or capsule. It grows on the arms of the trees, everywhere in the woods, as also on the bark of their trunks, especially when they begin to decay, their barks receiving the seed, and yielding then more easily to the fibrils of the roots of this plant, which in some time dissolves them, and ruins the whole trunk.

The contrivance of nature in this vegetable is very surprising; the seed has many long threads of tomentum, not only that it may be carried everywhere by the wind, as pappous and tomentose seeds of hieracium, lysimachia, &c. are; but also that it may by those threads, when driven through the boughs, be held fast, and so stick to the arms and extended parts of the barks of trees; so soon as it sprouts or germinates, though it be on the under part of a bough or trunk of the tree, its leaves and stalk rise perpendicular or straight up; because if it had any other position, the cistern before-mentioned made of the hollow leaves could not hold water, which is necessary for the nourishment and life of the plant. In the mountainous, as well as the dry low woods, during a scarcity of water, this reservatory is necessary and sufficient, not only for the plant itself, but likewise is very useful to men, birds, &c.

There are some European plants which somewhat resemble this in some particulars. The virga pastoris,* or wild teasel, and most perfoliated plants, have their leaves enclosing the stalk, and so set by pairs opposite to one another and joined by their bases, that they make a hollow place fit to contain some water, which though open, yet doubtless contributes to the perfecting of the plant. Several fuci are lately discovered to have seeds, which when ripe break out of their places, and by means of a gluey juice, fasten themselves to the stones or substances at the bottom of the sea, where they are to grow. The common viscum has a gluey substance, probably for fastening its seed to the bark of trees. There is a fungus called by Clusius, fungus minimus anonymus,† and by Dr. Merret, campaniformis niger multa semina plana in se continens, which when ripe, opens in the rain, which filling a cup containing its seeds, they are washed out on every side to propagate its kind.

There are many families of plants with pappous or tomentose seeds, as dandelions, erigerums, lysimachias, clematises, anemones, &c. which when ripe, their seeds are, by means of their feathers or wings, scattered to all neighbour-

* Dipsacus sylvestris. † Peziza lentifera. Linn.

ing parts by the wind. This is so effectual a way, that the aster Canadensis annuus non descriptus Brunner, Hort. Bles. p. 10, or Conyza annua alba acris, Morris. which came at first from Canada, is now become a wild plant in many places of Europe, where it never was observed to grow, and far from the gardens where it was first planted, whence the seed had been carried by its wings, so that I have seen it in some parts of France, many leagues from such places.

There are likewise many plants with seed-vessels so contrived, as with a spring, and sometimes smart noise, when they are ripe, to throw off their seeds several ways, to a considerable distance; most plants having pods, as furze, &c. those called, noli me tangere, or herbæ impatientes, cucumis anguinus, cranes-bills, and many others, have this mechanism to sow themselves. Among those that have this property, none is more surprising than one in Jamaica, called spirit-weed, which when its seed is ripe, the vessel containing it, on the least touch of whatever is wet, instantly opens, and with a smart noise throws its seeds several ways to a considerable distance. Lychnises, poppies, antirrhinums, and many others, have their seeds in heads, which when ripe, are open at top, and by the winds, and help of their partitions, are scattered and directed to all quarters. Many similar instances might be adduced.

Of a Fœtus lying without the Womb. By Dr. Fern. N° 251, p. 121.

A woman 9 months gone with her 5th child was received into the Hotel Dieu, being then about 34 years of age, and of a tender constitution. The midwife who examined her body, found a considerable tumor on the right side, near the navel, which very much resembled a child's head, her belly below that place bearing no proportion to that above, or to the time of her pregnancy. On the left side there was nothing singular. The midwife thought she felt through the vagina, a thick membrane filled and distended with water, and in it the heel of a child, bent towards the thigh; but she could not be assured whether this was within the womb or not, because the inner orifice was drawn so high, under the os pubis, that she could not, without some difficulty, touch it with the end of her finger. Upon trying some time after, she could not discern any thing like the fœtus she had before felt. On inquiry she was informed by the patient, that for the first six weeks of her pregnancy she had great and continual pains, which shot towards the navel, and terminated there, and these lasted till the 3d month; that from thence to the 6th she had frequent convulsions, apoplectic fits, terrible syncopes, which had very much frightened those about her, so that they despaired of her life; that from the 6th to the 8th month, she had enjoyed a much better health, which in some measure had strengthened both her and her infant; that the pains she had endured since that time seemed to be so many alternate blows, probably proceeding from the repeated strokes of the child's head in that place, where the teguments were so thin, by reason of their great extension, that the hardness of the cranium could plainly be discerned through them. In this condition was this miserable woman when received into the hospital, till her affliction increasing, she could not lie on her side or back, being forced to sit in a chair, or kneel in her bed, with her head resting on her breast. From these strange and unaccountable symptoms, the physician and master surgeon of the house thought it was best to leave the work to nature, and prepare the woman for her labour by opening a vein in her foot. The evacuation was ordered to be small, in which regard was had to the weakness of the patient, and the delicacy of her constitution. However, after this time the child made no more efforts, and the tumor subsided, there remaining only an hydropic indisposition, which might be perceived by the fluctuation; and a great quantity of water came away for several days from the orifice of the vein; insomuch that she who seemed to have her lower belly and thighs extremely distended, was very much wasted before her death.

After the patient's decease her body was opened by M. Jouey, and on the first incision through the teguments, there came away 2 or 3 pints (Paris measure) of water and blood, and there appeared the head of a child naked; and when the parts were all laid open, there was found an entire female fœtus, contained in a sort of cover or bag, which at once served it both for a womb and membranes. M. Jouey took the child with the umbilical string out of the mother's belly, tracing the string to the placenta, into which it was inserted. This last appeared like a great round lump of flesh, and adhered so firmly to the mesentery and colon on the left side, that it could not be separated from them without some trouble. On one side of this lump was a lesser, about the size of a kidney, which principally adhered to the mesentery, and received several branches of the string into it. The larger lump was round, and the greater part of it adhered to the bag or sac which contained the child. As for the sac it was corrupted and mortified in part, which probably might proceed from the frequent strokes of the infant's head. It sprung from the edges of the tube, or fimbria of the right ovary, which was more entire than the left, and proceeded obliquely to the left side, terminating at the bottom of the pelvis. In its descent it sent out a small portion between the womb and the rectum. This bag, by compressing the parts, had gained a considerable space in the above-mentioned cavity; in such manner, that a great part of the child's body was lodged at the bottom of it, in a bended posture, with the head projecting forward, which formed the prominence near the navel. This bag seemed to be nothing else but an elongation and distension of the tube, and an expansion or production of the broad ligament on the right side, which was evident from its continuity to those parts, and the distribution of the spermatic vessels, which were larger than usual, and passed from the extremity of the tube to the larger lump.

The womb was entire, and in its natural state, except that it was something larger than ordinary, being about the size of that of a woman 10 or 12 days after her delivery, and no signs that the child had been lodged in it. M. Jouey, having observed this, called in several eminent physicians and surgeons, and the womb being carefully dissected, it was unanimously agreed, that the fœtus had never been in it; it being in the same state as in women who are not with child, except the small dilatation of its bulk, which might arise from a compression of the vessels, and interception of the refluent blood by the unnatural position of the fœtus. In thrusting a long and slender probe through the right horn of the womb, it easily passed into the tube of the same side, for 3 fingers breadth, but it could not be thrust further by reason of the constriction of the tube in that part. The capacity of the tube could not be distinguished; its parietes, by their coalition with the chorion and amnios of the child, forming the bag in which the child was included, which extended from the tube on the right side to that on the left, and was agglutinated to the viscera in the lower belly to the rectum, and to the back part of the womb, as appeared by some fragments remaining on those parts after the separation.

Of some Parhelia seen at Canterbury. By Mr. Stephen Gray. N° 251, p. 126.

Feb. 26, 169$\frac{8}{9}$, being Sunday, about half after 3 in the afternoon, looking out of a window facing the south-east, I saw, not far from the south to the westward, an appearance of somewhat not much unlike the sun when seen through clouds, viz. with its periphery not exactly defined; from which it likewise differed, one half of it being of a deep red and yellow, the other white. I took a theodolite into the garden, in order to take its distance from the sun, which the room would not permit; but was then presented with an appearance exactly like the former, but on the opposite side of the sun; I took the distance of this from the sun, which was 23° westward; but before I could take the distance of the eastern one, it vanished, but soon after re-appeared, and then I perceived manifestly, that they were both situate in the extremities of a semicircle, whose centre was the sun, passing between it and the zenith. This appearance continued about half an hour.

A Supplement to the Account of a Scolopendra Marina, &c. Described in N° 225 *of these Transactions. By Dr. Tho. Molyneux, F.R.S.* N° 251, p. 126.

I find a letter (Phil. Trans. N° 249) of Mr. Dale's to Dr. Lister, wherein he mentions the scolopendra marina I gave an account of, N° 225 of the Transactions, as described by Rondeletius, under the title of Physalus, in his book, De Piscibus; but I must crave leave to differ from him in opinion as to this particular: for I conceive that author could not understand by the name of physalus, what I mean by scolopendra marina, è mare Hibernico, &c. but some other marine animal, as the descriptions are quite different. From whence I think it is very plain that Rondeletius's physalus, and the scolopendra marina described by me, are quite different species of animals. But I confess Mr. Dale was thus far in the right, though he seems not to have known it himself, that the scolopendra marina I mention has been noticed by others, before I spoke of it; for upon further inquiry, since my writing that account, I meet in the Acta Medica et Philosophica Hafniensia, of Thomas Bartholine, vol. the 3d, p. 87, the figure of a sea-insect found at Katwick-up-Zee in Holland on the strand, and communicated to the publisher by Oligerus Jacobeus, who gives it the name of vermis aureus vel species erucæ marinæ rarior; which I am confident is the same with the scolopendra marina è mare Hibernico, &c. though Bartholine's figure is faulty, and the description short, false, and imperfect. And I am likewise apt to think, that Ulysses Aldrovandus, in his lib. 5, De Insectis, cap. 15, p. 636, designed our scolopendra by his first figure in that chapter, where he calls it scolopendra marina lato corpore subcastaneo velut pedibus innumeris longiusculis aurei coloris, and says no more of it; but his icon is much worse than Bartholine's.

An Abstract of an Account of Five Pair of Muscles, which serve for different Motions of the Head; on the First and Second Vertebræ of the Neck; and of Two Ligaments, one of which fastens the Head to the First Vertebra, and the other fastens the First to the Second. To which is annexed the History of an uncommon Appearance of a Human Skull. By M. Dupre, Surgeon to the Hotel Dieu in Paris; with Remarks by William Cowper. N° 251, p. 130.

This tract, lately printed in French, was sent to Dr. Lister. The author seems to put a value on it, and expresses his surprise that such obvious organs should escape the observation of anatomists: he hopes these discoveries will excite a noble emulation in those of his profession.

"Just at the root of the transverse process of the first vertebra of the neck, says he, arises on each side a muscle, 4 lines broad, which running obliquely inward, is implanted to a small superficial oval sinus, seated on the forepart of the processus styloides;" and this he calls rengorgeur oblique, or the oblique bridler of the head.

This pair of muscles I have described in my Myotomia Reformata, p. 126, where I have called them the recti interni minores, because they incline to a right position, lying under the recti majores, and are antagonists to the recti minores on the back part. They may be called from their use annuantes, because they nod the head directly forward.

"On the transverse process, says he, of the first vertebra of the neck, there arises a thick fleshy muscle, of about a finger in breadth, which is inserted after a perpendicular ascent below the processus styloides, between it and the mammillary process; this he calls rengorgeur droit, or the straight bridler of the head."

Both this and the former pair of muscles I discovered in a human body 13 years since; and about that time showed them to Dr. Brown, in the presence of Capt. Wine: but in examining the original writers on the muscles, I soon found this latter pair were partly mentioned by Oribasius after Galen, and described by Fallopius. These are described and figured in the above-mentioned tract, p. 127, fig. 3, k. The 3d pair of muscles mentioned by M. Dupre, by him called rengorgeur posterieur, seems no ways to differ from those commonly treated by authors, called obliqui superiores.

The 4th pair he mentions seem to be parts of the recti minores: "These, he says, are auxiliaries to the greater and lesser oblique muscles;" which I cannot but think a mistake, since those muscles are employed in different motions of the head, on the first and second vertebræ; and therefore one pair of muscles cannot be the assistant of both. He observes, that this 3d and 4th pair of muscles are not found in all subjects; I guess he means distinct from the recti minores.

"The last pair of muscles, mentioned by our author, arises from the middle of the transverse processes of the second vertebra, and are small, short muscles, inserted to the roots beneath the transverse processes of the first vertebra. These from their use he calls the flexors of the first vertebra on the second."

Having lately an opportunity of examining these parts in a boy; though much emaciated, I could discover fleshy fibres that resembled sush muscles, and that not only between the transverse processes of the first and second vertebræ, but the two next also; and I am apt to think the next to them in like manner; but my time would not give me leave to prosecute the inquiry. However I can hardly persuade myself that those muscles can bend the first vertebra on the

2d; the difficulty of which motion in these vertebræ, will be very manifest to any that will be pleased to examine their manner of articulation: since it appears that the 2 flat processes of those vertebræ are applied to each other in a horizontal manner, and are therefore only fitted for turning to either side, by means of the axis or tooth-like process of the second vertebra. These muscles I am inclined to think are auxiliaries to the obliqui inferiores, but, being very small, are only employed in shaking the head; either of them acting may draw the transverse process of the first vertebra to a perpendicular with the second; as when we express sorrow by shaking the head. The muscles placed between the transverse processes of the other vertebræ of the neck are employed in drawing the superior vertebræ laterally.

"The first of the two ligaments mentioned by M. Dupre, is placed, he says, between the first and second vertebræ, in their middle and foreparts;" which in no respect seems to differ from that described by Galen, Vesalius, and almost all writers on the subject; the like being found between the foreparts of the rest of the vertebræ.

"The second ligament, he says, is an inch long, and of the thickness of a goose-quill, and is fastened above to the middle of the elongation of the occipital bone, and the upper, middle, and anterior part of the first vertebra: he adds, it is observable, when this ligament is wanting, the aponeurosis, which fastens the occipital bone to the vertebra, is stronger and thicker in that part." In this likewise I see no such disagreement from the description given by most writers of the ligaments of this part, as deserves the title of a new discovery; it being very obvious, that the middle of the forepart of that ligament is much thicker than any other part of it.

The first figure of M. Dupre represents the lower part of the occipital bone, with the three upper vertebræ of the neck, viewed on the foreside, fig. 1, pl. 8. A. The mammillary process; 2, the elongation of the occipital bone; 3, the hole in the occipital bone through which the spinal marrow descends: 4, the first vertebra of the neck; 5, the second; 6, the third; 7, the muscle which he calls rengorgeur posterieur, or the posterior muscle which bridles the head: 8, the muscle called rengorgeur droit, by Dupre, or the straight muscle which bridles the head: this I have called rectus lateralis, from its position; and it is described by Fallopius; 9, the muscle he calls rengorgeur oblique, or the oblique bridling muscle: this I have called annuans, and rectus internus minor; 10, the muscle which he calls the flexor of the first vertebra on the second; 11, a ligament, whose upper part is fastened to the middle of the elongation of the occipital bone, and its other extremity to the upper part of the first vertebra; 12, the other short ligament, which is commonly observed between the foreparts of all the rest of the vertebræ.

The second figure of M. Dupre, fig. 2, pl. 8, represents part of the occipital bone, with the first two vertebræ of the neck, viewed from behind: 1, the interior part of the occipital bone; 1 2, the musculi recti minores; 3 3, the fourth pair of muscles mentioned by Dupre, which he calls the auxiliary to the greater and lesser oblique muscles: these I take to be parts of the last mentioned recti; 4 5, the first and second vertebræ of the neck. A. The mammiform process. These figures being very ill done, I thought it not amiss to add 2 figures of the same bones in the like position, done after the life; not only for the better explanation of the above-mentioned muscles, but some others also, which M. Dupre may perhaps find in dissecting these parts, and take to be new discoveries also.

Fig. 3, pl. 8, represents part of the external surface of the basis of the skull, with the fore parts of all the vertebræ of the neck. The pricked lines denoting the progress of the muscles on the bones.—AA, &c. part of the basis of the cranium; BB, the two mammiform processes; CC, the processes styloides; D, the elongation of the occipital bone; E, part of the foramen, by which the spinal marrow descends; aa, parts of the two condyliform processes of the occipital bone, which are received by the first vertebra: 1 2 3 &c. the fore parts of the seven vertebræ of the neck; bb, the transverse processes of the first vertebra; cc, their perforations, through which the trunks of the vertebral veins and arteries pass; dd, the transverse processes of the second vertebra; efghi, the rest of the transverse processes of the vertebræ of the neck; kk, parts of the oblique ascending and descending processes behind the transverse; ll, &c. the foramina between the vertebræ for the egress of nerves from the spinal marrow; FF .... the musculi annuantes, by M. Dupre called rengorgeur oblique; GG.... the recti laterales, by him called rengorgeur droit; HH.... the muscles, which he says are the flexors of the first vertebra on the second; which I rather think are employed in shaking the head, as they arise from the transverse processes of the second vertebra, and ascend obliquely forwards to the first; I.... the obliquus superior, which M. Dupre calls rengorgeur posterieur.

Fig. 4, pl. 8, the hinder parts of the bones, represented in the preceding figure, with pricked lines as before.—A, the occipital bone; BB, parts of the lambdoidal sutures; CC, that part of the occipital bone where the splenius, complexus, and the rest of the muscles of the head cease to terminate; DD, the mammiform processes; EE, parts of the styliform processes; 1 2 3 &c. the back parts of all the vertebræ of the neck; FF, the musculi recti minores; GG..... the muscles which M. Dupre says are the auxiliaries to the greater and lesser oblique; which I take to be parts of the last mentioned recti minores, and not found distinct in all bodies; HH..... the recti laterales, mentioned by Fallopius; II..... the small muscles placed between the transverse processes of the first and second vertebræ of the neck; i...... another small muscle like the former, placed between the second and third vertebræ; KK, &c. the four pair of muscles I call interspinales colli, which are described in my book of the muscles, &c.

Concerning a deformed Human Skull. By M. Dupre. N° 251, p. 138.

Nicholas Brodes, 30 years of age, having been for 10 years afflicted with an incessant head-ache, which for the last 12 months before his decease had been more violent than formerly, and deprived him of his sight, was received into the Hotel Dieu. After his head was shaved, there appeared a large tumor, which extended itself over the hairy scalp. In the midst of the left parietal bone, there was the pulsation of an artery, and a small fluctuation, the rest of the tumor being very hard. M. Dupre, fearing this might be an aneurism, was unwilling to open the tumor, till he was constrained to it, by the importunate intreaties of the patient, who chose rather the hazard of his life, than any longer to endure so exquisite a torment. As soon as an aperture was made, there issued out a quantity of thick concreted blood, which wet the bolsters at every dressing. The second day he felt a hard body with his probe, loose in the flesh, which being taken out, appeared to be a small fragment of a bone exfoliated, resembling a small comb-brush. On the 4th day the patient died.

On dissecting the head, the tumefied part of the skull appeared to arise more than an inch above the sound bone. The whole swelling of the cranium was made up of several substances, not unlike little horns, or innumerable small hollow cones, with their points downwards; besides a great number of bony fibres, straight, stiff, and pointed, resembling the teasels used by cloth-workers. There were also several holes, some of which perforated the skull, others not. There was no distinction of the sutures. The meninges were mortified and confounded together, and in part adhered to the bony excrescences of the left parietal bone; yet the brain was sound and entire. The inequalities of the inner surface of the cranium, resembled melted metal poured down from a considerable height, on a light moving sand; or the inside of a grotto, in which the stones jet out in an irregular manner. The whole left side had lost its natural form, and the right had only a few impressions, made by the beating of the arteries of the dura mater.

Mr. Cowper's Remarks.—Excrescences not unlike this of the skull, have been observed in most other bones of the body, the os petrosum, incus, malleus, stapes, &c. not excepted; and the disease is commonly called spina ventosa. It is remarkable, that the bones of children and young bodies, especially their appendages, are more subject to the like accidents, than those in years; by reason their fibrillæ are much softer and apt to extend, by which that part of the bone itself grows tumid, and frequently becomes carious; and this probably might give occasion for imposing the name of pædarthrocace on that disease, which is vulgarly called, the joint evil. When the cartilages on the extremities of bones in their articulations are eroded, and their appendages thus diseased, the bony fibres sometimes germinate and unite both bones, in such a manner, that they afterwards appear to be one continued bone, as I have seen in the hip and thigh bone; and again in the thigh bone, the tibia and patella, and frequently in the ossa tarsi, metatarsi, and bones of the toes. This uniting of bones at their articulations may also happen through a defect of the mucilage.

Account of a Child born without a Brain. By Mons. Bussiere. N° 251, p. 141.

A woman of a good complexion, and in perfect health during all the time of her pregnancy, was brought to bed of a boy, of a full size, well shaped in his body, and limbs very sound, without the least mark of corruption, except that his eyes looked as if they had been placed at the top of the forehead; the skull was unequal, its skin, though full of hair, was a little redder than the rest of the body. And though it be uncertain whether he was born alive, yet the mother assured M. Bussiere that she felt him stirring an hour before; and indeed the good condition of his body left no doubt of his having been then living.

The skin being taken off the skull, the coronal bone was laid flat upon the sphenoid, which made the eyes look as if they had been at the top of the forehead. The squamous part of the temporal bones was wanting, and the os petrosum, the only bone which was in its natural place, and in which the organs of hearing were in good order. There were no parietal bones, nor any thing equivalent, which probably was the cause that the coronal bone was set upon the sphenoid. Of the occipital bone, there was only the basis that joins to the sphenoid, in the middle of which was the great hole, through which the medulla oblongata commonly passes; all the upper part of this bone being wanting, without any mark of having been corroded or decayed, and its edges very smooth. All the upper part of the bones of the skull being wanting, the skin had no other support than its basis, which was the reason why the top of the head was very unequal and rough. No brain was found, nor any mark in the whole extent of the skull that there had been any, there being no space left between the basis of the skull and the skin, to contain it; neither was there any dura mater, the bones being covered only with a very thin membrane. Neither the carotid nor the vertebral arteries penetrated the skull, but by small twigs spread themselves in the thin membrane.

The beginning of the spinal marrow was under the fourth vertebra, like a small stump wrapped up in the dura mater; the medulla was very sound, and of the usual size; and all the nerves, which issued from it, were in their natural order. The eyes were well shaped, and all the parts belonging to them in their natural situation. But all these nerves terminated in the holes of the skull, through which they commonly pass; they reached no further, nor had any communication with any other. The tongue was very fresh, and doubtless had performed the deglutition to make the child swallow the colliquamentum, a good quantity of which was in his stomach. The larynx, and all the parts of the throat were, as the rest of the body, in a good and natural condition.

Account of the New Regulations of the Royal Academy of Sciences, at Paris. By Mons. Geoffroy, F.R.S.* N° 251, p. 144.

The academy is now composed of 10 honorary academicians, learned and eminent gentlemen; of 8 foreign associates, distinguished by their learning; 20 fellow pensioners, 20 pupils, and 12 French associates. Out of the honorary academicians, two are elected every year, one for president, the other for vice-president. Only 20 pensioners have every year 1500 French livres; and after the death of one pensioner, the Academy will propose to the king three persons associates, or pupils, or sometimes others; and his majesty will name one of the three for pensioner.

The following is the catalogue of the academicians, the names of honorary and foreign associates, who are disposed according to the order of reception; but the others are distributed into classes, into which the academy is divided.

Academicians 70.

	Honoraries 10.	Foreign Associates 8.
President,	M. L'abbe Bignon	M. Leibnitz
2 Presid.	M. Le Marquis de L'Hopital	M. Tschirnhaus
	M. Le Chevalier Regnaut	M. Guillelmini
	M. De Malesieux	M. Bernouilli, a Basle
	Le R. P. Sebastien, Carme	M. Bernouilli, a Groningue
	Le R. P. Malbranche, de L'Oratoire	M. Hartsoeker
	Le R. P. Gouye, Jesuite	M. Romer
	M. L'abbe de Louvois	M. Newton.
	M. Fagon, 1ier Medicin du Roy	
	M. de Vauban	

* The Royal Academy of Sciences at Paris was founded in 1666 (about 4 years after the establishment† of its prototype, the Royal Society of London) and was remodelled in 1699 upon the plan above-mentioned. It was abolished by the National Convention in 1793. The memoirs, which amount to a great number of volumes, that have been published by this learned body, constitute a most valuable repository of researches, observations, and discoveries, in almost every department of philosophy and science.

† The Royal Society was incorporated in 1662; but its meetings had been held several years before under the name of the Philosophical Society.

Classes 6.	Pensioners 20.	Pupils 20.	French Associates 12.
Geometricians	M. L'abbé Galois M. De la Hire M. Roole	M. Chevalier M. Lieutaud M. ———	M. Maraldi M. Regis
Astronomers	M. Cassini M. Lefeure M. Varignon	M. ——— M. Amontons M. Carre	M. Cassini, Jun. M. De la Hire, Jun.
Mechanicians	M. Desbillettes M. Geaugeon M. Daleme	M. Parent M. D. Seine M. ———	M. De Chazelles M. De Lagny
Anatomists	M. Du Hamel M. Du Verney M. Merrie	M. De Litre M. Du Verney his brother M. Poupart	M. Tauvry M. Bourdelin, Jun.
Chemists	M. Bourdelin M. Homberg M. Boulduc	M. Thuillier M. Geoffroy M. Boulduc, Jun.	M. L'Anglade M. L'Emery
Botanists	M. Dodart M. Marchand M. Tournefort	M. Burlette M. Reneaume M. Berger	M. Morin de Toulon M. Morin de St. Victor.
Secretary	M. De Fontenelle	M. Simon	
Treasurer	M. Couplet	M. Couplet, Jun.	

Account of a Book, viz. The Natural History of the Chalybeate and Purging Waters of England, with their particular Essays and Uses, &c. with Observations on the Bath Waters in Somersetshire. By Benj. Allen, M. B. 1699. N° 251, p. 146.

This treatise contains an account of the origin and principles of the chalybeate and purging waters of England, with the trials that have been made of them, and a register of their several virtues and properties.

Of a Dropsy in one of the Ovaries of a Woman. By Hans Sloane, M. D. Sec. R. S. N° 252, p. 150.

Mrs. Browne, aged 29, of a sanguine complexion, had been married about 4 years, in which time she had had one child; after that, her belly swelling, she thought herself with child again. She had often violent hysteric fits, something like those of an epilepsy. These, by proper remedies, were removed at several times with difficulty. When about 6 months, as she thought, gone with child, she began to have some doubt whether it were so or not, because she had her catamenia very regularly: I was of opinion she was not with child, and would have treated her with steel and chalybeates of water, as bodies hydropically disposed require; but she fancying she felt the child stir, it put a stop to that course, and she prepared for her lying in. She delayed the proposed method for three or four months beyond the ninth, thinking she had counted wrong; but at last she was persuaded to take medicines, and underwent a very strict course, as is usual in hydropical cases. Her legs did not swell nor pit; her belly was unequal, and the swelling more on the right side, so that the naval was thrust over to the left side. She had also discutient plaisters applied to her belly: but all in vain, excepting that with much anxiety, gripes, and trouble, so much water might be evacuated, as to bring down her belly three or four inches. At length she submitted to a tapping, which was performed at several times, by discharging great quantities, of first a limpid thick serum, like whites of eggs, insipid and coagulable by heat into the like substance; it came afterwards to the colour and consistence of thin honey, and coagulated on evaporation. Some time after she fell into a fever, with a great thrush, hickups, and in about 9 days she died.

Out of her body, when dissected, was discharged some buckets of the same watery substance that had been discharged by the tapping; part of it was floating in the abdomen, but far the greater part voided out of large and thick bags, some of which were as large as the stomach, others smaller, many of them rotted to pieces, and all of them in the right ovary or testicle: the uterus, tuba fallopiana, and every thing else was sound, except the omentum, which was quite consumed; what was very strange was, that several bags of the larger size, in this ovary, contained others smaller within them; and the larger were filled with a sweet liquor, and the smaller with a substance like whites of eggs. Here and there between were imposthumes, which were small, and filled with yellow matter. The gall-bladder was full of several triangular yellow stones. She was very lean all over her body, and never had her legs swell or pit; nor the noise of water on her stirring in bed, till some small time before tapping, when she fell into so great an orthopnæa, that she could not breathe unless in an erect posture.

The great Tendon above the Heel, after an entire Division of it, stitched and cured. By Mr. William Cowper, F. R. S. N° 252, p. 153.

Being called to Thomas Wheatly, a carpenter, aged 33, who had totally divided the great tendon of the musculi gastrocnemii of the left leg, about 3 fingers breadth above the os calcis, I found the upper part of the tendon withdrawn from the lower at least 2 inches.

The applications being prepared, and two or three large needles, with strong silk in them, well waxed, I was first obliged to divide the external teguments, a, b, fig. 5, pl. 8, to come at the ends of the divided tendon, A, B. This done, I passed the first needle c through the body of the tendon A, about half an inch above its divided extremity; the 2d needle D was thrust through this upper part of the tendon, a little under the former, lest the two threads should meet each other at their crossing in the middle of the tendon. Afterwards both the needles were passed through the lower part of the divided tendon B. The foot being held extended, the two ends of the tendon were applied to each other, by the assistance of the ligatures C, D, which were so tied as to keep the divided parts close together, while the foot remained in this posture. After the four ends of these ligatures were cut off, I found it was necessary to bring the sides of the divided skin nearer each other, with one single stitch, a little above the suture of the tendon. This done, a pledget of lint, dipped in balsam of turpentine, was laid on the wounds, and another large pledget of flax, armed with linimentum è gummi elemi, over it. After the application of common bandages, bolsters, &c. I found it necessary to place a thick piece of pasteboard, of a convenient arched figure, on the fore-parts of the foot and leg to keep the part inflected, and prevent any motion of it, which might break out the stitches in the tendon. The patient complained very much in passing the needles through the upper part of the divided tendon; though its middle and internal part at the division was scarcely sensible of the touch of my finger. He had no pain in passing the needles through the lower part of the tendon. After 14 oz. of blood were taken from his arm, I left him on his bed. Six hours after, I found his pulse somewhat quicker than before: he then took 1 oz. of syrup. de meconio. The next morning I found him in no ill condition, having had some sleep that night, but was often awakened with twitchings in the calf of the wounded leg. The third day after the operation, I dressed the wound with the same applications as before; only using a fomentation, made of a docoction of wormwood, sage, rosemary, bay-leaves, &c. On the 4th day after the operation I found the applications on the wound very wet with a serous humor, commonly called a gleet. On the 6th day the matter became somewhat thicker, and the skin being a little distended about the wound, I was obliged to divide the last mentioned stitch to admit of the free discharge of the pus, which on the two succeeding days became much thicker than before, and the gleet consequently lessened.

About this time the 2 ends of the tendon were not a little dilated, and a white slough appeared on it, towards the upper part of the wound; on which, instead of the balsam of turpentine, I applied tincture of myrrh. Some days after, this slough came off, and the two ends of the tendon were over-spread with a fungous flesh, by which I was assured that its blood vessels and nutritive tubes were not compressed by the first two ligatures. Afterwards I made use of drier applications than before; sometimes using lint only, and at other times powder of turpentine. About 10 days after the operation I found one of the two ligatures in the tendon hanging loose, which I divided and drew out. And 2 or 3 days after I found the other ligature loose also, which in like manner I removed. The part all this while being kept inflected by the pasteboard above-mentioned.

I was often obliged to apply gentle escharotics to lessen the fungus on the tendon. In less than 30 days after the operation he went abroad very lamely. And not many days after, he told me he had walked round St. James's Park; and within 8 weeks he walked from Wich-street, Temple-bar, to Greenwich, and returned in a few hours. He has now recovered all the motions of his foot, and shows very little lameness in walking, and is not in the least incommoded in working at his trade.

It is a common opinion, that stitching divided tendons is hazardous, if not impracticable; although the authority of many eminent writers would have prevailed with me in some measure to have an opinion of the success of such an attempt; yet the contradictions of others, of no less note, would have left me dubious, had I not some time since seen large blood-vessels in the tendon of a horse's leg; which at that time convinced me that tendons, as well as bones, and other parts, would unite, though they were quite divided, in case the neighbouring parts remain entire, if their two extremities could be artificially applied to each other, without compressing all or the greater part of their blood-vessels. This distribution of the blood-vessels is expressed in the annexed fig. 6, pl. 8, where one trunk, AA, with its branches, aa, to the fibrilla of the tendon, BB, is represented; whether it was a vein or an artery I could not discover in that subject, but in all probability both those vessels have the like disposition in such large tendons. I am inclined to think the like distribution of blood-vessels is not to be found in the tendon, which was divided in this present instance; but that its blood-vessels pass into it and back again at its internal side, next the muscles of the toes and tarsus; which ought to be taken notice of by the operator in the like case, and that he does not free it of its fat and membranes next those muscles, lest its communication with the blood-vessels be destroyed.

On the Operation of a Blister in the Cure of a Fever. By Dr. Wm. Cockburn, F. R. S. N° 252, p. 161.

To give a reasonable conjecture how a blistering plaister, the chief ingredient of which is cantharides, may cure a fever, and its most terrible symptom, a delirium, and that in a few hours; the doctor first employed microscopes to view the fly and its powder, to try if he could perceive any sharp instruments in those animals, but without discovering any such thing in the fly; and the powder was seen only as a dark cloud. He next put half a pound of cantharides into a retort, with a small sand heat, and in a very short time there came over vast quantities of animalcules, so very small, that he was not able to discern their shape; that very little salt adhered to the neck of the retort, and the volatile salt shot into beautiful crystals in the receiver, and that of the 8 oz. of cantharides only 2 oz. 5 dr. were left as a caput mortuum in the retort. When the liquor came to be purified, the smallest heat suddenly brought over oil, salt, and spirit, which could not be separated, but by repeated operations with brick-dust. He mixed the spirit with salt of wormwood, spirit of hartshorn, and sal-ammoniac, yet without fermenting; but with spirit of vitriol it fermented very strongly.

In inquiring how wounding the skin by cantharides makes the pulse not so quick, and consequently the blood to have a slower and more natural motion, he considers that the heart being a muscle, and contracted at every pulse, is not either the chief or sole cause that determines and stretches the sides of the arteries, and so making a pulse, or a very extraordinary measure of such distensions. These contractions having always been supposed to be performed by an influx of spirits into the fibres of the muscles so contracted; the question now becomes, how wounding by cantharides makes the contraction of the heart weaker? After rejecting other methods as inadequate to this effect, the doctor concludes, that the only way by which a blister can produce its effect is by wounding the channel that conveys those animal spirits which contract the heart, give a quick pulse and a fever, with all its attendants, as deliriums, &c. Thus then, the least quantity of animal spirits let out by the wounds of the cantharides, will in a very little time proportionably weaken the heart's contraction, and give a slower pulse, which is all that is wanted.

But how to apply a blister that may most effectually wound the conveying nerves, we must recollect that the 8th pair of nerves, which serves for the heart's contraction, has its rise from the sides of the medulla oblongata, behind the processus annularis, by several threads which join together, and pass out by the same hole that the sinus laterales discharge themselves into the jugulars; and since the union by the atlas is not so firm and compact as in the other vertebræ, there is no extraordinary hindrance why some of these wounding particles may not reach that nerve, since either it, or considerable branches of it, run superficially enough on the neck.

Hence the doctor concludes: 1. That the operation of a blister is great and sudden. 2. That the wounding of this nerve, or a branch of it, is so necessary for curing a delirium and fever, that whatever effect the applying of vast numbers of blisters over all the body may have, yet the main end is neglected if we omit a large one on the upper part of the nape of the neck. 3. That when there is no vesication after laying on a strong plaister, it necessarily causes a new and extraordinary hardness in the skin and vessels, and a thickening of the blood for a further and total stoppage.

On the Nature and Qualities of Silk. By William Aglionby, Esq. F. R. S. N° 252, p. 183.

Silk, which is the spittle* of a worm, has its good or bad qualities from the nourishment the worm receives from a good or bad leaf.

When the spring proves agreeable, the worm feeding on a good and tender leaf, free from the prejudices of an unkind season, which sometimes spoil the leaf, by giving it a gross nature, then one may expect a profitable harvest. About Midsummer they begin in Piedmont to draw the silk from its cocon, to see what it yields, and judge of its increase or scarcity, as well as the estimate of its qualities, which are, being clean, light, and strong.

With respect to the silk, its goodness is most distinguished by its lightness: for the organzine is the best sort. It must be observed that the two threads are equal in fineness, that is, both alike in smoothness, thickness, and length, for the thread of the first twist; for the second, it matters not whether the single thread be strong, before the two are joined, unless to see whether the first twist prove well. It is necessary the silk be clean; the straw colour is commonly the lightest, and the white the heaviest. It is likewise convenient that the skains be even and all equal, which shows they were wrought together.

Two Propositions desired to be answered in a Year and half by any Person; if they are not answered in that Time, the Proposer promises he will do it himself. N° 252, p. 186.

1st question.—Dato nascente vegetabili quolibet à nascendi modo, ejusdem cohærendi nisus, seu partium ejusdem mobilitas ac immobilitas, determinari possunt?

2nd question.—An esse possit signum aliquod, et quidnam sit illud, quod ex anatomiâ, ac cadaverum dissectionibus, certo poterit indicare quemlibet ob assumptum opium interemptum fuisse?

* The term spittle is improper. The glutinous fluid from which silk is produced, is secreted in 2 canals which run along the back of the worm, and after making several sinuosities near the stomach terminate at the mouth by an extremely slender duct (or according to some naturalists by 2 ducts) from which this peculiar fluid is discharged by the muscular efforts of the worm in the act of spinning.

On a figured Stone found in Wales. By Mr. Llwid. With a Note by Dr. Sloane. N° 252, p. 187.

I send the representation of a limestone-marble, lately discovered in this country, when polished. We have plenty of it; but few pieces exceed 6, 9, or 12 inches diameter; for it is only a sort of alcyonium, incorporated in several small blocks of the limestone. Fig 7, pl. 8, represents a piece polished perpendicularly, and fig. 8, horizontally. I think it more beautiful than the Florentine marble, but much more hard and substantial.

Dr. Sloane's Note.—This stone is a sort of coral, and the lapidis astroitidis sive stellaris primum genus Boet. de Boadt, or astroites worm, Mus. It grows in the seas adjoining to Jamaica. It is frequently found fossil in England. I have some of it, found here, that will polish as well as agate. Many other things grow in the seas about Jamaica, and are not to be found in these parts, that are frequently dug up in the inland parts of England and elsewhere, near to which places they do not naturally grow.

Concerning a Disease caused by swallowing Stones. By Sir Cha. Holt. With Remarks on the same, by Dr. Hans Sloane. N° 253, p. 190.

Thomas Gobsill, a lean man, aged about 26, being for 3 years extremely troubled with wind, was advised to swallow round white pebbles; which he did as often as the fit returned, and the stones passing easily through him he found great relief, and repeated it often with the same success. But some months after, being seized with a violent fit of wind, he swallowed his usual number of stones, viz. 9, but these not passing, he repeated the dose continually, till he had taken above 200. He had these stones in him above 2½ years, when he first came to me, and then complained that his appetite was gone, that he could digest nothing, but threw up every thing he eat. On examining his belly, I found the stones lay almost as low as the os pubis, and thrusting my fingers just above that bone, so that the lower part of the abdomen might lie on my hand, I could with the motion of my hand shake them, and make them rattle as if they had been in a bag. Having made this discovery, I caused a ladder to be set against a wall, and hung him by the hams on the inside of the ladder with his head directly perpendicular to the ground. Whilst in this posture, he told me the stones were got up to his stomach, but being set again upon his feet, after a very small time we could plainly hear the stones drop successively one after another, and so distinctly, that they might be counted.

When his body is not laxative, he vomits all he eats or drinks; to prevent which he commonly keeps it open with whey. As he lies in bed, the stones will sometimes get up, as he expressed it, almost to his heart, and give him great disturbance; at which times he is obliged to get upon his knees, or to stand upright, and then he can hear them drop as before mentioned; and at such times he has counted more than 100. He is now so disabled by these stones that he cannot work but in pain, and when he attempts it, he finds the same night and the next day a great soreness in the bottom of his belly, and voids large quantities of blood by stool. Before I saw him, he had been under the hands of several quacks, some had vomited him with stibium, and purged him, but could never bring one stone from him.

I lately introduced the man to Dr. Fowke, who examined his case, and told me he had never heard, or met with in books, any thing like it.

This day, June 12, I saw Cobsill; he looks better than he did when I left the country. Dr. Davies was with me, and examined all the particulars herein mentioned.

Many people, continues Dr. Sloane, are of opinion, that the swallowing of stones or pebbles is very beneficial to health, by helping the stomach to digest their food. The reason of this, I suppose, is because they see birds languish, unless they swallow gravel or small stones. But I have always opposed this practice in men, because though the stomachs or gizzards of birds, which have no teeth to grind their food, are made very strong, muscular, and defended in the inside with a coat, by the help of which, and these stones, their food is ground; yet the stomach of men being very different, it is not reasonable to think they should be of any use to them. I knew one Mr. Kingsmill, who used to swallow for many years 9 stones at a time, every day, without any injury: they were near as large as walnuts, roundish and smooth, and he found they always passed; but at last he died suddenly.

Thoughts and Experiments on Vegetation. By John Woodward, M. D. F. R. S. N° 253, p. 193.

The ancients generally have ascribed to the earth the production of animals, vegetables, and other bodies; for which reason it was that they gave it so frequently the epithets of parent and mother. But several of the moderns have given their suffrage in behalf of water. Lord Bacon is of opinion, that for nourishment of vegetables the water is almost all in all; and that the earth only keeps the plant upright, and saves it from over heat and over cold. Others assert that water is the only principle or ingredient in all natural things. They suppose that, by some process of nature, water is transmuted into stones, into plants, and all other substances whatever. Helmont particularly, and his followers, are very positive in this, and offer some experiments to render it credible. And Mr. Boyle tries these experiments over again, and discovers a great propensity to the same opinion; declaring for this transmutation of water into plants and other bodies, though with great modesty and deference.

The experiments they insist upon are chiefly two: The first is, that mint and several other plants thrive very much in water. The other is this: they take a certain quantity of earth, and bake it in an oven, then they weigh it, and put it into an earthen pot, and having watered it well, make choice of some fit plant, which, being first carefully weighed, they set in it; there they let it grow, continuing to water it for some time, till it is much increased in bulk. Then they take it up, and though the bulk and weight of the plant be much greater than when first set, yet upon baking the earth, and weighing it as at first, they find it little or not at all diminished in weight; and therefore conclude that it is not the earth, but water, that nourishes, and is turned into the substance of the plant. I must confess I cannot see how this experiment can ever be made with the nicety and justness that is requisite, in order to build upon it so much as these gentlemen do. And nothing like what they infer can possibly be concluded from it; unless water, which they so plentifully bestow upon the plant in this experiment, be pure, homogeneous, and not charged with any terrestrial mixture; for if it be, the plant after all may owe its growth and increase entirely to that. Some waters are indeed so very clear and transparent, that one would not easily suspect any terrestrial matter were latent in them: yet they may be highly saturated with such matter, though the eye be not presently able to discern it. It is true, earth is an opaque body, but it may be so far dissolved, reduced to so extreme small particles, and these so diffused through the watery mass, as not sensibly to impede vision, or render the water much the less diaphanous. Silver is an opaque, and indeed a very dense body; and yet, if pure and perfectly dissolved in spirit of nitre, or aquafortis that is rectified and thoroughly fine, it does not darken the menstruum, or render it less pellucid than before. So that were there water any where found so pure, that the quickest eye could discover in it no terrestrial intermixture, that would be far short of a proof that in reality there is none. But, after all, even the clearest water is very far from being pure and wholly defecate, in any part of the world, that I can learn. Nor did I ever meet with any, however fresh and newly taken out of the spring, that did not exhibit, even to the naked eye, great numbers of small terrestrial particles, disseminated through all parts of it. Thicker and crasser water exhibits them in still greater plenty.

These particles are of two general kinds. The one a vegetable terrestrial matter, consisting of very different corpuscles, some proper for the formation and increment of one sort of plant, and some of others: as also some for the nourishment of one part of the same plant, and some of another. The other kind of particles, sustained in water, are of a mineral nature and also of different sorts. In some springs we find common salt, in others vitriol, alum, nitre, spar, ochre, &c. nay frequently several of these, or other minerals, all in the same spring; the water, as it drains and passes through the strata of stone, earth, &c. taking up such loose mineral corpuscles, as it meets with in the pores and interstices of those strata, and bringing them on with it quite to the spring. All water whatever is much charged with the vegetable matter; this being fine, light, and easily moveable. For the mineral, the water of springs contains more of it than that of rivers, especially when at distance from their sources, and that of rivers more than the water that falls in rain. Any one who desires further satisfaction in this may easily obtain it, if he only put water into a clear glass phial, stopping it close to keep dust and other exterior matter out, and letting it stand without stirring it for some days; he will then find a considerable quantity of terrestrial matter in the water, however pure and free it might appear when first put into the phial. He will in a very short time observe the corpuscles that were at first, while the water was agitated and kept in motion, separate, and hardly visible, by degrees, as it is more still and at rest, assembling and combining together: by that means forming somewhat larger and more conspicuous moleculæ. Afterwards he may behold these joined and fixed to each other, and thus forming large thin masses, appearing like nubeculæ, or clouds in the water; which grow more thick and opaque, by the continual appulse and accretion of fresh matter. If the said matter be chiefly of the vegetable kind it will be sustained in the water, and discover at length a green colour: becoming still more and more green as the matter thickens and increases. But if there be any considerable quantity of mere mineral matter in the water, this, being of a greater specific gravity than the vegetable, as its particles unite and combine to form moleculæ, their impetus of gravity surpasses that of the resistance of the water, and a great deal of it subsides to the bottom; and frequently entangling with the vegetable nubeculæ, forces them down along with it.

Now the question is, to which of these, the water, or the earthy matter sustained in it, vegetables owe their growth and increase. For deciding which, the following experiments may afford some light, having been made with due care and exactness.

I chose several glass phials, all as near as possible of the same shape and size. After putting what water I thought fit into every one of them, and taking an account of its weight, I strained and tied close over the orifice of each phial a piece of parchment, having a hole in the middle, large enough to admit the stem of the plant I designed to set in it, without straitening it so as to impede its growth. My intention in this was to prevent the enclosed water from evaporating, or ascending any other way than through the plant. Then making choice of several sprigs of mint, and other plants, that were as near as I could judge, alike fresh, sound, and lively; and having taken the weight of each, I placed it in a phial, ordered as above; and as the plant imbibed and drew off the water, I took care to add more of the same from time to time, keeping an account of the weight of all that was added. Each of the glasses, for better distinction, had a different mark or letter, as A, B, C, &c. and all set in a row in the same window, in such manner that all might partake alike of air, light, and sun. Thus they continued from July 20 to October 5, just 77 days. I then took them out, weighed the water in each phial, and the plant likewise, adding to its weight that of all the leaves that had fallen off during the time it stood thus: and lastly, I computed how much each plant had gained, and how much water was spent upon it. The particulars are as follow:

Marks of the glasses.	The kinds of plants and water.	Weight of plants		Gained in 77 days.	Expence of water.	Proportion of the increase of the plant to the expence of water.
		when put in.	when taken out.			
		gr.	gr.	gr.	gr.	As
A	Common spear-mint, set in spring water	27	42	15	2558	1 to $170\frac{8}{15}$
B	Common spear-mint in rain water	$28\frac{1}{4}$	$45\frac{3}{4}$	$17\frac{1}{2}$	3004	1 to $171\frac{23}{35}$
C	Common spear-mint in Thames water	28	54	26	2493	1 to $95\frac{23}{26}$
D	Common solanum, or night-shade, in spring water....	49	106	57	3708	1 to $65\frac{3}{57}$
E	Lathyris, or cataputia Gerh. in spring water	98	$101\frac{1}{2}$	$3\frac{1}{2}$	2501	1 to $714\frac{4}{7}$

The common solanum, in the phial D, had several buds on it when first set in the water; these in a few days became fair flowers, which were at length succeeded by berries. Several other plants were tried, that did not thrive in water, or succeed any better than the cataputia.

Two other phials, F and G, were filled, the one with rain, the other with spring water, at the same time as those above-mentioned were, and stood as long, but neither of them had any plant; my design in these being only to inform myself, whether any water exhaled out of the glasses, otherwise than through the bodies of the plants. The orifices of these two glasses were covered with parchment, perforated with a hole of the same size with those of the phials. In this I suspended a bit of stick, about the thickness of the stem of one of the plants, but not reaching down to the surface of the included water.

I put them in thus, that the water in these might not have more scope to evaporate than that in the other phials. Thus they stood the whole 77 days in the same window with the rest; when, on examination, I found none of the water in these wasted or gone off. Though I observed, both in these, and the rest, especially in hot weather, small drops of water, not unlike dew, adhering to the insides of the glasses, above the surface of the inclosed water.

At the end of the experiment, the water in these two glasses that had no plants in them, exhibited a larger quantity of terrestrial matter than any of those that had the plants in them; the sediment at the bottom of the phials was greater, and the nubeculæ, diffused through the body of the water, thicker; and of that which was in the others, some of it proceeded from certain small leaves that had fallen from that part of the stems of the plants that was within the water, where they rotted and dissolved. The terrestrial matter in the rain water was finer than that in the spring water.

The experiment was repeated the year following; the plants being all spear-mint, the most kindly, fresh, sprightly shoots I could choose. The water and the plants, weighed as above, and the phials set in a line in a south window; where they stood from June 2, to July 28, which was just 56 days.

Marks of the glasses.	The kinds of water. The plants all of spear-mint.	Weight of plants when put in.	Weight of plants when taken out.	Gained in 56 days.	Expence of water.	Proportion of the increase of the plant to the expence of water.
		gr.	gr.	gr.	gr.	As
H	Hyde-Park Conduit-water . .	127	255	128	14190	1 to 110$\frac{110}{128}$
I	Hyde-Park Conduit-water . .	110	249	139	13140	1 to 94$\frac{74}{169}$
K	Hyde-Park Conduit-water, in which was dissolved an ounce and half of common garden earth	76	244	168	10731	1 to 63$\frac{147}{168}$
L	Hyde-Park water, with the same quantity of garden mould as in the former . .	92	376	284	14950	1 to 52$\frac{182}{284}$
M	Hyde-Park water, distilled off with a gentle still. . . .	114	155	41	8803	1 to 214$\frac{89}{41}$
N	The residue of the water which remained in the still after that in M was distilled off.	81	175	94	4344	1 to 46$\frac{20}{94}$

The plant set in H was all along a very kind one, having run up to above 2 feet in height: it had shot but one considerable collateral branch; but had sent forth many and long roots, from which sprung very numerous lesser fibres: these lesser roots came out of the larger ones, on two opposite sides for the most part; so that each root, with its fibrillæ, appeared not unlike a small feather: to these fibrillæ adhered pretty much terrestrial matter: in the water, which was at last thick and turbid, was a green substance, resembling a fine thin conserve.

The plant in I was kindly as the former, but had shot no collateral branches: its roots, the water, and the green substance, all much as in the former.

The plant in K, though it was annoyed with many small insects, that happened to fix upon it, yet had shot very considerable collateral branches; and at least as many roots, as either that in H or I, which had a much greater quantity of terrestrial matter adhering to their extremities. The same green substance here, that was in the two preceding.

The plant in L was much more flourishing than any of the former, having several very considerable collateral branches, and very numerous roots, to which the terrestrial matter adhered verry copiously. The earth in both the glasses, K and L, was very sensibly and considerably wasted, from what it was when first put in. The same sort of green substance here as in those above.

The plant in M was pretty kindly, and had two small collateral branches, and several roots, though not so many as that in H or I, yet as much terrestrial matter adhering to them as those had. The water was pretty thick, having very numerous small terrestrial particles swimming in it, and some sediment at the bottom of the glass, but without any of the green matter above-mentioned.

The plant in N was very lively, and had sent out 6 collateral branches, and several roots. The water in this glass was very turbid, and as red as ordinary beer.

O was Hyde-Park Conduit water, in which was dissolved a drachm of nitre; and the mint set in it suddenly began to wither and decay; and died in a few days. As likewise did two more sprigs, that were set in it, successively. In another glass I dissolved an ounce of good garden mould, and a drachm of nitre: and in a third half an ounce of wood-ashes, and a drachm of nitre; but the plants in these succeeded no better than in the former.

P was Hyde-Park Conduit-water. In this I fixed a glass-tube about 10 inches long, the bore about one 6th of an inch in diameter, filled with very fine and white sand, which was kept from falling down out of the tube into the phial, by tying a thin piece of silk over the lower end. On immersion of its lower end into the water, this by little and little ascended quite to the upper orifice of the tube. And yet, in all the 56 days which it stood thus, a very inconsiderable quantity of water had gone off, scarcely 20 grains; though the sand continued moist up to the top till the very last: the water had imparted a green tincture to the sand, quite to the very top of the tube; and in the phial it had precipitated a greenish sediment mixed with black: to the bottom and sides of the tube, as far as it was immersed in the water, adhered pretty much of the green substance described above.

Q, R, S, &c. are several plants set in phials, ordered in like manner as those above, in October, and the following colder months: these throve not near so much; nor did the water ascend in near the quantity it did in the hotter seasons, when the above trials were made.

Some Reflections on the foregoing Experiments.—1. In plants of the same kind, the less they are in bulk, the smaller the quantity of the fluid mass, in which they are set, is drawn off; the wasting of it, where the mass is of equal thickness, being pretty nearly proportioned to the bulk of the plant. Thus, that in the glass marked A, which weighed only 27 grains, drew off only 2558 grains of the fluid; and that in B, which weighed only 28¼, took up but 3004 grains, whereas that in H, which weighed 127 grains, spent 14190 grains of the liquid mass. The water seems to ascend up the vessels of plants in much the same manner as up a filtre: so that as a large filtre draws off more water than a smaller, so a plant that has more and larger vessels takes up a greater share of the fluid, in which it is set, than one that has fewer and smaller ones.

2. Much the greater part of the fluid mass, that is thus drawn off, and conveyed into the plants, does not settle or abide there; but passes through their pores, and is exhaled up into the atmosphere. The least proportion of the water expended, was to the increase of the plant, as 46 or 50 to 1; and in some the weight of the water drawn off was 100 or 200, nay, in one above 700 times as much as the plant had received of addition. This so continual an emission and detachment of water, in so great plenty from the parts of plants, affords a manifest reason why countries that abound with trees, and the especially larger vegetables should be very obnoxious to damps, great humidity in the air, and more frequent rains than others that are more open and free. Nor does this moisture go off pure and alone; but usually carries with it many parts of the same nature with those of the plants through which it passes. The grosser particles indeed are not so easily borne up into the atmosphere, but are usually deposited on the surface of the flowers, leaves, and other parts of the plants. Hence come our mannas, our honies, and other gummous exudations of vegetables: but the finer and lighter parts are with greater ease sent up into the atmosphere; and thence they are conveyed to our organs of smell, by the air we draw in respiration; and are pleasant or offensive, beneficial or injurious

to us, according to the nature of the plants from whence they arise: and since these owe their origin to the water that ascends out of the earth through the bodies of plants, we cannot be at a loss why they are more numerous in the air, and why we find a greater quantity of odours exhaling from vegetables eu warm, humid seasons, than in others.

3. A great part of the terrestrial matter that is mixed with the water, ascends up into the plant, as well as the water itself: for there was much more terrestrial matter at the end of the experiment in the water of the glasses F and G, that had no plants in them, than in those that had: the garden-mould dissolved in the glasses K and L was considerably diminished, and carried off; nay the terrestrial and vegetable matter was borne up in the tubes filled with sand, cotton, &c. in such a quantity as to be evident even to sense.

Our shores, and parts within the verge of the sea, will present us with a large scene of plants that, along with the vegetable, take up into them mere mineral matter also in great abundance: such are the sea-purslains, the several sorts of algas, of samphires, and other marine plants, which contain common sea-salt, which is all the same with the fossil, in such plenty as not only to be plainly distinguished on the palate, but is extracted from them in considerable quantities. How apt this vegetable matter, being so very fine and light, is to attend water in all its motions, and follow it into each of its recesses, is manifest from the instances above alledged, and many others. Percolate it with all the care imaginable; filter it with ever so many filtrations, yet some terrestrial matter will remain: the fluid will indeed be thinner every time, and more disengaged of the said matter; but never wholly free and clear. I have filtered water through several sheets of thick paper, and after that through very close fine cloth, 12 times doubled; nay, I have done this over and over; and still a considerable quantity of this matter discovered itself in the water after all. Now if it thus pass interstices that are so very small and fine along with the water, it is the less strange it should attend it in its passage through the ducts and vessels of plants. It is true, filtering and distilling of water intercepts and makes it quit some of the earthy matter it was impregnated with; but then that which continues in the water after this, is fine and light, and such consequently as is in a peculiar manner fit for the growth and nourishment of vegetables. And this is the case of rain water: the quantity of terrestrial matter it carries up into the atmosphere, is not great; but what it does, is chiefly of that light kind of vegetable matter, and that too perfectly dissolved, and reduced to single corpuscles, all fit to enter the tubules and vessels of plants: on which account it is that this water is so very fertile and prolific. But a great deal of the mineral matter not only gross and ponderous, but scabrous and inflexible, and so not disposed to enter the pores of the roots: and a great many of the simple vegetable particles by degrees unite, and form some of them small clods or moleculæ, such as those mentioned in H, K, and L, adhering to the extremities of the roots of those plants: others of them are entangled in a looser manner, and form the nubeculæ and green bodies, so commonly observed in stagnant waters, which when thus conjoined, are too large to enter the pores, or ascend up into the vessels or plants, which singly they might have done: those persons who are conversant in agriculture will easily subscribe to this; they are well aware that be their earth ever so rich, good, and fit for the production of corn, or other vegetables, little will come of it, unless the parts of it be separated and loose. And it is on this account they bestow such pains in the culture of it, in digging, ploughing, harrowing, and breaking the clodded lumps of earth. It is the same way that sea-salt, nitre, and other salts promote vegetation; they loosen the earth, and separate its concreted parts; by that means fitting and disposing them to be assumed by the water, and carried up into the seed or plant, for its formation and increase. There is no man but must observe how apt all sorts of salts are to be wrought upon by moisture; how easily they liquate and run with it; and when these are drawn off, and have deserted the lumps with which they are incorporated, those must moulder immediately, and fall asunder of course. The hardest stone we meet with, if it happen, as frequently it does, to have any sort of salt intermixed with the sand of which it consists, on being exposed to moist air, in a short time dissolves and crumbles all to pieces: and much more will clodded earth or clay, which is not of near so compact and solid a constitution as stone is. The same way likewise is lime serviceable in this affair: it contains nothing in itself that is of the same nature with the vegetable mould, or can afford any matter fit for the formation of plants; but it merely softens and relaxes the earth, by that means rendering this more capable of entering the seeds and vegetables set in it than otherwise it would have been; the properties of lime are well known; and how apt it is to be put into ferment and commotion by water; nor can such commotion ever happen when lime is mixed with earth, however hard and clodded that may be, without opening and loosening it.

4. The plant is more or less nourished and augmented, in proportion as the water in which it stands contains a greater or less quantity of proper terrestrial matter in it. The truth of which proposition is eminently discernible through the whole process of these trials. The mint in the glass C was of much the same bulk and weight with those in A and B; but the water in which C was, being river water, which was apparently stored more copiously with terrestrial matter than the spring or rain water, wherein A and B stood; it had thriven to

almost double the bulk that either of them had; and with a less expence of water too. So likewise the mint in L, in whose water was dissolved a small quantity of good garden mould, though it had the disadvantage to be less when first set than either of the mints in H or I, whose water was the very same with this in L, but had none of that earth mixed with it; yet in a short time the plant L not only overtook, but much out-stripped those, and at the end of the experiment was very considerably larger and heavier than either of them. In like manner the mint in N, though less at the beginning than that in M, being set in that thick, turbid, feculent water, that remained behind, after that in which M was placed, was distilled off, had more than doubled its original weight and bulk: and received above twice the additional increase of the plant in M, which stood in the thinner distilled water; and, which is not less considerable, had not drawn off half the quantity of water that that had.

The reason why I limit the proportion of the augmentation of the plant to the quantity of proper terrestrial matter in the water, is, because all, even the vegetable matter, to say nothing of the mineral, is not proper for the nourishment of every plant. There may be, and doubtless there are, some parts in different species of plants that may be much alike, and so owe their supply to the same common matter; but it is plain that all cannot: and there are other parts so differing, that it is no ways credible they should be formed all out of the same sort of corpuscles: so far from it, that there want not good indications, as we shall see by and by, that every kind of vegetable requires a peculiar and specific matter for its formation and nourishment; yea, each part of the same vegetable does so; and there are many and different ingredients that go to the composition of the same individual plant. If therefore the soil, wherein any vegetable or seed is planted, contains all or most of these ingredients, and those in due quantity, it will grow and thrive there; otherwise it will not. If there be not as many sorts of corpuscles as are requisite for the constitution of the main and more essential parts of the plant, it will not prosper at all: if there be these, and not in sufficient plenty, it will starve, and never arrive to its natural stature: or if there be any of the less necessary and essential corpuscles wanting, there will be some failure in the plant; it will be defective in taste, in smell, in colour, or some other way. But though a tract of land may happen not to contain matter proper for the constitution of some one peculiar kind of plant; yet it may for several others, and those differing much among themselves. The vegetative particles are blended together in the earth, with all the diversity and variety, as well as all the uncertainty conceivable. So that it is not possible to imagine how one, uniform, homogeneous matter, having its principles or original parts all of the same substance, constitution, magnitude, figure, and gravity, should ever constitute bodies so egregiously unlike in all those respects, as vegetables of different kinds are; nay, even as the different parts of the same vegetable. That one should carry a resinous, another a milky, a third a yellow, a fourth a red juice, in its veins: one afford a fragrant, another an offensive smell: one be sweet to the taste, another bitter, acid, austere, &c. that one should be nourishing, another poisonous, one purging, another astringent: in short, that there should be that vast difference in them, as to their several constitutions, makes, properties, and effects, and yet all arise from the very same sort of matter, would be very strange.

The cataputia, in the glass E, received but very little increase, only $3\frac{1}{4}$ grains all the time it stood, though 2501 grains of water were spent upon it: the reason of this may be, that the water was not a proper medium for it to grow in; and it is known that many plants will not thrive in it. Too much of that liquor, in some plants, may probably hurry the terrestrial matter through their vessels too fast for them to arrest it. Be that as it may, it is certain that there are peculiar soils which suit particular plants: in England, cherries are oberved to succeed best in Kent; apples in Herefordshire; saffron in Cambridgeshire; wood in two or three of our Midland counties: and teasels in Somersetshire, &c. But that soil which is once proper for the production of some one sort of vegetable, does not always continue to be so; for in time it loses that property; but sooner in some lands, and later in others. If wheat, for example, be sown on a piece of land proper for that grain, the first crop will succeed very well; and perhaps the second, and the third, as long as the ground is in heart, as it is termed. But in a few years it will produce no more, if sowed with that grain. With some other grain indeed it may, as barley: and after this has been sown so often, that the land can bring forth no more of that kind, it may afterwards yield good oats; and perhaps peas after them. At length it will become barren; the vegetable matter that it at first abounded in being extracted from it by those successive crops, is most of it borne off: for each sort of grain extracts from it that peculiar matter that is proper for its own nourishment. After all this, that very tract of land may be brought to produce another series of the same vegetables; but not until it is supplied with a new fund of matter, of like sort with that it at first contained; which supply is made several ways; either by the ground's lying fallow some time, until the rain has poured down a fresh stock upon it; or by the tiller's care in the manuring of it: and for further evidence that this supply is in reality of like sort, we need only reflect a while upon those manures that are found, by constant experience, best to promote vegetation and the fruitfulness of the earth: and these are chiefly either parts of vegetables, or of animals; which indeed derive their own nourishment immediately either from vegetable bodies, or from other animals that do so. In particular, the blood, urine, and excrements of animals; shavings of horns and of hoofs; hair, wool, feathers; calcined shells; lees of wine, and of beer; ashes of all sorts of vegetable bodies; leaves, straw, roots, and stubble, turned into the earth by ploughing or otherwise, to rot and dissolve there; all of these are the best manures, and being vegetable substances, when refunded back again into the earth, serve for the formation of other like bodies.

In our gardens we meet with still further confirmations of the same thing: the trees, shrubs, and herbs cultivated there, after they have continued in one station, till they have derived thence the greater part of the matter fit for their increase, will decay and degenerate, unless either fresh earth, or some proper manure be applied to them. It is true they may maintain themselves there for some time, by sending forth roots further and further to a great extent all round, to fetch in more remote provision; but at last all will fail: and they must either have a fresh supply brought to them, or they themselves be removed and transplanted to some place better furnished with matter for their subsistence. And accordingly gardeners observe that plants that have stood a great while in one place, have longer roots than usual; part of which they cut off when they transplant them to a fresh soil, as now not of any further use to them. All these instances, and a great many others that might be alledged, point out a particular terrestrial matter, and not water only, for the subject to which plants owe their increase. For were it water only, there would be no need of manures, nor of transplanting them from place to place, since the rain falls in all places alike, in this field and in that indifferently, in one side of an orchard or garden as well as in another; nor could there be any reason why a tract of land should yield wheat one year, and not the next; since the rain showers down alike in each.

5. Vegetables are not formed of water, but of a certain peculiar terrestrial matter. It has been shown, that there is a considerable quantity of this matter contained in rain, spring, and river water, that the greatest part of the fluid mass that ascends up into plants, does not settle there, but passes through their pores, and exhales up into the atmosphere; that a great part of the terrestrial matter, mixed with the water, passes up into the plant along with it: and that the plant is more or less augmented in proportion as the water contains a greater or less quantity of that matter: from all which we may reasonably infer, that earth, and not water, is the matter that constitutes vegetables. The plant in E drew up into it 2501 grains of the fluid mass, and yet had received only 3 grains and a half of increase from all that quantity. The mint

in L, though it had at first the disadvantage to be much less than that in I, yet being set in water with which earth was plentifully mixed, and that in I only in water, without any such additional earth, the former had considerably outgrown the other, weighing at last 145 grains more than it. In like manner, that in K, though a great deal less when put in, than that in I, and also injured by insects; yet being planted in water wherein earth was dissolved, while the water in which I stood had none, it not only over-took, but considerably surpassed the other; weighing at last 29 grains more than that in I, and yet had not expended so much water as that by above 2400 grains. The plant in N, though at first a great deal less than that in M, yet being set in the foul crass water, that was left in the still, after that in which M was set was drawn off, at last had gained in weight above double what that in the finer and thinner water had. The proportion of the augment of that plant which throve most, was to the fluid mass spent upon it, only as 1 to 46: in others it was only as 1 to 60, or 100, or 200; nay, in the cataputia, it was but as 1 to 714. The mint in B took up 39 grains of water a day, one day with another; which was much more than the whole weight of the plant originally; and yet with all this it gained not one fourth of a grain a day in weight. Nay, that in H took up 253 grains a day of the fluid, which was near twice as much as its original weight, it weighing when first set in the water but 127 grains. And after all, the daily increase of the plant was no more than $2\frac{5}{56}$ grains.

6. Spring and rain water contain pretty near an equal charge of vegetable matter: river water more than either of them. The plants in the glasses A, B, C, were at first of much the same size and weight. At the end of the experiment the mint in A had gained 15 grains out of 2558 grains of spring-water; that in B $17\frac{1}{2}$ grains, out of 3004 grains of rain-water; but that in C had got 26 grains out of only 2493 grains of river-water. From these and other trials I know that these proportions hold for the main: but doubtless the water that falls in rain, at some times contains a greater share of terrestrial matter, than that which falls at others. A more powerful and intense heat must needs carry up a larger quantity of that matter along with the humid vapours that form rain, than one more feeble and remiss ever possibly can. The water of one spring may flow out with a higher charge of this matter than that of another; this depending partly on the quickness of the ebullition of the water, and partly on the quantity of that matter latent in the strata through which the fluid passes, and the greater or less laxity of those strata. For the same reason, the water of one river may abound with it more than that of another: nay the same river, when much agitated and in commotion, must bear up more of it, than when it moves with less rapidity and violence.

That there is a great quantity of this matter in rivers, and that it contributes vastly to the fertility of the earth, we have an illustrious instance in the Nile, the Ganges, and other rivers that annually overflow the neighbouring plains; which thence show the fairest and largest crops of any in the whole world.

7. Water serves only for a vehicle to the terrestrial matter which forms vegetables, and does not itself make any addition unto them. Where the proper terrestrial matter is wanting, the plant is not augmented though ever so much water ascend into it. The cataputia in E took up more water than the mint in C, and yet had grown but very little, having received only 3½ grains of additional weight; whereas the other had received no less than 26 grains. The mint in I was planted in the same sort of water as that in K; only that the latter had earth dissolved in the water; and yet the former drew off 13140 grains of the water, gaining itself no more than 139 grains in weight: whereas the other took up but 10731 grains of water, and was augmented 168 grains in weight. Consequently the former spent 2409 grains more of the water than this in K did, and yet was not so much increased in weight as this by 29 grains. The mint in M stood in the very same kind of water as that in N, but the water in M having much less terrestrial matter in it than that in N, the plant bore up 8803 grains, gaining itself only 41 grains, whereas that in N drew off no more than 4344 grains, and yet was augmented 94 grains: so that it spent 4459 grains of water more than that did: and yet was not itself so much increased in weight as that was by 53 grains. This is both a very fair and a very conclusive instance, that water is not the matter that composes vegetable bodies, but only the agent that conveys that matter to them, that introduces and distributes it to their several parts for their nourishment.

This fluid is fitted for the office here assigned it several ways: first, by the figure of its parts; which, as appears from many experiments, is exactly and mathematically spherical; their surfaces being perfectly smooth, and without any the least inequalities. So that it is evident, corpuscles of such a figure are easily susceptible of motion, indeed far above any others whatever, and consequently the most capable of moving and conveying other matter that is not so active and moveable. Then the interstices between bodies of that figure are, with respect to their bulk, of all others the largest, and so the most fitted to receive foreign matter. Besides, as far as the trials inform us, the constituent corpuscles of water are each singly considered absolutely solid, and do not yield to the greatest external force, which secures their figure against any alteration; and hence the interstices between the corpuscles must be always alike. By the latter it will be ever disposed to receive matter, and by the former, when once received, to bear it on along with it. Water is further fitted to be a vehicle to this matter, by the tenuity and fineness of the corpuscles of which it consists: we hardly know any fluid in nature, except fire, whose constituent parts are so exceedingly subtle and small as those of water are: they pass pores and interstices that neither air nor any other fluid can: this enables them to enter the finest tubes and vessels of plants, and to introduce the terrestrial matter, conveying it to all their parts; whilst each, by means of organs it is endowed with for the purpose, intercepts and assumes to itself such particles as are suitable to its nature; letting the rest pass on through the common ducts. Nay, we have almost every where mechanical instances of much the same nature. It is obvious to every one how easily and suddenly humidity, or the corpuscles of water sustained in the air, pervade and insinuate themselves into cords, however tightly twisted; into leather, parchment, vegetable bodies, wood, and the like. And this it is that fits them for hygrometers; and to measure and determine the different quantities of moisture in the air, in different places and seasons.

8. Water is not capable of performing this office to plants, unless assisted by a due quantity of heat, which must concur, else vegetation will not succeed. The plants that were set in the glasses Q, R, S, &c. in October and in the following colder months, had not near the quantity of water sent up into them, or near so great an additional increase, as those that were set in June, July, and the hotter months. It is plain that water has no power of moving itself or of rising to the vast height it does in the more tall and lofty plants. So far from it, that it does appear that even its own fluidity consists in the intestine motion of its parts; there being no need of any thing more, for solving all the phænomena of fluidity, than such a figure and disposition of the parts as water has: for corpuscles of such a make, and that are all absolutely spherical, must stand so very tottering on each other, as to be susceptible of every impression: and though not perpetually in motion, yet must be ever ready and liable to be put into it, by any the slightest force imaginable. It is true, the parts of fire or heat are not capable of moving themselves, any more than those of water; but being more subtle, light, and active, than these are, they are more easily put into motion. In fine, it is evident, and matter of fact, that heat operates on and moves the water, in order to its carrying on the work of vegetation.

That the concourse of heat is really necessary in this work, appears not only from the experiments before us, but from all nature, in fields and forests, in gardens and orchards: for we see in autumn, as the sun's power abates, so its effect on plants is remitted, and their vegetation slackens by little and little. As the heat returns the succeeding spring, they all recruit again:

and are furnished with fresh supplies and verdure. As the heat increases, it grows too powerful, and hurries the matter with too great rapidity through the finer and more tender plants. These therefore go off and decay, and others that are more hardy and vigorous, and require a greater share of heat, succeed in their order. By which mechanism provident nature furnishes us with a very various and different entertainment; and what is best suited to each season all the year round.

As the heat of the several seasons affords us a different face of things, so the several distant climates show different scenes of nature, and productions of the earth. The hotter countries yield commonly the largest and tallest trees; and those too in much greater variety than the colder ever do. Even those plants which are common to both attain to a much greater size in the southern than in the northern climes. Nay there are some regions so bleak and chill, that they raise no vegetables at all to any considerable size; and the very shrubs they afford are few, little, and low.

Again, in the warmer climates, and such as yield trees and the larger vegetables, if there happen a remission or diminution of the usual heat, their productions will be impeded and diminished in proportion. Our late colder summers have given us proof enough of this. For though the heat we have had was sufficient to raise the vegetative matter into the lower plants, into our corns, as wheat, barley, pease, and the like; and though we may have plenty of strawberries, raspberries, currants, gooseberries, and the fruits of such other vegetables as are low and near the earth; and even a moderate store of cherries, mulberries, plums, filberts, and some others that grow at a somewhat greater height; yet our apples, pears, walnuts, and the productions of the taller* trees have been fewer, and those not so kindly, or thoroughly ripened and brought to that perfection they were in the former more benign and warm seasons. Nay even the lower fruits and grains have had some share in the common calamity, and fallen short both in number and goodness of what the hotter and kindlier seasons were wont to show us. As to our grapes, apricots, peaches, nectarines, and figs, being transplanted hither out of hotter climes, it is the less wonder we have of late had so general a failure of them.

Nor is it the sun, or the ordinary emission of the subterraneous heat only that promotes vegetation, but any other heat indifferently, according to its power and degree; as we see by our stoves, hot-beds, and the like. All heat is of

* The dwarf apple and pear trees have succeeded better. And indeed in trees of the same kind, those that keep closest to the earth always produce the most and best fruit. For which reason it is that the gardeners check and restrain the growth of their better fruit-trees, and prevent their running up to too great a height.—Orig.

like kind, and wherever the same cause is, there will be constantly the same effect. There is a procedure in every part of nature that is perfectly regular and geometrical, if we can but find it out; and the further our searches carry us, the more shall we have occasion to admire this, and the better it will compensate our labour.

Account of Mr. Tho. Savery's Engine for Raising Water by the help of Fire. N° 253, p. 228.

Mr. Savery, June 14, 1699, exhibited to the Royal Society a small model of his engine for raising water by the help of fire; the experiment succeeded to their satisfaction.

The engine may be understood by the draughts of it, where fig. 1, pl. 9, is the front of the engine for raising water by fire; A the furnace; B the boiler; C two cocks which convey the steam by turns to the vessels D; D the vessels which receive the water from the bottom, in order to discharge it again at the top; E valves; F cocks which keep up the water, while the valves on occasion are cleansed; G the force pipe; H the sucking pipe; I the water. Fig. 2, the side prospect of the same engine.

Account of Loch-Ness. By the Rev. Mr. James Fraser, of Kirkhill. N° 254, p. 230.

Loch-Ness, according to our Highland tradition, took its name from Nisus, an Irish hero, who, with Dornadillo his wife, settled a colony in Stratharig. The promontory on which he had his residence is to this day called Doun Dearnill; and he being the first that ever offered to set out boat or barge upon this lake, it is after him called Loch-Ness. It is 24 miles in length, and in most places 2 in breadth. In many parts of this lake it has been sounded, with more than 500 fathoms of line, but no bottom found. The banks of this lake are high and mountainous, with woods. The lake never freezes, which is imputed to the many great springs and fountains in it: the only fish in it is salmon. This lake discharges itself into a river of the same name, 6 miles in length, which never freezes, but always smokes with frost. On the north side of Loch-Ness stands, on a rock, the famous castle of Urqhart; the great ditch round it was for the most part cut out of the rock, and received water from the lake. This castle consisted of 7 great towers, and it is said was built by the Cuminees, or Cumings, but was demolished by King Edward the First of England, leaving only one tower to the east, still remaining. About 4 miles to the westward of this castle, on the side of Loch-Ness, stands that great mountain

Meal-fuor-vouny, of a round shape, and very high, esteemed 2 miles of perpendicular height from the lake. On the very top of this hill is a lake of cold fresh water, about 30 fathoms in length, and 6 broad, no course or stream running either to it or from it. The bottom of it cannot be sounded. With 100 fathoms of small line I could find no bottom. It is always equally full, and never freezes.

There is, due west, from the end of the river Ness, an arm of the sea, called Beuly Frith, 6 miles in length and 2 in breadth. This bottom seems to have once been firm land, for near the middle of it are found long oak trees, with their roots entire, some above 60 feet in length, lying covered with the sand, which doubtless have grown there; there are also three great cairns or heaps of stones in this lake, at considerable distance from each other; one of a huge size, in the middle of the Frith, is accessible at low water, and appears to have been a burial place, by the urns which are sometimes discovered. As the sea encroaches and wears the banks upward, there are found long oaken beams of 20 or 30 feet long, some of them 8, 12, or 14 feet under ground. I saw one of them 14 feet long, that had the mark of the axe on it, with several augre bores in it. The river Beuly, which falls into this arm of the sea, near Lovat, has sunk so low that oaken trees of great length, and 16 feet under ground, are discovered in the banks, with layers of sand, gravel, clay, and earth over them; and we have found some oaks, with coals, and pieces of burnt timber, as low as 16 feet deep.

About 17 miles due west from Beuly, there is a forest called Affaruck, in which there is a mountain called Glenin-tea, and on the north side, under the shade of a great sloping rock, stands a lake of fresh water, called Lochan Wyn, or Green Lake, 18 feet in diameter, about a fathom deep, which is always covered with ice, summer and winter. The next mountain, north of that, is called Scúre-in-Lappich; on the top of which is a vast heap of white stones like crystal, each of them larger than a man can throw, which strike fire like flint, and have the smell of sea-weed. On this mountain is found also oyster, scallop, and limpet-shells, though 10 miles from any sea. Round this hill grows the sea-pink, in Irish, teartag, having the taste and colour of that which grows on the sea banks.

The Pagan temples, or high places of idolatry, are still very numerous here; on the river side of Narden I reckoned 13 in 2 miles: they are round, and at the west end have two high stones like pyramids; there is an outer and inner circle of lesser stones, and a round mote in the centre for the sacrifices. Another sort of them is only of earth, with a trench round about, and a mote in the middle. In many of these I find a round heap of stones with urns in

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them. It seems a different religion afterwards changed these places of worship into burial places.

A Discourse on Concoction. By Clopton Havers, M.D. F.R.S. N° 254, p. 233.

The sentiments of physicians on this subject have been various, and the hypotheses by which they have endeavoured to explain it, very different. Some have thought the concoction of the food to be a kind of elixation; and that the grosser and more solid parts being, as it were, boiled in the fluid by the heat of the stomach, and the parts adjacent to it, as the liver, spleen, and omentum, are by a long and continued elixation first rendered more tender, and then colliquated and dissolved into minuter particles, so as to mix more equally with the fluid, and with that to make one pulp, or chylous mass. And though Hippocrates does not plainly call it an elixation, yet he seems to attribute the concoction of the food to the heat of the stomach, as its great cause. Others have supposed it to be performed by attrition; as if the stomach by those repeated motions, which are the necessary effects of respiration, when it is distended by the aliment, did both rub and grind off some minuter particles from the grosser parts, and by continually agitating the mass of food, make those parts, which are not contiguous to the stomach, strike against one another, and break each other in pieces, until they are all attenuated. As for bread, and such things as are made of flour, which may be softened and dissolved with any common liquid, and though that agitation of the stomach, which moves them in respiration, might seem capable to break and dissolve them when they are sufficiently moistened with a fluid, yet this cannot be thought sufficient to break and digest flesh, fruits, or any thing that will not be dissolved in water, or some such liquid. But although this motion of the aliment caused by respiration does not actually digest it, yet it has a great and necessary use in concoction, and makes all the grosser parts, as they are attenuated, mix equally with the fluid parts.

Some think that the bilious juice, and others again that the spirits are chiefly concerned in this affair. Galen makes it the effect, not of one, but of several causes; as the pituitous juice in the stomach, the bile, &c.

Some will have the food to be dissolved by a menstruum, supplied from the glands of the stomach, or some other way; but these differ in their notions of the nature of the menstruum; for some suppose it to be an acid, which corrodes the grosser parts of the food, and dissolves them as vinegar, spirit of vitriol, or any such like acid, will dissolve even so solid a body as iron. And though it cannot be denied but that oil of vitriol will dissolve flesh and reduce it to a pulp; yet it is not to be supposed that the fibres of the stomach can bear any such strong and corroding acid, without being injured in its tone, and labour under great and extraordinary pains. Neither does such a menstruum, though it will digest some things, seem capable of dissolving so great a variety of things as we eat, especially when many of them are of contrary natures. Some will have the menstruum to be a nitro-aëreous spirit, subtile, and very penetrating, and included in its proper vehicle; which being in its own nature apt to penetrate the mass of the aliment, diffuses itself through the whole, and breaking the cohesion of the most solid parts, dissolves their compages. By others, it is thought to be some saline juice in the stomach, by which the parts of the aliment are divided and dissolved, and those fit for nourishment are volatilized.

Lastly, there are some who suppose the digestion of the food to be performed by means of a ferment, which, when mixed with the aliment, excites in the mass an intestine motion; and the different and contrary motions or tendency of the parts, making some kind of collision, gradually break off particles from the grosser and more solid parts, till they are so attenuated, as to mix more equally with the fluid parts, and with them constitute one soft or chylous substance. But these also differ either as to the nature of this ferment, or the manner in which it is supplied. For some take it to be the remains of the food that was last digested; which, having lain some time in the stomach after the rest is carried down into the intestines, contracts an acid, or some other quality, and is so altered as to partake of the nature of a leaven. And this leaven being a part of the food which has been already digested, is so soft and liquid as to be capable of mixing with the aliment which is next taken into the stomach, and being agitated with it by the repeated pressures of the diaphragm, liver, and abdominal muscles on the stomach in respiration, diffuses itself through the whole mass, and being mixed with it like leaven, or yest added to new wort, &c. puts it into a state of fermentation, and by this fermentation, or the expansion of the ferment, and the more subtile parts, which are first put into motion by it, those parts which are more solid, and with which they are intermixed, are rent and divided, and so attenuated as to become a soft and pulpous matter. And although the greatest part of the food, thus broken and concocted, is by the contraction of the fibres of the stomach pressed into the duodenum, yet they do not contract themselves so as to force out all the aliment, but leave between the rugæ or folds on the inside of the stomach a sufficient quantity to be a leaven to the next meal; and so on from time to time.

Some have a notion that this ferment or principle of fermentation is in the aliment itself; which being a congeries of matter, consisting of various parts of a different nature, is no sooner inclosed in the stomach, and digested in the heat of that and the adjacent parts, but the more spirituous and subtile particles are put into motion, both from that warmth and the difference of their natures, and commence a fermentation; and so by their intestine commotion, and the violence they offer to those parts which oppose the tendency of any of them, they break and dissolve the more solid parts. Again: some suppose that this ferment is supplied from the glands of the stomach. And lastly, others, and perhaps with much better reason, contend for the saliva, and make that to be the ferment which serves principally for the digestion of the food; which in mastication being mixed with our aliment, is with that carried down into the stomach, where its parts being put into motion by a kindly and agreeable heat, they ferment with and agitate first those parts of the food which are most apt to ferment with it, and then both conspire to break and dissolve the grosser and more stubborn parts. And Galen plainly allows that the saliva is concerned in the business of concoction; though he supposes the alteration, which is produced by this juice, to be made in the mouth.

Having given this short account of the various opinions of some ingenious men, concerning the manner how concoction is performed; I come now to propose my own hypothesis, by which I shall endeavour to explain it.

In order to the more easy and effectual digestion of the food, nature has appointed some parts for breaking our aliment, and reducing whatever is gross into smaller parts, before it is put upon digestion: others to supply the ferment, by which it is to be dissolved and concocted, aud which, before it comes to be included in the stomach, moistens and makes it softer, that it may more easily be penetrated and broken by those parts which serve to divide every morsel into smaller pieces.

For breaking that part of our food which is not liquid, nature has furnished us with teeth, and those of two sorts; some are appointed to divide and break off smaller morsels from a larger mass; others for grinding those morsels into much smaller parts. The teeth which serve to break off pieces of a convenient magnitude from a larger mass are of two sorts, accommodated to the nature of the substance which we eat: these are the incisores, and the dentes canini. If the substance which we have to eat be not hard, but more easily penetrated and divided, then the incisores are capable of making an impression upon it, and fixed firmly enough in the jaws to break off that part which they take hold of. But if it be more solid, and not easily penetrated, nor any piece without difficulty to be separated from that body of which it is a part, then we apply the dentes canini or eye-teeth to it, which are not spread, nor have such an edge as the incisores, but are sharp and pointed like an awl, and so do more readily penetrate a substance that is hard, and which the incisores can scarcely make any impression on. And as the parts of a more solid body are commonly with more difficulty separated, and there must be a greater stress put upon those teeth which pull it into pieces; so these teeth are much more firmly fixed in the jaws than the incisores, though they have but one single root. Besides, the position of all these teeth is accommodated to their use, as being planted opposite to the aperture of the mouth, so that they may be conveniently applied to the substance we have to eat, before it is broken, and when it is too large to be admitted within the mouth.

The teeth which by a compression and attrition reduce the little morsels to smaller parts are, from the manner in which they break the aliment, called dentes molares, because they grind the food like so many little mill-stones. And that they might be rendered fit for this purpose, they are made broad at that extremity which stands out of the gums, by which means they retain some quantity of the food between them every time the lower jaw is pulled up and forced against maxilla superior. And as they are broad, so they are formed with inequalities and protuberances, and by the motion of the lower jaw from one side towards the other they grind what lies between them into pieces. The position of these teeth too is as convenient as that of the incisores and the dentes canini: for being designed to break those pieces of our solid food, which are taken into the mouth, and these pieces, when they are compressed and moved by the dentes molares, being apt to fly out of the mouth if there were no contrivance to prevent it, they are placed beyond the aperture of the mouth, and opposite to the cheeks, which keep the food within that cavity; and not only so, but press it in between the dentes molares on one side, as the tongue does on the other, until they have sufficiently broken and divided it.

At the same time, whilst the dentes molares are breaking the food, there flows into the mouth a salival juice, which mixes with it, and not only serves to moisten it and to render it more apt and easy to be divided, but seems to be the ferment, by the benefit of which the food is dissolved and digested; and therefore it is intimately mixed with it by the teeth agitating them together in mastication.

This liquor, which we commonly call the saliva, or spittle, seems to be a composition of two several juices, very different in their natures; and therefore the several parts of it are separated by their proper glands, and nature has planted no fewer than four pair about the mouth, which supply the juices that make the saliva, viz. the parotides, and the glandulæ nuckianæ, the glandulæ maxillares internæ, and sublinguales. Not that I suppose, as there are four pair of salivary glands, so there are four sorts of juices supplied from them, to make the saliva; but, that there are only two different juices that constitute it. I think one of these to be an acid juice, the other an oleaginous liquor, something like oil of turpentine. For among the many experiments I have made, there was no one that gave me so much satisfaction as that which I made with oil of turpentine and oil of vitriol, though I tried several other things that will produce a fermentation on their mixture. And it was for this reason that I made the experiment with oil of turpentine and the other oil.

I took a piece of raw flesh, and having cut it into pieces, but much larger than what our more solid food is reduced to by due mastication, and mixed some crums of bread with it, I then poured in the oil of turpentine to them, and upon that the oil of vitriol, and having shaken them together, I digested them about four hours in balneo mariæ, and then shaking them again in the glass, I found the meat dissolved, and they all became a thickish pulp. I could not but take notice, that oil of camphire, though it does not otherwise seem very different in its nature from oil of turpentine, and oil of vitriol, being mixed together, produce an effervescence as well as the oil of turpentine and oil of vitriol, yet did not touch the meat upon which I poured them, so as in the least to dissolve it. I cannot deny but that an acid and a solution of salt of tartar dissolved some part of the flesh-meat which I mixed them with, but yet neither so soon nor so perfectly as the two forementioned oils. And I rather think one of those juices which constitute the saliva to be of the nature of oil of turpentine, than of a fixed salt, because it will correct and temper even oil of vitriol, so as to render it more tolerable to the fibres of the stomach.

I conceive that four of the eight salivary glands, or two pair of the four, supply one of these juices, and the other four glands the other. And this seems to be a very good reason why they are so planted and the orifice of their ducts so ordered, that the juice which is supplied by one gland is discharged into the mouth, very near to the orifice by which the juice of a different nature is transmitted from another, so that they must necessarily meet and mix together. Thus the glandulæ nuckianæ and the parotides throw in two different juices, by orifices which open into the mouth very near each other; and the glandulæ maxillares internæ and sublinguales below supply the same kind of juices by orifices that open so near to each other as to secure the mixture of the two different juices. These glands then between them afford two sorts of liquors, of such a nature as are apt to ferment on their first mixture, but perhaps more considerably when they come to be digested by the heat of the stomach. So that the colluctation or fermentation which attenuates and concocts the food in the stomach does not commonly arise between the aliment and the saliva, but between the several parts of the saliva itself. And indeed if the saliva did not consist of two juices, whose nature is in such a manner different as to render them apt to ferment on their mixture, it would be very hard to conceive how it should so readily and indifferently serve for the digestion of all eatables; how it should ferment with, and dissolve so great a variety of things, not only of a different but of a contrary nature; how it should ferment with acids as well as alkalies, digest things that are cold as well as hot or temperate, &c. But if we suppose that the fermentation which serves for the digestion of the food arises from a peculiar difference in the nature of two juices, which constitute the saliva, it will be easy to give a rational account of our concoction of innumerable things of a different nature. And this seems to be as effectual, and a more certain way to attenuate and dissolve the grosser parts of our food, than if the fermentation were made only between the saliva and the aliment: besides, the saliva seems to discover a fermentation on the mixture of its constituent juices, even at those times when we do not actually eat; for it is always attended with bubbles, and a froth, when it has not been at all agitated in the mouth; and many of those bubbles will remain for some considerable time after we have spit it out.

Nature therefore having appointed the saliva for the digestion of the food, has taken care that it shall be thrown in upon the aliment on every side. Thus the glandulæ nuckianæ and the parotides supply their juices to that part of the food which lies on the outside of the gums, between the cheeks and the teeth, and the glandulæ maxillares internæ and sublinguales bestow their liquor on the meat which is within the teeth and gums. Nature has also had regard to the mixture of the two different juices of the saliva, which is necessary to its fermentation, by placing the orifices of the salival glands near each other. The saliva being thus mixed, does partly as it is agitated with the food by the teeth and some other parts of the mouth, partly by its own fluidity, insinuate itself into and mix with the food, and not only moisten and soften it, but excite the fermentation which is to dissolve it. And when the aliment is thus mixed with the saliva, which serves to ferment the whole mass, it is then to be conveyed into the stomach, that great digestive vessel of the body, where it is kept in a digestive heat, and the fermentation not only continued but improved. This fermentation in the stomach first agitates the finer and more subtile parts of the food, and puts them into motion, and so with the fermentation of its own, and those alimentary parts, which it first communicates a motion to, improved by the heat of the stomach, the saliva must necessarily act on the grosser parts. For the intestine motion, which is excited in the mass, does not give the particles which are fermented the same tendency, but what is so various and confused, that they must inevitably strike not only against one another, but against those which are more gross, so as to attenuate them, sometimes by a collision, which strikes off smaller particles from the larger parts; sometimes by a compression, when the particles which are in motion happen to strike directly against any grosser part on every side of it; and sometimes by a kind of explosion. For without doubt the saliva, which is fluid, insinuates into the interstices of the grosser parts of the aliment; and whatever is agitated and expanded in those interstices, requiring a larger space for the freedom of its motion, and offering a violence to every thing that opposes its tendency, will, like gunpowder included in a shell, force its way out, and tear to pieces the matter which endeavours to confine it.

Thus the grosser parts are broken and divided, until they are at least so far attenuated, as to mix more equally with the fluid, and with them to make one pulp or chylous mass. And although I do not apprehend how the stomach should by its reciprocal motion in inspiration and expiration be able to break and attenuate any matter that will not be softened and dissolved by agitation in a liquid, yet it is certain that these motions, caused by the diaphragm and abdominal muscles in respiration, make those parts which are broken off, as they are dissolved, mix intimately with the liquid, as the meat which I digested with oil of turpentine and oil of vitriol did by agitation mix more equally with the oils, and became a pulp.

As the juices which constitute the saliva ferment on their mixture, so it is probable that from their mixture and fermentation there results such a tertium quid, as is apt to ferment with the bile. And therefore, when the aliment has been a sufficient time under the fermentation excited by the saliva, it is then thrown into the duodenum, where it meets with the bilious juice, which flows into that intestine from the liver, from which a new fermentation seems to arise; and the commotion of the parts of the aliment being still continued, carries on the business of digestion, till the food is perfectly concocted. Though it is probable, that this new fermentation serves not only for the more perfect digestion of the food, but likewise for the separation of the chyle from the feculent parts. Neither do I by an ungrounded conjecture suppose that from the mixture and fermentation of the two juices, which constitute the saliva, there results a matter which is apt to ferment with the bile; but the notion was confirmed by an experiment: for considering that the bile is generally allowed to have much of a saponaceous nature, I made a solution of soap in fair water, and mixed it with the oils of turpentine and vitriol first put together, and from their mixture I observed a gentle fermentation, which continued for a considerable time.*

* This doctrine of digestion being performed by fermentation is now exploded. See vol. iii. p. 71, of this Abridgment.

Account of the Moorish Way of dressing their Meat, with other Remarks, in West Barbary, from Cape Spartel to Cape de Geer. By Mr. Jezreel Jones. N° 254, p. 248.

The Mauritanian or Barbarian Moor, when he rises in the morning, washes himself all over, and dresses; then goes to their jiama, or church, says his prayers, and returns home, where his wife, concubine, or slave, has his breakfast provided for him, which is usually made of barley or wheat-gruel. It is made somewhat thicker than ours, till it be ropy; they put origan and other herbs powdered into it, which for such uses they keep dried all the year; some put a little pepper and other spices to it. I have often been treated with warm bread, fresh butter and honey, in a morning, which is often used among themselves an hour or two after they have had gruel; also hasty-pudding with butter, and sometimes butter and honey. Some again give cuscusoo, with milk, others with flesh, others again with roots. When any one has a guest in his house, the neighbours bring their dish to welcome him, on account of the respect and love they bear to their neighbour, as well as to show their readiness to entertain the stranger. This practice is found constantly used throughout the whole country amongst the Moors reciprocally, one towards another. And I have as often found the like civility, as I had occasion to take up my lodging at any place, where I was acquainted with any of the inhabitants. The Jews likewise show great civility to any Christian, and treat him with what they have, as stewed or baked hens, capons, hard eggs boiled or roasted, which they press flat, with pepper and salt, wine, brandy, &c. They have generally the best bread, and every thing else of the kind that they can get. They put anise, and two or three other sorts of seeds in their bread; one is black and angled, tastes almost like carrot-seeds, and I think I have seen these sometimes used in bread in Spain. They esteem honey as a wholesome breakfast, and the most delicious that which is in the comb, with the young bees in it, before they come out of their cases, and while they still look milk-white. These I have often eat of, but they seemed insipid to my palate, and sometimes I found they gave me the heart-burn.

Cuscus, or cuscusoo, is the principal dish among them, as the olla is in Spain: this is made of flour of wheat, and when that is scarce, of barley, millet, Indian corn, &c. They shake some flour into an unglazed earthen pan made on purpose, after first sprinkling a little water on the bottom of the pan, and then working it with both their open hands flat, turning them backwards and forwards to grain it, till they make it resemble Indian sago. They stew their flesh in earthen pots close covered, and put the cuscusoo into an earthen colander, which they call caskass, and this into the mouth of the pot, that so all the steam arising from the meat is imbibed by the cuscusoo, which causes it to swell, and make it fit to be eaten: when it is well done, they put the cuscusoo out in the dish, and heaping it up, they make a place for the meat to lie in, putting also a good deal of spices, as ginger, pepper, saffron, &c. This dish is set upon a mat on the ground, and four men may easily sit about it, though I have seen six and more at one dish; they sit with their buttocks on the calves of their legs, with the soles of their feet on the ground. If there are many to eat at this meal, there are more dishes. This dish they have in use sometimes at breakfast, as well as dinner and supper; but it is commonly used for the last two meals. They cover it with a thing made on purpose, and it will keep hot enough two hours. At a stately entertainment, they will have a sheep roasted whole, sometimes a half, or a quarter, on a wooden spit, or the most convenient thing they can find. They do not continually keep turning it as we do, but leisurely let one side be almost roasted before they turn the other. The fire is commonly of wood burnt to clear coal, and made so, that the heat ascends to the meat. They baste it with oil, incorporated with a little salt and water. They let it be thoroughly roasted; then they say, Bismiillah, in the name of God; after they have washed their right hands, they pull the meat in pieces, and fall to eating. For they never use but their right hand in eating, and one holds while the other pulls it asunder, distributing the pieces to the rest, as he pulls them off. They seldom use a knife, and a fork is a rare thing among them. They are dexterous at this way of carving, and never flinch at the heat of the meat, for that would look mean, and might occasion another more bold to take the office upon him. When they have done, they lick their fingers; and as often as they have a hot dish, they wash their hands afresh. They then have alfdoush, or vermicelli, with some meat on it, stewed meat well spiced, with savoury broth; which, after they have eat the meat, they dip their bread in the sauce, or broth, and eat it. They are cleanly in their cookery, and if a hair be found, it is a capital crime, but a fly not, because it has wings, and may get in after it passes from the cook's charge or management. Cubbob is small pieces of mutton, wrapped in the cawl of a sheep. Some make good cubbob of the liver, lights, and heart. They pepper and salt them, and put sweet herbs and saffron into them, then roast them, and when they dish them up, squeeze an orange or two on them. Thus they use commonly in their stewed meats lemon, and orange for roast or fish. Elmorosia is pieces of beef, of cow or camel, stewed with butter, honey, and water: some mix rob of wine in it; they add saffron, garlick, or onions, a little salt, and when it is enough serve it up. They will treat you with stewed hare and roasted hens and partridges: these they disjoint, and let stew in water and oil, or butter, if they are not fat enough of themselves. When they are almost enough, they beat a couple of eggs, mix them with the liquor, with juice of lemon or vinegar, which they usually have very good, and serve it up. They have more baked and roast, and another dish of stewed meat, which for its goodness would be esteemed among us: they take a leg of mutton, and cut off the fleshy part, leaving out the skin and sinews. This flesh they mince very fine; they also mince some suet, parsley, thyme, mint, &c. They then take pepper, salt, and saffron, beaten together, and some nutmeg; all these they add to the rest, with about half a handful of rice; they cut an onion of the best sort half through, and take off the first lay as not so fit for use, unless it be thick; this lay they fill with forced meat, then the next, and so on, which makes them look like so many onions; some they put up in vine-leaves: while this is doing, the bones and residue of the leg of mutton, being in moderate pieces, are stewing, with as much water as will just cover them; then they put on their forced meat balls over the meat, and a green bunch of grapes upon them, cover it, and let it boil till thoroughly enough. This I think is one of their best dishes, which they often use in Fez and other cities. Pillowe, or pilôe, is a dish very well known, made with rice boiled, with a good hen, mutton, and spice, the flesh and fowl being put on the rice in a dish, as cuscusoo, and so served up.

Their drink is plain water or milk, and sometimes rob of wine mixed with water. This they say is remedy against cold likewise, and pretend to take it medicinally; though rob of grapes is allowed by their law. Under this pretext, many Fez merchants to make rob, or vinegar, press all the grapes in their vineyards, put it up in great jars under ground, and keep it long, so that it proves excellent wine. When a number of them, with every one his mistress, appoint to be merry, they retire to their vineyard or garden, where they have music, and all or most of the above dishes, and there sit and carouse over a great earthen bowl full of wine, of about 4 or 5 gallons, drinking round out of a cup holding nearly a pint; and they seldom part till they have made an end of the whole jar, though rarely less than a week's time. Such as are known to drink wine, or make water standing, their testimony is not valid in law.

The hedgehog is a princely dish among them, and they are very nice in dressing it. The Moors do not care to kill lamb, veal, nor kid, saying it is a pity to part the suckling from its dam. They eat with their boiled meat many times carrots, turnips of two or three sorts, cabbage, beans and peas, &c. of which they have plenty, and very good. I have eat of porcupine stewed, which much resembled camel's flesh in taste, and that is the nearest to beef of any thing I know.

All things taken in game, as hawking, hunting, and fowling, are lawful for them to eat, if they take it before it be dead, so that they can have time to cut its throat, and say, Bismiillahe; or if he is known to be an expert man at the game, and says those words before he lets the hawk take its flight, lets slip the greyhound, or fires his gun, it is lawful. In short, every thing, except swine's flesh, and what dies of itself, they have liberty to eat, and may sell it. They eat snails boiled with salt, and praise their wholesomeness. Fish of all sorts are lawful. In Taffilet and Dra most of their food is dates: there are ten or a dozen sorts. They have good capons all the country over; no turkeys, ducks, nor geese, but wild, and those they have of two sorts: duck, teil, and mallard, curlews, plovers, snipes, oxbirds, pipers, a sort of black crow, with a bald pate and long crooked bill, is good meat; and a hundred other sorts of fowls. Partridges in Suse commonly roost on trees, foxes being so numerous would otherwise destroy them. The foxes are eaten if fat. They have many kinds of fruits and sweet-meats, as pumpkins, macaroons, almonds, raisins, dates, figs, excellent melons, and water melons, pomegranates, apples, pears, apricots, peaches, mulberries, plums, and damascens, cherries, grapes of many kinds, and very good, and if they would assist nature they might have every thing in perfection.

Their salleting is luttuce, endive, carduus, parsley, apium, and other sweet herbs, onions, cucumbers, radishes, fumatas, or love apples, all which they will cut, and put oil, vinegar, and salt, with some red pepper; this sallet they eat with bread. When the Moors have feasted, every one washes his hands and mouth, thanks God, and blesses the hosts and entertainers from whom they had it; they then talk a little, or tell some story, and lie down to rest.

Account of the Third Volume of Dr. Wallis's Opera Mathematica, folio, Oxford, 1699. N° 254, p. 259.

The first two volumes were noticed in N° 216. (page 29 of this fourth volume.)

Much of the present volume is employed in preserving and restoring several ancient Greek authors, who were in danger of being lost. For which work the doctor is fitted, not only by his excellent knowledge in mathematics, accurateness in the languages, and great industry in collating manuscript copies; but also, by what is peculiar to him, his art and practice in deciphering, which enables him to make sagacious conjectures, supplements, and emendations, which must often be an editor's business, and which we so justly admire in him.

He begins with Ptolemy's Harmonics, the most considerable of all the Greek musicians. To this he gives a new Latin translation, with copious notes, and clear explanations of what might seem difficult in the Greek music. To this he subjoins an excellent treatise of his own, comparing the ancient Greek music with that of the present age; by which that which was before admired rather than understood is now rendered very intelligible, according to the language of modern music. Next to this is the Commentary of Porphyry on a great part of Ptolemy's Harmonics, with like notes and necessary emendations as the former. Then follow the Harmonics of Manuel Bryennius, in Greek and Latin, with notes and necessary emendations as the rest. So that now we have all the ancient Greek musicians known to be extant, published in Greek and Latin; Marcus Meibomius having formerly published several of them in the year 1652, and the remaining three being now added.

The next piece is Archimedes's Arenarius; of this we had a Greek edition of Hervagius, published at Basil in the year 1544; which seems to be done by Hervagius with great care and fidelity, but out of a very faulty manuscript copy. To this is subjoined that of Archimedes, called Κύκλȣ Μέτρησις, or Dimensio Circuli, which had been formerly published in Greek with other works of Archimedes, in the Basil edition, by Hervagius.

To this is now added the Commentary of Eutocius, by which it is shown how troublesome it was to perform the arithmetical operations of division and extraction of roots, and other intricate operations, before the introduction of the Indian algorism, or calculation by the numeral figures now in use, of which Archimedes, in his Arenarius, gives us the true foundation as to the economy of numbers, but without the notation now in use.

After these pieces of Archimedes and Eutocius, follows a treatise of Aristarchus Samius, De Magnitudinibus et Distantiis Solis et Lunæ, first published by Dr. Wallis out of some manuscript copies in the year 1688, and now reprinted with the Latin translation and annotations of Commandine and of his own.

To this is subjoined in Greek and Latin, a fragment of the second book of Pappus Alexandrinus's Mathematic Collections. The Latin translation of which author, published by Commandine, begins at the third book, the two former being wanting. But a good part of the second book is now published in Greek and Latin, by which we may judge of the contents of what is lost; and that the loss is not great, as giving an account of the arithmetical operations then in use; which are now performed with much more advantage by the algorithm or numeral figures now used.

After this preservation and restitution of these ancient Greek authors follows a collection of divers letters, relating to mathematical affairs, which have formerly passed between Mr. Oldenburgh, the Lord Brounker, Mr. Newton, Mons. Leibnitz; and more lately between Dr. Wallis, Mons. Leibnitz, Mons. Menkenius, and some others; wherein may be seen by what steps some of the late methods for the improving and promoting of mathematics have proceeded, and by whom truly made, and to whom justly owing; as that of Dr. Wallis's Arithmetica Infinitorum: which, by way of induction and interpolation, has given an inlet to many new discoveries. And that of Mr. Newton's Methodus Fluxionum; and Mons. Leibnitz's Calculus Differentialis, with some others. There is also an account of the business of deciphering, wherein Dr. Wallis has been so remarkable; also an account of his methods for teaching persons deaf and dumb to speak, and to understand a language, and thereby to express their minds by writing.

And lastly, here is a letter of Mr. Flamsteed, giving an account of a very remarkable discovery of the parallaxis of the earth's annual orb, observable in some of the fixed stars. Which is a noble phenomenon, diligently sought after for some ages, but hitherto without success, and now at length discovered in England, and confirmed by the concurrent observations of 8 years, compared together, by which the Copernican hypothesis seems to be clearly established.

After these treatises he subjoins divers other miscellaneous tracts; which, though not so purely mathematical, may at least be acceptable to inquisitive persons, and show how useful mathematics are in most other studies, where the author has so dexterously and successfully applied them. Amongst these is first his Tractatus de Loquela Grammatico-Physicus, wherein he gives a very particular account of the physical or mechanical formation of all sounds used in speech, expressed by the letters of several languages. Then a grammar of the English tongue, adapted to the peculiar genius of this language.

Then follows his Institutio Logica, first published in the year 1687, giving a clear account of the true foundation of logic, and reducing it from the ordinary disputes in the schools to its true use in the common affairs of life. To which are annexed three theses, or particular discourses, for rectifying some mistakes commonly committed by logicians in their treatises of logic.

After this follow some Latin sermons, and theological discourses made on several particular occasions.

Part of a Letter from Mr. Leuwenhoeck, concerning his Answers to Objections made to his Opinions on the Animalcula in Semine Masculino. N° 255, p. 270.

Having seen in the Phil. Trans. N° 247, the objections which Dr. Lister makes against many positions concerning the procreation of an animal out of the masculine seed; Mr. Leuwenhoeck here takes occasion to state that the objections alluded to have no effect upon him in moving him from his opinion; that the numerous animalcules seen by the microscope in the seed of the male animals are the very animals in embryo, which are afterwards born of the female. An opinion which he does not here bring arguments or reasons to render either probable or credible.

Extract of a Letter from Dr. Wallis to Dr. Sloane, S.R.S. giving an Account of some late Passages between him and Mynheer Leibnitz, of Hanover. N° 255, p. 273.

Sir.—I received lately a letter from Mynheer Leibnitz, of March 30, 1699, wherein are some passages relating to mathematics; to be answered hereafter. Then follows a passage somewhat relating to the Royal Society, in these words: "I know not how it happens, but the sublimer studies are not now pursued so much as formerly; whereas after so many late assistances they could never be prosecuted to more advantage. I suppose it may be because of the unhappiness of the times, and that the wars have turned the attention of mankind another way; so that very few of the juniors are ambitious to attain to the glory of their predecessors. Even nature has now but few that cultivate her diligently. As the French Academy of Sciences has been reconstituted by their king, so I wish that a new ardour were infused into your Society." To which, what I have thought fit to return in answer you will see afterwards.

He then sends me the copy of a large French letter of l'Abbé de la Charmoye to l'Abbé Nicaise, giving him a particular account of the contents of a treatise intended to be shortly published, concerning the original of nations, wherein, out of ancient mythology, he endeavours to discover an historical account of the origin of divers nations, herewith sent to you.

Account of the Abbot Charmoye's Book, called L'Origine des Nations, sent by him to Abbot Nicaise, in form of a Letter. N° 255, p. 274.

The author says that his book will be entitled, The Origin of Nations; that it will be an historical comment on the 10th chapter of Genesis, where Moses mentions the first fathers and replenishers of the earth after the deluge. He divides it into 5 books. In the first he discourses on what relates to the inhabitants of the earth, before the confusion of tongues and tower of Babel, and who it was that undertook this great and wonderful work or enterprize. In the second book he discourses at large of the descendants of Sem. In the third, he inquires into the posterity of Cham. And in the fourth, the establishment of Japhet. He then proceeds on many other things, as of Mizraim or the Egyptians, and concludes this part with an account of the first ancient tribe they had.

In the fifth part he says, he discovers the beginning of the ancient Celtics, who were afterwards called Gauls: and he tells the Abbot Nicaise, he will make appear from Josephus, and other ancient writers, that they descended from Gomer, youngest son to Japhet, yet will not rest his proof here, but says he will give good reasons that Asia Major, toward the Caspian Sea, was their first establishment, that is, about Margia, Hyrcania, Bactria, and other adjoining parts: also that they had the name of Gomorians, or Gomarites, for many ages, as descending from Gomer, Japhet's youngest son.

Dr. Wallis's Answer to Mr. Leibnitz's Letter foregoing. N° 255, p. 280. *Translated from the Latin.*

SIR, Oxon, April 20, 1699.

What you complain of, that the sublimer studies are not now pursued so eagerly as formerly, and nature has fewer diligent observers, may be in some measure true; but it is not to be wondered at that the studies of men should have their vicissitudes like all other things. Doubtless in the present age, which is now drawing to a period, knowledge of all kinds has experienced very great and even unhoped for improvements, as physics, medicine, chemistry, anatomy, botany, mathematics, geometry, analytics, astronomy, geography, navigation, mechanics, and even, what I least rejoice at, the art of war; and indeed far greater than for many ages before. For formerly men seemed to aim at nothing more than to understand what had been delivered by Euclid, Aristotle, and the rest of the ancients; having little concern about making any further progress, as if they had established the limits of the sciences, which it might be presumptuous to extend. But after some few had ventured to look further, others were thence encouraged to enter the wide field of the sciences. Thus a new ardour, a new effort, urged them to attempt new things, and indeed not without success. But when the novelty ceased, this new ardour gradually declined. Many of the diligent scrutinizers of nature are dead, and others must soon follow them; and the novelty of the subject will no longer, as before, excite the young men to tread in the steps of their predecessors.

The matter also itself was great, but is now partly exhausted; so that a harvest is not to be expected, but only a gleaning; and it seems reasonable to allow that those that are tired and wearied should have some rest. Nay it may happen, though I wish it may be otherwise, that the sloth of the next age may exceed the industry of the present.

You wish, and so do I, as the French Academy of Sciences now seems to be regenerated, that a new ardour may likewise be infused into our Royal Society. And indeed I have admonished them of this, in your words. But they themselves, which you will not be sorry for, had in a manner prevented my admonition. For they have lately made some new regulations for themselves, by which every member is to promote some particular subject. But there is this difference between the French Academy, and our Royal Society; that the academicians are at the king's expence, every one having his salary; whereas ours do every thing at their own expence.

On some supposed Alteration of the Meridian Line; which may affect the Declination of the Magnetical Needle, and the Pole's Elevation. By Dr. Wallis. N° 255, p. 285.

An extract from an anonymous letter to the doctor is in these words: "What I would offer, is this, taking for granted that the earth moves, &c. You know, that besides the diurnal and annual revolutions, there must also be a third, to account for that slow motion of the fixed stars, upon the poles of the ecliptic, in about 25,000 years; which is solved by the direction of the earth's axis from one point to another of the polar circle. And that direction being nothing but a certain wabble in the earth's motion, must needs make the noon-shade of a perpendicular not lie always in the same line. I would request, that this hint might be improved in one of the next Transactions, if I were sure that it were not a blunder. But if so, I have this to excuse, that I have not made it tedious. I am, Sir, your most humble servant." To which the doctor answers,

Now this being a new suggestion, and which, if well grounded, may be of considerable consequence, both as to the declination of the magnetic needle, and the pole's elevation, and therefore deserving to be well considered: and it not being very probable that so careful a man as Tycho, and those concerned in the church of St. Petronio, mentioned in N° 241, should be so much mistaken in the Meridian line, I thought fit to recommend it to the thoughts of others. But, if there be ought of this nature, it must arise from a change of the terrestrial poles, here on earth, of the earth's diurnal motion; not of their pointing to this or that of the fixed stars; for, if the poles of this diurnal motion remain fixed to the same place on the earth; the meridians, which pass through these poles, must remain the same.

On the Antiquity of the Numeral Figures in England. In a Letter to Dr. Wallis, from Mr. Thomas Luffkin. N° 255, p. 287.

Rev. Sir.—Finding that you cannot trace the use of numeral figures in

England higher than the year 1133; but meeting with an undeniable instance of their exceeding that age amongst us by 43 years, I thought the communication of it to you could not but prove satisfactory. Over against our market place at Colchester, stands a house, the back part of which is an ancient Roman building, but the front is of later date. On the bottom sill (which is almost in the form of a triangular prism) of one of the windows of the front, between two carved lions stands an escutcheon, containing only these figures 1090.

Thomas Luffkin.

Some Attempts to prove that Herbs of the same Make or Class have generally the like Virtues. By Mr. James Petiver, F.R.S. N° 255, p. 289.

That plants of the same figure or likeness have generally much the same virtues and uses, will not be thought an improbable conjecture; especially if we consider, that the organs and structure of all plants of the same family, or class, must have much the same vessels and ducts to complete their regular formation, and consequently the juices circulated and strained through them cannot be very heterogeneous; and that as the scent and taste have great affinity, so of course their virtues likewise cannot be very dissonant. 1. As for instance, the tribe of umbelliferous herbs. It is the property of these herbs to have the position of their flower-branches in such a manner as to proceed from one basis or centre, from which they expand themselves into an umbella or tuft, whose flowers consist of five irregular, or rather unequal, (that is, differing in shape and size,) pentapetalous leaves, from whence their seed is produced, which are naked and double, or by their splitting seem to be so. This genus I generally observe to be endowed with a carminative taste and smell: they are powerful expellers of wind, and are therefore good in all flatulent disorders, and of great use in the colic, &c. as anise, carraway, cummin, angelica, smallage, parsley, lovage, &c. The chief virtue of these plants lies in the seed, next in the roots, and in the leaves of some few of them.

2. The plantæ galeatæ and verticillatæ, are a species of plants which bear their flowers in rundles or whorles, at more or less distances round the stalk, whose monopetalous flowers (if we may so call them, being such at the bottom) are tubulous, contrary to the last, and are generally divided into five unequal segments, as the umbels; but with this distinction, that the two greater petala or flower-leaves in this tribe are sometimes above, and at other times below; whereas the others are constantly the same, that is, always lie in the same place, being expanded on a flat or plain surface: the flowers of verticillated plants, from the different position of their petala, are therefore distinguished into floræ galeatæ seu labiatæ. The calyx or case to the lower, or tubulous

part of each flower serves also for its seed vessel; in the bottom of which is contained, in all I have yet observed, 4 seeds, set close together upon a plane, which drop out when ripe, the husk being always open, and commonly divided into five points, answering the segments of each flower. Now the chief virtue of these last consists in their leaves and husks, rather than in the flowers. My reasons for giving the preference to the husks of this tribe, before the flowers, are, because I commonly observe the calices are the chief, if not the only part of the plant, on which I find its viscous or sulphureous particles adhere; and this may be very easily perceived, not only by its much stronger and penetrating smell, but by the clamminess, far beyond the other parts, as is very apparent, particularly in the husks of sage and clary; and if with spirit of wine you make a distillation of these alone, you will find them much stronger than from a greater quantity of flowers only; for these, consisting of finer and more volatile particles, are capable of retaining only what the vicinity of the stronger and thicker texture, which the calices are composed of, and can without prejudice easily communicate to them.

I consider the generality of this tribe as a degree warmer than the last, and their heat consequently to approach nearer to the aromata or spices, than the carminatives; and the effects therefore to be more peculiarly adapted to such nervous diseases, as are more intense, and to which the umbelliferæ cannot so quickly reach, viz. apoplexies, epilepsies, palsies, &c. in which cases lavender, rosemary, sage, stæchas, and some others, are simples which all our ancient physicians have very much commended in these stubborn diseases; as also mint, balm, pennyroyal, savory, thyme, hyssop, marjoram, basil, origanum, dittany of Crete, marum or common mastic-thyme, with marum-syriacum, and some others.

3. Those herbs which have a tetrapetalous regular flower, i. e. four equal petala in each flower, in relation to their seed-vessels, are subdivided under two heads, viz. siliquosæ and capsulatæ, being such as have their seeds contained in long or short receptacles, as pods or capsules. The known herbs of this genus that are most commonly used in physic are mustard, rape, rocket, jack of the hedge, paronychia, or whitlow-grass, flix-weed, hedge-mustard, nose-smart, scurvy-grass, with some others. The most essential virtues and uses of the herbs of this class I observe are more particularly in the leaves and seed, next to these in the roots, and last in the flowers and pods.

The leaves are more particularly used in the water and garden cresses, sea and garden scurvy-grass, hedge-mustard, iberis, or sciatica cresses, lepidium, cardamom, shepherd's purse, &c. To which may be added our cabbage, coleworts, savoys, sprouts, &c. which are also of this tribe; and though they are of no great reputation in physic, yet for some ages past they have been greatly esteemed in the kitchen.

Others of this family that are more peculiarly eminent for the virtues contained in their seed are the common mustard and rape, the thlaspi Dioscoridis or treacle mustard, the eruca or rocket, and sophia chirurgorum, or flixweed, the seed of which last I am informed, by a very worthy member of this society, has for some years past been used by several people in the north of England for the stone and gravel with very good success.

The roots which have gained considerable repute, as well in diet as physic, are the radishes, both garden and Spanish, which is the large black rooted: as also the wild or horse radish; and to these the round and long rooted turnip must be added.

Most of this tribe I find, though they are hot, like the last two, viz. the umbelliferæ and verticillatæ, yet they exert their virtues in a very different manner, viz. by a diuretic volatile salt, and are found most prevalent and effectual in chronic diseases, as the scurvy, dropsy, gout, jaundice, and other ill habits of the body, where the blood is vitiated rather in its particles than in its motion; carrying off its impurity by a diuretic dyscrasis, or discharge of their offending heterogeneous salts; and consequently by purification disposing of it to a better, or more sanative temperament. Several of these herbs, as water-cresses, garden and sea scurvy-grass, with mustard-seed, and garden and horse-radish, which are all of this family, are by most if not all physicians, as well ancient as modern, allowed to be extraordinary diuretics and anti-scorbutics.

A Catalogue of Shells, &c. collected at the Island of Ascension, by Mr. James Cuninghame, Surgeon, with what Plants he observed there; communicated to Mr. James Petiver, F. R. S. N° 255, p. 295.

I shall arrange the following shells, according to the method of Dr. Martyn Lister, in his Historia sive Methodus Conchyliorum, and shall therefore begin with,

1. Buccinum parvum brevè asperum.—2. Pecten ex rubro alboque fasciatus, nodis inflatis striatus; an P. ruber striis circiter 10 nodosis, sive bullatis et inequalibus donatus, List. Hist. Conch. l. 3, fig. 24?—3. Ostrea rupestris sulcata, capite cavo.—4. Spondylus fere ruber muricatus List. H. C. l. 3, fig. 40. —5. Pectunculus albus, parvus, striatus et fasciatus.—6. Pectunculus albus compressus, rugis fasciatus; an P. orbicularis planior rugosus, List. H. C. l. 3, fig. 119?—7. Pectunculus triquetrus albus, striatus, undis rufescentibus.—8. Musculus arcuatus major, sulcis profundiorib. striatus; an M. angustior

crassioribus striis donatus, undatim depictus, List. H. C. l. 3, fig. 209?—9. Musculus triquetrus albus minor cancellatus.—10. Balanus compressus albus, 6 fissuris, sulcatus.—11. Patella foraminosa minor, striis ex albo rubroque alternis.—12. Vermiculus, circumflexus albicans, supernè striatus.—13. Nerita bidens fasciis sulcatis, ex albedine nigroque striata, clavicula productiore.—14. Concha. Venerea media castanei coloris, utroque capite bimaculato.—15. Buccinum persicum parvum, striatum, fuscum, ore trimaculato.—16. Buccinum dentatum læve subrufum, fasciis intersectis sive maculatis depictum, List. H. C. l. 4, Sect. 11, fig. 41.—17. Buccinum bilingue majus, tenue, ex rufo nebulatum muricatum, List. H. C. l. 4, Sect. 12, fig. 17.—18. Buccinum rostratum fasciis elatis ore crispo.—19. Buccinum nodis ornatum, costis iisdem alatis, ore crispo et aspero.—20. Buccinum recurvirostrum ventricosum, labro pulvinato, variegatum striatum, magnis præterea sulcis ad claviculam donatum, List. H. C. l. 4, Sect. 15, fig. D. 57. Turbo auritus Muricatus Bonan, p. 132. fig. D. et V. To the shells we add our small warted Barbadoes sea egg.—21. Echinus Ovarius Barbad. verrucis plurimis minoribus, Mus. Petiver. 123. We come now to the vegetables, &c. viz.—22. Chamæsyce frutescens elatior floribus comosis.—23. Chæmæsyce frutescens humilior floribus comosis.—24. Soldanella Malabarica cordato folio, Mus. Petiver. 98. Convolvulus maritimus majore folio Chinensis Pluk. Tab. 24. Fig. 5. Marinus Catharticus folio rotundo, Plum. p. 89. Fig. 104.—25. Ketmia fætida flore luteo fundo purpureo.—26. Festuca junceis foliis, spica minus sparsa, aristis trifidis, an Gramen Avenaceum paniculâ minus sparsâ, cujus singula grana 3 aristas longissimas habent SL. Jam. 35, pl. 5?—27. Corallium album minus conglomeratum.—28. Spongia globosa reticulata coralloides.—29. Terra spongiosa nigricans, carbonibus exustis persimilis.—30. Glareola maritima perlata.

On the Animalcula in Semine Humano, &c. By Mr. Leuwenhoeck. N° 255, p. 301.

An author in the *Republic of Letters*, speaking about the small animals in the seed of the male, says, Besides these, we discovered some small animals, of the same shape as are in pools in the month of May, &c. like the spawn of frogs in small waters; and this body hardly exceeds the size of a small corn-grain, the tail being four or five times as large as the body. These move themselves with a strange quickness, &c. and make, with the beating of their tails, small bubbles, which they draw along. How should we have believed, that a human body was locked up in them, &c. Yet we have seen it to be so; for on contemplating every thing with great attention, one appeared somewhat larger, &c. that had pulled off its skin, wherein it was locked up. This showed clearly the two naked thighs, the legs, the breast, the arms, &c. the skin being pulled up somewhat higher, covered the head like a cap. We could not discern the difference of sex, &c. and at the same time that it pulled off its skin, it died.

I discovered the salient parts, and the shape of the animalcula in the male seed, and sent the same to you in the year 1677, which was printed in your Phil. Trans. N° 142. But that one should find such a perfect human shape, as abovementioned, I am persuaded you will not allow of. We know that the small animals in the masculine seed of a frog have no similitude at all with those that come out of the eggs of a frog. Now it is certain, although we cannot discover the shape of a frog, in an animal that is come from the egg of a frog, when we anatomise it, that yet notwithstanding the frog is locked up in it.

Now if an animal, in the masculine seed of a beast or fowl, was provided perfectly with all its members, so that by the help of a magnifying glass they might be discovered, they endeavour to make us believe also, then these animals must from time to time, as they grow larger, increase in their perfection. But that it is not so, we see by the observations that the highly learned Malpighi has made, on the beginning of a chicken in the egg, for as much as was then in his power.

It perplexes me, because I cannot imagine, that an animal of the masculine seed can pull off its skin or film, or to free itself of it, but that the membranes or skins are strong, and more than one, and the membranes wherein the creatures lie in the uterus are not depending from it, but that the animals that are injected into the uterus, are only brought there to grow larger.

I have a hundred times contemplated the male seed of a man; but have not yet discovered any such creature as that before mentioned.

De Partium Septentrionalium quibusdam Affectibus et Remediis. Autore Philippo Lloyd, M. D. N° 256, p. 307.

This paper contains some observations on the baths of the Cossacs; on the diet of the Muscovites and Tartars; of a domestic remedy termed Barst among the Polonese; of the disease of the hair of the head termed plica polonica; together with some slight mention of 1 or 2 diseases observed in Hungary.

An Account of Coffee. By Mr. John Houghton, F.R.S. N° 256, p. 311.

I cannot learn that any other use is made of this plant, than by boiling the berries, of which a drink is made, used much among the Arabians and Turks, and also now in Europe.

The general use of it soon made it a trade. Hence public coffee-houses were set up, into which strangers coming, they learned the custom there, and carried it into their own countries. One Mr. Rastall an English merchant, whom I knew, went to Leghorn in 1651, and there founded a coffee-house. The next year Mr. Daniel Edwards, a merchant from Smyrna, where coffee had been used time out of mind, brought over with him, into England, a Greek servant, named Pasqua, who made his coffee, which he drank two or three dishes at a time, twice or thrice a day, and was probably the first who used it here; although I am informed that Dr. Harvey, the famous discoverer of the circulation of the blood, frequently used it. After this it grew more in use in several private houses, which encouraged Mr. Edwards to set up Pasqua for a coffee-man, who got a shed in the church-yard of St. Michael, Cornhill, where he had much custom, and thus became the first coffee-man in England.

The best coffee-berries are those that are large and plump, with a greenish cast, and transparent on the thin parts; the other has a yellowish cast, and is more opaque, but when they are roasted, it is hard to distinguish them. I put some berries into a glass of water about a week since, to see if they will sprout, but as yet there is no appearance, although they are tolerably swelled, and look white and bright. I have made a decoction of them, which has caused them to shoot.

The common way of preparing the berries for the coffee drink is roasting them in a tin cylindrical box, full of holes, through the middle of which runs a spit, under this is a semicircular hearth, wherein is made a large charcoal-fire: by the help of a jack, the spit turns swift, and so it roasts, being now and then taken up to be shaken. When the oil rises, and the berries are grown of a dark brown colour, they are emptied into two receivers, made with large hoops, whose bottoms are iron-plates, that shut into them, and there the coffee is well shaken, and left till almost cold; and if it looks bright, oily, and shining, it is a sign it is well done. The best way of keeping the berries when roasted, is in some warm place, where it may not be suffered to imbibe any moisture, which will pall it, and take away its flavour: it is best to grind it as used, except it be rammed into a tin pot, well covered and kept dry, and then I believe it will keep good a month. There swims on the coffee an oil, which the great coffee-drinkers among the Turks will take in great plenty, if they can get it. When the coffee has stood some time to cool, the gross parts subside, the briskness is gone, and it grows flat and almost clear again.

That I might farther understand coffee, and how it agrees with horse-beans and wheat, which sometimes I have heard have been used instead of it: I sent to the chemists 1lb of clean coffee, 1lb of husked beans, and 1lb. of picked wheat; and I received back

	Coffee			Horse-beans				Wheat			
	oz.	dr.	sc.	oz.	dr.	sc.	gr.	oz.	dr.	sc.	gr.
Spirit net......	6	6	0	6	1	0	12	8	2	1	0
Oil............	2	4	2	1	3	0	10	1	0	0	6
Cap. mort......	5	3	0	5	3	0	0	4	6	0	0

Thus it appears, that coffee yields by distillation, in a retort, almost double as much oil as beans, and almost treble as much as wheat; the other proportions may easily be seen above. The oils are very thick; and they and the spirits have all of them ill savours, as is usual from burnt materials. By spirit is meant the phlegm. The capita mortua have no smell. They have been calcined over and over with all the art of the chemist, but he cannot reduce them to a calx or ashes, and concludes there is no salt to be gotten from them.

I observe, that from the common drink called coffee, there is little good can come from any part, but its oil, because its other thin parts are evaporated, and its thick subside; but its oil I suppose to be nutritive as oil, and warm as a chemical oil, for all the warm parts are brought as to a point, and thereby it may enliven and invigorate some heavy parts in the fermentative juices, and nourish weak parts within, as other chemical oils do the external parts when rubbed; but being diluted, as it usually is, I question whether it does any more good than hot tea, hot broth, or any thing else that is actually hot; for I believe that actual and potential heats are much of the same operation.

Coffee has generally been reckoned an antihypnotic, or preventer of sleep, according to the opinion of Dr. Willis and others; but now it is come into frequent use, the contrary is often observed, although perhaps custom, as it does with opium, alters its natural qualities. As to the political uses of coffee, I am told, that our three kingdoms consume about 100 ton a year, whereof England consumes about 70 ton, which at £14* a ton (a middle price now) will amount to £20580 sterling, and if it were to be all sold in coffee-houses, it would reach treble that sum, or £61740, which at £10 a head will find employment for 6174 persons, although I believe all the people of England one with another do not consume 5 pounds each.

Coffee, when roasted, loses about a 4th part; then there is spent about 52½ tons of roasted coffee, which makes 117600 pounds, or 1881600 ounces, or

* There must be some mistake among these numbers; for 70 tons at 14l. each, come to only 980l. sterling.

15252800 drachms, which if there be 8 millions of people, it is not 2 drachms or $\frac{1}{4}$ a pint of coffee a piece for a year.

*Concerning a Hydrocephalus. By Mr. John Freind.** N° 256, p. 318.

The external dimensions of this head, taken before it was opened, were as follow:

	Inches.
From the eyebrows over the crown to the nape..........................	23

* Dr. John Freind was not more distinguished for his skill and judgment as a physician, than for his erudition and classical acquirements as a scholar. He was born at Croton in Northamptonshire, in 1675, was sent to Westminster School, and from thence to Christ Church, Oxford. While he was yet only in his 21st year, he, with the assistance of another student, published (1696) the 2 memorable orations of Æschines in Ctesiphontem, and of Demosthenes de Coronâ, accompanied with an improved Latin translation, and explanatory notes. Not long after this, he resolved upon studying physic, to which he accordingly applied with great assiduity. In 1703 he published his Emmenologia, in which he endeavoured to prove that the menstrual evacuation is the consequence of plethora. In this work there is more of ingenious reasoning than of practical utility, and his manner of accounting for the operation of certain emmenagogue medicines by the attenuation or thinning of the blood, is wholly inadmissible. In 1704 he was chosen professor of chemistry at Oxford, and the year following he attended Lord Peterborough in his military expedition to Spain; and afterwards visited Rome and other parts of Italy. On his return to England in 1707, he wrote 2 tracts in defence of his patron Lord Peterborough, whose campaign of Valencia had excited the censure of some opponents. In 1709 he published the chemical lectures which he had read at Oxford 5 years before, under the title of Prælectiones Chymicæ. He dedicated this work to Sir Isaac Newton, upon whose principles he endeavoured to explain the leading phænomena of chemistry, not being aware of the difference between the laws of gravitation and attraction, and those of chemical affinity. In 1711 he attended the Duke of Ormond into Flanders, and on his return from thence settled in London. In 1716 he published the 1st and 3d books of Hippocrates de Morb. Popul. Gr. et. Lat. with 9 Commentaries on Fevers. In 1722 he was elected to a seat in Parliament for Launceston in Cornwall. The same year he was committed to the Tower, on a suspicion of being concerned with Bishop Atterbury in a plot to bring in the Pretender. During his confinement as a state prisoner for 3 months, he employed himself in composing the chief part of his celebrated work, entitled The History of Physic, from the time of Galen, to the beginning of the 16th century, addressed to his friend Dr. Mead who had interceded for his liberation, and who nobly presented him with all the fees he had received from the author's patients, during his confinement in the Tower. In the work last mentioned, Dr. Freind's object was to continue the History of Physic from the period where Le Clerc had left off, and this he has done in a very able manner. As he had a more profound knowledge of the Greek language than Le Clerc, he was enabled to correct some few errors into which that author had fallen respecting the later Greek physicians; and in particular he has given an excellent view of the writings of the Arabian physicians. This work has been translated into most of the European languages. It was translated into Latin by Dr. Wigan. After his release from the Tower, Dr. Freind was made physician to the Prince of Wales, and on the Prince's accession to the throne, he was appointed physician to the Queen. He enjoyed these honours but a short time, dying of a fever in 1728, aged 52. A sketch of his life and writings is given in Dr. Wigan's preface to Freind's Opera Omnia, fol. 1733.

		Inches.
Circumference from the nape, round	the ossa bregmatis	26
	the os frontis	24
From ear to ear over the crown		19
From the eyebrows to the chin		4
From one extremity of the eyebrows to the other		$4\frac{1}{2}$
From the chin to the coronal suture		$7\frac{1}{2}$
Circumference from the chin round the crown		30
From one extremity of the ear backward to the other	round the nose	12
	round the nape	$6\frac{1}{2}$
From temple to temple over the forehead		11
Circumference of the head round the os frontis and occipitis		29
Circumference of the neck		$9\frac{1}{2}$
Length of ditto		2
Length of the body		33
Circumference of the thorax		18
Length of the foot		$4\frac{1}{2}$
From the middle finger's end to the acromion		$12\frac{1}{2}$
Circumference of the	Arm	5
	Calf	$5\frac{1}{2}$
	Thigh	8

After the integuments were removed, the top of the cranium appeared soft and membranous. The extent of the membrane, from one temple to the other, was 8 inches, between the parietal bones $3\frac{1}{2}$; from the os frontis to the os occipitis, 12. In the middle, just on the crown, lay a bone (in some places a little cartilaginous) 5 inches long, and 1 broad, joined to the membranes on every side, of the same thickness with the rest of the upper part of the cranium that was bony, which was extremely thin every where, and the laminæ lay so close, that in many places no diploe could be discerned. The membrane was as thin as the pericranium, which yet was easily divided from it. None of the sutures were entirely closed; those of the upper jaw were very loose. In the temporal and lambdoidal sutures there was a vast number of the triquetra Wormiana, all which had so many distinct sutures.

Upon piercing the dura mater, a great quantity of water flowed out; which lay as well between the dura mater and the pia as in the ventricles of the brain: the liquor was thin, pale, and insipid, and amounted to 5 quarts. The dura mater was firm and entire, of its usual thickness, and stuck very close, as well to the membranous as to the bony parts of the cranium. All its processes and sinuses were singular, the 4th sinus somewhat larger than ordinary. A very large vein of the dura mater entered the longitudinal sinus, directly forwards towards the crista galli, contrary to the course of the blood.

The pia mater was very much distended, and seemed to be stretched as much as it could bear. It lay smooth and equal on the surface of the brain, there being neither any circumvolutions in the brain for it to go between, nor any partition to the corpus callosum, though there was a large falx in the dura mater. The lateral ventricles were very thin; towards the cerebellum their upper part was quite wasted, so that nothing was left to cover the cavity in that place, but the pia mater. This was so thin, that in bending down the head to empty the water, it broke, and hindered us from knowing exactly how much water the lateral ventricles contained; but by their cavity, which was very large, one might guess they held at least a pint each: the 3d and 4th ventricles had some little water in them, but were scarcely larger than usual, as Steno has observed in his hydrocephalous calf.

The brain had all its parts plain and entire, though its substance in most places was but very thin and loose: about the corpora striata et thalami nervorum opticorum it was tolerably thick and firm enough, though nothing to what it is in a natural state. The cerebrum et cerebellum, when laid out in their proper position, were 11 inches long; the cerebrum across the lateral ventricles 9 broad. After all the water was taken out, both of them weighed $1\frac{1}{4}$ lb. The corpora striata et thalami nervorum opticorum were very small in all their dimensions; withinside toward the ventricles they were wrinkled, and lay in folds, like those in the inner coat of the stomach. In the corpora striata there were no striæ discernible.

The plexus choroides was very small: the glandula pinealis was somewhat larger, but less compact than ordinary. The nates were very red and large; 2 inches long, 1 broad, and 1 thick: the testes were not distinguished from them by any protuberance: they seemed rather to be a production into which the nates lessened by degrees, like a sugar-loaf.

The cerebellum was very firm every where, and did not much exceed its natural bulk. The medullary trunk, which sends out those little branches like trees, was thicker and harder than usual; the branches were not so much disposed like those of a tree, but went rather in single oblique lines, like so many rays drawn from a point. The nerves were all regular and plain, only the olfactory were very small; the optic did not join before they entered the orbits. The rete mirabile was very large; and so was Dr. Ridley's circular sinus.

On the right side were two carotid arteries, the intercostal nerve lying between them, and they entered the skull at the same hole. The trunk of the vertebral, where those arteries unite, was extremely large and full of blood.

The veins were neither larger nor more in number than usual. Upon the brain, over the lateral ventricles, I could easily discern three or four lymphatics; but they were too small to be traced. Whether this great effusion of water was caused by an obstruction in the capillary arteries, (which might make the finer part of the serum ouse through their coats,) or by a rupture in the lymphatics, could not be determined.

The mother of the child brought it to Oxford, for a show. The account she gave of it was, that she was in travail 3 weeks, and that at last she was forced to have the vagina ripped for its passage. The child was 2 years and 6 weeks old, and it could speak a little, but could neither walk nor hold up its head; it was always merry, never subject to drowsiness, pain in the head, want of appetite, or indigestion. Its sight was somewhat dim, and its smelling but dull. It never had any illness, only 2 or 3 days before it died it was very much troubled with the gripes, and on opening the abdomen the guts were found extremely swelled with wind. Every thing else in both the lower cavities was in the natural state.

By comparing those two hydrocephali which Tulpius gives an account of, we may see how different each of them is from this. For his first was a boy 5 years old, the skull no larger than a man's, and only 5 pints of water in it; the brain had lost all its shape, and most of its substance, the relics of which stuck to the skull. He says nothing more of the latter, than that it had a quart of water in one of the lateral ventricles.

Some Observations on the Mercury's Altitude, with the changes of the Weather at Emüy in China. Lat. 24° 20′ N. By Mr. James Cunningham. N° 256, p. 323.

The weather at the above place, as appears by this journal, was variable, like that at most other places in middling latitudes, sometimes clear, or cloudy, rainy, windy, or calm, &c. The height of the barometer mostly between 29 and 30 inches. The height of the tides about 3 fathoms, or 18 feet; about half a foot higher 3 days after the full moon.

Dr. David Gregory's Observations on the Eclipse of the Sun, Sept. 13, 1699, *in a Letter to Dr. Sloane, dated Oct.* 12, 1699, *Oxford.* N° 256, p. 330.

I send you a scheme of the phases of the late eclipse of the sun, as I observed them. I did not see the beginning of it: but the end happened here precisely 24 minutes and 9 seconds after 10 o'clock in the morning, apparent time: the greatest observation, which was 10 digits and a quarter, was about 7 minutes after 9.

Of the Origin of White Vitriol and the Figure of its Crystals. By Dr. Martin Lister, F.R.S. N° 256, p. 331.

Among the desiderata, relating to fossil salts, the origin of white vitriol is obscure, and its crystals undescribed. All I can find of this matter is, out of Borrichius de Docimastice Metallica, that it is produced from a certain lead ore boiled raw. None that I know of, of our English lead ores, gives us any suspicion of any such vitriol. It is true I have by me some sorts of white lead ore, spar-like, plentifully yielding lead: but I cannot say that either those or any coloured lead ores gave me any reason to suspect, after diverse experiments upon them, that they yielded white vitriol.

As to the crystals of white vitriol, they are very difficult to describe, and seem to be a congeries of infinitely small needles; for which reason it is of a most speedy operation, and irritates the stomach suddenly, before they can be well dissolved or broken.*

On the Cures performed by Mr. Greatrix, the Stroker. By Mr. Thoresby, F.R.S. N° 256, p. 332.

The first instance I shall mention of his cures was my brother John D—n, who was seized with a violent pain in his head and back when about 14 years of age; one of my sisters at that time had the small-pox, and my mother judging that he was taken with the same distemper, used no means to remove it, till by accident Mr. Greatrix coming to our house, and hearing of his illness, desired to see him; he ordered the boy to strip to his shirt, and having given present ease to his head by only stroking it with his hands, he fell to rub his back, which he most complained of, but the pain immediately fled from his hand to his right thigh; he followed it there, it fell to his knee, from thence to his leg, but he still pursued it to his ancle, thence to his foot, and at last to his great toe; as it fell lower it grew more violent, especially when in the toe it made him roar out, but upon rubbing it there it vanished, and the boy cried out it is quite gone. It never troubled him after, but he took the small-pox about 3 weeks after. The next instance was Mrs. D—, she was seized when a girl with a great pain and weakness in her knees, which occasioned a white swelling; and having used divers means to no effect, after 6 or 7 years' time Mr. Greatrix

* White vitriol is a salt compounded of vitriolic or sulphuric acid and calx or oxyd of zinc. In the modern chemical nomenclature, it is called sulphate and supersulphate of zinc. The form of the crystals has been well described by Bergmann. Dr. Lister's mechanical account of the operation of this metallic salt upon the coats of the stomach is inadmissible.

coming to Dublin, he was brought to her, where he stroked both her knees, the pain flying downwards from his hand, it drove it out of her toes; he gave her present ease, and the swelling in a short time wore away, and never troubled her after. One Mrs. L—e, who after a fever was much troubled with a pain in her ears and very deaf, came to Mr. Greatrix, who put some of his spittle into her ears, and turning his finger in them rubbed and chafed them well, which cured her both of the pain and deafness. Mr. Charles L—n was cured by him of the same malady, having much lost his hearing by some accident, till Mr. Greatrix by stroking restored it. Mrs. S—n when a child, was extremely troubled with the King's evil; her mother sent her to be stroked in King Charles the 2d's time to London, but she received no benefit; yet Mr. Greatrix perfectly cured her. One Pearson, a smith, had two daughters extremely troubled with the evil, the one in her thigh, the other in her arm; he cured them both.

I could add many things of this nature, both of what I have seen and heard from my mother, who was much more with him than myself, but wanting room shall only tell you, that where he stroked for pains, he used nothing but his dry hand; but for ulcers or running sores he used spittle on his hand or finger; and for the evil, if they came to him before it was broke, he stroked it, and ordered them to poultice it with boiled turnips, and so did every day till it grew fit for lancing; he then lanced it, and with his fingers would squeeze out the cores and corruption, and then in a few days it would be well, with his only stroking it every morning. Thus he cured many who continue well to this day; but if it were broke before he saw them, he only squeezed out the core, and healed it by stroking. Such as were troubled with fits of the mother, he would presently take off the fit, by only laying his glove on their head, but never cured the distemper thoroughly, for the fits would return. I have heard he cured many of the falling sickness, if they stayed with him, so that he might see them in 3 or 4 fits; otherwise he could not cure them.

Account of Books, viz.—1. *Geography Anatomised, or the Complete Geographical Grammar. Being a short and exact Analysis of the whole Body of Modern Geography, after a new and curious Method, 2d Edit. By Pat. Gordon, M. A. F. R. S.* N° 256, p. 335.

The principal design of this treatise is to give a compendious and methodical tract of modern geography. It consists of two parts, whereof the first has a general, and the second a particular view of the terraqueous globe.

2. *The Celestial World discovered, or Conjectures concerning the Inhabitants, Plants, and Productions of the Worlds in the Planets. Written in Latin by Christianus Huygens,* 8vo. N° 256, p. 337.

The author having spent much time in making celestial observations and discoveries, by telescopes of the largest sizes, and other instruments; having acquainted himself with the latest and best observations and discoveries made by other modern astronomers; and having well weighed and considered the import and significancy of them, acquaints his brother Constantine Huygens, to whom his book is inscribed, what is his opinion and belief concerning the form, stricture, and fabric of the universe, or the whole visible world. Nor can such inquiry he thinks be detrimental to religion, but will rather be a means to make men have a greater veneration and adoration of that wonderful wisdom and providence which is universally displayed through the whole fabric of the universe.

As to the form and disposition of the whole, and of the parts of this universe, he agrees with the system of Copernicus; for the better explication of which he has added two figures, the first showing their order and positions, and the second their comparative magnitudes. And since it hereby appears that the earth is moved about the sun, as well as the other planets, and that those planets are enlightened by the sun in the same manner as the earth is, and some of them, as Saturn and Jupiter, have their own moons, or secondary planets, moving about them, sometimes eclipsing them, and eclipsed by them, as the earth also is by its moon, and that some of them are much larger as well as some others smaller than the earth; and so that the magnitudes are not proportioned, either according to their order or their distance; since also they are observed to have the same kinds of motion, both annual and diurnal, therefore he thinks it very probable that they resemble the earth also in other qualifications. He therefore thinks we may safely conclude that the other planets have solid bodies, and gravity towards their centres, as the earth has, since we find them to have the same figure, and the same motions, and the same concomitants, and that they have atmospheres and air and water, &c. And since it would be too great a depreciating of them, in comparison with the earth, to suppose them not to be likewise adorned with the more admirable productions and fabrics of plants and animals, which more evidently manifest the wisdom and design of the divine architect, which we find the earth to be enriched and beautified with; but to suppose them only lifeless lumps of matter; as earth, water, &c. he therefore conceives them to have animals as well as the earth;

and consequently plants for their nourishment. And these possibly not very different from those we have; but that whatever be the difference, it probably arises from the different distances of those globes from the sun.

And pursuing this train of thought, he thinks them to have rational animals also, and that they have all those senses, and other necessary organs for reasoning that men have here.

He endeavours in his second book to give us his judgment concerning the phænomena of the heavens; what they might appear to one of us supposed to be there in one of them, which he founds on the knowledge we now have of them, as to magnitude, distance, &c. And here, after he has censured Father Kircher's Iter Extaticum, a book published on the like subject, he begins to tell what must be the phænomena of the sun and planets, seen in Mercury, and next what the same must be seen in Venus, which since with a 60 foot telescope, and all his diligence, he could never discover to have spots, or differently illuminated parts, as are visible in Mars, Jupiter, and Saturn. He conjectures that the reflection of light from it is made by the atmosphere about it, and not by the body itself. Thirdly, What they are in Mars, which he makes much less than Venus, or the earth, though without a moon, and further distant from the sun. And fourthly, What in Jupiter and Saturn, which so vastly exceed all the other three, both for their magnitude, and for their concomitants, Jupiter having four and Saturn five, together with a ring, whereas the earth has but one, and the other three none at all. On explaining the phænomena of these, he more largely insists, and has therein summed up all the latest and best phænomena that have been observed concerning them, as to the five moons about Saturn, though he confesses that he had not seen the two innermost of them, yet he confides in the observations of Monsieur Cassini, and suspects also that there may be more yet discovered,* when glasses of 170 and 210 feet shall come to be used for that purpose. Then he proceeds to consider the sun and the fixed stars, premising the magnificence of the solar system; this he does by words, because schemes he could not render large enough to represent the proportionate magnitudes of the orbits to the minuteness of the plenary bodies; for that Saturn would require an area of 360 feet in diameter, and that of the earth, one of 36 feet, to draw them proportionate to the globes, for the orbit of the earth is 12000 times the diameter of the earth's ball. And consequently the distance of the earth from the sun will be above 17000, or 17000000 of German miles. To make the vastness of these distances the more conceivable, he computes them by the times that a cannon-bullet, supposed to

* Which conjecture has lately been realized by the observations of Dr. Herschel.

pass 100 fathom in a second of time, would spend in passing those spaces: whence he concludes it would be 25 years passing to the sun from the earth, 125 from Jupiter, and 250 from Saturn. Then he proceeds to consider the body of the sun, where he is nonplused, as about the moon; for he is not satisfied whether it be a solid or fluid body, but he inclines to think it a fluid. Next, he knows not what to think of animals or vegetables in it, since there can be nothing like any thing we know, by reason of the continual fire and heat which would consume all such as we have here. He thinks therefore it might be made for the illuminating and enlivening of the parts of the other planets. And as for the fixed stars, he conceives them to be so many suns, and to be dispersed in the vast expanse of heaven, at various distances, and each of them to have a proper system, and planets moved about them. And though it be impossible for us ever to see those planets, by reason of their vast distance, yet from the analogy that is between the sun and stars, we may judge of the planetary systems about them, and of the planets themselves, which probably are like the planetary bodies about the sun, that is, that they have plants and animals, as great admirers and observers of the heavens as any on the earth. This represents to us a wonderful scheme of the prodigious vastness of the heavens, so that the distance between the earth and the sun, though of 17000000 of German miles, is almost nothing to the distance of a fixed star. And because of the difficulty in making observations for this purpose, in the common ways, he therefore proposes a new method of his own for this purpose, which he also explains, and by that one may the better conceive the vastness of the distance of one of the nearest, as for instance from the sun, which by this way he proves to be 27664 times the distance of the sun from the earth, and to make this distance yet more comprehensible, he makes use of the former explication, by the time that a cannon bullet moved as swift as has been just now explained. Wherefore multiplying 27664 by 25, he finds that a cannon bullet moving 100 fathoms in a second would be 700000 years in its journey between us and the fixed stars. Here by the way he makes some reflections on Descartes' Vortices, and explains his own sentiments concerning the present state of the universe. Nor will he trouble his mind about their beginning, or how made, as knowing it to be out of the reach of human knowledge or conjecture.

Orang Outang, sive Homo Sylvestris; or, the Anatomy of a Pigmy, compared with that of a Monkey, an Ape, and a Man. To which is added a Philological Essay concerning the Pigmies, the Cynocephali, the Satyrs and Sphinxes of the Ancients, &c. By Edward Tyson, M.D. F.R.S. London, 4to. 1699. N° 256, p. 338.

An Experiment on the Refraction of the Air. By J. Lowthorp, A. M. N° 257, p. 339.

We took a cylinder of cast-brass, ABCD, fig. 3, pl. 9, and cut one end CD perpendicular to the axis acx, the other end AB inclined to it at an angle of about 27° 30′, and therefore the perpendicular to this inclining plane, pc, and the axis of the cylinder ax comprehended an angle pca of about 62° 30′. These ends were ground very true on a glass-grinder's brass tool, and each of them was compassed about with a narrow ferrule of thin brass bbbb. Into the upper side of the cylinder at E was soldered the brass pipe EF, and into the under side at G the other brass pipe GH; the former of these pipes being about 3 inches long, and the latter 6 inches. Upon the plate ddd, were fixed two other plates LL, perpendicular to it, and parallel to each other. Each of these two plates had an arch of a circle, equal to the circle of the cylinder, cut out of its upper edge: so that when the pipe GH was let through a hole near the middle of the plate ddd, the cylinder fell into the arches; and being fastened there with solder the axis ax lay parallel to the plate ddd, and about an inch and a half above it. The perpendicular end of the cylinder DC was closed with an object glass of a 7½-foot telescope, oo, and the other end AB, with a well polished flat glass ff, which was carefully chosen to transmit the object distinct enough, notwithstanding its obliquity to the visual rays. The ferrules were well filled with cement round about the edges of the glass, and they laid flat and every where touched the smooth ends of the cylinder, that they might firmly support the pressure of the excluded air.

Instead of a cistern, as in the Torricellian experiment, we used the inverted siphon of brass, MNO, fig. 4, soldered to the plate ggg. One of the sides MN stood perpendicular to the plate, and the other side NO inclined to it, and was supported near the upper end o by a little prop kk.

We then placed the cylinder, as in fig. 5, upon a table which was well fastened to a firm floor; the pipe GH was let through a hole, and the axis laid almost parallel to the sides of the table, and the plate ddd was nailed down to it. The tube of the telescope sss, with the eye-glass in it, was applied to the object-glass, and a hair fixed within it at x, the common focus of both glasses, in the axis of the cylinder continued. Upon the floor, under the cylinder, we nailed the plate ggg, with the inverted siphon upon it, and joined M to H by the insertion of the glass tube T. The joints were very carefully closed with cement; and then they were covered over with pieces of a bladder, and tied hard with strong thread. There was also a bladder tied below each joint at m, and when it was filled with water it was tied above it at n: so that no air could

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come to the cement, or insinuate itself through its pores or fissures, if any happened to be left unclosed. With all these precautions, the experiment succeeded at last as wished, after this manner.

We placed the object a, which was a black thread sliding in a little frame over a piece of white paper, in the axis of the cylinder cx continued to it, we filled the pipes and cylinder with mercury, and having stopped the uppermost pipe at F with the small iron stopple K, and closed it at the other joints, we let the mercury run out gently at o into the bladder u, till it remained suspended at the usual height, as in the barometer, leaving the space above it between the glasses oo and ff void of air. We then found the object, which before appeared in the axis at x, raised considerably above it, and we reduced it to appear at x by removing it from a to α. The axis therefore of the visual ray xa, which was also the axis of the cylinder xca, falling perpendicularly on the void space in the cylinder, passed through it without any refraction; but emerging obliquely into the air, it was refracted towards the perpendicular pc, and there received a new direction to α. And therefore the space a α subtended the angle of refraction acα, which we measured, and found as follows:

The height of the object above the axis of the unrefracted visual ray a α	inc. dec. 0,425		
The distance of the object from the refracting plane αc about 51 feet or	0,612		
Therefore the angle of refraction acα was	0°	2′	23″
The angle of emersion pca (by the construction of the cylinder) was	62	30	0
Therefore the angle of incidence pcα = (= pca + acα) was	62	27	37

And therefore universally, according to the known laws of refraction,

The sines of the angles of incidence being	100000
The sines of the angles of emersion are	100036
And the refractive power of the dense air	36

By the refractive power of a pellucid body, I mean that property in it by which the oblique rays of light are diverted from their direct course, and which is measured by the proportional differences, always observed, between the sines of the angles of incidence and emersion.

This property is not always proportional to the density, at least not to the gravity, of the refracting medium. For the refractive power of glass to that of water is as 55 to 34, whereas its gravity is as 87 to 34, that is, the squares of their refractive powers are very nearly as their respective gravities. And there are some fluids which, though lighter than water, yet have a greater power of refraction; thus the refractive power of spirit of wine, according to Dr. Hook's experiments, Microg. p. 220, is to that of water as 36 to 33, and its gravity reciprocally as 33 to 36 or 36½. But the refractive powers of air and water seem to observe the simple proportion of their gravities directly, as I have compared them in the following table. The numbers there expressing the refraction of water are taken from the mean of nine observations at so many several angles of incidence made Jan. 25, 164$\frac{0}{1}$, by Mr. Gascoigne (the ingenious first inventor of the micrometer, and the ways of measuring angles by telescopes), and those of air are produced by the experiment above related, &c.

	Water.	Air.
The assumed sines of the angles of incidence through........	100000	100000
The sines of the correspondent angles of emersion out of.....	134400	100036
The refractive power of................................	34400	36
Spec. grav. (if as 900 to 1 at the time of the experiment) of	34400	38
or (if as 850 to 1) of..................................		40

From hence it seems very probable, that their respective densities and refractive powers are in a just simple proportion, and if this should be confirmed by succeeding experiments, made at different angles of incidence, and with cylinders continuing exhausted through several changes of the air, it would be more than probable that the refractive powers of the atmosphere are every where, and at all heights above the earth, proportional to its densities and expansions. And hence it would be no difficult matter to trace the light through it, so as to terminate the shadow of the earth; and, together with proper expedients for measuring the quantity of light illuminating an opaque body, to examine at what distances the moon must be from the earth to suffer eclipses of the observed duration.

The Julian Account not to be changed for the Gregorian. By Dr. Wallis. N° 257, p. 343.

That in our ecclesiastical computation of the Paschal tables there is some disorder, is not to be denied; yet an alteration may be attended with still greater inconvenience. A thing of moment when once established should not be rashly altered. In the business of geography, by removing the first meridian on some plausible pretence from where Ptolemy had placed it, though a thing at first purely arbitrary, it is now come to pass that we have, in a manner, no first meridian at all; every new map-maker placing his first meridian where he pleases, which has created much confusion.

And, as to the disorder in the Paschal tables, it was a thing observed and complained of for 3 or 400 years, before Pope Gregory unhappily attempted the correction of the calendar. But it was all that time thought advisable rather to suffer that inconvenience than, by correcting it, to run the hazard of a greater mischief. And it had been much better if it had so continued to this day, rather than Pope Gregory, on his own single authority, should take upon him to impose a law on all the churches, kingdoms, and states of Christendom, to alter both their ecclesiastical and civil year, for a worse form than what we had before.

Or, if merely on account of the Paschal tables, for he made no other pretence, it were thought necessary to make a change, he might have corrected them, or given us new Paschal tables, instead of those of Dionysius, without altering the civil year, which has introduced the confusion of the old and new stiles, and which now can never be remedied, unless all nations should at once agree upon one, which is not to be supposed. I say, at once; for if some should alter their stile sooner, and some later, the confusion in history will be yet greater than it is now.

As to the equinox going backward, for 10 or 11 minutes each year, it is very inconsiderable, and which in celestial computations is easily rectified, as are many other inequalities of much greater concern. And I think it was never pretended that the civil year must necessarily agree exactly to a minute with the celestial, which is impossible; for the solar and sidereal year differ more from each other than the Julian from either, which is a middle between them. And the seat of Easter, which only concerns the ecclesiastical, not the civil year, may easily be rectified, without affecting the civil year at all. Or, if not rectified, the celebration of Easter a week or month sooner or later does not influence at all our commemoration of Christ's resurrection. And it is agreed by most, if not all chronologers, that as to the year of our Lord, the vulgar year is not the true year, though it be not agreed how much they differ; but it would create much confusion in history if we should now alter the vulgar account. All the pretence that I can understand for altering our stile is, that in so doing we should agree with some of our neighbours, with whom we now differ; but it will then be as true, that we shall differ from others, with whom we now agree. If it be said, that they in time may come to follow our example, this would only make the confusion the greater; for then we must be obliged not only to know what countries use the new stile, but from what time they began to do so, if we would understand their dates. And if we should, by a new law, alter our stile in England, this would not comprise Scotland. And after all, there will still be a necessity of keeping up the distinction of old stile and new stile, which Pope Gregory's pretended correction has made necessary, and with that distinction things may be now as well adjusted as by a new change of our stile. I forbear to discourse at large how much better a constitution the Julian year is than the new Gregorian, being so well known that no astronomer can be ignorant of, however he may dissemble it; so that, in their astronomical calculations, they are first obliged to adjust their calculations to the Julian year, and thence transfer them to their new Gregorian. It would be much more reasonable that the Papists should quit their new Gregorian and return to their old Julian year.

As to what Mr. Locke advises, viz. that for 11 leap-years we should omit the intercalation of Feb. 29, and then go on with the Gregorian account, the last of which 11 leap-years should be 1744. But if we begin in the change, as it is suggested, at the year 1700, the last of those 11 leap-years must be 1740, not 1744. This is the same expedient that was suggested at Oxford in the year 1645, viz. that from thenceforward we should omit ten such intercalations. Against which there seems to me this great objection; In the time of Julius and Augustus Cæsar, there was a year which was called annus confusionis, and which happened on the settling, unsettling, and resettling, the Julian year; and the like happened in the year 1582, when Pope Gregory at once struck out 10 days of that year. But should this advice take place, we should now, instead of one annus confusionis, have a confusion for 44 years together, wherein we should agree neither with the old nor with the new account; but be sometimes 10, sometimes 9, and sometimes 8 days, and so on, later than the one and sooner than the other account; and a foreigner would not be able to judge of an English date without knowing in which of these years we vary 10, 9, or 8, &c. days, from either of these accounts; and this for 44 years together. Which seems to me a much greater confusion than if, as in 1582, we should once for all cast out 11 days. But I cannot think it advisable to do either.

As to ourselves, this cannot be done without altering the act of uniformity, and the common prayer book; for at least all the calendar must be new framed, and it is well known how strenuous some were lately against touching that in the least. If yet it be thought necessary that the seat of Easter should be rectified, that may easily be done without altering the civil year: for if in the rule for Easter, instead of saying next after the 21st of March, we say, next after the vernal equinox, the work is done; and we might be excused the trouble of Paschal tables, and the intricate perplexities of the Gregorian epacts; for then every almanac will inform when it is the equinox, and when it is full moon, for the current year, without disturbing the civil account: and this Pope Gregory might as well have done without troubling the accounts of Christendom. But if he must needs disturb the civil year, he should have rectified it, not to the time of the Nicene council, but to the time of our Saviour's birth; for our epoch is not from the Nicene council but from the birth of Christ. And it is certain, that at our Saviour's birth, the vernal equinox was not on the 21st of March, as this new account supposes, but nearer to the 25th.

Report of the Consultation on John Dee's Proposal for Reforming the Calendar, A. D. 1582. *By the Lord Treasurer Burleigh.* N° 257, p. 355.

It was agreed on by Mr. Digges, Mr. Savile, and Mr. Chambers, that on their perusal of the book written by Mr. Dee, viz. as a Discourse upon the Reformation of the vulgar Calendar for the Civil Year, that they allow of his opinion; viz. that as in the Roman calendar reformed there are 10 days cut off to reduce the civil year to the state it was established in at the council of Nice, it had been better to have cut off 11 days, and to have reduced the civil year to the state it was in at the birth of Christ. And therefore the better to agree with all the adjacent countries that have received the reformation of subtracting 10 days only, they think it may be agreed to without any manifest error, having regard to observe certain rules hereafter, for omitting some leap years in some hundred years. And for the subtracting of 10 days, Mr. Dee has compiled a form of a calendar, beginning at May and ending at August, wherein every of these four months, May, June, July, August, shall have in the ends of them some days taken away without changing of any feast or holy day, moveable or fixed, or without altering the courses of Trinity term, that is to say, May to consist of 28 days, taking from it 3 days; June to have 29 days, taking from it but 1 day; July to consist of 28 days, taking from it 3 days; August to consist of 28 days, taking from it 3 days; all which together make 10 days.

And because the Roman calendar has a great many rules added to it, which skilful computists or astronomers alone are capable of understanding, it is thought proper to make a short table like an ephemerides, to continue the certainty of all the moveable feasts, depending only on Easter, and agree with the Roman calendar, which may serve for 1 or 200 years, and so be easily renewed when there shall be occasion for it.

Reflections on the foregoing Paper. By Mr. John Greaves, Savilian Professor of Astronomy at Oxford, 1645. N° 257, p. 356.

As I cannot wholly approve of this reformation of the Roman calendar, proposed by Mr. Dee, so I cannot altogether disapprove. For I like the subtraction of 10 days, as the church of Rome has done, beginning the computation from the council of Nice, though it cannot be denied, but that the reformation from the time of our Saviour had been much better. But since the fathers of the council of Nice thought it better to look forwards than to look backwards, and to have a greater care of avoiding distractions in the church about the celebration of Easter for the future than to remedy errors past, I think we shall do well to follow the example of the church of Rome. And whereas some have thought of a more exact calculation than this emendation, introduced by Pope Gregory the xiith, which they ground upon the late astronomical observations of the learned Tycho Brahe; yet since the difference is not so great as to make any sensible error in many ages, and since that error may be easily corrected by the omission of an intercalary day, I think it not fit for so small a nicety to make a new dissension in the church. Much less am I of their opinion, who think this correction of the year therefore to be rejected, because it comes recommended by the church of Rome; which would be all one as to refuse some wholesome potion, because it is prescribed by a physician whose manners we do not approve of. And thus far I agree with Mr. Dee.

But I cannot subscribe to his opinion, that this reformation should be made by the subtraction of 10 days out of one year alone. For though I grant that this were a quick cure of a lingering disease, yet it is against all rules of art in curing one malady to make 10. For the defalcation of 10 days in one year must cause endless disturbance in the commonwealth in all contracts, where necessarily a certain time is defined. And therefore when Julius Cæsar the dictator corrected the Roman year by the help of Sosigines, after this manner, that is, by subtraction of days, that year in which he did it was called by the ancients annus confusionis, by reason of the great confusion and inconveniences which thereby happened: and I doubt not but that the year 1582, in which the defalcation of 10 days was made by the bull or edict of Pope Gregory, might also be justly stiled annus confusionis. So that such examples as these are not to be imitated.

I shall therefore recommend that course, which was long since proposed by many able mathematicians to Pope Gregory, on the first notice of his purpose of correcting the calendar, viz. that for 40 years time there should be no bissextile or intercalary years, or as we call them leap-years, inserted in the calendar: by which course it is most evident, that 10 days will be subtracted in 40 years, and these 40 years each of them will be anni æquabiles, consisting of 365 days; as our common and ordinary years do, without any alteration in the whole year.

On the Credibility of Human Testimony. N° 257, p. 359.

Moral certitude absolute, is that in which the mind of man entirely acquiesces, requiring no further assurance: as if one, in whom I absolutely confide, shall bring me word of 1200l. accruing to me by gift, or a ship's arrival; and for which therefore I would not give the least valuable consideration to be insured.

Moral certitude incomplete has its several degrees, to be estimated by the proportion it bears to the absolute. As if one in whom I have that degree of confidence, as that I would not give above one in six to be insured of the truth of what he says, shall inform me as above, concerning 1200l. I may then reckon that I have as good as the absolute certainty of 1000l. or five-sixths of absolute certainty for the whole sum.

The credibility of any reporter is to be rated, 1. By his integrity or fidelity; and 2. By his ability: and a double ability is to be considered; both that of apprehending what is delivered; and also of retaining it afterwards, till it be transmitted.

"What follows concerning the degrees of credibility, is divided into four propositions. The first two respect the reporters of the narrative, as they either transmit successively, or attest concurrently; the third the subject of it, as it may consist of several articles; and the fourth joins those three considerations together, exemplifying them in oral and in written tradition."

Prop. I.—*Concerning the Credibility of a Report made by Single Successive Reporters, who are equally credible.*—Let their reports have each of them $\frac{5}{6}$ths of certainty; and let the first reporter give me a certainty of 1000l. in 1200l.; it is plain that the second reporter, who delivers that report, will give me the certainty but of $\frac{5}{6}$ths of that 1000l., or the $\frac{5}{6}$ths of $\frac{5}{6}$ths of the full certainty for the whole 1200l. And so a third reporter, who has it from the second, will transmit to me but $\frac{5}{6}$ths of that degree of certainty the second would have delivered me, &c. That is, if a be put for the share of assurance a single reporter gives me; and c for that which is wanting to make that assurance complete; and I therefore supposed to have $\frac{a}{a+c}$ of certainty from the first reporter; I shall have from the second, $\frac{a^2}{\overline{a+c}|^2}$; from the third, $\frac{a^3}{\overline{a+c}|^3}$; &c.

And accordingly, if a be $= 100$, and $c = 6$, (the number of pounds that 100l. put out to interest, brings at the year's end,) and consequently my share of certainty from one reporter be $= \frac{100}{106}$, which is the present value of any sum to be paid a year hence: the proportion of certainty coming to me from a second, will be $\frac{100}{106}$ multiplied by $\frac{100}{106}$ (which is the present value of money to be paid after 2 years;) and that from a third-hand reporter $= \frac{100}{106}$ thrice multiplied into itself; (the value of money payable at the end of 3 years,) &c.

Corollary.—And therefore, as at the rate of 6 per cent. interest, the present value of any sum payable after 12 years is but half the sum; so if the probability, or proportion of certitude transmitted by each reporter, be $\frac{100}{106}$, the proportion of certainty after 12 such transmissions, will be but as a half; and it will be by that time an equal lay, whether the report be true or not. In the same manner, if the proportion of certainty be set at $\frac{100}{101}$, it will come to a half from the 70th hand: and if at $\frac{1000}{1001}$, from the 695th hand.

Prop. II. *Concerning Concurrent Testifications.*—If two concurrent reporters have, each of them, as $\frac{5}{6}$ths of certainty; they will both give me an assurance of $\frac{35}{36}$ths, or of 35 to one: if three, an assurance of $\frac{215}{216}$, or of 215 to one. For if one of them gives a certainty for 1200l. as of $\frac{5}{6}$ths; there remains but an assurance of $\frac{1}{6}$th, or of 200l. wanting to me, for the whole. And towards that the second attester contributes according to his proportion of credibility, that is to $\frac{5}{6}$ths of certainty, before had, he adds $\frac{5}{6}$ths of the $\frac{1}{6}$th which was wanting; so that there is now wanting but $\frac{1}{6}$th of a $\frac{1}{6}$th, that is $\frac{1}{36}$; and consequently I have from them both $\frac{35}{36}$ths of certainty. So from three, $\frac{215}{216}$, &c.

That is, if the first witness gives me $\frac{a}{a+c}$ of certainty, and there is wanting of it $\frac{c}{a+c}$; the second attester will add $\frac{a}{a+c}$ of that $\frac{c}{a+c}$; and consequently leave nothing wanting but $\frac{c}{a+c}$ of that $\frac{a}{a+c} = \frac{c^2}{\overline{a+c}|^2}$. In like manner the third attester adds his $\frac{a}{a+c}$ of that $\frac{c^2}{\overline{a+c}|^2}$, and leaves wanting only $\frac{c^3}{\overline{a+c}|^3}$; &c.

Corol.—Hence it follows, that if a single witness should be only so far credible as to give me the half of a full certainty; a second of the same credibility would, joined with the first, give me $\frac{3}{4}$ths; a third $\frac{7}{8}$ths; &c.: so that the co-attestation of a tenth would give me $\frac{1023}{1024}$ths of certainty; and the co-attestation of a twentieth $\frac{2096999}{2097000}$ths, or above two millions to one, &c.

Prop. III.—*Concerning the Credit of a Reporter for a particular Article of that Narrative, for the whole of which he is credible in a certain Degree.*—Let there be six particulars of a narrative equally remarkable: if he to whom the report is given, has $\frac{5}{6}$ths of certainty for the whole, or sum of them, he has 35 to one against the failure in any one certain particular. For he has 5 to 1 there will be no failure at all: and if there be, he has yet another 5 to 1, that it falls not on that single particular of the 6. That is, he has $\frac{5}{6}$ths of a certainty for the whole; and of the $\frac{1}{6}$th wanting, he has likewise $\frac{5}{6}$ths or $\frac{5}{36}$ths of the whole, more; and therefore, that there will be no failure in that single particular, he has $\frac{5}{6}$ths and $\frac{5}{36}$ths of certainty, or $\frac{35}{36}$ths of it.

In general, if $\frac{a}{a+c}$ be the proportion of certainty for the whole; and $\frac{m}{m+n}$ be the chance of the rest of the particular articles m, against some one or more of them n; there will be nothing wanting to an absolute certitude, against the not failing in the article or articles n, but only $\frac{nc}{\overline{m+n} \times \overline{a+c}}$.

Prop. IV.—*Concerning the truth of either Oral or Written Tradition, in whole or in part, successively transmitted, and also coattested by several Successions of Transmittents.*—1. Supposing the transmission of an oral and narrative to be so performed by a succession of single men, or joined in companies, as that each transmission after the narrative has been kept for 20 years, impairs the credit of it a 12th part; and that consequently at the 12th hand, or at the end of 240 years, its certainty is reduced to a half; and there grows then an even lay (by the corollary of the second Prop.) against the truth of the relation: yet if we further suppose, that the same relation is coattested by 9 other several successions, transmitting alike each of them, the credibility of it, when they are all found to agree, will (by the corollary of the first Prop.) be as $\frac{1023}{1024}$ of certainty, or above 1000 to 1; and if we suppose a coattestation of 19, the credibility of it will be above two millions to one.

2. In oral tradition, as a single man is subject to much casualty, so a company of men cannot be so easily supposed to join; and therefore the credibility of $\frac{100}{106}$ths, or about $\frac{19}{20}$ths, may possibly be judged too high a degree for an oral conveyance, to the distance of 20 years. But in written tradition, the chances against the truth or conservation of a single writing are far less; and several copies may also be easily supposed to concur: and those since the invention of printing exactly the same: also several distinct successions of such copies may be as well supposed, taken by different hands, and preserved in different places or languages. And therefore, if oral tradition by any one man, or company of men, might be supposed to be credible after 20 years, at $\frac{19}{20}$ths of certainty; or but $\frac{9}{10}$ths of $\frac{4}{6}$ths; a written tradition may be well imagined to continue, by the joint copies that may be taken of it from one place, (like the several copies of the same impression,) during the space of 100, if not 200 years; and to be then credible at $\frac{100}{101}$ths of certainty, or at the proportion of 100 to 1. And then seeing that the successive transmissions of this $\frac{100}{101}$ of certainty, will not diminish it to half, until it passes the 69th hand, (for it will be near 70 years before the rebate of money, at that interest, will sink it to half.) It is plain that written tradition if preserved but by a single succession of copies, will not lose half of its full certainty, until 70 times 100, if not 70 times 200 years are past; that is 7000, if not 14000 years; and further, that if it be likewise preserved by concurrent successions of such copies, its credibility at that distance may be even increased, and grow far more certain from the several agreeing de-

liveries at the end of 70 successions, than it would be at the very first, from either of the single hands.

3. Lastly, in stating the proportions of credibility for any part or parts of a copy, it may be observed, that in an original, not very long, good odds may be laid, that a copy by a careful hand shall not have so much as a literal fault; but in one of greater length, that there may be greater odds against any material error, and such as shall alter the sense; greater yet, that the sense shal not be altered in any considerable point; and still greater, if there be many of these points, that the error lights not upon such a single article: as in the third proposition.

On the late M. Swammerdam's Treatise de Apibus; the Ahmella Ceylonensibus,† and the Faba Sancti Ignatii.‡ By Dr. Hotton.* N° 257, p. 365.

Account of a Book, viz. Analysis Geometrica, sive Nova et Vera Methodus resolvendi, tam Problemata Geometrica, quam Arithmeticas Quæstiones. Pars prima, de Planis; Authore D. Antonio Hugone de Omerique Sanlucarense. N° 257, p. 351.

The author of this book being of opinion that the method of deducing geometric demonstrations from an algebraic calculation, is forced and unnatural, has studied how to find an analysis purely geometrical, from which a synthesis might easily be derived, according to the method of the ancients.

He begins with an introduction; consisting of about 20 geometric propositions; which are so many lemmas, in order to make his analysis the more easy. The chief proposition of his introduction, and which he has occasion to use most, is this: to find two lines whose sum or difference is given, that shall be reciprocal to two given lines: this comprehending the construction of quadratic equations. He divides the rest of his book into four parts. In the first he considers those Problems that are solved by Simple Proportions. In the 2d, he considers those that are solved by using compound ratio. In the 3d, he re-

* The manuscripts of Swammerdam were at length purchased by Boerhaave, who caused them to be published under the title of *Biblia Naturæ.* Swammerdam before his death became melancholy, and had been long a convert to the doctrines of the famous female enthusiast Madam Bourignon. See the biographical account of Swammerdam, vol. i, p. 190, of this Abridgment.

† Verbesina Acmella. Linn.

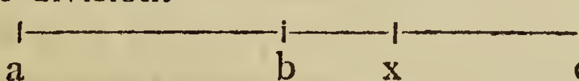
‡ The Faba Sancti Ignatii has been celebrated for its efficacy in fevers, dysenteries, and many other complaints, and is a strong bitter. It is a native of the Philippine islands. It is of a roundish figure, irregular, and uneven, and about the size of a middling nutmeg, and is said to be the seed of a climbing gourd-like plant. See p. 356 of this vol.

solves those wherein it is necessary to consider quantities connected by the signs + and — . And in the 4th, he considers indeterminate Problems.

He prefixes to his first part some general rules, how to proceed in a geometric investigation; and because these rules contain what is most material in his method, we think it not improper to relate them as he has laid them down himself.

1. An unknown line is always terminated in an unknown point; hence to avoid confusion, the unknown points ought to be denoted with the last letters of the alphabet v, z, y, x, &c. to distinguish them from the known points a, b, c, d, &c. and if there is occasion, one and the same point may be denoted with two letters, when a known and unknown line concur in it.

First definition.—Additive ratio is that whose terms are disposed to addition, that is, to composition. Subtractive ratio is that whose terms are disposed to subtraction, that is, to division.



Let the line ac, be divided in the points b, and x, the ratio between ab, and bx, is additive; because the terms ab, and bx, compose the whole ax; but the ratio between ax and bx is subtractive, because the terms ax, and bx, differ by the line ab.

2. The same order of the letters which is in the figure, ought to be kept in the analysis, that so by mere inspection it may be known whether the ratio is additive or subtractive; and consequently whether you ought to compose or divide.

3. When you are to argue by proportions, and the proportion lies in a right line, there is no other way to proceed on but by composition or division; therefore if both ratios are additive, you must argue by composition; if both subtractive, by division; so as always to use that way of arguing which is the fittest for the preservation of those terms that are known; but when one ratio is additive and the other subtractive, the additive must either be made subtractive, or the subtractive additive; and this change is made by repeating either term.

For if we design to change the additive ratio of ab to bd, into subtractive, let bc be made equal to ab, and thus the ratio of bc to bd, that is, of ab to bd, will be subtractive; and likewise, if the subtractive ratio of bd to bc was to be made additive, it is but making ab equal to bc.

4. This is always to be observed, when the terms of the ratio which is to be reduced, are known; but if they are unknown, and their sum or difference is

known, it is often convenient to use the 7th and 8th proposition of the introduction by means of which the difference of the terms of an additive ratio, or the sum of the terms of a subtractive one, may be expressed, whence you may argue by division or composition. Now the 7th proposition of the introduction is this; if a right line is divided into two equal parts, and into two unequal parts, the middle part is the half difference of the unequal parts. The 8th proposition is this: if a right line is divided into two equal parts, and a right line is added to it, that which is compounded of the half and of the line added, is the half sum of the line that is added, and of that which is compounded of the whole and the line added.

Second Definition.—That ratio is called common, which is common to two proportions, whether it be direct or reciprocal. Let there be two proportions, a, b :: d, e, and b, c :: e, l, having the same terms b and e, and constituting a direct ratio; this ratio is called common, because it is common to both proportions: in like manner let there be two proportions a, b :: e, l and b, c :: d, e, each having the same terms b and e which constitute a reciprocal ratio, this ratio is called common, because it is common to both proportions.

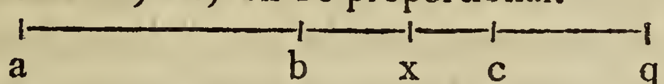
5. Therefore if two proportions have a common ratio, we may argue by equality; but if a common ratio is wanting, it must be introduced, that we may proceed farther, which will be done by the reduction of some ratio into another equal to it. Likewise if a proportion lies in a triangle, or any other figure, we must use a new proportion, by repeating some angle, that is, by changing its position, that so we may have two equal terms in two different proportions, and so may argue by equality: hence it is evident, that that angle ought to be transposed, which together with the other angles and sides of the figure, shows the most convenient similitude of triangles.

6. Now what is sought being assumed as granted, all our endeavours must be to retain in arguing those magnitudes which are already known, and to extinguish as much as we can the unknown point; and the analyst understanding where to use additive or subtractive ratio in one proportion, and how to introduce a common ratio in two proportions, if it be wanting, will come to the end of this resolution by necessary consequences: now this end is obtained when the unknown magnitude is found equal to some known one, or the unknown point is in one term, which is a 4th proportional, or in two terms either means or extremes whose sum or difference is known; for a 4th proportional, or two reciprocals will do it.

7. The analysis being ended, the order of the construction and demonstration is evident, for nothing else is required for the construction, but what has, or is supposed to have been done in the analysis; and for the demonstra-

tion, nothing but to begin from the end of the analysis, and proceed to the beginning of it; observing that where the analysis argues by alternate or inverted propositions, the synthesis argues by the same; and that where the analysis compounds, the synthesis divides, and vice versa. Take the following example out of a great variety which the book contains.

Problem.—The line ac being divided at pleasure in b; to divide it again in x, between b and c, so that ax, xc, bx be proportional.



Analysis.—Let therefore	ax, xc ::	xc, bx.
and componendo	ac, xc ::	bc, bx.
and alternando	ac, bc ::	xc, bx.
Let cq be made = bc	, cq	
and componendo	aq, cq ::	bc, bx.

Therefore the problem is solved.

Construction.—Let the construction be made as before.

Demonstration.—For since, by the construction, aq is to cq as bc to bx, therefore dividendo ac is to cq, that is to bc, as xc to bx; and alternando ac is to xc, as bc to bx. Therefore dividendo ax is to xc, as xc to bx, which was to be done.

Account of two Glands and their Excretory Ducts, lately discovered in Human Bodies. By Mr. William Cowper. F. R. S. N° 258, p. 364.

About a quarter of an inch below the prostrate glands E, fig. 1, pl. 10, I found two other small glands GG, placed on each side the urethra, F, a little above the bulb of its cavernous body I. These glands are of a depressed oval figure, not exceeding the size of a small French bean. After those parts of the musculus accelerator LL are removed, which pass over these glands, you may feel them placed like two hard bodies on each side the urethra. They incline to a yellowish colour, like that of the prostates. Their excretory ducts appear on their internal surface, fig. 2. A, B, next the inner membrane of the urethra C, whence they descend about half an inch in length before they grow less, and pierce that membrane obliquely, at their opening into the urethra D, in which they discharge their separated liquor. After opening the upper part of the urethra towards the dorsum penis, and expanding its inner membrane, if you compress these glands, you may see their liquor issue from two distinct orifices, which is very transparent and tenacious: these two orifices open into the urethra, just below its bending, under the ossa pubis in the perinæum.

The artifice of nature is very extraordinary in thus placing these glands and their excretory ducts, since on the erection of the penis, and the distension of the bulb of the cavernous body of the urethra, they are thereby necessarily compressed, and the liquor contained in their excretory ducts forced through their own orifices, into the cavity of the urethra: besides this, that part of the musculus accelerator, mentioned above, which passes over these glands, contributes to this compression. It seems requisite such agents should conspire in compressing these organs, since the liquor they separate is so very tenacious; which consistence of it is necessary for the uses it is employed in.

The main design of nature in framing these glands, seems to respect the grand work of generation, which will be more evident if we examine the analogous organs in other animals. In rats these glands are remarkably large, and are so placed, that on the erection of the penis they are compressed by its turgescency and apposition of the ossa pubis; the same may be observed in other animals, particularly in hedge-hogs. Boars have these glands very large, and the matter they separate is more tenacious, and not so transparent as in all other creatures I have examined; there is something peculiar in the contrivance of them in this animal, each gland being covered with a peculiar muscle, not unlike the gizzards of some fowls; which mechanism seems contrived for more forcibly compressing them, to discharge their very tenacious contents into the urethra, and that not only in the time of coition, but at any other time; which seems to be more peculiarly required in those creatures, because the passage of their urine is very long, and therefore stands in need of more of this glutinous matter to besmear it, whereby it is defended from the injuries that may arise from the salts of the urine. As the urine of different animals is more or less impregnated with pungent salts, so the proportion of these glands differ, as well as on the account of the various lengths of their urethras. It is remarkable, that we do not find these glands in females, like those in males, though they have something analogous to them, which are described by De Graaf, and called prostatæ mulierum; but the orifices of their excretory ducts opening at the exit of the urethra, they serve to defend the nymphæ and labia pudendi only from the urinous salts, and discharge their liquor in coitu; the whole urethra in them being so short, that the contraction of the sphincter muscle of the bladder is sufficient to expel any remains of urine from that passage.

The use of these glands is twofold: first on the erection of the penis there is so much of their liquor discharged into the urethra as suffices to drive out any remains of urine, and prevent its mixing with the semen; and at other times the continual discharge of some part of their liquor into the urethra, defends that passage from the salts in the urine: the like continual exudation cannot happen either from the excretory ducts of the prostates, or those of the vesiculæ seminales, because the nearness of the sphincter muscle so corrugates the inner membrane of the urethra, as prevents an easy passage of the liquor by the ostiola of the former: nor can the semen run out of the latter, since the caruncula or caput gallinaginis is contrived on purpose to prevent it: wherefore the diaphragm, abdominal muscles, and levatores ani, are employed in compressing those parts, to discharge their contents.

It is not improbable that the matter which flows at the latter end of the cure of venereal diseases, and is called a gleet, proceeds from these glands, and not from the prostatæ or vesiculæ seminales, as is commonly supposed; which may afford us no mean argument for the use of injections in such cases; instead of which, some practitioners persecute their patients with violent purges, and cram them with vast quantities of astringent medicines. We may easily conceive how such gleets become sometimes very obstinate, if not incurable, by supposing the ulcer in that contact to happen upon the ostiola of these secretory ducts.

In fig. 3, pl. 10, A, is a portion of the bladder of urine; BB, parts of the ureters; CC, parts of the vasa deferentia; DD, the vesiculæ seminales, somewhat distended with wind, by blowing into the vasa deferentia; aa, the blood vessels of the vesiculæ seminales; E, the glandulæ prostatæ; F, the urethra expanded, after opening its superior and fore part, to see the ostiola of the excretory ducts of the following glands; GG, the two glands above described, which from the liquor they separate may be called glandulæ mucosæ; H, the excretory duct of one of the last mentioned glands, before it passes under the bulb of the cavernous body of the urethra; I, the bulb of the cavernous body of the urethra, partly distended with wind, and divested of the accelerator muscle to show its external membrane, which is very thin, whereby the last named muscle more adequately compresses that bulb, and drives its contained blood towards the glands, when the penis is erected; K, the third pair of muscles of the penis; LL, the accelerator muscle, divided in its middle seam on the bulb, and afterwards freed from it, and expanded; ll, the upper part of this muscle which passes immediately over the mucous glands; MM, the musculi directores penis; NN, the cavernous body of the penis; O, the cavernous body of the urethra; P, the ligature made to prevent the wind from passing out of the cavernous body of the urethra and its bulb; Q, the aperture by which the inflation was made.

Fig. 2, one of the mucous glands, after being macerated in water, and its excretory duct filled with quicksilver; A, the mucous gland somewhat distended; B, its excretory duct; C, a portion of the internal membrane of the urethra expanded; D, the ostiola of the last mentioned excretory duct.

Epistola D. Raymundi Vieussens, M. D. et S. R. S. ad Societatem Regiam Lond. missa, de Organo Auditus. Dated Montpelier, Feb. 20, 1699. N° 258, p. 370.

In this very long letter the author gives an account of some particulars relative to the structure and diseases of the ear, not noticed in the treatise on this subject written by his countryman Du Verney,* of whose anatomical labours, however, he speaks in terms of high commendation.

He gives a minute description of the membrana tympani, which he divides into internal and external. This membrane is a production of the membrane which lines the aquæductus Fallopii. From the greater or less degree of expansion and sensibility of this membrane he accounts for acuteness and dulness of hearing, and certain disorders of the ear, such as tinnitus aurium. Then follow observations on the muscles of the internal ear, which he makes to be only 2, not 4, as other anatomists; for he considers what have been regarded as two muscles of the malleus, as but one, having two tendons but only a single belly. He accordingly terms it musculus monogastricus. Next he enters into a description of the two apertures of the labyrinth of the ear; the upper or oval one of which (fenestra ovalis) he calls the fenestra labyrinthi, and the lower one (fenestra rotunda) which is round, he proposes to call the janua labyrinthi. He then describes the distribution of the portio mollis over the membrane which lines the internal surface of the semicircular canals; and lastly he treats of the cochlea, which he divides into two parts, the first of which he calls the cochlea, the other the ductus semi-ovalis spiralis.

An Argument for the more frequent Use of Laryngotomy. By Dr. Wm. Musgrave. N° 258, p. 398.

Laryngotomy is highly to be valued, because when a man is in most imminent danger of suffocation, and apparently within very few minutes of his last, by opening a new passage for breath it gives immediate relief, and that when all other methods fail, and without any considerable injury from the instrument. The patient is thus in a minute or two brought from the struggles of death to a state of complacency, ease, and security.

That laryngotomy may be practised in danger of suffocation, and that the wound is curable, will appear by the following case, communicated by Mr. Keen, who performed the cure.

Nicholas Hobb, of St. Enodor in Cornwall, aged about 63, was set upon by ruffians, who first by a blow on the occiput knocked him to the ground, then

* See vol. ii, p. 643, of this Abridgment.

cut the trachea or wind-pipe, somewhat beneath the pomum adami, together with several of the adjacent muscles, and some large blood-vessels, from which he lost a very great quantity of blood. The ruffians having robbed him, and thinking him dead, left him. After some time the wounded man recovered so much sense and strength as to thrust his neckcloth into the large and gaping wound, and by degrees to crawl home to his own house not far off. Lipothymies, or fainting fits, came frequently upon him, especially on every little motion of his body, and these were after some time succeeded by convulsions.

Having examined the wound, a great difficulty arose from the parts of the trachea being now at a vast distance from each other; the lower part being at every turn of inspiration sunk deep into the neck, as low as the claviculæ, and only just appeared upon every expiration. To secure fast hold of the lower part of the trachea, I ordered a strong fellow to hold the legs of the patient over his shoulders, and by this means raise them, together with the abdomen, above the thorax, collum, &c. in which posture the divided parts came so near to each other, that with strong waxen thread I sewed several of them together; but as to the divisions of the trachea, I secured them together by passing large needles deep into the flesh on each side, and twisting strong waxen thread about them, as in labio fisso. Over all, for greater security, I applied a restrictive, ex pulv. restring. commun. covering the greatest part of the neck with a defensative, ex bolo cum albumine ovor. advising the patient to lie as quiet as he could.

The patient now began again to speak, and with a low voice gave an account of the occasion as above. An arteriac was then made up for him, to smooth the trachea, and promote expectoration, viz. e troch. pectoral. Batean. (in aq. stephan. ℥ß. solut.) ʒiij. syr. tussilag. ℥iß. balsamic. ℥j pulv. anis. glycyr. ana ʒj. balsam. sulphur. terebinth. ℥ß. Peruv. gut. vj. cum mellis opt. despumat. q.s. fiat linctus per bacillum glycyr. sæpius adhibend. From the use of which his cough abated, and he discharged by expectoration much grumous blood and other matter. As to the convulsions and lipothymies, I applied to his nostrils spir. c.c. succin. &c. and embrocated the back part of his neck with a liniment, ex ol. lil. alb. ℥j. tereb. succin. ana ʒj. N. M. ʒß. ung. nervin. ʒvj. mis. And then took leave, and upon my return the next day found the convulsions had left him; nor had he from that time any return of them, or of the syncope.

But on the 4th day the stitches were torn open, and the wound appeared large enough to admit a middle sized hand; a great part of the œsophagus appeared in view, much inflamed and scratched by the instrument. The epiglottis did not as usual cover the rima of the larynx, so that I could easily see up into the mouth; part of the annular cartilage was cut obliquely, and hung only by a little fibre to the upper part of the larynx, &c. Indeed there were frequent ruptures, the waxed thread and needles often fretting through the flesh they held; but I as often repeated the said stitches as before-mentioned. About the 10th day, the larger blood-vessels appeared conglutinated, and covered with new flesh, the gula had a good aspect, and the inflammation of that and all the neighbouring parts gone off. I now dressed with liniment. arcæi. On the 11th day the symptomatic fever was in a manner gone, and the wound under the circumstances of good digestion.

In the mean time the diet, when he could swallow, was of mutton broth, medicated ale, and poached eggs. The cough continuing a long time very severe, was at length overcome by duly adhering to the linctus aforesaid, with repeated boluses of balsam. lucatel. cons. rosar. rub. hora somni, with a draught of a pectoral decoction, used also instead of common drink. To mitigate the violence of the cough, and procure him sleep, the following draught was frequently used, and never failed: ℞ ol. amygdal. dul. rec. express. ℥ß. syr. de mecon. ʒvj. laud. Lond. (aq. steph. ℥ij. solut.) gr. ij. fiat haustus horâ somni sumendus. About the 11th and 12th days we plainly discovered little portions of new flesh arising, not only from the carneous membrane incumbent on the gullet, but also out of the substance of the cartilages themselves, both on the upper and lower parts of the divided trachea. The external containing parts of the neck now began to unite by incarnation; new flesh arising and apparently lessening the dimensions of the wound every time there was a laceration of the stitches, insomuch that two needles were now sufficient, whereas I used in the beginning not less than six. And those carneous portions, both of the trachea and exterior parts, gradually joining and intermixing, became one solid cicatrix, from each end of the wound almost to the middle of the wind-pipe, where the air continued in some degree to have an exit. About the 15th day I removed several pieces of bone, which had contracted a caries in the cartilage, which in this old man, as in many others, was grown osseous, and were expelled by the new flesh.

At this time he swallowed with little trouble, eat sufficiently, and was nourished in proportion. The aperture about the 26th day was almost closed up, and in 4 or 5 days more the sides of the wound were perfectly joined and cicatrized, the trachea performing its part in respiration as at other times, without any considerable inconvenience. He speaks indifferent well, but is forced to take care in swallowing, the rimula not being exactly shut as before the wound, which makes liquor of any sort more apt to fall into the canal, and so cause a cough, hoarseness, &c. He does not swallow dry meats as well as formerly, but in all other respects is as well as ever.

This signal history affords matter for much observation; but the only use I shall at present make of it is, that if, in a person of this age, above 60, in a wound whereby the trachea was cut through, and several of the cartilages beaten together, the divided parts of the trachea may be made to unite and grow together: certainly then laryngotomy, which is a much less dangerous wound indeed, in violent quinzies, in danger of suffocation from causes of a like nature with them, may safely, and ought to be put in practice. The disadvantage is a slight wound, easily cured: the advantage nothing less than the saving of life.

On the Application of the Pneumatic engine to Cupping Glasses. By Mr. Tho. Luffkin. N° 259, p. 408. *Translated from the Latin.*

Let ABCD, fig. 5, pl. 10, be a concave cylinder of brass, of a proper thickness, 1 inch in diameter, and 10 or 12 inches long, so exquisitely polished on the inside, as not to have the least flaw or inequality, and having a small hole O near the bottom; also let there be a lid or cover EF, fig. 6, to be fixed on the cylinder by two screws, and a bottom GH, fig. 7, to be soldered to the cylinder; and let that end of the syringe, 1, 2, be perforated in the middle through to the outside of the bottom. Let the iron rod NN, fig. 8, of a proper thickness, be fitted to the length of the cylinder; at its extremity let there be a plate of brass LM, and at 2 inches distance another IK; the intermediate space being filled up with threads moistened in oil, so as to shut exactly the cavity of the cylinder, and having a handle at N. This engine, composed of all these parts, is not unlike a surgeon's syringe. Let there be also made another brass cylinder OPQR, fig. 9, of the size of the figure, with two wings OS, PS, and of such a bore as that its inside being cut into a female screw, it may be exactly fitted to receive the male screw; let the bore be enlarged from Q and R to TT: lastly, make the shoulder VV, and a plate W, perforated in the middle to fit the shoulder, and be fixed to it. Further, make a right cone 1, 2, 3, fig. 10, bored through its axis, and enlarge the bore from 1 2 to 4 4; also make a shoulder 5 5 to fit exactly the cavity of the cylinder TT, and be firmly fixed in it; make also a brass spring fig. 11, in a spiral form round the cylinder, of a proper strength, and nearly equalling the diameter of the box VV 4 4, but a little higher than the box when left to itself, and having at the lower extremity a plate 7 7 of the same magnitude, the lower part of which is to be armed with a soft leather moistened in oil, to close the orifice of the syringe. Then, at the top of the cupping glass, fig. 12, is made a round bore, by which the cone is let down as far as the wings SS of fig. 9, the chinks or fissures being filled with cement made of rosin, turpentine, and lime. Finally, the lid 6 7 6 7, fig. 13, is to be wrapped up, as high as the shoulder, in leather steeped in oil, by which the air, when exhausted out of the glass, (should there happen to be any fissures in the little valve) may be excluded. When the thumb is applied close to the bore, the plate 9 9, fig. 14, is raised by the handle to 10 10; now because at first the air filled only the space 9 0 9, it is now so rarefied and expanded, as to occupy the space 9 9 10 10, which is 300 times greater than the former; therefore the elasticity of the air included in the glass, exceeding both the elasticity of the spring, and of the air contained in the cylinder, the valve or plate will be pushed upwards, which will continue open till such a quantity of air get out of the glass into the cylinder, as that the elasticity of the complement of air contained in the glass shall be equal to the elasticities both of the spring and of the air now contained in the cylinder; and on opening the hole o the valve is firmly shut by the pressure of the external air, cæteris paribus, on 3 or 4 suctions, more or less, $\frac{999}{1000}$ parts of air (according to the power of the spring, and the ratio between the capacity of the cylinder and that of the cupping glass) will be exhausted; and if the elasticity of the air in the same space be as its quantity, the resistance or pressure under the glass will be to the pressure on the circumjacent parts, as 1 to 1000; because, before the air was exhausted out of the glass, the resistance or pressure under the glass was the same with that on the parts without the glass. It may be worth observing, that by how much the cylinder is greater than the spring, so much greater will be the quantity of air that is exhausted out of the glass, because the air 9 0 9 is expanded into a greater space, and consequently has a less elasticity; therefore the elasticity of the air in the glass has a greater ratio to the elasticity of the air contained in the cylinder and spring, and for that reason a greater quantity of air will be exhausted out of the glass.

On the Quadrature of the Parts of the Lunula of Hippocrates of Chios; by Mr. John Perks. With the further Improvements of the same, by Dr. David Gregory, and Mr. John Caswell. Communicated by Dr. Wallis. N° 259, p. 411.

The squaring a certain lunula by Hippocrates of Chios long since has been known as to the whole lunula for many ages. But as to its parts new discoveries have been lately made, which had not been considered by any before this present age. I received in Nov. 1699, from Mr. John Perks, of Old Swynford in Worcestershire, a brief account of his squaring the portions of Hippocrates's lunula. For the better understanding of which, I shall premise as known, because long since demonstrated, that, if on AB, fig. 1, pl. 11, the chord of ADB, the quadrantal arc of a circle, whose centre is C, be described, as a diameter, a semicircle AEB; this semicircle will be equal to that quadrant. Because the squares of their diameters are as 2 to 1; and in the same proportion are their respective circles; and therefore a quarter of the one equal to half the other. Consequently, if from each of these be subtracted the common segment ABD: the remaining lunula ADBE on the one side, will be equal to the remaining triangle ABC, on the other side; or to ABK, supposing AB bisected in K, that is, to half the square CK, inscribed in the lesser circle. Which is commonly called, the squaring of Hippocrates's lunula, that is, the finding a rectilinear figure equal to that lunula.

This being premised, the point in hand is the squaring a given portion of such lunula; suppose ADE, cut off by a straight line CDE, drawn from the centre C. Which Mr. Perks performs after this manner, viz. Drawing the straight lines EA and EB, fig. 2, cutting the arc EB in G, and on AG a perpendicular EF, which will pass to the centre C, because bisecting AG at right angles; the right lined triangle AFE is equal to ADE, the proposed portion of the lunula.

Demonstration.—ADB being a quadrantal arc, the angle AGB will be three halves of a right angle, and its conjunct angle EGA, half a right angle. And that angle being external to the triangle AGE, is equal to the two opposite internals GEA + EAG. Thereof GEA, because an angle in the semicircle AEB, is a right angle, and therefore EAG is half a right angle, as are also FEG and FEA. And the three triangles AFE, GFE, and GEA, each of them half a square. And AG to AE, as $\surd 2$ to 1, proportional to the respective radii of the two circles. And the like segments ADG, AE, in their respective circles, as the squares of their respective radii, as 2 to 1. And therefore the semisegment AFD, equal to the segment AE. Consequently, one taking from the triangle as much as the other adds to it, the portion of the lunula ADE equal to the triangle AFE.

If the point E chance to be in K, fig. 1, the middle of the arc AEB, there will be no intersection at G, the points G, B, coinciding, but without any disturbance to the demonstration. If it fall beyond it, toward B, then G will be on the other side, and what is here said of EGB must be accommodated to EGA, which things are so obvious, as not to need any long discourse. And this is applicable to other lunulas beside that of Hippocrates, if, by altering the angle at F, or otherwise, we take in such a portion of the common segment ABD on the one side, instead of AE cut off on the other side, as the proportion of the two circles requires.

I showed this quadrature of Mr. Perks to Dr. David Gregory, our learned professor of astronomy at Oxford, who gives his opinion about it, with his improvement of it, as follows:

"The quadrature of the parts of the lunula of Hippocrates of Chios, by Mr. Perks, is very elegant. I remember the like was done some years since by

Monsieur Tchirnhause; who assigns as equal to the same portion, not the same triangle with that of Mr. Perks, but another equivalent to it. His theorem is in the Acta Lipsiæ, for the month of September 1687; but, without any demonstration. But neither of them have considered this affair in its full extent. For if we complete the two circles, whose arcs contain the lunula of Hippocrates; the same is true, as well of the points in the other semicircle ACB, as of those in the semicircle AEB; and, for the same reasons. As appears in the scheme, fig. 3, wherein I have marked the points in the semicircle ACB, correspondent to those of Mr. Perks in AEB with the correspondent small letters of the Roman and Greek alphabets.

"If Mr. Perks had made his construction universal, by making both EA and EB meet the greater circle, which he might have done by protracting these lines and the greater circle until they meet, he might have found that the portions of the spaces AεCM, BHCM, supposing MCN parallel to AB, are quadrible, as well as those of Hippocrates's lunula: and that, EAγ being a straight line, the portion AED of Hippocrates's lunula, is to Aεδ, the correspondent of AεCM, in the duplicate proportion of Cε to Aε. For ERε, at R the centre of the lesser circle, is in this case a right angle.

"Moreover, if you take any point ε in the semicircle ACB, and proceed according to Mr. Perks's construction universalized as above-mentioned; you will find on one side, the trilineum Aεδ (contained by the arcs Aε, Aδ, and the straight line εδ) equal to the rectilineal triangle Aεφ. And, on the other side, the trilineum contained by the arc Bε (the complement of εA to the semi-circumference,) and the arc B d (the complement of Aδ to the fourth part of the circumference,) and the straight line εd, (that is, the trilineum BHCd diminished by the segment Cε) to be equal to the rectilineal triangle Bεf. And that those two spaces Aεδ, and the difference of BHCd from the segment Cε (parts of the lunula ACBgγA) taken together, are equal to the triangle ACB; as well as the two spaces AED and BED, parts of the lunula of Hippocrates.

"So that, on the whole it appears, that the two circles, containing the lunula of Hippocrates being completed; this lunula AEBGA, and the other ACBgγA, make up one system, and are conjugate figures. For (drawing a straight line CDE, or Cεδ, or Cεd, at pleasure through C the centre of the greater circle, and cutting those two circles,) the space contained within two arcs of these two circles and part of the said straight line, (as AED, or Aεδ, or BHεd,) is equal to the rectilineal triangle AEF, or Aεφ, or Bεf respectively. And it so happens that, if this line going out from C be on the same side of the diameter MN with the lunula of Hippocrates; the aforesaid space (which receives a perfect quadrature) is solitary; such as are the parts of Hippocrates's lunula; and of the two spaces AεCM, BHCN, which therefore are parts of the lunula more nearly relating to each other. But if that line going out from C, be on the other side of MN; then the space which is equal to the rectilineal triangle, is the difference of two mixtilineal figures, (the one a trilineum, the other a segment of the lesser circle,) as is abovesaid; neither of which can be squared severally.

"All these particnlars are plain from Mr. Perk's demonstration; which, with a little variation (such as is usual in the different cases of the same theorem), is applicable to all of them: though perhaps he was not aware of it.

"In the dimension of the parts of Hippocrates's lunula, it might perhaps be expected, that the triangle assigned equal to a portion of the lunula should be part of the triangle to which that whole lunula is wont to be assigned equal; that is, that the triangle assigned equal to the portion ADE, should be the respective part of ACB which is equal to the whole lunula, which in that of Mr. Perks is not.

"But in that of Mr. Tschirnhause, above-mentioned, it is so, which is to this purpose. If from any point E, in the circumference of the lesser circle, we let fall on AB, a perpendicular cutting it in L, and draw the line CL; the triangle CAL is equal to the portion of the lunula AED. And consequently the triangle CBL, equal to the portion BED. Which, because Mr. Tschirnhause has not at all done it, I shall briefly demonstrate, so as the demonstration may reach the portions of the conjugate space ACBgγA. For the triangles ACB, AEF, are like triangles, each being the half of a square: and therefore by 19 El. 6, the triangle ACB is to the triangle AEF in the duplicate proportion of BA to AE, that is, by 8 El. 6, as BA is to AL. But, by 1 El. 6, the triangle ACB is to the triangle ACL as BA is to AL. Therefore by 9 El. 5, the triangles ACL and AEF are equal. But the triangle AEF is (by Mr. Perks) proved equal to the portion AED. And therefore the said portion AED is also equal to the triangle ACL. "D. GREGORY."

Mr. Caswell had a sight of this quadrature of Mr. Perks, and had given a specimen of its being capable of further improvement, as follows:—On the centre B, he draws by A a third circle, which forms another lunula than that of Hippocrates; and thus he very dexterously squares the portions of this lunula; and thence lets us into a new system, which may be pursued in like manner as Dr. Gregory has done that of Hippocrates.

After these learned disquisitions on so trite a subject, it will not be needful for me to say much. I shall but briefly compare the two quadratures of Mr. Tschirnhause and Mr. Perks, wherein they agree or differ with each other. And then show how, by either of them, to divide the lunula in any given proportion. Monsieur Tschirnhause, letting fall from E, on AB, a perpendicular EL, fig. 4, determines the triangle ALC equal to the portion ADE. Which being admitted, we may thus divide the lunula in any given proportion. If we divide AB at L, in such given proportion; CL will in the same proportion, because of the common altitude, divide the triangle ACB, which is equal to the whole lunula. And LE, erected at right angles on ALB, will determine the point E; from whence if we draw the straight line EC, this will at DE, divide the lunula in the same proportion.

Mr. Perks, on EDC, drawing the perpendicular AF, fig. 5, determines the semiquadrate AFE, equal to the proposed portion ADE. Which semiquadrate is a like figure, and alike situated to AE, as is ACB to AB. And therefore, because like figures are in the duplicate proportion of their respective sides, if we so inscribe AE, as that the square of AE be to the square of AB in such given proportion, the lunula will at DE be divided as is required. And this will hold, if duly applied, according as the different cases may require, though E be taken, in the continuation of the semicircle, beyond B. For still like figures will be in duplicate proportion of their respective sides, and $CE = CD \pm DE$. And the same is yet improveable much further. JOHN WALLIS.

Answer to the Animadversions concerning the Catenary. By Dr. David Gregory. Translated from the Latin. N° 259, p. 419.

What has been objected by an anonymous author, in the Leipsic Acts of Feb. 1699, in his animadversions on my demonstrations concerning the catenary, is this: that I have undertaken to demonstrate, after my manner, a matter found out and published by others seven years ago. This is true, and I cannot find any thing in it that is blame worthy. Those great men Huygens, Leibnitz, and Bernouilli, have discovered and communicated many properties of the catenaria, but without demonstration. I have contrived demonstrations, which was the thing I undertook to do.

But was this matter (that is, the nature and primary properties of the catenaria) all found out and published by others? Surely that property of the catenaria, in Cor. 6, Prop. 2, was not at all mentioned by others, before the publication of these demonstrations; although, if I am not mistaken, it may be reckoned among its primary properties, and is the most useful of all, and most easily reduced to the common purposes of life. From all ages architects have made use of arches in public buildings, as well for strength as beauty. Yet what was the true geometrical figure of an arch was not known before my demonstrations came out.

The first he finds fault with is, that I affirm some things are plain from mechanics, which he thinks should have been explained and applied more distinctly.

As I undertook to demonstrate some theorems to geometricians, I did not think it necessary to pursue every thing very minutely. But that I may oblige the animadvertor, I will now demonstrate that lemma, Prop. 1, because I cannot express it more fully than I have already done, in the following words:—"Three powers, constituted in equilibrio, have the same ratio as three right lines, which are parallel to the directions of the powers, or are inclined in a given angle, and terminated by their mutual concourse."

As suppose three powers are in equilibrio, that either draw, press, or any how act according to three right lines PA, PB, PC, fig. 6, pl. 11; and let the three right lines EF, FD, DE, be inclined to these directions in any given angle; that is, let the angles EAF, FBP, DCP, be equal: I say the powers A, B, C, are to one another, as the right lines FE, FD, DE. Let the right lines AP, BP, CP, be produced to G, H, K. In the quadrilateral FABP, because by the hypotheses the external angle EAP is equal to the internal and opposite angle PBF, the two internal opposite angles FAP and FBP will be equal to two right angles; and since all the four internal angles are equal to four right angles, the other two angles F and APB, opposite in the same quadrilateral, will also be equal to two right angles. But APB and BPG make two right ones; therefore the angle F is equal to BPG. In like manner D and E may be shown equal to BPK and APK.

Now because the three powers are in equilibrio, they are immoveable, and therefore any one of them, in respect of the two others that remain in equilibrio, may be considered as a fulcrum. If B is the fulcrum, by a well known theorem in mechanics, the power A is to the power C, as the sine of the angle BPK to the sine of the angle BPG, that is, as the sine of the angle D to the sine of the angle F; that is, as the right line FE to the right line DE. Again, supposing C the fulcrum, the power A is to the power B, as the sine of the angle CPH to the sine of the angle CPG, or the sine of the angle BPK to the sine of the angle APK; that is, the sign of the angle D to the sine of the angle E, or as the right line FE to FD. Therefore the three powers A, B, and C, are as the right lines FE, FD, and DE. Q. E. D.

We must now say something about the application of this mechanical lemma. If the absolute gravity of the little line dD, fig. 7, expounded by dD, as said above in Prop. 1, is conceived to be collected in its centre of gravity M, and this heavy line, by virtue of its gravity, endeavours to descend according to the direction MF perpendicular to dD; the power drawing according to MD, which is in equilibrio with the said heavy line by the foregoing lemma, is to its momentum or power drawing according to MF, as δD is to δD. For the angle δDd, in which Dδ is inclined to MD, is equal to the angle dεF, in which dδ is inclined to MF, for each is the complement of the angle d to a right angle. And this will obtain, as the animadvertor acknowledges, if the aforesaid weight (as in the common mechanics) incumbing upon the plane MF, is drawn by help of a pulley at M, by another weight incumbing upon MD; then this will be to that, as Dδ to dδ.

Other things remaining as before, if the manner of application of these powers be changed, so that to the middle point M of the flexible line dD, whose extremity d is fixed, a weight be applied exerting its force according to MF; (for in descending it would describe an arch with centre d and radius dM) the force of this weight to bend the flexible right line at M, would be infinite in respect of the force of its absolute gravity. And the force drawing according to MD, which is required in order to prevent the aforesaid bending, would also be infinite in respect of that which was before required, to support the weight M in the plane MF. So that the powers which in the former manner of application were expounded by dδ and δD, must now be expounded by infinitely greater lines, which are still proportional to the former. For as before, the weight M draws according to the direction MF, and the power sustaining it according to MD; and that these two are in equilibrio appears from the parts of the chain being at rest. Therefore the ratio of these remains the same as before. But the cause which extends into a right line, the flexible line dD (whose extremity d is immoveable, and to whose middle point M a weight is applied, which is indeed infinitely little, but whose force by this manner of application is made infinitely greater, and therefore in the language of the animadvertor becomes assignable) is the weight of the chain DA, fig. 6, pl. 4, which is proportional to its length. This therefore is to the constant and assignable quantity a, (proportional to the constant but not assignable quantity dδ) as Dδ to δd. And thus I hope it will appear to the animadvertor, that I have proved the conclusion to be true, without making any erroneous positions.

Of two Monstrous Pigs, and a Monstrous Double Turkey. By Sir John Floyer. Communicated by Dr. Edward Tyson, F. R. S.* N° 259, p. 429.

By the description of the following monsters I design to prove, that the distortion of the parts of a fœtus may occasion it to represent the figure of

* This physician was author of several ingenious works, such as Pharmacobasanos, or the Touchstone of Medicines (1687); in which he attempted to account for the virtues of medicines by their taste and smell; both of them fallacious tests, since some of the most sapid substances possess but little medicinal action; while others, which make but a slight impression on the tongue and olfactory nerves, in many instances produce the most powerful and salutary effects; not to mention (as a celebrated physician has remarked) that it is impossible to define all the different degrees of taste and smell. Psychrolusia, or a Treatise on Cold Bathing 1702; the Physician's Pulse Watch; a

different animals, without any real coition between the two species. There was showed to me a pig at Weeford in Staffordshire, with a face something representing that of a man's; the chin was very like that of a human fœtus; the roundness of the head and flatness of the ears was surprising. But when I had carefully viewed the head, I observed there was a depression of the bones of the nose in that place which was between the eyes, in which the pig's face seemed to be broken, and the nose drawn up to appear like human: the under-jaw was inverted, growing up to meet the upper; the tongue and mouth were made more like the human, being altered by some external pressure on the pig's mouth, which broke the bones of the nose, and caused their depression towards the palate, and the inversion of the under-jaw. This pressure on the mouth forced the bones upward, so as to cover the eye-holes, and the pig appears blind: the depressed bone shut itself with a spring, when forcibly opened; so that it had grown close up ever since it was cartilaginous. By this breach or depression of the pig's face, I was first convinced that this monster was not from the conjunction of both kinds, but only occasioned by some sort of compression: and that the pig's head was straitened in its growth, appeared by the flatness of the ears; and that this depressure happened while the bones were cartilaginous, appears by the bones depressed, which remained cartilaginous, and at the same time the under jaw was inverted, and the head made more round. I farther observed that all the head was covered with hair, as the other pigs were; that the teeth in the mouth were pig's teeth; the hair of the pig's head was yellow as that of the sow was: the monstrous pig was as large, and as well grown as the rest of the pigs, and therefore begot by the boar at the same time; the nose was a perfect pig's snout, and there was no upper lip, as in the human kind; in all the other parts it appeared to be a perfect pig, no parts being wanting but those of the face, distorted by some external accident. This monster was pigged alive; but died because it could not suck, the nose being stopped. Its cry was not like the other pigs, because of the stoppage of its nose, and the alteration of the figure of its mouth. The sow pigged 8 pigs; the first five were perfect pigs, the sixth was the monster, and after that two more perfect pigs, all which I saw sucking the sow, and as well shaped, and as large as usual, being then three or four days old.

work which contains many original observations, prosecuted for a series of years, on the pulse, both in its natural and diseased states. A Treatise on the Asthma 1698; in which there is an excellent description of the paroxysms of that obstinate disease, under which the author himself laboured upwards of 30 years, together with many valuable hints relative to its treatment. One of the last of this author's works is his treatise entitled Medicina Geronica; which relates to the means of preserving the health of persons in advanced years.

This kind of monstrous pigs, produced by the unnatural situations of parts by some external compression, I believe is very frequent: I had another of the same kind sent me out of Derbyshire, which had a resemblance of a man's face, and all the other parts of a pig, and this had the same chin, and depression between the eyes, the roundness of the head, and flatness of the ears above described, only that this wanted hair, as pigs which come too soon do: and no sex could be distinguished in it.

At Thorpe, two turkeys were taken out of one egg, which was not observed to be larger than ordinary; they grew together by the flesh of the breast bone, but were in all other parts distinct; the two heads, four legs, four wings, and two trunks of the body appeared something monstrous; but it was evident that the monstrosity was only two turkeys sticking superficially together, and both seemed less than the ordinary size of turkeys; there wanted both nutriment and room for the growing of both turkeys, which was the occasion of their cohesion and smallness. These turkeys had distinct cavities in their bodies, and two hearts; so that they had two distinct cicatriculas, and consequently the egg had two yolks from whence they were produced; which accident is very common. I have a dried monstrous chicken, which has but one head, four wings, four legs, and one cavity in the body, and consequently had but one heart; in this case this monstrous chicken was produced from one cicatricula, and consequently one heart. So Paræus mentions a double infant with one heart; in these cases the original of the infant was one, and the vessels regular, but in the extremity the arteries and nerves were divided into more branches than ordinary, and produced double parts; and this is like the double flowers of plants, which are produced so by the richness of the soil.

As the two yolks of eggs are joined in the ovarium, and covered with one skin; so the eggs of quadrupeds are joined in the ovarium, and as they grow their bodies externally cohere. So that there are these two reasons for the multitude of the parts in an embryo; the joining of two perfect animals, or else the extraordinary division of the original vessels, the arteries and nerves.

An Account of Maryland. By the Rev. Mr. Hugh Jones. N° 259, p. 436.

Chesapeak-Bay, which runs N. and by W. about 200 miles or more, divides this province, as well as Virginia, into two parts, called the eastern and western shores. The land is generally low on both sides. No hill that I have seen or heard of is 50 yards perpendicular; but about 100 miles back, or west of us, towards the heads of rivers, the ground rises, and appears in very high mountains and rocky precipices, running north and south, from the top of which a man may have a clear prospect of Virginia and Maryland. All the low land is very woody, like one continued forest, no part clear, but what is cleared by the English. And though we are pretty closely seated, yet we cannot see our next neighbour's house for trees. In time it may be otherwise; as the tobacco trade destroys abundance of timber, both for making of hogsheads, and building of tobacco-houses; besides clearing of ground yearly for planting. The soil is generally sandy, and free of stone, which makes it very convenient for travelling. As for the natural situation of the country, the number of navigable rivers, creeks, inlets, render it very convenient for exporting and importing goods. The rich and plentiful gifts of nature likewise add to the happiness of the place; the three elements affording plenty of food for the use of man; and for the preserving of health many excellent herbs and roots, the discovery of whose virtues we owe chiefly to the Indians. As for the natural product of the country, we have for timber several sorts of oak, viz. the red, white, black, chesnut, water, Spanish and line oaks; which last bears a leaf like a willow. We have cedar, white and red; the red serves only for posts and groundsels, the white to rive or split into boards, that being the freest from knots. Here is a tree called cypress, which is very large, and bears a leaf like the sensitive plant; it is soft and spongy, will not split, and is fit for no use. We have black walnut, which is greatly esteemed by the joiners, for its grain and colour. Here is a sort of poplar, that makes good white plank: it is a large tree, and bears a flower like a tulip. We have also plenty of pine and dog-wood, which is a fine flower-bearing tree. Sassafras, locust, a tree of very quick growth, and very durable in building. Hickory, of which we have two sorts, red and white, this serves chiefly for fire-wood, being the best for that use. We have also plenty of chesnuts, and chinquapine, another species of chesnut; and a sort of elm like a Dutch elm, called the sugar-tree, from the sweetness of its juice, with which some have made good sugar. Here is also a sort of elder, whose bark is closely guarded with prickles, like those of a briar. Tulip-bearing laurel and myrtle of several sorts; one bearing a berry, with which they make in the eastern shore green wax, very proper to make candles if mixed with tallow.

Among the inhabitants of the air, which are very numerous, the humming bird is the most curious; they continue all summer feeding only on flowers, like bees. Of reptiles, the rattle-snake is the most noted: and what is commonly reported of its charming birds, squirrels, &c. is not groundless, having been affirmed to me by several eye witnesses.

As for the nature of the clime, the air is now more wholesome than formerly, which I suppose proceeds from the opening of the country, giving the air a freer motion. Our summers are not extremely hot as in the first settling; and our winters are generally severe. The north-west wind is very sharp in winter, and even in the heat of summer it cools the air very much. We have little or no woollen or linen manufacture, excepting what is made in Somerset county, over the Bay; because we are yearly supplied from England with necessaries: but tobacco is the standard for trade, not only with the merchants, but also among ourselves.

Our common drink is cyder, which is very good. We have wine from Madeira and Fayal, rum from Barbadoes; beer, malt, and wines from England. We have plenty of good grapes growing wild in the woods, but there is no improvement made of them. We are governed by the same laws as in England, besides some acts of assembly of a local nature.

The church of England is pretty firmly established. Churches are built, and there is an annual stipend allowed to every minister by a perpetual law, which is more or less according to the number of taxables in each parish; every christian male above 16 years old, and negroes, male and female, above that age, pay 40 pounds of tobacco to the minister; which is levied by the sheriff among other public levies which makes the revenues of the ministers, one with another, about 20000 pounds of tobacco, or 100l. sterling per ann.

On the first seating of Maryland there were several nations of Indians in the country, governed by several petty kings; now I do not think that there are 500 fighting men of them in the province, and those are most on the eastern shore, where they have two or three little towns. The cause of their diminishing proceeded from their own perpetual discords and wars among themselves, as being a scattered people under several heads, and always at variance with one another. One thing is observable in them, though they are a people very timorous and cowardly in fight, yet when taken prisoners and condemned, they die like heroes, braving the most exquisite tortures that can be invented, and singing all the time they are upon the rack.

END OF VOLUME TWENTY-FIRST OF THE ORIGINAL.

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*The Construction of a Quadratix to the Circle, being the Curve described by its Equable Evolution.** N° 260, p. 445. *Vol. XXII.*

1. By the equable evolution of a circle, I mean such a gradual approach of its periphery to rectitude, as that all its parts do together and equally, evolve

* This paper, which is anonymous, has much of the manner, style, and peculiarities, of William Jones, Esq. who soon afterwards made so conspicuous a figure in the Royal Society, and in the mathematical world.

or unbend; or so that the same line becomes successively a less and less arc of a reciprocally greater circle.

2. Let AHKA, fig. 8, pl. 11, be the periphery of a circle; AE a tangent to the point A. Let this circular line be supposed cut or divided at A, and then to unbend like a spring, its upper end remaining fixed to its tangent AE, while the other parts equally evolve or extend themselves through all the degrees of less curvature, as in ABD, AMC, &c. till they become straight in coincidence with the tangent AE.

3. Let AMC be the evolving curve, in any middle position between its first and last. Join the fixed end A, and the moving end C, by the chord-line AC, intersecting the first circle at H. That AMC is a like segment to ANH, cut off in the first circle, by the chord AH. For, by the supposition AMC is the arc of a circle, having AE a tangent common both to it and ANH, and both arcs are terminated in the same right line AC.

4. Hence the curve ADCE, described by the moving end of the periphery in its evolution, may be thus constructed. Let the circle AHKA be by bisections divided into any number of equal parts. Let H be one of the points of such division. Then say, as the number of equal parts in the arc ANA : is to the number of parts in the whole periphery AHKA :: so is the chord AH : to a fourth line, which let be AC in AH produced. So is C a point in the curve ADCE.

5. Dem. Upon AC describe AMC, an arc like to the arc ANH. Whence AH : AC :: ANH : AMC. But by construction, AH : AC :: ANH : periphery AHKA, therefore is the arc AMC equal to the whole periphery AHKA, and similar to the arc ANH. Consequently AMC represents the evolving periphery, in a position similar to the arc ANH, and C is the describing point.

6. After the same manner may be found other points through which the curve may be drawn. But here, as in the old quadratix of Dinostratus, the point E cannot be precisely determined, but the curve may be brought so near it, that its flexure or tendency will so lead to the point E, that AE shall be near enough to the truth for common uses.

7. Supposing the point E found, a tangent to any point of the curve may be drawn: and supposing a tangent drawn, the point E may be determined; the property of the tangent being this, that supposing RT a tangent to the point C, and CA, CE, drawn from C to each end of the rectified circle, the angle ACT (the lesser angle that AC makes with the tangent) is equal to the tangent made by the two lines drawn from C.

8. Let *c* be a point in the quadratix indefinitely near to C; and draw Ac intersecting AHKA in h, and AMC in o. To Ac as a chord, draw the arc Amc like to the arc Anh. To the point C of the arc AMC draw the tangent CL

= AE, and join LA: so is oc an indefinitely little particle of the arc coincident with its tangent.

9. Because of the like segments AnhA, AMOA, AmcA, as chord Ac : to chord LO :: so is arc Amc = AMC : to arc AMO. Or Ac : AO :: Amc = AMC : AMO. And dividing Ac — AO (= co) : AO :: Amc — AMO (= co, : AMO. That is, co : AO :: co :: AMO, and alternately, co : co :: AO : AMO. Put AC for AO, and AMC for AMO (as differing infinitely little) and then it is co : co :: AE : AMC. But by construction CL = AE = AMC; whence co : co :: AC : CL, and the angle LCA = coc, (oc being infinitely near to AC, is therefore parallel to it,) and therefore coc, ACL are similar triangles.

10. Because of CL = AE, ang. EAC = LCA, (CL and EA being tangents to the two ends of the same circular arch AMC, make equal angles with its chord AC,) and AC common to both, the triangles EAC, ACL are like and equal: therefore are all three coc, ACL, EAC, like triangles. Whence it follows, that the angle ACE, in the triangle EAC, is equal to the angle occ, in the triangle coc. But occ = ACT, because oc and AC are parallel; therefore ang. ACE = ACT. Q.E.D.

On the Circulation and Stagnation of the Blood in Tadpoles. By M. Leuwenhoeck. N° 260, p. 447.

M. Leuwenhoeck procured tadpoles of several sizes, the largest were arrived to such a magnitude, that their hinder legs stuck out from their bodies; and of the smallest 30 of them together made but the size of one great one: hence we must conclude, that the frogs lay their eggs, but very slowly; for it was already about a month's time since he had made his observations, when some amongst them appeared to be half grown.

The first observation he made of the motion of the blood, was in a small vessel, that was a little wider, than that a red globule of the blood could go through it, as A and B, fig. 9, pl. 11. This vessel, which is an artery, through which the blood coming from the heart from A to B, is impelled with great swiftness, divides at B into two branches, BC and BE. These two branches united again at D, where they continued united but a little way, from D to F, after which it divided again into two branches, FG and FI. These two branches run crooked, and were united again at H, where they made again somewhat a larger vessel, HK, and at K it united again into a larger vessel. Hence we must call these blood vessels, ABCDFG and ABEFI, arteries, because they carry the blood from the heart first in G and I; and the blood vessels GHK and IHK we must call veins, because they convey the blood to the heart again.

In another place Mr. L. saw the blood run in an artery that was so large, that about 20 of these red globules could run together at once through it. This was a great artery, in comparison to those abovementioned, and in this the blood moved very slowly, a small portion of which is delineated in fig. 10, at LM. Out of this blood vessel proceeded a less one, as MO. The blood in the vessel from L to M, had not so quick a motion as it had in others, because the blood in the vessel at R stagnated in a manner, so that no separated parts could be discerned in the blood, for it appeared there of one uniform red colour. Yet in the blood vessel MO the circulation was as swift as in any other vessel. Mr. L. was fully persuaded that the blue spots, occasioned by a fall or a bruise, were not stagnated blood that was stopped, and that this coagulated blood, which before it begins to corrupt, perspires through the skin with the sweat, by the following observation. The blood by R being thus without the least motion, it was by every pulsation of the heart impelled upwards from N to P, and the next moment it recoiled back again, and so backwards and forwards with an undulatory motion. As is known, if we use ever so great violence in the compression of water, yet we cannot press it closer together than it was before; so the blood being now impelled forwards through the heart, cannot be compressed into a less place.

This being so, we must conclude, that the tunic of the blood vessel between N and P, and also somewhat below N, is distended by every pulsation of the heart; and as soon as this uncommon distension is performed, so soon also does the tunic of the vessel contract again, by which the blood that was thus pushed forth is driven and forced to run back again.

Mr. L. after some time, observed the blood began to move, from P to R, after such a manner, as to be pushed back again; and he judged that the blood vessel MO was during his observation a little more distended, and of course more blood ran through it than when he first began to look on it. The blood in the vessel NS, wherein before was little or no motion, now ran as swift as in any other vessel. The blood vessel PQ, which was so small, that but one single particle of the blood could pass through it at once, and wherein at first view there was not the least motion to be discerned, now also began to flow; yet the particles of the blood that at first passed through it, were but few in number, and consequently far asunder. Further, all the blood from P to R was put into a motion, as well by being put forward, as by running back again, and that at every pulsation of the heart.

So that now it plainly appears, that the stagnant blood cannot only be made to move again by the motion of the heart, which we call the beating of the pulse, but also, that the coagulated red globules of the blood are dissolved again, and assume their first figure. And therefore there is reason to conclude, that the coagulated blood in any animal, occasioned by a blow or bruise, can in a few days be made to move again, it being taken for granted, that the heart of a man pushes out the blood about 75 times in a minute.

Now finding that in 14 days time the coagulated blood seems to vanish, and also considering that in this time the heart performs its pulsation 1080000 times, and that in each motion, into several vessels together, only the size of a grain of sand has been loosened and set a going, how much may be set a going in the time before-mentioned? Mr. L. could see, in the before-mentioned blood vessel, each impulse which the blood received from the heart.

Now if we conceive that the size of a cubic inch of coagulated blood is very much that is occasioned by a blow, and that seldom so much is coagulated at once, then we may easily comprehend that such coagulated blood, by so many motions as before-mentioned, may be loosened, and its motion restored again, if not in all, yet in most of the vessels.

At another time Mr. L. laid one of these tadpoles on a clean paper, for a little while before he came to look upon it, by which a small part of the tail came to be wounded, the skin being dry, and stuck to the paper, so that out of an artery in that part, which seemed to be so large, that 4 red globules of the blood could pass through it at once, some blood flowed out: yet that whereon his sight was fixed, not being half a hair's breadth from the wounded part, there proceeded a small branch of a vein, in which the circulation or flowing of the blood still remained, as if the artery had not been broken.

In fig. 11, TV represents the artery, wounded a little above V; VX shows the extravasated blood, VW the small artery, where the blood retained its full course, although it was so near the vein as TV, whence the blood flowed, and was extravasated. This seemed very strange at first; but on observing that the blood-vessel VW was united at W to a large blood-vessel that conveyed the blood to the heart, then this blood out of VW was carried on with so great swiftness, as if impelled from T to V; nay, in such a manner, that he imagined that if the vein at V was not united with T, but had only lain with its opening at V in the extravasated blood, that so the extravasated blood was only for a little while sucked up and conveyed through it.

Then Mr. L. saw a vein, where the motion of the blood seemed very uncommon; for example: let ab, fig. 12, be an artery in which the blood is impelled with great swiftness from a to b; then we must call bc, by which the blood is conveyed towards the heart a vein: but what name must we give to be, since, close by it there lay another artery, viz. dce, through which the blood was also conveyed from the heart, from d to c. Now if the vein bc be united with the artery de, as at c, and thus the blood be conveyed from c to e; bc must be called a vein, and the blood coming to c, and being there infused in ce, is the arterial blood, because it is carried there from the heart, it being certain that dce is an artery.

Amongst the rest Mr. L. had a tadpole before him, in which he could not perceive any motion at all of the blood, how attentively soever he viewed it; of which at first no reason appeared; till on contemplating this animal with the naked eye, he observed that the fore-part of its body was contracted, by which he imagined that the heart was oppressed so, that it could not force out the blood, and receive it back again. While he was considering this, the little animal made a very strong motion, beating its tail about, and bending his body, by which it got clear of the oppression it was under; and on viewing it again, he immediately perceived that the blood began to have a small motion and impulse in several vessels, which increased so, as at length to come to its motion, yet not with such velocity, as it would have had, if the body or the heart had not been oppressed. The motion of the blood in these tadpoles exceeds all the rest of small animals and fish that Mr. L. has seen.

Fig. 13, represents the tadpole of a frog, come to such a size, that it could make use of both its legs; and the fore legs were also discernible, but yet covered with the skin.

At last Mr. L. spied a small artery, which though it seemed so small, that only one small red globule of blood could pass through it; yet out of such a branch of a vein there still proceeded two other branches, in each of which the blood flowed, yet further asunder, and slower, than they had done before they came into the separated vessels. After this, he fixed his eye on the great artery and vein, which were so close to each other, that there was not above the distance of the 4th part of the breadth of a hair between them; and it happening that the animal, when he was viewing it, moved its head upwards and the tail downwards, the blood ran upwards in the artery, and downwards in the vein, and that with an equal velocity; yet, what was most remarkable was to see the manifold small arteries, which proceeded from the great one, and spread into several branches, and returning unite again in one, and which, at last, poured out the blood again into the great vein. These particles of the blood he computes, are so small, that a million of them cannot make up the bulk of a large grain of sand; and from thence may be conjectured, that such small vessels have branches or channels; for if they were not provided with them, the blood vessels in the thinnest part of the tail, where they meet, would not lie cross one on another, but must unite, which has not been observed to be the case.

An Ivory Bodkin cut out of a Woman's Bladder. By Mr. Proby. Communicated by Dr. Thomas Molyneux, F.R.S. N° 260, p. 455.

Dorcas Blake of Dublin, a lusty young woman, of a sanguine complexion, about 20 years old, being much troubled with a hoarseness, was very desirous to take a vomit for it: but her friends not consenting to it, she endeavoured to provoke vomiting, by thrusting her finger into her throat; which not answering her desires, she drew an ivory bodkin, of 4 inches long, out of her hair, and thrust the small end forward into her throat; on which she heaved so often as be out of breath, and was obliged to stand upright to draw some air; which she did without taking the bodkin out of her throat; and at that instant it slipped out of her fingers, and passed into her stomach. Though at first alarmed, yet she found no immediate inconvenience. The next day about noon, she felt a sharp pricking pain in the right side of her belly, lower than the navel: towards evening she felt the pain nearer her right groin than before, which hindered her from walking, and obliged her to go to her bed, where she lay restless all that night, by reason of the excessive pain. Next day a midwife searched her, and said she felt the end of the bodkin, but thought it was in a gut. Being sent for next night, in searching her by the anus I could not find it, but putting my finger into the vagina uteri, I felt the bodkin; and because she complained of a difficulty in voiding urine, I made use of my catheter, and felt it, as I conceived, in the bladder; but immediately trying a second time, I could not find it, which made me dubious for some time what to do. Within a fortnight after, in the presence of Dr. John Madden, and Dr. Thomas Molyneux, I conveyed a catheter into her bladder, where the bodkin was at that time very plainly felt. And in about ten days more, after duly preparing her body for the operation, I attempted to extract it, after the same manner as the stone from women; but having introduced the forceps into the neck of the bladder, I very readily took hold of the bodkin, but could not move it. I then passed my finger through the dilatation into the bladder, and tried to bring the whole bodkin into the bladder, but could not; nor could I turn it one way or another, but round like a spindle. I often seized it with my forceps, but found it impossible to remove it by reason of the position, which was the smaller end, resting on the inside of the ischium, as I imagine. Finding all my attempts to be fruitless, I despaired ever to effect it this way, which made me desist from farther trial for some time: but now the weather being more favourable, and her pains increasing, notwithstanding that she was frequently informed of the danger of the operation, by the physicians and me, yet by her daily importunity, I was prevailed to attempt the extracting of it in the manner of the higher operation for the stone, which was as follows, in the presence of Doctors Madden, Molyneux, and Smith. Having placed her in a convenient posture, I put my finger into the vagina uteri, and felt the bodkin lying close to it on the outside, whilst I held my finger there, I pressed with my left hand above the os pubis, where I felt the head or thicker end of the bodkin. I then removed my right hand, and desired Doctor Smith to put his finger into the vagina, as I had done before, and press hard against the bodkin, which he did and held it very firm and steady, whilst I made an incision about 1½ inch in length on the outside of the right musculus rectus, till I came to the bladder. I then passed my fore-finger and thumb into the wound, and got hold of the head of the bodkin, the substance of the bladder only being between ; upon which, with a small crooked bistory, I cut the bladder, and by gently pressing my finger and thumb the bodkin slipped out of the bladder between them, by which I very easily extracted it. I dressed the wound and put her into bed, and in less than a month she was perfectly cured.

The bodkin was cut out of her bladder exactly 9 weeks after she swallowed it. Only half the bodkin was in the bladder, and it was incrustated with a gravelly calculous matter; the other part was out of the bladder in the pelvis, the point resting on the ischium.

On the Viper and some other Poisons. By Sir Theodore De Mayerne ; and communicated by the late Sir Theodore De Vaux, M.D. and F.R.S. N° 260, p. 459.

Through some inadvertence this is a republication, verbatim, of Sir Theodore Mayerne's observation on the viper, &c. inserted in the 18th vol. p. 62, of the original Transactions, and in the 3d vol. p. 653, of this Abridgment.

A Letter from Dr. George Hicks, concerning the Saxon Antiquity mentioned N° 247 *of these Transactions; with an Account of his Book now in the Press at Oxford.* N° 260, p. 464.

Dr. Hicks thinks the picture in King Alfred's antiquity might be the picture of his patron St. Cuthbert, whom it is said, both he and his mother in one night dreamed they saw and heard speak the same words, in which he told them he should conquer the Danes, and be a great king, and bidding him be of good courage. This story of St. Cuthbert's appearing to King Alfred is at large in William of Malmsbury.

The title of the book mentioned above is as follows: Linguarum Vett. Septentrionalium Thesaurus Grammatico-criticus et Archæologicus. Accedit Catalogus Librorum Veterum Septentrionalium, tam eorum qui excusi sunt, quam qui in Membranis Scriptis nondum eduntur, quam fieri licuit, locupletissimus.

Account of a Double Pear. N° 260, p. 470.

This double pear had one part growing over and fixed in the other, not unlike an acorn in its cup. From the edges of the lower pear grew five leaves of different sizes, at almost equal distances from each other. The largest was an inch long, half an inch broad, as large again as the smallest leaf. These leaves grew out of the skin of the lower pear, and had no fibres rising from the carneous part of it. The largest leaf had a fibre of the size of a small hair, continued from the place where the leaf rises, just within the skin, and loose from it, to the pedunculus. The outer coat of the pedunculus was continued to the skin of the lower pear, and this skin to that of the upper. The inner fibres of the pendunculus go through the lower into the upper pear, and disperse themselves in it. The upper part was twice as large as the lower, and had several kernels in it, but the lower none at all.

Account of the Number of Persons who have been Christened, Married, and Buried, in the Towns and Villages of the Old, Middle, and Lower March, in the Year 1698. N° 260, p. 471.

The several numbers of all the particular towns, villages, and places in the above-mentioned districts, when summed up, amount to the following, viz. christenings 13776—marriages 3698—deaths 7139. So that the births were nearly double the deaths, and the births to the marriages rather more than $3\frac{1}{2}$ to 1.

The Method of the Transmutation of Copper into Brass, &c. By Thomas Povey, Esq. F. R. S. N° 260, p. 474.

In like manner this is a republication of Mr. Povey's paper, inserted in the 17th vol. of the Transactions, p. 735, and in the 3d vol. p. 535, of the present Abridgment.

Account of a Book, viz. Recherches sur la Nature et la Guerison des Cancers. Par Mr. Deshayes Geudron, Docteur en Medecine de l'Université de Montpellier. A Paris, 1700, *in* 8vo. N° 260, p. 476.

Mr. Geudron thinks that true cancers are seldom extirpated with success, and that this operation is only suited to those "whose basis ends at once, and which do not send strings to the neighbouring parts." Among topical applications, by way of palliation, he recommends the belladonna or solanum lethale. To the juice of this plant he adds saccharum saturni. Another application which he mentions is made of a porous stone found in la Beausse, calcined, and several times extinguished in vinegar. This, it is stated, he has much improved by mixing with it the sulphurs of iron, copper, and lead.

Beds of Oyster-shells found near Reading in Berkshire. By Dr. James Brewer. N° 261, p. 484.

These shells have the entire figure and matter of oyster-shells, and doubtless are such. The compass of the ground where they are dug up is near 6 acres. Just above the layer of these oysters there is a greenish earth, or rather sand, and under them chalk. I have often seen in several chalk-pits a few scattered oyster-shells. But in this place they are as it were one continued body, and in an even line, through the whole extent of the ground.

This stratum of green sand and oyster-shells is about 2 feet thick. Immediately above this layer of green sand and shells, is a bed of a bluish sort of clay, very hard, brittle, and rugged, called a pinny clay, and is near 3 feet thick; and immediately above it is a stratum of fuller's earth, which is near 2½ feet deep, often used by the clothiers; and above this earth again is a bed of a clear, fine, white sand, without the least mixture of any earth, clay, &c. which is near 7 feet deep; then immediately above this is a stiff red clay, being the uppermost stratum, of which tiles are made. The depth of this cannot be conveniently taken, it being so high a hill, on the top of which is dug a little common earth, about 2 feet deep, and immediately under appears this red clay. I dug out several whole oysters, with both their valves or shells lying together, as oysters opened before. These shells are so very brittle, that in digging, one of the valves will frequently drop from its fellow, but it is plainly to be seen that they were united together, by placing the shell that drops off to its fellow valve, which exactly corresponds. I dug out several that were entire, nay, some double oysters with all their valves united.

An Account of Giants. Occasioned by some further Remarks on the large Human Os Frontis, or Forehead-bone, mentioned in the Phil. Trans. of Feb. 1684-5, N° 168.* *By Dr. Thomas Molyneux.* N° 261, p. 487.

The os frontis in the anatomical school at Leyden, though it be so vastly large, cannot in the least be suspected to have appertained to any other animal than a man, being complete every way, and answering in all particulars to the common forehead bone of other men, excepting its magnitude; especially if we

* Abridgment Vol. III. page 121.

consider that the os frontis of a man is of so peculiar a make from the globose shape of the head, that no bone among all the animals of the creation bears any resemblance to its figure, excepting that of a monkey, but all this genus is of a much smaller size than a man. In order rightly to understand and to form a clear conception, both of the agreement in shape and of the remarkable difference in size between this great os frontis and the same bone in a man of ordinary stature, and the better to apprehend what deductions may be made from hence, to determine the true height of the person to whom it formerly belonged, we must have recourse to the figures. Of these, fig. 15, pl. 10, shows the common shape and size of an os frontis, or forehead bone of a man of an ordinary stature, convex or outside forwards; abcde is the line the coronal suture makes with its indentures, surrounding the upper edge of the bone, and by which it is joined to both the ossa bregmatis or verticis; e the place where the coronal and sagittal sutures meet; f the part to which the bones of the nose are fastened; gg the upper part of the orbits of the eyes; hh the holes in the bone over the eyes, which give passage to the two large branches of nerves that supply the frontal muscle, and those of the eye-brows; ii the two processes, or protuberances, that join with the first bone of the upper jaw, which by some accident were broken off the large bone, and therefore are not expressed in the following figure.

The measure round the ambit of the coronal suture, from a to g, was $10\frac{1}{10}$ inches, in this bone from c, where the coronal and sagittal sutures meet to f, where the bones of the nose are fastened, $4\frac{1}{2}$ inches; from b drawing a transverse line across the forehead to d, 6 inches; the thickness of the bone about a quarter of an inch.

Fig. 16 represents the gigantic forehead-bone, in the same posture with the former, and drawn exactly to the same proportion.

Here we may remark, not only its extraordinary magnitude in comparison with the foregoing figure, but also its natural and true proportions, every way agreeable to its large dimensions, that is, as to its circumference, height, breadth, and thickness, in all which respects it bears, to the greatest exactness, a conformity to the symmetry or common rules of nature.

abcde is the coronal suture, in some place a little worn and defaced; c the place where the coronal and sagittal sutures meet; f the part where the bones of the nose were fastened; gg the upper part of the orbits of the eyes; hh the two holes for the nerves that pass into the muscles of the eye-brows and the frontal muscle.

The measure round the ambit of the coronal suture in this bone, from a to e, was about 21 inches; from c where the sagittal and coronal sutures meet, to f, where the bones of the nose are fastened, $9\frac{1}{10}$ inches; from b drawing a transverse line across the forehead to d, $12\frac{2}{10}$ inches; the thickness of the bone, from one table to the other, about half an inch.

Fig. 17 shows the reverse or inside of the same bone, drawn likewise in the same proportion. What is most observable in this figure, is the great thickness of the bone marked kk, which could not appear in the other posture; and the sharp and high process of the os cribrosum, called crista galli, marked l.

By comparing these figures, it is evident what an exact conformity there is in all particulars between this large bone, and the like bone in a man of an ordinary height; and that they differ only in magnitude; and as to the difference in size, the dimensions of the larger were more than double those of the smaller; whence it follows that this great os frontis was above twice as large every way as a common bone of this sort in a full grown man. And arguing from the proportion that the same bone in other men bears to their height, it must follow that the man to whom this os frontis belonged, was more than twice the height that men usually are, according to the common course of nature. And setting down, as the most moderate computation, but $5\frac{1}{2}$ feet for the height of a man, he to whom this bone belonged must have been more than 11 or 12 feet high.

It cannot reasonably be supposed, that a man of an ordinary size and stature could have had such an exceedingly large head; for it cannot be conceived how such a one could possibly subsist while so ponderous and excessive a mass of bone as this skull, with all that quantity of brain requisite to fill its spacious cavity, was growing; much less continue so long alive as to come to maturity of years, to which it is certain this person must have attained, by the great thickness and solidity of this bone, as well as its large size. And though it is true, that sometimes from obstructions or other morbific causes, our glands and softer viscera are so unequally nourished as to grow to an immense size; yet such a preternatural excess of growth in a hard and bony part has never yet been observed. And if it should be alleged that infants far gone in the rickets, are frequently observed to have great heads in proportion to their small emaciated bodies, and that young children are also liable to another malady, called hydrocephalus, or dropsy in the head; which sometimes so dilates it, as to swell their skull to a more immense size; but neither of these disorders otherwise affect the head than by a preternatural collection of serous humours inclosed in the brain, which extend the yielding sides of the weak and tender skull, but do not in the least increase its bony substance, nay, on the contrary, they rather diminish it; for it is always observed that they reduce it to a more than usual thinness, and sometimes to be no thicker than an egg-shell or parchment.

Nor can such distempers possibly affect those of adult ages, so as to enlarge their skulls; because all the bones are by that time become solid and firmly knit together, so as to be incapable of further growth; and hence it is that these maladies are incident to children, and them only, whilst their skulls are membranous, rather than bony. And daily experience assures us, that unless such diseases be timely removed by the physician's or surgeon's art, or overcome so early by the strength of nature, as that the children have time enough to outgrow this disproportion in their heads, by the bulk of their body coming up to it before it arises to too exorbitant a degree of magnitude they all die in their infancy, and their unshapely skulls are easily distinguished from all others by the large fontanel, or aperture in the vertex of the head, which remains membranous, and never becomes like the rest of the skull, a bony substance. And that they cannot possibly arrive at manhood is plain; for this monstrous and unequal growth, or rather swelling of their heads, meeting with no restraint, but still increasing, when it arrives to such a certain degree, that its extravagant dimensions become inconsistent with the natural functions of the body, the animal economy must sink under the pressure of such a load, and the whole machine tend to its dissolution, as not being able to bear any longer with so highly morbid a disposition, in so principal and necessary a part of life as the brain.

I shall not deny but by some accident a disproportion sometimes between the head and rest of the body, in such as are grown up to the complete stature of man, sometimes happens; yet a disproportion of this kind, though it may be very conspicuous, and presently taken notice of as unseemly, is never so extraordinary as to be very considerable in itself. For, the circumference of a man's head of the common size, is usually about 22 inches; and if we chance to see one of 25 or 26 on a man of ordinary height, which certainly is very rare, it appears large and remarkable; but should there be found a head still larger, as of 28 or 29 inches in ambit, which, for the reasons above-mentioned, has scarcely ever happened, unless where the proportion of the other parts of the body were such as necessarily required it, such a one would be accounted monstrous. Yet the circumference of the head, of which this large forehead-bone was a part, amounted to something above a third part more than the largest of these measures; for I compute its dimensions, when entire and covered with the hairy-scalp, to have been about 44 inches round, and therefore must have had a body belonging to it that bore a proper conformity to this spacious circumference.

Nor do I apprehend so great a stature as this in a human body, though it be indeed extraordinary, any way absurd or repugnant to the course of nature;

but rather, if duly weighed, very conformable to a certain anomalous method, that she apparently affects in most of her productions.

Thus, to take an instance from her vegetable kingdom, we cannot but observe among trees and other plants, though of the same species, that some are of a dwarf kind, while others arise to so stupendous a growth, that they more than double the bulk even of such as are esteemed large in the same tribe. And among animals, if we compare that small low race of horses, some of which I have seen not much larger than a large dog, we have from the Isle of Man, usually called Manks horses, to that lofty, large, and stately breed they have in Northamptonshire in England, or in the Bishopric of Liege in Flanders, we may properly enough esteem these in comparison with those a sort of gigantic horses. And the same may be said of the Irish wolf-dog, of the greyhound kind, and of so beautiful and large a make, that for its curious form, as well as size, it far surpasses all other dogs of the creation, and if compared to a common greyhound, shows itself truly of a gigantic breed; and we may further add concerning it, as the giants' stock of old is extinct, at least in these countries, so this gigantic dog is now so rare, that in a few generations more I doubt not but it will be quite lost in these parts, and the species may perish from the face of the earth.

That nature also takes the same uncertain measures in the generation of mankind I think is not less apparent. Thus, the Laplanders are remarkable for their low stature, and it is certain that there are, and have been, dwarfs in all ages and countries, and some of them of a very extraordinary small size of body, not above 30 inches in height, and some even lower.

Now since natural causes operate so as to produce human creatures partaking of all properties common to their kind, and of so small a model as to fall short even of half the common standard, it cannot be unreasonable to imagine the same natural causes may sometimes act in the other extreme, and produce instances of twice the height of a middling stature.

There is a manifest alliance and congruity observable in nature, between the stature of a man's body, and his age during the time of his growth; and as $5\frac{1}{2}$ feet may well be esteemed the most settled and ordinary degree of height in a man, so about 70 years may justly be allowed the most common period of his age: we have daily instances of exceptions; Thomas Parr and Henry Jenkins, both of England, and the old Countess of Desmond and Mrs. Eckleston, both of Ireland, who fully completed double the usual term of life; so we have no reason to question the accounts given us of others, that have been found in stature double the common standard of man. Nay both longevity and high stature naturally so result from their proper causes, that they are often observed to become hereditary, and run in whole families; whence the Greeks had their Macrobii, and the Romans their Celsi; and in Palestine of old they had their Anakims, or sons of the giants. So that human gigantic bodies are nowise inconsistent with the course of nature. And indeed we have testimonies from authors of unquestionable credit, that there have been men in the world, and it is likely there still are, of such stature, as properly to deserve the name of giants.

The first I shall mention was one I saw and measured at Dublin, in the year 1682, his name Edmond Malone, who measured 7 feet 7 inches. Walter Parsons, porter to King James the First, born in Staffordshire, was nearly of the same stature; and I find several other men born in England who have arrived to this height.

Isbrand Diemerbroeck, in his Anatomy, tells us, that he saw at Utrecht, in 1665, a man 8½ feet high, all his limbs well shaped, and his strength proportionable to his height; he was born at Schoonhoven in Holland, of parents of an ordinary stature. Mr. Ray in his Travels, mentions having seen this man at Bruges in Flanders. Johannes Goropius Becanus, who lived in Flanders, has recorded several instances still more remarkable; he says he saw a youth almost 9 feet high, a man near 10 feet, and a woman quite 10 feet in height. Pliny the naturalist particularises by name several men in his own age much of the same height as those mentioned by Becanus.

To these histories we may add the many concurring testimonies given us by various travellers of gigantic men seen in their voyages in the more remote parts of the world. Andreas Thevet, in his Description of America, tells us, that he was shown by a Spanish merchant the skull and bones of an American giant, who was 11 feet 5 inches in height, and died in the year 1559: he showed them to M. Thevet, who took the measures of the principal of them; the bones of the legs measured 3 feet 4 inches in length, and the skull was 3 feet 1 inch about. Which circumference is exactly proportionable to the length of the legs, and if we make an allowance for the hair and skin that covered the skull when he was alive, it falls very little short of the dimensions we have before set down, in computing the size of our giant's head when it was entire.

From these warrantable histories, and this particular bone before us, we may clearly deduce that there have been human bodies 11 or 12 feet high; equal to the stature of the tallest giants mentioned in holy writ. For the height of Goliah of Gath, is expressly said to be but 6 cubits and a span; and taking a cubit in the most usual acceptance for a foot and a half, his stature will not amount to above 9 feet 9 inches. Indeed we may reasonably conclude, that Og the King of Basan must have considerably exceeded Goliah in height, if we make an estimate of his stature by the dimensions of his bedstead, which is said to have been kept as a memoral of him at Rabbath of the children of Ammon, and to have been 9 cubits in length; but then we cannot imagine but that his bed must of necessity have been much longer than his body; and the least allowance we can make for the overplus is the space of nine inches above his head, and as much below his feet; and if we make this deduction it will follow he was not above 12 feet high; much of the same standard with this giant, whose forehead bone is still kept in the Medical School at Leyden.

An Account of the Number of Persons Married, Christened, and Deceased in all the Dominions of the Elector of Brandenburgh, in the Year 1698. N° 261, p. 508.

The amount of all these was as follows, viz.—Married 18298—Christened 67763—Deceased 44678.

On the Worms in Sheep's Livers, Gnats and Animalcula in the Excrements of Frogs. By Mr. Antony Van Leuwenhoeck. N° 261, p. 509.

I have been considering the animal our butchers call maggots, which are often found in the livers of sheep,* in wet summers. When the sheep have drunk water where these animals were, they are carried with their food, out of the stomach into the beginning of the guts, where the gall bladder empties itself, and being pleased with the taste of the gall, they swim against it into the bladder itself, and thence go into the vessels (like veins and arteries) of the gall.

To try to discover the animals in the water, I went in August into several pasture grounds, where sheep feed that were troubled with these diseases, and there I took up some water in a clear glass out of the ditches, which I examined with a more than ordinary magnifying-glass, and observed that several sorts of animalcules swam in it. The greater kind of animals were those that produce gnats, which have stings, and annoy both men and beasts. One sort of the animals generally sunk to the bottom, as soon as they ceased to move their bodies; and when in moving they came to touch the surface of the water with any prominent part, then their heads hung down, and they remained hanging by the surface of the water. The 2d sort of these animalcules could not remain at the bottom, but were generally carried towards the surface of the water, where they remained hanging by 2 horns that came out of the upper

* Fasciola hepatica. Linn.

part of their body, and when they would sink, they made a strong and violent motion, by means of a transparent instrument fixed on the end of the tail.

The two sorts of gnats proceeding from these animals had stings; they placed themselves on the glass, and sat down also sometimes on the water, spreading out their long legs over it. I saw also many large round particles, of the size of a grain of sand drive and move in the water; and when I brought these particles before the magnifying-glass, they not only appeared round, but had the outward skin set over with many protuberant parts, which seemed to be triangular, and pointed towards the end;* so that on the great circle of the roundness stood such particles, all orderly and equally from each other, that on a small body stood about 2000 of them, which never lay still, and their motion proceeded from their turning round; and the smaller these particles were, the greener was their colour; and on the contrary, in the greatest, that were as large as a grain of sand, no green colour was to be discerned on the outside. Each of these particles included 5, 6, 7, nay, some 12 small round globules, of the same shape with the body in which they were included.

Among the rest I observed, that the outward part of one of the greatest particles began to open, and that one of the round particles within it, which was of a delicate green colour, slipped out, and began to move in the water as that part had done, out of which it proceeded. After this, the first round particle remaining motionless, and soon after the 2d and 3d particles slipped also out, one after the other, and so by degrees till they all came out. After some days, the first round particle united again with the water, for I could perceive no signs of it. And in all the motions I saw in the first round particle, I could not observe that the included particles changed their place, nor touched each other, but remained equally distant.

Now as there was a great many of the said round particles in one glass, wherein were also a great many living creatures, I observed that in 3 days time they were all gone, so that I could not discern any of the said particles in the glass. I had a glass tube of about 8 inches long, fig. 1, pl. 12, and of the thickness of a goose quill, wherein I had put some drops of the water, as CD. I left one end at A open, and the other end B stopped up with a piece of cork, so that between D and B was nothing but air, that the water might not run out of the tube when it was handled; which being shut up in the tube, it cannot remain of the same magnitude or expansion, but changes every moment; for

* The animalcule here described is the *volvox globator.* Linn. It is occasionally seen in vast quantities in stagnant waters, and varies in colour, being sometimes found of a green tinge, and sometimes yellow.

1

you cannot come near that tube with your hand, breath, or any part of the body, that is a little warmer than the surrounding air, but the air in the tube is also expanded, which puts the water into motion, and is forced from D to A, although we perceive no motion with the naked eye. Now as the least warmth expands the air included in the lesser tube, so the warmth is also soon over, and the water receives another motion from C to B.

In this water there were two of the said small round particles of the greatest sort, in each of them were included 5 smaller round particles, which inclosed particles were pretty well grown in size, and in a 3d large particle lay 7 lesser round ones, which were incomparably small. Four days after the said particles had been put into the tube, I saw that the outer pellicle of two of them, which was exceedingly thin and transparent, was broke in pieces; and that the 10 particles included in the two great ones, by the motion of the water moved from one side to the other. I observed further, that after the expiration of 5 days, the small particles included in the third great particle, were not only increased in size, but I could also discern that from the inside of the small particles proceeded other round ones. After the expiration of 5 days more, the 3d round particle was also a little broken open, and the particles that lay there in it were also got out; and although it was open at one side, yet it turned round in the water, as nimbly as ever it had done before.

Some days after I could not discern any, but only some small particles, of which the great one consisted, which also vanished in a little time. I never missed a day without looking on the small particles that came out of the greater one, and observed that they not only increased in size, but that the inclosed particles also grew larger. In the latter end of September, I perceived that the inclosed particles were not so exactly round as the great ones that included them; and also that some of them were protuberant, and that the last particles that came out of the great ones, not being round, lay against the side of the glass without any motion. Now the last greater particles, when they were discharged of their inclosed particles, or were broken in pieces, were about 4 times less than those that came out of them; wherefore I concluded that they had not their full growth, or not their full food. I have also observed, that the said round particles are of an equal weight with the water; so that by the least motion the water received from the air, they were also put into motion.

In fig. 2, EF shows one of the larger particles, with its enclosed ones, that were increased so much in size that they were ready to be emitted, which lay more regularly here than in any of the rest, where there was not the ordinary motion, which made me believe that this was only caused by the inclosed particles not lying all equally distant from their centre, and that these that lay farthest from the centre, made the one side of the round particle heavier, which hindered the motion.

When I perceived that the great number of round particles in the great glass, mixed with a great number of animalcules, were gone in 3 days time, I considered whether these particles were not created as food for these animalcules. Now when we see that the globules before-mentioned do not proceed from themselves but by procreation, as we know that all plants and seeds are procreated, each seed though ever so small having its plant inclosed within it; we are now more than ever assured of the procreation of all things. As for me I set it down as a certain truth, that the small round particles, found in the great ones, are seeds, and that without them the round particles could not be produced.

I caught a small frog, which I judged had been an egg the preceding spring, and putting it into a glass tube, an inch wide and 10 inches long, I stopped both the ends up with cork, yet in such a manner, that at one end the air had free admission. I here viewed the toes of the fore-legs with a magnifying-glass, to observe the circulation of the blood, which I could not discern without great difficulty. But when I came to view the hindermost legs, I saw for several days successively, on the web-skins between the toes, the blood circulate in several very small vessels. I also observed that when the frog stretched out its leg, the circulation of the blood was thereby stopped for a little time, but as soon as it stood still, the blood began to circulate again. After the frog had been about 24 hours in the tube, I saw its excrements, as it were on a heap. After it had been there 48 hours, it had fouled again; and looking on the excrements with a magnifying-glass, in the first excrement I saw that it had fed upon an animal, whose body was beset with hair of several thicknesses, very sharp pointed, which I judged to be of some flying insect; when I viewed the second excrement, I saw no hair, at first; but upon laying it asunder, I saw not only some hair, but also a piece of the foot, part of the eye, a piece of a wing, and many pieces of the skin of an animal, which I judged to have been a small insect, whose wings are covered with a sheath, very like those called beetles. These excrements lay in a clear moisture round about them, wherein swam or crept some eels, or about 30 small worms, the fore and hinder-parts of whose body were very clear.

These eels in the frog's excrement, are very like those found in vinegar, if not altogether the same; only with this difference, that the eels of the vinegar, as they come out of the mother, are somewhat thinner and harder.

In the first excrement I discovered only 2 of these eels. When I looked the next day, and saw that the moisture wherein the small eels swam, was partly evaporated, and that the eels moved but very little, I put a little rain water round about the excrements wherein all the worms and eels were, which water I put into a small glass tube, wherein were six eels, thinking to keep them alive, and to observe whether they would breed any young ones. Yet I found the contrary; for they moved less, and within a few hours after some were quite motionless; and the next day I saw, after strict examination, only a part of an eel. Hence I must conclude, that the eels were dissolved in the water.

The frog had so moved about in the glass tube, that he had so separated the first dung, that I saw almost a whole wing of a flying insect, about the size of a gnat, and this was almost quite entire, so that I could see perfectly the great number of small hairs which grew all over the outside, and also on the edge of the wing. Underneath this wing I saw 3 of the said eels, and another in another place, which had still a strong motion. On the 4th day after the excrements were made, I saw some eels alive, as well above as under the wing; and as the moisture wherein they lay, was but very small, so was their motion but little; and afterwards I could perceive no motion at all.

From these observations we may very well conclude, that the water was not proper for these eels; and that they either came out of the ground, or that the animals the frog fed upon were loaded with them. On the 5th day the frog had dunged again, and it lay oblong against the glass, without any moisture at all. I took it out of the glass, and spread it abroad, because it was blacker to the eye than the former, and saw that there were also parts of flying insects; and among this stuff also lay several of the before-mentioned eels, but they were all dead, and somewhat less than the former.

Account of the Houses and Hearths in Dublin, for the Years following. Communicated by Captain South. N° 261, p. 518.

	Houses.				Hearths.			
	Good.	Poor.	Waste.	Total.	Good.	Poor.	Waste.	Total.
Jan. 1695-6	4665	485	849	5999	24402	1080	3439	29220
1696-7	4905	502	717	6124	25366	1227	2627	29519

In the total of hearths there are included 229 which are in colleges, &c. and are not reckoned in the first three columns.

A List of all the Seamen, Fishermen, Boatmen, and Sea-faring Men, of every Kind, in Ireland, in 1697. *Communicated by Capt. South.* N° 261. p. 519.

Seamen, 1158; Fishermen, 2315; Boatmen, 951.—In all, 4424. Whereof are papists, 2654.

Account of the Number of People in the Counties of Armagh, Lowth, and Meath, and the City of Dublin. With an Estimate of the Number of People that were in the Kingdom of Ireland, Jan. 10, 1695-6. *Communicated by Capt. South.* N° 261, p. 520.

County of Armagh, 25640; County of Lowth, 17203; County of Meath, 43319.—Total of these three Counties, 86162.—City of Dublin, 40508.—In the rest of the kingdom, according to the first quarter's assessment of the poll, there are, in proportion to the above three counties, which were very exactly returned, 907432.—Grand total, 1034102.

An Account of the Romish Clergy in Ireland, in 1698. *By the same.*

Counties.	Reg.	Sec.	Counties.	Reg.	Sec.	Counties.	Reg.	Sec.
Cavan	5	29	Kerry	19	23	Longford	15	22
Fermanagh	6	13	Tipperary	48	39	Roscommon	24	52
Donegal	22	24	Londonderry	5	15	Leitrim	13	20
Tyrone	7	22	Wicklow	6	15	Sligoe	31	31
Downe	4	15	Wexford	16	24	Mayoe	42	50
Antrim	5	13	Kildare	9	16	Gallway	39	45
Armagh	4	10	Lowth	12	14	Meath	19	23
Monoghan	5	20	Carlow	8	8	Dublin	1	26
Waterford	16	23	Kilkenny	17	30	Drogheda town	4	2
Limerick	15	51	King's County	13	19			
Clare	18	43	Queen's	1	16		495	872
Cork	30	97	Westmeath	16	22			

Shipped for Foreign parts, by act of Parliament, the number of regulars following, their passage and provisions being paid for by the Government, viz.

From Dublin. . 153. Gallway. . 170. Cork. . 75. Waterford. . 26.—Total 424.

The Way of making several China Varnishes. Sent from the Jesuits in China, to the great Duke of Tuscany. Communicated by Dr. William Sherard. N° 262, p. 525.

Take of crude varnish 60 ounces, ordinary water 60 ounces, mix them well together till the water disappears, afterwards put this matter into a wooden vessel 5 or 6 palms long, and 2 or 3 broad; mix them with a wooden spatula, for a whole day in the summer's sun, and for two in the winter. It is afterwards kept in earthen vessels with a bladder over it, and this is the varnish prepared in the sun.

The Way of boiling the Oil of Wood, called by the Portugueze Azeite de Pao.—Take 20 ounces of the oil of wood, 10 drams of that of the fruit. Give them 5 or 6 boilings, till it comes to be a little yellow. Let it cool, and put to it 5 drams of quick-lime powdered.

To give the first Grounds called Camiscia.—Take swine's blood and quicklime powdered, mix them well; lay this mixture on the wood, and when it is dry, smooth it with a pumice stone.

To make the black Varnish.—Take of the varnish prepared in the sun 60 ounces, stone black alum, (supposed to be a sort of copperas,) dissolved in a little water, 3 drams, 70 drams of lamp oil, called by the Portugueze azeite da candea. It is prepared in a wooden vessel as the prepared varnish, observing to put in the lamp oil at twice.

To make the Varnish of the Colour of Pitch.—Take of the oil of wood crude, called de pao, 40 drams; of the lamp oil called de candea, crude, 40 drams; it is prepared in the sun in a wooden vessel as the prepared varnish.

To make red Varnish.—Take 10 drams of cinnabar, 20 drams of varnish prepared, a little oil de candea or lamp oil; mix them well.

To make yellow Varnish.—Take of the yellow colour 10 drams, 30 drams of prepared varnish, with some lamp oil.

To make Varnish of a Musk Colour.—Take of the red varnish 10 drams, of the black varnish 4 drams, mix them well.

Part of a Letter from the Rev. Mr. Derham to Dr. Sloane, giving an Account of his Observations of the Weather for the Year 1699. N° 262, p. 527.

Contains the usual columns of barometer, thermometer, rain, wind, &c.

Mr. Derham adds, I observed last year, that the highest pitch I ever found the mercury at, was 30.40 inches. But Dec. 22 last, the weather being misling and wind northerly, it rose to 30.50 inches, the highest I ever saw it at Upminster.

Concerning the exact Quantity of acid Salts contained in acid Spirits. By M. Homberg. Communicated by M. Geoffrey, F. R. S.* N° 262, p. 530.

M. Homberg, chemist to the Royal Academy, in a discourse before them, observed, that though we have a very sure way of measuring the quantity of solids, by balances and ordinary weights, yet we cannot come to the same pre-

* M. Homberg was a zealous cultivator of chemistry. His father was a Saxon, but the son was born at Batavia, in Java. He was early brought to Europe, studied in Germany, and after much travelling in various countries, settled in Paris. He furnished many communications to the French Academy of Sciences, and died in 1715, aged 63. He was the discoverer of the boracic acid, (which he called sedative salt,) of the phosphorus which goes by his name, &c. &c.

cision in liquors; and still less can we know the precise quantity of the different matters contained in those liquors; as, what is the quantity of acid volatile salt contained in acid spirits: but for that purpose he has contrived a new areometer, or a measure of liquors, which is thus described:

A, fig. 3, pl. 12, is a glass bottle like a small matrass, of which the neck BC is so small, that a drop of water in it takes up the space of 5 or 6 lines; near that neck is a small capillary tube D, about 6 lines long, and parallel to the neck BC; in the opening at B it is a little dilated, in fashion of a tunnel, for pouring more easily the liquors in the bottle; and the little tube D is for giving a vent to the air contained in the vessel when the liquor is poured in B; the point C is a little mark at the same height as the end of the little tube D.

When the vessel is filled with some liquor for the experiments, it is poured in by the opening B, until it goes out by the small tube D; and if the height of the liquor is even with the mark C, it is right; if lower, we must fill more to that point; if higher, we must strike softly on the opening B, till the overplus of the liquor be even with the point C in the neck of the bottle. By that means we have always exactly the same volume of liquor, and we can know how much the same volume of the several liquors weighs precisely, the one more than another; but as the volume of liquors is not always the same, and changes according to the alteration of the weather, we must consider the variation of the weather, when making the experiments at several times, and when we will compare the weight of the liquor weighed in summer time, with the weight of another weighed in winter; for the same liquor being more rarefied in the hot season, the same volume of it will be more weighty in cold weather than in warm; for this purpose M. Homberg has given a table of the various weights of the most usual liquors in the coldest and hottest seasons, as follows:

	In Summer.			In Winter.		
	℥	ʒ	gr.	℥	ʒ	gr.
The areometer full of mercury	11	0	6	11	0	32
Full of oil of tartar	1	3	8	1	3	31
Spirit of urine	1	0	32	1	0	43
Oil of vitriol	1	3	58	1	4	3
Spirit of nitre	1	1	40	1	1	70
Spirit of salt	1	0	39	1	0	47
Aqua fortis	1	1	38	1	1	55
Vinegar	0	7	55	0	7	60
Spirit of wine	0	6	47	0	6	61
River Water	0	7	53	0	7	57
Distilled water	0	7	50	0	7	54

This empty areometer weighs 1 dram and 28 gr.

By this table it appears that all liquors, and even mercury itself, are condensed and rarefied in cold and hot weather.

For the quantity of the volatile acid salt contained in the acid liquors, M. Homberg declared first what he means by this salt, and says, the acid spirits are no other than a salt dissolved by a little water, its taste and effects showing it to be an acid. He calls it volatile, because it is raised by the fire with the phlegm, and it can hardly be separated from it, and reduced in a dry form. He has shown the way to know the quantity of salt contained in a determined quantity of acid spirit, viz. by the weight of its volume compared with the weight of another spirit, of which the quantity of salt contained in it was known, 1st. he poured on an ounce of salt of tartar well dried; as much acid spirit as the salt of tartar could take up; then he evaporated all the insipid phlegm out of this salt, and he weighed the matter; the quantity of its weight, above the weight of the salt of tartar before saturation, is the quantity of acid volatile salt contained in the quantity of acid spirit which has been taken up by one ounce of salt of tartar. Here is the table of the quantity of acid that has been necessary to the perfect impregnation of the salt of tartar; and by the same means the table of the quantity of acid volatile salt, contained in one ounce of several acid spirits.

For the perfect impregnation of 1 oz. of salt of tartar, there was poured on it 1 oz. 2 dr. 36 gr. of spirit of nitre; the weight of that salt after the evaporation of the insipid humidity was increased to 3 dr. 10 gr. above 1 oz., that increase from the acid remaining in the salt of tartar, shows that 1 oz. of spirit of nitre contains 2 dr. 18 gr. of acid salt.—So for the impregnation of an ounce of salt of tartar there was poured upon it 2 oz. 5dr. of spirit of salt, and the increase after the evaporation has been found 3 dr. 14 gr. and therefore 1 oz. of spirit of salt contains 1 dr. 15 gr. of acid salt.—Upon an ounce of salt of tartar was poured 5 dr. of oil of vitriol, and the increase was found 3 dr. 5 gr.; therefore an ounce of oil of vitriol contains 3 dr. 15 gr. of acid salt.—Upon an ounce of salt of tartar was poured of aquafortis 1 oz. 2 dr. 30 gr. the increase was found of 3 dr. 6 gr.; therefore an ounce of aquafortis contains 2 dr. 26 gr. of acid salt.—Upon an ounce of salt of tartar has been poured of distilled vinegar 14 dr. the increase was found of 3 dr. 36 gr.; therefore an ounce of distilled vinegar contains 18 gr. of acid salt.

It appears by this table, that the quantity of acid salt for saturating the salt of tartar is nearly the same, though the quantity of acid liquors should be very different; it is only the acid of vinegar of which the salt of tartar retains more than it does of the others, that M. Homberg attributes to the subtilty of the particles of the vegetable acid, which have been very much divided by the alterations in the fermentation of the liquors in the plants, &c. of the wine, and also in the distillation, which alterations the mineral acid has not received. The vegetable acid by that subtility of particles is able to impregnate a greater quantity of liquor than the same quantity of mineral acid, and by that it is more easily raised by the fire than the others.

By these observations M. Homberg makes evident the reason of some cases difficult to be explained without them; as it is well known that one ounce of aqua regia, compounded with the spirit of nitre and the ammoniac salt, dissolves twice more gold than an ounce of the spirit of salt can do. Chemists attribute that effect to the softness of the points of one acid, and to the hardness of the other; when these observations show evidently that the spirit of nitre contains twice more acid salt than the like volume of spirit of salt, and points out at the same time the true cause of this effect.*

M. Homberg also showed how, by the comparison of these two tables, we may know the quantity of acid salt contained in an acid spirit, in the following manner: he took an acid spirit, as spirit of nitre, he weighed it by his areometer, and at the same time he weighed also distilled water, (for the weight of the phlegm contained in the acid spirits is proportionable to the weight of the distilled water,) then he consulted the tables, where he saw that the bulk of spirit of nitre compared with the like bulk of distilled water has given a certain quantity of acid salt for each ounce; and from thence he concludes, that the bulk of other spirit of nitre, of which the weight is known, compared with the like bulk of water, shall give a determined quantity of acid salt, which will be obtained by the computation of the relations of the weights of those spirits, with the weights of the like bulks of distilled water, by concluding from them, and from the known product of acid salt for the unknown product of the same.

An unusual Parhelion and Halo. By Mr. Stephen Gray. N° 262, p. 535.

April the 7th, 1699, between 4 and 5 o'clock, I perceived the following phænomena; There appeared on each side the sun a parhelion, connected by a halo of the usual diameter; they had each of them a tail of a whitish colour; extended opposite to the sun, of about 15 or 20 degrees in length; the upper part of the halo was touched by the arch of a circle, whose ends were turned towards the zenith; it had the colours of the iris but faintly. Between this and

* Modern chemists explain this phenomenon differently. They suppose that in the preparation of aqua regia as above described, the nitric acid (spirit of nitre) imparts a quantity of oxygen to the muriatic acid contained in the sal ammoniac, thereby converting a portion of it into oxymuriatic acid; in which state this acid acts readily upon gold.

the zenith was another portion of a circle, which had the colours of the iris with greater vivacity than the former. The appearance is represented by fig. 4, pl. 12; where A represents the sun, BC the parhelia, with their trains, D the coloured arch touching the halo BDC, E the more vivid arch that passed between D and the zenith Z.

Part of a Journal from Scotland to New Caledonia in Darien, with an Account of that Country. Communicated by Dr. Wallace, F. R. S. N° 262, p. 536.

This journal contains little or nothing that is now uncommon or interesting. The account commences at Madeira, and so continues among and near the West India islands, to the coast of Darien, with the usual sea occurrences.

Abstract of a Book, viz.—An Account of the Islands of Orkney. By James Wallace, M. D. and F. R. S. To which is added an Essay concerning the Thule of the Ancients, 8vo. London. N° 262, p. 543.

The work consists of 8 chapters. The first treats of the several names, the longitudes, latitudes, boundaries, the ebbings and flowings of the sea, the harbours and merchandises. The second comprehends the plants, animals, and fossils. The vegetables alone amount to near 300, all or most herbaceous ones, there being no indigenous trees, only here and there some planted in gardens, but they prove dwarfs, seldom bearing any mature fruit; whereas in more northerly parts of Norway trees rise strong and lofty, thriving even on small rocks, surrounded by the sea.

Here are some few roses, the juniper, the myrtle, and heath, and some kitchen herbs arrive here to as great size as about London, and artichokes to a greater than in any other place. The little cows yield plenty of milk, and the ewes generally produce two lambs at a birth, some three or four. The horses are small, but strong; great herds of swine, and rich coney warrens. Plenty of most sort of fish, and vast conveniences for the herring and cod trade, if any ways encouraged. The natives are very healthy, and live sometimes married 80 years, sometimes bearing children beyond 60. The ancient monuments, the civil and ecclesiastical history, are not neglected; in all which the author has discovered a large compass of knowledge, especially on the Pights or Picts, Belus, and Ganus, the ancient Norwegians, the Sinclars and Earls of Orkney, the Stewards and Douglases. What he delivers of the obelisks, the causeys, urns, and burial places, of the ancient state of the church of Orkney, of the propagation of the Christian faith there, and of the particular customs of the inhabitants, is very remarkable.

The whole is illustrated with an exact map of all the islands, together with the soundings and the setting of the tide of flood. At the end is annexed a learned essay concerning the Thule of the ancients.

On a Polypus of the Lungs. By M. Bussiere, F. R. S. N° 263, p. 545.

A boy 5 years of age died at Kensington of a consumption. A year before he died he was troubled with a dry cough, which continued ever after, spitting now and then a little blood; 10 or 12 days before he died his nurse took notice of some thick skin, as she said, he spit out. His physician having examined one of them, found it had the consistence and shape of a vessel, which made him think it might perhaps be some vessel of the lungs. The child being dead I was sent by his relations to open the body. I began by the abdomen, in which I found nothing of moment, except that the omentum was quite destitute of fat, so were likewise all the parts of the body, and the glands of the mesentery were hardened and blackish. In the left side of the lungs I found a little purulent sanies; the inside of the trachea or wind-pipe was incrustated with a slimy membrane, insomuch that the pellicle made a perfect vessel from the larynx to the very extremities of the bronchia, from which it came off very easily without breaking either the trunk or the branches. It adhered to the inner coat of the trachea, only by small filaments, which were so tender that they easily broke off, which made me think the production of that extraordinary vessel was nothing but the mucilaginous humour which is continually discharged by the glands of the trachea, which being grown more clammy by the distemper, was reduced to a kind of jelly by the dryness of the air, which dryness not permitting the spitting it out, incrustated the inside of the trachea and bronchia, and growing thicker was at last shaken off by the violent fit of coughing the child was sometimes taken with, and then was renewed again by the succeeding mucus. Having taken this new vessel out of the lungs, I put it in hot water, to try if it could be dissolved by it, but it resisted. The vessels of the lungs, that is, the trachea and bronchia, the pulmonary arteries and veins, were all whole and sound.

Extract of a Letter from Dr. Wallace to Mynheer Leibnitz at Hanover, concerning some easy Methods for the Measuring of Curve-lined Figures, Plain and Solid. N° 263, p. 547. *Translated from the Latin.*

In a letter of mine to you, dated July 30, 1697, and since printed in vol. iii. of my mathematical works, among other methods for quadratures, are these two: the one I call the method of convolution and evolution, the other the method of complication and explication. By help of these I show which is the simplest manner of measuring all curve figures, and particularly the cycloid.

By a like artifice may be shown how to compare the sphere and cylinder, which Archimedes thought fit to chuse for his monument.

If to the basis P, equal to the circumference of a circle, a height R be assumed equal to radius, there will be made a rectangular parallelogram = RP, fig. 12, pl. 12. This may be conceived as composed of an infinite number of small parallelograms, of the same height, according to the received method of indivisibles.

Now if the vertices of all these are conceived to be contracted into one point, fig. 13, so that of those minute parallelograms as many triangles may be made, having the same basis and an equal height; each will be half of each of the others, and therefore all of all; and the base being bent into the circumference of a circle, a circle will be made whose radius is R, and centre C, which therefore is half the parallelogram or $\frac{1}{2}$RP.

This is Archimedes's dimension of a circle, which is equal therefore to a right-angled triangle, one of whose sides about the right angle is equal to the periphery, and the other to the radius of the proposed circle. For $\frac{1}{2}$ R, or half the altitude of the triangle drawn into P the base, exhibits the magnitude of that triangle $\frac{1}{2}$ RP, which is equal to the circle. And the same may be accommodated to the circular sector, taking the arch A instead of the periphery P.

Again, if to that parallelogram = RP as a base, be taken in like manner an altitude R, fig. 14, in order to a hemisphere, there will be made a parallelopiped = RRP. This in the same manner may be conceived as composed of an infinite number of small parallelopipeds of the same height, insisting upon the minute areas of that plane, of all which the common altitude is R, and the aggregate of bases = RP. Now if this parallelogram, the magnitude RP continuing, be supposed to be bent into a cylindrical surface, (whose base P is now bent into the periphery of a circle, and whose altitude is R) that those minute parallelopipeds may be changed into so many wedges, or prisms, with triangular bases, each of which are half their respective parallelopipeds, and therefore all are half of all, having for their vertices so many points C, or minute lines, in the axis of the cylinder, and thus filling it up; the cylinder will become half the parallelopiped, or $\frac{1}{2}$RRP.

Or in order to come at the entire sphere, if on each side be taken the altitude R, so that the whole altitude may be D = 2 R, and if a convolution be made in like manner, a cylinder will be produced as before, consisting of wedges or prisms infinite in number, having their points or vertices in the axis of the cylinder, which will be equal to RRP = $\frac{1}{2}$ RP × 2 R, equal to the product of $\frac{1}{2}$ RP, or the circular base, into the altitude 2 R; or, which is the same thing, it will be equal to $\frac{1}{2}$R × 2 RP, or equal to the product of $\frac{1}{2}$R, the half of the common altitude of the wedges into the aggregate of the bases 2 RP.

Which aggregate of the bases is the curved cylindric superficies itself, which is equal to P × 2 R, or to the product of P, the periphery of the circular base, drawn into the altitude 2 R, or equal to $\frac{1}{2}$RP × 4, four of the great circles of the sphere. To which if we add the two opposite circular bases, there will be made the whole superficies of the cylinder circumscribed to the sphere, equal to six great circles, $\frac{1}{2}$ RP × 6 = 3RP. And the magnitude of the cylinder = RRP = $\frac{1}{2}$ RP × 2R, equal to the product of the circular base $\frac{1}{2}$RP drawn into the altitude 2 R, as before.

Now if the vertices of all these wedges that constitute the axis of the cylinder are conceived to be contracted into one point, so that these wedges or prisms may now become so many pyramids, being on the same bases and the same height, each will be of each, and therefore all of all, in a proportion subsesqui-tertial, or as $\frac{1}{3}$ to $\frac{1}{2}$; and the superficies, which before was curved cylindrical, will now become spherical, because of all its points being equally remote from the centre, the aggregate of the bases remaining as before, = 2 RP, or equal to four great circles, we shall then have the whole superficies of the sphere = 2 RP = $\frac{1}{2}$ RP × 4 = four great circles; and equal to the whole curved cylindric surface, and the parts respectively equal to the parts that belong to the same parts of the axis; also the magnitude of the sphere $\frac{2}{3}$ RRP = $\frac{1}{3}$ RP × 2 R, equal to the product of $\frac{1}{3}$R, a third part of the common altitude of all the prisms, drawn into 2 RP the aggregate of the bases, which is now become the spherical surface.

Therefore both the superficies and magnitude of the cylinder circumscribed to the sphere, is sesqui-alter to the superficies and magnitude of the inscribed sphere, or as 3 to 2: there because the proportion is as six great circles = 3 PP to four great circles = 2 RP; here because the proportion is as RRP to $\frac{2}{3}$ RRP: which is the very invention of Archimedes so much celebrated.

The same would be had a little shorter, if in the parallelopiped upon the plane base 2 RP, of the altitude R, composed of minute parallelopipeds, all their vertices were immediately supposed to be contracted into one point C: that the aggregate of the bases continuing as before = 2 RP, those parallelopipeds may be reduced to so many pyramids, having their vertices meeting at the centre of the sphere, whose radius R is the common altitude of all the pyramids, and the spherical superficies is the aggregate of all the bases.

For $\frac{1}{3}$ R, a third part of the common altitude, drawn into 2 RP, the aggregate of the bases, exhibits as before the magnitude of the sphere $\frac{2}{3}$ RRP, and the surface of the sphere = 2 RP.

In like manner this may be accommodated to the spherical sector, by drawing $\frac{1}{3}$R, a third part of the common altitude of all the pyramids in it, into a portion of the spherical surface cut off by a plane: which is to the whole spherical surface, as the part cut off of the diameter or axis, is to the whole diameter; as was shown above.

Now the reason of this whole process depends on these principles. That a figure composed of triangles is half the figure composed of parallelograms, upon the same bases and of equal height. That I call a convolute figure, and this an evolute. And that a figure of pyramids is a third part of a figure of parallelopipeds, on the same bases and equal height. That I call a complicate figure, and this an explicate.

These principles may be accommodated in a thousand manners to curvilinear figures, whether superficial or solid, however perplexed and intricate.

Concerning the Circulation and Globules of the Blood in Butts. By M. Leuwenhoeck. N° 263, p. 552.

Butts * are small, some of them, bating the tail, not above an inch in length. Having often examined them with a magnifying-glass, in order to see the circulation of the blood, and the variety of its motion, my thoughts were again turned to those little particles which constitute the blood of a red colour, which I formerly asserted to be flat and oval.

The greatest motion of the blood observable through the fins, was on each side of the various little single bones placed among them; where the blood vessels were so large that 25 of the above-mentioned particles could pass a-breast; but disappeared as they drew nearer to the extremity of the fins, small vessels being all along detached from the arteries. On one side of a little bone runs an artery, and on the other a vein corresponding to it; and besides a vein and an artery lay so close together, as if their coats had been united. From the above-mentioned artery, there arose smaller vessels across the membrane between the little bones, and after running out the breadth of three or four hairs, they unite again into one vein. These small vessels receive about two or three particles of the blood at once, especially if the fish lies still, and consequently its little bones close to each other. When it exercises its fins in swimming, the distance between the little bones is enlarged, the interjacent membranes stretched out, and the blood vessels that run across them, especially those in the tail-fin, are drawn out so as to be above twice as long as before.

Finding it very easy to extend the tail-fin, and accordingly having stretched

* The fry of plaice and of flounders.

it to a breadth equal to what the fish gives it in swimming, in order to observe the motion of the blood in the thus extended vessels; I found that whereas when the fish did not move, the small vessels received two or three particles a-breast; the same vessels now stretched out with the tail-fin which they run across, not only admit no more than one particle, but likewise the particles do not move so fast as in the extended vessels; and in some places these particles are so separated, that one or two may lie in the intervals. In this observation the particles appeared not perfectly oval, but sometimes round, and sometimes in a shapeless figure; arising from the little vessels being stretched to an unusual length, by which they become narrower, and the particles being very pliant, are pressed and squeezed out of their circular form.

For further satisfaction I cut off a piece of the tail from several little butts, in order to view the blood out of the vessels: when it appeared that the blood of fishes consists of six little globular bodies, making up the particles as well as that of men and other animals; for I could observe several particles broken in 4, 5, and some few in 6 pieces; and it was very remarkable that some oval and other figures became roundish, and at last perfectly round.

The blood of a salmon appears blackish, by reason of a greater number than ordinary of the reddening particles. I put some of this blood on a very clean glass, and where the particles lay thin perceived them oval, nay, in several ovals little globes, and in some few particularly six globes. Where these little globular bodies were crowded in upon each other, the particles of the blood were congealed together, so that no ovals could be discerned; nay the particles seemed to be huddled up together so as that six of them had made a compound body.

In fig. 5, pl. 12, ABCD represents the oval particles of the blood of a salmon, that weighed above 30 pounds. AB represents the particles that appeared flat and broad, but did not face the eye directly. Those about C came straight upon the eye, and for the most part had a little clear sort of light in the middle, larger in some than in others. These particles are heavier than the serous liquor in which they swim; and which, together with the particles, constitutes the blood. I likewise put upon a magnifying glass the blood of a very small butt, which was not mixed with any liquor, only the particles lay in their serum; which are represented fig. 6, between E and F. These particles, which are distinguished by little shining spots in the middle, are delineated fig. 7, between G and H. I also put the blood upon the glass to a greater magnifying glass, the thinner moisture arising from the serous matter, and the oval-like blood being exhaled; so that some small oval particles were to be seen, that were so far from running together, that they did not touch, and plainly showed that they consist of 6 little globular particles, represented in fig. 8, between I and K.

In pursuance of this new observation, I viewed the circulation of the blood with glasses that magnified still more than any I have yet used; by which at last the oval figure of the particles was plainly made out. Now the greater the magnifying glass is, the swifter does the circulation of the blood appear in the vessels. Having retarded this motion, I employed two or three seconds of time in observing the little veins; and found that in several small vessels the oval particles were so broke that I could neither see them nor those of which six had made up a particle of blood; but only a simple fluid of a faint colour running along the vessels; but in a large artery at the tail, the blood moved so slowly that I could easily discern that the particles in that vessel were oval; and not only so, but I likewise perceived more clearly than before the little globes that constitute the oval particles, if not always, at least for the most part. For it is easy to conceive how 6 little globules, which are pliant and always in motion, and driven one upon another, should settle in the fashion of a bowl. Thus fig. 9 represents the first coalition of the 6 little globules into one. I have made up such a globe as is represented in the last figure of 6 wax balls put together, to show the form and composition of the little globular particles of the blood; and I am certain each of these little globes is at least compounded of 36 others. These little bullets being moved and squeezed together, and being at the same time pliant, and packed up into one complete round form, are represented fig. 10.

From such a scheme we may conceive how the globular parts of the blood of man and other animals acquire a roundness; but how the oval particles are compounded of the 6 globules is not easy to apprehend. And should we divide one of these globules by our imagination into smaller and smaller parts, the little particles that enter into the composition will still be inconceivably smaller. Yet supposing we could discover the figure and shape of parts less than a globule of blood by a thousand millions, we should still be far from reaching the first constituent parts.

That venous blood may become arterious without being first in the heart, appears by the following experiment. Suppose AB in fig. 11, to be a vein, in which the blood, seen through a magnifying-glass, passes with great celerity from B to A. From this vein run two little branches, C and D, which unite between E and F. Now supposing HI to be an artery in which the blood moves upwards with equal swiftness from H to I. Out of HI arises a venous spring, delineated in K, F, L. The blood moving from K to F joins the other in F; and by this means part of the blood coming from the artery is thrown into the vein, as passing from F to G; and to the best of my observation, a quantity of blood just equal to that carried from KF to G, moves from CE to F, and directs its course upwards from F to L: so that whatever arterious blood passes through FK and FG, an equal quantity of venous blood passes back through CE and FL. Though the pleasing variety of the blood's motion was formerly apparent, yet this experiment pleased me still more, as it afforded me a very clear perception of the above-mentioned variety; and besides, this union of the blood vessels was not formerly discovered.

I viewed the seed of two young cocks that were not yet arrived at their full growth, in order to trace as much as possible the length and singular narrowness of the tails of the little animals in the male seed. But I could not compass my end, though I tried them sometimes living, and sometimes dead. However I am certain that the least of the tails of those animals is more than 10000 times smaller than a hair, though I cannot say that I saw it distinctly.

Concerning some Roman Antiquities in Lincolnshire. By the Rev. Abr. de la Pryme. N° 263, p. 561.

I have observed many Roman Ways in Lincolnshire, but none more observable than that called High-street, which I think runs almost directly in a straight line from London to Humber-side. This High-street is so visible, that it is a great guide to strangers and passengers. It is cast up on both sides to a great height, and discontinued in many places, and then begun again, and so on to Humber-side. I have observed that where it runs over only bare mould and plain heath, that it consists of nothing but earth thrown up; but where it runs through woods, it is not only raised with earth, but also paved with great stones set edgewise, so very close to each other, that the roots of the trees that had been cut down to make way for the same, might not spring up again and blind the road. This paved causey is still very strong, firm, and visible in many places of this street, where woods are yet standing on both sides, as undoubtedly they were in the times of the Romans, else it had not been paved; and in some other places it is paved where no remains of wood is now to be seen, though undoubtedly there was when it was made. In one place I measured the breadth of the said paved street, and found it just 7 yards broad, English measure.

This street or causey, in its course full north, runs by the fields of Hubberstow, which perhaps signifies the place where the Danish General Hubbin was buried; in which fields, not far from this street, are the foundations of many Roman buildings to be seen, as is manifest from their tiles found there, and according to tradition there has been a city and castle in that place, and there are two springs, the one called Julian's stony well, and the other Castleton well; and several old Roman coins are now and then found there. This might perhaps be some little old Roman town by the highway side, and in after times, before that it was ruined, called Castletown, or Casterton, from its being built upon or near some of their camps, which might then be in those fields.

About a mile further to the northward, on the west side of the said street, on a great plain or sheep-walk, the foundations of another old town are very visible; though now there is neither house, stone, rubbish, tree, nor hedge, to be seen belonging to it. I counted the vestigia of the buildings, and found them to amount to about 100 that are still visible; and the number of the streets or lanes is 4 or 5; and not far from it northward is a place called the Kirk-garth, where the church is supposed to have stood that belonged to this town. Tradition calls this place Gainstrop, and vol. 2 of the Monas. Angl. shows that there were lands and tenements herein, given to Newsted priory, not far from this place, in an island in the river Ank, falsely called Ankham.

About a mile or two hence the street runs through Scawby wood, where it is all paved, and from thence close by Broughton, by a hill which seems to be a barrow, from which the town had its name, quasi barrow town, but that it seems to be too excessively great for one. However, I have found fragments of Roman tiles and bricks there, and millions of petrified shell-fish.

From thence the causey, all along paved, is continued about a mile further, to the entrance upon Thornholm, where there is a place by the street called Bratton Graves, and a little to the east near Broughton-wood side is a spring that turns moss into stone; and a little further stands the ruins of the stately priory of Thornholm, built by king Stephen. Opposite to this priory, about a quarter of a mile on the west-side of the street is a place called Santon, from the flying sands there, which have over-run and ruined above 100 acres of land. Among these sands was in ancient times a great Roman pottery, as Dr. Lister shows from the relics of ruinous furnaces, and the many fragments of Roman urns and pots still to be met with. I have also found there several Roman coins, and a large piece of brass found in the bottom of one of the furnaces, like a cross, which perhaps was part of a grate to set some pots on, while they were baking or drying.

Returning back to the street, there are several sand-hills, somewhat like barrows, on the top of one of which was erected a great flat stone, now so far sunk in the earth that there is not above a foot of it to be seen. Entering then into Appleby-lane, the street leads through the west end of the town, where two old Roman games are still practised, though very imperfectly, the one called Julian's Bower, and the other Troy's Walls. From hence the street runs straight on, leaving Roxby, a little town half a mile on the west, and Winterton, a pretty neat town. And then about 3 or 4 miles further, leaving Wintringham about half a mile to the west, the street falls into the Humber, and there ends; at which end has been a town called Old Wintringham, and a sort of a beach for ships.

All this part of the country on the west side of this street has been occupied by the Romans, as may be gathered from the medals, coins, and the many tiles and bricks that are commonly here found, especially at a cliff called Winterton Cliff, where some old Roman buildings have stood; and further about 2 miles more to the west is Alkburrow, which seems to have been a Roman Town, not only from its name, but from a small four-square camp or entrenchment there, on the west side of which is a barrow called Countess Barrow or Countess Pitt, to this day, hollow in the middle.

In the town of Roxby is a close, or garth, where a Roman pavement was discovered, on the south-west of the church. The occasion of its discovery was the tenant digging to repair a fence between this close and another; as soon as he had discovered it, he bared a little of it, and it lay about a foot and a half in the ground, and on digging in many places he found it about 6 or 7 yards broad, and as many long, if not more.

Having got a spade, shovel, and besom, we fell to work, and with a great deal of labour (the ground being very hard) bared about a yard and a half square; by which we cast up many pieces of Roman tile, the bone of the hinder leg of an ox or cow broken in two, and many pieces of plaster painted red and yellow, which seemed to have been the cornish at the foot of some altar, or perhaps of some part of the building; and we observed that several great stones in their falling, when the building over this pavement was destroyed, had broken and lodged themselves in the pavement. Then having swept the space thus bared very clean, the pavement looked very beautiful, and one could not imagine that such mean stones could make such pretty work; being nothing but small square bits of bricks, slate, and cauk, set in curious figures and order, and only of three colours, red, blue, and white. Several whole rows of red, blue, and white on the outsides of the smaller work, consisted of pieces twice as long as the rest. The material that these small stones is set in, is a floor of lime and sand, and not plaster; which floor is so rotten and decayed with time, that the little stones, &c. are easily dug up.

The whole pavement consists of circles, and quadrangular and many irregular figures, with rows of the aforesaid stones, red, blue, and white: in some of these circles and figures there are urns, in others flowers, and in others interchangeable knots, according to the workman's fancy.

An Account of Books, viz. Petri Chirac, de Motu Cordis Adversaria Analytica. Monsp.* 1698. 12mo. N° 263, p. 559.

The author of this discourse endeavours to deliver an entire system of the motion of the heart, and its causes, in an analytic method, advancing each position in the order the mind arrives at its knowledge; dividing his subject into 3 distinct inquiries. 1. What is the cause of the contraction of the heart? 2. What is the cause of its dilatation? 3. Why the motion of the ventricles and auricles are not contemporary, but alternate? To justify himself from the charge of borrowing from M. Vieussens, he annexes the whole 11th Chap. de Motu Cordis et Auricularum illius, out of his book de Principiis proximis et remotis Mixtorum. Nor can he forbear charging that gentleman with robbing him of his invention, of extorting an acid out of the blood, by distilling its fixed salt with bole, which way he pretends first to have taught in his public lectures.

* Mons. de Chirac was designed for the church, but exchanged the study of theology for that of physic; and in 1682 was admitted a member of the Faculté de Montpellier, where he read a course of medical lectures for several years. In 1692 he was appointed physician to the army of Roussillon, and the year following he gave proofs of his professional skill in the treatment of a dysentery, which prevailed among the French forces at the siege of Roses. In 1706 he attended the Duke of Orleans as physician, in his campaigns in Italy. The duke was so badly wounded in the wrist at the siege of Turin, that it was apprehended an amputation of the arm would be inevitable. M. de Chirac proposed as a chance of saving the limb to have it bathed in the water of Balaruc, which was accordingly procured from France, and a perfect cure was the consequence. M. de Chirac afterwards accompanied the Duke into Spain; and when these expeditions were ended, he settled at Paris, where he soon got into extensive practice; though his deportment was very different from that of the majority of his rivals, for he had nothing of obsequiousness or flattery in his manner, being a man of very few words, and always resisting the whims and caprices of his patients, whenever they interfered with his plans of medicine and diet; from a persuasion that it is as much the duty of a physician to enforce discipline to the sick, as of a general to enforce it in an army. On the death of Homberg in 1715, the Duke of Orleans, then Regent of France, made him his chief physician; and in 1730 he was appointed first physician to the King. He died in 1732, aged 82. In the course of a long life he acquired, by the exercise of his profession, a considerable fortune; a part of which he bequeathed to the University of Montpellier, for the endowment of 2 new medical professorships. He had projected the establishment of a medical society at Paris, which should hold a correspondence with practitioners in various parts of the country, especially on the subject of epidemic diseases; but he died before his plan (which was opposed by the faculty at Paris) could be completed. His principal writings, besides the work above noticed, consist of a Treatise des Fiévres Malignes, and Dissertations et Consultations Medicinales de Chirac et Sylva, published some years after his death.

Ejusdem Dissertatio Academica An Incubo Ferrum rubiginosum? Monsp. 1694. 12mo. N° 263, p. 565.

The incubus or night-mare is supposed by M. Chirac to proceed from indigestion and acidity. He therefore proposes for the cure of it aperients in the first place, and afterwards absorbents, together with chalybeates, such as rust of iron.

Ejusdem Dissertatio Academica An Passioni Iliacæ Globuli Plumbei Hydrargyro præferendi. Monsp. 1694. 12mo. N° 263, p. 567.

In the cure of the iliac passion M. Chirac recommends bleeding, liquid diet such as broths made of soft and relaxing ingredients, barley and rice cream, decoctions of the roots of marshmallows, adding oil of sweet almonds to the quantity of several ounces, lenient and emollient clysters, with oil of linseed, white lilies, &c. &c. opiates and other narcotics, a tepid bath of water: lastly, such things as by their weight shall make their way through the body, as bullets of lead, gold, or a pound or two of crude mercury. After taking these it is best (he says) to lie for some time on the right side, to allow them to pass the pylorus, and so by turning from side to side to favour their descent through the duct of the guts. M. Chirac thinks crude mercury not so safe as small bullets of lead,* on account of the acid liquors in the bowels, which he imagines must corrode and dissolve some of the metal.

Christiani a Steenvelt Dissertatio de Ulcere verminoso, ad Clarissimum Virum Godefredum Bidloo. Lugd. Bat. 1697. 4to. N° 263, p. 570.

The author recites in this treatise, a very extraordinary case, viz. Mary Bulte, a healthy maiden of 48 years, fell down 12 stairs, and broke her left leg 3 inches above the ankle, so that the tibia bone came out of the skin above an inch, the parts being very much in pain. The wound was dilated, the bone set, and a proper bandage applied. Many pieces of bones of different sizes came from the wound. Care was also taken to prevent a gangrene. Five weeks after the fracture, appeared an ulcer about the prominent part of the ankle, from whence issued matter. This ulcer was healed, and 15 days after it broke open afresh, when they thought the cure perfect, and in the bottom of the ulcer they saw 50 worms live, move, and grow. These put into a box in a warm place, changed into chrysalids in 6 days, and after 14 days they turned into flies.

* British practitioners, on the contrary, think that it is not so safe to swallow bullets of lead as crude mercury. The supposed "acid liquors in the bowels," would act as readily upon the lead as upon the quicksilver.

The author proposes it as a question, whether these eggs had been laid or deposited in the ulcer after the hurt, or brought thither by the mass of blood.

Godefredi Bidloo Observatio de Animalculis in Ovino aliorumque Animantium Hepate detectis, ad Virum Celebrem Antonium Leuwenhoeck. Lugd. Bat. 1698. 4to. N° 263, p. 571.

After a short account of what has been said of the worms in the gall bladder of a sheep,* he proposes to treat of 4 particulars. 1. Concerning the body and disposition of these worms. 2. Concerning their place. 3. Their numbers, propagation, &c. 4. Their being the cause of many diseases. He compares their figure and motion to those of a sole or plaice, and exhibits them in a copper plate in several positions, both of their natural size, and magnified. The sheep are fat, and show no outward sign of having them. If the worms lose their motion, they recover some of it when heated with a warm hand, or put into a warm liver. They are pellucid, and their viscera are visible, they have eyes, a heart, near it the guts close together, and 2 distinct liquors moving in its vessels. He observed in them many egg-like bodies, whereof 100 would not be larger than a grain of sand. He always found these worms in the gall-vessels, which they dilate to a considerable magnitude in some places, and when they lie in the smaller vessels they accommodate their figure to their place. He has taken 870 out of one animal, and 1000 out of another. They are found in stags, calves, &c. He thinks he has likewise remembered to have seen them in men's livers. He is of opinion they come not from putrid matter, but as all other living creatures, from eggs. He believes their eggs are eaten by the cattle, together with the liquor in which they live. He could not any way by experiment find the stomach or intestines of animals troubled with this disease perforated. He believes they cannot get from the duodenum into the gall bladder, but supposes them to pass by the chyle into the blood, and with the blood to the liver, where they stay in the gall-vessels. This he endeavours to make probable. He gives a long catalogue of worms observed in several parts of the body, and thinks he has seen or read of them in all parts of the same, except the spleen. He thinks these worms may in several places be the cause of several diseases, by occasioning swelling of the parts, corroding and gnawing them, creeping into strait places, or exciting a motion in the juices of the body, appropriating them to their own use, and fouling them with their excrements and off-spring.

* The Fasciola Hepatica. Linn.

Description de la Piece d'Ambregris que la Chambre d'Amsterdam a reçue des Indes Orientales, pesant 182 *Livres; avec un petit Traité de son Origine et de sa Vertu, par Nicolas Chevalier, a Amsterdam chez l'Auteur.* 1700. 4to. N° 263, p. 573.

The Dutch East India company presented the author of this treatise with the plates they had caused to be engraven of the piece of ambergris which they had from the East Indies, of 182 pounds weight, 16 ounces to each pound. In the preface he mentions and figures a medal made on this occasion. About the figure of the piece of ambergris on this medal is this inscription, Occultum Naturæ ac nobile Doron. Under it, Fragmen. Ambr. Grys. Librar. 182. Huc Allat. 1694. On the reverse is Amsterdam, and its port, with 2 fleets, one entering, another setting sail, about which is this inscription, Sibi et Urbi, and under it, Vivant Dii Mei Penates.

Part of a Letter from Mr. James Cuningham, from the Cape of Good Hope, April 6, 1700, *giving an Account of his Observations on the Thermometer and Magnetic Needle in his Voyage thither.* N° 264, p. 577.

The greatest height of the spirit in the thermometer was 2 divisions below extreme heat, when we were near the equinoctial. And 2 degrees to the northward of the line, the north point of the needle inclined 8 degrees downward, but as we went to the southward it was inclined about 48 degrees upward.

Of an Accident by Thunder and Lightning at Leeds. By Mr. Ralph Thoresby, F.R.S. N° 264, p. 577.

April 27, in the evening, we had a severe storm of thunder and lightning. One clap was particularly loud, and very near us, as appeared by the effects, which, though not fatal, are remarkable; for falling on a cottage, it broke down part of the chamber chimney, and thence made its way through a chink in the floor to the lower room, where it melted several holes in two pewter dishes; it melted also, and run into little lumps, several places in a pewter candlestick, and of a brass mortar; it burnt also some holes in a tin vessel, and smutted a white stone plate it stood upon, as if it had been with lamp-black, and filled the room with such a bituminous smell, like fired gunpowder, as almost stifled the poor woman, who was alone in the house. A more fatal accident happened in this neighbourhood formerly, of which the parish register has this note: "2d of Sept. 1672, was buried Thomas, the son of James Lambert jun. deceased, of Holbeck, slain the day before, being the Lord's day, by a thunderbolt." There were other children in company, who were also thrown down by the storm, among whom were two, a brother and sister he had a pair of new stockings burnt off his legs, and himself was so scorched, that he never recovered his natural complexion; she having a waistcoat clasped before, as the fashion then was, was so burnt between her breasts, that the scars remain to this day; another had the stiffened neck of his doublet struck off; but all recovered except Lambert's boy, who was found with his face upward, whereas all the rest had theirs to the earth: which reminds me of our coal-miners' practice, who, when any swoon away by their sulphurous damps, dig a hole in the earth and lay them on their bellies, with their mouths in it, which, if it prove not an absolute suffocation, recovers them. The skin of the deceased boy was perfectly burnt black, and was shrunk up hard like parchment or leather burnt with fire.

An Account of Part of a Collection of curious Plants and Drugs, lately given to the Royal Society by the East India Company. N° 264, p. 579.

At the beginning of the 20th volume of these papers, an account was promised of a curious collection of plants and other simples, gathered by Mr. Samuel Brown, a physician at Fort St. George in the East Indies. The performance of which promise has been hitherto delayed, because some of the seeds were distributed and raised in the most curious gardens in England, as at the duchess of Beaufort's at Badminton, the bishop of London's at Fulham, Dr. Robert Vuedale's at Enfield, Mr. Jacob Bobart's in Oxford, Mr. Du Bois's at Mitcham, and Mr. Samuel Doody's at the Apothecaries' Garden in Chelsea.

The plants themselves, and the original papers of Mr. Brown are kept in the same order, and with the same numbers in the repository of the society, as they are here published.

Then follow an enumeration and description of 47 East India plants, gathered by Mr. Brown from Feb. 26th to the 28th at Hingner Pollum, about 20 miles from Fort St. George (Madras). To the Malabar names Mr. Petiver adds, the synonyms of Bauhine, Pluckenet, Commelinus, and other botanists.

A Relation of the bad Condition of the Mountains about the Tungarouse and Batavian Rivers, having their Source from thence, occasioned by the Earthquake between the 4th and 5th of January, 1699. *Drawn up from the Account given by the Tommagon Porbo Nata, and sent to the Burgomaster Witsen, F. R. S.* N° 264, p. 595.

The great Batavia river, from above Tangala Warna, from whence the river receives the greatest part of its water, is stopped up, or covered with earth from the fallen hills, till beyond the hill Tsyouspokitsjil, so that the place where the river had its course formerly was not to be seen. Far beyond the hill Tsyouspokitsjil, towards Batavia, the water comes out again from under the earth, which is sunk down, but thick and muddy, passing over and through the trees, with which the river formerly was stopped up. The trees lying in the river are of a great size, and so close packed together, that it is impossible to conceive how they came so. From the mountains near the beginning of the Batavian river, called by the Javanians Songsy-tsialiwong, 7 hills are sunk down, viz. 5 on this side and 2 on the other. But that the mount from whence the river has also its source, above Talaga Warma, within the mountains Terbackti, are not sunk down, nor have received any damage.

The Tangarang river, called by the natives Songhy Sedany, is also stopped up and covered with earth, from the hill and branch Salack to the river Antum, and from thence to Tangaram, being filled up with trees, but not in such a great quantity nor so close together as in the Batavian river. On this side the Tangaran river 9 are sunk down by the earthquake, and 7 branches, which had formerly their issue in the river Tangaran, are also covered with earth; but 3 other hills lying also on this side of the same river, and called Minjan, Dauw, and Kasfichi, had not sustained any damage, whereby the branches Autan and Kaniki, the latter into the first branch, and the first into the river Tangaran, have kept their course. And the hill Oudjong teboe, being called also Sedani, from whence the Tangaran river had its source, is not sunk down.

The high lands between the Batavian and Tangaran rivers, behind the old court of the Jaccatra kings, called Pakkowang, having been a great wood, is changed since the earthquake into an open field destitute of trees, the surface of the ground being covered with a fine red clay, such as masons use here.

The Tommagon Porbo Nata, in his going towards the mountains, heard a noise like thunder; and fearing that a sinking down of the ground or an eruption of water would follow, he stood still with those that were about him, and saw afterwards that the earth from the top of the mountains sunk down, and hearing no further noise he went on his journey, having in going and coming back spent 19 days by the way, and felt 40 times an earthquake: and since his return from the mountains he has felt the like shakings 208 times.

Extract of a Letter from Dr. James Burrough to Mr. Houghton, F.R.S. concerning a Bulimia. N° 264, p. 598.

About a month ago at Stanton, a labouring man of a middle age, had for some time so inordinate an appetite, that I had it attested by an eye-witness, that he eat up an ordinary leg of veal roasted at a meal; and fed at such an extravagant rate for many days together. He would eat sow-thistles and other herbs as greedily, during the time his βȣλίμία lasted, as beasts which use such food. I am told he voided divers worms as long as an ordinary tabacco-pipe, and some of them thicker than its shank. After which his appetite declined by degrees till it came to be of a common rate with that of others. He cannot do so good a day's work now as he was wont, but has almost recovered his wonted strength again.

Responsio Almi Collegii Romanorum Archiatrorum ad Epistolas Clariss. D. Raymundi Vieussens, M. D. Monspel. in qua potissimum agitur De Existentia Salis Acidi in Sanguine, et de Proportione Principiorum ejusdem. Scripta per Jo. Mariam Lancisi olim S. D. Innocentis XI. Med. &c. N° 264, p. 599.

It is here objected that the acid spirit which M. Vieussens obtained in his experiments on human blood, might come from the bolar earth which he employed in the distillations; and secondly, that the proportions of alkaline salt, &c. assigned by M. V. to the different parts of the blood, do not accord with the experiments and observations of Mr. Boyle; and that in fact it seems impossible to assign any general and fixed proportions of the ingredients whereof the several parts of the blood are composed, considering that they must vary not a little in different subjects, and in different climates.

An Account of Books, viz.—I. Dissertatio Anatomico-Medica de Motu Bilis Circulari, ejusque Morbis, quam publice olim habuit Mauritius Van Reverhorst, Medic. Cand. Lugd. Bat. nunc Professor Anatomicus Hagæ Comitis, 8vo. N° 264, p. 610.

This is a second edition of a dissertation concerning the [supposed] circulation of the bile, in which is an anatomical description of the liver and all its parts, illustrated with a figure of its internal and external lymphatics.

II. Pharmacopœia Harlemensis Senatus Auctoritate munita. Harlemi apud Wilhelmum Van Kessel, &c. 1693, 12*mo.* N° 264, p. 612.

A Letter from Dr. P. Silvestre, of the Coll. of Phy. et F. R. S. to the Publisher, giving an Account of some New Books and Manuscripts in Italy. N° 264, p. 613.

Four extraordinary Medico-Surgical Cases. By Mr. Greenhill. N° 265, p. 617.

Francis Butler's lady being afflicted with a large and painful tumor of the umbilicus, consulted Mr. Knowles and Dr. Eels about it, who from some very odd symptoms were dubious both of the nature and consequence of it, and unwilling to open it. However, soon after it broke of itself, and discharged a great quantity of prune-stones, and notwithstanding all the care that could be taken of it, she died in about 20 days.

Mr. Knowles being called to open a youth, who died, as was supposed, of the colic and convolvulus, found the cæcum vastly extended, and stuffed with abundance of cherry-stones, which thus were proved to be the occasion of his death.

A servant to Sir Anthony Keck complained of a pain and hardness in his right side, which had continued more or less for 12 years, and was observed to approach daily nearer the skin. This encouraged him to have it opened, and an incision being made, I plucked out a rusty wire with my forceps, when upon a nice examination we found it to be a broken needle, which he thought he might have formerly swallowed. It stuck so firm in the flesh as if it had been fixed in wood, so that it could not be extracted without some violence, and a small hæmorrhage.

Sir F. L. was greatly swelled in his legs, abdomen, stomach, and to his very throat, even to suffocation, that he died. Mr. K——s was sent for to let out the supposed waters; for his physicians had treated him as in a dropsy, with powerful diuretics, &c. and one or two pails were provided ready to receive the matter; but upon opening him there issued forth nothing but a gust of wind. He cut $6\frac{1}{2}$ inches deep of fat on the peritonæum, and died of corpulentia nimia, having fed prodigiously.

An Abstract of some Observations made of the Eclipse of the Sun. By John Philip Worzelbaur, at Nuremberg, Sept. 13, 1699. N° 265, p. 6

The beginning of the eclipse	8h.	57m.	14s.
The end of the same	11	33	56
The digits eclipsed	10°	45′	

The equinoxes of this year, 1699, according to the author's observations, happened as follows: March 9d. 20h. 35m. 27s. Sept. 12d. 10h. 22m. 42s.
but by the author's tables, 9 20 40 30 12 10 32 52.

Besides this observation, we have two others of very eminent men, viz. of M. Godfred Tuber, Archdeacon of Ciza, and of M. Jacob Honold, pastor in the village of Hervelsing, in the diocese of Ulm. The former was observed at Ciza, the latter at Hervelsing near Ulm of Suevia. The former began at 9 o'clock, and ended at 11h. 35m. and increased to 11 digits. The latter began at 8h. 55m. and ended at 11h. 31m. and its greatest defect was 10 digits.

At Leipsic the moon was observed to enter the disc of the sun at 9h. 11m. (by the times corrected by altitudes taken of the sun) and to end at 12h. 38m. 30s. The greatest obscurity was 11,20 digits. It lasted from 10h. 16m. 45s. for 6′, 10 digits being obscured.

The Dimension of the Solids generated by the Conversion of Hippocrates's Lunula, and of its Parts, about several Axes; with the Surfaces generated by that Conversion. By Ab. De Moivre, F. R. S. N° 265, p. 624.

Let BCA, fig. 15, pl. 12, be an isosceles triangle, right-angled at C. With the centre C, and distance CB, describe the quadrant BFA; on BA, as a diameter, describe a semicircle BKA; the space comprehended between the quadrantal arc BFA and the semicircumference BKA, is called Hippocrates's lunula.

If upon BC you take any two points D, E, and draw the perpendiculars DH, EM, meeting BA in I and L, and cutting off a portion FGMH of the lunula; the solid generated by the conversion of this portion about the axis BC, is equal to a prism whose base is ILMH, and height the circumference of a circle whose diameter is BC; and the solid generated by the semicircle BKA, is equal to a prism or semicylinder, whose base is the semicircle BKA, and height the circumference of a circle whose diameter is BC.

Having bisected BA in R, and BC in P, the surface generated by the conversion of the arc HM about the axis BC, is equal to $\frac{c}{r} \times \overline{BP \times HM + BR \times DE}$, supposing the ratio of the radius to the circumference to be as r to c; and the surface generated by the semicircumference BKA is equal to a rectangle whose base is the sum of that semicircumference and diameter BA, and height the circumference of a circle whose diameter is BC. As for the surface generated by the arc GF, it is well known, that it is equal to a rectangle whose base is the circumference of a circle whose radius is BC, and height DE; therefore the surface generated by the conversion of the portion MHFG is known.

If upon BA, fig. 16, you take any two points I, L, and draw IN, LV, perpendicular to it, cutting the quadrant in O and T, and the circumference in N and

V; the solid generated by the conversion of the portion ONVT, about the axis BA, is equal to a prism whose base is IOTL, and height the circumference of a circle whose diameter is BA.

Having bisected BA in R, and drawn CR meeting the quadrant in G, the surface generated by the conversion of the arc OT about BA, is equal to $\frac{c}{r} \times \overline{CG \times IL - CR \times OT}$.

Bisect DE in Y, fig. 15, through the centre R draw SQ parallel to BC, meeting the circumference BKA in S, BK parallel to AC in V, and the lines DH, EM in N and O; the solid generated by the conversion of the portion FGMH about the axis AC, is $\frac{c}{r} \times \overline{\frac{1}{3}MO^3 - \frac{1}{3}NH^3 + PC \times NOMH + CY \times DNOE - \frac{1}{3}EG^3 + \frac{1}{3}DF^3}$; and the solid generated by the segment KBS, is $\frac{c}{r} \times \overline{\frac{1}{3}VK^3 + PC \times BVKS}$. Therefore the solid generated by the semicircle BKA about AC, is $\frac{c}{r} \times \overline{PC \times VQAK + PC \times BCQV - \frac{1}{3}AC^3 + \frac{2}{3}VK^3 + PC \times BVKS}$; which by due reduction will be found equal to the solid generated by the conversion of the same semicircle about the axis BC.

The solid generated by the portion ONVT about the axis CD, is equal to $\frac{c}{r} \times \overline{\frac{1}{3}LV^3 - \frac{1}{3}IN^3 - \frac{1}{3}QT^3 + \frac{1}{3}PO^3 + CS \times PQIL}$.

From the points M, H, drop the two perpendiculars MZ, HW, upon CA, prolonged if need be; the surface generated by the conversion of the arc HM about the axis CA, is equal to $\frac{c}{r} \times \overline{PC \times HM - RA \times WZ}$, when the point Z is next to C, or $\frac{c}{r} \times \overline{PC \times H + MRA \times WZ}$ when the point W is next to it.

Those who may think it worth their while to bestow some little pains to find the demonstration of this, may solve the following problem:

Any two conic sections being given, forming a lunula by their intersection, and a right line being given by position, about which, as an axis, this lunula is imagined to turn, to find the solids generated by the conversion of any of its parts, cut off by lines perpendicular to that axis, or parallel to it, or making any given angle with it; as also the surfaces made by that conversion.

Concerning the State of Learning, and several other Observations in Italy. By Dr. Peter Silvestre, F. R. S. N° 265, p. 627.

I wrote to you that I had seen at Bononia Signor Sbaragli. There is a second letter of his De Recentiorum Medicorum Studio, and De Generatione Vivipara Scepsis, &c. both printed at Vienna. He is certainly a man of wit and learning; but I found at Rome and in other places, most physicians angry with him, for having abused the deservedly famous Malpighi.

I had a very particular acquaintance with a learned Benedictine monk, D. Bernard de Montfaucon. He had been sent from France into Italy by the Congregation of St. Maur, to search into all the libraries, and gather all the works of the ancient fathers that were never printed; and he told me he had found out some of St. Athanasius, St. Basilius, St. Gregorius Nazianzenus, St. John Chrysostomus, and other Greek fathers, with a great many of the writers of the middle age. He will publish his Itinerarium Italicum, and in another volume give in the form of a spicilegium, all these pieces he has copied. But what is more to the purpose, he designs to print a catalogue of the MSS. of all the libraries that are in Italy: a considerable collection of inscriptions which never were printed, or which have been miserably debased in Gruterus, Reinesius, Spon; and lastly give an account of some old coins, ancient weights and measures, and several other curiosities relating to sacred and profane antiquity.*

I was much surprised on coming to Naples, to find a great many persons applying themselves to the corpuscular philosophy and mathematics. They owned they were obliged for it to Tho. Cornelius Consentinus, who began first to introduce them, and to Leonardo di Capoa, who followed his steps. This great man died three years ago. I was acquainted there with Signior Joseph Valeta, a gentleman who has a very good library, and has learned a little English on purpose to understand English books, for which he has a very great value. He lent me a manuscript of his that he will speedily publish. His design is to commend and encourage the experimental philosophy.

I made the following observations on the bronchocele, a distemper very frequent all over Lombardy and Savoy. By the disposition of this tumor, I am satisfied it has principally its seat in the glandulæ thyroideæ, and sometimes too, but very seldom, in the parotis conglobata. I could plainly see the parotides conglomeratæ were nowise concerned. This I have observed in several bronchoceles of a very great size. I conceive these tumors (which are generally attributed to the water the people drink, that is melted snow) to proceed from the viscidity of the lympha, which by degrees extends the membranous coats of the glands; and being there congealed, hardens them to that degree, that an inveterate bronchocele is almost like a stone. But why these swellings are to be seen no where else but in these glands of the neck, it is difficult to give a good reason. It may be, the natural conformation of the glandulæ thyroideæ (which being harder and of a more solid substance than other glands, give sooner a stop to the viscid lympha) is the occasion of this tumor always beginning and settling there.

Sal Montis Vesuvii is found in pretty large lumps, after Mount Vesuvius has thrown out vast quantities of ashes. The great rains that fall upon these ashes make a sort of leys, which, left in the hollow places, are evaporated by the

* This he (Montfaucon) did in his great and learned work entitled Antiquité expliquée.

heat of the sun, and there remains behind this urinous salt, whose taste is something like sal ammoniac.

At the Sulfatara, between Naples and Pozzuolo, they make alum in this manner. In the summer they gather as much earth as they have occasion for, which is there in the middle of a large area, and keep it in a dry place. Afterwards they put it in lead kettles of a good thickness, and pour upon it rain-water; which is also impregnated with the same mineral. For which purpose they take great care to dig some large pits, to preserve in them the rain-water, which they carry to a large cistern near the kettles. They take away the earth when the lixivium is made, and as it grows stronger by evaporation, they put it from one kettle into another, till it is sufficiently evaporated. They then take it out and convey it into a wooden tub, where after it is cooled the alum sticks to the sides in the form of crystals. But the most remarkable thing is, that these kettles are placed upon some of the great spiracula, where, without any expence of fuel, only by the violent heat of these effluvia, the evaporation is constantly made sufficient for the crystallization. All this laboratory, where the kettles, the cistern, with the tubs are, is only tiled over. The governors of the great hospital of the Annunciata, who have been at the charge of this ingenious contrivance, make now about 3 or 400 pounds a year by it.

As to sulphur: all summer long some labourers dig up and down in several places of the same area, as in a kitchen-garden; by which means they give vent to the copious sulphureous streams, that are within the bowels of all this mountain: then out of the superficies of this earth, by the means of earthen pots, they sublime the brimstone.

For native sal ammoniacum: at the mouth of the largest spiracula, where there is an excessive heat with a continual noise and smoke, is found a sort of native sal ammoniac: it seems the steams arise in a liquid form; for if you put in a key, a sword, or any thing solid, these effluvia will stick immediately to it and drop down like water. All this mountain must be very full of mineral substances; for when the effluvia are sublimed to the top of the spiracula, they stick there to tiles or stones, where they form this salt, of which there is gathered yearly about 200 pounds weight. It has much the taste of the factitious sal ammoniac; and, as a learned physician told me, being distilled in a sand furnace, it yields a volatile urinous spirit, absolutely like sal ammoniac, both as to its sensible qualities and all other effects: he only observed that the spirit had something aluminous in it; to correct which, they added a greater quantity of quicklime or salt of tartar, than in the distillation of the common spirit.

Concerning Worms pretended to be taken from the Teeth. By M. Leuwenhoeck, F. R. S. N° 265, p. 633.

July 27, 1700.

On the receipt of your letter I immediately opened the piece of black silk contained in it, where I found two little worms dead and one alive, which were sent you to be conveyed to me, as being taken out of a corrupt tooth by smoking.

I had not spent much time in examining the living worm which wanted above one half of its full growth, when I concluded that it sprung from the egg of a small fly, of that sort that mostly frequent cheesemongers' shops, and lay their eggs on the cheese; now the worms taking their rise from those eggs, they bore through the cheese, and take their nourishment and growth from it; and afterwards become little flies again. When these little worms arrive at such a bulk as is discernible by the naked eye, we call them worms.

I took a small glass tube, hermetically sealed at one end, and put into it the living worm, together with some crumbs of very old and fat cheese, to try if the worm, feeding on the cheese, would come to its full growth. I stopped the glass with a cork: For I am positive that a worm may live and grow in a glass as well as in a firm cheese covered up all about. Being confident that both the dead worms and the living one were of the above-mentioned sort, I got a cheese-monger to single out that sort of old cheese and bring some of its little worms to my house. I put 6 or 8 of the largest of these worms in two distinct little glasses, together with one of the dead worms you sent me, designing to compare the living and dead worms before a magnifying glass: and could not descry the least difference, either in the head or the whole body.

When these worms had been shut up 5 days without any food, I observed them gnawing the corks that stopped the glasses. Then I put in a little cheese, that if they did not arrive at their full growth, they might not want food, in order to their change into flies. I likewise endeavoured to bring one of these worms to an extended and quiet posture, in order to view the internal parts, which succeeded with me several times; and saw to my great admiration, such moving instruments all over the body within, that not one of a thousand would be persuaded to believe that in such a contemptible insect there is so much to be seen; for in one place I thought I saw the motion of the heart, and near that the motion of the stomach: but after all the closest inquiry, I could not descry any motion in the blood in those parts which I took for veins.

I would fain know what food these creatures live upon besides cheese. In the first place, because I never yet saw them any where else but in cheese; and in the next place, because they cannot arise from flesh; for the worms that spring from the eggs of flies in flesh, which we also call mites or fly-blows, are fully grown in the space of 9 days; but those which feed upon cheese require a longer time for completing their growth, and flesh will not keep so long without salting or smoking. It is probable therefore these flies lay their eggs on cheese, which does not soon corrupt.

Now we may imagine that the patient whose tooth threw out the worms by smoking, had some time before eaten cheese laden with young worms, or eggs of the above-mentioned flies, and that these worms or eggs were not touched or injured in the chewing of the cheese, but stuck in the hollow teeth, and at last insinuated themselves so far into the substance of the teeth, that they gnawed the sensible parts, and so occasioned the great pain. It appears very strange to me that smoke in the mouth or tooth should have such an effect as to bring worms out of hollow teeth; for I cannot conceive how the little worms should have a respiration, to be so far prejudiced by the smoke, that they are obliged to come forth.

To satisfy myself on this point, I took a glass ball, the diameter of which was almost 3 inches, with a little hole in it, about the width of a goose quill. In this glass I put 10 cheese-worms of the largest sort, and twice or thrice threw in burning brimstone on a slender piece of hemp; and observed that the burning brimstone did not at all injure the worms, so far as I could see; and about an hour after the burning of the sulphur, I put the mouth of the glass to my nose, and could still plainly perceive the smell of the sulphur.

The living worm that you sent me I have kept still alive, and think it is larger since I had it. I shall try to preserve it till it turns into a fly. These worms have a hard and strong skin, and may last a long time. I remember some years ago my late wife being much afflicted with the tooth-ache, complained that the pain was such as if the flesh had been gnawed through. At last she found benefit by dropping the oil of vitriol into the hollow tooth, which I did with a glass instrument, that conveyed the oil to the tooth without injuring the muscles.

Now it is possible she might have got one or more of these little worms in the hollow tooth, at a time when she eat heartily of old cheese, which was seized with whitish rottenness, and had a great many little worms in it which she did not observe, though she fed often upon it. Upon this supposition the pain might be occasioned by those worms, which were afterwards killed by the oil of vitriol when we knew nothing of them.

Sept. 7, 1700.—The worm which you sent me, and that was still alive, I put into a glass hermetically sealed at one end, and stopped with a cork at the other, after I had conveyed into it a bit of cheese, that the worm might come to its full growth and change. At the end of 14 days I observed it was changed into a tonneken,* though it did not seem to be arrived at its full growth, which made me believe it would never be a fly, but I was mistaken, for soon after I spied the fly leaping about the glass, and the empty tonneken by it. I send you the said dead fly, and the tonneken inclosed in N° 1. In N° 2 are several empty tonnekens, and the flies that came out of them, all which proceeded from mites that one of our cheesemongers helped me to; and by comparing yours and mine together, you will easily observe that they are alike in all their parts.

On the Catacombs at Rome and Naples. By John Monro, M. D. N° 265, p. 643.

The catacombs are a narrow gallery, dug a vast way under ground, with an infinite number of others going off from it on all sides, and also a vast number of little rooms going off from the principal, and the secundaries too. Those of San Sebastiano, of San Lorenzo, of Sant Agnese, and the others in the fields a little off from Sant Agnese, are commonly shown to strangers. They take their names from the churches in their neighbourhood, and seem to divide the circumference of the city without the walls between them, extending their galleries every where under it, and a vast way from it, so that all the ground under it, and for many miles about it, is said to be hollow. Now there are two sorts of authors that run into extravagance on this subject; the one will have them made by the Primitive Christians, adding, that in the times of persecution, they lived, held their assemblies, and laid up the bodies of their martyrs and confessors in them. This is the account that prevails at Rome, and in consequence of it men are kept constantly at work in them. As soon as these labourers discover a repository, with any of the marks of a saint about it, intimation is given to the cardinal treasurer, who immediately sends men of probity and reputation to the place; where they find a palm painted or engraven, or the cypher Xp, which is commonly read pro Christo, or a small round projection in the side of the gallery, a little below the repository; what is found within it is carried to the palace. Many of these projections we have seen open, with pieces of phials in them; the glass indeed was tinctured, and it is pretended, that in these phials was preserved the blood of the martyrs, which was thus laid up near their bodies towards the head, to distinguish them from those of others, who were not called to the honour of laying down their lives for the faith of the gospel. After the labourers have surveyed a gallery, they close up the entry that leads

* Chrysalis.

into it; thus most of them are shut, no more being left open than what is necessary to keep up the trade of showing them to strangers. To this opinion it may be justly excepted, that allowing the catacombs to be proper for the end for which they are presumed to be made, and that the Christians of that age were in a capacity of making that conveniency for themselves to live and assemble in below ground, at a time when it was so very unsafe to appear above it; yet to suppose that a work of that vastness and importance could be carried on without the knowledge of the government, is to suppose the government asleep, and that that was actually done under its nose, which must necessarily have alarmed it, had it been attempted even on the frontiers of the empire.

The other sort of authors represent them as a work so immense, that the Christians in the persecuting times had not numbers enough to carry it on; but they most unadvisedly confound them with the puticuli in Festus Pompeius; where, at the same time that the ancient Romans used to burn the bodies of their dead, the custom was, to avoid expence, to throw those of the slaves to rot. The Roman Christians, say they, observing at length the great veneration that certain places gained by the presence of relicks, resolved to provide a stock for themselves; entering therefore the catacombs, they made in some of them what cyphers, what inscriptions, what painting they thought fit, and then shut them up; intending to open them again upon a dream or some other important incident. The few that were in the secret of this artifice either dying, or as the monks, who were the only men that seem to have had heads adapted to a thought of this quality, were subject to so many removes, being transported to other places, the contrivance became forgot, and those galleries continued shut, till chance opened them at last. Thus they conclude, that the remains of the vilest part of mankind are trumped up in the church for the bodies of the most eminent confessors and martyrs.

But surely either the catacombs are not that great work they are represented to be, nor to be found every where about the city, or it was very improper in Festus Pompeius to call them by the little name of puticuli, and so confine them to one place only, that I mean unknown now without the Esquiline gate. Indeed the characters of the places are so very unlike, that one would wonder how a common burying place, where bodies were thrown together to rot, came to be confounded with repositories cut in the face of a long gallery, one over another, sometimes to the number of seven, in which bodies were singly laid, and handsomely closed up again, so that nothing could offend the view of those that went in, especially with the little rooms of the fashion of chapels, that have all the appearances of being the sepulchres of people of distinction. Whereas, when the persecutors spilt the blood of so many martyrs, they used to dig holes perpendicularly in the ground, and to throw their bodies promiscuously in them; of this the memory is still preserved, churches having been built in the places where the holes were made, and little monuments erected over the holes themselves, to which the name of Putei is continued to this day.

This is the true notion of the puticuli, holes dug perpendicularly in the ground to receive bodies carelessly thrown in; as appears to have been the custom of the Romans to their slaves; but how does this apply to the galleries and chambers of the catacombs, where decency and distinction of quality is nicely observed. I cannot forbear thinking they were made for this purpose, and in consequence of the two ancient opinions, that the shades hate the light, and love to hover about the place where the bodies are laid: they appear so easy and decent a resting place for the one, without the least fear of being ever disturbed, and at the same time there is provided a noble and a vast conveniency, full of variety, for the others, to space themselves freely and with pleasure in.

I think it will not be denied, that laying up the bodies in caves was the original way of disposing of the dead; this was the manner of the Phœnicians; and as they with their colonies peopled the western parts of the world, it is more than probable they carried it along with them. Afterwards, as men grew great and powerful, they erected noble and magnificent monuments for themselves above ground; at length others of inferior degree imitated them, all leaving room enough, and excluding the light: but then interring as we do now in the open air, or in temples, was never the manner till christianity introduced it. Of the whole we have many instances, and Il Signior Abbate Bencini, librarian of the propaganda assured me, that on the great roads in most parts of Italy little catacombs have been, and still are found under ground, and that it was the custom to build small houses over them. This, and the testimony of the labourers whom I consulted, made me abandon an opinion of which I was once fond, that the catacombs are of the nature of our gravel-pits, as old as the city itself, and that out of them was taken the puzzolana, the famous ingredient in the Roman mortar. The same learned gentleman added, as to the marks of a martyr, that they do not conclude much; and that the so famed cypher xp was in use among the ancients long before christianity. And that it was composed of the two Greek letters XP, under which something mystical was comprehended, but that he met with no author that gave account what the mystery was.

Upon the whole, the catacombs I conceive were the burying-places of the ancient Romans; at length the manner of burning, which they received from the Grecians, coming by degrees to prevail universally, they fell under a total neglect. This is the state in which the primitive christians must be supposed to have found them. Thus then the christians finding them in a state of neglect, laid up the bodies of their dead in them; and perhaps when the persecution was hot, concealed themselves, and kept little separate assemblies in their chambers. At last, the empire turning christians, they fell again into the old state of neglect; in which they continued till upon some mention of them, they came to be looked into and searched. This relates to the catacombs of Rome; those of Naples are quite another thing, of which in my next.

An Account of a Book, viz. Flora Noribergensis, &c. being a Catalogue not only of such Plants as grow spontaneously about Nuremberg, but also of such Exotics as the Physic Garden of that City has lately raised, with the Figures and Descriptions of many of the most rare. Opera Johannis Georgii Volckameri, M. D. Noriberg. 1700. *4to.* N° 265, p. 651.

On some Roman Inscriptions found near Durham. By Mr. Christ. Hunter. N° 266, p. 657.

These inscriptions were found near a village called Lancaster, about 5 miles north west from Durham which I am fully persuaded has been the Longovicum of the Romans. It has been a very considerable place in these parts, and their Watling Street lies through it. It is on the top of a hill, which has a descent on three sides; towards the west it is overlooked by a high hill, and almost eastward from it about a quarter of a mile, stands the present Lanchester, a tolerable country village, with a pretty church, which, before the reformation, was endowed with a deanery and six prebends. The form of this place has been square, and fortified with a thick strong stone wall, faced with hewn stone. Within the wall are nothing but ruinous heaps of stones; as also without the wall, especially towards the east. Above a year ago, I found part of a large earthen urn near this place, within which I suppose there has been a lesser; such I remember was found at another village not far from this, which I am persuaded has been another colony.

Concerning some Insects observed on Fruit Trees. By M. Leuwenhoeck. N° 266, p. 659.

We have not for many years observed about this town (Delft) the fruit trees more loaden with blossoms than this last spring, nor at the same time more covered with a sort of black flies, which appeared to me less than those of former years. This induced me to take some of the leaves of the trees, and some of the blossoms of a quince tree, that had a great many of those black flies upon them, and put them into a glass tube, in order to make my observations of them. I observed that those flies would not live above two days, and that some of them had laid a great number of longish eggs. The reason why they live no longer, I thought might be the want of food; I was therefore resolved to observe what the flies did, as they sat upon the leaves of the plum-trees, and found that they had insinuated themselves into the curled leaves of the trees.

The leaves of these plums, and of other fruit trees, were covered with a great number of small creatures, that are frequently found on the leaves of currant and cherry-trees, which creatures we here call lice,* some of them being green, and others which are sometimes less, and of another shape, blackish, and both sorts in time become flies.

On the 20th of May, I plucked four little leaves off a plum-tree, upon which were 36 of those black flies, besides some hundreds of those little creatures we call lice, and amongst them several little ones that were newly come out of their mother's belly; all these with the leaves I shut up in a glass tube. Of the 36 flies, most of them were females, and had their eggs in them, except one that had laid hers against the sides of the tube. Amongst these flies I found two sorts, with this difference, only that the hoorn vliesen, wherein their eyes are placed, were in some of them four times as large as in others.

As the flies did not live above two days in the last closed tube, I went again on the 25th of May into two distinct gardens, because I could find but one fly in the first garden, where there had been so many before; and in the other, where there had been many thousands both of flies and lice, I could with great care get but nine. These were all females, and had their eggs in them; from whence I more strongly concluded, that the black flies did the trees no harm; for if they had laid their eggs on the trees, and all their eggs had produced living insects, there would not, I am positive, one leaf, or any fruit have remained on the trees. After these last flies had remained two days, and as many nights, shut up in the glass tube, there were but three left alive. And the next day these were dead also.

Upon the occasion of taking these flies, and the great number of lice that sat upon the leaves, of which I have given a draught, in my printed letter of the 10th of July 1695, where I also said that these creatures bring forth their young without copulation; I shall send you a draught of them, as if I had-

* These insects belong to the Linnæan genus *Aphis,* and exhibit the wonderful phenomenon of a continued impregnation through several successive generations.

never spoken of them before, because I intend to bring these creatures into the class of those that are found living in the seed of males. For, opening these creatures anew, not those that were come to their full growth, but those that were so small, as that 25 of them would make but one great one, as I had taken out of the full grown ones the young, in which I not only perceived the shape of their limbs, but could also behold very distinctly their eyes; so out of the little ones I took several small oval figures, which were very transparent, and doubtless would have become living creatures; for when I dissected such as were a little larger, and that gradually, I found that the oval figures were also proportionably greater, so far that the little creatures were compleatly grown, and in a state to be brought forth.

Now we observe in those little creatures called lice, something that does not occur, that I know of, in other creatures, viz. that these creatures bring forth young without any copulation with males; afterwards they cast their skins, and from creeping insects become flies, which, when one beholds them with the naked eye, one would not imagine to proceed from such a change, for they are twice as long, reckoning their wings, after they are turned to flies as before.

I also caused several of the said green lice, that were in great numbers on the leaves of currant-trees, to be brought to me, and those of them that lay for dead, and were rounder and whiter than the others that were living and moving, I cut out with the little pieces of leaves whereon they lay and stuck fast; for if we should attempt to remove one of these little creatures with a needle or a pin, we should probably hurt the others that are shut up in the bellies of the dead ones. These pieces of leaves, on which the dead creatures lay, I put into a large wide glass tube, covered at both ends with fine linen; for I concluded that the death of those lice was occasioned by another creature, or an egg thrust into their bodies, where it receives its food and growth, and then makes its way out of their bodies again. I had shut up these dead lice about 8 days, when I observed two little flies,* of quite another make, in wings, colour, and shape, leaping about the glass. I shifted these flies into another glass tube, where I had before put six green lice, which I had taken from the leaf of a currant-tree, and those of the most full grown, and yet they were not come to that perfection, as that I could observe those parts which were to become wings. As soon as these flies came near the said lice, they brought the hinder part of their body, which was pretty long, between all their feet, and stretched their body so far out, that their tail making a kind of semicircle with the rest of the body, stood out beyond their head, and in this man-

* These flies appear to have been some small species of *Ichneumon.*

ner they insinuated their tail into the bodies of the worms; and this the flies did in a short time to all the worms they came near; but what was most remarkable in this action was, that in this conjunction they never touched the lice, either with their feet or bodies, being much too large to approach them; and as they entered the bodies of the lice they made a trilling motion or shaking with their tail, that they might thrust it in the farther.

Now as the flies remained but two days alive without copulation, whereas the green lice lived seven or eight days, I thought the flies by that insinuation of their tails into the bodies of the lice, they conveyed their eggs in at the same time, and that from those eggs young worms should have been produced, which having received their nourishment and increase from the bodies of the lice, should be changed again into a fly, but the green lice died, and for the most part dried away.

Not content with this observation, I collected 25 dead lice, all of which had in their bellies a worm, or else a fly newly changed, for I saw through the skin of some of the lice, living flies, which flies I took out alive from the bodies of some of those green lice. Having shut up these lice in a clean glass tube, and some days after the fly coming out of them, I went into the garden to get four caterpillars or riper worms, amongst which there was one that was very hairy, and I observed that when one of the flies approached this hairy ripe worm, to thrust his tail into him, as soon as he touched the hair, he suddenly drew it back again.

I put also into the glass tube, together with the worms or creeping insects, three aureliæ cases or popkins, which had lain in their web in some withered leaves, with the intent that the flies should insinuate their eggs into the bodies of the worms, and that so doing, there might proceed from the body of each one 25 flies; but they did not succeed with me, because, as I imagined, all the flies, though six or eight of them together were running and flying about the glass tube, died away without laying eggs, which I judged, was only because they wanted food, for we see that there are some flies that lay eggs without eating, and then die, whereas others shall lay no eggs unless they eat.

Now if we observe the wonderful formation of such a small creature, and how such a fly is produced, and then consider that the worm which is changed into the fly, and we imagine that such a thing will not happen, unless the worm that comes out of the egg of the fly, makes use of another creature for its food, we must remain perfectly amazed. Further, I saw many dead creatures lie about in the tube from whence no flies were produced, and from whence I did not imagine that any flies would come, believing I had not handled them tenderly enough, and that therefore they were dead; but about a fortnight after

I saw seven flies leaping about the glass, which also remained but two days alive, and were of a quite different make from the other flies, for their bodies were shorter than those of the other creatures.

After this I saw small lice on the leaves of a hazel-nut tree, of which I took some, and viewing them, I observed that they agreed in shape with the green ones, with this difference, that they were less by half; for after some of them were changed into flying creatures, their bodies were not larger than a single coarse sand, and covered with abundance of hair; and at the ends of those hairs, small clear drops of moisture; but when they had shed their last skin, and were turned into flies, I could perceive no hair on their bodies. I opened also several of these lice, and took the young ones out of their bellies. These three beforementioned aureliæ, after they had been shut up about 8 days in the tube, I saw that from one of them a flying creature was produced, which was of a grey colour, and the underpart of the wings and the body was yellowish; in other respects it was just like the creature we call a moth, only larger than the white moth that eats cloth, when they are worms.

The next day I had the luck to observe, that the little creature in the second aurelia, began to stir, in order to get out of its fold or inclosure. The first motion the creature made was, stretching out the hinder part of its body, which at the same time lengthened the hinder part of the case in the fold or circular part, and it remained so; this was soon followed by a second and third, whereby the circular parts of the case were much lengthened; and in this action the case, at the end where the head of the fly was, burst open, and a moth was perceived flying about the glass. The wings of this new creature were but half so long as the wings of that creature which came out the day before. This moth raised his short wings straight up, then stretched them out several times, and then spread them over his body; in doing which the wings came to their length, and the manifold feathers, which lay so thick over one another upon the wings, on the stretching them out were parted in several places, which was not unpleasant to behold, yielding a sort of a marble, or party-coloured glance. These three skins of the aureliæ, were with their smallest end fastened to the other in a little of the web of the worms, and though I endeavoured to divide them with shifting their places, or shaking them together, yet it was all in vain. This made me inquire into the reason of such a concatenation; when taking one of them out of the tube, I saw that at the end of all, and also a little lower, it was armed with an odd sort of crooked hooks, which seemed to be given to them on purpose that they might get the easier out of their inclosure.

For if the imprisoned creature stretches out its body, in order to come out, one of the before-mentioned hooks will remain in the web, whereby when it draws in its body, the shell wherein it is involved cannot follow; in doing which, the creature gets rid of it more readily; and we anew discover the unspeakable perfection of such a small insect, if we take a view of the manifold and inconceivable number of the feathers and quills, which stick in the body and wings of such a moth, and which by their flying and leaping about the glass, stuck against the sides of it.

Three or four years ago all the leaves of the trees in my garden, and all the blossoms were so devoured by the worms or creeping insects, that in the spring there was not one remaining; and I imagined that few of those insects, for want of food, would arrive to their change, that is, be turned into flying creatures; however I took several of those dried and consumed leaves and blossoms, together with the webs, and shut them up in a box, and the following year I perceived that several little and different sorts of flies were produced by them.

Concerning Crabs' Eyes. By Mr. Charles King. N° 266, p. 672.

I cannot give you any satisfactory account of the stones in the heads of craw-fish, for I never made any observations but casually, and without any design of a particular account of them. I only remember in general, that they are always on the outside of the stomach, while the old coat sticks on the back of the fish, and pass into the stomach as soon as they cast their coats, having never seen them on the outside when they have changed, nor within before. And I also remember the males change their coats a considerable time before the females; for these always keep theirs till they have parted with their young from their tails.

On the Insect called Libella. By M. Poupart.* N°266, p. 673.

The libella is a flying insect, called in France demoiselle, from the variety of its colours, transparency of its wings, and its stately flight; they also call it perla, from the figure of its head, or rather from the roundness and colour of its eyes. It is called by the Latins libella, perhaps, because in flying it usually carries its body horizontally. It is divided from space to space into rings, by means of which it can compose angles with its body, whose lines it can make longer or shorter as it finds occasion. These different sections serve to the motion of this insect, as we know the tail does in birds, and, as they are lengthened or contracted, they carry themselves according to their various incli-

* The modern name of this genus of insects is *libellula*. An ample history of its nature and transformations, accompanied by figures, may be found in the works of Reaumur and Roesel.

nations, the point or centre being fixed between their wings. The great sort of libella are generated under water, wrapped up in a membrane, which at length dissolves.

When the young libella is ready to quit its case, it dilates its belly, that the water may enter at the anus into the intestines, then it compresses itself, to circulate the water, which it expels and shoots out a great way; it receives more water into its intestines, and ejects after the same manner. It continues this action with great force for some time, and makes the water circulate in the vessel, all which motions may be compared to the breathing or panting of a horse who has been run hard.

To satisfy myself that it took in the water at the anus, and not at the mouth, I put a libella upon my finger, which I held fast by the legs, and dipped it under water, with its head downwards, the anus being even with the water, so that it might get into the intestines, which it cast out a good way: I then drew my finger a little further out, so that the water could not enter at the anus, the fly continued its motion, but ejected no water. My opinion is, the animal does this in order to cleanse its body from all excrements in that element, where it leaves its old robes, to appear in a more glorious and new form in the open air.

There are a great number of small vessels which closely unite the body of the libella to its case; it is necessary that these be dry, that they may the sooner break when it makes its efforts to get out of its case, which cannot be done as long as there is any aliment in the intestine to afford nourishment to the case and its strings; and perhaps this is the reason why no insects will take any food when they are going to change their forms; and if they do not cleanse themselves as the libella do, yet they stay a great while longer before they change without any aliment; the libella is not longer than half a day in quitting its case and taking its flight.

It is wonderful how this insect cuts the air, making a thousand whirlings with extraordinary quickness. To know the cause, we must cut the skin of the libella, which is very fine all along the back, and be sure to bear the point of the scissars upwards, lest we cut the interior parts. We must also draw the skin to the right and left hand, and fix it with pins on a table, that we may discover the sixteen muscles which lie between the wings and the legs, eight on each side, of the thickness, length, colour, and almost figure or shape of a grain of barley, contiguous to one another, and without adherence. We may observe that each muscle is composed of many fleshy fibres, which do not seem to be joined together, but terminate round at the ends of the muscle, where they compose a common tendon, so that one might discern any of these fibres to be a small muscle, of which the chief muscle is composed.

The use of these muscles seem to me very particular, for the same muscles which flutter the wings serve also to move the legs; the upper tendons of the muscles enter into the wings, the same I believe which the fibres compose, and the lower enter a good way into the legs; yet the contrary motions of these organs are not at all hindered; for as long as the wings play, the feet lie still, and serve for a prop to the muscles which move the wings. And when the feet are in action, the wings are quiet, and in their turn serve to support the tendons which direct the feet.

The eyes are like two thick oblong pearls, which begin at the fore part of the head, and end in the hinder part. Their outer membrane is dry, thin, transparent, and incloses a small soft ball, filled with a very black liquor; two small canals, filled with air, enter into each of these eyes, and run along to the great channel, also furnished with air, which accompanies the intestine from the head to the tail. This stricture made me at first think that the libella could drive the air contained in these canals into the eyes, to give it a greater convexity, to behold objects that are very near; and on the contrary, the air is forced out of the eyes again, to flatten them when they look at remote objects; and this conjecture is not altogether frivolous, for having blown into the thick canals, which are about the middle of the body, the eyes became considerably tumefied, and by letting the air return, they became flat again.

On the Use of the Numeral Figures in England in the Year 1090. *By Dr. Wallis.* N° 266, p. 677.

I now send you, from Mr. Thomas Luffkin of Colchester, a draught of the window in Colchester, mentioned in the Transactions N° 255, whereby it appears that the numeral figures were here in use in the year 1090.

On the Fossil Shells and Fishes in Lincolnshire. By the Rev. Mr. Abr. de la Pryme. N° 266, p. 677.

Broughton in Lincolnshire lies near that Roman way, which I gave you an account of in my former letter.* The town is small, but ancient, apparently of Roman origin, being situated near one of their highways, and to have taken its name from some ancient burrow or barrow there.

In this parish are two stone-pits, or quarries, very remarkable. The first is at the east end of the town, the other in the field, on the south of the town. The stones of the first are not much used for building, being soft, but what they dig them chiefly for, is to get a clayey substance, or earth, that lies under them, to cement and lay the stones of the second quarry in, of which they

* Page 494 of this volume.

build their walls and fences. In which earth are innumerable fragments of the shells of shell-fish of various sorts, of pectinites, echini, conchites, and others, with some bits and pieces of coral. And here are sometimes found whole shell-fish, with their natural shells on, in their natural colours, much bruised and broken, and some squeezed flat by the great weight of earth that yet lies, and that was cast upon them at the deluge.

The other quarry is in the field on the south side of the town: it is a hard blue stone, which in the antediluvian world was most certainly a pure fine blue clay, in the stones of most of which are innumerable petrified shell-fish of various sorts, but so united to the stone, that it is very difficult to get them out whole, and I have always found that they lie in the superficies of the quarry within a foot of the top, and few or none deeper. In many places of the surface of the quarry, (which looks rugged and drifted, as snow does after a storm,) there are many shell-fish, half in the stone and half out, just as we see in rivers and ponds that are dry, they will lie half within the mud half without. That part which is within the quarry is entire and whole, but a hard stone, and that part which is without, which the petrific effluvia did not touch, is consumed and gone, all but a little of the edges, which edges are plain shell, and have all the radii and striæ on them that the shells of those sorts of fishes commonly have.

All these shell-fish have their shells on: some of which are comparatively thin. Sometimes the shells are in their petrifaction so thoroughly united unto and incorporated with the stone, that they are scarcely visible. Others in the same quarry have a thick white shell on them petrified, but not incorporated with the substance of the bed in which they lie. In getting the fish out, all the shell sticks so fast to the rock, that most commonly it is left behind; but sometimes the shell cleaves in two, one half of the shell on both sides of the fish sticks to it, and the other half to both sides of the bed, but others come out by lying in the air in frosty nights, with the whole natural shell on, and the radii or striæ very exact. There are other fish here, that have a black smooth shell, with several striæ, but no radii, very like, if not the same with the concha nigra Rondeletii.

I have also seen in this quarry some shell-fish half open, and filled with the matter of the bed in which they lie, and petrified with it. Others being in heaps together, I have found some of them broken, some bruised, and the edges of one fish thrust into the sides of another, some with the one shell thrust half way over the other, &c. and so petrified in the bed together. Others in the same bed have been so close, that the matter of the bed could not insinuate itself into them. Some of these that are thus found, are quite empty, others are filled with crystalline fluors; others I have seen half full of the bluish clay of the bed, and half full of the said crystallizations, which proceeded from nothing but subterraneous heat and effluvia.

Among the fish in this quarry, I have seen several large horse-muscles, such as breed in fresh water rivers and ponds, which are exactly like the concha longa Rondeletii, but are thicker and fuller than they commonly are; which largeness proceeds from the fertility and fatness of the bed where they breed; and in an old pond beyond Broughton Hall, there are some of the largest sort of this shell-fish that ever I saw; as if this soil agreed better to the breeding of this sort of fish than any other.

As some thrive in a rich clayey soil, so other sorts of shell-fish love a stony gravelly soil, others a chalky soil, others a rocky soil, others a lime-stone, or salt soil; others again love an ouzey soil, a sort of a confused mixture of all the foregoing, as part of the country about Frodingham, Brumbee, Ashbee, Botsworth, &c. In the fields and stones of which towns is one particular sort of fish, which I know not what genus or species to compare to, bending somewhat like a ram's horn, and exactly creased on the outside like one, with an operculum or lid on it, which the fish opened and shut as it had occasion. The bed whereon the said shell-fish bred in the antediluvian sea, is not above a foot thick, in which, but for the most part in the superficies, are millions of the said fish sticking half in the stone and half out, which having a most durable shell, that part which sticks out of the stone is not consumed, as in the shell-fish of Broughton, but remains whole and entire. Yet I have seen whole lumps of them, that by some great weight fallen upon them at the deluge, have been shattered in pieces, and so petrified in the bed as they lay.

In the parish of Broughton also, in the loose earth above the blue quarry, and elsewhere, I have found, in a whitish stone, the echini galeati puncticulati Lluydii, the turbinites major Lluydii, the coclites lævis vulgatior Lluydii, in blue stone, the concha altera longa Rondeletii, exactly agreeing to the draught and size of it in Gesner de Piscibus. I have found also multitudes of belemnites, great and small, perforated and flat at the root, by which they grew in the antediluvian sea, to some of which were found sticking little shell-fish.

From all this it sufficiently appears, that there was a time when the water overflowed all our earth, which could be none but the Noachian deluge.

And hence it happens that we find shells and shell-fish, and the bones of other fishes and quadrupeds, and fruits, &c. petrified and lodged in stone, rocks, mountains, quarries, and pits, over the whole earth; for it was then the proper place for them to breed in, and upon, and to be found in at this time. And as all countries were thus raised out of the bottom of the antediluvian sea and lakes, so that part of the country about Broughton appears manifestly to have been, in the antediluvian world, the bottom of some fresh water lake, because those are fresh water shell-fish that are found there, and the bed on which they breed was a fine blue clay, which is the colour of the stone to this day. Which bed, by the power of the subterraneous steams and effluvia, was turned by degrees into stone with all the fishes therein.

I have also a hard stone, part of the same blue quarry, with little bits of wood-coal in it, and whole leaves of vaccinia, or whortle-berries, such as grow on heath; and Mr. Llwyd and the Miscel. Cur. in Germany, have given several large accounts of whole leaves and plants found in stones and rocks, and deep in the bowels of the earth, some folded, some plain, some imperfect, all of which is very easily solvable, by their being in that general hurry and confusion seized upon, and embodied in lumps of clay and other matter, while others were caught and intercepted in rolling beds of earth, as they tumbled down from rising hills and mountains, and so were lodged deep in chasms of the ground, and petrified.

Concerning a Stone cut out of the Bladder, with Hair on it, &c. By Dr. J. Wallace, F.R.S. N° 266, p. 688.

I am sorry I can give so ill an account of those things you wrote of to me: For that of Sir William Elliot's voiding hair with his urine, at several times, I had from Sir Archibald Stevenson and Dr. Pitcairn, his physicians; and after his death I saw with the Doctor the stone that was taken out of his bladder, which was about the size of a goose's egg; the stone was hard and heavy, and for the most part covered over with a scurf, not unlike the lime-mortar of walls, and in the chinks of the scurf there were some hairs grown out. It was thought the other hairs he voided in his life-time, which were a great many, and some of an extraordinary length, grew out of that stone, because when the hairs hung out of his penis, as they did frequently, to his great torment, they were obliged to pull them out, which was always with a resistance as if plucked out by the root. It was from Dr. Pitcairn that I had the discovery of the cheat of those stones that an account was sent you of, and which you published in the Phil. Trans. No. 242. The particulars of that story I have quite forgotten; as all I remember is, that Dr. Pitcairn was at the pains to find out the imposture; and it was discovered at last that a roguish boy, to be kept from school, had so much cunning as to impose on a fond mother and other people.

Concerning a Stone cut from a Child, having a Flint within it. By Dr. Geo. Garden. N° 266, p. 689.

A young boy, of 5 or 6 years of age, was lately cut here for the stone; and when the stone was taken out of the bladder, being by accident broken a little, there was to be seen within it a flint stone, shaped like to that of a pistol, with a calculus crusted about it. That the flint has not been formed in the bladder, but that this might have been occasioned by the boy's swallowing the flint stone, seems probable, from another strange instance of a man in the same country, who voided with his urine a small pistol bullet, crusted over with calculous matter, after the same manner.

A Letter from Dr. Wm. Musgrave, F. of the Lond. Coll. of Phys. and of the Royal Society, concerning a Polypus found in a Dog. Translated from the Latin. N° 266, p. 690.

In dissecting a dog we found near the spleen a globular substance, resembling at first sight a gland. It was 3 inches in diameter, with a tunic like that of the veins. This tunic was supplied with a branch proceeding from the splenic vein. On cutting into it, it exhibited an imperfect fleshy substance, intermixed with clots of blood. There was a passage for the blood through the middle. This was certainly a polypus of a very extraordinary size.

On the Cataract in Gottenburg River, and the Remains of the Observatory of Tycho Brahe. By the Rev. Mr. Gordon, F. R. S. N° 266, p. 691.

Gottenburg river, at some leagues distance from that town, comes to a prodigious high precipice, and rushes down it with a terrible noise, and such a mighty force, that the masts and floats of timber to Gottenburg, rushing down from the precipice into a deep pit, many of the masts, which usually turn topsy-turvy in their fall, fly to pieces when dashed against the surface of the water in the pit. This happens when the masts fall side-wise on the water; but if they fall end-wise, they dive so far under water, that they rise not again for $\frac{1}{4}$ hour; others $\frac{1}{2}$ hour, several $\frac{3}{4}$ hour; and some a whole hour and upwards. The lake or pit into which they fall, has been often sounded with a line of some hundred fathoms long, but they could never find any bottom.

As to the island Ween, commonly called the Scarlet Island, famous for Tycho Brahe's Astronomical Observations, I had an opportunity of viewing the ruins of the noted Observatory erected by that astronomer. The island, I think, was not so proper for some astronomical observations, such as taking the exact time of the true rising and setting of celestial bodies, together with their respective amplitudes; because the island lies low, and is land-locked on nearly all points of the compass. Besides, the sensible land-horizon of the Ween is extremely uneven and rugged, the north and eastern parts being some rising hills in the province of Schonen, and the western part is mostly overspread with trees on the island of Zealand; from the remotest of which coasts the Ween is not distant above three leagues.

Account of some Stones and Plants lately found in Scotland, and of some Books now printing there. By Sir Robert Sibbald. N° 266, p. 693.

Mr. Lluyde met with several curiously figured stones here, and with some inscriptions on the Roman wall, and in Icolms Kill, and other places, of which it is likely you may have an account from him. Mr. Sutherland found, last summer, several curious plants growing wild in Anaandale, some of which he had not seen before. I am told Dr. Pitcairn's writings, with additions, are to be published in one volume in quarto, in Holland. We are about the christian poet Sedulius Scotus de Mirabilibus Dei, with notes, from a manuscript of 700 years' antiquity. We have here in the lawyers' library, Arator, another christian poet, which is intended to be printed from an old manuscript I have.

Account of an Aneurism of the Arteria Aorta. By Mr. Lafage, Surgeon. N° 267, p. 696.

In the year 1685, a servant to the Lord Culpeper had a fall, which caused a heavy pain in the breast. A month after, a musket burst in his hands, which gave so violent a recoil against his right side, that it made him spit blood immediately, and so continued for 6 months. A year after, he began to feel a pulsation on that side, and then he spit blood again, which continued ever after, but only in the spring and the fall, till he died. He bled likewise by the nose twice a year, for a month every time. About the year 1696, a tumour began to appear under the right nipple, which growing by little and little, came at last to an extraordinary size; after using some emollient ointments upon it, it suddenly broke, and he died soon after. M. Lafage opened the body, and he found first, that two of the cartilages of the ribs were worn off, by the continual pulsation of the tumour, as also part of the sternum bone. The dilatation of the artery began precisely on its trunk next the heart, before it divided itself into the ascending and descending trunks; and though there is but a little space, yet it dilated itself so excessively, that the bag filled up the whole cavity of the thorax on the right side, and pressed the lungs so much, that they were greatly contracted. The bag adhered by the outside to the mediastinum, to the diaphragma, the pleura, and to the sternum, in which it had dug 2 great holes, so strong was the impulsion. The inside of the bag was lined almost all over with bony laminæ, some larger, some less, like so many shells. The heart was greatly relaxed, insomuch that it was twice as large as it ought to be. And among its fibres there were some stones, like those sometimes found in the lungs of scrophulous bodies.

Account of Mr. Samuel Brown's second Book of East India Plants, with their Names, Virtues, Description, &c. By James Petiver, Apothecary, and F. R. S. N° 267, p. 699.

An enumeration and description of 44 more East-Indian plants, gathered by John Osmond on the 27th and 28th of April 1696, at Pearmeedoor, about 16 or 17 miles from Fort St. George, (Madras.) To the Malabar names Mr. Petiver adds the synonyms of Plukenet, Ray, and other botanists.

To determine the Colours and Diameter of the Rainbow, from the given Ratio of Refraction; and the contrary. By Edm. Halley, F.R.S. N° 267, p. 714. *Translated from the Latin.*

To those who have attentively considered the phænomena of the rainbow, it has always been manifest that the sun's rays, reflected by a watery cloud, have entered the eye at some certain angle: whence proceeds its form of a bow. But the reason of its colours, as also of the magnitude of that angle, by which we find the rainbow constantly to be distant from the point opposite to the sun, has given much trouble both to the ancients and moderns.

Nor did they do any thing to the purpose, till the famous Des Cartes, calling to his assistance the mathematical sciences, informed us by many examples, that these physical speculations might and ought to be treated in a stricter method of argumentation. And among other things he has given us the theory of the rainbow. From his demonstrations it is plain, that the primary iris is produced by such rays of the sun, in which the excess of the two refracted angles above the one angle of incidence, is the greatest of all possible angles. That the secondary iris is formed by those rays only, in which the excess of the three refracted angles above the one angle of incidence, in like manner is the greatest possible. And so we might go on to the third, fourth, or any other iris, which are made when the rays emerge, out of the drops, after three, or four, or more reflexions. Now in all these there is a general rule, that the excess of four, or five, or more refracted angles, (that is, the number of reflexions must be increased by an unit,) above one angle of incidence, must be the greatest of all. Now that greatest excess being doubled, is always the distance of the iris from the point opposite to the sun, when the number of reflections is odd. But if that number be even, the double of that greatest angle is the distance of the iris from the sun itself.

Now that those greatest excesses may be had, the refraction of any liquid being given, or the ratio of the sine of incidence to the sine of the refracted angle; we must take notice that the excess of two refracted angles above one angle of incidence, is then greatest, when the momentary augment of the angle of incidence is exactly double to the momentary augment of the refracted angle. But, of three refracted angles, the excess is then greatest, when the momentary augment of the angle of incidence is triple to the moment of the refracted angle; and so of the rest. And this is manifest of itself. Now we shall obtain the angles themselves by premising the following lemma, which we must demonstrate.

Lemma.—The legs of any plain triangle continuing the same, if the vertical angle be increased or diminished by any angle less than any given one, the moments or instantaneous mutations of the angles at the base will be to one another reciprocally as the segments of the base.

Let ABC (fig. 17, pl. 12) be a triangle, whose vertex is A, the legs AB and AC; and the base BC; upon which let fall the perpendicular AD. Then let the angle BAC be increased by any indivisible moment CAc, and draw the lines B*cd* and *c*D which will differ from the lines BCD and CD only intellectually. I say the moment of the angle ABC, that is CB*c*, is to the moment of the angle ACB, or ACD, as CD to BD, that is reciprocally as the segments of the base. For as the angle ACD is the sum of the angles ABC and BAC, its moment will also be the sum of the moments of those angles, or CA*c* + CB*c*. But CA*c* is equal to the angle CD*c*; for because of the right angle at D, the points A, D, C, *c*, are at the circumference of a circle whose diameter is AC, by Eucl. 3, 9. And therefore the sum of the angles CB*c* and CD*c*, that is the angle D*cd*, will be the moment of the angle ACD, or ACB. But the angles CB*c*, and D*cd*, being indefinitely little, are to one another as their opposite sides, or as *c*D or CD to BD, that is, reciprocally as the segments of the base. Q. E. D.

Now if either of the angles B or C be acute, changing what is to be changed the lemma will be demonstrated as above.

Corol.—Hence it follows, that the moments of the angles at the base are to one another directly as the tangents of those angles.

By the help of this lemma we may easily obtain the diameter of any rainbow, either by a geometrical construction or a calculation. For assuming any right line CA (fig. 18), first let it be divided in D, so that CA may be to CD in the ratio of refraction, which in water is as 250 to 187, or more accurately as 529 to 396, Then let CA be divided in E, so that CE may be to AE, as unity is to the number of reflections which a ray of the sun suffers, proper to produce the proposed rainbow. Then with the diameter AE let the semicircle ABE be described, and with centre C and radius CD draw the arch BD, meeting the semicircle ABE in the point B. Lastly, drawing the right lines CB, and AB, upon AB produced let fall the perpendicular CF, and EB parallel to it. I say the angle CBF will be the angle of incidence, and CAB the refracted angle, as were required; and these will produce the proposed rainbow.

Demonstration.—Since the triangles ACF and AEB are similar, it will be AF to BF, so is AC to EC, that is, as the number of reflexions encreased by unity, is to unity, by the construction. Therefore the moment of the angle CBF will be to the moment of the angle CAF, in the same proportion, by the foregoing lemma. But the sine of the angle CBF is to the sine of the angle CAF, in the ratio of the sides CA and CB, that is, the ratio of the given refraction, also by construction. Therefore the angle of incidence CBF has its corresponding refracted angle CAF, and their moments are in the ratio proposed; therefore they are the angles required. Q. E. D.

And now multiplying the refracted angle by the number of reflexions encreased by unity, and from the product subtracting the angle of incidence, we shall have half the distance of the rainbow from the sun, if the number of the reflexions is even, or from the point opposite to the sun, if odd, as said before.

Hence by a construction that is neat enough and not inelegant, we may exhibit, by way of synopsis, the incidences of all rainbows in order, in any liquid, the refraction of which is known. For if the assumed line AC be divided in two equal parts at E, in three at e, in four at ε, in five at η, and so on; and with the diameters AE, Ae, Aε, Aη, &c. be described the semicircles ABE, Abe, Aβε, Aυη, all which are met by the circular arch DBbβυ; described with centre C and radius CD, (which radius is to AC in the given ratio of refraction,) in the points B, b, β, υ; I say that drawing the lines AB, Ab, Aβ, Aυ, they will constitute with the line AC the angles CAB, CAb, CAβ, CAυ, equal to the refracted angles; and with the rays CB, Cb, Cβ, Cυ, respectively, angles equal to the angles of incidence required. That is, ABC, or rather its complement to a semicircle, for the primary rainbow, Abc for the secondary, AβB for the third, and AυC for the fourth; and so on.

Now if any one is desirous to investigate these angles by an exact calculation, from the same source an analyst will easily discover, that making radius = 1, and the ratio of refraction as r to s, the sine of incidence will be $\sqrt{\frac{4 - 1rr}{3 - 3ss}}$; but the sine of the refracted angle will be $\sqrt{\frac{4ss - 1}{3rr - 3}}$, from which angles the primary rainbow proceeds. But for the secondary $\sqrt{\frac{9 - 1rr}{8 - 8ss}}$ will be the sine of incidence, and $\sqrt{\frac{9ss - 1}{8rr - 8}}$ the sine of the refracted angle. For the third, the sine of incidence will be $\sqrt{\frac{16 - 1rr}{15 - 15ss}}$, and the sine of the refracted angle will be $\sqrt{\frac{16ss - 1}{15rr - 15}}$. For the 4th the sine of incidence will be $\sqrt{\frac{25 - 1rr}{24 - 24ss}}$, and the sine of the refracted angle $\sqrt{\frac{25ss - 1}{24rr - 24}}$. And so of the rest.

Admitting the ratio of Descartes, you will find by calculation, that the primary rainbow is distant from the point opposite to the sun 41° 30′; the secondary 55° 55′; the third 40° 20′; and the fourth 45° 33′, from the sun itself. These last I know not whether any one will be able to see, because of the light of the sun growing more and more feeble in every reflexion and refraction. And this may suffice concerning the magnitude of the rainbow in the transparent drops of a fluid, whose refractive power is known. We must now add something concerning the colours with which the rainbows are painted, and their order in each; being varied by the refraction through all possible degrees.

First it must be known, that all light of the blue kind is refracted something more than any red light; from which difference arises the breadth of the rainbows, which is hardly to be determined by observation, because of the uncertain limits of the colours in the cloud. But the greater is the ratio of inequality between CA and CD, or the greater the refraction is, so much the greater is the distance of any rainbow from the sun; and therefore the limits of rainbows that are more remote from the sun always shine with purple colour, and the nearer are intensely ruddy. This may always be seen in the primary iris, which vanishes opposite to the sun, if the sine of incidence be to the sine of the angle of refraction, as CA to CE, or as 2 to 1. If that ratio be greater, no primary rainbow can be seen at all.

But it is to be observed, that the secondary iris goes off in a point opposite to the sun, whenever the ratio of refraction is as 1 to 0,847487. Thence it returns to the sun itself, and there vanishes, if the said ratio is as 3 to 1, or as CA to CE. But in intermediate ratios, such as obtain in all known fluids except air, the greater the ratio is, so much the more the iris is distant from the opposite place of the sun, or rather from the sun itself, reckoning the arch beyond the semicircle. And therefore the colours will be found in an inverted order from the primary, in these returns, unless the distance of the iris from the sun is taken in this sense. And this is to be observed every where in the rest.

The third rainbow is lost in opposition to the sun, when the ratio of refraction is as 1 to 0,91855. And thence recurs to the sun in the ratio of 1 to 0,6825. Whence again, the order of the colours being restored, in the ratio of 4 to 1, or of CA to Cε, it ceases opposite to the sun. But the fourth iris beginning from the sun in the ratio of equality, passes over in opposition to it in the ratio of 1 to 0,94895, and thence returns to the sun, if the ratio be as 5 to 4. Hence again it is spread to the sun's opposition, in the ratio of 1 to 0,56337. And in this space are included the known refractions of all fluids. Lastly, the ratio being as 5 to 1, or as CA to Cη, it vanishes in the sun itself: the colours being every where inverted as to sight in the return to the sun, but direct in the egress from it. Hence in watery clouds, the primary and fourth iris object their scarlet colours to the sun, but the secondary and third, their purple.

But whence the different refractive virtue of fluids arises, is a problem of no small difficulty, and may very justly be reckoned among the secrets of nature, not yet discovered by our senses, or our argumentation. For, among fluids, pure water is found to refract the rays of light least of all. But imbued by any salts dissolved in it, the refraction is increased according to the quantity of the salts, and its own weight. And corrosive spirits, which are much heavier than water, turn aside the rays of light much more. Nor is it a wonder, since they are denser bodies, and therefore may be conceived the more to obstruct the passage of light. But it does not appear by a like argument, why so great a refraction is found in any ardent spirits or oils, especially in spirit of turpentine or wine, since they are very light fluids in respect of water, and consist much of ethereal particles. This seems to require a very intimate knowledge of the nature of light, as also of matter.

Now from the given distance of the iris from the sun, to deduce the ratio of refraction, supplies the curious with an occasion of observing very accurately, and with little trouble, the refraction of any fluid whatever. For if a drop of any transparent fluid hangs at the lower part of a small glass tube, and the sun being near the horizon, but shining clearly, it be observed under what angle with the opposite place to the sun the colours of the iris are seen in the drop; the ratio required may be had by a little calculation. The equation arising is cubic explicable but by one root, by which the ratio is computed from having the primary iris given. The equation is $T^3 - 3TTt \ldots . 4rrt = 0$, where T is the tangent of the angle of incidence required, and t the tangent of half the distance of the iris from the point opposite to the sun, to radius $r = 1$.

Whence according to Cardan's rules, arises this theorem. From the cube of t subtract the product of 2tr into the excess of the secant of the same arch above the radius ; the difference will be a lesser cube. And the sum of the same, adding 4trr, will be a greater cube. The sum of the sides of each cube, and of t, will be equal to the tangent of the angle of incidence, half of which will be also the tangent of the angle of refraction ; whence arises the ratio required.

Of this take the following example. In a drop of oil of turpentine, the distance of the primary iris from the point opposite to the sun, is observed to be 25° 40′. The ratio of refraction is required.

t = tangent 12° 50′ = 0,2278063
s = secant of the same = 1,0256197

ttt = 0,01182217
s − r into 2 tr = 0,01167265

difference, or lesser cube = 0,00014952. $\surd$0,0530773

sum 0,02349482
4trr = 0,91122525

greater cube 0,93472007. $\surd$0,9777486
t = 0,2278063

T = tangent incidence 51° 32′ 1,2586322
$\frac{1}{2}$T = tangent refraction 52° 11′ 0,6293161

Finally, as $\sqrt{TT + 4}$, is to $\sqrt{TT + 1}$, so is r to s, so is 1 to 0,68026. And this ratio approaches nearly to that, which we find by experiment obtains in glass, and most other pellucid solids. But a diamond does not only exceed all other diaphanous bodies in hardness and value, but also in this refractive virtue; its ratio being nearly as 5 to 2, or more truly, as 100 to 41. But of these perhaps more at large in a proper place.

While I was employed in writing this, the very skilful geometrician, Mr. De Moivre, at my request, took the pains to find a like equation for the ratio of the secondary iris, when the diameter is given. By this the ratio may be determined very accurately, but the equation being biquadratic, the calculation cannot be performed with the same ease. The equation is $T^4 + \frac{8}{3}T\,t^3 - 2TTrr - \frac{1}{3}r^4 = 0$. Here T is the tangent of the angle of refraction, t the tangent of half the distance of the rainbow from the point opposite to the sun, and the radius r = 1. Now this equation is of such a form, as always to be explicable by one affirmative and one negative root, one of which, being the lesser, is the tangent of the angle of refraction in the regress to the sun, that is, when the purple colours are the nearer to the sun. But the greater root is the tangent of the angle of refraction, in the iris going from the sun, as we have observed above, that is in a fluid of lesser ratio. In oil of turpentine the distance of this iris from the point opposite to the sun, is observed to be 81° 30′. Whence the curious reader may derive the roots 0,80822, and — 2,98131, the tangents of the refracted angles. Hence is computed the ratio of greater inequality, as 1 to 0,67995. Such it is in oil of turpentine. But from the greater root proceeds the lesser ratio, as 1 to 0,9540 nearly. Such it would be in a fluid exhibiting the secondary iris of the same diameter, but which would look towards the sun with its red colours, after the manner of a primary rainbow.

The Way of Colouring Marble. N° 268, p. 727. *Translated from the Latin.*

1. The marble should be smooth, without any stain; the harder the better, to bear the heat of the fire, and therefore alabaster is not fit for this purpose.

2. Fire must be used to open its pores, yet in such a degree, as that it may not be red hot; for then the colours are burnt; nor in too little a degree, for though it receives the colours, yet they are less fixed; and even cold marble will imbibe some colours: as saffron, stone-blue, (for a sky colour,) &c.; but these are soon dissipated by the least degree of heat; therefore let the degree of heat be such as suffices gently to boil the liquor poured upon the marble.

3. The menstrua are various according to the diversity of the ingredients to be dissolved, as a lixivium made of horse's urine, though dog's urine be better, and pot-ashes four parts, together with one part of quick-lime; also spirits of wine, common lixivium, wine, and some oleaginous substances.

4. The colours that are laid on with vehicles are the following: 1. Stone-blue, dissolved either in spirits of wine or in a lixivium of unslaked lime. 2. Lacmus in the common lixivium. 3. Saffron or sap green, dissolved in a lixivium of urine and unslaked lime, or in spirits of wine. 4. Vermilion or cochineal dissolved as above. 5. Sanguis draconis dissolved in spirits of wine s. a. 6. Brasil wood dissolved in spirits of wine. 7. An extract of alcanna root with oil of turpentine; for it cannot be dissolved in any other menstruum; neither in spirits of wine, nor in a lixivium of unslaked lime as above; there is another kind of sanguis draconis, called lachryma, which mixed with urine strikes a pretty agreeable colour, but with difficulty; colours mixed with urine answer best.

5. Colours laid on without any vehicle are, 1. Sanguis draconis well cleaned, for a red colour. 2. Gum-gutta for a yellow. 3. Green wax for a green. 4. Sulphur, pitch, and turpentine, for a brown colour; and you need only give the marble a proper heat, and then rub on your colours, which experience will further teach you; these colours are discharged with more or less difficulty, as a red colour in 24 hours with oil of tartar per deliquium, without spoiling the polishing; a brown colour in a quarter of an hour with aquafortis, but the polishing is spoiled; for a golden colour, take sal ammoniac, white vitriol and verdigris, and grind them very fine.

Account of the Religion, Rites, Notions, Customs, Manners of the Indian Priests, called Bramins. By Mr. John Marshal. Communicated by the Rev. Mr. Abraham De la Pryme. N° 268, p. 729.

Upon what grounds some travellers have stiled these people polytheists, or atheists, I cannot tell; and if there be any such people in the world, except some of the base common sort in all nations, I much question. It is very observable here, that when their priests or bramins, and holy men, whom they call jagees, have occasion to write any thing, they always put a figure of one in the first place, to show, as they say, that they acknowledge but one God, whom they say is Burme, that is, Immaterial. When they preach to the people, which is commonly every feast-day, full moon, or the time of an eclipse of either luminary, they tell them much of God, heaven, and hell, but very imperfectly, obscurely, and mystically. They say that when God thought of making the world he made it in a minute.

They account this world the body of God, and that the highest heavens are his head, the fire his mouth, the air his breath and breast, the water his seed, and the earth and its foundations his legs and feet. Yet they hold that God is immaterial, and assert in general that he is the life of every thing, which yet is neither greater nor less for him.

They hold that God dwelt in a vacuity before he created the world, and that as he dwelt in that vacuity he created several beings out of himself: the first were angels, the second souls, the third spirits, all differing in degrees of purity, the first being more pure than the second, and the second than the third. The angels, they say, neither act good nor evil, the souls either good or evil, but the spirits, or dewtas, as they call them, act scarcely any thing but evil. They have a good opinion of the angels, and think their state very happy, hoping that when they die, they shall be made partakers of the same bliss and pleasure.

They believe that every thing that has life has a soul, but especially man;

and they accordingly affirm, that as these souls behaved themselves in their pre-existent state, so are their actions in this world either good or bad, by a sort of fatal necessity, which is very hard to conquer or overcome. Hence it is, say they, that there are so many different humours and dispositions of men; for their souls before their entrance into their bodies being tainted with different affections, causes the like difference in the parties whose bodies are their vehicles. So that if a man happen to have a sudden or unfortunate death, they immediately ascribe the same to the party's own wickedness, or the bad life that his soul led before it entered into his body. For, say they, the fore-acted evil that his soul did in its other life brought these accidents upon him, by getting the upper hand of him, and by being too powerful and strong. And they believe that the souls of those who die thus, turn immediately into devils. They maintain Pythagoras's transmigration, or metempsychosis, but in a grosser sense than he did; for they believe that the souls of men who have not lived well, go as soon as the body dies, not only into birds and beasts, but even into the basest reptiles, insects, and plants, where they suffer a strong sort of purgation, to expiate their former crimes; but as for the souls of the jogees, or fuches, that is, of religious men and saints, they inhabit with the good dewtas, or angels, among the stars.

As for the spirits, or inferior angels, they believe that they are very bad, and have a hand in all wickedness, murders, wars, storms, and tempests; so that when they solemnize the funerals of the dead, they always present dishes of meat, as offerings to those spirits, and sometimes they sacrifice to them, that they may not hurt the souls of the dead.

As they acknowledge the being of a mighty God, so they hold that he created the world, and every thing in it. They believe that there is almost an infinite number of worlds, and that God has oftentimes annihilated and re-created the same. But how he came first to create the world and mankind, they relate to have been thus—Once on a time, say they, as he was set in eternity, it came into his mind to make something, and no sooner had he thought the same, but the same minute a beautiful woman was present before him, and he called her Adea Suktee, that is, the first woman; then this figure brought into his mind that of a man; and immediately a man also started up before him; this he called Manapuise, that is, the first man; then on reflection he resolved to create several places for them to abide in, and accordingly assuming a subtile body, he breathed in a minute the whole universe, and every thing in it, from the least to the greatest.

They constantly believe that the universe cannot possibly last longer than 71 joogs,* a certain measure of time. Which when it is come, God not only annihilates the whole created world, but every thing else as well angels, souls

* The term yoog or yug, it seems, in the Indian chronology, denotes a period or revolution of a certain number of years, or a conjunction or coincidence, as if being the period of years in which all the planets come into a conjunction in the same sign, counting by their mean motions. The Indians however have yugs of different kinds. According to their romantic ideas, the age of the world is divided into four grand periods, of astonishing duration, called yugs, or distinct ages. The first is the satya yug, that is, the age of purity, or of truth; this it is said lasted 3,200,000 years; that the life of man, during that period, was extended to 100000 years; and that his stature was 21 cubits. The second was the treta yug, or the age in which the third part of mankind became corrupt, the word treta in the sanscrit, it seems, denoting the number 3. This yug is supposed to have lasted 2400000 years, and that men in this period lived to the age of 10000 years. The third was the dwapar yug or the age in which half the human race became depraved; dwa or dua signifying the number 2, or the second, and by the addition of par, or paar, it denotes a half. The duration of this yug is stated at 1600000 years, and in it the life of man was reduced to 1000 years. The fourth, or present age, is the calee yug, or cali yug, in which all mankind are said to be depraved or shortened. The Hindoos suppose that the cali yug will subsist for 400000 years, that it commenced in the year 3102 before our Christian era, and consequently that the present year, 1804, is the 4906th of the Indians' cali yug.

But other accounts of the yugs make the current, or cali yug, to consist of 432000 years, and the preceding ones, in retrograde order, to be respectively double, triple, and quadruple of that; by which means it happens, that if the first number denote a period, or cycle, in which any certain celestial phænomena come to a coincidence, then the like coincidence must occur at the other three periods also, because they are multiples of the first. It is remarkable that the four Indian ages have their relations and gradations of qualities, as to purity or depravity, similar to the like four ages among the ancient Greeks, viz. the golden age, the silver age, the brazen age, and the iron age. Hence, multiplying the cali yug by the numbers 4, 3, 2, we have the length of the four Indian yugs, or ages, as follow:

The first yug, or golden age............	1,728,000
The second yug, or silver age............	1,296,000
The third yug, or brazen age............	864,000
The cali yug, or iron age............	432,000
The sum of all, or 10 cali yugs..........	4,320,000

As to the quantity of the cali yug, various speculations and calculations have been made concerning it. The prevailing idea seems to be, the coincidence of the period of the moon's nodes, with that of the Platonic year, that is, with the period of the precession of the equinoxes. Now the period of the moon's nodes is very nearly $18\frac{2}{3}$ years; but the Platonic year, or period in which the solar node will move through all the points of the ecliptic, or 360 degrees, has been variously stated by both the ancients and moderns; at present the motion of the equinox is taken to be $50\frac{1}{3}$ or $50\frac{1}{4}$ seconds per year; but other ages and other nations have accounted it different, some more, some less; and the Indians in particular, it is said, state the precession to be at the rate of 54 seconds per year. Now calculating from this number, if 54″ answer to 1 year, then 360°, or 1296000″, will answer to just 24000 years, for the Platonic year. Then if this number be multiplied by 18, the even years in the period of the moon's node, it produces 432,000, the very number of the cali yug. It is true and spirits, as inferior creatures; and then he remains in the state he was in before the creation; but they say that after he has a while respired thus, he breathes again, and every thing is created afresh, angels, souls, and all other things, except the spirits, which are no more thought of. After 71 joogs more, all is annihilated again. How many joogs are past since the world was last created, they cannot certainly tell; only it is observable that in an almanack of theirs, written in the Sanscrit language in 1670, they make the world then 3892771 years old from its last creation.

The Bramins of Persia relate stories of a giant that was led into a most delightful garden, which upon certain conditions should be his own for ever. But one evening in a cool shade, one of the wicked dewtas, or spirits, came to him, and tempted him with vast sums of gold, and all the most precious jewels that can be imagined; but he courageously withstood that temptation, as not knowing what value or use they were of: But at length this wicked dewta brought to him a fair woman, who so charmed him, that for her sake he most willingly broke all his conditions, and thereupon was turned out.

They tell a great many absurd and ridiculous stories of the first ages of this present world, which would be too tedious here to take notice of; only I shall give you out of one of their own books what they tell us of a great flood that formerly happened. They say, that about 21,000 years since, the sea overwhelmed and drowned the whole earth, excepting one great hill, far to the northwards, called Bindd, and that there fled thither only one woman and seven men, whose names were, Dehoolah, Sunnuk, Sunnaud, Trilleek, Sannotah, Cuppyloshaw, Suraschah, and Burroopung; these understanding out of their books that such a flood would come, and was then actually coming, prepared against the same, and repaired thither; to which place also went two of all sorts of creatures, herbs, trees, and grasses, and of every thing that had life, to the number in all of 1,800,000 living souls. This flood, say they, lasted 120 years, 5 months, and 5 days: After which time all those creatures that were thus preserved, descended down again, and replenished the earth: But as for the 7 men, only one of them came down with the woman, and dwelt at the foot of the mountain, the other six turned fuchees, or holy men, and spent there the remainder of their days.

this calculation employs only the round number 18, instead of $18\frac{2}{3}$, as well as the other number 54″, which is not very certain. Suppose then we employ the exact number $18\frac{2}{3}$, and the number 56″ for the ancient Indian precession in one year; at this rate the Platonic year, or the period of the whole 360° of precession, will be $23\frac{1}{7}$ thousand years, which number multiplied by $18\frac{2}{3}$, gives exactly 432,000 years, the very same period as before. Upon the whole therefore it appears probable, that for the term of the cali yug, the Indian astronomers take the product of the coincidence of the said two periods, viz. of the moon's and of the earth's or sun's nodes.

They hold in general the Ptolemaic system of the universe, and say that there are 8 or 9 heavens, counting the air and earth, every one exceeding another in beauty and glory.

Their religion consists of nothing, that I could ever see or learn, but the leading of a pure life, the washing away of their sins in the river Ganges, muttering divers prayers, and doing strange and incredible penances. They say, that God is such a one, that whoever seeks him, let it be after what manner he pleases, whether by thinking that the sun is he, or the moon, or the like, if they do it but sincerely and honestly, with a right affected heart, they shall be accepted of him. They report, that on a time a mussulman seeing a hindoo or pagan priest in heaven, he asked God how that infidel came to have admittance there, whom Mahomet so often calls by the name of bitter roots? To whom God answered, What if a bitter root bring forth sweeter fruit than any of you, why should I not receive it? Upon which the mussulman had no more to say. They hold, that such as suffer not their minds to wander after the lusts of the world are perfect jogees, or saints, and hold that God is always present with them in all their actions.

It is to be found in many of their books, that there was a time, a good while ago, in which God took upon him the shape of a man, and spent many years in reforming the world, and giving better rules to walk by than had been before: but at length having left them, they soon forgot him and his rules, and returned to their former courses; upon which he told them, that he would leave them to their ways, and never undertake any such thing again.

The religious at certain seasons of the year come to the river Ganges, which they call the holy river, in vast multitudes, even from many parts of Tartary, to wash away their sins, and make expiation for their faults. This Ganges is a delicate fine river, chiefly on account of its very sweet, clear water, which has got it the greatest esteem of any river in the East. I have often sailed many miles up it, and have found it in some places not above a mile broad, in others not half so much, and in one or two places not above one-eighth of a mile. In April, when the water is at the lowest, it is almost dry in many places; but when it is at the highest, which is commonly about the middle of September, it is very deep, and many miles broad. When the people are gathered together here, they have a great many strange customs and ceremonies, and pay a kind of divine honour and worship to the river, too long here to mention. The Hindoos and Bramins preach then every day to the people, teaching them their duties, and ordering them to say such and such prayers; but above all things to be charitable to the poor and needy.

It is reported, that on the hills of Casimir there are men that live some hundreds of years, and can hold their breaths, and lie in trances for several years together, if they be but kept warm; and that every year some of them come down to the people at the Ganges, and perform many great cures; for whom they have such a veneration, that they frequently drink the water they wash their sweaty feet in. The penances and austerities they undergo are almost incredible; most of them, through their continual fastings, and lying on the parching hot sand in the heat of the sun, are so lean, dried, and withered, that they look like skeletons, and one can scarce perceive them breathe, or feel their pulse beat.

When any great man dies among them, but especially any of their jogees or saints, they make great preparations for his funeral; the corpse is laid on its belly, and salt and rice placed round it on the ground. Then the nearest relations to the party deceased carry a pot of water on their shoulders several times about the funeral pile; then breaking the pot in pieces, they spill the water; which ceremony being ended, the pile is fired, and then all the relations begin to howl, and embrace one another; then washing themselves in some neighbouring river, they all depart home; and as for the remaining ashes, if he be rich, they gather them up, and cast them into the Ganges, or the sea. Sometimes the wife of the deceased party, if she have no children, and be old, or have lost her love for the world, will burn herself with the dead body; but this happens very seldom. It is said, that in such cases the Bramins give the woman a stupifying liquor, which by the time that she is in the fire makes her senseless of any pain.

To know into what body the soul of the deceased is transmigrated, they do thus; they strew the ashes of the dead on the place where he was first laid after his death, and handfuls of odoriferous flowers about the same, and returning again in 44 hours, they judge by some pretended impression or other in the ashes, into what body it is gone; if the foot of a horse, or dog, or ox, or such like appear, then they pretend that it is gone into that particular animal; but if nothing appear, then they think it is certainly gone to the starry regions.

Their learning and knowledge is but small; they have indeed several books, written in divers languages; but they contain only a great deal of cant about their worship, rites, and ceremonies. They are ignorant of all parts of the world except their own; they wonder much at us who take such care and pains, and run through so many dangers both by sea and land, only, as they say, to uphold and nourish pride and luxury. For, say they, every country in the world is sufficiently endowed by nature with whatever is necessary for the life of man, and therefore it is madness to seek for, or desire, what is unnecessary.

The last time I was at Modufferpore in Indostan, I had a great deal of talk with a Bramin, somewhat more learned than any of the rest, his name was Ramnaunt: he told me many secrets in physic, as also many traditions and stories. They have books full of charms, and cabilistic complications of figures; as for example, if you write these following numbers,* 28, 35, 2, 7—6, 3, 32, 31—34, 29, 8, 1—4, 5, 30, 33, in the squares of a square figure, and your enemy's name under it, and wear it always about you, your enemy shall never be able to hurt you. So if you write the following figures in the like manner upon the left hand, 2, 9, 2, 7—6, 3, 6, 5—8, 3, 8, 1—4, 5, 4, 7—with turmeric, and wash the same off with fair water of Ganges, and drink it, it will cure all venomous bitings.

They have many similar ridiculous fancies; all which they seem to have borrowed from the cabala of the Saracens.

When they have any mad men among them, they put them into a close room, just large enough to hold them, and smoke them almost to death with musk and cold smells, which soon brings their brains into their right temperature, and so recovers them, &c.

There happened two things in our voyage hither; which I thought very observable. The first was, that all the tornadoes brought much rain with a stench; and if the seamen laid their clothes by but for 24 hours, they became all full of little maggots. The second is, when we came out of Europe, we took in some water at St. Jago's, and when we were almost at our journey's end, our cooper going with a candle to open one of the casks, he had no sooner done it, than the water immediately took fire, and burnt his face, hands, and fingers; but turning suddenly about, he quenched it, by setting his breech on it. The water also stunk much at the same time, but afterwards came to its natural sweetness, &c.

* It is remarkable that these 16 numbers, being formed into the 16 cells of a square in the order as they stand, they will compose a magic square, every horizontal row and every vertical column, and each diagonal of which amount always to the same sum, viz. 72, as in the annexed scheme of the first square. And the like for the second set of 16 numbers in the 2d square, whose horizontal, vertical, and diagonal sums amount always to 20. Of these two curious sets of numbers, it is remarkable that the former consists of two sets or halves of 8 numbers each in a continued series, the one from the number 1 to 8, in succession, the other 8 from 28 to 35 inclusive; but in the latter set of 16 numbers there are two of each number, from 2 to 8, then one of 1 and one of 9.

28	35	2	7
6	3	32	31
34	29	8	1
4	5	30	33

2	9	2	7
6	3	6	5
8	3	8	1
4	5	4	7

Further Observations on the Animalcula in Semine Masculino. By M. Ant. Leuwenhoeck, F. R. S. N° 268, p. 739.

Having procured from a butcher the testicles of a young ram, as soon as killed, when only between 4 and 5 months old, I opened the seminal vessel that lies without upon the testicle, from whence I took out the seed, which to the naked eye appeared white, and viewing it with my glass, I observed an unspeakable number of living creatures in it, swimming in the liquor in vast shoals together, some steering the same course, then by thousands at a time breaking off from one company, and joining themselves to another; in short, the strange and wonderful swimming of these creatures is impossible to be described.—I placed also some of the seminal vessels before the microscope, to discover, if possible, the creatures living therein; but could not discover any thing of it. I followed the vasa deferentia till I brought them to their joining with the adferentia, in which vessels I found a vast number of these worms, but none living. Next, I opened the testicle into which these vessels went, but could not discover in the least any of these creatures in the seed; but instead thereof I saw a great many bubbles or bladders, some as large as those worms, and some less.

The next morning early I opened again some of the seminal vessels, near the place where I had opened the others the day before, and found them as lively as at the first time; but when I continued the same observations about noon, I could not perceive that any of the worms were living. The like experiments were afterwards repeated.

There is a gentleman, who boasts that he was the first that ever discovered these creatures, by the help of a microscope; but he is mistaken, for he owns that his first discovery was in the year 1678; whereas I not only gave the Royal Society an account of the same, in Nov. 1677; but even 3 or 4 years before, at the request of Mr. Oldenburg, I had made an enquiry into those matters.

Fig. 19, pl. 12, exhibits a group of these animalcules, in different postures, as magnified by the microscope.

It is well known to many, that my hypothesis is, that every one of these includes a lamb; yet after they are nourished and enlarged in the belly of the female, they soon put on the same shape. But this is not strange, as we find by experience in a worm or maggot, in which, after it is come to its full growth, whether we dissect it, or examine the outside only, we find none of its parts like those of a fly; and that all these creatures, a little before their transmutation, lie as still as if they had no life in them; and a few hours after their change, they shut themselves up in a skin or shell, which we call a popje or tonneken,* some of which are so thin and transparent, that I have often seen their limbs and their numerous eyes distinctly within. Now if this figure and parts of a fly were not actually included in the worm, such a transmutation would have been inconceivable; so it is also with the creature in the male seed; but it is impossible for any man to penetrate into the secret parts of such a wonderful minute animal.

If we should consider the tail of one of those aforementioned creatures, we must needs be astonished at the incomprehensible number and smallness of its parts, especially if we conclude that such a very small tail is provided with as many joints in proportion as the tails of larger animals, otherwise it could not move nimbly on every side as it ought to do; and again, that every one of these little joints consists not only of muscles, but also of arteries and veins, which convey the nourishment down to it: when we consider this, and the smallness of all the other parts of the body, we cannot sufficiently admire the wonderful works of God.

Part of a Letter to Dr. Sloane, containing Solutions to two Problems. 1. *On the Solid of least Resistance.* 2. *The Curve of quickest Descent. By the Rev. John Craig.* N° 268, p. 746. *Translated from the Latin.*

In the first part of this paper Mr. Craig assigns his reasons for wishing these solutions to be published: observing, that Sir Isaac Newton had thought it proper to conceal his analyses; and that although some other eminent men, as Bernouilli, and the Marquis De L'Hospital had exhibited solutions, yet he hoped the simplicity of his investigation would recommend it; and the sciences might be farther extended in proportion as the same things were treated with the greater variety.

Lemma. To find the ratio between the resistances which the right angled triangle AIG, and the circumscribing rectangle AIGg, meet with in moving through a fluid, according to the direction of the line IA, from I towards X. Pl. 13, fig. 1.

To any point B in AG let the perpendicular BC be drawn, and Bb parallel to AI, likewise BM perpendicular to AI. Also in bB take bH $= \frac{CM^2}{BC}$, and bE $=$ BC: through the points H, E, draw the right lines HA, EA, which produce till they intersect Gg in K and F: then the resistance of the triangle AIG will be to the resistance of the rectangle AIGg, as the area of the triangle AKG, to the area of the triangle AFg. And the resistance against any part taken at pleasure in the line AG, to the resistance against the corresponding part of the line Ag, for example, against AB and AB, as the area AHB to the area AEb. The demon-

* Chrysalis.

stration depends on a general theorem, which is easily deduced from Prop. 35. Book 2. Newton's Principles, &c.

Corol. 1.—Hence, if BG, bg, be infinitely small parts of the lines AG, Ag, and bB be produced to L; then, the resistance against BG (which call *e*) will be to the resistance against bg (which call E) as GL^2 to GB^2.

For, $e : E :: KHbg : FEbg$, that is, $e : E :: bg \times bH : bg \times bE$ (by the preceding lemma); therefore, $e : E :: bH : bE$; that is, $e : E :: \frac{CM^2}{BC} : BC$ (by the construction in the above lemma): therefore, $e : E :: CM^2 : BC^2$. But, by reason of the similar triangles BMC, GLB, $CM^2 : BC^2 :: GL^2 : GB^2$; therefore $e : E :: GL^2 : GB^2$. Q.E.D.

Corol. 2.—The resistance against an infinitely small part GB, is expressed by the cube of the line GL divided by the square of the line GB. For, if all the infinitely small parts of the line Ag, as bg, be supposed equal, then the resistance against bg, may be expressed by the same bg, that is, E = bg, which is the same as E = GL. Therefore, by *Corol.* 1, $e : GL :: GL^2 : GB^2$, whence $e = \frac{GL^3}{GB^2}$. Q.E.D.

Corol. 3.—If *r* be the radius and *c* the circumference of any circle, then the resistance against the conic surface, generated by the rotation of the small line GB about AI, is equal to the product of $\frac{c \times BM}{r}$ into $\frac{GL^3}{GB^2}$. For the resistance against the conic surface is equal to all the resistances of the lineolæ GB, or to all the *e*'s, that is, equal to the circumference of the circle whose radius is BM, multiplied into *e*; that is, the resistance against such a conic surface is $= \frac{c \times BM}{r} \times e$; which, by *Cor.* 2, is $= \frac{c \times BM}{r} \times \frac{GL^3}{GB^2}$.

Problem I.—To discover the curve line whose rotation shall produce a solid, which while it is moving in a fluid medium according to the direction of its axis, shall meet with the least resistance.

Let OG, GB, (fig. 2, pl. 13,) be two infinitely small particles in the required curve, which by revolving about AQ will produce the solid of least resistance. Draw BM, GP, perpendicular to AQ, likewise BL and GN to AQ, and ON parallel to BM. Now $\frac{c \times BM \times GL^3}{r \times GB^2}$ is the resistance against the surface generated by the rotation of GB about AQ, and $\frac{c \times GP \times ON^3}{r \times OG^2}$ is the resistance against the surface generated in like manner by OG. (*Cor.* 3.) Now the resistance to both these together should be a minimum, that is to say, $\frac{c \times BM \times GL^3}{r \times GB^2} + \frac{c \times GP \times ON^3}{r \times OG^2}$ = a minimum. This is as much as to find, in the line RS so drawn that AQ will be parallel to it, and ON = GL, where the point G will fall; which, supposing the points O and B to be fixed, may be easily discovered by the known method of Max. and Min. Prosecuting the calculation, it comes at length to $\frac{\text{BM} \times \text{BL}}{\text{BG}^4} = \frac{\text{GP} \times \text{NG}}{\text{OG}^4}$, whence it is evident that $\frac{\text{BM} \times \text{BL}}{\text{BG}^4}$ = a constant quantity; if the absciss AM be called x, and the ordinate BM, y, it will be BL = dx, and LG = dy (supposed constant throughout the calculation); then will $\text{BG}^2 = dx^2 + dy^2$, whence $\frac{y\,dx}{dx\,dx + dy\,dy^2}$ = a constant quantity. Let a be any constant line, and then seeing that we observe the law of homogeneity it will be $\frac{y\,dx}{dx\,dx + dy\,dy^2} = \frac{a}{dy^3}$, agreeing with what was found by the celebrated L'Hospital, and Jo. Bernouilli. And this, by the way, Bernouilli exhibited as a fine specimen among some select methods for the construction of curves by differential equations, in which either x or y is considered as indeterminate; published in the Leipsic Acts for May, 1700, and from which was deduced an elegant method of constructing any curves required.

Problem II.—To determine the line of swiftest descent. Let BC, CD, (fig. 3, pl. 13,) be two infinitely small particles in the required curve. Now that the curve may be such that the passage from B to D, after falling from the horizontal line AQ, be made in the shortest time, it is necessary that in the line RS, drawn parallel to AQ, the point C be so taken, that the differences of the ordinates, GC, DE, may be equal.

Now the velocity in the point C is $\sqrt{\text{LC}}$, and the velocity in the point D is $\sqrt{\text{QD}}$; therefore $\frac{\text{BC}}{\sqrt{\text{LC}}}$ is the time of descent through BC, and $\frac{\text{CD}}{\sqrt{\text{QD}}}$ is the time of descent through CD (by Prop. 54, Book I. Newton). Therefore the point C should be so taken that $\frac{\text{BC}}{\sqrt{\text{LC}}} + \frac{\text{CD}}{\sqrt{\text{QD}}}$ = a minimum. Suppose B and D to be fixed, and the constant quantities GC = DE = m, LC = b, QD = p; the indeterminates BG = u. CE = z; we have $\frac{\sqrt{m^2 + u^2}}{\sqrt{b}} + \frac{\sqrt{m^2 + z^2}}{\sqrt{p}}$ = a min. Therefore $\frac{u\,du}{b^{\frac{1}{2}}\sqrt{m^2 + u^2}} + \frac{z\,dz}{p^{\frac{1}{2}}\sqrt{m^2 + z^2}} = 0$. But d$u$ = − dz, because $u + z$ = a constant quantity: therefore $\frac{u}{b^{\frac{1}{2}}\sqrt{m^3 + u^2}} = \frac{z}{p^{\frac{1}{2}}\sqrt{m^2 + z^2}}$; whence it is obvious that $\frac{u}{b^{\frac{1}{2}}\sqrt{m^2 u + {}^2}}$ = a constant quantity. Now let the absciss AL = x, ordinate LC = y; then will BG = dx, GC = dy, BC = $\sqrt{dx^2 + dy^2}$; and if a be put for any constant quantity, $\frac{dx}{y^{\frac{1}{2}}\sqrt{dx^2 + dy^2}}$ will be $= \frac{1}{\sqrt{a}}$, whence $dx\sqrt{a} = \sqrt{y} \times \sqrt{dx^2 + dy^2}$. But in all curves d$x$: $\sqrt{dx^2 + dy^2}$ :: subtangent:

1

the tangent; therefore the curve required is of such a nature, that its subtangent is to the tangent, as $\sqrt{a}$ to $\sqrt{y}$. Now every cycloid has this property, since it is known that the tangent of the cycloid is parallel to the chord of the conterminous arc of the generating circle, whose diameter is a, and whose vertex is considered as downward. And with equal facility may the curve of swiftest descent be determined, for any other hypothesis of gravity.

Concerning a triple Bladder, &c. By M. Bussiere. N° 268, p. 752.

If the bodies of such as die of extraordinary distempers were often opened, it might sometimes be found that those effects which were attributed to the alteration of the blood or humours, depend merely on an extraordinary conformation of the parts of the body. Of which this triple bladder, found in the body of the late Mr. Booth, will be a proof. We have been told of a double bladder found in the bodies of some men, as there was in the body of the famous Casaubon; but no instance has yet been mentioned of three urinary bladders in one person.

This gentleman, in his best health, could not make urine in a full and continued stream, but running out by little and little, and with great efforts of inspiration, especially when there was but a small quantity of it in the bladder, which fatigued him very much, though the passing of the urine through the neck of the bladder was not painful; except in the last two or three years of his life, because of a thick mucus, which was then discharged with the urine. That mucus growing in greater quantity of late, made him apprehensive it had been caused by a stone in the bladder; upon which he applied himself to one, in order to be searched, who accordingly introducing his catheter, and meeting with some resistance in the urethra, he forced the catheter through the membranes, and made such dilaceration in them, that the patient immediately lost a great quantity of blood; which bleeding continuing for 10 days, without his seeking any help, brought him under very great torments, by reason that the blood was become grumous in the urethra, and could not be forced out, but by very violent efforts and acute pain, which caused a mortification in the part, of which he died.

The day after his death I opened the body, in presence of Drs. Dawes, Chamberlain, Woodward, Mr. Bernard, the surgeon, and several others; in which the natural urinary bladder was found lying on the left side of the pelvis upon the ilium bone; then searching what should be the cause of such unnatural situation, we found one large round bag lying under the pubis upon the rectum, filling up all the cavity of the hypogastrium. Then in order to examine the thing more exactly, I dissected the penis and the rectum, and having taken them out of the body, and laid them on a table, laying open the urethra, to examine whether there was any carnosity, as the surgeon who first introduced the catheter had suspected; but there was none, and that ductus was as plain and sound as could be, except the dilaceration the catheter had made in it. Then introducing a conductor into the bladder, I divided it quite; and first it was observed, that the round bag, which consisted of two bladders, or rather two cysts, were divided from each other only by a membrane; that which was next the true bladder was something larger than it, the other which lay on the right side being much smaller. Each of these two cysts had its orifice opening in the neck of the natural bladder, which was longer than it naturally is. Neither of the ureters were inserted into any of these cysts, into the neck of the true bladder, by the orifices of the two cysts, insomuch that the urine could be equally received by them and the bladder.

Secondly, it was observed that the glandules of the true bladder were exceedingly large and red, that colour being very likely the effect of the inflammation caused by the dilaceration of the urethra. I have oftentimes observed that a thick mucus, which runs out of the bladder, and which some take to be the matter of an imposthume or ulcer in the kidneys, is only produced by those glandules of the bladder becoming scrophulous; and that when that mucus grows thick and clammy, it causes the same pain on the neck of the bladder, as if it were a stone. The glandules of the great cysts were very apparent, but very small, but they were not at all sensible in the smaller cysts.

Now it is easy by the description of these bladders to account for the symptoms; for by the situation of the great cysts, it is plain that the urine could not be discharged but by the force of the inspiration, its own muscles being not able to force it out, and consequently could only be voided by little and little; and these efforts of inspiration were to be the greater, when there was but a small quantity of urine, because it required a greater force to make it ascend from the bottom of the cysts, which could not be done but with great labour and fatigue.

In plate 13, fig. 4, AA represents the body of the true bladder, 1, 2, 3, 4, 5, 6, its glands; BB the great cysts; CC the smaller cysts; 1, 2, 3, its rugæ or wrinkles; D part of the true bladder turned over; E the neck of the bladder; FFFF the two urethras; G the insertion of the spermatic vessels in the urethra; HH the prostates; II vesiculæ seminales; KK the vasa deferentia; L the urethra; MM the erectores muscles; N the penis.

Account of an unusual Medical Case. By Dr. Francis Manginot.
N° 268, p. 756.

I was surprised yesterday with a very extraordinary case. Madam R——'s daughter fell into violent convulsion fits, and while she was in them voided a large quantity of blood by the mouth, the nose, the ears, and the eyes. All these symptoms were over in half an hour's time, and the girl, who some days before had had a violent head-ach and fever, and a great oppression, was well presently after that hæmorrhage. The same accidents it seems have happened several times. I am apt to believe they are epileptic fits; but the sudden relief and cessation of them by bleeding through all these parts, I must confess is wonderful to me.

The girl was between 2 and 3 years old, when on a sudden she complained of a very violent head-ach, she was also observed to be feverish and restless. At the same time her eye-lids were much swelled, and so heavy that she could not open her eyes, without great pain. These symptoms continued for 3 or 4 months, though more or less violent. At last she fell into convulsive motions in her arms, legs, and other parts, and these were very severe for 2 days, till she began to bleed by the nose, the mouth, the ears, and the eyes. This hæmorrhage lasted above a day; and when it was expected that the child would be extremely weakened, she found herself so free from her illness that she recovered her gaiety, and asked for some victuals. Within 12 months afterwards she had four of these attacks, but not so severe, the convulsion fits were inconsiderable, in comparison of the first. The same symptoms returned again about 2 or 3 times every year, and the head-ach about 8 days before the bleeding, and even then it was much more supportable. About 2 months ago I was sent for to see the girl, who is now 7 years old. I found her in bed, complaining extremely of a head-ach, attended with a fever, a great catarrh, and such a shortness of breath, as if she had had a peripneumonia. She had been 3 days in that condition. I told the mother, my opinion was she should be blooded presently, to which she readily consented, telling me, that she did not doubt but these were the fore-runners of the same hæmorrhage the girl had before; but it being very late, it was put off till next morning, and then indeed it was needless, for very early in the morning, after some convulsion fits, she began to bleed from the nose, the mouth, &c. When I came it was almost over. The girl was then pretty well, without any fever or catarrh; she could breathe freely, was in good spirits, and had a good appetite; and ever since has continued in perfect health. Now as the returns are not so frequent, and the symptoms are so notably diminished, I am in hopes this may soon have an end, or at least it is very probable to me, that these accidents will totally cease, whenever she comes to have her catamenia.

Concerning several Roman Antiquities found near the Devizes in Wiltshire. By Mr. Clark. N° 268, p. 758.

On Dec. 4, 1699, a person digging in a ground of Sir John Eyles's, near the Devizes in Wiltshire, about 2 feet under the surface, took up a pot with a narrow mouth, about 18 inches in its greatest circumference, and 10 inches deep, the clay of a bluish colour, and of such strength and compactness, as it seemed but little injured by time, containing several hundred pieces of ancient Roman coin of different emperors, with a variety of curious figures and devices on the reverses. Most of them were of copper, and a very few of mixed metal. A great number had the characters effaced, but the legible ones were very fair. It is observable that many of the pieces were gilt with silver, which on several that I have seen seemed very little impaired, though they have lain under ground for some ages, and appeared as much cankered as the rest. About the same time, and within a few yards of the same place, were found some pots, made of a very firm and durable clay, of rather strange shapes and different earth; one of them somewhat resembling an oyster-pot, is about $\frac{3}{16}$ of an inch thick, 9 inches in circumference, and $5\frac{1}{2}$ in depth, and for strength and compactness scarcely to be paralleled by any now made; the other is one half of the pot, in which the treasure was found. There is likewise another pot in the hands of another person, of about 11 inches circumference, and $3\frac{1}{3}$ deep, wherein was found a whitish powder, supposed by the owner to be the ashes of human bones, and therefore by him taken to be an urn. But the experiment made on the supposed bone ashes, by putting a small portion into the bowl of a clean tobacco-pipe made glowing, it soon appeared to the contrary; for the matter immediately kindled into a bright flame, and sent forth a scent somewhat like that of hoofs or horns, though it had a very fragrant smell before.

*Extract of a Letter from Peter Hotton, M. D. Professor of Botany at Leyden, to the Editor, concerning the Lithontriptic Virtues of Acmella.** N° 268, p. 760.

This plant is a native of the island of Ceylon. The leaves and seeds of three species of acmella are said to have been administered with remarkable success in cases of stone and gravel. The leaves are gathered before the plant comes

* This plant was at first designated by Linnæus verbesina acmella, but it was afterwards removed to the genus spilanthus. This remark applies to the note at p. 442 of this vol. of the Abridgment.

into flower, and after being dried in the sun, are rubbed into a powder and infused in hot water after the manner of tea.

Observations on the Fossils of Reculver Cliff, and a New Way of Drawing the Meridian Line. By Mr. Stephen Gray. With a Note on this Letter by the Editor. N° 268, p. 762.

I was extremely satisfied with the account which Mr. De la Pryme gave of his observations on the shells in the quarries near Broughton. To the many instances the earth exhibits of the great and violent mutations she has suffered, be pleased to take a remarkable one of those I have observed in Kent. About half a mile from Reculver, towards Herm, there appears in the cliff a stratum of shells in a greenish sand; they seem to be firm, and some of them are entire, but when you attempt to take them from their beds, they crumble to powder between your fingers; the shells are of the white conchites. But what is most remarkable is, that in the lower part of the stratum, where the shells lie thickest, there are scattered up and down portions of trunks, roots, and branches of trees. The wood is become as black as coal, and so rotten, that large pieces of it are easily broken with the fingers. I know not at what depth these may lie, the surface of the stratum not appearing above 2 feet from the beach, but I judge it from the superficies or top of the cliff about 12 feet. The stump of one tree standing upright was broken off about a foot from the ground.

New Way to Draw a Meridian Line.—I have lately thought of a new contrived instrument for drawing a meridian line, which, for any thing I know to the contrary, is my own; it is easy in its use, and sufficiently exact. Take the gnomon of a horizontal dial for the latitude of the place, and to the hypothenuse fix two sights, whose centres may be parallel to the same; let the eye-sight be a small hole, but the diameter of the other must be equal to the tangent of the double distance of the north star from the pole, the distance of the sights being made radius; let the stile be rivetted to the end of a straight ruler; then when you would make use of it, lay the ruler on a horizontal plane, so that the end to which the stile is fixed may over-hang, and look through the eye-sight, moving the instrument till you see the north star appears to touch the circumference of the hole in the other sight, on the same hand with the girdle of Cassiopea, or on the opposite side to that whereon is the star in the Great Bear's Rump at that time; then draw a line by the edge of the ruler, and it will be a true meridian line, as it is very easy to demonstrate.

A Note on this Letter by the Editor Dr. Sloane.—It is very likely that the black wood above-mentioned is oak, which has lain so long as to be turned of that colour, by the vitriolic juices of the earth, as galls and a solution of vitriol do.

I never saw any oak that had lain any time in any kind of earth where water soaked into it, that was not turned of that colour: and I have seen many large trees of black wood taken up, as well as less pieces, and all of it was oak. It looks at first taking up like ebony, and is very ponderous; but as it dries it splits, grows friable, light, and comes to be good for little.

Abstract of a Letter from Dr. Wallis to Dr. Tyson, concerning Man's feeding on Flesh. Dated Feb. 3, 1699. N° 269, p. 769.

Gassendus in one of his epistles espouses it as his opinion, that it is not originally natural for man to feed on flesh; though by long usage, at least ever since the flood, we have been accustomed to it, and it is now become familiar to us; but rather on plants, roots, fruits, grain, &c. And Dr. W. takes it to be the opinion of many divines, that before the flood men did not use to feed on flesh, because of what God says to Noah after the flood, in Gen. ix. 3, "Every moving thing that liveth shall be meat for you, even as the green herb have I given you all things;" compared with Gen. i. 29, where God says to Adam, "I have given you every herb bearing seed, and every tree in the which is the fruit of a tree yielding seed, to you it shall be for meat;" but without any intimation of his feeding on the flesh of animals. Yet the Doctor had some doubt remaining, seeing we find very early that Abel was a keeper of sheep, as well as Cain a tiller of the ground, both employments seeming equally in order to their food and sustenance; and their first clothings were the skins of animals. It may perhaps be thought, that these animals were slain for sacrifice, and the sheep fed only for that purpose; but even their sacrifices seem to have been offered only as a portion, or first-fruits, of things appointed for food; and that as Cain was not to sacrifice the whole fruit of his tillage, so neither was Abel the whole product of his sheep, but the best, that is the firstlings of his flocks, and the fat thereof, reserving the rest for his own use. And it cannot seem likely, that God would give to Noah after the flood a greater dominion over other animals, than had been given to Adam in Paradise before the fall. The Doctor then considers this permission to Noah, not as contradistinct from that to Adam, but rather as introductive of the prohibition which presently follows, viz. Though he might eat flesh, even as the green herb, so far as it might be wholesome food, yet "not with the blood thereof;" that is, not raw flesh; not carnem crudum, or carnem cum cruore. The Doctor adds also, that the same rule is given to other animals, Gen. i. 30, as is to man, at ver. 29. "I have given them every green herb for meat:" yet there are, we know, many carnivorous animals, without any further permission that we know of.

But, without disputing it as a point in divinity, whether men before the flood, did or might feed on flesh, supposing it to be wholesome nourishment, the Doctor considers it, with Gassendus, as a question in natural philosophy, whether it be proper food for man.

The consideration insisted on by Gassendus, is from the structure of the teeth, being mostly either incisores, or molares; not such as, in carnivorous animals, are proper to tear flesh, except only 4, which are called canini; as if nature had rather furnished our teeth for cutting herbs, roots, &c. and for bruising grain, nuts, and other hard fruits, than for tearing flesh, as carnivorous animals do with their claws and sharp teeth. And even when we feed on flesh it is not without a preparative coction, by boiling, roasting, baking, &c. And even so we forbid it to persons in a fever, or other like distempers, as of too hard digestion. And children, before their palates are vitiated by custom, are more fond of fruits than of flesh-meat. And their breeding worms is wont to be imputed to their too early feeding on flesh.

This ingenious conjecture of Gassendus presently suggested to the Doctor another speculation, which seems not less considerable, viz. There is in swine, sheep, oxen, and in most quadrupeds that feed on herbs or plants, a long colon, with a cæcum at the upper end of it, or somewhat equivalent, which conveys the food by a long and large progress from the stomach downwards, in order to a slower passage and longer stay in the intestines; but in dogs of several kinds and probably in foxes, wolves, and divers other animals which are carnivorous, such colon is wanting; and, instead of it, is a more short and slender gut, and a quicker passage through the intestines.

What the Doctor would propose hereupon is, to consider whether it generally holds, or how far, that animals which are not carnivorous have such a colon, or somewhat equivalent; and, that those which are carnivorous have it not. For if so, it seems to be a great indication that nature, which may be reasonably presumed to adapt the intestines to the different sorts of aliments that are to pass through them, accordingly informs us to what animals flesh is proper aliment, and to what it is not; and that from thence we may judge more solidly than from the structure of the teeth only, whether or not flesh was designed as proper food for man.

Now it is well known, that in man, and propably in the ape, monkey, baboon, &c. such colon is very remarkable. It is true, that the cæcum in man is very small, and seems to be of little or no use: but in a fœtus it is in proportion much larger than in adults; and it is possible that our customary change of diet, as we grow up, from what originally would be more natural, may occasion its shrinking into this contracted posture. But the Doctor adds also, that man's being indued with reason supplies the want of many things, which to other animals may be needful. Man is not covered with such quantity of hair or feathers all over his body, which to other animals serve for clothing; but can by his use of reason, supply himself with clothes suitable to every climate, and to the different seasons. He is not furnished with claws, hoofs, horns, &c. which serve for arms to other animals, but can by the use of his reason, supply himself with weapons and other instruments for different occasions, to much better advantage. And in the present case, though raw flesh be not proper, as it is to some other animals, he can by preparative coctions, and other expedients, render it more agreeable. Nor is he wholly destitute of dentes canini; but is indeed furnished with all sorts of teeth, for all sorts of wholesome food.

The Doctor takes the sheep, the goat, the swine, the ox, the horse, the ass, the camel, the elephant, the hart, the hare, the rabbit, the mouse, &c. not to be carnivorous; but the dog, the wolf, the fox, the cat, the lion, the leopard, the tiger, &c. to be naturally carnivorous; and which of all these have or have not the colon, or what other distinctive mark may be observed between these different tribes of animals, he thinks may deserve a serious consideration.

Abstract of Dr. Tyson's Answer to the foregoing Letter of Dr. Wallis, concerning Man's feeding on Flesh. Dated Jan. 16, 1700. N° 269, p. 774.

The argument you propose from the conformation of the intestines, why man should not be carnivorous, seems far more rational than that which Gassendus urges, from the structure of the teeth. Though it must be owned there is nothing he has omitted that could have been said to favour it.

But before more particularly considering your hypothesis, it may be remarked, that had man been designed by nature not to have been a carnivorous animal, no doubt there would have been observed in some part of the world, men who did not at all feed upon flesh. But since no history furnishes us with such an instance, I cannot but think that what has been done universally by the whole species, must be natural to them. What the Pythagoreans did in abstaining from flesh, was upon the notion of a metempsychosis, or transmigration of souls, a mistake in their philosophy, and not a law of nature. And though in some countries men feed more freely on flesh, in others more sparingly, this is owing to their own choice, from the advantage they find thereby. Nature having given mankind reason, he can or ought to chuse what food he finds most agreeable to him in the climate he occupies; and is not determined to any one sort, but has liberty to use all. And it is as probable that the antediluvian world had so likewise. Wherefore I wholly acquiesce in your determination of this point, and am fully satisfied with the reasons you give for it.

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We shall therefore now, as you direct, consider it as a question in natural philosophy; whether from the observation of the structure of the parts in man, we can find reason to think nature did or did not design him to be carnivorous. For I am of Gassendus's opinion, that from the conformation of the parts of the human body, we may form conjectures concerning their mere natural functions; for all the knowledge we have of the uses of the parts in animal bodies, is by observing nature's wonderful contrivance in their formation, which most wisely adapts them to the uses they are designed for. Not because they are casually so and so formed, are they necessarily put to such and such uses; but therefore they are so contrived, that they may perform such offices in the economy of animal bodies as nature intended them for. And there are several remarkable instances I have given in my late treatise of the Homo Sylvestris, that sufficiently confutes such unphilosophical atheists.

I come therefore now more closely to our business. Since you have so fairly represented Gassendus's opinion and argument from the structure of the teeth, why man should not be designed by nature to be carnivorous; and have likewise sufficiently answered his reasons; I shall wholly pass that over at present: and shall only consider the observation you have made of the different formation of the intestines in carnivorous animals, from those that are to be met with in such as do not feed upon flesh, but other food. And indeed this seems to me to be of far greater weight, and to carry more strength in it than any thing I have met with before; and all the instances you give are very true. We shall therefore first of all observe, that the ductus alimentalis (for so I call the gula, the stomach, and intestines, all which make but one continued canal or duct;) this ductus I say is properly the true characteristic of an animal, or proprium quarto modo. For there is no animal but has such a duct; and whatever has such a duct may properly enough be ranged under the class of animals. Plants receive their nourishment by numerous fibres of their roots, but have no common receptacle for digesting the food received, or vent for carrying off the recrements: but in all, even the lowest degree of animal life, we may observe a stomach and intestines; even where we cannot perceive the least formation of any organ of the senses, unless that common one of touch, as in an oyster: where also we may observe a sensible muscular motion or contraction; though it would be difficult to assign what part should be reckoned the brain, or medulla spinalis, from whence the nerves arise that give it so strong a motion.

Now this duct being so principal a part in an animal, and its use being to receive and digest the food, and distribute the chyle, it is reasonable to suppose, that according to the difference of the food, the structure of the organ should also be different; or where the organ was the same, there the use was the same also. Man therefore having these parts formed, not like carnivorous animals, as you well observe, but more resembling those that live on herbs, roots, fruits, &c. it may seem reasonable to conclude, that nature never designed him to live on flesh; but, that the wantonness of his appetite and a depraved custom had inured him to it, as Gassendus remarks in one of his epistles, viz. that custom may make that seem natural to us, which nature never intended: as he instances in a lamb bred on ship-board, which refused the green pasture of the fields for the diet it was formerly used to: and I have often seen here in London a horse that with a great deal of pleasure would eat oysters, scranching them shell and all between his teeth, and swallowing them down, and this he took to by accident, being left at a tavern door where stood a tub of oysters; and since that has frequently done the same whenever they were offered him. Now Gassendus observes, that children (from whom he thinks we may better take the instincts of nature than from our appetites when depraved by custom) are much fonder of fruit than of any flesh that is offered them; and therefore he supposes it more natural to them.

The instance you give wherein the structure of the intestines of carnivorous animals is different from that in men, is, that the former want a colon; whereas in men there is a very large one, which is not to be observed except in such animals as live upon fruits, roots, herbs, &c. What therefore you propose to me is, to consider, whether it generally holds, or how far, that animals that are not carnivorous have such a colon, or somewhat equivalent, and those that are carnivorous have it not.

To begin with those animals that are carnivorous, and have no colon or large cæcum; for though they may have the appendicula vermiformis, yet if that is not extended, or filled with the fæces, which the other guts contain, I think it not properly to be esteemed a distinct gut, or to come into that number, since here it does not perform the office of one, in containing the food or excrement. So in a man, in dogs, and other animals, when it is thus contracted I exclude it out of the number of the intestines, though by use and custom (but I see no reason for it) it is commonly reckoned one of the intestina crassa.

Animals therefore that have no colon or large cæcum, though some of them have this appendicula vermiformis, and are carnivorous, I reckon, 1. The dog-kind, under which, besides their own species, may be included the fox, the wolf, the coati mondi, the badger, the otter, &c. 2. The vermin kind; as the weasel, the fitchet, the pole-cat, the martin, &c. Both these kinds have a bone in the penis: have no colon or cæcum; some have the appendicula vermiformis, and all are carnivorous. 3. The cat-kind; to which may be reduced besides their own species, the lion, the tiger, the leopard, the linx, the catamountain, &c. It is true the French memoirs tell us, that a lion has a colon 18 inches long, and an appendicula vermiformis 3 inches; and that in a lioness the colon was two feet, and the cæcum two inches long: yet I question whether we may properly call this a colon: for though the gut about this place may be more extended than in others, yet not having those ligaments by which the gut is corrugated into cells as in a human body, I think strictly it does not deserve that name. So likewise as to the colon in a cat. 4. A boar has no colon nor cæcum. 5. A mole, which feeds on worms and insects, has no colon nor cæcum.

In the next place we may consider those animals that are not carnivorous, but live upon herbs, fruits, roots, &c. all which have a colon or cæcum, or both; for as to your query, I think it much the same, whether they have either one of these only or both; provided that the capacity of the gut there be large and extended, and do contain fæces: as 1. The horse-kind; in which may be included the ass, the mule, &c. which have a large colon and cæcum; 2, the elephant; 3, the dromedary and camel; 4, the several species of the swine-kind; 5, the guinea-pig; 6, the castor or beaver; 7, the hare kind; 8, the ape and monkey-kind.

Now there are several animals that have a large cæcum and no colon, and these also are not carnivorous, but live upon grass, fruits, roots, &c. as 1, the neat-kind; 2, the sheep-kind; 3, the stag-kind; 4, the goat-kind; 5, the antelope; 6, the squirrel-kind; 7, the rat-kind.

By all which you may plainly perceive what good grounds you have for forming your notion: since there are so many animals that are carnivorous, that have no colon nor cæcum at all; and, on the other hand, how vast a number there are that are not carnivorous, that have either a colon or cæcum, or both.

But notwithstanding all this, we may be mistaken in the conclusion, which we may be apt to draw from hence: and may as well argue, that because the neat-kind, the stag-kind, the goat-kind, and the sheep-kind, that live on herbage, have four stomachs, therefore those that have not four stomachs were not designed by nature to be graminivorous. Now the horse-kind, the hare-kind, &c. have but one stomach, and yet their food is grass. And the case is here the more remarkable, because the stomach is a part more principally concerned in digesting the food. The intestines are for separating the chyle and carrying off the fæces. Yet we observe even in animals that live on the same sort of food, that their stomachs are very different. One would therefore be more apt to think, that for digesting the variety of food, and what is of a different nature, that the organ that is to perform it should be different too. Yet we find the stomachs of animals that live upon flesh, of others that live upon fruits, and others that live upon grass, &c. to be much alike. If therefore we cannot make a conclusion from the structure of the stomach, what food is most natural to an animal, much less can we from the colon, or the cæcum, being parts of the alimentary duct, that are remote from the stomach; and seem rather as a sewer for the reception of the fæces.

There would be no end in expatiating on nature's great variety, in the formation of the structure of this alimentary duct in different animals; and even where we may observe much the same sort of food, yet we do not always find the same structure, though her intention be the same in all, viz. to digest the food, distribute the chyle, and eject the fæces. But herein she shews her great wisdom, in attaining the same end different ways. Had chance any concern herein, we should not observe that constant regularity in the same species, nor variety in different, where the action is so much the same.

Since man therefore has all kinds of teeth, fit for preparation of all sorts of food, before it be conveyed to the stomach; and this last organ is also adapted to digest all sorts of food; I should rather think, that nature did intend he should live upon all; or at least is so bountiful, as not to deny him any, or stint him to one sort only; as in the text you have quoted, Gen. 9, v. 3, Every moving thing that liveth shall be meat for you; even as the green herb have I given you all things.

But perhaps you may expect I should give you some instances in brutes, where it does not hold, that all carnivorous animals have no colon nor cæcum, though, as to man, the case may be very different. Now the carigueya, or opossum, has a long colon, though not cellulated, and a large cæcum, that receives all the fæces as they pass down; yet this animal feeds on poultry and birds, and other flesh. On the other hand, the hedge-hog, that has no colon nor cæcum, and therefore by your rule, should be carnivorous, feeds on roots, fruits, herbs, &c. and not on flesh. Hogs likewise, that have both a colon and cæcum, will feed upon flesh greedily enough, when they can meet with it, though their ordinary food be of another kind. And a rat and mouse, that have a large cæcum, but no colon, feed upon bacon, as well as bread and cheese. Your observation therefore as to brutes, though it may hold for the most part true, yet is not universal; and like all other rules, may have some exceptions.

Abstract of a second Letter of Dr. Wallis to Dr. Tyson, on the same Subject. Dated Jan. 23, 1701. N° 269, p. 783.

Upon the whole, I find your sentiments to be much the same with mine. I am inclined to think that all nations, both before and since the flood, have used to feed on flesh duly prepared. On the other hand, I believe you think, as I do, that raw flesh is not a natural food for us. I do not know that any nation has, of choice, used to feed on raw flesh; unless in cases of extremity, &c. For I put a great difference between raw flesh, which is the common food of carnivorous animals, and flesh duly prepared for our food. If there be any such, I look upon it as an anomalous case; like that of the lamb mentioned by Gassendus; and the horse that eats oysters, or the rat eating bacon, for want of other food, and the swine sometimes eating poultry: Which latter I do not take to be purely natural: but rather the effect of an appetite depraved by custom; because much of the hog wash we give to swine, arises from the coction of flesh for our own use; which inures them to the taste of flesh.

I leave it to you to consider, from what reason, and for what use, the passage of flesh through the alimentary duct should usually be more quick, and that of herbs more slow. And again, whereas nature seems to have originally designed a large cæcum in man, as in some other animals, how it comes to pass that it is now of little or no use; but shrinks up into an appendicula vermiformis: whether or not this may not partly proceed from our feeding so much on flesh.

Concerning Excrescencies growing on Willow Leaves, &c. By M. Anth. Van Leuwenhoeck, F. R. S.* N° 269, p. 786.

I took some of the largest and greenest willow leaves, and having opened the knotty part which is found in some of them, I frequently discovered more than one sort of worms; but none of them being full grown, I cut some of those knots off the leaves, and opening one a little, I saw there was a worm in it, and shut it together again. Having put several of these knots into a large glass tube, that the worms might attain their full growth, I could not find that any of them did so. I observed at the same time, that several of those knots had no worms in them, but were almost full of the excrements of the worms that had been there, and were dislodged through a small hole, which I could perceive in the knots.

Fig. 5, pl. 13, ABCD represents the leaf of a willow tree, in which are seven knobs or tumours, some of them with holes, as EFG, another, as K, shows the posture of the worm as it lay in that knob which I dissected. Several of the worms lay dead in the knobs, and considering what should be the reason of it, I was at last aware that there was a small worm fast linked to the

* The insects found in the excrescencies on willow leaves, belong to the Linnæan genera of Cynips and Ichneumon, the larvæ or caterpillars of the latter preying on those of the former, and frequently preventing their regular progress to the fly state.

great one, which small one had no conveniency of getting out, being at both ends of a pointed form, but chiefly in the hinder part; his mouth was screwed into the body of the great worm, from whence it seemed to draw its nourishment, and by that means to occasion the other's death.

How these last worms got into the cavities of these tumours, is to me unknown. But we may suppose that the first or great worm is produced from an egg, which some fly has laid on a willow leaf; and that this worm having gnawed through the vessels of those leaves, a sort of viscous matter issued thence, which intangled the worm, and being dried up together, produced such knobs in the leaves, which inclosed the worms. Now some time after a lesser sort of fly might pitch upon the same knob, and make a hole, and lay its eggs in it, from whence proceeded the above-mentioned little creature, which devoured and lived upon the great worm.

After the knobs had been in the glass tube about 8 days, I opened one of them, and saw that the worm was turned into a tonnekin or aurelia; I then opened others, and took out 13 or 14 more tonnekins. In some of the said knobs I found those little devouring worms before-mentioned; I call them devouring, because they prey upon a worm at least 50 times larger than themselves; they were so far advanced in growth, that without using any more food, they were ready to be changed into flying insects, which I also put into the glass tube. These tonnekins were of a darkish red colour. On opening one of them, I found the worm lying entire as it was, though it had been shut up in its shell above 14 days.

After some weeks, I perceived certain black flies proceeding from the tonnekins, the hinder parts of their body being of an oblong figure, and shaped like a hook; the others could not arrive to maturity, but having made a small opening in their pellicles, they just put their heads through, and died. From the same tonnekins proceeded a second sort of fly, that were less than the former, and not so pointed at the end. I saw two of those small worms which used to devour the great ones, endeavouring to shut themselves up into a web: but by reason of the large space they lay in, they could not bring it quite round them, and only made it on one side. But their change happened in so short a time, that I could not make my remarks on it, and as the moths, silk-worms, &c. lie very regularly in a sort of skin or membrane, with their legs and wings after their change, so lay also the horns and feet of these little animals, each in a particular pellicle, but separate from the body, and after the same manner lay the hinder part of their body, which were shaped much like a hook. These onnekins, which at first were white, after a few days turned blackish, and at last produced that kind of fly with the above-mentioned instrument, like a hook, in its hinder part, which at length amounted to near two thirds of the whole body.

Fig. 6 represents the aforesaid fly, just as it appeared to the naked eye; CD shows the long, slender, and hooked part. When brought before the microscope, it seemed a sort of hook, and covered with a great number of fine hairs, as seen magnified in fig. 7, and it appeared also to be hollow. Upon which imagining it might rather be the case for a hook, I endeavoured to split it, and then the hook itself appeared, the point of which is only delineated, jagged with teeth like a saw, as EF, fig. 8. The more I viewed this hook, the more I fancied that there was another inclosed in it; nor was I mistaken, for I split the first hook, and took out of it two other distinct hooks, of the same shape; a small part of one of which is represented at GH, fig. 9. Each hook was fortified with teeth like saws, which I observed was peculiar to them, and did not belong to fig. 8. After I had taken these hooks out of fig. 8, I was convinced that what I took for a hook, was only a second case or sheath for the other two, as IK, fig. 10, where likewise the hollowness plainly appears. And there is also a cavity to be seen in fig. 9, which may contain a sharp poisonous liquor.

From this discovery, it is easy to conceive, that such flies do not only lay their eggs on the leaves of trees, but also make an opening in the skin of the leaf, and convey an egg into it, from whence comes the worm, which gnawing the vessels for its sustenance, occasions the sap to flow out of them, and coagulate into that knotty substance. Besides one small fly produced one of those small worms, whose hinder part was also hooked much like that species of flies that proceed from the lice of worms on currant trees.

I took two tonnekins out of the above-mentioned knobs in willow leaves, no larger than grains of coarse sand, to describe the shape of such a small animal; but three hours after I missed them, and concluded, that in that time they were turned to flies, and got away. I have taken dead worms out of the said knobs, without being able to find the lesser sort of worm that uses to devour the other; but I observed two longish white particles on the dead worm, which were so very small, that they escaped my naked eye; I fancied that they were eggs, for I could see nothing of them that was like a worm, and the third day there plainly appeared two worms, exactly of the same size and shape with those which devour the larger ones.

I took a small devouring worm from a greater that lay dead by it, and from which it took its nourishment, and put it upon a living worm: immediately it fastened its snout in the said living worm, which at the same time used all its might, with bending, stretching, contracting, and winding its body, to free itself from its troublesome guest, but in vain, the small one keeping his hold. This devouring worm, when arrived at its full growth, is exactly represented in fig. 11.

In fig. 12, ABCDEF represents a tonnekin, which but the evening before had been a worm, and which had cast a very thin skin; and as the body of the worm consisted of so many rings or circles, so likewise did the tonnekin. In this I not only observed the feet, but even their joints. CG and DG represent its two horns, and though they were inclosed in a thin membrane, yet I could clearly see all their joints, and they were loose from the body, excepting only at the head. This worm, both before and after its change into a tonnekin, is very white, and some days after the eyes appear full of many sights, and of a brownish colour. I have often endeavoured to watch the change of these worms, but it is so sudden, I could never do it.

I formerly mentioned that the mites in cheese turned into tonnekins, and from thence into flies: I can now add, that when they are turned into tonnekins, they lie inclosed in a thin transparent membrane. Now this pellicle that covers the tonnekin, is a great defence for the worm within it, which being not able to shut itself up in a web, as many other insects do, before their approaching change, that they may not be devoured by their enemies, without such a pellicle would certainly become a prey to the maggots that swarm in cheeses.

I have observed that some of the said flies produced from these cheese worms, which I kept in a glass, and put cheese into them to feed upon, after they had eat of it, they coupled; and soon after, all of them laid eggs of an oblong form, and then died. From these eggs came young worms, which also fed on the cheese, and when I judged them to be at their full growth, and the weather began to be cold, I took six of the largest and carried them about me, and after a few days I observed that 4 were changed into tonnekins, that 2 worms were dead, and 2 flies were skipping about the glass. I tried the same thing in January, and with the same success; whilst I kept them in the cold, there was little or no sign of life or motion, but as soon as I put them into my pocket, they were as brisk as in summer. I opened a tonnekin that had never produced a fly, and found a dead one within it, which had been making its efforts to get out, but was not strong enough to effect it.

Dissection of a Woman who died in Childbed. By Peter Sylvester, M. D. and F. R. S. N° 269, p. 787. *Extracted from the Latin.*

A woman, named Duchesne, about 40 years of age, after having gone the usual time with child, was seized with a profuse flooding about four o'clock in the afternoon, on the 12th of November, 1697, and was delivered of a dead child about midnight, the after-birth coming away easily and entire. Nevertheless the flooding continued, and she died about 6 o'clock the next morning.

The abdomen being opened, there appeared in the right ligament of the uterus, and in the lower part of the neck of the womb, where it lies upon the rectum, a large ecchymosis. Being taken out of the pelvis for the better examination of it, the internal orifice of the uterus was found wide enough to allow half of the hand to be introduced. On dividing it longitudinally, some clots of blood were seen collected in its fundus, which in other respects appeared sound and perfect; indeed, where the placenta had adhered, there was an inequality on its internal surface, and its substance in that place was thicker and more fleshy. In the lower part of the neck of the uterus there was discovered a laceration, wide enough to admit 2 fingers. Hence, the larger blood vessels being ruptured, the profuse hæmorrhage ensued which proved the cause of this woman's death.

Account of Dr. Robert Hook's Invention of the Marine Barometer, with its Description and Uses. By E. Halley, R.S.S. N° 269, p. 791.

Since it was first found that the Torricellian tube, commonly called the mercurial barometer, by the rising and falling of the quicksilver in it, presages the changes of the air, as to fair and foul weather; from several years' observation it has been proved and adjusted for that purpose by Dr. Robert Hook, who made many attempts to improve the instrument, and render the minute divisions on its scale more sensible. Judging also that it might be of great use at sea, he contrived several ways to make it serviceable on board ship.

The mercurial barometer requiring a perpendicular position, and the quicksilver in it vibrating with great violence on any agitation, it is therefore unfit for being used at sea.

It is about 40 years since the thermometer of Robt. de Fluctibus, depending on the dilatation and contraction of included air by heat and cold, has been disused, on discovering that the pressure of the air is unequal; that inequality mixing itself with the effects of the warmth of the air in that instrument. And instead of it was substituted the sealed thermometer, including spirits of wine (first brought from Italy by Sir Robert Southwell) as a proper standard of the temper of the air, in respect to heat and cold; that ethereal spirit being, of all the known liquors, the most susceptible of dilatation and contraction, especially with a moderate degree of either heat or cold. Now this being allowed as a standard, and the other thermometer that includes air being graduated with the same divisions, so as at the time when the air was included, to agree with the spirit-thermometer in all the degrees of heat and cold, noting at the same time the precise height of the mercury in the common barometers, it will readily be understood that whenever these two thermometers shall agree, the pressure of the air is the same as it was when the air was included, and the instrument graduated: that if in the air-thermometer the liquor stands higher than the division marked on it, corresponding with that on the spirit-glass, it is an indication that there is a greater pressure of the air at that time than when the instrument was graduated; and the contrary is to be concluded when the air-glass stands lower than the spirit, viz. that then the air is so much lighter, and the quicksilver in the ordinary barometers lower than at the said time of graduation. And the spaces answering to an inch of mercury will be more or less, according to the quantity of air so included, and the smallness of the glass tube, in which the liquor rises and falls, and may be augmented almost in any proportion, under that of the specific gravity of the liquor of the thermometer, to that of mercury; so as to have a foot or more for an inch of mercury, which is another greater conveniency.

It has been observed by some, that in long keeping this instrument, the air included either finds a means to escape, or deposits some vapours mixed with it, or else by some other cause becomes less elastic, by which in process of time it gives the height of the mercury somewhat greater than it ought; but this, if it should happen in some of them, hinders not its usefulness, for that at any time may very easily be corrected by experiments; and its rising and falling are the things chiefly to be remarked in it, the just height being merely a curiosity.

In these parts of the world, long experience shows, that the rising of the mercury forebodes fair weather after foul, and an easterly or northerly wind; and that its falling, on the contrary, signifies southerly or westerly winds, with rain, or stormy winds, or both; which latter it is of much more consequence to provide against at sea than at land; and in a storm the mercury beginning to rise, is a sure sign that it begins to abate, as has been experienced in high latitudes, both to the north and south of the equator.

The form of this instrument is shown in fig. 13, pl. 13. Where AB represents the spirit-thermometer, graduated from 0, or the freezing point, through all the possible degrees of the heat or cold of the air, at least in these climates. CD is the air-thermometer, graduated after the same manner, with the like degrees. EF is a plate applied to the side of the thermometer CD, graduated into spaces, answering to inches, and parts of an inch, of mercury, in the common barometers. G an index standing on the plate at the height of the mercury, as it was when the instrument was graduated, as suppose here at

$29\frac{1}{2}$ inches. LM a wire, on which the plate EF slips up and down, parallel to the tube of the thermometer CD. K, any point, at which the spirit stands at the time of observation; suppose at 38 on the spirit-thermometer; slide the plate EF till the index G stand at 38 on the air-thermometer, and if the liquor in it stand at 38 likewise, then is the pressure of the air the same as at the time of graduation, viz. 29.5; but if it stand higher, as at 30, at I, then is the pressure of the air greater: and the division on the sliding plate against the liquor, shows the present height of the mercury to be 29 inches 7 tenths.

I had one of these barometers with me in my late southern voyage, and it never failed to give early notice of all the bad weather we had; so that I depended on it, and provided accordingly; and from my own experience I conclude, that a more useful contrivance has not for a long time been offered for the benefit of navigation.

Of a Polypus in the Vena Pulmonalis; and of the Structure of that Vessel. By William Cowper, F. R. S. N° 270, p. 797.

I send you an account and the form of a polypus, which I took out of a child of about a year old. Its first observable disorders were a quick pulse, and a difficulty of breathing. In about four days the gums were observed to be swelled, for which they were cut, and all symptoms disappeared for five or six hours; after which, they returned. Notwithstanding bleeding, and the application of other remedies, the difficulty of breathing increased, the pulse became still lower and quicker, and in four days more the child died.

The body was opened, and the viscera of the lower belly were found well constituted. In the thorax, the thymus exceeded the natural size, even in children. The fore part of the lungs appeared to be well disposed, but the back parts were very hard, and much inflamed. On making an incision on the diseased part, purulent matter followed the knife in such quantities, from divers cells, that it filled the wounds as fast as made, and the pieces cut from it sunk in water. But as we approach nearer to the parts unaffected, the pieces became gradually more buoyant, till at length we came to the fore part, which floated. The cavities of the right auricle and ventricle of the heart were filled with a polypus, which was continued into the superior and inferior trunks of the vena cava. Opening the vena pulmonalis at the basis of the heart, I found it there completely filled with a polypus, or coagulation of blood, which was continued into all its large branches in the lungs, and were easily drawn out, and when displayed appeared as in fig. 2, pl. 14.

This polypus affords us a better idea of the structure of the pulmonary vein, than any figures of that vessel yet published. For though in different subjects of the same species we meet with frequent varieties, in the distribution of the blood-vessels, especially of the veins; yet we no where find a more constant regularity and uniformity, than in the trunks and large branches of the pulmonary vein; of which I have added two figures, 2 and 3, drawn after a preparation of that vein injected with wax, and freed from the lungs of an adult human body.

The left auricle of the heart, in human bodies, (fig. 1 and 3) being much less than the right, it was necessary that the part of this vein next the basis of the heart should be very large, as AAB, lest the sudden strong motion of the systole should cause the refluent blood to recoil in the branches of this vein, DDEE, and prevent a ready supply in the succeeding diastole of the heart. But the weight of so much blood lying in the trunk of this vessel, AAB, effectually prevents its retrocession in the lateral branches within the lungs, as DDEE, and the more, because the orifices of those branches DD are not diametrically opposite at AA, to the mouth of the vessel on the basis of the heart B, its lateral branches making acute angles with the trunk, as represented by fig. 2.

A Letter from Dr. John Freind to the Editor, containing the History of an extraordinary Kind of Convulsion. N° 270, p. 799.

Dr. Freind here gives an account of a remarkable species of convulsion, of a mixed nature between hysteria and epilepsy, occurring in the children* of 2 families living at Blackthorn, in Oxfordshire. The convulsions were accompanied with an unusual kind of vociferation, and with a nodding of the head, &c. and were preceded by globus hystericus. After these symptoms had continued for some time, the patients would fall upon the ground, after the manner of epileptics. This disorder seems to have spread among these young people partly through terror and partly from imitation.

Of a Water-Spout observed in the Downs. By the Rev. Mr. Patrick Gordon. N° 270, p. 809.

Between 10 and 11 o'clock I observed a remarkable water-spout in the Downs. It bore N. by E. off our ship, about 2 leagues distance by estimation; the wind at E. N. E. a top-sail gale, and very cold. The horizon was entirely open and serene, except the northern parts, from N. N. W. to N. E. by E. or

* All girls, except one, from 6 to 15 years of age.

thereabouts. The highest part of the cloud appeared to make an angle of 45° elevation. The upper part of the cloud was very white, and the other extremely black. The spout itself, which hung from the lower part of the whitish cloud, hovered up and down for about 20 minutes, and during 2 or 3 minutes of the time, that part of the sea exactly under the spout, sparkled up water to a considerable height. The sparkling ran along to the Leeward, (the cone of the spout moving that way, and making, it seems, a discharge, though not visible to us in its fall,) and continued running along for six ships' length. Afterwards the body of the spout quickly contracted itself, and then it disappeared. About two hours afterwards the heavens were entirely overcast, and during that afternoon there fell abundance of hail, and both wind and cold increased. I have seen several water-spouts in the Mediterranean, and those usually during the time of a dead calm, and in hot summer weather; but to see one in our northern climate in March, and during weather both cold and windy, is, I presume, unusual.

Observations on Insects in Virginia. By Mr. John Banister; with Remarks on them by Mr. James Petiver, F. R. S. N° 270, p. 807.

1. Vespæ Ichneumones. Here are divers kinds, all long and slender waisted. They make their nests of dirt, and are therefore called dirt wasps. Some of them make their nests contiguous to one another, each adjoining cavity having in it 2 or more partitions: others build them in clamps, one upon another: they fix them against a wall or ceiling of a house, or any dry place. There is not above 2 wasps belonging to one of these vesparies, for when they have made one cell, and put into it 6 or 8 live spiders, they close it up to work upon another, leaving them to brood upon their young, something like that of Aristotle in his Hist. Animal. Lib. 1. cap. 20. The young ones of these are inclosed in a thin transparent horny pellicle of an amber colour: those of the other are included in a brown case, with a certain number of regular protuberances at one end, and some are without any case.

2. We have several other coloured wasps. Two black and white, that build their nests on the small branches of trees. The nest is of an oval form, and about the size of a goose's egg. The other is much larger, and more round; the wasps also are somewhat larger. A third sort I found in shape and colour like our common English wasp, whose little nest was half round, like a clock bell, fixed under the covert of a rotten log. These nests in colour resemble brown paper, only the last tends to a brimstone colour. Here are others brown, with purple wings, and some with streaks of yellow under their bellies. These make their

combs of the same matter the former do, but naked, without any cover, and therefore commonly choose the shelter of a house, &c.

3. Bombylus Teredo. These bees eat into timber, and there make their nests. This was in the joist of a house, so firm and sound, that it was very hard entering with a piercer; the hole was but just large enough for the bee to creep in at, and went right up, about 2 inches in the wood, and then in a transverse line at least half a foot on each side, which seemed to be twice as wide as the entrance.

4. Oestrum. Forte Asilus Virginiensis Pennei.

5. Musca carnivora vivipara. A small brown fly, that discharges live maggots.

6. Cicada et earum exuviæ, Mouf. 130. Those insects that destroyed the trees in New England were cicadæ. But Mr. Petiver thinks this a mistake.

7. Locustæ, or Grashoppers. Barrard in Exod. 667-8.

8. Mantis. It is neither of the tree that Mouffet describes, p. 118; nor are those 2 figures in his Appendix like it. That of Piso most resembles it, lib. 5. cap. 21, p. 317, but his of an insect becomes a vegetable, which I dare not aver of mine.

9. Blattæ. These cockroaches are one of the plagues of this country. They are oviparous and large.

10. Blatta Volans. These are very rare, I have seen but this one here.

11. Cimices, or Wall Lice. These are another of our plagues, for where there is not great care taken to destroy them, they are as numerous in our beds, as the former are in our kitchens.

12. Cicindela mas, or the Fire-Fly. Cicindela Mariana vaginis teneris fuscis marginibus fulvis. This is not that great Virginian kind, whose head shines; nor is it that smaller one, which Piso says the Brasilians call memoa, nor the common kind, though much of that shape and size. This emits its light at 2 crescents, but the whole tail of our's shines, which it contracts and dilates at pleasure. Its sheath wings are of a dark purple, edged with yellow; and so is its head or helmet.

13. Cicindela Caroliniana vaginis omninò nigricantibus.

14. Cicindela Fæmina, or Glow-worm. Its armed back and head, are in joint armour of a deep murray colour, fastened to the thorax; the tail made of 9 shelly rings, in the last of which are visible the 2 shining points. Its head is black, so small that one cannot without the help of a glass perfectly discern the contexture of it. Its eyes, if it have any, like those of a snail, stand on the tops of 2 horns. It has 6 legs.

15. Scarabæus Πλατυκερως mas seu minor, Mouffet 149.

16. Scarabæus niger, ore cornuto seu forcipato, capite et scapulis colore succino, elytris luteis eleganter notatis.

17. Scarabæus ore cornuto, elytris purpureis, scapulis nigris scuti more cavis. This is found among rotten wood, logs, and when caught it makes a small squeaking noise.

18. Scarabæus Nasicornis ore cornuto.

19. Scarabæus Melolonthes Nasicornis.

20. Scarabæus Magnus rostratus ex nigro eleganter albo depictus. Found on a rotten log, 60 miles above the habitable parts of James's river.

21. Scarabæus cornibus obtusis.

22. Scarabæus cornibus acutis.

23. Scarabæus Stercorarius alter, ore forcipato.

24. Scarabæus Stercorarius capite, scapulis et elytris quasi sculptura excavatis.

25. Scarabæus Stercorarius. Noctu tantum volans.

26. Scarabæus Melolonthes. This and that other dung-beetle among the nasicornes are not described, but may I think be very aptly ranked with those of this.

27. Scarabæus luteo-viridis. They are found among James-Town-Weed, i. e. Strammonium.

28. Scarabæus minor viridi-cæruleus. These lie among the flowers of the apocynum.

29. Scarabæus colore viridi auro radiante et luteis maculis eleganter notatus. I know not but these last 3 may be cantharides.

30. Here is also a smaller kind; all black.

31. Scarabæus colore griseo, scapulis binis quasi oculis nigris mollitie pubescentibus notatus. It is found among rotten wood, and is called a snapper, from the noise it makes by thrusting part of its neck into its breast, and springing it back again: it something resembles the cicindela Virginiensis of Mouffet, but its head does not shine.

32. Scarabæus arboreus pilosus.

33. Scarabæus arboreus minor glaber.—These two kinds they say the Indians eat.

34. Buprestis Mariana viridis, vaginis sulcatis et punctatis.

35. Cantharus Carolinianus niger, undis pallescentibus.

36. Cantharus Marianus viridis perelegans, vaginis sulcatis signaturis flavescentibus ornatis.

37. Cantharus Marianus minor, vaginis ex nigro flavoque striatis.

38. Capricornulis Carolinianus vaginis ex nigro luteoque mixtus. This has

its shoulders black, and only edged with yellow, and its sheath wings equally mixed; whereas that from Maryland has most black in its sheaths, and a yellow ring round the middle of its scapula.

39. Crioceros Marianus castanei coloris, antennis tortilibus membranaceis. This resembles the 2d figure in Mouffet, p. 153.

40. Crioceros Marianus castanei coloris, antennis tenuioribus geniculatis. This is slenderer than the last, both in body and horns especially, otherwise very like. I believe they are male and female.

41. Curculio Carolinianus ruber, maculis nigris.

42. Melolonthes Marianus maximus, maculatus.

43. Melolonthes Marianus viridis, marginibus flavis.

44. Nasicornis Tauroceros Marianus splendens castanei coloris.

45. Scarabæus Carolinianus, oblongus, niger, forcipatus, vaginis striatis.

46. Scarabæus Carolinianus subrotundis niger lævis.

47. Scarabæus Marianus pediculosi rostro simili. The sulcæ or furrows on the vaginæ in this are larger, otherwise very like N° 9, in my Museum, p. 4.

48. Scarabæolus Carolinianus nigro flavoque mixtus.

49. Testudinulus Carolinianus flavus margine transparente.

50. Phalæna magna cinerea cruribus spinulis armatis. The horn worm fly, so called from a horned eruca, or caterpillar, that feeds on green tobacco, and towards the fall creeps into the ground, and becomes an aurelia of a reddish brown colour, in which the proboscis of our moth has its involucrum, &c.

51. Tinea Scorpiuncularis libros depascens. It has 8 legs besides its claws, and creeps very fast, both backward, forward, and sideways, and is found in old musty books.

52. Phalangium Imperati 681 desc. and 692 fig.

53. Phalangium alterum oculis quatuor majoribus in segmento arcus circuli sursum curvanti, totidemque minoribus simili more subtus in fronte dispositis.

On drawing the Meridian Line by the Pole Star, and finding the Hour by the same. By Mr. Stephen Gray. N° 270, p. 815.

I have sent some farther thoughts on the instrument for drawing a meridian line,* and have improved it so far, as that no other star will be made use of than the polar one to obtain the hour and minute of the day or night; but I shall describe the instrument.

Let there be taken a telescope of 16 feet, or longer; in the plane of its focus place a ring of brass at right angles to the axis of the glass, the diameter of

* See p. 549 of this volume.

the inward circle equal to the double tangent of the pole star from the pole, the focal length of the object glass being made radius, as mentioned in the description of the meridian instrument; let the ring be divided into 24 hours with their minutes numbered from the right hand towards the left, as in the common nocturnals; the eye glass must be equal in its diameter to the horary ring; but this perhaps will be thought too chargeable, especially for such large telescopes as above, which has made me think of this contrivance; the eye glass must lie in a broad index towards one end, which is to turn on a centre pin in the centre of the glass, and consequently over the centre of the horary ring, from which it must be equal to the distance of the focus of the eye glass; then let the tube be elevated to the height of the pole, and directed to the pole star, till by turning the index through the eye glass, you perceive the star to touch the horary ring on that side where the star in the great bear's rump lies, or on the opposite to that in the hip of Cassiopea; but the contrary, had not the glass inverted the object; then bring one of the 12's to be in a perpendicular to the other by a plumb-line, so will the star stand at its horary distance from the meridian; or if the latitude of the place be unknown, by the right ascension of the sun and star, the line of its coming to the meridian will be easily obtained, and then the hour of the night found, will as easily give the star's horary distance from the meridian; then elevate the tube towards the star, bringing the meridian, or 12 and 12 into the plain of the perpendicular, turn the glass about till you see the pole star stand at its horary distance from the meridian; so will the instrument when fixed, show the horary distance throughout the whole day, or as long as it remains in this position, by the apparent motion of the star in the ring. The best time to fix the instrument will be when this, or any of the other two stars abovementioned, are about 6 hours from the meridian. Observe also, that the latitude of the place is now given with the utmost preciseness; for the axis of the glass lies now in the axis of the world; and if one of the sides of the tube be parallel thereto, as it ought to be at the upper end, hang a line and plummet from the point of the suspension; find another point equal in distance to the length of the line, or a knot towards the lower end, the distance from this knot to the former point will be only the chord of the latitude, and if from the same edge of the index, another line and plummet be hung towards the lower end of the tube, these two lines, when at rest, will be in the plain of the meridian.

This instrument may be made to show the hour with as much facility as a clock or sun-dial, if the horary ring be made to move within a larger fixed one, and the outward circle of the former be divided into the days of the month, respect being had to the right ascension of the sun and star; then by bringing the two opposite points in the fixed circle to the perpendicular, which is done at the fixing the instrument, move the circle till the day of the month come to any of these, and the ring is rectified for that day; and if the air be clear, you will see the star stand at the true time of the day or night.

Mr. Flamsteed has lately discovered, that there is a parallax of the earth's annual orbit at the pole star, of about 40 or 45 seconds, by which the diameter of the star's parallel is greater in June than in December, by about 1′ 2″, which he has evinced from 7 years' successive observations, by which the earth's motion is indubitably demonstrated.

Now if on the edge of this index there be drawn a scale of deg. min. and sec. to the radius of the glass, we shall not only have a very accurate instrument for the hour, but be furnished with one by which we shall see the truth of the earth's motion confirmed by the access and recess of our star, towards and from the pole, according to the earth's place in the ecliptic; and that not only when the star transits the meridian, but in clear air at any time of the day; we may likewise observe that annual increase of the pole star's declination, caused by the precession of the equinox.

Concerning Powdered Blues passing the Lacteal Veins, &c. By Dr. Martin Lister, F.R.S. N° 270, p. 819.

It has been experimented both by myself, and at Oxford by Dr. Musgrave, with surprising success, that a dog kept long fasting would not only admit into the lacteals a tinctured liquor, but a very substantial one, such as powdered blue. And therefore to account for fevers and the obstruction of the glands, we must admit of crude, and otherwise vitiated chyle, as well, if not oftener, than the external accidents from cold and heat, and the disorderly temperature of the air.

The Transactions are single tracts, and have been very uncertainly published, so that the gentleman who is of the contrary opinion, might not have seen some of the former, or forgot the passages relating to this experiment; what makes me believe he has not read them all is, that he has assigned the ordinary quantity of blood in a human body to be 20 pounds, according to that groundless and most extravagant guess of Dr. Lower; whereas if he had perused them all, he would have found a most certain proof, by Dr. Molins, that the blood of all animals is but as 1 to 20 of their weight, and therefore that of man, at a medium, not to exceed 8 pounds.

On the Spawn of Cod-fish, &c. By M. Leuwenhoeck. N° 270, p. 821.

About the middle of January I observed for several days the spawn of a live cod-fish; but could not bring the animalcula to such a position as to have a full and perfect view of them; not only by reason of their wonderful smallness, but also because their bodies are so tender and soluble, that when I diluted the spawn with rain-water, in order to separate them from each other, and afterwards exhaled the watery parts, their little bodies burst in pieces; after which I could only see the tail; these oval small parts I concluded to be the animalcula turgid with water, and burst to pieces, and these broken parts seemed to be four times as large as the entire body of one of them.

In another place, where a great many of these animalcula lay together, they appeared like bright bubbles, lying in a watery slimy matter, inclosed in a circular pellicle or membrane.

I have observed more than once the animalcula in several cod-fish, even in the male seed, where I little expected to find them living, because the seed was not newly come from the fish, but squeezed out of the vasa deferentia, and exceedingly thick, and have discovered an infinite number of exceedingly small creatures alive and swimming together, and I viewed them often so long till the liquid matter in which they swam was quite exhaled, and the animalcula dead; and where they were a little dispersed, they were burst asunder; but where they lay thicker and closer together I could not perceive the broken pieces of their bodies.

Whilst I observed these animalcula, without putting them into any liquor, they seemed smaller than when I viewed them in a round glass tube. That I might represent their smallness as well as I could, I took one of the hairs of my head, and placed it near those creatures; when it could easily be judged that 90 of them did not exceed the diameter of the hair; but to keep within compass, I will only say, that as the air appeared through the glass to be an inch broad, so at least 60 of those animalcula would easily lie within its diameter. This being supposed, and their bodies being allowed to be, as they are, spherical, then 216,000 of them are equal to a globe, whose axis does not exceed such a single hair's breadth. As for the tails, I judge them to be as long as the tails of those animalcula found in the male seed of a ram. One cannot easily perceive these tails, and I must own that I could not see the tips or smaller end of them; for as all tails are thickest in that part which imdiately joins the body, these were not as thick, even there, as the tips of the tails of the above-mentioned animalcula.

As there is a vast difference in the solidity or consistency of the skin, flesh, and bones of a cod-fish, when compared with the same parts in a sheep, or other land animal, so I observed likewise, that the same may be asserted of the several kinds of animalcula found in the male seed of different animals. For, among so many thousands as I have taken out of the testicles of a ram, I never found any that broke to pieces, though several of their bodies, after the exhalation of the moisture, might be observed flat, &c. I have tried several times to take off the uppermost skin of some of the animalcula of a ram, which I had kept five months together upon glass before my miscroscope, with a very fine pencil dipped in water, in hopes of making further discoveries, but could not succeed.

In January I took a live cod-fish, and finding that its seed came from it very thin, with a little pressing, I took a drop of it, in which I discovered a vast number of animalcula. I repeated the observation the same evening with the same success; but next day I could find none of them alive; and whereas I had laid that drop upon a small copper plate, I fancied the exhalation of the moisture might be the cause of their death, and not the cold weather, which at that time was very moderate.

In the beginning of April I took the male seed of a jack or pike, but could discover nothing more than in that of a cod-fish; but having added about four times as much water in quantity as the matter itself was, and then making my remarks, I could perceive that the animalcula not only waxed stronger and swifter, but, to my great amazement, I saw them move with that celerity a river fish does when chased by its enemy, just ready to devour it. You must observe that this whole course was not longer than the diameter of a single head hair.

A Scale of the Degrees of Heat. N° 270, p. 824. *Translated from the Latin.*

0 .. 0 .. The heat of the air in winter, when the water begins to freeze; and it is discovered exactly by placing the thermometer in compressed snow, when it begins to thaw.

0,1,2 .. 0 .. The heat of the air in winter.

2,3,4 .. 0 .. The same in spring and autumn.

4,5,6 .. 0 .. The same in summer.

6 .. 0 .. Heat of the air at noon about the month of July.

12 .. 1 .. Greatest heat the thermometer received on the contact of a man's body, as also that of a bird hatching her eggs.

$14\frac{3}{11}$ .. $1\frac{1}{4}$ .. Almost the greatest heat of a bath, which a man can bear by moving his hand in it for some time; also that of blood newly drawn.

17 .. $1\frac{1}{2}$ .. Greatest degree of heat of a bath, which a man can bear for some time without stirring his hand in it.

$20\frac{2}{11}$ .. $1\frac{3}{4}$ .. Heat of a bath, by which melted wax swimming on it by cooling hardens and loses its transparency.

24 .. 2 .. Heat of a bath, by which wax swimming on it is melted by growing hot, and kept in continual fusion without ebullition.

$28\frac{6}{11}$ .. $2\frac{1}{4}$ .. Mean heat between that by which wax melts and water boils.

34 .. $2\frac{1}{2}$ .. Heat by which water has a strong ebullition, and a mixture of two parts of lead, three of tin, and five of bismuth, by cooling hardens; water begins to boil with a degree of heat of 33 parts, and by boiling scarcely acquires any greater degree than that of $34\frac{1}{2}$; but iron growing cold with the heat of 35 or 36 parts, when hot water, and 37, when cold water is dropped on it, ceases to cause any ebullition.

$40\frac{4}{11}$ .. $2\frac{3}{4}$ .. Least degree of heat by which a mixture of one part of lead, four parts of tin, and five parts of bismuth, by growing hot is melted and kept in continual fusion.

48 .. 3 .. Least degree of heat, by which a mixture of equal parts of tin and bismuth is melted; this mixture with the heat of 47 parts, by cooling coagulates.

57 .. $3\frac{1}{4}$ .. Degree of heat, by which a mixture of two parts of tin and one part of bismuth is melted, as also a mixture of three parts of tin and two of lead; but a mixture of five parts of tin and two of bismuth, with this degree of heat, by cooling hardens, and in like manner a mixture of equal parts of lead and bismuth.

68 .. $3\frac{1}{2}$ .. Least degree of heat, that melts a mixture of one part of bismuth and eight parts of tin; tin by itself is put into fusion with the heat of 72 parts, and by cooling hardens with the heat of 70 parts.

81 .. $3\frac{3}{4}$ .. Degree of heat that melts bismuth, as also a mixture of four parts of lead and one part of tin; but a mixture of five parts of lead and one part of tin, when melted, and cooling again, it hardens with this heat.

96 .. 4 .. Least degree of heat that melts lead; lead, by growing hot, is melted with the heat of 96 or 97 parts, and cooling it hardens with 95 parts.

114 .. $4\frac{1}{4}$ .. Degree of heat, by which ignited bodies in cooling quite cease to shine by night, and again, by growing hot begin to shine in the dark, but with a very faint light, which is scarcely perceptible; in such a degree of heat there melts a mixture of equal parts of tin and regulus martis, and a mixture of seven parts of bismuth and four parts of the said regulus by cooling hardens.

136 . . $4\frac{1}{4}$. . Degree of heat with which ignited bodies glow by night, but not at all in the twilight, and with this degree of heat both a mixture of two parts of regulus martis and one part of bismuth, as also a mixture of five parts of the said regulus and one part of tin, by cooling hardens; the regulus by itself hardens with the heat of 146 parts.

161 . . $4\frac{3}{4}$. . Degree of heat, by which ignited bodies manifestly glow in the twilight immediately preceding the rising of the sun, or after his setting, but not at all in a clear day, or but very faintly.

192 . . 5 . . Degree of heat of live coals in a small kitchen fire, made up of bituminous pit-coals, and that burn without using bellows; as also, the heat of iron made as hot as it can be in such a fire; the degree of heat of a small kitchen fire made of faggots is somewhat greater, viz. 200 or 210 parts, and that of a large fire is still greater, especially if blown with bellows.

In the first column of this table are the degrees of heat in arithmetical proportion, beginning with that which water has when it begins to freeze, being as it were the lowest degree of heat, or the common boundary between heat and cold; and supposing that the external heat of the human body is 12 parts. In the second column are set down the degrees of heat in geometrical proportion, so that the second degree is double the first, the third double the second, and the fourth double the third; and making the first degree the external heat of the human body in its natural state. It appears by this table, that the heat of boiling water is almost 3 times that of the human body, of melted tin 6 times, of melted lead 8 times, of melted regulus 12 times, and the heat of an ordinary kitchen fire is 16 or 17 times greater than that of the human body.

This table was constructed by means of the thermometer and red-hot iron. By the thermometer were found all the degrees of heat, down to that which melted tin; and by the hot iron were discovered all the other degrees; for the heat which hot iron, in a determinate time, communicates to cold bodies near it, that is, the heat which the iron loses in a certain time, is as the whole heat of the iron; and therefore, if equal times of cooling be taken, the degrees of heat will be in geometrical proportion, and therefore easily found by the tables of logarithms. First it was found by the thermometer with linseed oil, that if, when it was placed in melted snow, the oil possessed the space of 10000 parts; then the same oil rarefied with the heat of the first degree, or that of a human body, possessed the space of 10256 parts, with the heat of water just beginning to boil, the space of 10705; with that of water strongly boiling, the space of 10725 parts; with that of melted tin, beginning to cool, and to be of the consistence of an amalgama, the space of 11516; and when it is quite hardened the space of 11496; therefore the rarefied oil was to the same expanded by the heat of the human body, as 40 is to 39; by that of boiling water, as 15 to 14; by that of tin beginning to cool, coagulate, and harden, as 15 to 13; and by the heat of cooling tin when quite hardened, as 23 is to 20; the rarefaction of air by an equal heat was 10 times greater than that of oil, and the rarefaction of oil was 15 times greater than that of spirits of wine. From these data, putting the degrees of the heat of the oil proportional to its rarefaction, and taking 12 parts for the heat of the human body, we then have the degree of the heat of water when it begins to boil, viz. 33 parts, and when it boils more vehemently 34; of tin when melted, or when it begins in cooling to harden, and have the consistence of an amalgama, 72 parts, and in cooling is quite hard, 70 parts.

Having discovered these things; in order to investigate the rest, there was heated a pretty thick piece of iron red-hot, which was taken out of the fire with a pair of pincers, which were also red-hot, and laid in a cold place, where the wind blew continually upon it, and putting on it particles of several metals, and other fusible bodies, the time of its cooling was marked, till all the particles were hardened, and the heat of the iron was equal to the heat of the human body; then supposing that the excess of the degrees of the heat of the iron, and the particles above the heat of the atmosphere, found by the thermometer, were in geometrical progression, when the times are in an arithmetical progression, the several degrees of heat were discovered; the iron was laid not in a calm air, but in a wind that blew uniformly upon it, that the air heated by the iron might be always carried off by the wind, and the cold air succeed it alternately; for thus equal parts of air were heated in equal times, and received a degree of heat proportional to the heat of the iron; the several degrees of heat thus found had the same ratio among themselves with those found by the thermometer: and therefore the rarefactions of the oil were properly assumed proportional to its degrees of heat.*

Account of Books, viz.—I. Profluvia Ventris: or, the Nature and Causes of Loosenesses plainly discovered, their Symptoms, and Sorts evidently settled, the Maxims for Curing them fully demonstrated, and all illustrated with the most remarkable Methods and Medicines of all Ages; and with some practical Observations concluding every Sort. By William Cockburn, M.D. F.R.S. &c. London, 1701, *8vo.* N° 270, p. 829.

* A method if not more accurate, at least more expeditious than the above, of measuring high degrees of heat, was invented some years ago by the late Mr. Wedgewood; founded on the property which argillaceous earth possesses, of contracting its dimensions when placed in the fire. See Phil. Trans. Vols. 72, 74, and 76.

Sanctorii Sanctorii de Statica Medicina Aphorismorum Sectiones Septem, cum Commentario Martini Lyster. Lond. 1701, 8vo. N° 270, p. 832.

Of this work an account has been given under the life of Sanctorius, inserted in vol. ii. p. 412 of this Abridgment.

Proposals for Printing by Subscription, the third and last volume of the General History of Plants. By John Ray, F. R. S. In Fol. N° 270, p. 833.

On an Insect commonly called the Death-Watch. By the Rev. Mr. Wm. Derham.* N° 271, p. 832.

Of these death-watches, or insects which make a noise like the beats of a watch, I have observed two sorts. Of one of them I find a very exact account in Phil. Trans. N° 245. The insect there described being less shy, and much larger than that which I discovered some years since. This year I caught many of them; two of which, a male and female, I kept alive in a little box about 3 weeks; and could make one of them beat whenever I pleased, by imitating his beating. At last one died, and the other gnawed its way out through the side of the box.

The reason why I judge these to be male and female is, because I have often by my ticking noise invited the male to get up upon the other in the way of coition. That which I took to be the male was somewhat less than the other, and was freest in answering my beats. Before he got upon the other, he would beat very eagerly; and when he found that he was got up in vain, he would get off and beat again eagerly, and then up again. From whence I guess these pulsations to be the way whereby these insects woo each other, and invite to copulation. This Mr. Allen takes no notice of in his account, from which I differ only concerning the part with which the ticking noise is made, which he says is "the extreme edge of the face, which may be called the upper lip;" but I observed the insect always to draw back its mouth and beat with its forehead.

The other death-watch is in appearance quite different from the last; it beats only about 7 or 8 strokes at a time, and quicker; but this will beat some hours together without intermission, and his strokes are slower, and like the beats of a watch. I have several years observed these two sorts of beating, but took it to be made by one and the same animal. The insect which makes this long

* See note relative to this insect at p. 319 of this 4th vol. of the Abridgment.

beating is a small greyish animal, much resembling a louse, when looked on with the naked eye; for which reason I call it pediculus pulsatorius. It is very nimble in running to seek its shelter when disturbed. It is very common in all parts of the house in the summer months. They are extremely shy of beating when disturbed; but will answer you when you beat, if you do not disturb them. I cannot tell whether they beat in any other thing, but I have heard their noise only in or near paper.

Concerning their noise, I am somewhat in doubt, whether it be made by beating their heads or rather snouts against the paper; or whether it be not made after some such manner as grashoppers and crickets make their noise. I rather incline to the former opinion. But my reason for doubting is, because I have observed the animal's body give a sudden jirk at every stroke, but I could scarcely perceive any part of it touch the paper. It is possible it might beat the paper, and I not perceive it, as its body is small, and near the paper when it beats, and its motion in beating is sudden and swift: for which reasons also it is hard to perceive the insect to beat without a very quick eye: and therefore I made use of a convex-glass, which by magnifying gave me much better opportunity of observing it.

I observed another, after much beating, come and make offers to the beating insect; who left off his beating, and got upon the back of the other. When they had conjoined he got off again, and they continued some hours joined tail to tail, like dog and bitch in coition. The female, which I saw, was somewhat larger than the male, and of a lighter colour, inclining to a yellow.

The Human Allantois fully discovered. By Rich. Hale, M. D. N° 271, p. 835.

Most of the ancients allow a human allantois; not from their experience, but because they took it for granted that man and other animals were alike, in the viscera, membranes, vessels, &c. and the accounts which the ancients have left of many parts, particularly of the urachus and allantois, as to its name, figure, situation, &c. agree only to their appearance in brutes. Dr. Needham first discovered part of the allantois in human subjects; but neither he nor any other has taken the right method of finding it entire. He says, that after the amnios is cleared, and left fixed to the umbilical cord, you may divide by the fingers or a knife, the remaining part of the involucra into two membranes. The exterior he justly calls the chorion, the interior he takes to be the allantois. But by these ways of separation, you will presently tear the allantois, and be able to discern only some small pieces of it. Besides the allantois is at first sight so like the amnios, that many who suppose the amnios double, and that its coats are easily separable, have taken these pieces of the allantois for broken parts of one of the coats of the amnios. Whereas having first found the opening whence the urine issued, if the allantois is not too much torn, you may blow up the allantois with a blow-pipe to its full dimensions, and then see its true shape, the fundus, the cervix, the insertion there of the urachus, and its relation to the other membranes, &c. Be the allantois ever so much torn, yet this way you may easily separate many inches of it from the chorion and amnios. Which easy separation demonstrates a distinction of membranes, since no double membrane can be divided by the breath alone.

Indeed Hoboken and Diemerbroeck make it a very easy thing to separate the allantois from the other membranes only by the fingers; but it is plain from their descriptions that they never saw one entire. Among other mistakes, Diemerbroeck says that the urine of a fœtus lies between the urinary membrane and the chorion; as though not contained in a distinct bladder, but in a cavity made partly from the chorion, partly from the urinary membrane.

It is true De Graaf tells us, that by blowing with a pipe into a hole made through the chorion, all the membranes of the secundines will appear distinct. He has also delineated an allantois with the other membranes, &c. as he found them: yet this fig. must have been drawn from his own fancy, and not from any preparation; and that for these reasons. 1st, Because by this way of separation you can only part the allantois from the chorion, but never see its true dimensions, nor any appearance of a bladder; for a bladder, as the allantois is, can be shown only by blowing into its cavity, or by finding it full. Yet in this fig. no sign can be observed where it was blown up and tied. Nor can this allantois be supposed full of urine, because it is not of the shape of a full allantois, and he himself calls it only the inflated part of the allantois. However I cannot conceive how the allantois could remain partly filled with air, any more than it might with urine, so long as till this fig. was drawn, unless some hole was tied up whence the urine issued, and the air was blown in. 2dly, Because in this fig. the umbilical cord seems to run through both amnios and the allantois, to its insertion on the placenta. Whereas the allantois is no where perforated by the umbilical cord, nor does it any where pass through the amnios, but only runs under it, at the place of its insertion on the placenta. If the navel-string could be allowed to enter the amnios, and to pass under it to the placenta, why should it not appear (which it does not) under the amnios, as well as the thin substance of the allantois? Again, according to De Graaf's position of the secundines, nothing could hinder a plain view of the place where the navel-string is attached to the placenta. This will be easily apprehended, by supposing the part H in my first fig. to lie uppermost, the fundus G, and navel-strings being turned over; for then the strings will run over the allantois as in De Graaf's cut, and its insertion appear plain on the placenta, which yet cannot be discovered in his figure, which is quite irregular, and I take it to be fictitious. As for the urinary membrane G, in his figure, it seems to be the allantois of a colt (where Needham says, the umbilical cord runs through the urinary membrane) not less absurdly added to the secundines of a human fœtus, than the secundines of a whelp are to a like fœtus by Vesalius.

Lastly, it is evident that De Graaf knew nothing of the true shape of this membrane, and that he had never seen one entire, because he assents to Needham's description of it as true; which yet is false in several particulars. For 1st, the urinary membrane does not cover the whole fœtus, as he affirms, but only that part of it which respects the chorion, and does not lie on the placenta; for the allantois can be extended at farthest only to the edges of the placenta, where the amnios and chorion are so closely joined by fibres, that no membrane can come between them. Wherefore, 2dly, the allantois is not every where fastened to the chorion. And consequently, 3dly, the allantois cannot be of the same shape that the other membranes are of, nor be like the allantois of a colt, which contains the fœtus in the amnios; all which Needham asserts. In short Dr. Needham had seen only pieces of the urinary membrane, but never an entire one, and so could only guess at its shape, &c. from what he had observed in mares and glanduliferous animals. He might have made a better guess at the figure, site, &c. of a human allantois, from that of a whelp, which does not every where encompass the fœtus as he observes.

Bidloo, in most of his figures of the secundines, marks some vestiges of the urinary membrane; but in any of these figures are only to be seen broken pieces of one placed so confusedly, that no idea of its size, shape, or situation can be formed from them. I must own that the membranes of the secundines are often so torn, that no art can exhibit an entire allantois. However, among the many secundines that have come under the hands of anatomists, several no doubt must have been entire enough for a fuller discovery than they have made, had it not been by their ways of proceeding, viz. by knife, fingers, or blowing under the chorion, impossible to discover any thing plain or satisfactory, even in the fairest subjects.

I come now to answer the objections of those who still deny a urinary membrane to a human fœtus. The difficulty of finding this membrane, is by no means an argument against its existence; but a woman that dies big with child, is so fair a subject for the discovery of three membranes, that I wonder Parey, having such an opportunity, could find only two. Dr. Tyson observed three membranes in a like subject; and after the chorion was divided and laid aside, he saw two bladders, containing liquors of different colours; which on pressing one towards the other did not mix, but remained distinct. This observation fully satisfied that great anatomist, as to the existence of an allantois; and its figure, texture, site, &c. might also have been discovered by him, had not the less curious spectators been impatient to pass on to other parts of the dissection.

Some deny a urinary membrane to a human fœtus, because they suppose the urachus to be impervious, and that therefore there would be no passage for the urine, consequently no need of an allantois. Needham indeed says that he could never find any sign of a cavity in the urachus; yet is of opinion, that by blowing from the bladder, the air might be forced through a human urachus, as easily as he has often done through that of a whelp. I do not understand why Dr. Needham and others should insist so much upon an apparent cavity in the urachus, or expect that air should necessarily pass through it on blowing, or think that otherwise it cannot be fit for the assigned office: since many bodies, as membranes, &c. will not admit air, &c. yet let water pass freely through them. It will not seem strange that water should pass through the substance of the urachus, if we consider that the cavity of the urachus to the navel is open, as appears by inflation or injections, (to say nothing of those who are mentioned to have made water by the navel,) and that the rest of the urachus is pervious, though not plainly hollow, (the urine rather soaking gently than running through its more straight tubes,) may be gathered from hence: 1st, That the substance of the urachus, as well as the cavity of the allantois, is always found turgid with a liquor, that in colour, taste, and smell, seems to be urinous. 2dly, That since the mucous coat of the intestines is demonstrated to be vascular by Mr. Leuwenhoeck, therefore the mucous substance of the urachus may also be vascular. 3dly, That urine may as easily ouse through these mucous vessels, as other fluids run through vascular cartilages, and bones, &c. or the chyle into lacteals, whose orifices as Leuwenhoeck observes, will scarcely admit of particles so large as the 1000000000 part of a grain of sand, the great cavity of the intestines being open at the same time; or as easily as grosser parts of the semen pass the tubes of the testicles, whose cavities are not more perceptible. I am sure the urine is more assisted in its motion by the detrusor urinæ, &c. than any of these fluids can be by the heart or other muscles.

Others will not admit of a urinary membrane, imagining it would be useless, because they think, that when the bladder is full, the urine must be discharged at its cervix, and not at its fundus, by the urachus. But in answer to this, the urine can never pass through the cervix and urethra, unless the abdominal muscles contract, because we never void urine naturally but by the help of these muscles, nothing less being able to force open the sphincter vesicæ. Now it being more than probable that these muscles never act before respiration, no urine can pass through the sphincter before the child breathes. No reason can be given why the abdominal muscles of a fœtus should voluntarily contract, since neither the quantity nor quality of the urine can excite to such an action. For when the bladder is too full of urine it will ouse through the lax spongy substance of the urachus, being gently pressed by the detrusor alone. There would arise many inconveniencies from the voluntary contraction of the abdominal muscles of a fœtus, as voiding fæces as well as urine into the amnios, which would be more prejudicial than sweat, &c. Yet if we should suppose the abdominal muscles of a fœtus to act, the urine will however pass where it can most easily, i. e. through the urachus, which is partly open, and altogether of such a texture as is nowise to hinder the passing of the urine, much less to be able to resist a considerable force, as the sphincter vesicæ can. Besides, the urachus is not only thus qualified for the admission of urine, but when the mother lies down, it is almost on a level with the urethra, and what has once passed the urachus cannot return, by reason of the length, situation, and peculiar structure of it. Lastly, the pudendi clausura sometimes happening in both sexes, demonstrates, that then at least the urine cannot pass through the urethra.

Dionis not finding any allantois, nor an urachus plainly pervious, thinks there is no need of either, on another account. For he supposes that the blood which serves for the nutrition of the fœtus, is depurated from all excrement. But I cannot apprehend what should make this portion of the blood and chyle freer from excrement than the rest of the mass of blood. There is indeed no portion of it which does not contain parts unfit for assimilation and nutrition. Dionis would have been convinced of this error had he ever opened abortions of five months old, or upwards, their bladders being always full of urine, and some fæces constantly in the intestines. It is difficult to determine when this separation of urine first begins; but I am apt to think it much sooner than is generally supposed. Fig. 1, pl. 15, is the allantois of a very small abortion, which I have still by me. Since all the parts are perfectly formed before impregnation, not very long after it they may begin to perform their offices. No doubt they begin as soon as there is occasion for any separation, and a separation of urine is necessary when the fœtus is first nourished by the umbilical arteries.

The existence of an allantois is denied by some who grant a urachus, but will have it convey the urine between the amnios and chorion. Diemerbroeck's opinion is somewhat like this, only he would have the urine lodged between the urinary membrane and the chorion. These men do not consider that the urine in this case would get into the amnios as well as the succus nutritius of the chorion, whether imbibed from the uterus by the chorion, or separated by its glands. Such a nutritious juice of the chorion is allowed by the maintainers of the fore-cited opinions, as well as by those who deny an allantois entirely, or suppose it to have a different figure, &c. from what Diemerbroeck assigns it. The transudation or filtration of this juice through the membranes, seems most likely in mares and sows; for in a mare the chorion is not joined to the uterus till she is half gone; and in a sow it does not adhere to the uterus, till near the end of her going with young. But it is most evident that the urine of a human fœtus is not contained between the chorion and amnios, nor between the chorion and allantois, from the close connection of these coats to one another: as also from the observation of midwives, who often find a bladder of water which they call a bye-bladder, offering itself before the child, whereas the humour of the amnios is little, and of the chorion much less, and of another colour, &c. at the time of birth. This bye-bladder is taken notice of as an argument for an allantois, by Mr. Cowper, to whom we are indebted for the correctness of the figures belonging to these papers.

Dr. Harvey will not allow an allantois even to brutes, and fancies that the allantois and the chorion are the same membrane, under two names: the first from its shape, the other from its office, or number of vessels. Yet it is plain from Galen, and all the ancients, that they meant two distinct membranes by the allantois and chorion. Dr. Harvey thinks that a fœtus does not void urine; but that the bladder contains it till the time of birth. What was offered against Dionis's opinion, may serve for an answer to this also. Because it was impossible for this diligent anatomist not to observe sometimes a urinary bladder, he has thought of ways to explain such phænomena without granting an allantois. In sheep and in does he had seen as it were a certain process between the umbilical arteries, full of urine; which process is doubtless the allantois, though Bartholin calls it the urachus. Again, he thinks what is called by others an allantois, if it be not the chorion, is some coat accidentally formed from a reduplication of the membranes; because since every membrane is double, nature may on extremity lodge the urine between a duplicature. Yet he does not tell us how his duplicature is to be filled, since he allows no urachus. But, in short, this urinary bladder can be no duplicature of the other membranes, since in all animals it differs from them, as to figure, texture, and in having a urachus, which no other membrane has. And since every animal that has a bladder, must have a like necessity for a receptacle of urine till born, and since the urachus also is always alike inserted in the same species of animals, and the urinary bladder constantly the same as to shape, texture, situation, &c. the urachus and allantois, with its water, can be no accidental or preternatural things.

Plate 15, fig. 2, represents the secundines of twins, to show the allantois, and its relation to the other membranes, &c. after the parts were prepared and dried. AAAA part of the chorion expanded; BBB a line, expressing the edges of the placenta; CCC the amnios, which is united to D the allantois, at EEE the line of union; F the cervix of the allantois; G a hole at the fundus of the allantois, whence the urine issued, and where the allantois was blown up; H part of that half of the allantois which lies under the line of union, and immediately covered the fœtuses, unless it be supposed that the amnios is continued under the allantois; II two styles, or probes, thrust under the amnios; they support the allantois, and keep open the aperture **** of the amnios, whence the twins come forth; K part of the placenta, with some blood-vessels injected; LLLL the arteries of the navel-string filled with red wax; MM the umbilical veins filled with green wax; N a communicant artery, by means of which all the arteries of both navel-strings were filled at once, and the veins were filled by one injection in like manner; O a pin that keeps out the amnios, where from the edge of the placenta it runs partly to the line of union, or adhesion, and partly over the placenta; P part of the chorion at the edge of the placenta, where it runs under the amnios on the placenta; Q a pin, that by a thread helps to pull open the aperture of the amnios; RRR the urachus, lying between the arteries; aaaa fibres, or vessels, which fasten the allantois to the chorion.

Fig. 3 exhibits a side-view of the same preparation, that the insertion of the urachus, &c. may be better seen. Note that A and all the same letters in these three figures denote the same parts in every one. S shews the course of the urachus R at F in pricked lines; T part of the amnios raised from the edge of the placenta, to discover the placenta K and V; V that part of the allantois which is below the line of union, near its neck F.

Fig. 1 shews an entire allantois of a very small abortion. Note, this allantois was easily separated from the other membranes between which it lay; and the amnios remained an entire bladder or membrane under the allantois.

It is objected by some that what is called the line of union can be no real thing. As to this I do not know whether the allantois of twins may not require such a conjunction to sustain, and keep steady a greater quantity of urine: nor can I resolve whether the allantois of twins (like that of a single fœtus in fig. 1) may not be distinct and separable from the amnios, but which I could not discover. However, the reasons why such a line was figured, are these: 1. Although I used more force, with equal care, to separate the allantois from the amnios, in this place, than in any other, (where nevertheless the separation was very easy,) yet I could not divide these membranes further than that line. 2. This line seeming so regular as to divide the allantois into two equal parts, I could not take it to be the effect of chance, or my separation. 3. The part

H below the line EE was alike in transparency with that part of the allantois D above it. Whereas had the amnios been still joined to the allantois, as the objection supposes, the allantois below this line must have appeared thicker than that part above it, since the amnios alone is much thicker than the allantois. It is easy indeed to conceive the amnios running an entire bladder, or membrane, under the allantois, and perhaps it may be so.

Others have taken this allantois to be an amnios of one of the twins belonging to these secundines. This objection, though it may seem plausible, yet is of no force. For 1st, this allantois is much finer to the touch, and also much more transparent than the other amnios; which still remains stiff, while the much thinner allantois sinks on the least blast of air, notwithstanding the styles II which assist it. 2dly, This allantois had two visible urachi, and it is of an oviform figure, somewhat resembling the common figure of a man's bladder. Also this allantois no where touches the placenta, unless at the neck F. But on the contrary, the amnios is of the same irregular figure, as the position, motion, &c. of the fœtus require. Likewise, it covers the whole internal surface of the placenta. 3dly, They who make this objection must suppose some hole in this bladder, and in the amnios, through which one umbilical cord may pass from the placenta to the fœtus. But such a foramen would be preternatural, because the navel-string runs only from the placenta to the fœtus, under a coat taken from the amnios, and lies with the fœtus in the cavity of the amnios, which is no where perforated. 4thly, The hole at the fundus G was scarcely wide enough to receive the end of a man's finger, whereas the twins did not want six weeks of their full time. Since therefore a fœtus of near eight months could not possibly pass this orifice, this bladder could not be an amnios.

Nothing in these secundines is preternatural, only some things were not observed before. Hitherto anatomists have not allowed twins to lie in a common amnios, but supposed each fœtus to have a distinct one. The reason of this opinion might be, that some denying any urinary membrane, called every membrane they found, except the chorion, an amnios; and these finding two membranes in the secundines of twins, supposed them to be two amnii. That others granting an allantois, but not distinctly discovering it, but only two membranes, also imagined them to be two amnii. Both of these taking that for an amnios, which might really be an allantois. But since one chorion, and one placenta, these being ever of the same number, generally serve twins, nay, sometimes three fœtuses, why should it seem strange, that one amnios, at least sometimes, and one allantois, should serve the like number?

I am not ignorant that Mauriceau, and Diemerbroeck, think there is an absolute necessity for every fœtus to lie in a distinct amnios, and that otherwise twins in the same membrane would grow together, and make a monster. Aquapendens further says, that all ova gemellifica produce some other sort of monster. Yet it is most certain that ova gemellifica exclude two perfect chickens, though not both alive. Dr. Harvey indeed thinks it possible, that such an ovum may produce a monstrous chicken, if its vitelli be contained in the same membrane, &c. yet he does not positively say it must be so. For my part, I cannot see any more reason why twins in one amnios should grow together, than that the hands or heels of the same fœtus should grow to its own body. How can the humours that lubricate a single fœtus, and help it to move, join two together? since the humours are the same, and the parts of the same fœtus, as tender as those of twins are, lie as close to each other as twins do. It is very observable, that among all the monsters we read of, there are very few, which seem to be made of two entire bodies joined together; and that most of these, on dissection, were found to have only one heart, one liver, &c. whence it is evident, that these monsters, and no doubt all others, were originally monsters in the ova, before impregnation, and not so from the want of an amnios. Yet Diemerbroeck does not a little boast of having first, as he thinks, found the reason, why twins must lie in distinct amnii. But since the matter in question (sometimes at least, as in these secundines, where there was only 1 amnios and 2 regular fœtuses) is not true, his argument for a necessity of two amnii for two fœtuses will never prove valid, even where twins, and two amnii are found. Indeed any part may be made to grow to any part, as we see in the cure of hair lips, &c. but then the fibres must be first broken, before there can be any union. Now I cannot conceive what should naturally break the fibres of the twins in the uterus. But although it is evident from what has been said, that twins may lie distinct in the same amnios, yet there must be as many urachi as fœtuses. In these secundines I saw two running over the placenta to the neck of the allantois. The urachus passes under the amnios, as the other umbilical vessels do, and runs from that part where the umbilical cord is joined to the placenta, straight to the cervix F. S describes the course of that urachus, marked R at F in the 3d fig. The other urachus lay about a quarter of an inch laterally beyond that marked R in the same figure. I mean by two urachi, two long roundish bodies, of a depressed figure; they seemed as large as a common knitting-needle, and were of a darker substance than the placenta on which they lay. They appeared in every respect like that part of the navel-string which is allowed by all anatomists to be the urachus, and in like manner shrunk in two or three days, from a mucous substance to a mere membrane.

These two are the only entire urinary membranes that I have prepared. Yet in the many secundines that have come to my hands, I have always found three distinct membranes easily separable.

An Account of Mr. Sam. Brown's third Book of East India Plants, with their Names, Virtues, Description, &c. By James Petiver, Apothecary, and F. R. S. To which are added some Animals sent him from those Parts. N° 271, p. 843.

An enumeration of 44 more East-Indian plants gathered by Mr. Brown between the 22d and 27th of March, 1696, at Chamberamback and Aumerampead, 14 or 16 miles from Fort St. George, (Madras.) As before, Mr. Petiver adds to the Malabar names the synonyms of Pluckenet and other botanists. The animals were principally conchylia and insects.

On a very extraordinary Periodical Hæmorrhage in the Thumb. By Dr. Wm. Musgrave. N° 272, p. 864.

Mr. H. formerly a servant to the Queen Dowager, had from his infancy to the 24th year of his age, a periodical hæmorrhage in one of his thumbs. The time of the eruption was about the full of the moon, seldom more than a day before or after it. The orifice was on the right side of the nail of the left thumb. He has not known the blood to be less in weight at any one periodical discharge than 4 ounces; and when he was 16 years of age, the quantity was then increased to half a pound at each eruption. The manner of the flux was also remarkable; for, without any pain of the head, straitness of breath, or other symptoms, excepting only a stiffness on the utmost joint of the said left thumb, the blood used to spin out on a sudden with a considerable force, in several small streams, and continue to do so till the greater part of the quantity was discharged. Under this discharge, however copious, he was strong and vigorous to the age of 24, from his most early and tender years.

At that age, finding this evacuation troublesome, and being uneasy under it, he seared with a hot iron the part, which used to open, and give vent to the flux of blood. I saw the part; it was hard and callous to the diameter of $\frac{1}{4}$ of an inch. The searing had stopped the hæmorrhage to the day I took this account, about 20 years.

This stoppage was in its effects very dangerous, and of ill consequence; for within one quarter of a year after it, he fell into a spitting of blood; bringing up from his lungs vast quantities of it. This new complaint, together with a cough attending it, reduced him very low; so that his physician, old Dr. Dike of Somersetshire, thought him far gone in a consumption; but by frequent bleeding, &c. delivered him from this hæmoptoe; yet not with that relief which was expected; for in a very little time the patient fell into a most violent colic, from no other occasion, that he could discover, than his late illness putting on a new form, and the matter settling on the bowels. This colic was in good measure overcome by purging medicines; but a disposition to it still remains; for he has ever since been often troubled with it, as also with a spitting of blood, on the least excess of cold or motion. In short, he has, ever since the stoppage of that first hæmorrhage, been weak, sickly, of a faint look; much impaired as to health, in comparison to what he enjoyed during the time of its periodical returns; which proves, that when nature has chosen, and for some length of time exercised, new and extraordinary methods of economy, she seems to be as fond of their continuance, as at other times, and in her most regular state, she is of that which is her most usual and ordinary course.

A further observation may be made from this, and such like monthly hæmorrhages, in men; whether by the thumb, or per penem, or any other part of the body. For these evacuations, being analogous to the menses in women, confute the opinion of all such as derive that discharge from a fermentum uterinum. For how can we think the menses come from such a local ferment; when a discharge, in all respects equivalent to them, takes place, where no such ferment is, or can be supposed.

Concerning Spiders, their Way of Killing their Prey, Spinning their Webs, Generation, &c. By M. Leuwenhoeck, F. R. S. N° 272, p. 867.

About the latter end of February, I caught a black spider, and viewing it with my microscopes, I observed that his body and legs were covered with a great number of hairs, that stood as thick as the bristles on a hog's back. Though hairy, yet the legs were so clear, that I could easily perceive the circulation of the blood in several veins which were not a hair's breadth distance from each other; and afterwards I saw other fine blood-vessels, that were not the tenth part of a hair's breadth distant from each other. With the strictest observation I could not discover the course of the arterial blood; but I could see, even in the smallest of the legs, three vessels together that conveyed the blood directly to the heart. Notwithstanding that this animal is by the ancients esteemed a bloodless insect, because they could discover no red matter in the body when they killed or crushed it to pieces, yet I plainly perceived some particles of blood, which according to all appearance were spherical, circulating in a liquid matter. But these particles of blood were extremely small, in comparison of those globules that are discovered in larger animals, for I saw a space of three hairs' breadth, where no particles of blood circulated; and the blood was expelled with great swiftness. I have viewed this spider a great many times, and at last, on the 8th of March, I could see the blood in one of the arteries, but could not discover where the circulation began.

I have often taken up that sort of spider whose breech is much larger and thicker than of others, to see whether I could discover any circulation of the blood, but in vain; and to satisfy myself, whether they had any globules in their blood, I cut off one of the hinder legs of such a spider, and viewed the blood that ran out, in which I found but very few globules; but wounding it in the breast, or fore-part of the body, and observing the blood that flowed from thence, I discovered abundance of globules in it; and cutting off part of the leg of another spider, I found more globules there, though I could not perceive any circulation of the blood in the legs.

I have often seen a spider hanging down from a branch of a tree by a thread of his own making, and holding fast by one of his hind-legs, which has three particular claws, two of which are at the very end, and each claw is armed with several teeth like saws, which towards the joining with the foot grow narrower and closer together, and where the thread it has spun may be close twisted, just as in a pully, on which the clockmakers put their lines to fasten the weight on, which in the beginning is wide and large, but the longer it grows the narrower it is.

Fig. 4, pl. 15, ABCDEF represents a small part of the leg of a spider; BCD show the two extreme claws, armed with teeth like saws; E the third that has no teeth; which claw I suppose he uses on several accounts; this is certain, that when the spider does not wind himself by his thread upwards, but runs along his web, then he takes hold of the spun thread with this third claw. The above-mentioned spider is provided with eight long and two short legs; which last stand out on each side of the head, having such claws as are before-mentioned. Further, I discovered eight distinct eyes, two of which are on the top of the head, in order to see what passes above him. Below those were two other eyes, to look straight forwards. On each side of the head were two more, close to each other; the two foremost eyes to see, I suppose, what passed collaterally before him, the two hindmost to see the same backwards.

Fig. 5 shows the forepart of the body separated from the membrane or pellicle it lay in; PQ the eyes that look upwards; KL those that look straight forwards; IM those that look sideways forward; HN those sideways backward.

Now as the spider's eyes are immoveable, having no muscles belonging to them, it is easy to conceive how necessary 8 eyes are, in order to look round about, the more easily to catch his prey.

I found that the spider has two instruments or cases for his sting, in the forepart of his head, which, when he does not use, he places in great order under his eyes, and between his two short legs. These stings are crooked like a claw, and very much resemble the stings of scorpions, or Indian millepedes. The stings of a spider* have towards the end, and on each side, a little hole, from whence, according to all appearance, when he strikes his enemy, he ejects a liquid matter, which we call poison.

In fig. 3, ABCDEF &c. show the two instruments that contain the stings; BC the sting as it is cased or laid up; HIK the sting extended, and ready to wound; C and I the small holes in each sting, which go quite through; EFG represent the 2 rows of teeth, which serve for a case to the stings, and are covered with hairs; CB the sting when at rest. These two rows of teeth I fancy are given the spider to hold the prey that he has hunted, and struck with his sting, so fast that it cannot be wrested from him.

When I put two or three of the largest sort of spiders together in the glass, I observed that when they met, they never parted without an engagement, in which one has been sometimes wounded in such a manner, that his body was wet with the blood spilt in the battle, and that he died soon after. I always observed that the lesser fled from the greater; and when it happened that two of an equal size met together, neither retired, but held one another so fast by their stings, that one would remain dead without once stirring, and so wet with the blood it had lost, as if it had lain some time in the water. I had one spider that was wounded by his antagonist in the thickest part of his leg from whence issued one drop of blood as large as a sand grain; not being able to use this wounded leg in running away from his enemy, he raised it up on end, and presently after the whole limb† fell off from his body; and I have observed that when they are wounded in the breast, or upper part of their bodies, they always die.

I used to be of opinion, that when the spider would fasten his thread to any thing, or join one thread to another, that the last spun thread was indued with a sort of slimy or gluey matter, by which it stuck to whatever the spider fastened it, as it happens in silk-worms. But I have found, on the contrary, that the spider cannot fasten his thread, unless he presses with his breech upon the place where his thread is to be fastened, which pressure causes vast numbers of exceedingly fine threads to issue out of his body; from whence it may be concluded, that as soon as those threads come into the air, they lose their viscosity.

When I formerly opened or dissected a spider, in order to discover that

* What Leuwenhoeck here calls stings are more properly termed fangs.

† This seems to indicate some analogy between the constitution of spiders and crabs, which latter are known to cast off the whole limb when a part is wounded.

viscous matter, which I took to be the beginning of their web, and not finding it, I was amazed, being unable to conceive how such a strong thread could in so short a time proceed out of such a moist body, strong enough to bear the weight not of one only, but even six spiders; and when I endeavoured to find out the manner how they make their webs, one and the same thread seemed to me sometimes to consist of a single thread, and sometimes of four or five; but I could never see how the threads issued from the spider's body. Since then I took a spider, and laid it on its back, so that it could not stir, and with a very fine pair of pincers drew out a thread, which I could perceive sticking out of one of the working instruments; in doing which I saw abundance of very fine threads coming out of the body at the same time; which, as soon as they were one or two hair's breadth distant from the body, were joined together, and so made thick threads. Not content with these my observations, I bethought myself how to fasten these fine threads while they were divided, and just as they came out of the body of the spider; which succeeded with me three several times, and the oftener the better. But it is impossible to describe or conceive the extreme fineness of those threads; for though I used my best glasses, yet even then they appeared so small as almost to escape the sight. I endeavoured to count those threads as they came out of the body, but could not; for in some places I found threads that were 25 times as thick as others that lay next them.

I caused the limner to look at some of these threads, as they came out of the spider's body, who was forced to own that there was no describing them, either with pen or pencil, and that they could hardly be engraved on copper plates; however I have sent them as well done as I could. MNOPQ, fig. 7, pl. 15, represents a part of the threads, which came out of but two of their working instruments, and are divided from one another, just as they issued from the body. Now, as we may perceive that a spider's web, which to our naked eye seems but single, yet consists of many other threads, and thus acquires a greater strength; we may from hence certainly conclude, that no flexible bodies (excepting metals, whose parts are strongly cemented by the force of fire) can attain to any degree of strength, unless they consist of long united parts; and the more these are twisted together, or cemented with any viscous matter, the stronger they are; which is very obvious in flax, or silken thread, ropes, &c. And thus also hair or wool, according to its fineness, has more or less strength, because each of those hairs consists of longer and finer parts, which are not only united by a viscous matter to one another, but are also armed with a skin or bark, which more strictly joins the contained parts. Now if we seriously reflect on the vast number of fine threads, which at once proceed from the body of such a spider, we must own that it could not be otherwise; for, to make a thread so thick and strong as is necessary in a spider's web, with the viscous matter, which for that purpose is thrown out of the animal's body, cannot be done near so soon, nor be immediately congealed in the air, as the thin and fine threads, 100 of which put together will not, in my opinion, make the 100th part of the thickness of one single hair of my head: in short, we may hereby discover the consummate wisdom of God in the perfection of his creatures.

To endeavour to discover the internal machinery of these curious threads, I proceeded to the dissection of the body of one of the largest spiders I could get, and very curiously investigated each part of it, and at last, to my great amazement, I discovered the vast number of instruments, from whence each single thread proceeded; indeed the number was so great, that I judged them to be at least 400: yet they did not lie close by one another, but were divided into 8 distinct parts or instruments; so that if the spider set all these 8 instruments to work at once, there would proceed from the same 8 particular threads, which were again subdivided into a great number of smaller; but one of the great threads would be thicker than the other, because one part of the body would produce twice as many threads as the other just by it. When I viewed the dissected body with my microscopes, and the place whence the threads issued, I found that they were shut up by five distinct parts, which are pointed at the extremity; but from the middlemost there proceeds no thread at all. The other four instruments, which shoot out these threads, are covered externally with thick hairs, so that all the small instruments lie inwards; for this reason (as I imagine) that they may not receive any damage, when the spider creeps into any hole where there is no occasion of making his web, or when he runs along the ground in quest of his prey. Now on separating the abovementioned four instruments, we find four others lying between them, which contain within them yet smaller and slenderer instruments, from each of which proceed exceedingly fine threads. After those four instruments have been dissected, in order to expose to view what lies inwards, the scene is like that of a large field, covered with a vast number of pointed twigs, and each delivering out a single thread: these instruments are double, and may be compared to a reed that is thicker at bottom than at top; out of which proceeded another, the largest end of which was incased within the smaller end of the former, and out of the small end of this last issued a thread of an exceeding fineness. It sometimes happened, that I could not discover the working instruments in some of the abovementioned parts: which I supposed, when the spider did not employ them in making his web, were shut up, and then I could see nothing in the place whence they used to proceed, but their small points or tips of them, yet with a little squeezing, they presently appeared in great numbers. I observed also, that some few of those parts, from whence the threads proceeded, were larger and longer than the rest, which I suppose produce threads of an extraordinary size, in comparison of the others.

Now, if we take it for granted, as it is really true, that a young spider just come out of the egg, is 300 times smaller than a full grown spider, and at the same time allow that this young spider has all the working instruments within its body, as the old one, (which as it grows in size are also enlarged in proportion,) we must necessarily conclude that the threads spun by the young, are 300 times smaller than those spun by the old spider; which fineness is hardly to be conceived.

I always observed, that when the spider does not fasten his thread at one stretch, it is drawn inwards with bents and crinkles; on which I concluded that each of those fine threads was of itself round, but by the addition of several other threads it acquired a flatness, as several common threads laid together appear to us. The same thing is also observed by the gold wire-drawers, whose threads, if they break, or hang loose, crinkle, and then always appear round.

I could not forbear describing (as far as the limner was able) the above-mentioned instruments, from whence those wonderfully small threads proceed.

In fig. 8, RSTV shows one of the four outermost instruments, which instrument, with all its quills or reeds together, is not so large as one common sand; from whence you may imagine how small those instruments must be, and how fine the threads that are incased within the first instruments. In the said figure at W the working instruments stood as thick by one another, as they do between R and S; but because it is opposite to the sight, and consequently was not easily to be distinguished, I ordered the limner to leave that place empty. And that part which was from the sight was not covered with such kind of quills, but with hairs only. The number of quills or reeds on turning this instrument about, was upwards of 100. A few of these instruments as before said, were larger than the rest, and consequently produced a larger thread; two of these, which produced crinkled or harled threads, are represented at AB, DE, fig. 9. Sometimes, on squeezing such an instrument as fig. 8, instead of threads, there issued out matter that became a round drop, which I suppose was occasioned for want of a continuation of the same matter; whereas the other parts that stood next produced threads. When I pressed the hinder part of the spider's body, from whence its web proceeds, with my tongs or pincers pretty hard, it has frequently happened that a round particle, the third part of an inch in length, and as thick as a horse-hair, came out, very transparent, and of a tough and viscous nature, whence I thought whether this might not be the substance of which the threads were formed, and also whether the body of the spider was not so framed, as to be able to press or insinuate into its working instruments, that matter, which is the foundation of the threads issuing from thence. I have often cut off a piece of that part of the spider's body from whence these threads proceed, and afterwards drawn long threads out of it.

I once took a very small frog, the length of whose body was about an inch and a half, and put him into a glass tube, together with a large spider, in order to see how they would behave; when I observed that the spider passed by the frog without touching him, but yet he had drawn out his stings, as if he intended to have fallen directly upon the frog. Afterwards I caused the frog to run against the spider, who thereupon struck it in the back with its stings, and wounded the frog in two several places, in such a manner, that in one place he left a red speck, and in the other a blue one. Hereupon I brought them together again, when the spider struck his stings into the fore-leg of the frog, who upon that struggled so hard that the spider was forced to leave him, and I observed that some few of the blood-vessels in the frog's legs were wounded. Once again I forced the frog to jostle the spider, who upon that struck both his stings into the frog's nose, after which they both stood still about half a minute, then opening the glass I took the spider out, while the frog sat still about an hour, then stretched out his hinder legs, and died.

The next day I took another frog, about the same size with the former, and another spider, and putting them both into the same glass, the spider passed by the frog without meddling with it; but when I suddenly shook them together, the spider struck both his stings in the frog's back, but I could not perceive that he was wounded so far as the veins, as there was no blood spilt. This frog was very shy of the spider, and as soon as the spider came near him, or touched him with his feet or claws, the frog used his utmost efforts to avoid him. Again, I brought the frog so near as to touch the spider with the fore-part of his body, who thereupon gave him two blows with his stings in the lower part of the head, one of which pierced the blood-vessels, so that there remained a red spot; the spider presently quitted the frog, because of the strong efforts he made to get from it, and then set itself to cleanse its stings with a moisture that came from its mouth for that purpose. I then separated the spider from the frog, and viewed the circulation of the blood in the veins of the latter, that I might see whether any alteration was occasioned by the wound received from the spider; but I could discover nothing, neither could I perceive that the frog had received any harm, for the next day he was as brisk as ever.

Now it is possible that the stinging of spiders in hotter countries may be more pernicious than in our climate; it is also possible, that this spider might have spent his poison lately, by wounding another spider, or some other animal. When I had kept this frog four days in the glass tube, and found that it was not altered, I threw it into the water, and observed that it endeavoured to swim towards land, as all frogs do in deep waters, for fear of being devoured by the fish.

I observed the blood of a spider, and found that every particle of blood consists of several other smaller parts, each of which I imagined was composed of six others, analogous to the blood of the human body; and I also observed several other little particles, some less than others; but these last particles were not visible till the fine serum of the blood was quite exhaled. Moreover, in viewing the blood that issued from the feet that were cut off, I observed that the serum would exhale, and the salt particles would cleave together like so many fine twigs or branches, like the night-dews when congealed on glass-windows: but when I forbore looking, and laid the glass by, the air being cool, the crystallized salts returned to their former shape; and again, if I brought my warm hand but half a minute near the glass, all the salt particles were coagulated again; but with breathing a little on them, they were quickly reduced to a clear water. It was curious to see these salts, which seemed to have their rise from a point, or exceedingly small particle of blood, stream and branch themselves, as it were, into trees.

Afterwards I took up another spider, and put it into a glass tube, in order to discover the circulation of the blood; which I saw very plain, both in the veins and arteries; and its legs being very transparent, like those spiders found in trees or shrubs, I saw several times a sudden and brisker motion of the blood, which I suppose was occasioned by every systole and diastole of the heart. I took another which I found on a thistle, which was eight times less than the large garden spider, and observed the circulation of his blood, which I could easily perceive both in the veins and arteries.

In the middle, or about the latter end of October, I took several of the largest spiders I could find, and shut them up severally in glass tubes, that they might lay their eggs, and to see what I could discover in these. I was amazed to find in their excrements whole wings and heads and legs of small flies, which are so large, that I could not conceive how they passed through their bodies. On the 30th of October, I observed that two of my spiders had laid eggs, and had covered them with so vast a quantity of their web, that I was astonished how they could do it in a few hours. I took the web, with the eggs inclosed, and opened several of them, which I found to be of a yellowish colour.

These eggs were almost round, and the axis of one of them was about the 30th part of an inch; and when they lay altogether, they made a roundish body, whose axis was half an inch, but looking upon them sidewise, their diameter appeared a quarter of an inch; from whence it is very easy to calculate what a vast number of eggs one spider will lay. On a narrow view of this large heap of eggs, that lay in order by one another, one would think it impossible for such a number to proceed from the body of one spider. But the wonder will cease, when we consider that the eggs are not exactly round while they lie in the spider's body, but being pressed together they assume particular figures. These eggs being round and lying in order, and touching each other only in one point, must needs take up more room than when they lay in the spider's belly. The membrane or shell of these eggs is very weak, so that in endeavouring to separate them, for they stick together by a viscous matter, I could not help oftentimes breaking them.

On the last of October, about five in the evening, I observed that another spider had made its web against the sides of the glass-tube, to lodge its eggs there; and whereas before I could not imagine how the spider had placed its eggs in the middle of the glass, I was now fully satisfied in that matter, for I saw plainly that she made her web like a thick bed against the glass, that as yet there were no eggs in it; and it was remarkable that this bed was not flat, but had a well-contrived hollowness within it, not exactly round, but oval. About 40 minutes after, viewing the spider again, I found that the bed was not only full of eggs, but that there was a large heap of them standing above the bed, and the spider very busy in covering them with her web on every side, using her two hinder feet as well as her breech to fasten the threads that proceeded from thence, and to range them all in order; all her working instruments were open, and all of them seemed to be delivering out thread for the work; sometimes she raised up her body a straw's breadth, then removed it as much, that the threads might have a freer passage, and cover her eggs the better. When she was delivered of all her eggs, her body was not the fourth part so large as before; and though lately smooth and distended, it was now full of wrinkles and cavities.

Being desirous to see how the spider laid her eggs, on the 7th of November I had my wish in some measure; for I saw 6 or 8 eggs laid, which did not issue from the hindmost part of the body, as in all other animals, but from the upper part of the belly, not far from the hind legs, where is a sort of hook of a particular form; this hook came partly over the opening from which the eggs proceed. I could have wished indeed, that I had come sooner to the laying of the eggs, that I might have mentioned it with greater certainty, for the spider, as soon as ever she had laid her eggs, covered them with her web. But that I might be fully satisfied, I took several spiders which had not yet laid, and throwing them on their backs I pressed their bellies, by which I had not only a clear view of the opening, but by squeezing a little harder, I made a great many eggs come out, and not the least moisture proceeded from the hinder part of the body. This experiment convinced me, that this was the place from whence she voided both her eggs and excrements.

In fig. 10, ABC represent the spider as laid on its back, and D the hook. Fig. 11, GHIK show the hook separated from the body, as it appeared through the microscope; between I and K are seen the wrinkles or folds which I imagine were made to produce a more than ordinary motion; EF show that part that joined it to the body. The use of this hook may be to arrange the eggs in order. In the said figure, between F and G, are two round balls, which I cannot conceive the use of.

January 1, for the third time I took a spider's eggs, and putting them into a gl ss tube, carried them about me, to see if they would hatch. They were laid by the largest spider that I had seen the last summer, and it was one of the last I could meet with in the gardens. I viewed them several days without opening them, and finding no alteration in them, which I attributed to the cold weather, I kept them four days without looking at them, imagining I should have no better luck with them than with the former ones; but on the 17th of the same month, in the morning, viewing them again, I saw 25 young spiders that were come out of so many eggs, and about 25 more whose bodies were but half out of the egg-shell, and some of them had their shells hanging upon their tail; and in the evening about six o'clock I reckoned 150 young ones. The next day I viewed them again, and then I concluded that no more spiders would come out of the eggs, and that several which I saw lying about the glass were barren, and that in others the young spiders were dead, the number of which I judged to be about 50, and about 10 or 12 eggs were blackish. When the glass tube, where the young spiders were, had been out of my pocket but 15 minutes, in very cold weather, I could hardly discover any life or motion in some of them; but so soon as the glass tube had been a little warmed again, they were brisk and lively, and most of them got together in a company, as we see in swarms of bees, and so hung about the web, where the eggs had been lodged before.

January 21st, I could perceive the 8 eyes in every spider, which before were not so visible; but now being of a brown or darkish colour, they were easily distinguishable from the fore-part of their body, which was white, as the hinder part was yellowish. Now if we consider what a vast number of spiders are produced by one, and in how short a time, we cannot conceive whence, or how they get their food, especially as the old ones, as far as I could see, feed upon nothing but animals.

January 22d, I observed that the legs of many of the spiders, which before had been clear and transparent, now assumed a dark colour, and afterwards began to be covered with hair, whereas I could perceive none a little before.

On the 23d, their legs grew darker, as also the hinder part of their bodies, whence their web proceeds, and that also began to be covered with hairs; then I observed likewise a great many particles of a moist or watery matter hanging on the sides of the glass, which moisture I had not before taken notice of; but now there was so much of it, that the barren eggs, which before rolled freely about the glass, were glued to it by this viscous matter, which so much abounded, that the young spiders could hardly pass through it. I observed also that they had cast their very thin skins, and began to be much nimbler in their motions.

The 25th I saw them spin a thread, and manage it with their hinder-feet as well as the old ones; I observed also that they had eat up the barren eggs, and the others wherein I supposed the young ones to be dead, which were about 50 in number: for a few days after there remained nothing but the bare shells.

I have compared the threads of a full-grown spider with one of the hairs of my beard; the thickest part of which placed before the microscope, and according to the nicest observation, I judged that above 100 of those threads laid together, did not equal the diameter of one hair; now supposing this hair to be round, then 10 of the fine threads of a spider's web are not thicker than one single hair. Now if we add to this, as it is most certainly true, that 400 young spiders, when they first begin to spin, are not, one with another, larger than one full-grown spider, and that each of those young ones is provided with all the working instruments of the old one, it would follow that the smallest thread of such a young spider is 400 times smaller than that of a large one, and if so, then 4000000 threads of a young spider are not so large as a hair; but then again, if we consider of how many parts one of those smallest threads consist, we must stand astonished at the thought. I observed that half the young spiders were smaller in the hinder part of their bodies than the rest, which last I supposed to be males. Also that most of these young spiders had bored into the web, and in a manner lodged themselves in it, which made me suspect that for want of other meat they had fed on the web, and the rather because some of them were grown pretty much.

January 30th, most of them were employed in weaving their web, so that the glass swarmed with them.

February 8th, I could perceive that many of the spiders had eaten each other up, and at the very time I looked on them there were four upon one, whom they had almost devoured; and here and there I saw pieces of legs, and now the shells of the barren eggs were eaten up so clear, that I could see nothing of them remaining.

February 10th, my spiders were reduced to half their number, and those that remained were eating the thickest of their companions' legs. Thus they diminished daily, so that on the last of the said month I could see but 30 of them alive, among which a few were 20 times as large as some that remained. March 5th I could see but 3 or 4 alive, and about the web I observed a black matter, about which the spiders had swarmed very much, and I found that it was nothing else but a heap of legs of those young spiders, whose bodies had been devoured.

I kept by me the eggs of several spiders in glass-tubes in my closet, and particularly January 24th I put the eggs of two different spiders in two distinct glasses, and on the 6th of February could perceive in one of them 3 young spiders crawling out of the web. I took one of those young spiders, whose egg-shell was still hanging at his tail, and set it before my microscope in the open air; and though the fore-part of its body was as clear as glass, yet I could not perceive the least motion in the inner parts: from whence I concluded that the heart was not settled in their breast, for if it had been there, I must needs have perceived its motion; I therefore believe it lies near the eyes, where it was not so transparent; for that the expulsion of the blood in a spider proceeds from the heart, I think is not to be doubted. I endeavoured also to discover the circulation of the blood in the legs of these small animals, which observation succeeded with me several times. When I cast my eyes on the hinder part of their bodies I could perceive that the entrails consisted of a vast number of globules of several sizes, of which the eggs are composed.

On the 7th of February I could not perceive that there were any more young spiders come out of the web, but I saw at least 25 egg-shells, lying without the web. On the 9th of the said month a few young spiders were come out of the web, which had cast their skins, and others were crowded together in the web. On the 10th, all the young spiders were got out, and had shed their pellicles, before which time I do not believe they endeavoured to come out. On the 12th, I laid one of the glass-tubes on my desk, to see how the spiders would fare in cold weather; and the next morning I found that most of them were crept into their web; but after I had carried them some hours in my pocket, I found they were come abroad again.

The 20th of February I took two young spiders out of the said glass-tube, and put them into another that was thinner, and stopped both ends of this other tube with paper, so that they might not get out, and yet have air enough. The 14th of April I perceived that one of my spiders lay dead, and the other very well and lively; but on the 26th of the same month it began to flag in its motion, and the next day it was dead also, and yet I could not see that one had hurt the other; whence I concluded, that these young spiders will live more than two months, if it be cold weather, without eating.

In the great glass-tube, from whence I had taken the above-mentioned two spiders that had been hatched at the same time, there were still, on the 26th of April, 20 young spiders alive, sitting altogether in the web, which they had spun without once touching or running about the glass, because, as I suppose, the glass was too cold for them; and on the 22d of May there were but three of them living, which I could not perceive to be grown much larger; the rest of them lay by as dead, but mostly devoured by the longest livers.

In the second glass-tube, which I had carried about me a long time, the young spiders in it did not live near so long as the others; because, as I conceive, that the warmth of my body caused them to perspire more, and consequently to stand in need of their food sooner.

Now I had in my desk the eggs of six distinct spiders, which I often viewed, to know when the young spiders would come out; and on the 20th of May I observed the eggs to change colour a little; on the 22d the young ones were hatched, and lay so close to each other in the web, that they took up but little more room than when they were in their shells, and I could not discover any motion in them, only they that lay outermost stirred their legs a little.

On the whole, in this animal, which to some people is so odious, I have discovered as much perfection and hidden beauties as in any other; for when I took the fleshy muscles out of their legs, and viewed them through the microscope, I was astonished at their transparency, and they seemed to be one body; but when I came to separate them, I found that they were composed of very long particles, each consisting of so many folds or wrinkles, that the muscle might be dilated or contracted, as occasion should require.

Chartham News; or an Account of some strange Bones dug up near Canterbury. N° 272, p. 882.

Mr. John Somner, in Sept. 1668, sinking a well at a new house of his in Chartham, a village about 3 miles from Canterbury, towards Ashford, on a shelving ground, or bank side, within 12 rods of the river, running from thence to Canterbury, and so to Sandwich Haven; having dug about 17 feet deep, through gravelly and chalky ground, and 2 feet into the springs, met there with a parcel of strange bones, some whole, and others broken, with 4 teeth, sound and entire, but in a manner petrified; each tooth weighing something above half a pound, and some of them almost as large as a man's fist. Ludovicus Vives mentions such a tooth, but a little larger; which was showed to him for one of St. Christopher's teeth, and was kept in a church that bore his name. Just such another tooth was seen by Acosta in the Indies, dug out of the ground, in one of their houses there, with many other bones, which put together represented a man of a formidable size. And so must we have judged of these teeth, and of the body to which they belonged, had not other bones been found with them, which could not be human bones. Some that have seen the teeth, and by some other circumstances, are of opinion, that they are the bones of an hippopotamus, or sea-horse. The mould about them, and in which they all lay, resembled a sea-earth or fulling-earth, without a stone, unless you dig 3 feet deeper, and then it rises a perfect gravel.

An Account of a Person who could neither Read nor Write, yet could Reckon Sums to great exactness. Communicated by Mr. Locke, dated Rotterdam, March* 25, 1701. N° 272, p. 893.

Yesterday I had here a young lad of 17 years old, that can neither read nor write, yet by his head will reckon any of the most difficult sums you can give him, even to the utmost fractions. I gave him an average to make of a ship run ashore, to save ship and goods were worth 13679,14; the charges on the salvage 2931,16. I asked him how much that was per cent.? he told me after a little talking to himself, that it was 21 gild. 9 st. and a small fraction. I asked him what 4943,3, 2848,4, 2244,7, 2194,7, 544,19, 351,18, and 52,16 must pay respectively, and he told me exactly to so many stivers and $\frac{270}{1000}$. I aked how he came by that knowledge; he said by selling sea snails and muscles, for which he received nothing but doits, so he brought his father home so many doits, but could never tell how much money they amounted to, till he asked his father how many doits made a gilder, and being 160, then he reckoned how many in 10 and 100, and so from one thing to another. He has a table of multiplication in his head of half a yard long or more; I tried him by a table I have, and he answered me as readily as you can upon the ordinary table of multiplication; and he divides almost with as much ease as he multiplies, and reduces things to the least denomination in fractions. He wanders from town to town, to see who has any thing to cipher, and so gets some money; but he would fain learn to read and write. This I mention because it is so

* It does not appear that this was the great Locke, as according to the accounts of his life, Mr Locke never was in Holland after the revolution in 1689; and besides, the style and writing of this paper, seem not like Locke's.]

prodigious. I have a great mind, could I be assured of his fidelity, to take him into my house, and teach him to read, write, and cipher.

A Letter from Dr. Davies to Sir Charles Holt, containing a Relation of a Person who voided many Hydatides in her Urine. Dated Birmingham, in Warwickshire, July 14th, 1699. N° 273, p. 897.

A gentlewoman, between 40 and 50 years of age, in the autumn of 97, drank some aluminous water for a month or five weeks, and in a month's time after the use of these waters, found a pain in the renal region, where she never had been afflicted with any before; this pain returned after the first paroxysm in about a month's time, and afterwards more frequently; till about the Christmas following it visited her every day, about which time she sent for me; she had then the symptoms of a stone in her left kidney, viz. a grinding, and sometimes a very acute pain on that side of the spina dorsi, a vomiting, her urine during the paroxysm tinged with blood, and in it bloody ramenta; but what was most surprising was, a dozen at least of hydatides, some of the largest of them 1½ inch long, and their circumference equalled that of an ordinary goose-quill; in shape they exactly represented the vesiculæ natatoriæ in fish, growing smaller about the middle, as those generally do, and were filled with a liquor, which by the taste and smell seemed to be urine; I never discovered any pus in her urine, nor had she any pain at the sphincter of the bladder, nor in the meatus urinarius, either before, at, or after making urine. The paroxysm lasted generally 3 or 4 hours; as soon as these hydatides came away, (which they did not all at once making water, but at several times) the pain in her back, &c. abated very sensibly, and she continued easy and well the rest of the day, excepting an external soreness, which the pain had caused. I thought these vesiculæ at first to be membranous, since their consistence was so tough, as to bear taking out of the chamber-pot and gentle handling; but afterwards was convinced that they owed their origin to a glutinous slimy matter; because upon long standing in urine, or fair water, they quite disappeared, and were dissolved, making the water or urine to look thick and turbid. By the use of medicines all these symptoms disappeared, and she continued well.

A Letter from Mr. Antony Van Leuwenhoeck, F. R. S. to Mr. Chamberlaine, concerning the Causes of the different Tastes of Waters, and the Edge of Razors. Delft in Holland, June 21, 1701. N° 273, p. 899.

In water that was but little boiled, the taste and smell was unpleasant, and different from that which was well boiled. The reason of which M. L. takes to be from the salts contained in the water. This he judged from the circumstance, that when some of the former water was gently evaporated, many salt crystals remained behind; but the well-boiled-water, so evaporated, left no crystals. As to the razors, he found none, but when viewed with the microscope, showed many notches on the edges; an appearance common enough.

Part of a Letter from Mr. Antony Van Leuwenhoeck, F. R. S. concerning several Microscopical Observations. Delft in Holland, June 21, 1701. N° 273, p. 903.

About 3 years ago I was shewn a magnifying glass, whose chief excellence was, that one could see an object a great distance from it. As soon as I had put the glass to my eye, I concluded there was a hole or cavity in it, by which the remote object came to be seen; and viewing it by one of my own, I not only discovered one deep pit or cavity in it, but several other lesser, which had not been ground out. Last winter a glass-grinder came to me with a magnifying glass, by which he said he could see into metals and minerals. I answered that the pores of metals were so close and impervious, that it was impossible ever to see through them; and that leaf gold, though ever so thinly beaten, could not be seen through.

Upon which he put the glass into my hands, adding, that I should see the light of the candle through a copper circle, which stood before the magnifying-glass, and accordingly I saw a very imperfect light through the copper circle. But this was only occasioned by a small part of the glass, which was not ground, as I discovered by applying an extraordinary magnifying-glass.

It has often happened that in the bursting of glass, or of sparks flying out of wood-coals, small particles of the glass or fire came into my eye, and caused it to smart; upon which I used to arm my eyes with spectacles, against the like accidents for the future. Now I observe, when I look through one of my glasses by candle light, that near the upper part of my eye in the tunica cornea, there appears a fine small flame of a candle inversed, no larger than the common letters we use in writing, and opposite to it appear two round clear lights, so very small, that the flame of the candle is not to be perceived in it. From hence I conclude, that the tunica cornea of the eye, by the wound it received from those particles of glass, has lost somewhat of its roundness, which occasioned those appearances, and that when the wounded part stood just before the sight, it obstructed it, &c. I observed also, that in several places of the tunica cornea, there lay veins no longer than the breadth of 2 or 3 hairs put together, wherein I could perceive the globules of blood very distinctly; these vessels were so small, that they could contain but one globule in their diameter, and the blood had no motion. The vessels seem to be broken off from other blood-vessels; and when the particles of blood are a little crowded together, or when one of those longish vessels are somewhat bended, it appears to the sight, as if one saw a thick cloud. The eyes are surrounded with this cloud of small particles, but more at one time than another, for some are dispersed, and then others arise in their stead, on viewing these vessels with their globules of blood, through one of my glasses against a candle, or other strong light, they seem to be in a continual motion; by which, those particles that are in the tunica cornea, be their motion ever so small, seem to us as if they were moving in the air; but by a strict examination we shall find, that they are one and the same particles, which sometimes appear ascending, and at other times descending.

It has often happened too, when I looked against a strong light, through my microscopes, that I saw a vast number of exceedingly small particles, that had all a glittering motion. These I imagine are in the crystalline humour of the eye, between the tunica cornea and the crystalline, the motion of which small particles is occasioned by pressing the tunica cornea, when we shut our eye close together.

I have often taken several sorts of moist matters, and laid them on a very clean glass, and viewed them, as also the breathings of my mouth; and by the help of my microscopes I could see their fine subtile parts rising up from the glass like clouds, and at last quite vanish, so that I could not perceive the least remnant of them; and finally, I am absolutely of opinion, that though I could see the effluvia of bodies, that were a thousand millions of times smaller than those, yet I should not be able to perceive the perspirations of bodies, and much less the imaginary influences of the stars.

A new Kind of Walnut-tree, discovered by Mons. Reneaume, of the Royal Academy of Sciences. N° 273, p. 908.

The walnut-tree, or nux juglans sive regia, has been described by many authors, who, however, seem to have known only six species of it, though I can reckon nine. They confounded with the common sort, that which the country people call noix Angloises, which one may call nux juglans putamine durissimo, which appears to me to be that which in Hermolaus, and in the Historia Lugdunensis, is called moratiæ moracillæ, and which Cæsalpin calls surdæ. Besides, the same authors have distinguished another species, which might be called nux juglans fructu præcoci, because they are sooner ripe than the others, and eaten about the feast of St. John en Cerneaux, which has given them, among the country people, the name of noix joannettes. As for that species I am to treat on, I cannot find any author that knew of it, and therefore I shall call it nux juglans, folio eleganter dissecto, or acanthi-folia.

The oil which is pressed out of the walnut-tree, in certain provinces, is used instead of butter and olive-oil. In Berry, where they have very good wool, and where they trade very much in cattle, they have yet but very little butter; and that little which they have is worth nothing, and is very dear; so that they use nut-oil in dressing their meat. For this reason, there are vast numbers of walnut-trees planted in the middle of the ploughed lands, so that afar off one would take these lands for woods of walnut-trees. The want of these trees in this country obliges the inhabitants to cultivate them, which they take care to nourish in particular places, as in a sort of nursery, in order to plant them afresh when they die, whether it be of age, which is rare, or whether they decay, or that they are felled for the timber.

The last autumn being in an orchard near a place where they bred up a vast number of young walnut-trees, I perceived in the middle a sort of leaf or foliage which I had never noticed before; and on examining the taste, smell, wood, and figure of the tree, persuaded me that it was a walnut-tree, and one that I had never read or heard of.

The common walnut-tree bears its leaves by pairs, on a stalk which terminates with a like leaf, commonly larger than the rest: And it has very seldom above three pairs on each stalk. But this has sometimes four or five pairs, and sometimes more, which are sometimes opposite, other times alternate. The first pair, and sometimes the second, are less cut than the rest, being so only on the circumference: but the others are cut so deep, that it looks as if the nerve in the middle of the leaf was only a stalk. And the cuts of the leaves are sometimes by pairs, sometimes single on one side. These leaves are sometimes forked at the end, and sometimes end with a point. There are also some places, where it looks as if the leaf was torn on purpose, almost like the angelica canadensis, foliis quasi præmorsis. There are others, where it seems that they are double, as if the stalk or the nerve was winged, just as the winged stems or trunks or caules alati.

On the Asbestus, and the Manner of spinning and making an incombustible Cloth of it. By Signior John Ciampini of Rome. N° 273, p. 911.

Sig. Ciampini mentions four sorts of the asbestus stone, of which he has specimens in his museum. The first was sent him from Corsica or Corfu, which was of a woody form, of half a palm length and more, of a pinkish colour. The second sort is of a silver colour, softer, about 3 inches long, and was brought from Sestri di Ponente in Liguria. The third, which is the worst of all, resembles scales or laminæ, one upon another, like an onion, of a blackish earth colour, with some white, black, and dark red veins interspersed, scarcely two parts of a Roman inch long, and therefore is fitter for making paper than for spinning and weaving. The fourth sort was given him by Signior Boccone, and found in the Pyrenees, some of which was a Roman palm long; its filaments though longer, were yet thicker and rougher; he says also that he heard of another sort in Montibus Volateranis.

Then quoting some passages out of Pliny, Dioscorides, and other authors, that have mentioned this stone, and the cloth made of it, he touches upon its supposed uses for the wicks of sepulchral lamps, and from some experiments he concludes it unfit for that purpose, having always found the wicks made of it to go out, and not attract or continue up the oil for the flame. Next he says he kept it for 3 weeks in a glass-house fire, but found it unaltered: though it would not preserve a stick wrapt in it from the fire: whence he concludes that the amianthus loses nothing in the fire, because it does not burn or flame; but in the handling it wastes, though not much, as he found by an exact balance. Lastly, he proceeds to show the manner of spinning it, which he tried thus: first he laid the stone in water (if warm the better) for some time to soak; then it is opened, and divided with the hands, that the earthy parts may fall out of it, which are whitish like chalk, and hold the thready parts together; this makes the water thick and milky; this is repeated six or seven times with fresh water, where it is again opened and squeezed, till all the heterogeneous parts are washed out, and then the flax-like parts are collected, and laid in a sieve to dry. After which the amianthus is placed between two cards, such as wool is carded with, so that some of it may hang out of the sides; then lay the cards fast upon a table or bench; take a small reel, made with a little hook at the end, and a part to turn it by, so that it may easily be turned round, which reel is to be wound over with fine thread; then having a small vessel of oil ready, with which the fore-finger and thumb are constantly to be kept wet, both to preserve the skin from the corrosive quality of the stone, and to render its filaments more soft and pliant; thus by twisting the thread about upon the reel, with the asbestus hanging out of the cards, some of it will be worked up together with it; by little and little, this thread may with care be woven into a coarse sort of cloth, and by putting it into the fire the thread and oil will be burnt away, and the incombustible cloth remain. But finding this way of uniting the stone with the thread very tedious, instead of the thread he put some flax upon a distaff; and by taking 3 or 4 filaments of the asbestus, and mixing them with the flax, he found they might easily be twisted together, and the thread thus made much more durable and strong; so that there is no need of carding, which rather breaks the filaments than does any good; only, after washing, open and separate the filaments, upon a table, and take them up with the flax, which is sufficient.

As to the making of paper, he says in the washing the stone, there will remain several short pieces in the bottom of the water, and of these after the common method paper may be made.

He concludes with the best way of preserving the cloth, for by reason of its dryness it is apt to break and waste; this is by keeping it always well oiled, and when the cloth is put in the fire the oil burns off, and the cloth comes out white and purified.

Of his four sorts of amianthus, he found that from Corsica the best, being long and soft; and the Cyprian sort the worst.

An Account of Books.—1. *Jac. Gaveti Academ. Monspel. Alumni Avenionensis Doct. Medici et apud Camberienses Practici Nova Febris Idæa, ceu Conjecturæ Physicæ circa Febris Naturam. Genevæ,* 1700, *8vo.* N° 273, p. 914.

An attempt to explain the action of the heart and arteries, and the nature of fever, upon mathematical principles.

D. Dominici Sanguineti Appuli Dissertationes Iatrophysicæ Neapoli, 1699. N° 273, p. 918.

Of some large Bones found in a Gravel-pit near Colchester. By Mr. John Luffkin. N° 274, p. 924.

In digging for gravel at Wrabness, a small village in the most eastern part of Essex, on the River Stowe, near Harwich, were found divers bones of an extraordinary size, at 15 or 16 feet beneath the surface of the earth.

We read in Camden, p. 351, that in the time of King Richard II. and in the reign of Queen Elizabeth, there were found in the most eastern promontory of Essex, at a place called Odulfiness, which I take to be Walton, large teeth and bones of an extraordinary bulk, which were accounted the bones of giants. But Mr. Childrey, in his Britannia Baconica, p. 100, rather thinks them to be the bones and teeth of some elephant buried there by the Romans. That they are so is my opinion; first, because they far surpass in magnitude the bones, &c. of the largest animals we have now in our island. 2dly, Because it is evident, from Dion Cassius, as quoted by Mr. Camden, in his Britannia, p. 347, that abundance of elephants were brought over into England by the Emperor Claudius, in his wars with the Britains; even into Essex itself, as appears from the same Dion, a little after in these words; Claudius having at last joined Plautius, and taken the command of the army, passed the River (Thames), and upon a fair engagement with the enemy, who were posted there to receive him, obtained the victory, took Camolodunum, &c. 3dly, In comparing this bone with the osteology of Dr. Mullins in his anatomical account of the elephant burnt at Dublin, &c. I find it perfectly to agree with its os humeri, not only as to outward appearance, but to measure also; whence we may conclude, that these were the bones, &c. of some elephant, rather than of any other animal.

And it seems to me also, that those teeth and bones mentioned by Mr. Somner, N° 271, might have been the teeth and bones of some elephant, rather than of the hippopotamus: and that, 1st, in respect to the place; for, as Mr. Camden says in his Britannia, p. 197, speaking of Chilham in Kent, of which this Chartham is a neighbouring village, in the same down, and on the same River Stowre, that it is a current report among the inhabitants that Julius Cæsar encamped there, in his second expedition against the Britains; and thence it was called Julham, as if one should say, Julius's station or house. It appears further, Britan. p. 208, that Rhatupiæ, near the present Sandwich, was the place of Claudius's landing in Britain; and that through this down was his nearest way to the Thames, whither he was going. So that it is highly probable, that during the stay, the passing, or repassing of these Roman armies, through these downs, one of their elephants might die, and be buried there. 2dly, By the teeth themselves, compared with the descriptions of Dr. Mullins, Anatomy, p. 40, you find them the very same as to breadth and depth, &c. and their being molares. 3dly, and lastly, to solve that great difficulty, which obliged Mr. Somner to imagine this down to have been an æstuary, that his hippopotamus might therein dig itself a grave; otherwise, says he, how should these bones be found at such a depth? for who with reason can imagine that any land animal could ever have had at first so deep a burial? But it is easily explained why these bones should now be found at such depths, if we consider the alteration or rising of the valleys, by the continual washing down of the loose earth or soil, by the rains and snows, from the adjacent hills, and by the annual rollings of the grass, sedge, &c. growing upon it: for proof of which, take the following instance, from Dr. Plot's Nat. Hist. of Staffordshire, chap. vi. pp. 48, 220, speaking of a moss, &c. wherein was found a parcel of coins of Edward IV. of England (supposed to be lost in a purse or cloth, now rotten away) at 18 feet deep, which being about 200 years since, by computation this moss grew about one foot in 11 years, or one inch per annum and nearly $\frac{1}{12}$th. Divers other instances of alteration are mentioned in the same history. Now it will be easily granted, that if this moss grew or advanced itself above its former surface 18 feet in 200 years, then this vale or down might be raised 17 feet in almost 1700 years.

A Description of some Shells found on the Molucca Islands; as also an Account of Mr. Sam. Brown's Fourth Book of East India Plants, with their Names, Virtues, &c. By James Petiver, Apothecary, and F. R. S. N° 273, p. 927.

These shells it seems were brought from the Molucca Islands, by Mr. Sylvanus Landon and Mr. Rowleston Jacobs. They are 24 in number.

After the description of them follows an enumeration of 41 more East Indian plants gathered at Perre-pollum, and Eremita-pollum in April 1696, by Mr. Brown, with the synonyms of Bauhin, Ray, and others, added to the Malabar names by Mr. Petiver.

An Account of the strange Effects of the Indian Varnish. Written by Dr. Joseph del Papa, Physician to the Cardinal de Medicis, at the Desire of the Great Duke of Tuscany. Communicated by Dr. William Sherard. N° 273, p. 947.

The using and handling of the Indian varnish or lacker, so far as is necessary to apply or lay it on subjects to be varnished, having produced such extraordinary effects on Signior Ignatio, and more remarkably on his maid servant, viz. great swellings of their heads and eyes, and in their arms, and indeed almost their whole body, with an intolerable itching, inflammation, and pimples, is so new and extraordinary a phenomenon in nature, as exacts our wonder, and may well excite our curiosity to search out the reason; and the rather, that among the numerous ingredients of the materia medica, and all other natural substances known to us, there is not one that produces an alteration equal or similar to what this does in human bodies. All our liquors and corrosive spirits affect only the parts of the body where they immediately touch, and diffuse not their mischievous qualities over the whole body, as this varnish does. Poisonous fumes or steams from mercury, or antimony, manifest their malignancy on the brain and nerves, by great and incurable evils: whereas the effluvia and touch of this varnish affect only the external skin of the body, and though in a very strange manner, yet not destructive of the part affected, which recovers again by itself. There are indeed some juices of roots and herbs, and other parts of vegetables, which by touching our flesh either inflame or ulcerate it, or produce swellings, pustules, and itchings; but all these cause the disorder only where they touch, and do not spread their invisible venom over other parts of the body. In short, I know not an instance of any one thing, which either touched with the hand, or insinuating itself by its fumes into our body, is able to produce almost over the whole skin, inflammations, swellings, itching, and pustules, as if the whole body were stung with an infinite number of wasps, or gad-bees, for such exactly are the effects produced by this varnish.

The great difference between this and all things else, and the ingredients of which it is made being absolutely unknown, render it impossible to penetrate into the cause of the above-mentioned effects. Yet it may be proposed as a probable conjecture, that this varnish contains some ingredient, which when hot sends into the body a subtile vapour, which only affects the skin, leaving the other parts of the body untouched; after the same manner, cantharides, not only taken inwardly, but also outwardly applied, communicate a venomous quality of a particular nature, affecting only the kidneys, bladder, and urinary passages, causing sensible pains and excoriations, without in the least affecting the other viscera. Some physicians are of opinion, that this particular disagreement of cantharides with the urinary ducts, arises from the salt and nitre contained in the urine, which gives vigour to the poison of the cantharides. So after the same manner, it may be said, that the noxious fumes of the varnish become hurtful to the skin, because they mix there with some juice they meet with in the skin itself, especially in the miliary glands, of which the whole skin is full. It is certain that this varnish exerts all its malignancy against the skin, the viscera and blood being untouched: besides, I observed that the maid (at the same time that almost her whole skin was hard, inflamed, swelled, and full of pustules) had yet no fever, no pain in the head, nor any inward illness; and as to what disorders Signior Ignatio or she felt in their eyes, this was a swelling affecting the eye-lids only, which may be reckoned but as skins: but possibly the ill effects of the varnish were more sensible and troublesome in that part, because the skin there is thinner than on the rest of the body. This varnish therefore is only an enemy to the skin; and that this mischief should attend it, it is not necessary that the varnish should be heated; for when cold it emits the same steams which insinuate themselves into the body, especially when touched and handled.

I have several times spread a great deal of this varnish hot upon the naked skin of poultry, and they never received any hurt from it, either internal or external. I have caused other fowls to swallow crumbs of bread sopped in the varnish, and they seemed to like it very well. Others I have pricked in their breast till the blood came, and then anointed it all over with varnish, which instead of hurting them proved a balsam to heal them. It is possible this varnish on the very thin skin of fowls does not produce the same effects, as on that of men, because they are very different from each other, both in their structure and in the quality of the humours contained in them. And to say something of its substance; I have observed that this varnish is in a great part composed of a gummy and unctuous matter; for it is very light, swimming on brandy and oil, and not uniting either with water or spirit of wine, or any other liquor, except oil alone; and besides it burns or takes fire, for I have dipped cotton in it, which has burned all away to ashes, though at first there was some difficulty to make it take fire; owing perhaps to some other matter not unctuous being mixed with it. And lastly, since, being observed with the microscope, its composition shows like that of oil or lard, or the like unctuous matter, it is very probable from all these, that it is composed of the gum or juice of some resinous herb or tree, or of the fat of some animal, or hog's lard. And, to make some guess, possibly the gall of some animal may be mixed with it, to make it the more easily receive a smoothness and lustre, as limners use to put gall into their water-colours, to make them run and spread the better; and that the mischief, found by touching and using it, may proceed from hence.

I believe there is no mercury in this varnish; not only because it is very light, but because I have been very diligent in trying whether gold would discover any sign of mercury, either in the body of it or the smoke, but could never find any; and besides, mercury produces very different effects in our bodies from those of this varnish.

I have observed that the varnish mixed with spirit of vitriol, juice of lemons, or vinegar, or spirit of wine, makes no ebullition, nor change of colour; but it readily changes colour, when taken out of the vessel and exposed to the air, becoming at first reddish, and afterwards almost quite black; the outward skin of it, which is next to the air, becoming very hard and black; this skin is very thin, under which the rest of the varnish remains soft and fluid, of the colour and consistence of honey; and as often as you take off this outward black hard skin, there will be formed immediately another like the former, and this as often as you please to repeat the experiment. So that the whole substance of the varnish will in time be changed into these hard and black skins.

Finally, it is worth observing, that this varnish has this known power; for having spread some of it on the naked breast of some fowls, leaving it sticking there for three days, I afterwards found between the dried varnish and the flesh the place all festered, and full of a yellowish serum, but without any further harm. I have attempted the same thing in dogs and cats, but without success, for these animals with their tongues and claws soon take off all the varnish from their bodies, and so take no hurt by it. Possibly in horses, and such like animals, the experiment might succeed better if the varnish has this corrosive or caustic quality on their bodies that it has on poultry.

Observations on those Solutions and Fermentations, which may be called Cold. And of a new Thermometer, from a Discourse made by M. Geoffroy, F. R. S. to the Royal Academy of Sciences, April 21, 1700. N° 274, p. 951.

The different researches I have made into the nature and properties of salts, and the different experiments which I have tried, in examining their solutions or mixtures in certain liquors, have given me occasion to observe, that the mixture of the greatest part of the salts in several liquors is attended with a sensible coldness, notwithstanding the prompt and violent fermentations which ensue on many of these mixtures. I have distinguished these solutions or mixtures into 2 classes; the former comprehends all the simple cold solutions; that is, such as are not accompanied with any sensible fermentation; the second takes in only the cold ferments, or solutions of salts, which are attended both with a sensible fermentation, and a coldness of the liquor.

Class I. *Of Simple Cold Solutions.*—I put a pint of common water into a phial, and an ordinary thermometer of 18 inches in the water, and so let it rest for some time, to adapt itself to the temperature of the water. I afterwards put into the water 4 ounces of sal ammoniac, and in less than a quarter of an hour the liquor of the thermometer descended 2 inches and 9 lines. Observing the same circumstances, I made the same experiment with saltpetre, and the liquor of the thermometer descended 1 inch 3 lines. The same experiment being made with vitriol, the thermometer descended almost an inch. Sea-salt made the liquor descend only 2 lines. All the alkali volatile salts cooled the common water by their mixture, causing the thermometer to descend by some lines: but I observed that they caused it to do so, more or less, according as they were more or less purified; and the salt of urine seemed to do so soonest of all. As for the alkaline lixivious salts, they were so far from cooling the water, that they heated it, more or less, according as they were more or less calcined.

On the whole, we may observe, that the salts for heating the water, ought to be purely alkaline; for if they approach near the nature of nitre or sea-salt, they heat the water but a little, or not at all, if they do not rather cool it. This is also done very considerably by the salt of tamarisc, extracted from the lixivium of the ashes of this vegetable. Sal ammoniac mingled with the acids of vegetables, as distilled vinegar, juice of lemons or verjuice, gave no signs of fermentation, but cooled these liquors very much. An ounce of sal ammoniac, cast into 4 or 5 ounces of distilled vinegar, causes the thermometer to descend 2 inches 3 lines. The same salt mixed with the juice of lemons, caused it to descend 2 inches. And it does the same with verjuice.

Class II. *Of Cold Fermentations.*—Saltpetre, cast into its acid spirit, raised some smoke, or vapours, and caused the liquor of the thermometer to descend 4 lines. From saltpetre, mixed with spirit of vitriol, smoke exhaled in great quantity, and caused the liquor to descend from 6 to 7 lines. In these two experiments I put half an ounce of salt upon 3 ounces of liquor. I put half an ounce of sal ammoniac into 3 ounces of spirit of nitre, and the thermometer descended 2 inches 5 lines. This mixture emitted some vapours, which seemed more considerable than those which usually exhale from spirit of nitre alone. I poured half an ounce of sal ammoniac into 3 ounces of spirit of vitriol, which made a violent fermentation. The matter was considerably raised, and much vapour emitted; the liquor was very thick, and the thermometer descended 3 inches 6 lines. I observed, that the vapours which were raised by this mixture were hot, and that they considerably raised the thermometer, which I held hanging over the matter, though that which was dipped in it descended, and shewed a very great cold.* Sea-salt mixed with acid spirits, heats the liquors, instead of cooling them. Being mixed with spirit of salt, it raised the thermometer some lines, without showing any sensible fermentation. With oil of vitriol it ferments with a noise, and raises a great smoke: the liquor thickens, and becomes a sort of a clear jelly. The thermometer rises very much in this mixture, and the heat is sensible to the touch. All the volatile alkaline salts, mixed with different acid liquors, excited a fermentation, more or less strong, according to the acidity of the liquors, and the purification of these salts from their fetid oils. They all made the thermometer descend: but that which did so the most considerably, is the salt of urine. One ounce of volatile salt of urine, very well rectified, in 4 ounces of distilled vinegar, made a strong fermentation. The substance is elevated very much, and with noise; and the thermometer descends in the fermentation one inch 9 lines. One ounce of volatile salt of urine, in 3 ounces of spirit of vitriol, raised a violent fermentation, during which the thermometer descended 2 inches 4 lines. The mixture of salt of tartar, or other fixed alkaline pure salts, with acid liquors, excited fermentations with heat. I made all these experiments with the same thermometer, when the weather was sufficiently cold, and the temperature of the air equal enough.

As to the reason of these experiments, I first of all examined the simple cold solutions; and having, with all philosophers, fixed this principle, that cold is no-

* Much greater degrees of cold than those here mentioned may be produced by employing other saline substances; such as sulphate of soda and diluted sulphuric acid; sulphate of soda and muriatic acid; phosphate of soda and diluted nitric acid, &c. When snow can be procured, a mixture of that with muriate of lime produces a most intense cold. See the experiments of Mr. Walker of Oxford, inserted in the Phil. Trans. for 1795 and 1801.

thing but the diminution of motion; so that the coldness which the salts bring to the water, seems to be occasioned from this, that the salt particles being without motion, and dividing that liquor, diminish it so much the more. And this is what produces the cold, more or less in the same liquor.

There is one thing to be observed, which is, that some time after the solution is made, the liquor of the thermometer rises again a little. Which may be occasioned by this, that the subtile matter which glided abundantly between the liquid particles, had ceased to glide there in the same quantity for some time, the gross particles of the salts opposing themselves against their passage; but these saline particles being divided by little and little, they opened again the passage to the subtile matter. This gave the liquor more motion than it had at the beginning of the solution; but yet less than it had when it was pure, and without mixture; the saline particles, although dissolved, abating somewhat of their motion.

We may easily comprehend why lixivious salts, purely alkaline and well calcined, as also the salt of tartar, heat the liquor, and are very far from cooling it, if we consider that these salts, in the strong calcination, which they have undergone, are impregnated with many fiery particles, which they hold, as it were in prison, in their pores. These igneous particles regain their liberty by the solution of the saline particles. And in the same time that these salts ought to slacken the motion of the aqueous particles, and cool it, the igneous particles, being very active, augment the agitation of the watery particles, till they make it very hot.

I observe next, that sal ammoniac cools the water wherein it is dissolved more than any other salt. Its cold equals that of water which is ready to freeze. And it happened once that in dissolving a good quantity of this salt in water, some drops which fell on the outside of the phial, in which I made the solution, froze, and the straw upon which the phial stood being wet, was fastened to the glass vessel for some time by the ice: and this at a time when the weather was warm.

I often tried the same experiment after in different ways, but without ever being able to produce ice. Chance had apparently made meet in this experiment, not only a very exact proportion between the salt and the water, but also a temperature in the water besides, which I suppose necessary: because, the solution being quick, the cold must also be more sudden and great: and this is that degree of temperature to which I could never afterwards attain.

The great coldness of the solution of sal ammoniac does not proceed from any difficulty it has to be dissolved, since it dissolves sooner than any other. And sea-salt, whose solution is difficult and very slow, is that which least cools its dissolvent. On the contrary, it seems that the facility and readiness with which it dissolves, may be the very cause of this great cold, in this manner.

Sal ammoniac, as every one knows, is a composition of sea-salt * and salt of urine; † the one very easy, the other very hard to dissolve; the particles of sea-salt being imprisoned among the particles of the salt of urine, it happens that many of the aqueous particles, at first penetrating the saline particles of the urine, do there immediately lose much of their motion: and this motion grows weaker by so much the more, as the aqueous particles meet afterwards with saline particles of another nature, whose resistance is much more considerable, than that of the salts of urine. So in the first instance of the solution, the motion of a great quantity of aqueous particles being very much abated all at once, by the salts of urine, and by the sea salt, it excited in a few moments a cold far greater than the cold of other solutions of salts, which water does not penetrate so readily.

It may be objected, that the sea-salt being the hardest to dissolve, its solution should also be the coldest. To which I answer, that this might be, if the water could penetrate suddenly into all its parts: but the slowness with which it penetrates them, because of the close texture of the molecules of this salt, prevents the diminution of the motion of the parts of the water from being so ready, and by consequence so great; whereas in sal ammoniac, the parts of the sea-salt being extended by the salt of urine, the pores of the alkaline salt of urine are like so many passages, open to the parts of the water, in order to penetrate the parts of the sea-salt in numberless places.

I place in the rank of cold solutions, an experiment made by M. Homberg, which serves to prove what I am going to say about the cold of sal ammoniac. It is made thus: Take a pound of corrosive sublimate, and a pound of sal ammoniac, and powder them each apart; then mix both the powders very exactly; put the mixture into a phial, pouring upon it a pint and half of distilled vinegar, shaking it well together. This composition will be so very cold, that a man can hardly hold the vessel in his hands in summer. And it happened as M. Homberg was making this mixture, that the mixture froze. In this experiment we see a cold still greater than that in the solution of sal ammoniac alone in common water. And this cold is caused by the corrosive sublimate, which alone is not at all, or at least very little soluble in distilled vinegar. So that the fluid parts of the distilled vinegar having quickly penetrated the parts of the sal ammoniac, and having already lost a great deal of their motion, engaging afterwards in the pores of a body which they could not dissolve, and having action not more than

* Of the acid of sea-salt. † By salt of urine (i. e. of putrid urine) the author here means vol. alkali.

enough for that, they there lose that little activity which they had, and coagulate, if not all, at least the greatest part: and this want of action is the cause of that great cold which we perceive there.

Hitherto, I have only considered simple cold solutions of salts, in which there is no augmentation of a sensible motion; let us now pass to the solutions of the second class, which are the cold fermentations, in which the cold appears as a consequence of the agitation of the parts of the liquor. In order to show the reason of cold fermentations, I own that heat and cold in liquors are neither more nor less than motion in the little parts of these liquors, caused by the continual current of the subtile matter in their intermediate spaces. And I affirm, that every time this motion is diminished, and when the course of the subtile matter is interrupted, the liquor appears less hot, or more cold. This being supposed, if we attend to what happens in cold fermentations, we shall observe on the one hand, for the most part, very considerable coagulations, and a very sensible thickening of the liquors; on the other hand, we shall perceive a very violent agitation of some of the parts of these mixtures: Many vapours are exhaled, the matter swells, emits many bubbles, and ferments with noise. And thus I conceive all these effects are produced.

In the mixture which I made of salts with acid liquors, the greatest part of the liquor coagulating with a part of the salts, its motion was much abated in a little time; but its parts not being able to coagulate, without stopping or weakening the current of the subtile matter, this matter finding the passages shut up, takes its course by the interstices, which remained between the coagulated particles, where the passage was yet free; and as it glided away in a quantity together, it caused a very considerable agitation in the parts it met with in its passage; which agitation produces the fermentation we perceive, raises bubbles of air and smoke, and swells the matter with so much the more violence, that all the parts of the liquor, being almost half coagulated, hinder the motion and agitation of these little particles. Nevertheless this agitation, how violent soever it may appear, is not considerable enough to break the coagulum entirely, which is formed in the liquor, nor consequently to overcome the cold, which causes this coagulation. All it can do, is to preserve still some kind of fluidity. In short, the more these mixtures are disposed to coagulate, the more they excite the cold. This we may see in the mixture of sal ammoniac with oil of vitriol, in which the coagulum becomes so strong, that at last, it forms above the liquor a very thick saline crust. In the mixture of other salts with weaker acids, as in the mixture of volatile salts with spirit of vinegar, the coagulum can hardly be perceived; nor is the cold so considerable as in the former.

I add further, that even the violent agitation which this mixture causes, not being universal, and reaching no further than some few places in the liquor, it may yet contribute to the great cold in the mixture of sal ammoniac and oil of vitriol, in increasing the coagulum, so that the little particles which are violently agitated in this mixture, not being able to carry along with them in their motion the coagulated parts, which are too gross, they drive them away from their centre of motion: So that the almost half coagulated particles, being got among these little whirl-pools, and pressed against each other, they stick close together, coagulate more strongly, and lose their motion entirely; which causes a very great cold. And that the violent agitation in some parts of the mixture contributes to its coldness, appears by the following experiment.

I put some cold water into a large basin, and into the middle of it a glass cucurbit full of water, equally cold; and into the cucurbit I put a very good thermometer, which I let lie a good while for a trial. When it was adjusted to a degree proportionable to the cold of the water, I threw suddenly into the water in the basin four or five shovels full of coals, well kindled; and in an instant the liquor of the thermometer descended 2 or 3 lines. After some moments the liquor rose again, when the heat of the water in the basin was communicated to the glass cucurbit. Now the cold of the water in the cucurbit cannot be attributed to any thing but the pressure or sudden condensation, which the fire caused in the water, in which it was put. Which condensation may be explained in this manner: In the instant that the burning coals were thrown into the water, the vortex of the subtile matter, by which it was turned round, being pressed by the matter which environed it, scattered with violence all the particles of the water; which happening all at once in several places of the water in the basin, all round the glass cucurbit, the particles which environed the vessel being at once pressed on all sides, were condensed considerably and successively. The vessel being in the centre of pressure, bore all its weight, as well as that of the liquor, which contained it. And this liquor lost by its condensation very much of the motion it had before, which was considerable enough to cause the liquor of the thermometer to fall. This cold goes off quickly, because all the water in the basin being very much heated, it quickly heats also that in the glass cucurbit.

The ordinary thermometers not marking the cold of the water so readily and nicely as I wished, I had recourse to another sort of thermometer, which was more exact. It consists of a bowl or bottle of glass, which has no opening, but by a little tunnel at the end; and which descends to the bottom. This tunnel is open at both ends BC. B dips into the liquor E which is at the bottom of the bowl. Fig. 1, pl. 16. The space of the bottle of glass is filled with air, which has no communication with the exterior air. When the air contained in this space is rarefied by the exterior air which touches the bottle, it presses at the same time the liquor E, and obliges it to rise through B in the tunnel BC. On the contrary, when it condenses by the exterior cold, by not pressing the liquor E, it permits that which is in the tunnel to fall. The readiness with which the air condenses or rarefies by cold and heat, makes the effects of this thermometer much more sudden than those of any other sort. Besides, the effects of this are much greater, the air being more capable of a great rarefaction, or of a great condensation, than any other liquor.

As for the sensible heat of the vapours which rise from the mixture of sal ammoniac with oil of vitriol, it is not difficult to find the cause, if we consider that these vapours are only the most subtile and active parts of this mixture, which the subtile matter raises with itself in crossing it. The motion of these particles is free in the air; and it is only more repressed by the two gross coagulated particles. It becomes by so much the more violent, by how much it has been retained and hindered for some time; and is perceived by heat, which is the ordinary effect of rapid and violent motion.

I will relate another considerable experiment of the cold fermentation caused by the mixture of sal ammoniac and oil of vitriol. If after having made the mixture of 4 ounces of oil of vitriol, and an ounce of sal ammoniac, you throw upon it a spoonful of common water, at the time when the fermentation is strongest, the cold is greatest, and the thermometer falls with the greatest quickness, the ferment ceases, and the cold changes immediately into a great heat, and makes the liquor of the thermometer to rise very high. The reason of this experiment may be readily conceived, if we consider, that the water heating quickly and strongly by the oil of vitriol, produces here the same effect. And this heat is sufficiently great at that time to destroy the cold of the coagulated particles, the water of itself being otherwise proper to dissolve this coagulum.

It remains that I give an account why sea salt heats with different acid liquors; but as to that, we ought to inquire into the nature of this salt, which would carry us too far.

I will only say before I make an end, that I do not here pretend to enumerate exactly all the cold solutions and fermentations; I have related only the experiments which I have made upon the salts and liquors which we oftenest use, and which I thought most considerable. As to the reasons which I have given of these cold solutions and fermentations; I advance them only as conjectures, which I submit to the judgment of philosophers, who understand these matters better than I do.*

* The reasons or explanations here given of the chemical phenomena mentioned in this paper, are of no sort of value; but they could not well be separated from the experiments themselves.

Concerning an unusual Colic. By Dr. Davies. N° 275, p. 965.

A person, aged between 50 and 60, had been for 3 or 4 years troubled with gripes, which generally returned about once a month; his body being for the most part costive, he was obliged to spur nature with Daffy's Elixir or aloes, and sometimes a pipe of tobacco supplied the use of these medicines. Having overheated himself in a walk, he had a return of his colic pains, which continued upon him for 18 days, notwithstanding the methods commonly used in such cases, during which time he had no stool, except what the first and second clysters brought away. He complained upon his seizure of a pain in his right side, in the iliac region. Some time before he died, his belly swelled much, and was as tense as a drum. At first he vomited for 2 or 3 days; which left him, and did not return till just before he died, which was at the expiration of the 18th day, at which time he brought up 2 or 3 mouthfuls of black choler; but never during his whole illness vomited any of the fæces. On opening the abdomen, some black choler was found in the stomach; the duodenum, and the rest of the intestina tenuia were void of fæces, but greatly inflated with wind; and tracing the guts as far as the cæcum, found this was of a blackish colour; and from thence, for about a yard in length, the colon was so mortified, that the fæces had made their way through it at several places, into the cavity of the abdomen; about 2 inches of the mortified gut was fastened to the peritonæum on the right side. This part of the colon was much distended with fæces of a soft consistence: at the extremity of the mortification, towards the rectum, the obstruction which caused all these disorders, offered itself to view very plainly; for about 10 inches of the colon was doubled, as if you had taken a piece of tape, and folded it; the two contiguous surfaces of the duplicature adhered so firmly together, that they could not be separated, without tearing the external coat of the intestine. On separating this coalescence, there fell from that part a whitish mucus. The adhesion was about 3 inches broad; the middle of the duplicature, which made an acute angle, and where the fæces stopped, was smaller, and the membranes thinner, than in any other part of the gut; from whence towards the rectum, the colon was sound, and void of fæces, occasioned by the frequent use of clysters.

On the Isthmus, or Neck of Land, which is supposed to have joined England and France in former Times, where now is the Passage between Dover and Calais. By Dr. John Wallis. N° 275, p. 967.

Mr. Somner, No. 272, is of opinion with Mr. Camden, and other antiquaries, that France and England were anciently joined by an isthmus, or neck of land, where now is the narrow passage between Dover and Calais; which, many ages since, was by the violent beating of the sea on both sides worn away, or broken through.

In support of which opinion I may add one argument more, of which Mr. Camden takes no notice, viz. from the unity of language between the ancient Gauls and Britons, and from the great intercourse between the Druids in Gaul and those in Brittany; which is not likely to have been the case, if there had not been an easy communication between them.

I think it not amiss to enforce Mr. Somner's arguments by considering what must have happened if this hypothesis be true, and how it agrees with what we see. 1. If such an isthmus had once existed, then the great seas on both sides must have continually beaten upon it, with a fierce impetuous tide, twice in 24 hours, viz. the northern sea between us and Holland, called the German Ocean, on the eastern side: and the western sea, between us and France, called the British Ocean, on the western side; which in process of time may well be supposed likely enough to wear away, or break through a narrow isthmus. The western tide coming in fiercely between us and France, and fretting on the coast on both sides, must needs be supposed to bring with it a great deal of earth, sand, or mud; but being stopped in its current by this isthmus, did not deposit it, as might be thought, on its side, which might strengthen it, but found an opportunity of discharging itself on the spacious level of Romney-marsh, fretting that isthmus as it came along: and then, at about the tide's recess, letting it fall on that level, and lodging it there; but then again fretting that isthmus and the coast all along, as the tide returned with a like force as it came in. Which gives us a fair account, both how that isthmus might be washed away, and how that level might be raised to the height it is now at. For no man can doubt, who well knows the situation of the place and the nature of the soil, but that all that level had heretofore been sea. And, even at this day, it lies so much lower than the surface of the sea at high water, that much of it would be overflowed every tide, if not defended by Dim-church wall for many miles together. Whether it had a like opportunity of such an in-draught, and in what proportion on the French coast, I cannot tell; but that this is the condition of Romney-marsh no man doubts.

The northern sea, between us and Holland, must in like manner have beat on the east side of the isthmus with a like impetuous tide, twice in 24 hours. But, being there stopped in its course, would have the like opportunity of discharging itself on the coast of Holland, as the western sea did on Romney-marsh. Whence it is that Holland and Zealand, which by all is judged to have been once sea, is now raised 30 or 40 feet higher than it had once been. And the same northern sea, which on this account has so large an inlet eastward on the coast of Holland, would, westward, insinuate itself likewise on the English coast, wherever it might find low grounds. Which is the case of this large valley, where now runs the river Sture, Stoure, or Esture, which name it is supposed to have taken from the corruption of Æstuarium, for more than 20 miles; entering at the low grounds near Sandwich, close by that isthmus, and running up that level, by Canterbury, Chartham, Chilham, and so on, as far as Ashford, or farther. Which valley had once been much deeper than it is now; for it seems that even at Chartham, which is now 12 miles from the sea, the ground is raised at least 17 feet; and the soil at that depth is found to be of a like condition, as where the sea is known to have been; and nearer to the sea it may well be presumed to have been yet deeper. Which is confirmed, as Mr. Somner tells us, by the relics of the marine animals found there; as also by anchors and shells of fish, found elsewhere in the borders of this valley, at a great depth under ground.

Now, that the sea may thus raise the ground on such in-draughts by sand, earth, and mud, brought in and lodged there at every tide, is not at all unlikely, for we see the same at this day, particularly in the isle of Oxney, near Romney-marsh, where was a low level, often in danger of being overflowed by the river Rother. But, somewhat more than 60 years since, the sea being let into it has raised that level very considerably, by bringing in and lodging there a considerable deal of earth and mud every tide. And it has besides so fretted the channel by which it enters and returns again, that the channel near Rye, which within my memory was so shallow near what was called Kent-bridge, that men and women used to ride through it; but now, by the tides entering and returning, that bridge is long since swallowed up, and the channel become so broad and deep, that a vessel of good burden might ride there at anchor; which is a fit resemblance of the sea's fretting this isthmus, and filling up the æstuaries on both sides of it. The like, in a good measure, is to be seen at the Dogger Sands, which is a bank of sand lying obliquely from about the coast of Norfolk towards the coast of Zealand, or north part of Holland; which is the place where the northern and western tides, since the rupture of the isthmus, do now meet, and do there, at still water, for about an hour, or at the turning of the tide, deposit the mud and sand, which by their rapid motion is brought thither both ways, and which is supposed to be the true cause of that sand bank. Whether this, in process of time, may form a new isthmus there I cannot say; but I am apt to think that the former isthmus, if the tides had stopped there, and had not found those in-draughts, on which to lodge what it washed from thence, might have continued, and been more strengthened, by what, on the return of the tides, would daily be lodged there. And on this account I think it is, that the isthmus at Corinth, though beaten on by the two seas which give it the name of Bimaris Corinthus, is not thereby destroyed; because there are not such tides to wash it away, nor such in-draughts, on which to lodge what might be washed from thence.

But the case is far otherwise with this isthmus of ours; where all circumstances concur to countenance this hypothesis. The steep cliffs at Dover and those at Calais answering directly to each other, and appearing to view, as if what between them had been violently torn away; and also the sea between them, even at this day, being much shallower at that place than on either side of it, as Camden well observes; which are strong presumptions that there had been formerly such a conjunction.

The greatest doubt in this case is, that there is no history extant, which takes notice of such an isthmus, or of such a rupture, in this place; which being a thing remarkable, might have been thought worthy to be reported. But this need not be thought very strange, since we have no particular account of the British coast (which might determine this question) older than Julius Cæsar; whereas this might have happened many hundred years before that time, when, though the island might be known to the Greeks or Romans, yet not its particular coastings. And further, Plato tells a story (as of a thing which had happened some ages before his time, and which at that time was in a manner generally forgotten) of an island somewhere in the Atlantic Ocean, which by a deluge and earthquake in the space of a night and day was destroyed and swallowed up by the sea, by which that sea, formerly navigable, was for some time become dangerous, by reason of the mud and relics of that absorbed island. Which seems very applicable to the rupture of this isthmus; by which this island was not indeed wholly destroyed, but was broken off from the continent to which it was before united. And on such an accident the sea must needs be disturbed, and put out of its course, and rendered unsafe for passage, before it came to be settled again. For though the first breach might be made in the space of one night and day, we cannot suppose the whole bulk of it, when once broken, was presently carried quite away; but first the top or upper part of it in a day and night's time, and afterwards the lower parts of it by degrees. Which would render that sea, if not quite impassable, at least troublesome and unsafe. And if in some circumstance this narration happen to differ from the matter of fact, as calling the rupture of this isthmus the submersion of an island, this must be allowed in the narrative of an old tradition from hand to hand, for as such it is there brought in. Plato introduces Critias, then an old man, telling a story, which, when a boy 10 years old, he had heard from his grandfather, who was 90 years of age, of what Solon, long since dead, had told him; namely, that an Egyptian priest had, long before, told Solon, that it appeared from some old Egyptian records, of which the Greeks had no knowledge, that such a thing had happened, in an age so long before, as in comparison of which the Greeks were but as children. And all this tradition, through so many hands, and at such great intervals of time, is, at every step, reported from the relator's present memory. And it is very possible, that some one or other of these relators might so far mistake or misremember as to call that a dissolution or disappearance of an island, which was only a tearing of it from the continent.

It serves however to the present purpose, if at least so much of the story be true, that long before Plato's time, there had been some such dissolution or rupture of an isle or isthmus, somewhere in the Atlantic Ocean, that is, in the northern sea, of which there were some symptoms yet remaining in Plato's time. For, this being admitted, it is as applicable to the present case as to any we know, of which there are so many symptoms yet remaining to this day.

Further, Mr. Somner tells us, that this æstuary from Sandwich to Ashford, might perhaps flow so much further, as to meet with that æstuary on Romney-marsh, and both conjoined together become one level. There is, I think, about 3 or 4 miles distance, between Ashford and the nearest part of Romney-marsh. And if it be admitted, that the two æstuaries of Stoure and Romney-marsh in former times did thus meet, this opens a new scheme, of which before we were not aware; for then we must say, that the two tides from the north and west, which now meet at the Dogger Sands, did then meet at the confluence of these two æstuaries; and then, as before said of the Dogger Sands, bringing on both sides earth, mud, and sand, to this place, and lodging it there, might first form an isthmus there, and by degrees fill up those æstuaries on both sides; mean while, washing away that isthmus between Dover and Calais, and opening a new passage, as now it is.

There are many other æstuaries in England, where the sea now enters a great way into the land; and how far it might have entered further in former times, cannot be known: as that sea near Bristol, between Wales and Cornwall; that of the Humber, between Yorkshire and Lincolnshire; and we may reasonably suppose that the washes and the fens in Lincolnshire may heretofore have been sea, or overflowed by the sea at high tides; and that of the Thames between Kent and Essex, which now flows above London and Brentford, within a mile of Kingston, at spring tides; it may perhaps seem too daring to think that it may formerly have flowed as far as Oxford, between Shotover hill and

Foxcomb Hill, and so on towards Wallingford, in the time of the Romans called Galena. But there is this to countenance it, that there are frequently found, in the stone-quarries and gravel-pits about Oxford, fish shells, and even the bodies of fish petrified, at great depths under ground. And there have no doubt been, and now are in England, many other æstuaries, creeks, or arms of the sea, entering a great way within land, some of which may in a manner be filled up, and become firm land; others much narrower, shallower, and shorter, than in former times. For it is the nature of æstuaries, where the tides flow in, to leave behind them, at their return, a deal of mud, ouse, or sleech, which in time becomes firm land.

Moreover, at Hythe in Kent, which is one of the Cinque Ports, there was formerly a convenient harbour for small vessels; which is now swarved up. Several attempts have been made to recover the harbour, but with little success. For when, with great labour and charge, they have in some measure opened it, it has soon been filled up again, by what the sea throws up. And whoever considers the vast quantity of beach, that is, a vast multitude of small loose stones and fish shells, cast up by the sea at Hythe, Lyd, and elsewhere on the coast of Romney-Marsh, for several miles in length and breadth, and to a great depth, will not think it strange, that a creek or æstuary should come in time to be filled up, and become firm land. And in many places of this beachy ground, where, within the memory of persons now living, nothing was to be seen but such loose stones and shells to a great depth, it comes by degrees to be covered with earth, and becomes pasture ground. On the contrary, that what was formerly firm-land, might be so destroyed, or washed away, as to become sea, is evident from the Goodwin-sands, on the coast of Kent, which are said to have been the lands of Earl Goodwin; but lost by an inundation about the time that Tenterden steeple was built, which gave occasion to that ironical Proverb of things contemporary, that Tenterden steeple was the cause of Goodwin sands. The occasion of such different effects, depending on the different situation of the shores, and the setting of the tides, so as to wash off from one place what it lodges on another.

And many such alterations have no doubt happened on the face of the earth, all the world over, of which we have no particular histories. For the world was of a great age, before the writing of any histories, except the Bible, as far as we know. And who knows, but that in former ages, even amidst the alps, there may have been large lakes, which in process of time, by earthquakes or other accidents, may have been drained of their water, and become fruitful valleys: of which it is said many symptoms have been discovered, even among the alps, in later ages. And something of the like nature it is known, has happened in Jamaica, in Sicily, and other places.

Concerning Trees found under Ground in Hatfield Chace. By the Rev. Mr. Abraham De la Pryme. N° 275, p. 980.

The famous levels of Hatfield Chace in Yorkshire were the largest chace of red deer that King Charles the first had in all England, containing in all above 180,000 acres of land, about half of which was yearly drowned by vast quantities of water. This being sold to one Sir Cornelius Vermuiden, a Dutchman, he at length effectually dischased, drained, and reduced it to constant arable and pasture grounds, and at the immense labour and expence of above 400,000l. In the soil of all, or most of the said 180,000 acres of land, of which 90,000 were drained, even in the bottom of the river Ouse, and in the bottom of the adventitious soil of all Marshland, and round about by the skirts of the Lincolnshire Woulds unto Gainsburg, Bautry, Doncaster, Baln, Snaith, and Holden, are found vast multitudes of the roots and trunks of trees of all sizes, great and small, and of most of the sorts that this island either formerly did, or that at present it does produce; as firs, oaks, birch, beech, yew, thorn, willow, ash, &c. the roots of all or most of which, stand in the soil in their natural position, as thick as ever they could grow, as the trunks of most of them lye by their proper roots. Most of the large trees lie along about a yard from their roots (to which they evidently belonged, both by their situation, and the sameness of the wood) with their tops commonly north-east; though indeed the smaller trees lie almost every way, across the former, some over, and others under them; a 3d part of all being pitch trees, or firs, some of which are 30 yards in length and upwards, and sold for masts and keels for ships. Oaks have been found of 20, 30, and 35 yards long, yet wanting many yards at the small end; some of which have been sold for 4, 8, 10 and 15l. a piece; they are as black as ebony, and very durable in any service they are put to. As for the ashes, it is commonly observed, that the constituent parts of their texture are so dissolved, that they become as soft as earth, and are commonly cut in pieces by the workmen's spades, which, as soon as flung up into the open air, crumble into dust; but all the rest, even the willows themselves, which are softer than ash, preserve their substance and texture entire to this day. I have seen some fir trees, that as they have laid all along, after they were fallen, have shot up large branches from their sides, which have grown up to the bulk and height of considerable trees.

It is very observable, and manifestly evident, that many of those trees of all sorts have been burnt, but especially the pitch or fir trees, some quite through, and some all on a side; some have been found chopped and squared, some bored through, others half split with large wooden wedges and stones in them, and broken axe-heads, somewhat like sacrificing axes in shape, and all this in such places, and at such depths, as could never be opened, since the destruction of this forest, till the time of the drainage. Near a large root in the parish of Hatfield, was found 8 or 9 coins of some of the Roman emperors, but exceedingly consumed and defaced with time; and it is very observable, that on the confines of this low country, between Burningham and Brumby in Lincolnshire, are several great hills of loose sand, under which, as they are yearly worn and blown away, are discovered many roots of large firs, with the marks of the axe as fresh upon them, as if they had but been cut down only a few weeks; as I have often with pleasure seen.

Hazel nuts and acorns have frequently been found at the bottom of the soil of those levels and moors, and whole bushels of fir-tree apples, or cones, in large quantities together: and at the very bottom of a new river or drain, (almost 100 yards wide, and 4 or 5 miles long,) were found old trees squared and cut, rails, stoops, bars, old links of chains, horse-heads, an old axe, somewhat like a battle axe, two or three coins of the emperor Vespasian, one of which I have seen in the hands of Mr. Cornelius Lee of Hatfield, with the emperor's head on one side, and a spread eagle on the other: but what is more remarkable is, that the very ground at the bottom of the river was found in some places to lie in ridges and furrows, thereby showing that it had been ploughed and tilled in former days.

My friend, Mr. Edward Canby of this town, told me that about 50 years ago, under a great tree in this parish was found an old fashioned knife, with a haft of a very hard black sort of wood, which had a cap of copper or brass on the one end, and a hoop of the same metal on the other end, where the blade went into it. He also found an oak tree within his moors, 40 yards long, 4 yards diametrically thick at the great end, 3 yards and a foot in the middle, and 2 yards over at the small end; so that by moderate computation, the tree seems to have been as long again. At another time he found a fir-tree, 36 yards long, besides its computed length, which might well be 15 yards more. So that there has been exceedingly great trees in these levels; and what is also very strange, about 50 years ago, at the very bottom of a turf-pit, there was found a man lying at his length, with his head upon his arm, as in a common posture of sleep, whose skin being tanned as it were by the moor-water, preserved his shape entire, but within, his flesh, and most of his bones were consumed.

To illustrate and render more intelligible this strange subject of subterraneous trees, we may here advert a little to what has been observed in other places and countries. Cambden and others have told us, and it is a very common and well known thing, that most of the great morasses, mosses, fens, and bogs, in Somersetshire, Cheshire, Lancashire, Westmoreland, Yorkshire, Staffordshire, Lincolnshire, and other counties in England, are full of the roots and trunks of large trees, most of which are pitch or fir, and that they have the same positions and impressions of the fire and axe on them, as those above-mentioned.

Giraldus Cambrensis tells us, that in King Henry the 2d's days, by the force of extraordinary storms, the sands were so much driven off the sea-shore in Pembrokeshire, that under them were discovered great numbers of roots and trunks of trees in their natural positions, with the strokes of the axe as fresh upon them, as if they had been cut down only yesterday, with a very black earth, and some blocks like ebony. And the like were discovered also at Neugall, in the same county, in 1590, and in Cardiganshire, and in other places since.

Dr. Plot mentions the like roots and trees, found in Shebben-Pool, the old Pewit-Pool, and at Layton, and other places in Staffordshire; and from their natural situations he rightly concludes, that they certainly grew there.

Dr. Leigh, in his History of Cheshire, observes, that in draining Martin Meer, there was found multitudes of the roots and trunks of large pitch trees, in their natural positions, with great quantities of their cones, and 8 canoes, such as the old Britons sailed in; and in another moor was found a brass kettle, beads of amber, a small mill-stone, the whole head of a Hippopotamus, and human bodies entire and uncorrupted, as to outward appearance. Many places too of the soil of Anglesea and Man, as also of the bogs of Ireland, are likewise full of roots and trees.

As to other countries, Verstegan tells us, that in many places of the moors and morasses of the Netherlands, large fir-trees are commonly found, with their tops lying to the north east, just as they do in the levels of Hatfield chase. And Helmont mentions the Peel there, a moss more than 9 miles broad. Also M. De la Fer says, that trees and roots are also frequently found in the low grounds; and in the levels and morasses of France, Switzerland, and Savoy. And lastly, Rammazzini assures us, that in the territories of Modena, which are several miles long and broad, and at present a most fruitful dry country, though in the time of the Cæsars it was nothing but a great lake, are found at 30, 40, and 50 feet deep, the soil of a low marshy country, full of sedge, reeds, shrubs, roots, trees, nuts, ears of corn, leaves of trees, branches and boughs of oaks, elms, wallnuts, ashes, willows, and the very trees themselves, some broken, some whole, some standing upright, some lying at their length, &c. with old coins of the Roman emperors, old marbles and stones squared, cut, carved, and wrought with the hands of men, &c.

But now, seeing that we find roots and trees, with other things that are common to these levels, not only there, but also in other countries, it yet remains to inquire, how all this comes to pass, and what reasons and causes can be given for it. I know, that most men are for referring all this to Noah's flood. But if so, how comes it, that the trees and their roots lie so near each other, and why lengthwise, from south west to north east? Why some of them burnt, others chopped, some split, others squared, and some bored through? Why the soil at the very bottom of a large river lies in ridge and furrow, and why are the coins of the Roman emperors found in those places, &c.? For me, I humbly conceive, that all those trees grew in the very places where they are now found, both in this country and elsewhere. Against which I know of only two objections, of any consequence. 1. That Cæsar expressly says, that no fir-trees in his time grew in Britain. But this is nothing at all to the purpose: for those trees that are called firs by the vulgar, from their near conformity and likeness to that tree, are well known by all learned men, by the redness, the resinous nature of the wood, the gracile cones hanging downwards, &c. to be the true pitch-tree, of which there are such great plenty in Norway, Sweden, and other countries of the north, and of which there are whole woods at this very day in Scotland, and upon a hill at Wareton in Staffordshire, they grow wild to the present time. Also in an old deed relating to this very chace, fir-trees or bushes are mentioned as growing here and there, about 300 years since.

2. That those sorts of trees grow always on high mountains and rocks, and never thrive on such low grounds and morasses, as these are, where we now find them buried. But though they do, in all cold countries of the north, thrive best on the hardest rocks and mountains, yet are they sometimes seen even large and plentifully in the low morasses of Liefland, Courland. Pomerania, and other countries thereabouts; and in the low forests and woods; for the truth is, that these stately trees chiefly delight to grow in a sandy soil; and if it lie never so high, or never so low, there they will grow, and there it is natural to them. It was lately observed in digging the pit of a great decoy in these levels, that the roots of the firs always stood in the sand, and

the oaks in the clay; and I have observed the same in multitudes of places of these commons.

Thus, as all those great and stately trees flourished here, and composed one of the largest and most beautiful forests in all the country; so in the next place, I shall inquire how it came to be destroyed, and for what reason and causes it was so. All this may be known by searching into the ancient Roman writers and historians: who frequently tell us, when their armies and generals pursued the wild Britons, that they always fled into the fastnesses of miry woods and low watery forests. Cæsar himself confesses the same, and says, that Cassibelen and his Britons, after their defeat passed the Thames, and fled into such low morasses and woods, that there was no possibility of following them. We also find that the stout nation of the Silures did the same, when they were set upon by Ostorius and Agricola. The like did Venutius king of the Brigantes, who fled into the great woody morasses of this country, and perhaps into those very same that formerly overspread these levels. And Herodian plainly tells us, that it was the custom of the wild Britons to keep in the fenny bogs and thick marshy woods, and when opportunity offered to issue out and fall upon the Romans, who were at length so plagued with them, that they were forced to issue out orders for the destroying and cutting down of all the woods and forests in Britain, especially of all those that grew upon low grounds and morasses. This order, I think, is mentioned in Vopiscus; and that they were thereupon accordingly cut down, is evident from many writers, who tell us, that when Suetonius Paulinus conquered Anglesea, he cut down all the woods there. Galen tells us, that the Romans kept their soldiers continually employed in cutting down woods, draining marshes and fens, and in paving bogs. It is also manifest, that they not only did this themselves, but also imposed the same heavy task on captive Britons; for Galgacus, in his speech to his soldiers, tells them, that the Romans made slaves of them, and wore out their bodies in cutting down woods, and in cleansing bogs, amidst a thousand stripes and indignities; and Dion Cassius tells us, that the Emperor Severus lost 50,000 of his men in a few years time, in cutting down the woods, and cleansing the fens and morasses of the country.

Now all that has been said may I think sufficiently prove, that the Romans were the destroyers of all those great woods and forests, which we now find under-ground in the bottoms of moors and bogs; and that they actually were in this part of the country, and destroyed this great and beautiful one, of stately firs, that overspread all those vast levels, and the country round about, I come now more particularly to show and prove.

The common road of the Romans out of the south into the north, was formerly from Lindum or Lincoln, to Segelocum, or Little-burrow upon Trent, and from thence to Danum or Doncaster, where they kept a standing garrison of Crispinian horse. A little off, to the east and north east of this road, between the two last-named towns, lay the borders of the great forest, which swarmed with wild Britons, who were continually sallying out, and retreating into it again, intercepting their provisions, taking and destroying their carriages, killing their allies and passengers, and disturbing their garrisons; which at length so enraged the Romans, that they were resolved to destroy it; and that they might do the same more effectually, as well as the more easily, they marched with a great army, and encamped on a large heath or moor, not far from Finningly, (as appears by their fortifications still to be seen there) where it is probable that a great battle ensued, for hard by is a little town called Osterfield. Now as the latter part of the word is never used to be added to any other, but where there has been a battle; so the former seems to inform us what Roman general it was that commanded, to wit, the famous Ostorius, whom all the Roman historians assure us was in those parts. But who got the victory is not directly mentioned, though no doubt it was the valiant Romans, who besides the multitudes of the Britons they slew, drove the rest back into the great forest and wood, that covered all this low country. Whereupon the Romans, that they might both destroy it and the enemy the easier, took the opportunity of a strong south west wind, and set great fires therein, which taking hold of the fir-trees, burned like pitch, and consumed immense numbers of them; and, when the fire had done what mischief and execution it could, the Romans brought their army nearer, and with whole legions of captive Britons chopped and cut down most of the trees that were yet left standing, leaving only here and there some large ones untouched, as monuments of their fury; which being destitute of the support of the under-wood, and of their neighbouring trees, were easily overthrown by strong winds. All which trees falling cross the rivers that formerly ran through this low country, soon dammed them up, and turned it into a large lake, and gave origin to the great turf moors that are here, by the girations and workings of the waters, the precipitation of terrestrial matter from them, the consumption and putrefaction of rotten boughs and branches, and the vast increase of thick water moss, which wonderfully flourishes, and grows upon such rotten grounds. Which even now since the drainage, and since that the country is laid dry for many miles round about, yet for all that, are so turgid with water, and so soft and rotten, that they will scarcely bear men to walk upon them.

Hence it is, that old Roman coins, old Roman axe-heads, &c. have been found near those roots and trees, that lie at the bottom of these moors and levels. Hence it is, that in all these grounds are found great numbers of trees that are burned, some in two, and some lengthwise, others hewn and chopped. Hence it is, that they lie near their own roots, with their tops north east. Hence it is that some of the greatest trees are found with their roots on, and others as they have laid all along have had branches growing out of their sides, to the thickness and height of considerable trees. Hence it is that both the clay and moor soil of the country, is in some places 2 or 3 yards higher than it was formerly, by the growing up of the same, and the daily warp that the rivers continually cast thereon, &c.

But to return; as the Romans were the destroyers of this great forest, so were they likewise of all those others that formerly grew on the low countries of Cheshire, Lancashire, Yorkshire, Lincolnshire, Staffordshire, Somersetshire, &c. and also of the very countries before-mentioned beyond sea, where such like trees are found. But as the Romans were not much in Wales, the Isle of Man, nor Ireland, so it cannot be supposed that they cut down their woods; but yet others did: for Hollinshed and others of our historians tell us, that Edward the First not being able to get near the Welsh to fight them, by their continuance and skulking in boggy woods, commanded them all to be destroyed by fire and the axe: and I doubt not at all but that the roots and trees, before-mentioned by Cambrensis in Pembrokeshire, were the relics of some of those that were then destroyed: and as for those in Man and other islands, they have all been cut down in time of war, and have lain till they were grown over with the soil of the neighbouring grounds: and as for those that are found in the bogs of Ireland, several of our historians expressly say, that Henry the Second, when he conquered it, cut down all the woods that grew on the low countries there, the better to secure his conquest and possession of it, to keep the country in a settled peace, and to disarm the enemy, who commonly trusting to such advantages are apt to rebel. I will only add, that it is a very common thing for generals and armies, even to this very day, to destroy all the woods that grow upon advantageous places, and fastnesses, in an enemy's country, if they intend to keep it; and that they always do it with fire and axe.

Concerning a Child who had its Intestines, Mesentery, &c. in the Cavity of the Thorax; and a further Account of the Person said to have swallowed Stones, in N° 253 *of these Transactions. By Sir Charles Holt.* N° 275, p. 992.

This child having died at about 2 months old, they gave the following account of its sickness: That it was uneasy and restless from its birth, and constantly laboured under a difficulty of breathing: that its illness was nothing like what they had seen in other children; nor could they perceive it relieved by any thing administered to it, though by the advice of a skilful physician; but it lay groaning and pining till it died: that they had always observed, when the child was undressed, an odd sort of working in its breast; and could perceive a crawling round the ribs and breast on both sides, as if a knot of small eels, or large earth-worms had been penned up within the cavity.

This relation seemed strange, but upon the dissection we found sufficient reason to believe the account. On opening the abdomen, there appeared none of the viscera belonging to the belly, except the liver, the kidneys, vesica urinaria, and intestinum rectum. We at first imagined that the other intestines might be covered by the liver, which, though commonly large in children, in this exceeded the usual size; but on turning it up towards the diaphragm, we only found under its concave part, the stomach, not lying in its natural position, for the pylorus was drawn by the duodenum across the vertebræ of the back, towards the bottom of the ventricle, and part of the duodenum passed through a foramen in the diaphragm, placed on the left side of that through which the gula descends, which occasioned the pylorus to lie almost under the bottom of the ventricle. We then resolved to trace the rectum from the anus upward, not doubting but that it would lead us to the mesentery and intestines. The rectum lay in an oblique line from the anus to this new foramen, and was received into it with a portion of the duodenum. This foramen seemed to be formed by nature from the first, for transmitting those guts into the thorax; for had it been made by any force, its sides would have appeared wounded, or lacerated; but on the contrary, round this orifice there was a smooth verge, as is seen in the previous foramen of the vena cava, or that by which the gula descends.

When we took off the sternum, we saw the mesentery with the intestines in the cavity of the thorax, lying upon the heart and lungs. There was no omentum spread over the intestines, which was entirely wanting, as was also the mediastinum. Most part of the duodenum lay in the thorax, and all the rest of the guts, except the rectum, which ascended in an oblique line from the anus, and its upper end was inserted into this orifice. After having some time admired this new situation of the intestines and mesentery, we began to consider how this child, according to the common notions of nutrition, could be nourished? That it was nourished, seems plain, because it daily received food, and regularly voided the fæces: so we proposed to inquire what communication there was between that gland, or glands, in the middle of the mesentery (commonly called pancreas Asellii) and the receptaculum chyli placed between the internal lumbar muscles, called psoas; but on the most accurate search there was none to be found; for the whole meseraic membrane and intestines lay perfectly loose upon the heart and lungs, absolutely disengaged from any manner of communication with any other part.

That vermicular motion, which showed itself on the ribs and breast, we ascribed to the peristaltic motion of the guts; and the dyspnœa, or difficulty of breathing, we thought might be occasioned by the pressure made on the lungs by the intestines and mesentery, which so filled the thorax, that there wanted room for the lobes of the lungs to move freely in, and consequently inspiration and expiration would be performed with difficulty. See fig. 12, pl. 15, where a shows the foramen through which the vena cava passed; b the foramen through which the gula descended; and c the foramen through which part of the rectum and duodenum went into the thorax.

Gobsill, whose case was noticed in the Transactions, N° 253, came lately to me, and told me the stones grew very troublesome to him; that he had vomited up two of them, which I weighed, and found one weighed 2 drachms, and the other 1 drachm 2 scruples and a half; he complains, that his strength is of late much impaired; that he voids great quantities of blood by stool, which keeps him very weak. His appetite is much impaired, and will retain but few things. His hands are paralytic, always extremely cold, and his fingers contracted; he is not able to open them without help, or keep them so, unless by force. His legs are very likely in a short time to be as useless to him as his hands; for he says they begin to fail him, and in the same manner grow cold, and have little sensation in them. But the most remarkable of all his complaints was, a new progress the stones had either found or made. Formerly at night in bed, they used to get up, as he expressed it, to his heart, and upon turning to his knees, or standing upright on his feet, they would drop one by one so distinctly, that they might be counted, and in this state they always arose straight up on the right side of his breast; but now they rise obliquely, and get under his right arm, inclining towards the scapula, and when they are in this place, by giving him a blow with the fist on his right shoulder, they will all fall down in a lump together, and may very plainly be heard to clash on the other stones, which lie as they did formerly just above the os pubis. After he had told me this story, I made the experiment before Dr. Fowke and Dr. Davies, and the matter proved true as he related it.

Some Experiments made for transmitting a Blue-coloured Liquor into the Lacteals. By Dr. Wm. Musgrave, F. R. S. N° 275, p. 996.

Feb. 1682-3 I injected into the jejunum of a dog, that had had but little food for a day before, about 12 ounces of a solution of indigo in fountain water; and after 3 hours opening the dog a second time, I observed several of the lacteals of a bluish colour; which, upon stretching the mesentery, disappeared several times; but was most easily discerned when the mesentery lay loose; an argument that the bluish colour was not properly of the vessel, but of the liquor contained in it.

A few days afterwards, repeating the experiment, with the solution of stone-blue in fountain water, on a dog that had been kept fasting 36 hours, I saw several of the lacteals become of a perfect blue colour, within a very few minutes after the injection: for they appeared so before I could sew up the gut.

About the beginning of March following, having kept a spaniel fasting 36 hours, and then syringing a pint of a deep decoction of stone-blue with common water into one of the small guts; and after three hours opening the dog again, I saw many of the lacteals of a deep blue colour. On cutting several of them, they afforded a blue liquor, viz. some of the decoction running out on the mesentery. After this I examined the ductus thoracicus, on which, together with other vessels near it, I had upon my return made a ligature, and saw the receptaculum chyli, and that duct of a bluish colour; not so blue indeed as the lacteals, from the solution mixing with lympha, in and near the receptaculum, but much bluer than the duct uses to be, or than the lymphatics under the liver were, with which I compared it.

The entrance into the lacteals (which is much the narrowest part of all the passages from the mouth to the mass of blood) being thus proved beyond exception to be wide enough to admit so gross a body as stone-blue, we may here in part explain the admission of liquors, as of diuretic waters, &c. into the vessels in vast quantities, in a very little time. The same width of the lacteals makes them ready to receive those grosser bodies, conveyed in proper vehicles, which afterwards compose the grumous part of the blood, the cartilages and the bones. And this open entrance being allowed, it will no longer seem impossible, that with our nourishment, eggs or animalcula themselves should enter these vessels; there being no manner of question, but that of both the one and the other some are much less in bulk than the larger particles of indigo, in the decoction above-mentioned, seen in the lacteals. Add to this the many species there are of small insects, and their great fertility; so many and so great, that a very small proportion, perhaps not a quarter part, comes within view of the naked eye; then we shall be the better able to account for the great variety, as well as numbers of insects observed in the juices of the animal body.

But the chief use of the wideness of the lacteal orifices, is in deducing from thence the reception of gross matter, such as are the effects of indigestion, &c.

which afterwards in the blood and genus nervosum, often produce severe distempers. Which notion was in some degree confirmed by its first proposer, Dr. Lister. Vide de Fontibus Medicatis Angliæ Exercitationem alteram, Ed. Lond. p. 48.

Concerning a great Quantity of Opium taken, without causing Sleep. N° 275, p. 999.

One Mrs. Lovelock was seized with a fever, which affected her so as to make her delirious to a great degree, convulsed and restless; upon which the physicians ordered her great quantities of opiates; but, with the quantity mentioned below could not procure any sleep, though they seemed to refresh her, and make her sensible. The quantity she took from Tuesday night 12 o'clock to Friday night 12 o'clock, was in all, in various forms, 102 grains of laudanum. She died after 11 days illness.

Account of the greatest Part of a Fœtus voided by the Navel. By Mr. Christopher Birbeck. N° 275, p. 1000.

The wife of Mr. Roper at Coxwold, 12 miles from York, falling in labour, the midwife extracted the secundines, which offered first, but could not perceive any thing remaining: the woman's body falling, and being pretty easy for some days, and the uterus being contracted, the midwife took the secundines for a mola, or false conception; but in about a week more the patient began to discharge plenty of fœtid matter by the vagina, which continued, and, in process of time, she felt a troublesome hardness on the hypogastrium, which increased daily for above 6 weeks; and so reduced her that they despaired of her life. This lump and soreness wrought upwards to the umbilical region, and continued fixed there for about a month. At length, being very painful, the neighbouring women took it for a great boil or imposthume, and applied what they usually do in such cases, to assist its suppuration and breaking, which had its effects, and it broke rather under the navel, discharging then, and afterwards, a great quantity of a thin fœtid and discoloured liquor. The part about it mortified, and the ulcer enlarged so that a man's hand might be introduced in it. It continued exceedingly painful, and emitted such a stench, that neither herself nor any one else could endure to look on it. A short time after they found some little bones wrought out of it, which being shown to me, I found them to be the bones of a child's finger, which made me curious of going to see her. When I examined the place, I perceived the fœtus in a confused heap, or mortified lump; for with my probe I felt several bones, and at that time extracted (after I had separated and dilated the mortification about it) above half the ribs, some vertebræ of the back, and other bones, and cut out above a pound of the child's mortified substance, as black as ink, with an extreme nauseous smell. And every 2d or 3d day for a month, I extracted what I could, being obliged to do it very slowly on account of the exceeding weakness of the patient who certainly would have died in the operation, had I forcibly extracted it, and not given her time; for we were obliged every moment to support her with cordials, and after every operation she found herself lightsomer, and by degrees sweeter, which for the first time gave me hopes of her recovery. For not only the linea alba and muscles of the abdomen, but the peritonæum and omentum were mortified to a great breadth, and the intestines lay fairly in view, and exposed to the air a long time. After extracting a part, and having a plentiful discharge of thin fœtid matter, the other discharge downwards began to lessen and abate, so that I endeavoured to assist it by bandages and compresses, with deterging and drying injections up the vagina; by which means in a little time there was no discharge that way, and those parts soon became perfectly well; and in some time after the ulcer separated (with the assistance of fomentations, good digestives, and mundificatives,) from its putrefaction, contracted and united, and has now been quite cicatrised near 3 months, all the abdomen being soft, easy, and well conditioned. The woman laboured all this season at hay and corn harvest.

I presume by the forcible extraction of the secundines, the uterus had been lacerated, and so ulcerated; and the woman being extremely weak, and constantly lying in bed, gave the more liberty for its working upwards.

Account of the Lapis Amianthus, Asbestos, or Linum incombustibile, lately found in Scotland. By Mr. Wilson. N° 276, p. 1004.

Having heard that in the grounds of Francis Gordon of Achindore, Aberdeenshire, there were found some pieces of petrified wood; I had the curiosity to go to see them. On the side of a hill, of a heath kind of ground, somewhat inclining to what we call moss, in a very small brook, and hard by it, in the space of 10 or 12 yards, I found a great many of those stones, some a foot in length, which appeared like wood: but because I could not perceive any vestige of wood thereabouts, nor could find any of the stones, except in that very spot of ground, I could not think they were petrified wood. But on cutting up the ground about the place with my knife, where I found likewise some pieces of the stone, and very near the surface several pieces of a fibrous matter, which my knife could not cut; this I immediately judged to be an incombustible substance, as it proved afterwards, when I tried it by the fire.

When I found some pieces of the stones very hard in the middle, and fibrous matter on the outside and ends, I was inclined to believe that the flax came from the stones; but then finding several pieces of the flax so condensed, that at first they appeared to be hard stones; but being a little wetted, the filaments were easily parted from each other. I got many more, some less and some more condensed, into the nature of a stone; and all of it, both that which was condensed together, and what was not, was lying about an inch within the ground, parallel to the surface, and so interwoven with the fibres of the grass-roots, without any root of its own, but alike at both extremities, as if cut with a knife, that it seemed to me much more probable that the flax turned into stone than that the stone turned into flax, especially, as most part of the stones appeared so tender, and brittle on the outside, that it is hard to believe how they could turn into that tough substance of flax.

The stones are of different sorts, some are white, the colour of the flax, and of a very soft substance; so that they may be easily cut with a knife without blunting it; others are much mixed with a whitish talc, but most of them are of a greyish colour, and very hard. The ground where it is found is of a greyish colour, about one inch or two thick, under which there is a black earth for a foot in depth. So that I could find nothing in the places where most of it was got, that I could rationally conclude to produce it: but in some other spots I found a deal of a talcous sand, with some pieces of flax near it, as also some pieces of the stone much whiter than the rest, and very like talc, from which it is probably produced. Yet there being no appearance of any talc in the other places, where most of it was found, I can scarcely conclude any thing about its production.

It seems to me, by what Pliny, Aldrovandus, and Olaus Wormius write concerning it, that this which I found in Scotland, is not inferior to any they speak of; for generally they make it very short, whereas some of this I found 5, 6, 7, and some 8 inches long. As for the making of it into cloth, they all conclude it very difficult; yet it may be seen by an experiment I have shown, in making yarn of it, that cloth may be made of it also, for the difficulty is much greater in the one than in the other.

An Account of Mr. Sam. Brown's Fifth Book of East India Plants, with their Names, Virtues, Description, &c. By James Petiver, F.R.S. To which are added some Animals sent him from those Parts. N° 276, p. 1007.

An account of 46 more East India plants gathered by Mr. Brown at Salawacka and Keraputta Kaudoo, about 30 miles from Madras, with the synonyms of various authors added to the Malabar names by Mr. Petiver. The animals enumerated belong to the tribes of insects and conchylia.

The Strange Bones, and the Isthmus between Dover and Calais further considered. By Dr. Wallis. N° 276, p. 1030.

Mr. John Luffkin in the Trans. N° 274, informs us of several bones of an extraordinary size, found lately in a gravel-pit not far from Harwich in Essex, much like those found at Chartham in Kent, at a great depth under ground, which he thinks rather to have been those of an elephant, than of a hippopotamus, or other marine animal. But whichever it is, the circumstance will equally prove those valleys to have been much deeper in former times than now.

I observe, that the river in Essex, and that in Kent, near which the bones were found, are both of them named the Stoure; which, whether it be a corruption of the Latin æstuarium, as Mr. Somner conjectures, or of the British ys-dwr, that is, the water, I will not dispute. And that the bones being found in both places much at the same depth, viz. about 16 or 17 feet, they may probably have been lodged in both places much about the same time; and that perhaps when the Emperor Claudius brought his elephants into Kent and Essex, as Mr. Luffkin intimates out of Dion Cassius.

I observe also, that those petrified bones, in both places, were found in gravelly soils, as are those petrified shells, and bodies of fish, in gravel pits and stones quarries near Oxford. How far the steams, fumes, or fluors of the earth, which contribute to the formation of stone or gravel, might conduce to the petrifying of these bones, shells, or other bodies, I leave to the consideration of inquisitive naturalists. And whether the impregnation of such steams might not swell such petrified bodies to a larger proportion than they had before. Like as we observe wood, and other like materials, to swell in a moist air, by the distension of their pores, on the intromission of moist particles. For I take all petrifactions to be made either by incrustation or intromission of stony particles. And I well remember, that many years since, at Moldash in Kent, not far from Feversham, on some high and very stony grounds, which sometimes used to be pasture and sometimes ploughed land, I have observed several oyster-shells petrified, or partly so, much larger than the ordinary proportion of oysters in those parts, and very weighty; which oyster-shells might have been purposely thrown there long before, as being reputed a good manure for land; and might have been there impregnated with like halitus and effluvia, as are the numerous stones on those lands.

But, to return, I do not see why we may not think the Stoure in Essex and the Stoure in Kent, to have been both æstuaries of the northern tide, before the rupture of that isthmus between Dover and Calais; and the like of the river near Malden, and other small creeks on the coast, though not so large as those of the Humber and the Thames, which were then æstuaries of the same sea, as are many others on the coast of Scotland. I say, before that rupture; for, since that rupture, the case as to the Thames is somewhat altered; for the western tide between us and France, which was then stopped at this isthmus, now flows on through that fretum, beyond the mouth of the Thames, as high as the Dogger-sands; which therefore supplies the æstuary of the Thames, which was formerly furnished from the northern sea. And these smaller æstuaries might sooner be choaked up by what every tide lodges there, while those larger æstuaries are only shortened and become narrower than they had formerly been. And as to the Thames in particular it seems very evident, if we consider their situation, and the nature of their soil, that much of the low grounds in Kent and Essex, on both sides of the mouth of the Thames, adjacent to the sea, had formerly been sea, as well as that of Romney-marsh. And when the mouth of the Thames was so much wider, no doubt but it flowed much farther than it now does.

It may perhaps be objected, that the small rivers still remaining in the bottom of these vallies, which may have been supposed to have been æstuaries in former times, run now with more turnings and windings than these vallies themselves do. But this need not at all seem strange, when we may daily see the same in the bottom of a muddy ditch, or water course, when the water is almost drained off, the mud still remaining soft, that the little water which is left will work out for itself, amidst the mud, a winding passage, according as the mud will more or less give way, much more crooked than the ditch itself when full of water. And the like must needs happen in the gradual draining of such æstuaries, according as the soft earth will permit. Which crookedness will continue when the banks on both sides by degrees grow firmer.

As to what I observed concerning the Isle of Oxney; that a low level in that isle, which had for several years lain under water, is now raised by introducing the tide to a considerable height above what it was formerly, and that the channel from thence to Rye is, by the tides passing in and out, become much wider and deeper than heretofore. If we look in the more ancient maps of Kent before the year 1640, we shall find that, what we call the Isle of Oxney, was then only a peninsula, being, by a small isthmus at the north-east corner of it, continued to the rest of the country; and the tide from Rye to that place, which now flows straight on by the north side of the isle, was there stopped by that isthmus, and wheeled about on the south side of it, or rather, the river

Rother, from the north side of the island, wheeled about by the south side to that eastern corner, and thence by the channel to Rye.

While things were in this state, divers moorish or marsh lands, adjoining to the river Rother, were often in danger on great rains of being overflowed. But so it once happened, that this drowned land had unexpectedly in one night's time, or little more, discharged itself on another level, somewhat lower than itself. On which indication it was thought advisable, by cutting that isthmus to allow those waters on the north side of the island a straighter passage toward Rye: and to let those lower grounds lie for some time under water, till by intromitting the tide, they might be somewhat heightened and then timely recovered. In order to which, commissions of sewers have ever since, from time to time, been issued out for that purpose; and the work in good measure effected, though not quite finished.

Of the Invention and Improvement of the Mariner's Compass. By Dr. Wallis. N° 276, p. 1035.

It is not agreed on where, or by whom, the mariner's compass was first invented. I have guessed it to have been an English invention, not only because we have been long conversant in navigation, but even from the name compass, which is used in England; I am sure it was wont to be so used in Kent when I was a youth, for what we otherwise call a circle. And I take it to be an old English word in that sense, though now, in imitation of the French, the word circle be more common. I know not whether a compass, or any word like it, be so used for a circle in any other language; but rather cercle in French, circhio in Italian, circulo in Spanish, or some other word derived from the Latin circulus. And from hence the circulus nauticus may come to be called the mariner's compass, which name, being given it by the first inventors, might give occasion for like names in other languages; as compas, compasso, zee-kompas, &c. Indeed the circinus, or instrument by which we describe a circle, called by us a pair of compasses, may have some like name in other languages; but how anciently I do not know, nor that a circle absolutely considered other than this circulus nauticus is so called. How far this conjecture, from the name, may give us a title to the invention, till a better appears, I shall not determine, but only suggest to consideration.

I think it is now agreed on all hands, that what we called the variation of the variation is an English discovery, of Mr. Gellibrand, if I mistake not, one of Sir Thomas Gresham's professors at Gresham College, about the year 1625. That is, that the magnetic needle, in its horizontal position, does not retain the same declination or variation from the true north, in the same place, at all times, but successively varies that declination from time to time. Which, though it were about that time a new discovery, is now admitted as an undoubted truth.

And what is called the dipping needle, is admitted also to be an English discovery, somewhat prior to the former; I cannot say at present whether by Mr. Blagrave, or some other Greshamite. That is, that the magnetic needle, besides its direction toward the north, in its horizontal position, has also a direction of altitude above the horizon; and, if duly poised about a horizontal axis, will point to a determinate degree of altitude or elevation above the horizon, in this or that place respectively. Of which discovery, though made so long ago, I do not find that much use has hitherto been made, that of its horizontal declination being more serviceable.

It is also an English observation, that not only a magnetic needle, but any piece of iron, if kept long in the same position, will of itself contract a polarity. As for instance, an erect bar in a window, after long continuance in that position will, if duly poised, be found with its upper end to point toward the north, and southward with the other end; and if afterwards it be continued long in a contrary position, it will attain a contrary polarity.

And Mr. Gilbert's notion, of the earth's whole body being but one great magnet, and lesser magnets being so many terrellas sympathizing with the whole, is English also.—It has been observed also, that a magnetic needle, if heated red-hot, will lose its polarity; and if then cooled in a contrary position will acquire a contrary polarity.—It has also been observed by our English mariners, that upon a great flash of lightning at sea, their magnetic needle has lost its former polarity, and contracted the contrary, pointing the wrong way, and directing the mariner to a wrong course.

And in general, the doctrine of magnetism has been more improved by our English naturalists than by any other nation. And if some of the Gresham gentlemen would take the pains to give us a true history of these and the like improvements, it would be an acceptable service for the honour of the nation, and of that college in particular, as well as of the Royal Society.

Account of a Book, viz.—Aloysi Ferdinandi Comit. Marsigli Danubialis Operis Prodromus. Ad Regiam Societatem Anglicanam. Fol. 1700. N° 276, p. 1038.

Of this book an account has been given, in the life of Marsigli, inserted at pp. 307, 308, of this vol.

END OF VOLUME TWENTY-SECOND OF THE ORIGINAL.

*Account of the taking and taming of Elephants * in Ceylon. By Mr. Strachan, a Physician, who lived* 17 *Years there.* N° 277, p. 1051. *Vol. XXIII.* †

All the natives within 20 miles of the sea-coast between Matura and Negumbo, are subject to the Dutch; when therefore orders are given by the East India Company to hunt the elephants, they choose a convenient place for a warren or park, which is broad at the entrance, and within so narrow, that an elephant cannot turn about, yet long enough for 20 to stand one behind another. This being done, the inhabitants surround the woods, where the elephants resort, for about 60 English miles in circuit. At first each man stands from the other at the distance of about 5 poles, or 25 yards, and kindles a fire in the intermediate space; then by shouting, beating of drums, and sounding of horns, they make the elephants retire towards the park, till the circumference become so small, that they stand close by each other. The elephants, when they find themselves enclosed within the park, make the more resistance, and some of them turn on the men; but posts are ready standing between them and the elephants, and long stakes lying on the ground; so that they have only to lift these stakes, and make their ends fast to the posts, and thus the elephants are enclosed. Then by following the elephants, and casting fire-brands, they chase them still farther towards the end of the park, and close up the passage behind them, with stakes placed across the posts. There are several sorts of elephants, some a great deal higher before than behind, and many who never have the two long teeth; others are of a more savage nature, known by their fierce looks, and these are of no service, even if kept for 10 years, but are used by the king of Candy for punishing transgressors, for they kill all persons that come within their reach. Such elephants being among the others in the fore-mentioned park, are kept out of the narrow entrance by throwing firebrands at them when they draw near it, and by endeavouring to kill them with guns, and cutting off their trunks, by which they take all their food; and thus, they perish for hunger when they escape; for the natives, being very swift, come very near them with their swords. When all the choice of the elephants have

* For more particulars respecting the methods employed for taking and training wild elephants, the reader is referred to Mr. Corse's paper, inserted in the third volume of the Asiatic Researches, and to Percival's History of the Island of Ceylon.

† This vol. is dedicated for the first time to Isaac Newton, Esq. (afterwards Sir Isaac Newton) and where he is first mentioned as the president of the Royal Society. He was elected a member Jan. 11, 1671-2; and it is a curious fact that, by an order of council, Jan. 28, 1674-5, he was excused from making the usual weekly payments (one shilling per week) on account of his low circumstances, as he represented.

entered the narrow passage, there are posts put across, so that none of them can come back, but such as are not fit for service, have liberty to escape.

It is easy to conceive how the natives invented the chasing elephants by drums and noise, because it is observed that they themselves are affrighted by drums. I heard an ancient Portuguese relate, that when his countrymen were in possession of this island, they pursued the natives too far up among the woods and hills; the Ceylonese by this means got the advantage of them, and killed every man of them, except one drummer, who observing them not to draw near where they heard the drum, he kept continually beating his drum, and the Ceylonese, thinking that the greatest power was where the drum beat, did not come near him, by which means he saved his life.

When the elephants have remained some time in the narrow passage, they are taken one by one to the stable, being tied fast between two tame elephants, the points of whose long teeth are cut; if the wild elephant be troublesome, they will hold his trunk with their trunks, and beat him with their teeth, a man sitting on each of the tame elephants to direct them by a staff, on the end of which is a little hook, with which he touches his head, and guides the tame elephant as he pleases, even without a bridle. When they come to the stable, they are led between two posts, with stakes put athwart before their breasts, and under their bellies, and so bound that they cannot stir, nor lie down on the ground; for should they be permitted to lie down, they would become heavy, sorrowful, and would not eat, but die. They are thus fed with the trunk of waltugas, or plantains; which tree they love better than any other food. When they have been so fed for 6 weeks, they begin to be tractable, and are fastened only by one foot with cords; and if the merchants come from Bengal, they are sold and conveyed to the ships; but if not purchased, they are fed with leaves of the cocoa tree for 12 weeks from the time of their being taken, when they become tame, and eat grass with the oxen in the fields.

When an elephant is put on board a ship, there is a contrivance made of 15 or 20 double sailcloths, which is laid about his breast, belly, and sides, and tied together upon his back, to which ropes are fastened; he is then led into the water between elephants bred for the purpose, upon each of which a man sits to govern him, and another elephant, upon which a man also sits, goes behind the elephant that is to be shipped; and when this is unwilling to enter the water, the other that is behind puts his head to the hinder parts of the foremost, and so pushes him forward; and when he is got deep enough in the water he is tied to the boat, the other elephants return, and he swims after the boat to the ship, where he is hauled on board. But a better way has been invented lately: a large flat bottomed vessel is prepared, covered with planks like a floor, so that this floor is almost of the height of the key; then the side of the key and the vessel are adorned with great branches, so that the elephant sees no water till he is in the ship.

When an elephant swims to the ship, or otherwise crosses a deep river, no part of him can be seen except his trunk, through which he breathes; and when he is washed on a river side, he usually lies with his head on the bottom of the water flat alike with his body; and though one side be above water, his head will be under, holding only his snout above it, through which he breathes.

If they fall at any time, though on plain ground, they either die immediately, or languish afterwards till they die, their great weight occasioning them so much hurt by the fall.

When an elephant frequents a plantation of fruit trees of the natives, for no hedges can keep him out, they sharpen to a point a heavy piece of wood, and hang it by a cord to a branch of the tree under which the elephant uses to come; and at night a man sits watching upon that branch, and when the elephant comes under it, the man cuts the cord, and the pointed wood falls a foot deep in his back; by which means the elephant languishes and dies.

An Account of Mr. Samuel Brown's Sixth Book of East India Plants, with their Names, Virtues, Description, &c. By James Petiver, F. R. S. with an Account of some Animals brought by the Rev. George Joseph Camelli, from the Philippine Isles. N° 277, p. 1055.

An enumeration and description of 20 East India Plants. Among the animals noticed is a quadruped called by Camelli cato-simius volans. The rest are moths and butterflies.

Account of a strange Cancer. By Mr. Jonathan Kay, Surgeon. N° 277, p. 1069.

You desire an account of my father's cancer, which I here send you, as near as I can remember, it being 20 years since he died. It took its rise from a small bruise on the os jugale, and in process of time spread itself over the whole cheek; and notwithstanding the endeavours of the most emiment surgeons in those parts where he lived, it ulcerated his eye quite round, which I saw him take out with his own hand, and afterwards extended itself to his ear, and through his cheek into his mouth, and across the upper part of his nose, and perforated the bone there: it likewise over-ran that side of his forehead, fouling the os frontis, which came away in pieces, leaving the dura mater bare, for the breadth of a half-crown; which rising through the perforation of the cranium, in a few days putrefied and exposed the brain itself to view, several portions of which came away fresh and untainted; and that which is most extraordinary, he perfectly retained his senses, and rose every day to dress the ulcer himself, till a considerable quantity of the brain was come away; and when he was confined to his bed, his speech first failed, and he died about 4 days after; his brain being totally consumed, and nothing remaining in the cranium but a small quantity of black putrid matter. He had neither spasms nor convulsions of any part, all the time of his illness.

On several Natural Curiosities. By Mr. Ralph Thoresby, F.R.S. N° 277, p. 1070.

On perusing the catalogue of the natural curiosities in my poor musæum, you desired a more particular account of the skin of the fish's stomach from the Indies; of the crystal, and the ways of its concretion; of the iron turned into ore; and of the octoedra from the copper mines in Sweden. The first was given me by Mr. Robert Midgley, apothecary, of this town, [Leeds,] who made 5 voyages as surgeon to the East Indies. It is the outward skin of the maw of a fish that was taken at Macassar, and was given him at Batavia by a Dutchman, who took it out of the fish. Its fibres or vessels curiously resemble a tree, with its stem, branches, leaves, &c. the skin is very thin, whitish, and transparent, and the veins that compose the stem and larger branches, are now rather black than dark red, as I presume they were at first; the leaves a sort of dark and faded green, variegated. The crystal, with other natural curiosities, was given me by Dr. Jabez Cay, of Newcastle, who brought it from Milan: I shall give you the description of it, together with his arguments on a sort of spar within a flint, sent me at the same time. That within the flint, says he, seems to differ from the rest of its substance, and somewhat to resemble spar: though after all, spar being nothing else but a crystalline sort of lime-stone, it differs not from flint in reality, but only in appearance, i. e. in the manner of concretion: and if the inclosed matter had differed in its nature from the rest of the stone, the thing had not been very uncommon, it being usual enough for stones, especially those of a globular or oval form, to have coat upon coat, and those coats sometimes very different from one another, some being soft, others hard, nay, sometimes, after a long space of time, one of these coats will shrink from the other, after the manner of a kernel, when the shell grows dry; and then, if the inclosed substance continue soft and marly, they call that stone geodes; but if stony, it makes one of those rattling stones that are known by the name of the ætites, or eagle stone. Many instances might be brought to confirm, that it is no unusual thing for stones to inclose substances of a very different nature from themselves; as appears by the shells in Sussex marble; and the stones found in our coal-pits, and known among the workmen by the name of cat-heads: these are found in a particular stratum near the coal, and inclose a fern, or sometimes a polypody leaf in the middle; and for that reason being struck with a hammer, they very readily break there: they seem to be a sort of ironstone, akin to that which they call in Staffordshire ballmine, and Dr. Lister, minera ferri pilæformis. And to give an instance that one and the same piece of rock does not always shoot into stone at one and the same time, but first one part of it and then another, and that not after the same regular manner, I have a piece of rock crystal, where may easily be observed the modus concrescendi in the middle, different from that of the outside; nay, sometimes I have seen in the middle of some transparent stones, a small drop that never would take the solid form of the rest of the stone at all.

The 3d curiosity was also sent me from the same very kind friend Dr. Cay; it is a piece of an iron-bolt, 2 inches long, found in a stone quarry, now returned into iron ore again; this being a property that iron has, and no other metal, as Dr. Lister observes in his Journey to Paris.

4thly, The copper ore so regulated shot into an octoedrous form, was sent me from Sweden by Mr. William Sykes of Stockholm, merchant: it has 8 solid triangles, and consequently 6 angular points, and is nearly of the size and figure of the draught of it, fig. 13, pl. 15. It was received from the copper groves at Fahlun, where many more of the same form were then found.

Extracts of two Letters from the Rev. Abraham de la Pryme, F. R. S. concerning the Subterraneous Trees at Hatfield Chace, the Bitings of Mad Dogs, &c. N° 277, p. 1073.

Being at Hatfield lately, I was told by several gentlemen, that about 20 years before, died one Saunderson of that town, aged near 80; whose father, much of the same age, frequently assured him and others, that he could very well remember many hundreds of large fir-trees that grew in those levels, standing here and there, in a decaying condition, whose tops were all dead, yet their boughs and branches always green and flourishing: and John Hatfield, Esq. who is not above 40 years of age, has by him a large twig that his father plucked off from a green and flourishing sprout of fir, that grew from the great root of one of the same kind in these commons. And an old man of Croul has heard his father say, that he could remember multitudes of shrubs and small fir-trees growing here before the drainage, while this country was a chace, and while the vert was preserved. And lastly, in several old charters that I have seen, of Roger de Mowbray, Lord of Axholm, who lived in the year 1100, relating to Hurst, Bellwood, Ross, Santoft, &c. it appears that then all these places were covered with a large old decaying forest or wood; as also all that low common between Croul Causey and Authrop on Trent; and though there be no traces of any such thing now to be seen, yet it is not only plainly manifest that it was a forest formerly, from the roots found there, but also that most of the trees which grew there were firs: all which were only the after-growth and relics of the large forest, destroyed by the Romans.

My brother had a greyhound bitch that had whelps; soon after, a mad dog bit this bitch, upon which about 3 weeks after she ran mad, and they were forced to kill her. But saving her whelps, because no sign of madness appeared in them, in about 3 weeks more they all pulled out each other's throats, except one, which escaped. At length perceiving that it could not lap, nor swallow any liquid thing, the servants put their fingers into its mouth, and felt its tongue and throat, but finding nothing wrong there, they let it alone a day or two longer, and then it went mad and died.

About 3 weeks after, my brother's servant, a very strong laborious man, who had frequently put his fingers into the whelp's mouth, began to be troubled at times with an exceedingly acute pain in the head, sometimes once, and other times twice a day, so very vehement, that he was obliged to hold his head with both his hands, to hinder it from rending asunder; which fits commonly lasted about an hour at a time, in which his throat would contract, as he said, and his pulse tremble, and his eyes showed every thing of a fiery red colour. Thus he was tormented for a whole week together; but being of a strong constitution, and returning to his labour in every interval, he wrought it off by sweat, and without any physic.

But one of his fellow servants, a young apprentice of about 14 years of age, who was not of so strong a constitution, fared worse: he was also seized with a pain in his head, was somewhat feverish, sometimes better, and sometimes worse, coughed much, eat heartily, but could drink nothing. "I know not what I ail," says he, "I cannot swallow any beer," &c. and so laughed at it. When he went out of doors, if there was but the least north wind, he always ran as if it had been for his life; and when asked why he did so, he said he could not tell—but that the wind would needs stop his breath. A day or two after this he was worse, and vomited an ugly sort of matter, like black blood, which stunk like rank oil, but much stronger; and this he did several times; after which he would be pretty well, and walk about; but most commonly ran as fast as ever he could, first out of one corner, then into another, then up stairs, then down again, &c. But on the 3d day of his confinement within doors, he became perfectly mad, would start, leap, and twist his hands and arms together, point at people, and laugh and talk any thing that came in his mind. In some of his fits he was so strong, that four young men could hardly hold him down in the chair where he sat: but as soon as they were over, he was lightsome, laughed, and talked; but all his discourse was of fighting, and that if they would but let him alone, he would leap upon them, and bite, and tear them to pieces. About an hour after, his fit came again, which soon made him speechless, seized wholly on his brain, and then he died.

Concerning some Water Spouts observed in the Mediterranean. By Mr. Alexander Stuart, a Physician. N° 277, p. 1077.

August 27, 1701, being on the coast of Barbary, to the northward of the town of Bona, upwards of 10 leagues distance at sea, about 7 o'clock at night, soon after sun-set, there appeared in the N. E. which was directly up the Gulf of Lyons from us, great and continued flashes of lightning, one after another, with hardly any intermission, and this, without thunder, it continued till the next morning; the flashes of lightning sometimes representing the sudden appearance of a star, and at other times of a flaming sword, and again of a silver cord stretched along the clouds, or as the irregular rents of a phial from top to bottom. About 8 next morning we had thundering, with a continuation of lightning of the kind and appearance as before, all from the N. E. or nearly so.

About 9 the same morning, there fell down from the clouds, which looked black, lowering, and as it were heavy with rain, in the N. E. three water spouts; that in the middle, being the greatest, seemed as large as the mast of a ship, and I judged it to be at least a league and a half distant from us; so that in itself it was doubtless larger than three masts. The other two were not half the size. All of them were black, like the cloud from whence they fell; and smooth, without any knot or irregularity; only at first falling, some fell perpendicularly down, and some obliquely, and all of them smaller at the lower end than above, representing a sword; sometimes also one of them would bend, and become straight again, and also sometimes became smaller, and again increase its bulk; sometimes it would disappear, and immediately fall down again; at other times it became extenuated to the smallness of a rope, and again became gross as before.

There was always a great boiling and flying up of the sea, as in a jet d'eau, or water-work; or this rising of the water had the appearance of a chimney smoking in a calm day. Some yards above the surface of the sea, the water stood like a pillar, and then spread itself, and was dissipated like smoke: and the sword-like spout from the clouds either came down to the very middle of this pillar, as if it had been joined with it, as the largest pillar, which fell perpendicularly down, always did from the beginning to the end; or else it pointed to this column of water, at some distance, either in a perpendicular or oblique line, as did the other two lesser ones. There were three or four spouts more, which appeared at the same time in the same quarter of the heavens; but not like the three former, either for bulk or duration: These last appeared and disappeared several times, during the continuance of these three aforesaid.

It was hardly distinguishable whether the sword-like spout fell first down from the cloud, or the pillar of water rose first from the sea; both appearing opposite to each other all of a sudden: only I observed of one of them, that the water boiled up from the sea to a great height, without the least appearance of a spout pointing to it, either perpendicularly or obliquely; and here the water of the sea never came together in the form of a pillar, but rose up scatteredly, the sea boiling furiously round the place. The wind being then N. E. the said boiling advanced towards the S. W. as a flitting or moving bush on the surface of the sea, and at last ceased. This shows that the boiling or flying up of the water of the sea may begin before the spout from the cloud appears: and indeed, if there be any small matter of priority between these two appearances, the boiling or throwing up of the sea-water has it; which first begins to boil, and then forms itself into a pillar of water, especially on the lower part.

It was observable of all of them, but chiefly of the large pillar, that towards the end it began to appear like a hollow canal, only black in the borders, but white in the middle; and though at first it was altogether black and opaque, yet one could very distinctly perceive the sea-water to fly up along the middle of this canal, as smoke does up a chimney, and that with great swiftness, and a very perceptible motion: and then soon after, the spout or canal burst in the middle, and disappeared by little and little; the boiling up and the pillar-like form of the sea-water continuing always the last, even for some considerable time after the spout disappeared, and perhaps till the spout appeared again, or reformed itself, which it commonly did in the same place as before, breaking and forming itself again several times in a quarter or half an hour.

I know not if any one has accounted for this phenomenon; but I imagine it may be solved by suction, or rather pulsion, as in the application of a cupping-glass to the flesh, after the air is first exhausted by the kindled flax.

It was further observable, that the oblique spouts pointed always from the wind; that is, that the wind being at N. E. the oblique spouts always pointed to the S. W.; though at the same time there were others perpendicular, which still continued so, notwithstanding the wind. Also that such as were curved, had always the convex side from the wind, and the concave towards it; that is, the wind being at N. E. the concave was towards the N. E. and the convex towards the S. W. It rained a great deal during the continuance of these spouts; and after their total disappearance, there was half an hour's violent storm from the N. E. with very little rain; but afterwards the weather cleared up.

Explanation of the Figures of these Spouts.—In pl. 16, fig. 2, A represents the spout, of a black colour, falling perpendicularly out of a black cloud; B the water of the sea, rising in the form of a pillar or column in the middle, and scattered round about the said middle column like smoke, or rather like the falling of a jet d'eau: these two meet each other directly, and the column of water from the sea is commonly grosser than the spout from the clouds.

In fig. 3, A is a curved spout, joining with the rising water of the sea at B.

Fig. 4, A represents a black spout, falling obliquely from the clouds of the same colour; B the ascending column of the sea-water as in fig. 2, with this difference, that here the spout and column of water did not meet.

Fig. 5, E and W denote east and west; 1 2 3 the successive progress of the boiling of the sea from east to west, or from N. E. to S. W., and that without any appearance of a spout from the clouds, pointing to either of these places.

Fig. 6, A represents the large perpendicular spout, a little before its bursting, white in the middle; B the column of sea-water joining it; 2 2 2 2 the water of the sea ascending in the form of smoke up a chimney, all along the column at B to the clouds.

Fig. 7, A the breaking of a perpendicular spout, commonly beginning in the middle at a; B the rise of the sea water, which begins to fail, and the middle column to disappear.

Fig. 8, A an oblique spout, which after reaching to the sea in a curved line, or obtuse angle, soon after breaks at a, and disappears; B the rising of the sea-water also beginning to cease.

Fig. 9, A, a perpendicular spout beginning to fall; B the beginning ascent of the water of the sea under it.

Fig. 10, A, an oblique spout beginning, or darting itself out of the clouds; B the rising, or boiling of the water, answering to it in an oblique line; these sometimes reach down to the sea or rising water, and sometimes not so far, but continue a while as here represented.

An Account of a Book, viz.—Edmundi Dickenson, M. D. Physica Vetus et Vera; sive, Tractatus de Naturali Veritate Hexameri Mosaici. Per quem probatur in Historia Creationis cum Generationis Universæ Methodum atque Modum, tum vera Philosophiæ Principia, strictim atque breviter tradi. Lond. 1702, *in* 4*to.* N° 277, p. 1063.

Many persons having cavilled at the Mosaical Cosmopæia, as unphilosophically written, the author here undertakes to show, that Moses, in his History of the Creation, has briefly delivered both the principles of true philosophy, and the method and manner of all generation.

Observations made in the Island of Ceylon; on the Methods of catching Fowl and Deer, of Serpents, of the Ant Bear, and of Cinnamon. By Mr. Strachan. N° 278, p. 1094.

The method used to catch water-fowl is this: in waters which are not very deep, the fowler puts upon his head an earthen-pot, in which holes are bored, to see through; he then wades into the water, nothing being seen but the pot which covers his head, and thus appearing like a floating vessel, he gets among the fowls and takes as many as he pleases, drawing them one by one under the water. Those who have guns, make a frame, covered with green branches, and broad enough to conceal the whole body: these they use in the manner of a stalking horse. They chase wild beasts by frightening them with fire, thus: In the night time two men go into the wood; one takes an earthen vessel on his head, in which is a fire made of sticks and a kind of rosin; and in one hand he carries a staff, on which are fastened 8 bells, the more harmonious the better; the other man follows with a spear in his hand; whenever the deer perceives the light, and hears the bells, he draws near, standing amazed, for he sees not the men; in the mean time the man with the spear pierces his body, and catches him. As to elephants, tigers, serpents, and wild swine, they run when they see the fire, so that the hunters need not fear them.

There are two sorts of serpents which are thought not to be venomous, and which a Ceylonese will not kill; the first is of a bluish colour, and frequently comes into houses to search for rats only, and eats them; he creeps into their nests, and destroys them all; this serpent is of the thickness of an inch and a half in diameter, and about two yards and a half long. The other is green, like the leaf of a tree, on which it winds itself, climbs up the trees and catches the birds; lying still as if it had no motion, till it sees a fit opportunity to catch: this is about half an inch diameter, and a yard long.

The talgoi, or ant-bear, will lie as if he were dead beside those little nests which are built by those ants called waia, lolling his tongue out as far as he can; these ants will immediately fix themselves in great numbers upon his tongue, then drawing it in, he swallows them.

There are two sorts of cinnamon-trees, of which the best has a leaf much larger and thicker than the other; but otherwise no difference is perceived. The leaves distilled yield oil and phlegm, as if cloves had been put into the still. On the root of the tree there is a thick bark, which, when distilled as the former, yields oil and camphire; which are separated by covering the receiver with a linen cloth, then the camphire remains in the cloth in a lump together, and the oil and phlegm run into the receiver. This camphire has the same colour, the same discussing, dissolving, and healing balsamic quality as the camphire of Japan; the oil is of the same virtue; for anointing scabs, itch and excoriations, it cures them in a short time. Drinking the phlegm among common water cures fluxes, and gives relief to such as are under that languishing disorder, called by the Hollanders the land's disease, and by the Ceylonese, pipa.

An Account of what passed in the last Public Assembly of the Royal Academy of Sciences at Paris, held Nov. 12, 1701. By M. Blondel, and communicated by M. Geoffroy, F. R. S. N° 278, p. 1097.

M. Cassini opened the assembly with a discourse, containing the observations he had made in his last journey for determining the passage of a meridian line, taken from a point in the observatory at Paris, from one end of France to the other. In the first part of this discourse he went back to the most ancient astronomers, and recounted their opinions of the spherical figure of the earth, and their methods to know its dimensions, of which the two most famous are, first, that of Eratosthenes the Cyrenian, who lived in the reign of Ptolemy Euergetes, King of Egypt: the second that of Possidonius of Rhodes, who lived in the time of Pompey the Great. He then proceeded to those of the moderns, Johannes Fernelius, and some others: and lastly related the method of the late M. Picard, of the Royal Academy, as the most exact. He then spoke of his own observations on the same subject. He showed his method of determining the passage of the meridian taken from a point in the observatory at Paris. By means of triangles, which he made through the whole course of his journey, and very exact calculations, he determined the place of this meridian, and marked all the considerable places through which it passed, from Paris to the highest of the Pyrenees, which separate Roussillon from Catalonia. Among these mountains he observed one of the height of 1440 toises. But the most extraordinary observation was that of the inequality of the degrees of the meridian on the earth; for he found that going southward one degree surpassed another an 800th part,* which may give great reason to doubt of the exact roundness of the earth. On this occasion he reported two different opinions: the one of M. Huygens and Newton, the other of a mathematician of Strasburg named Eisenschmid. The two former hold that the earth is flatted towards the poles, so that it is something of the shape of a Dutch cheese: which they both conclude by physical and algebraical deductions, from an observation made at Cape-Verd, viz. that the pendulums, though of the same length, make their vibrations there much slower than in the northern countries. The other mathematician holds that the figure of the earth is elliptical, so that it is lengthened out towards the poles, having the form of an egg. M. Cassini left the question undecided.† The cities through which he observed the meridian of Paris to pass, are Dunkirk, Amiens, Aubigny, Bourges, Aurillac, Rodez, Alby, and Carcassone.

M. Bolduc spoke next. He examined the principles of purgatives, and began with ipecacuanha, which he said he had endeavoured to sweeten and qualify by trying to take away its too great emetic power. He asserted, that howsoever violent ipecacuanha was, yet it is not so dangerous as scammony or coloquintida, which always leaves gripes, and sometimes dysenteries, whereas ipecacuanha leaves only a gentle astriction after it. From ipecacuanha he passed to hellebore, which is another violent emetic; which he distinguished into two sorts, the black and the white. He said, that the white caused mortal convulsions: that the black hellebore, which comes from England, is much weaker than that which grows on the mountains of Switzerland. He said, that having put it in a retort in a reverberatory fire, he at first drew off an acid spirit, next an oily acid spirit; thirdly a violent alkali spirit came over mixed with oil of tartar, and lastly a fetid oil. That from the caput mortuum he had by a lixivium, a fixed salt, which fermented with acids, such as all other plants give; besides these operations, he drew an extract of this root with spirit of wine, to get the resinous parts, and with distilled rain water for the saline. He got but very few of the former, but a great deal of the other. Comparing then the effects of these purgatives, he said that the purely resinous purge but little, and with much irritation; that the purely saline purge only by urine, but that both together purge very well. That it is for this reason that physicians make use of salt of tartar, to correct the bad

* This irregularity was probably occasioned by errors in the celestial observations, arising from the unequal deviations of the plummet near the mountains and valleys. See the note, p. 198, vol. ii. of this Abridgment.

† This question was afterwards fully decided in favour of the opinion of Newton and Huygens.

effects of resinous purgatives; but if this precaution were used to make the extract with aqueous dissolvents, instead of the sulphureous, there would be no need of that corrective.

Monsieur Moriu, who spoke thirdly, offered a particular project of a new system for the passage of the drink and urine. He said, that having observed the extreme swiftness with which the drink passes sometimes, as in drinking medicinal waters, he thence conjectured that it did not always go the way, which anatomy shows us it takes usually; and that therefore it must have some other shorter passage, which is not yet discovered. A strong proof of this conjecture is, that those who purge with an infusion of cassia, render in a very short time by urine, a tincture almost as black as the infusion they have taken; which would not constantly happen, if the drink took always the ordinary course. He then took pains to discover this unknown passage for the urine, and he persuades himself that he has found it.

He concluded that the drink, besides the ordinary passage which it has to the bladder by the emulgent veins, kidneys, and ureters, has likewise another by the pores of the stomach, and of the bladder. He called those which pass by this new way the first urines, and those that pass the ordinary way the second urines. He afterwards proved the possibility of this new system by experiments. He said that having taken the ventricle and bladder out of a dead body, and filled them with water, it ran out through the pores; and turning them inside outwards, the water that was put in them run through after the same manner; and that lastly, letting them swim in water, it easily soaked through into them. Whence he concludes, that in a living body it ought to pass with much greater facility by the tension of the stomach, for the aliment like a sponge soaks up the liquor, in which it swims, and so swells up the stomach; which in its turn again, pressing the food, squeezes out the liquor from it, and forces it to filter through its pores. With this pression it is easy to conceive, that the drink must pass easier through the pores of the stomach than the water, which was put into the stomach taken out of a dead body; and that this liquor re-entering into the bladder makes the first urine: it is evident likewise, that this pression is never strong enough to press out all the liquor from the stomach; so that there remains enough to carry on the aliment and chyle, after which it comes away high loaded and coloured, and makes what he calls the second urines. He added, that the passage of the drink into the capacity of the lower belly did not cause the dropsy, because that liquor, aided by the pressure of the parts that encompassed it, finds an easy entrance into the bladder, and none into the intestines, because of the thick mucus that lines them. The easiness of this passage is the cause that mineral waters run away so suddenly by the first ways, and by the second; but much more by the first, when there is but little nourishment in the stomach; for there runs more or less urine by the first ways than by the second in proportion to the aliment taken, and to the surplus of what is necessary for the digestion, respect being had likewise to what passes insensibly by transpiration.

The system being so laid down, he gave the reasons of two considerable phænomena. The first was the different colour of urine made at different times; which arose from hence, that those that pass by the first ways, are but little charged; whereas the others that pass by the second ways, having served for a vehicle to the chyle, and circulated with the mass of the blood, are charged with the volatile and sulphureous salts, and other excrements of the blood, and consequently more coloured. The second phenomenon was the red, greenish, and sometimes blackish colour of the urine, of those that are purged with the infusion of cassia. This according to him is because that tincture passes by the first ways, as was experimented in the stomach of a dead man, where this liquor passes indeed more slowly, and in less quantity, but always of a greenish red. It is the same of the red tincture of the urine after eating beetes, of the violet-brown, which is observed after drinking mineral waters; of the smell of violets after the taking pills of turpentine; and of the strong smell after asparagus; all which comes from the first urines being charged with that colour and smell, which is not taken away by any thing that is mixed with it; whereas the second urine, which carries the chyle and aliments, has no other colour nor smell than urine usually has.

Finally, M. Marchand closed the assembly with reading a discourse on the discovery of a new simple. He began with enumerating the advantages modern botanists have over the ancient; as the latter, in the space of so many ages, discovered at most not above 6000 plants, and the former, in this last age, have found out at least 4000, and among others, the excellent specifics ipecacuanha, jesuit's bark, &c. Whereas the ancients knew only some bad purgatives, such as scammony and hellebore. The plant of which M. Marchand spake is none of the least curious discoveries that has been made of this nature. A Portuguese surgeon who, having lived many years in Brazil, discovered the virtues of this plant, after returning into Portugal with a design to raise a great trade with it, he sent several specimens of it every where. He called the plant iquetaia, and attributed to it no less virtues than the cure of apoplexies, pleurisies, and intermitting fevers. He added one thing, which though more particular, yet seemed more probable, which was, that the leaves infused with senna took from it its disagreeable taste and smell, without altering any thing of its purgative quality. The samples that he sent were not in sufficient quantity to make experiment on the distempers he said it was proper for; but there was enough to try whether they had the virtue to correct the taste and smell of senna. Therefore there was infused two drachms of it with as much senna in a chopine of water, and the experiment confirmed the matter of fact. Being desirous to know what species of plant it was, and it being impossible to discover it by the leaves, the Portuguese surgeon had taken so much care to cut them very small, Monsieur Homberg, who had some of it sent him, perceived some seeds swimming on the water, in which they were infused, and taking up as many as he could of these seeds, gave them to Monsieur Marchand, who sowed them, from whence grew up a plant, which we need not go to Brazil to seek: it grows in Europe, nor need we go out of France to find it. It is the scrophularia aquatica, growing all about Paris. He finished his discourse with advice to physicians, to apply themselves to the knowledge of what grows in their own countries, before they think of going farther.

Abstract of a Letter from Dr. Wallis to Captain Edmund Halley; concerning the Captain's Map of Magnetic Variations; and other things relating to the Magnet. Dated Oxford, May 23, 1702. N° 278, p. 1106.

Your magnetical chart fixes the business of magnetic variation, in these seas, for the present time. If similar observations had been made in former ages, and transmitted to us, it would have been of great use. And if such be made in future, from time to time, and recorded; by which it may appear at what rate the variation varies; it will afford a great insight into the magnetic doctrine, about which we are now so much in the dark.

The doctrine of the magnet has been mostly improved at Gresham College, or by those related to it, and there conversant, for an age or two last past; as Blagrave, Gunter, Gellibrand, Gilbert, Norwood, Wright, Brigs, Foster, &c. and of late by yourself.

I have given some imperfect intimation of it in the Transactions, N° 276. I believe it was about the beginning of the reign of King Charles the First, that Mr. Gellibrand caused the great concave dial to be erected in the Privy Garden at Whitehall, which I think is still remaining; with great care to fix a true meridian-line; and with a large magnetic needle, showing its variation from that meridian, from time to time. I think it not amiss if exact observations were now made, whether the meridian be now just the same as it was then. For it is very possible, that the pole of the earth may in time suffer some little variation, though it may not readily be discerned, which may cause an alteration of the meridian-line. And this, if so, will be more discernible nearer the pole, than farther off. And though such provision were made at Whitehall for observing the needle's variation from the true north; and though no doubt notice has been given many times what the variation has been at such times; yet I doubt no register has been kept of such observations, whence we might form a scheme to know how such variations proceed from time to time.

It has been observed also of what is called the dipping needle, that, besides the horizontal direction towards the north, it has also a direction of altitude, above and below the horizon, if balanced on a horizontal axis: pointing as it were with its northern end, in our climate, to some point within the body of the earth. Whether or no this direction varies from time to time, like that of its horizontal position northward, I cannot tell; nor do I know whether it has yet been observed; nor whether the southern end in other parts of the world dips; as the northern end does with us. All which things deserve serious consideration.

I could wish that you yourself would take some pains, for I know not who can do it better, or whom else you shall think fit to associate, to collect, and give us a brief history of what has been done in this kind, how, when, and by whom; and by what steps the doctrine of the magnet has been gradually promoted: for it is pity the memory of it should be lost. And perhaps it may be the last request I may live to beg of you, being now at the age of 86; and it is for the public, and not for myself. Or if it be too great a task for you to undertake at present, having your hands full of other weighty business; I wish the Royal Society would seriously recommend it to the care of some other fit person of their members, who may be able and willing to undertake it: as a thing that would be welcome to the inquisitive world, would be an honour to the nation, to Gresham College in particular, and to the Royal Society.

I have, in the letter abovementioned, given my conjecture, that the mariner's compass was originally an English invention. Not only because England was at that time as famous for navigation, as any nation that I know, for the Holland sea-trade was not then in being, nor for a long time after; but even from the name of mariner's compass, for what in Latin is called circulus nauticus. For the word compass is an ancient English word, for what we otherwise call by a French name, a circle. And I am sure that within my memory, in the place where I was born and bred, it was wont to be commonly so called, though in latter times the word circle is more in use. And if we consult Minshew's Dictionary, we shall find that he takes circle and compass indifferently to signify the same with circulus. And hence it is that circinus is in English called a compass, or a pair of compasses, being the instrument by which we describe a compass or circle. Now I do not know that the word compass then was, or now is, in any other language, so used for a circle indefinitely, or for any other circle than the circulus nauticus. But now in all languages, French, Italian, German, &c. the circulus nauticus has the name of compass, or somewhat analogous, compass, compasso, zee-kompas, &c. Which name I guess, together with the art, they borrowed from England.

I might urge the same from another name, bossolo, bossola, &c. For, as circulus nauticus is the mariner's compass; so pyxis nautica is the mariner's box, for the English box is from the Latin pyxis; and pyxidula (as a diminutive from pyxis) must be boxel, or some word like it, which easily passes into the French buxole, boussole; and the Italian bossola, boussola; all which seem to be from the English boxel (pyxidala) a little box; softening the sound of the letter x into ss; as in Alessandro, for Alexandro.

All which, though it be not a direct demonstration, is at least a probable conjecture, and a plausible pretence to the invention, till a better claim appears. For, in the case of new inventions, when they come abroad, they commonly take their names from whence the invention itself is taken. And where inventions creep in by degrees, it must not be thought strange if it be not easy to say who is the first inventor. In the present case; he who first observed that the magnet has a polarity. or inclination northward, made the first step towards this invention. This I think was at first wont to be showed, by putting a magnet into a little boat, swimming on water, when it was observed, that this magnet would of itself so steer this little boat, as that a certain point in the magnet would turn toward the north: which point was thence called the magnet's north pole. He that afterwards observed, that this verticity or polarity, was communicable to a piece of iron or steel rubbed on a magnet, added a further step towards the business in hand. And he who contrived a way to set a needle, or piece of steel, so touched, on a sharp pin, so as in the air to move horizontally on it, and thus of itself to find out the north, and point towards it: had now discovered a new experiment in natural philosophy very surprising.

But this could not yet be called circulus nauticus, or the mariner's compass, till they had further contrived a way how to put a needle, thus poised, into a box, with a compass or circle round it; so divided as to denote the azimuthal points of the horizon, or the points of the compass; and so commodiously to fix this box to the ship, as thereby to instruct the mariner towards what point of the compass the ship moved; that he might put it into such a course, as was proper for his voyage. And it was now indeed pyxis nautica, or circulus nauticus, the mariner's box or compass, but not till then. And he who first contrived this application completed this invention of circulus nauticus. But all those antecedent discoveries were steps towards it, and parts of the invention.

Now it is not likely, that all these discoveries were made at once, by the same man, and at the same time, but successively, by the joint advice of several inquisitive men, and in a considerable tract of time; yet all perhaps of the same nation, and probably the English. But whoever gave the first hint of this invention, certain it is, that the great improvements of the magnetic doctrine are due to the English; and chiefly to those about London, and Gresham-College: and it is fit the memory of it should be preserved.

The case is much the same with that of printing, which we cannot reasonably suppose to be invented all at once; nor perhaps all by the same man; but rather by the concurrent advice of several, and in a considerable tract of time, before it came to that degree of perfection, which we now call printing.

A Method of squaring some Kinds of Curves, or of reducing them to Simpler ones. By A. Demoivre. N° 278, p. 1113. *Translated from the Latin.*

THEOREM I. Let A denote the area of a curve, whose absciss is x, and ordinate $x^m\sqrt{dx - xx}$. Let B denote the area of another curve, having the same absciss as the former, but its ordinate $x^{m-n}\sqrt{dx - xx}$. Put $\sqrt{dx - xx} = y$; then will the area be A =

$$d^n B \times \frac{2m+1}{2m+4} \times \frac{2m-1}{2m+2} \times \frac{2m-3}{2m} \times \frac{2m-5}{2m-2} \text{ \&c} = P$$

$$-\frac{1}{m+2} x^{m-1} y^3 = -Q$$

$$-\frac{d}{m+1} \times \frac{2m+1}{2m+4} x^{m-2} y^3 = -R$$

$$-\frac{d^2}{m} \times \frac{2m+1}{2m+4} \times \frac{2m-1}{2m+2} x^{m-3} y^3 = -S$$

$$-\frac{d^3}{m-1} \times \frac{2m+1}{2m+4} \times \frac{2m-1}{2m+2} \times \frac{2m-3}{2m} x^{m-4} y^3 = -T$$

&c.

Where it is to be observed, 1st. That n is supposed to be a positive integer number; 2d. That the quantity d^n B, in the series denoted by P, must be multiplied into as many terms as there are units in n; 3d. That there must be taken as many of the following series, denoted by − Q, − R, − S, − T, &c. as there are units in n. So that, to make this plain by an example or two, if $n = 1$, then the area will be $A = d^n B \times \frac{2m+1}{2m+4} - \frac{1}{m+2} x^{m-1} y^3$. And if $n = 2$, then $A = d^n B \times \frac{2m+1}{2m+4} \times \frac{2m-2}{2m+2} - \frac{1}{m+2} x^{m-1} y^3 - \frac{d}{m+1} \times \frac{2m+1}{2m+4} x^{m-2} y^3$.

4thly. That if y be put $= \sqrt{dx - xx}$, then will A be = Q − R + S − T &c. ± P.

Corol. 1. If m be put equal to any term of this series, $-\frac{1}{2}, \frac{1}{2}; \frac{3}{2}, \frac{5}{2}, \frac{7}{9}, \frac{9}{2}$, &c; then the quadrature of the curve whose ordinate is $x^m\sqrt{dx - xx}$, or $x^m\sqrt{dx + xx}$, becomes finite, and will be exhibited by our series. For example to find the area of the curve whose ordinate is $x^{-\frac{1}{2}}\sqrt{dx - xx}$; suppose this curve to be compared with the curve whose ordinate is $x^{-\frac{3}{2}}\sqrt{dx - xx}$; then because in this case $n = 1$, therefore $A = d^n B \times \frac{2m+1}{2m+4} - \frac{1}{m+2} x^{m-1} y^3$. But $m = -\frac{1}{2}$, therefore $2m + 1 = 0$, and $A = -\frac{1}{m+2} x^{m-1} y^3 = -\frac{2y^3}{3\sqrt{x^3}}$.

Here it may be observed, that the area thus found, will be sometimes less, and sometimes greater than the true area, by a given quantity. Now that such defect or excess may become known, let the area found be augmented or diminished by the given quantity q; then putting $x = 0$, let the area thus increased or diminished be put $= 0$, which will give the correction q. Thus, in the present case there will be found $q = \frac{2}{3}d\sqrt{d}$, and therefore $A = \frac{2}{3}d\sqrt{d} - \frac{2y^3}{3\sqrt{x^3}}$.

Corol. 2. If n be put equal to any term of the following series, 3, 4, 5, 6, 7, &c; then the quadrature of the curve whose ordinate is $x^{-n}\sqrt{dx - xx}$ or $x^{-n}\sqrt{dx + xx}$, becomes finite, and is exhibited by our series. For instance, to find the area of the curve whose ordinate is $x^{-3}\sqrt{dx - xx}$; suppose it compared with the area of the circle, which may be called A : then $m = 0$, $n = 3$; therefore $A = P - Q - R - S$. But since the quantity $2m$ is infinitely little, or rather nothing, and is found in the denominator of the third term by which $d^n B$ is multiplied, the quantity denoted by P is infinite; and for the same reason the quantity denoted by $-$ S becomes infinite; and therefore the quantities A $-$ Q, $-$ R, vanish: thence $P = S$, and the equation divided by $\frac{2m+1}{2m+4} \times \frac{2m-1}{2m+2}$, it gives $d^n B \times \frac{2m-3}{2m} = \frac{dd}{m} x^{m-3} y^3$, or $d^n B \times \frac{2m-3}{2} = d^2 x^{m-3} y^3$: and writing 0 and 3 for m and n, it gives $dB \times -\frac{3}{2} = \frac{y^3}{x^3}$, or $B = -\frac{2y^3}{3x^3}$.

Corol. 3. If m be put equal to any term of the following series, -2, -1, 0, 1, 2, 3, 4, 5, &c.; then the quadrature of the curve whose ordinate is $x^m\sqrt{dx - xx}$ depends on the quadrature of the circle; but that of the curve whose ordinate is $x^m\sqrt{dx + xx}$ on the quadrature of the hyperbola; and the relation of such curve to the circle or hyperbola, is exhibited by our series in finite terms.

Corol. 4. If m be expounded by any other number different from those abovementioned, then the curve whose ordinate is $x^m\sqrt{dx - xx}$ or $x^m\sqrt{dx + xx}$, is neither exactly squared, nor depends on the circle or hyperbola, but is reduced to a simpler curve by our series.

THEOREM II. Let A denote the area of a curve, whose absciss is x, and ordinate $\frac{x^m}{\sqrt{dx - xx}}$. And let B be the area of another curve, whose absciss is the same as the former, but its ordinate $\frac{x^{m-n}}{\sqrt{dx - xx}}$. Put $\sqrt{dx - xx} = y$: then will A be =

$$d^n\text{B} \times \frac{2m-1}{2m} \times \frac{2m-3}{2m-2} \times \frac{2m-5}{2m-4} \times \frac{2m-7}{2m-6} \, \&c = \text{P}$$

$$-\frac{1}{m} x^{m-1} y = -\text{Q}$$

$$-\frac{d}{m-1} \times \frac{2m-1}{2m} x^{m-2} y = -\text{R}$$

$$-\frac{d^2}{m-2} \times \frac{2m-1}{2m} \times \frac{2m-3}{2m-2} x^{m-3} y = -\text{S}$$

$$-\frac{d^3}{m-3} \times \frac{2m-1}{2m} \times \frac{2m-3}{2m-2} \times \frac{2m-5}{2m-4} x^{m-4} y = -\text{T}$$

&c.

The observations made on the first theorem obtain here also, and likewise in the following ones.

Corol. 1. If m be put equal to any term of the following series, $\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \frac{7}{2}, \frac{9}{2}$, &c. then the quadrature of the curve whose ordinate is $\frac{x^m}{\sqrt{dx - xx}}$ or $\frac{x^m}{\sqrt{dx + xx}}$, becomes finite, and is exhibited by this series.

Corol. 2. If n be put equal to any term of the following series, 1, 2, 3, 4, 5, 6, 7, &c; then every curve whose ordinate is $\frac{x^{-n}}{\sqrt{dx-xx}}$ or $\frac{x^{-n}}{\sqrt{dx+xx}}$ is squared by this series in finite terms.

Corol. 3. If m be expounded by any term of the following series, 0, 1, 2, 3, 4, 5, 6, 7, &c; then the curve whose ordinate is $\frac{x^{-m}}{\sqrt{dx-xx}}$ depends on the quadrature of the circle; but the curve whose ordinate is $\frac{x^m}{\sqrt{dx-xx}}$ on the quadrature of the hyperbola. For if with the centre C, fig. 4, pl. 14, and diameter AB = d, there be described the circle AEB; and there be taken AD = x, erecting the perpendicular DE, and joining CE: then the sector AEC divided by $\frac{1}{8}dd$, is equal to the area of the curve whose ordinate is $\frac{x^0}{\sqrt{dx - xx}}$. In like manner, if with the centre C, fig. 5, and transverse axis AB = d, there be described the equilateral hyperbola AE; and there be taken AD = x, erecting the perpendicular DE, and joining CE: then the sector ACE divided by $\frac{1}{8}dd$, is equal to the area of the curve whose ordinate is $\frac{x^0}{\sqrt{dx + xx}}$.

Corol. 4. If m be put equal to any term not included in the foregoing limitations; then the curve whose ordinate is $\frac{x^m}{\sqrt{dx \pm xx}}$, is neither squared exactly, nor depends on the circle or hyperbola, but is reduced to a simpler curve.

THEOREM III. Let A be the area of a curve whose absciss is x, and ordinate $x^m\sqrt{rr - xx}$; also let B be the area of a curve whose absciss is the same x, and its ordinate $x^{m-2n}\sqrt{rr - xx}$; and put $\sqrt{rr - xx} = y$; then will it be A =

$$r^{2n}\,\text{B} \times \frac{m-1}{m+2} \times \frac{m-3}{m} \times \frac{m-5}{m-2} \times \frac{m-7}{m-4}\ \&c = \text{P}$$

$$-\frac{1}{m+2}\,x^{m-1}\,y^3 = -\,\text{Q}$$

$$-\ \frac{r^2}{m} \times \frac{m-1}{m+2}\,x^{m-3}\,y^3 = -\,\text{R}$$

$$-\ \frac{r^4}{m-2} \times \frac{m-2}{m+2} \times \frac{m-3}{m}\,x^{m-5}\,y^3 = -\,\text{S}$$

&c.

Corol. 1. If m be expounded by any term of the following series, 1, 3, 5, 7, 9, &c; then the quadrature of the curve whose ordinate is $x^m\sqrt{rr-xx}$ or $x^m\sqrt{rr + xx}$ becomes finite, and is exhibited by this theorem.

Corol. 2. If n be expounded by any term of the following series, 2, 3, 4, 5, 6, &c. then the curve whose ordinate is $x^{-2n}\sqrt{rr - xx}$ or $x^{-2n}\sqrt{rr + xx}$, is exactly squared by this theorem.

Corol. 3. If m be expounded by any term of the following series, − 2, 0, 2, 4, 6, 8, &c. then the quadrature of the curve whose ordinate is $x^m\sqrt{rr - xx}$ depends on the circle; but that of the curve whose ordinate is $x^m\sqrt{rr + xx}$ on the hyperbola.

Corol. 4. If m be expounded by any number differing from those before-mentioned, then the curve whose ordinate is $x^m\sqrt{rr - xx}$, or $x^m\sqrt{rr + xx}$, is neither exactly squared, nor depends on the circle or hyperbola, but is reduced to a simpler curve.

THEOREM IV. Let A be the area of a curve whose absciss is x, and ordinate $\frac{x^m}{\sqrt{rr - xx}}$; and let B be the area of another curve having the same absciss x, but its ordinate $\frac{x^{m-2n}}{\sqrt{rr-xx}}$: then will A be equal to

$$r^{2n}\,\text{B} \times \frac{m-1}{m} \times \frac{m-3}{m-2} \times \frac{m-5}{m-4} \times \frac{m-7}{m-6}\ \&c = \text{P}$$

$$-\ \frac{1}{m}\,x^{m-1}\,y = -\,\text{Q}$$

$$-\ \frac{r^2}{m-2} \times \frac{m-1}{m}\,x^{m-3}\,y = -\,\text{R}$$

$$-\ \frac{r^4}{m-4} \times \frac{m-1}{m} \times \frac{m-3}{m-2}\,x^{m-5}\,y = -\,\text{S}$$

$$-\ \frac{r^6}{m-6} \times \frac{m-1}{m} \times \frac{m-3}{m-2} \times \frac{m-5}{m-4}\,x^{m-7}\,y = -\,\text{T}$$

&c.

Corol. 1. If m be expounded by any term of the following series, 1, 3, 5, 7, 9, &c; then the quadrature of the curve whose ordinate is $\frac{x^m}{\sqrt{rr-xx}}$ or $\frac{x^m}{\sqrt{rr+xx}}$, will be obtained by this theorem in finite terms.

Corol. 2. If n be expounded by any term of the following series, 1, 2, 3, 4, 5, 6, &c; then the curve whose ordinate is $\frac{x^{-2n}}{\sqrt{rr-xx}}$ or $\frac{x^{-2n}}{\sqrt{rr+xx}}$ is exactly squared by this theorem.

Corol. 3. If m be expounded by any term of the following series, 0, 2, 4, 6, 8, 10, &c; then the quadrature of the curve whose ordinate is $\frac{x}{\sqrt{rr-xx}}$ depends on the quadrature of the circle; for if with the centre C, and radius CA $= r$ (fig. 4, pl. 14) the circle AEG be described; and there be taken CD $= x$, erecting the perpendicular DE, and joining CE: then the sector CAE divided by $\frac{1}{2}rr$, is equal to the area of a curve whose ordinate is $\frac{x^0}{\sqrt{rr-xx}}$. In like manner, if with the centre C and transverse semi-axis CA $= r$, (fig. 5,) there be described the equilateral hyperbola EAM; and having drawn CF $= x$ perpendicular to AC, also FE parallel to the axis till it meet the hyperbola in E, and joined CE: then the hyperbolic sector CAE divided by $\frac{1}{2}rr$, is equal to the area of the curve whose ordinate is $\frac{x^0}{\sqrt{rr+xx}}$.

Corol. 4. If m be expounded by any number different from the foregoing; then the curve whose ordinate is $\frac{x^m}{\sqrt{rr-xx}}$ or $\frac{x^m}{\sqrt{rr+xx}}$, is neither exactly squared, nor depends on the circle or hyperbola, but is reduced to a simpler curve.

THEOREM V. If A be the area of a curve whose absciss is x, and ordinate $\frac{x^m}{d-x}$; and B the area of another curve having the same absciss x, but its ordinate $\frac{x^{m-n}}{d-x}$: then will $A = d^n B - \frac{x^m}{m} - \frac{dx^{m-1}}{m-1} - \frac{d^2x^{m-2}}{m-2}$ &c. But if the ordinate be $\frac{x^m}{d+x}$, then the area will be $A = \frac{x^m}{m} - \frac{dx^{m-1}}{m-1} + \frac{d^2x^{m-2}}{m-2}$ &c. $\pm\, d^n B$.

Corol. If m be expounded by any term of the following series, 0, 1, 2, 3, 4, 5, 6, &c; then the quadrature of the curve whose ordinate is $\frac{x^m}{d-x}$, or $\frac{x^m}{d+x}$, depends on the quadrature of the hyperbola. For drawing DE, EF at right angles, fig. 6, pl. 14, take EG $= d$, and draw GH perpendicular and equal to it; then between the asymptotes DE, EF describe an hyperbola passing through H; then take GK $= x$, towards E in the first case, but towards F in the second; and draw the ordinate KL: then the area HGKL divided by dd, is equal to the area of the curve whose ordinate is $\frac{x^0}{d-x}$, or $\frac{x^0}{d+x}$. Hence the solid generated by a portion of the cissoid revolved about the diameter of its generating circle, is exhibited in finite terms, having given the quadrature of the hyperbola.

THEOREM VI. Let A be the area of a curve whose absciss is x, and ordinate $\frac{x^m}{rr + xx}$; and let B be the area of another curve having the same absciss x, but its ordinate $\frac{x^{m-2n}}{rr+xx}$: then will the area $A = \frac{x^{m-1}}{m-1} - \frac{r^2x^{m-3}}{m-3} + \frac{r^4x^{m-5}}{m-5}$ &c. $\mp r^{2m}B$.

Corol. If m be expounded by any term of the following series, 0, 2, 4, 6, 8, &c; then the quadrature of the curve whose ordinate is $\frac{x^m}{rr+xx}$ depends on the rectification of the circular arc. For if with the centre C, and radius CA $= r$, the circle AEG be described, fig. 4, pl. 14; then drawing the tangent AK $= x$, and joining CK meeting the periphery in E; then the arc AE divided by rr, is equal to the area of the curve, whose ordinate is $\frac{x^0}{rr + xx}$.

A general Corollary to these six Theorems.

Every mechanical curve, whose quadrature depends on any of the infinite number of curves, whose ordinates can take the following forms, viz. $x^m\sqrt{dx \pm xx}$; $\frac{x^m}{\sqrt{dx\pm xx}}$; $x^m\sqrt{rr\pm xx}$; $\frac{x^m}{\sqrt{rr\pm xx}}$; $\frac{x^m}{d\pm x}$; $\frac{x^m}{rr+xx}$; may be squared by these series. One example of which may suffice.

Supposing the cube of the circular arc, corresponding to the versed sine, be made the ordinate of a curve, whose absciss is the same versed sine; to find the area of that curve.

Let the absciss be x, the circular arc v; then the fluxion of the area is $v^3\dot{x}$. Suppose the area to be $v^3x - q$. Then $v^3\dot{x} + 3v^2\dot{v}x - \dot{q} = v^3\dot{x}$, whence $\dot{q} = 3v^2\dot{v}x$. But $\dot{v} = \frac{d\dot{x}}{2\sqrt{dx-xx}}$, theref. $\dot{q} = \frac{3dv^2x\dot{x}}{2\sqrt{dx-xx}}$; but by th. 2, $\frac{x\dot{x}}{\sqrt{dx-xx}} = \frac{d\dot{x}}{2\sqrt{dx-xx}} - \dot{y} = \dot{v} - \dot{y}$; hence $\dot{q} = \frac{3}{2}dv^2\dot{v} - \frac{3}{2}dv^2\dot{y}$, therefore $q = \frac{1}{2}dv^3 - \text{fl.}\ \frac{3}{2}dv^2\dot{y}$. Hence it is reduced to this, that we must find the fluent quantity of the fluxion $\frac{3}{2}dv^2\dot{y}$.

Let it be the quantity $\frac{3}{2}dv^2y - r$.

Hence $\frac{3}{2}dv^2\dot{y} + 3dv\dot{v}y - \dot{r} = \frac{3}{2}dv^2\dot{y}$;

Therefore $\dot{r} = 3dv\dot{v}y = \frac{3}{2}d^2v\dot{x}$. Let $r = \frac{3}{2}d^2vx - s$;

Then $\frac{3}{2}d^2v\dot{x} = \frac{3}{2}d^2v\dot{x} + \frac{3}{2}d^2x\dot{v} - \dot{s}$;

Therefore $\dot{s} = \frac{3}{2}d^2x\dot{v} = \frac{3d^3x\dot{x}}{4\sqrt{dx-xx}} = \frac{3}{4}d^3\dot{v} - \frac{3}{4}d^3\dot{y}$ by theorem 2.

Hence $s = \frac{3}{4}d^3v - \frac{3}{4}d^3y$; and therefore the area sought $=$ $v^3x - \frac{1}{2}dv^3 + \frac{3}{2}dv^2y - \frac{3}{2}d^2vx + \frac{3}{4}d^3v - \frac{3}{4}d^3y$.

Now because solids generated by the rotation of curves, with the superficies produced by the same rotation, and the rectification of curves, as also the centres of gravity of all these, depend all on the quadrature of curves; these will be easily computed when they depend on any of the above curves.

After I had put these theorems into form, and had showed them to the great Newton, as the supreme judge of these matters; he was pleased to show me his own manuscripts, by which it appeared that he had long been in possession of a method, by which, when any trinomial equation is given, expressing the nature of a curve, he could either square the same, or reduce it to some simpler curve. It is much to be wished that he would condescend to publish not only what relates to these matters, but many others of his excellent inventions; which would be a great benefit to the republic of letters.

I doubt not but those learned men, whose writings in the Leipsic Journals, and elsewhere, have greatly contributed to the improvement of the mathematical sciences, may have methods similar to these; and therefore I assume nothing to myself, but that I have discovered these theorems, not knowing whether they may be already extant or not; and that I have reduced them to so easy a form, that all the calculation required, is performed as it were by intuition.

Before finishing this paper, it may not be amiss if, on this occasion, I add a few words in answer to the animadversions of the learned M. Leibnitz, on a certain series I published* for finding the root of an infinite equation. That celebrated man is of opinion, that that series is not sufficiently general, as not extending to the cases in which the quantities z and y are multiplied into each other; and therefore he substitutes another series for mine, which he asserts is infinitely more general. Now I suspect he has been led into this small mistake, by having taken the quantities a, b, c, d, &c, for given quantities; whereas they may be used at pleasure for either given or indeterminate quantities. But for one example to show that my series includes all cases whatever, take the equation $nyz - z^3 = y^3$. Now in my theorem make $a = ny$, $b = 0$, $c = -1$, $g = 0$, $h = 0$, $i = 1$; or, which is better, make $g = yy$, $h = 0$, $i = 0$; in either case it will be $z = \frac{y^2}{n} + \frac{y^5}{n^4} + \frac{3y^8}{n^7} + \frac{12y^{11}}{n^{10}}$ &c.

Account of several unusual Parhelia, or Mock Suns, and several Circular Arches, seen in the Air. By E. Halley. N° 278, p. 1127.

April 8, this present year, 1702, about 10 o'clock in the morning, the air being clear, I observed the sun shine faintly, or as we call it, waterish, and perceived several arches of circles round him, as represented in fig. 11, pl. 16;

* See p. 275 of this volume.

where S is the true sun; Z the zenith; STPP a large white circle passing through the sun, and, as near as I could judge, parallel to the horizon. It was very distinct and entire, about two deg. broad in the northern part about T; and held much the same breadth in the east and west, but grew narrower towards the sun: its edges were not very well defined, the whole appearing like a faint white cloud, and a part of it would have been taken for such, but the whole circle, seen in the pure azure sky, was a very extraordinary sight.

VNXY is a halo, or rather iris, that was also an entire circle, having the sun for its centre. I measured the semidiameter of this, which was about 22 deg. the breadth of this arch, which was well defined, was by estimate equal to the sun's diameter, and it was coloured with the colours of the iris, but by no means near so vivid as in the common rainbow. The red colours were next the sun, and the blue in the outer limb. Within this circle the sky appeared somewhat obscure, especially near the arch; and I suppose the cause of that obscurity was likewise that which made the sun shine so faint and waterish. I expected two parhelia at X and Y in the intersections of this with the white circle, having often seen them at that distance and position from the true sun, but at this time none such appeared.

PVP is an arch of another circle, of which only the upper part appeared; it was in all respects, both for breadth and colours, like the circle VNXY, which it touched in the vertical point V, but its centre was below at N, or near it. In the intersections of this arch with the white circle on both sides, there were two very bright parhelia, which were also tinged with colours, especially on the side next the sun, where they were very red. I measured their distance from the true sun, and found it $31\frac{1}{2}$ deg. About V, where the two arches were coincident, it was very bright also, and the red on the inside very strong; but the species of the sun was there drawn out so in length that it could not properly be called a parhelion; this arch PVP boke off on both sides, about 5 or 6 deg. below the parhelia PP.

At N, or the lower part of the circle VNXY, there appeared also a small piece of an arch, which touched it there, after the same manner as PVP touched in V; it seemed to have its centre in V, and about N there appeared another longish red species, such as at V, but not quite so bright.

The height of the sun, during the observation, was from 40 to 45 deg. when clouds interposing, no more was to be seen; the weather was cooler than ordinary, with a gentle N. W. wind. And it was plain that the vapour which caused this appearance, was higher than the clouds, for they were seen to drive under the circles.

Abstract of some Letters from Mr. Christopher Hunter to Dr. Martin Lister, F. R. S. concerning several Roman Inscriptions, and other Antiquities in Yorkshire. Dated from Stockton in April and May 1702. N° 278, p. 1129.

There has been a Roman station at a village called Ebchester in the county of Durham. It has been surrounded with a wall of hewn stone, and seems to have been an exact square, of about 200 yards on every side; there have been suburbs towards the west, south, and perhaps east, of a considerable extent; but towards the north the wall has stood upon the top of a steep bank, under which runs the river Derwent, in which not long since was found a long altar, but its inscription defaced; as also a smaller stone, with this word, HAVE, on one side. There is another, which is used as a grave-stone, that lies before the church-door, which by the engraving of a man from the breast upwards in a Roman dress, seems to have been Roman. These are all the stones I can meet with that have ever had any Roman inscription. I inquired of the most understanding inhabitants concerning what has been found there whilst they dug up the ruins of this place, all confess they have dug up many inscriptions, but (because nobody there understood them) they always broke them; and they add, that in most places they plainly discern two different foundations of ruined houses, and most stones thus dug up are tinged of a deep red colour, undoubtedly by fire. That part of the village which stands within the walls, is called the Mains, and there are the most ruins; here are many fragments of tiles dug up, of a red clay, but not one entire. On undermining an old foundation, still visible on a hill side, there was found a considerable quantity of pewter.

Watling-street passes by this place, about 100 yards to the west; for it could not conveniently be brought through the town, by reason of a brook 2 or 300 yards to the south, whose banks are very uneven; and the above-mentioned steep hill, towards the north, makes a passage that way next to impossible. I can meet with no certainty whether the Romans have had a bridge over Derwent, at Ebchester; but it seems probable they had, both from the number of soldiers who must needs have passed that way, and from the considerable size of this river.

Most of the words in the Roman inscriptions are so artificially erazed, that I am apt to believe it has been thus defaced on some revolution in the Roman government. These stones, beautified with inscriptions and sculpture, were dug up some time ago in a field called the Bower, about half way between the Roman wall and south Tine, and near 2 miles west from Busygap; here has been kept a Roman garrison; it is square, surrounded with a single wall, but now is nothing but heaps of stones, overgrown with bushes. Some years ago, on the west side of this place, about 50 yards from the walls, there was discovered, under a heap of rubbish, a square room, strongly vaulted above, and paved with large square stones set in lime; and under this a lower room, whose roof was supported by rows of square pillars, about half a yard high; the upper room had two niches like, and perhaps in the nature of, chimnies, on each side of every corner or square, which in all made the number 16; the pavement of this room, as also its roof, were tinged black with smoke. The stones used in arching the upper room have been marked, as joiners do the deals for chambers; those I saw were numbered thus X. XI. XIII. The other inscriptions were all found near the Housesteads, a place so called from the abundance of ruins there, about half a mile from Busygap towards the west, just within the Roman wall; among the ruins I found several pedestals, two or three pillars, two images, but somewhat defaced.

In my journey into Northumberland I found Watling-street very visible from near Ebchester, almost to Corbridge, which is about 7 miles. From hence I travelled on this street almost to Resingham; and it is very visible all this way; about a mile south from Resingham there is a pillar of about 8 feet in length, which has stood by the way side, but is now fallen; I got a brass medal which was found here a year ago; the emperor's name worn out, AVG.PIVS. very legible, but by the figures of other medals I take it to be Antoninus; on the reverse a wolf, without any inscription.

The next Roman town I visited was Rochester: Watling-street is very visible some part of the way, but how far I cannot tell, not having traced it. I cannot say this is the largest, but think it has been one of the best fortified places the Romans have been masters of in the north; and indeed it stood in need of being so, since it was not only a frontier town, but was surrounded by enemies. From this place I returned to the Roman wall at Carrow, between which and Walwich, the wall has been repaired, and fronted with its old stones again.

On the Planting and Culture of Tobacco in Ceylon. By Mr. Strachan. N° 279, p. 1134.

There are here two sorts of tobacco, both which are called dunkol, that is, a smoking leaf, for dun is smoke, kol a leaf; the one named hingele dunkol, or singele dunkol, for they make no distinction of h and s: the other is called dunkol kapada, which is very intoxicating, and much stronger than the former. They are the same species, the difference being only in the cultivation.

The natives clear a little piece of ground, in which they sow the seed of tobacco, as gardeners do parsley and coleworts; against the time that this is ready for transplanting, they choose a piece of ground, which they hedge about;

when the buffalos begin to chew the cud, they are put within this hedge ground, and let stand until they have done, and this they continue day and night, till it be sufficiently dunged; then the ground is dug with a spade, in form of a pick-axe, such as carpenters use when they dub planks, by hoeing the ground, and mixing the dung among the earth; when the ground is made smooth, they remove the plants out of the seed-bed, and set them in this ground, about a foot distance from each other, and then they grow up almost like a dock; when the stem has got 15 leaves, they cut off all the tops of the plants; and if they desire not to have the tobacco very strong, they let it grow till it has 18 or 20; but when they would have it stronger, they top it when it has got 10 or 12 leaves, not counting the 3 or 4 lowest leaves, which are nearest the ground, because they never grow so large and good as those above them. Thus the moisture of the ground not being wasted in leaves, flowers, and seed, it makes the remaining leaves 4 or 5 times larger, fatter, fuller of strength and virtue, than the tobacco which is not ordered after this manner. Every 3 or 4 days they go through all the stems, and brake off the buds or side-shoots whenever they spring out; and this they continue to do till the leaves be ripe, which is known by the thickness and firmness.

Then while the leaf is green they cut down the stem together with the leaves, and bring them into their houses, laying them in a heap; and thus the leaves begin to ferment and turn hot; and when they begin to sweat, they turn the innermost outward, that they may ferment easily, otherwise the innermost would ferment too much, spoil and rot; thus the longer they lie in a heap together, the tobacco turns the darker coloured. When it has sweated enough, they hang it asunder upon cords till the leaves are dry: then they separate the leaves from the stalks, and lay them up in bundles together, till they are wanted for use.

Abstract of some Letters from Mr. Anth. Van Leuwenhoeck, F.R.S. to the Right Hon. Lord Somers, P.R.S. containing several Microscopical Observations and Experiments concerning the Animalcula in Semine Masculino of Cocks; of Spiders; Shortness of Breath, &c. N° 279, p. 1137.

I have often observed, that young cocks, not arrived to half their growth, are wont to tease the young hens to couple with them, which the latter always refused till they had laid eggs, that is, till they were 4 or 5 months old. This made me conclude that when the young cocks were thus stimulated to copulation, the animalcula in their seed were living, which upon viewing I always found to be so. On opening the seminal vessels of a young cock that was newly killed, plucked, and still warm, I discovered these animalcula still living;

and they remained alive for the space of half an hour, after I had squeezed a drop of the seed out of the said vessels. These animalcules appear, both in motion and when they lye still, as if the fore-part of their body was crooked, or circular. ABCD, pl. 16, fig. 12, represent one of those animalcules in its full length; ABC is the body, which is seldom quite straight, but the tail mostly folded; its tail is long, and exceedingly small, which is shown by CD.

In the fore-part of the bodies of many of those animalcula I discovered a clear bright spot, which was not to be seen in others; and the tails of such as lay dead were like so many bows, as represented fig. 13, 14, 15, 16.

September 17, 1701, about 10 o'clock in the morning, I again viewed the semen masculinum of a young cock, which was about 12 weeks old, and had been killed an hour before, where I found the animalcula full of life. I took some of the same seed, about the quantity of a large pin's head, and ordered it so, that very little of the fluid matter could exhale. I observed this matter every hour, and the same evening about 7 o'clock I found the animalcula as lively as ever. But about 8 or 9 o'clock I could perceive that many of them were dead, and in one place, the space no larger than a grain of sand, there were great shoals of them living; but a little further, and in a place of much the same extent, I could not perceive the least motion in those that lay there.

September 18, in the morning, about 7 o'clock, and also about noon, I again made my observations of the same seed, as it lay in a glass tube, as large as a thick pin, but I could see no life in the animalcula; but when I looked on another part of the same matter, of the size of a large sand grain, and spread very thin on the glass, I saw a great many, very lively and nimble in their motions, but their life and motion dwindled away, till at last I could perceive none; the reason of which I judged to be, that the thin fluid matter was all exhaled from the seed, and that then the animalcula presently die.

To satisfy myself further in this matter, I took a dead cock, that had been killed and plucked the day before, between the hours of 7 and 9 in the morning, and opening the body, I pulled out the guts and stomach, that I might the better come at the vasa seminalia deferentia: I squeezed out of one of the seminal vessels a drop of the seed, and presently setting it before my microscope, I could see an infinite number of those animalcula, swimming in legions together, and crossing one another like clouds in a stormy day, and as brisk and lively as if the cock had been newly killed. I put into the body again that part of the intrails which I had taken out, and drew the skin over it, in order to take out a little more of the seed about 6 hours after; and accordingly at noon I took out a little of the seed, and found the animalcula in it still living.

But about 6 in the evening, having again taken some of the semen out of the vasa deferentia, I could not perceive any of them living. I then opened those vessels in several places, even where they terminate in the testicles, but the animalcula were all dead. Since then the animalcula in semine masculino are living when taken out of the body of the cock, so long after the cock himself is dead, perhaps they are intended to fasten in the ovarium or egg-nest of the hen, and impregnate not one yolk, but many, which compose the bed of eggs; and the rather as we find, that with one coition of the cock and hen, most of the eggs which the hen lays in a month or two after, are impregnated.

As to spiders, a certain gentleman, who had often considered their nature and copulation, told me that he could seldom meet with the males of the large spiders, and that he believed the females killed and eat them up.

And I was further told by the same gentleman, that where we saw the females of the smaller sort of spiders, there was also one male; and I have observed the same myself. But what this gentleman took for the membrum virile, was quite otherwise, and I told him he was mistaken; for the more I showed them, the more I was convinced that they were two working instruments, with which the spiders take up their food, and use also instead of short feet.*

Since that time I have often been in places where thistles, nettles, and other weeds grew, where I saw several kinds of spiders, and in great numbers; and observed that when the male spiders approached the females, in order, as I thought, to couple, the females always put the males to flight. I have often taken up the male spiders, that I might observe their seed, and have been fully satisfied that that little white matter which I have squeezed out of the hinder part of their bodies, and which was sometimes as large as a grain of sand, and sometimes a little larger, was nothing else but the male seed of these animals; I discovered in it a vast number of animalcula, which continued living a long while. These were so exceedingly small, that I believe a thousand millions of their bodies joined together would not be equal to a large grain of sand. By reason of the extreme smallness of these animals, it was impossible to represent the figure of their bodies, or of the instruments with which they moved so strongly, as to continue living above 5 hours after they were separated from the bodies of the spiders.

I shut up in a glass tube 3 male spiders, and 1 female together; and after the space of 2 days, I saw the female fall upon the males with such violence, that the blood ran out of their feet; on which I killed the female, and the next day I saw two of the male spiders lying dead, and the remaining male was

* The gentleman however happened to be in the right. See Clerk's *Aranei Suecici*, &c.

eagerly devouring the female. I had three other male spiders, which I had shut up in the glass tube 48 hours, and so having hindered them all that time from coupling with their females, I concluded I should find seed enough in all of them; and so it happened accordingly, and I observed the animalcula alive in it.

Having had frequent discourse with a physician about curing shortness of breath; he told me, that he was well acquainted with all the sorts of balsam that were esteemed useful in that disease, but that it was impossible to find any vehicle that could insinuate them effectually into the lungs, and that in vain they anoint the breast and stomach with balsams, which could never reach the lungs, and that the scent of the balsam which exhaled from those that used to anoint their breast with oil, does not exhale from the pipes of the lungs, but was evaporated from the breast by the neck.

I was also persuaded of the truth of this assertion, because I am convinced that nothing that is in the stomach or bowels can be conveyed to the lungs unless it has first passed through the heart; and consequently much less can balsams, laid on our breasts, find any passage into the lungs. And the only means I could think of, to insinuate the invisible particles of balsam into the lungs, was to take a little piece of silver or copper, of the size of a shilling, and making a small hole in it, to fill the cavity with a little balsam proper for the lungs of one that is troubled with a shortness of breath; that done, let him place it upon the tongue, and stopping his nostrils, let him admit no air into nor from his lungs, but through his mouth; by which means the subtle particles of the balsam, which I shall call its spirits, may exhale and descend into the pipes of the lungs.

Or better thus; I took two glass tubes, one of 9 inches, and the other of 18 long, and of half an inch diameter. I made several bends in these tubes, and made a small hole at the end of each, fit for my purpose, in order to put it into the mouth; and filling it half full of balsam, I placed it horizontally, that the air passing over the balsam might be conveyed into the lungs, more strongly tinged with the said balsam, than it could be by the other project. But afterwards I rejected this way also, and the next morning I took a glass tube, 15 inches long, and about 1 inch in diameter, as represented ABCDE &c. fig. 17, pl. 16. DEF the end which is put into the mouth, in order to draw in the air.

This glass tube, being open at AIK, is to be filled with a piece of linen, gauze, or muslin, or a little bit of sponge, of such a size that it might be put into the tube without pressing, and that a thread or string might be fastened to it, in order to pull the sponge or linen out of the tube, as seen at KL, the rag or sponge being moistened in balsam proper for the lungs, before it is put into the tube, as BCGH.

But considering, that if the said sponge did not touch the sides of the glass in every part, the air would pass by it, where there was no resistance, as also that the air would with difficulty pass through the linen or sponge that was dipt in balsam, especially if that were thick; I rejected this tube also, after all my preparations, and took another of the same length and size with the former, with this difference only, that it was throughout of the same width. This tube, which is represented by MNOP &c. fig. 18, I stopped at each end with a cork, as at MNWX and PQST. In this last cork, I made a small round hole quite through, in which I strongly fixed a small glass tube R; and so also I perforated the other cork MNWX. This done, I thrust into the lowermost cork another long crooked glass tube, YZ, tapering to a slender end as ZA, that the air when sucked in at R should come in leisurely at the straight passage ZA.

Having thus disposed the large tube, with the cork so strongly screwed in it, and the small tube in the cork, that not only no water, but even no air could enter in it, I judged that I had quite finished my machine. To make an experiment how it might succeed, I drew the cork PQST out of the tube, and poured a little brandy in it, as in NOVW; then having placed the said cork with the little tube in it, into the large tube again, and putting the small tube R between my lips, and sucking in the air, which rushed in at the small end A of the tube YZ, and which was obliged to pass through the brandy, I perceived the brandy to be put into a violent agitation and bubbling, by which its spirits, if I may so call them, were made to rise in an extraordinary manner up into the mouth, and consequently into the lungs, as the event plainly demonstrated.

If then the exhalations or volatile particles of balsams are rendered serviceable, not only for comforting, but even for curing diseased lungs, the more spirits of these balsams can be conveyed into the lungs, so much the better; but I would not have the air pass so simply through the balsam, as it went through the brandy, when the tube should be filled with the former so far as it is with the latter, but intended to put the glass tube, so far as it is filled with balsam, in hot water; however, in order to prevent the bursting of the tube by too sudden a heat, it ought to be laid in a bason fit for the purpose, with some cold water, pouring softly a little boiling water upon it to the height of the balsam, or else to lay the tube in a bason with the necessary quantity of water, and put it upon the fire. By this means the spirits of the balsam will exhale much more freely than when cold, and the lungs will be thus so heated, as to put the patient into a gentle sweat. I have often thought too, that these balsams, or at least some cordial gums, herbs, or juices, are not only good against shortness of breath, but will also preserve the lungs from cold stinking mist, and pestilential airs. The best balsam for shortness of breath, is the balsam of Peru, which I never saw, neither did I intend to make the abovementioned instrument a vehicle for balsams; for I freely own, I have no skill in balsams, of gums, or herbs, only this I have often experienced, that stinking smells are prejudicial to my lungs.*

In order to make the glass tube, fig. 17, as useful as the other, fig. 18, I prepared such another instrument as is represented, fig. 19, ABCDEF, longer than that which is represented by YZA, on this account, viz. that if we be inclined to put more balsams or juices into the tube, this long pipe might be thrust up higher into the water.

Now if we consider the structure of our bodies, as far as they are known to us, we may firmly conclude that no part of us is exposed to so many evils as the lungs; for how easily may they be hurt if we do but go into the cold air, which engenders and causes us to discharge phlegm, to cough and spit: and how easily may the globules of blood in the fine vessels of the lungs be coagulated by the cold.

In order to get further light into these matters, I took the smallest of the lungs of two several sheep, that I might view those parts with the microscope; and I was amazed to discover that the air vessels were filled with pus or matter, even at the extremity or smallest part of the lungs. A butcher coming to view the lungs, he felt them in several places, and showed me some hard parts, about the length and breadth of two fingers, and told me that the sheep had caught cold, which had occasioned that disease of its lungs; and the same thing was attested by several other butchers; I asked them whether the sheep would not have died of that disease, but was answered, that those hard places often disappear again. I could not discover the least pus or matter in the air vessels of the lungs of two other sheep, which were of an agreeable colour, and like the other. Having viewed the outside of the lungs of a sheep that had not been distempered, it seemed that a great many small transparent globules lay under the membrane; but when I separated the membrane from the liver, those transparent globules appeared to be nothing else but small particles of air pressed together into different and irregular figures; and those globules seem to lie out of the air vessels.

* Mr. Leuwenhoeck's idea of a direct application of balsamic and other medicinal substances to the interior of the lungs, has been acted upon by some modern physicians in this and other countries, they having attempted to cure phthisis pulmonalis and other disorders of the lungs, by causing the patients to inhale certain gases and æthereal vapours. This is what is termed the pneumatic mode of treatment.

I took several pieces of the lungs, and pressed the blood and air out of the vessels in which they lay, and was amazed at the vast number of bubbles of air that came out of the vessels, some of which were so exceedingly small, that they even escaped the sight of my microscopes; those globules I supposed to be contained in very fine vessels, and when the blood and the air were squeezed out of that part of the lungs, where there were no great vessels, the remaining ones, whose tunics were exceedingly fine, made together but a very small portion of matter.

I took also the unsound lungs of two other sheep, and found, in the handling, that their parts were much harder than others, that were not distempered, and that the matter or pus was stiffer or thicker in those lungs, than in the abovementioned: looking on the external parts of these lungs, I perceived in several places of them pellucid particles, which far exceeded in size the air globules beforementioned.

Being persuaded now that all the distempers in the lungs of sheep are occasioned by the cold air which those beasts inhale, I asked two butchers whence they thought the diseases of their lungs to proceed, they answered, that the sheep running in the meadows at the latter end of the autumn, and eating grass that was either actually frozen or covered with cold dews, was the reason their lungs were thus spoiled; and that the same happened sometimes in May. But for my part, I rather conclude that the frozen grass does not hurt their lungs, but stomachs, and that the cold air affects their lungs. Knowing that our butchers fetch abundance of fat sheep from Brabant, and that those sheep are driven every morning into the field, and folded every night by their shepherds; and that our sheep, on the contrary, are brought into the meadows in May, and there left till it snows and freezes; I asked the butcher whether the Brabant sheep had such bad lungs as ours; and was answered, seldom or never. From whence I was still better satisfied that the diseases in the lungs of sheep, and especially of such as lie in the field in the long cold nights, were occasioned by nothing else but their drawing in the cold air. I further asked whether such sheep were fat while they were kept up, and whether they could distinguish while living which of them had bad lungs; to which they answered, that those whose lungs were touched, never increased in fat after they were stalled; and that within a fortnight's time after they had been shut up, and fed with beans, in order to fattening, the distemper usually disclosed itself, by their coughing, and therefore they always killed those sheep first.

Now if we allow that the cold air is so prejudicial to the lungs, we ought not to wonder if such an inconvenience, as we call a cold, comes upon them. And I am of opinion, that in a long cold winter the lungs may be so much incommoded, that a great fit of sickness, and even death itself, may be the consequence of it; for if we do but consider what a deal of phlegm we discharge in that sickness which we call a cold; and if it be greenish, it is almost a purulent matter, which comes out of the air vessels of the lungs, we are presently frighted at it, and with reason, for the disease may proceed so far that a consumption of the lungs may ensue.

Concerning some Roman Coins, and other Matters lately observed in Lincolnshire. By Mr. Thoresby. N° 279, p. 1156.

One Edward Lenton being about to fence in a hay-stack, and digging a grip for that purpose about the depth of half a yard, he struck his spade upon a pot, in which, when he broke it, he found 36 pounds weight of old Roman copper coin. The pieces had been set in rows edgewise one by another, and stuck so together with the verdigrise or rust of copper, that many of them required a chisel or some such thing to separate them; but being separated, cleaned, and brightened, the heads or figures of all, or most of them, were very fair, some as when newly stamped, and the inscriptions of many very legible. The place where they were found, is in the midst of the largest flat or level in England, and in a ground that for many ages past used to be covered with water in the winter, and overgrown with reeds in the summer. It is about a mile and a half south by west from Fleet Church, and about as far south by east from Holbeach. There are no banks or hillocks, old works or ruins, to be seen near it; nor the remains or tokens of any thing extraordinary to be seen, excepting the old sea bank about 2 or 3 miles off: which Dugdale, from a passage in Tacitus, believes to have been cast up by the Roman soldiers. But all is as level as the sea, and a low country, producing a coarse flaggy grass round about it. The pot, which was narrowest at the top and bottom, but wider in the middle, had an inscription about it, which, though it seems in some of the sherds or pieces to be fair at first sight, yet is not legible.

Near the River Welland, that runs through the town of Spalding in Lincolnshire, at the depth of about 8 or 10 feet there were found jettys, as they call them, to keep up the old river bank; and the head of a tunnel, that emptied the land-water into the old river; also at a considerable distance from the present river, I guess 20 or 30 yards, there were dug up, at the like depth, several old boats; all which show that anciently the river was either much wider than now, or ran in another place or both. On the north west side of the river, and more upwards in the town, were dug up at about the same depth, the remains of old tan vats or pits, a great quantity of ox-horns, shoe soles, and the very tanners' knobs, &c. which shows that the surface of the country lay anciently much lower than now, and has been raised by the seas throwing in sand on the maritime parts, which are now mostly inhabited, and by the moor or rotten sedge in the fenny parts next the high country; the whole level is about 50 miles in length, and 30 miles over in the broadest parts. No record or tradition whatever informs us when these mutations happened.

At the laying of the present new sluice or gout, as they call it, at the end of Hamorebeck, at its fall into Boston Haven, on taking up the foundation of the old sluice they met with the roots of trees, many of them issuing from their several trunks, spread in the ground; which when they had taken up, and the roots and earth they grew in, they meet with a solid gravelly and stony soil, of the high country kind, but black and discoloured by the change it had suffered; upon which hard earth they laid the foundation of this new sluice; which was certainly the surface of the old country before it was covered by the sea, and was much deeper than that at Spalding, as the land is there at present higher.

I take this to be an experimental confirmation of Mr. Ray's sentiments, in his Physico-Theological Tract, concerning the great changes made in the terraqueous globe, viz. that the great level of the fens running through Holland in Lincolnshire, the Isle of Ely in Cambridgeshire, and Marshland in Norfolk, was sometime part of the sea, which by degrees had been raised up by earth brought down by floods from the upper grounds, and by the great quantity of mud subsiding there. The form of the shoe was much like those found with some urns at Kirby Thore in Westmorland, as described in the Phil. Trans. N° 158.

Observations on the Class of Sweet Tastes, made by comparing the Tastes of Sweet Plants with M. Lemery's Chemical Analysis of them, in his Treatise of Drugs. By Sir John Floyer. N° 279, p. 1160.

I observe that by our taste we may discern all the chemical principles in plants before their distillation; and that for want of a due observation of their tastes, Mr. Lemery has not fully described the chemical principles which plants yield in distillation. All watery plants show their phlegm as well to the taste, as in distillation; and in all dry woody tastes, we observe the earth, as well as we can by the chemical analysis. By the mucilage and gumminess, or oily taste, we distinguish the oil of plants, as well as by distillation. The aromatical smell shows us the volatility of the oil and salt of plants; and by the fœtidness we also know that the oil and salt are in a volatile state. By the acrimony and pungency we know that there is a volatile salt in plants; and by their burning taste we find there is a corrosive salt in them. By a crude rough acidity we observe the tartar, or essential salt of plants; but if the acidity be of a vinous smell, we observe that it is of a middle state of digestion, and may be called a vinous tartar, and the crude tartar an acerb tartar; but if the tartar had a pungent smell, then it is a volatile tartar, or acid acrid tartar.

I will next describe the principles observable in sweet tastes, and their several classes; but must first observe that sweet tastes show their oil by their slimy smoothness, and their tartar is evident in their extracts, as in the juice of liquorice. 1. The grass sweets, gramen caninum, have much essential salt and moderate oil; juncus equisetum, arundo, typha, nymphæ, are all of the rush kind, sweet and rough, and some of them have more oil, others more acid, and the most crude have more oil than tartar. 2. The corn sweets, as barley, rye, wheat, oats, rice, millet, have much oil and essential salt, and a little volatile: so bread yields oil and essential and volatile salt. Note, that fermentation or the fire produces the volatile salt, by exalting the tartar into a volatile salt; and the slimy mealiness in corn supplies the oil. 3. The subacrid sweets, as rampions, campanula, trachelium, contain much oil and essential salt; but the acrimony in these plants shows a volatile salt not described by the chemist. 4. The ferns contain oil and essential salt, as polypody; but the acrid principle is not observed by the chemist, nor the fragrancy in hart's tongue. Osmunda and the capillaries have more oil than salt, because more mucilaginous and crude. 5. All the leguminous slimy sweets have more oil than tartar, but all much of both, as broom, ononis, aquilegia, fumaria, asparagus, ruscus, thalictrum, polygonatum, sena, galega, lathyrus, luteola, periclymenum, glycyrrhiza, psyllium, much oil and volatile or essential salt. 6. The sweet nuts, as almonds, have much oil and essential salt; but the bitter have more salt than the sweet almonds; therefore it is probable that the tartar abounds more in all bitters, and that tartar is the effect of a higher digestion, and the crudest tastes, as styptics, sweets, and slimes, have least of it. So chesnuts and beech-nuts have much oil, and little salt. Filberts are described to have essential salt, and a little volatile as well as oil. 7. The sweet acid or vinous tastes have much oil and essential salt, as prunes, cherries, strawberries, raspberries. The sweet viscous fruits, as sebestens, have little essential salt, and much oil. 8. The sweet aromatic burning tastes contain a volatile salt and oil, as schenanthus, ginger, zedoary, cubebs, cardamoms, vanillas, contrayerva, calamus aromaticus; but these following are mistaken by the chemist, who says that costus amarus, dulcis, cyperus, galanga, orris, have a volatile oil, but essential salt only; for orris is acrid and aromatic as well as the rest, and therefore there is both volatile salt and oil in them, and also an essential salt from their sweetness. 9. The sweet acrid aromatics of the fennel class have all volatile salt and a volatile oil; as angelica, lovage, parsley, meum, dill. Note, the leaves and roots of fennel contain a volatile oil and essential salt, the seed a volatile oil and salt: but since the roots and leaves have a pungent taste, there is also a volatile salt in them, though the chemists do not observe it. All the parts of carraways have the odour of punaises, except the seed; from whence I may infer, that the fœtid plants have the same principles as the aromatics, viz. a volatile oil and salt; and this is confirmed by other fœtids which have them, as rue and assafœtida and vulvaria. Peucedanum is described of a bitter acid taste, with the odour of pitch, and must have a volatile salt, though Lemery describes only its essential salt and oil: so in smallage he describes only the essential salt and oil, but its acrid taste manifests the volatile salt. 10. The sweet gums; as manna, sarcocolla, contain much oil and essential salt; though honey and sugar have more essential salt than oil; by which we may observe how much essential salt is in all sweets, and why they are apt to turn sour and ferment; and from such sweet gums all sweet plants have their acid and oil on distillation. 11. Citrulls, melons, gourds, cucumbers, which are bitter sweets, and very mucilaginous, contain much oil and little salt.

Since the whole classes of sweet plants contain an oil and essential salt, some more some less of both, the virtues of the several sweet tastes can never be explained by the chemical principles, and no new virtues by them are discovered; therefore all the advantage we have obtained by these chemical distillations, is only to show the nature of sweetness in general, by discovering the principles contained in sweet plants, and this is a greater advantage to natural philosophy than to physic, to which the tasting of plants is more useful. By the taste we distinguish the sweets into their several classes, and we discern tempers and digestion, and mixture of their principles, and thence easily guess at their effects in animals; and by the taste we distinguish the different state of both the oil and acid in plants of different sweet tastes; whereas the chemists observe no difference of the tartar acid, whether it be acerb or vinous, or volatile; nor of the sweet oils from the bitter and slimy. By the taste we distinguish the acrid and the acid salts, which mix in distillation; and they are not well distinguished by the chemists. By the taste we discern when the fire makes new products and mixtures, not naturally found in plants; for in corn, beans, peas, bread, fire produces a volatile salt, not observable in them before: and a volatile salt is drawn from the lees of wine by the fire; and leven yields also a volatile salt; whereas before in corn only an oil and acid were observed; and it is probable that the tartar is volatilised, both by the fermentation and the fire. Coffee is a bean* by its taste and cods, and acquires a volatile salt by roasting; but Lemery only mentions its oil and fixed salt upon distillation, but the fixed salt is the

* Coffee is the seed of the berries of the coffea arabica, Linn. Each berry contains 2 seeds.

effect of fire, and its virtue depends on the volatile. No more chemistry is necessary for the discovery of the physical virtues of plants, than to make decoctions of them in fair water, and to observe the tastes and other sensible qualities of those decoctions, and from them to take the natural hints for the trial of their virtues on animal bodies. I hold these objections against decoctions, that the volatile parts exhale, and the mucilage dissolving in the water obscures the taste; I therefore confess, that plants are best tasted in their natural state, to discover all their virtues: but these decoctions help to confirm our tastes, and to discover the great variety of medicines which may be made from sweet tastes. Note, that all decoctions must be tasted cold.

Account of some strange Epileptic Fits. By Dr. Charles Leigh. N° 280, p. 1174.

We have this year (1702) had an epidemic fever, attended with very surprising symptoms. At first the patient was frequently attacked with the colica ventriculi; convulsions in various parts, sometimes violent vomitings and a dysentery; the jaundice, and in many of them a suppression of urine; and what urine was made, was highly saturated with choler: about the state of the distemper there appeared large purple spots, and on each side of them two large blisters, which continued 3 or 4 days; these blisters were so placed about the spots, that they might in some measure be termed satellites or tenders; of these there were in many four different eruptions; but the most remarkable instance I saw in this fever, was in a boy at Lyme in Cheshire, about 13 years of age, who was afflicted with the following symptoms; on the crisis or turn of the fever, he was seized with an aphonia, and was speechless 6 weeks, with the following convulsions; the distemper infested the nerves of both arms and legs, which produced the chorea Sancti Viti, or St. Vitus's dance; the legs were sometimes so contracted, that no person could reduce them to their natural position; besides these, he had most terrible symptoms, which began in the following manner; he could perceive the fits coming on about the os sacrum, or extremity of the back bone, and the region of the navel; and then the disorder, as he imagined, united about the top of his head; immediately after he fell into such violent convulsions in the abdomen, that sometimes two or three persons were obliged to lie upon him, to keep him in bed, his body being frequently raised from it; after this the nerves of the lungs were immediately affected, and then he barked in all the usual notes of a dog, sometimes snarling, barking, and at the last howling like a hound; afterwards, the nerves of the mandibles were convulsed, and then the jaws clashed together with such violence, that several of his teeth were beaten out, and then often there came a great foam from his mouth; afterwards he had an exceedingly wild look, snatching at any thing near him, and he would have tore off his flesh had he not been prevented by the persons about him. This made me conjecture he might formerly have been bitten by a mad dog, which had introduced the hydrophobia; but I was convinced to the contrary, for I put a basin of water by him, and he was not in the least afraid of it, nor attempted to lap it. I saw him in three of these fits, but at other times in these convulsions, he roared like a bull, made a noise like a hog, and sometimes like that of a gosling; all which different sounds seem to proceed from the different contractions of the lungs, variously forcing out the air, and consequently as they were differently convulsed, form various sounds. In a week's time I recovered the boy his speech, his senses returned, his convulsions vanished, and he is now very cheerful. There have been other persons in this country much after the same manner.

An Account of several Schemes of Arteries and Veins, dissected from adult Human Bodies, and given to the Repository of the Royal Society by John Evelyn, Esq. F. R. S. To which are subjoined a Description of the Extremities of those Vessels, and the Manner the Blood is seen by the Microscope to pass from the Arteries to the Veins in Quadrupeds when living: with some Surgical Observations and Figures after the Life. By William Cowper, F. R. S. N° 280, p. 1177.

The figures of the arteries and veins were drawn from the vessels themselves pasted and dried. They were dissected from adult human bodies, and displayed on tables in the repository of the Royal Society, and are the present of John Evelyn, Esq. from whom I received the following letter, concerning them and other tables of the nerves, &c.; to which I have subjoined a further account, &c.

For Mr. Cowper.—"Hearing, Sir, that you are causing the tables of veins, nerves, &c. which I some time since brought out of Italy, to be accurately delineated, in order to their being engraven, as more correct than any that are yet to be found among the figures of those vessels in books of anatomy; and desirous to understand how they came to my hands, I send you this little history of them for your satisfaction.

"Being some years since in Italy, and curious to see the many repeated dissections at the anatomical theatre at Padua, Cavalier Vestlingius being then professor, and reading on bodies several days during Lent, Dr. Johanno Athelsteinus Leoncena, who was then operator, by extracting the veins and other vessels, which contain the blood, spirits, &c. out of the human bodies, began to apply and distend them on tables, according to their natural proportion and position: some of these tables being finished by the direction and public approbation of the professor and several other physicians and anatomists, present at those lectures and operations; and understanding that Leoncenæ was about to dispose of his tables, I desired the late Dr. Geo. Rogers, then consul at Padua, for the students of our nation in that university, to purchase and procure them for me; which he did for 150 scudi; with condition, that he should add a table more, viz. that of the liver, the gastric nerves, and other vessels, to complete the fourth, &c." J. EVELYN.

These figures are accurately drawn after the original schemes; and it is some satisfaction to me, that I find the arteries here so agreeable to a figure which I drew and published not long since, from the arteries of a fœtus injected with wax. But this figure of the veins differs so much from any extant, as to incline one to suspect all of the subject hitherto published are fictitious, not excepting even those of Vesalius. But first of the arteries.

That the arteries are the vessels which convey blood from the heart to all parts of the body, is well known; and it is the common practice of nature, in distributing these vessels, to supply the parts with blood from the next adjacent trunk, till their ascending and descending trunks become conical, as well as their collateral branches: not that all the trunks and ramifications of arteries are uniform, and become conical in the same manner; nor do they all pass directly to the parts to which they convey blood; nor do all the parts receive arteries from their neighbouring trunks.

The trunks of the carotid, vertebral, and splenic arteries in adults, are not only contorted in their progress, but the diameters of their bores are variously dilated in divers parts, especially where they are contorted; but as these dilatations of their trunks are caused by the resistance the blood meets with at those angles of inflection, so those enlargements of them afterwards contribute to retard the protrusion of the blood to the extremities of those arteries: hence it is, that as the arteries of the fœtus are not contorted in such acute angles as in adults, so their trunks are more conical, and not here and there dilated in divers parts of them, as in the latter. The trunk of the splenic artery has a straight progress in the fœtus and infants; but in the adult I have hitherto constantly found it very contorted, as expressed in the figures.

The peculiar contrivance of the spermatic arteries of quadrupeds, as well as men, shows a constant design in nature to take off that velocity with which the blood would otherwise pass through the glands of the testes: it seems to be for this end that the testes of most animals, especially men and quadrupeds, hang out of the cavities of the abdomen, that the canals of their blood vessels may be lengthened; for the spermatic arteries, contrary to all others, arise from their great trunk, at a far greater distance from the testes, than the arteries of any other part of the body. Nor would the testes, which are such necessary organs, have been thus exposed to external injuries, if the design of nature in lengthening their blood vessels had not been very considerable. Besides this lengthening of the spermatic arteries, we find nature still contriving other impediments to check the current of the blood in those parts; it seems for this purpose that the spermatic arteries are lessened at their original from the trunk of the arteria magna in men, and that the spermatic arteries of quadrupeds are so much contorted before they reach their testes.

The principal design of nature in these different contrivances seems to be, that if the human spermatic arteries were contorted as in quadrupeds, before they reach their testes, the apertures in the abdominal muscles of men must have been much larger than they now are, and would frequently let the intestines descend into the scrotum; which nevertheless often happens: such ruptures are not so incident to quadrupeds, though the passages for their spermatic vessels, through the abdominal muscles, are much wider than in men, because the position of the trunks of their bodies is horizontal, and their intestines therefore cannot press on the processes of the peritonæum, as in men, who are erect.

After the circulation of the blood through the heart, lungs, and large blood vessels was demonstrated by Dr. Harvey, it was only guessed how the extremities of the arteries transmitted the blood to the veins, till Mr. Leuwenhoeck's microscopes had discovered the continuations of the extremities of those vessels in fish, frogs, &c. Yet there are some who doubt of the like continuations of the extremities of arteries and veins in human bodies and quadrupeds; since those animals it has hitherto been seen in, have been either such fish, or of the amphibious kind, as have only one ventricle in their hearts, and their blood actually cold, except in bats, where it appears very obscurely: besides, that the blood in those animals does not circulate with such rapidity as in those whose hearts have two ventricles: for in all animals that have biventrous hearts, the vessels of the rest of the body return their blood to the heart in equal time and quantity with those of the lungs, notwithstanding the inequality of their course.

* This difference in the principal organs of the circulation of the blood in

* Mr. Wotton in his Reflections upon Ancient and Modern Learning, chap. xviii. says, "Since it has been constantly found that nature follows like methods in all sorts of animals, where she uses the same instruments, it will always be believed, that the blood circulates in men after the same manner as it does in eels, perches, bats, and some other creatures, in which Monsieur Leuwenhoeck tried it. Though the ways how it may be visible to the eye in men, have not, that I know of, been yet discovered."—Orig.

those animals, on which only these experiments have been hitherto made, induced me to make some on animals whose organs differ only from the human in their gross figure, and not in their intimate structure; for this end I took a young cat about 10 or 12 days old, and fastened it to a board as in vivesection; and making an incision through the linea alba, the omentum and intestines were extruded; then causing the animal to be so held on the board, under a large double microscope, where a flat glass for receiving of objects was placed horizontally, on which I expanded the omentum or caul, a light being placed underneath, I saw the globules of the blood move very swiftly in the small vessels, which are only to be seen in the most transparent parts of the membranes of the omentum; but the motion of the blood soon abated, and its globules were withdrawn from the extremities of its blood vessels, and in a little time became stagnant in their larger branches.

This appearance of the continuation of the extremities of the arteries, with the veins, while the blood was moving in them, I saw very well in the omentum of a young lean dog, that was not large; but by the assistance of an instrument I had prepared to expand the mesentery, we all saw it there much better; that part having not only larger and clearer spaces than the omentum, but its blood vessels distributed more regularly.

Those who would view with microscopes the transparent parts of living animals, will find that the extremities of their arteries and veins are not all equally lessened though united: in the tail of the lacerta aquatica, tadpoles, and in most fish, I have frequently observed several communications between the arteries and veins, in which more than two globules of blood have passed abreast: and in the same area I have seen some of those communications so small that only one globule could pass before the other, and that very slowly. In young fish, particularly in grigs, I have frequently observed a communicant branch, so very small, as that one globule of blood only has passed it in two or three seconds of a minute; at other times I have found considerable intervals in the passing of one globule in such a communicant branch; even half a minute, a whole minute, and once in two or three minutes I have seen one globule of blood only pass in a particular tract.

The ready passing of injections by the splenic arteries, to the veins, shows that the communications between those vessels are more open than the arteries and veins of other parts. As also injections into the pulmonic arteries pass to their veins, though not altogether so freely, as in the spleen.

On viewing with a microscope the extremities of the pulmonic blood vessels in a live frog, I found their communications much larger than those that I had before seen, in the membrane between the toes, and in the feet of that animal.

Nor can we reasonably doubt of the like patent communications of the arteries and veins of human lungs and those of quadrupeds, when we consider that the blood of their lungs must return to the heart in equal time and quantity, with that of all the parts of the body besides. Hence it appears that the bronchial blood vessels (first taken notice of by the accurate Ruysch) are absolutely necessary, else the parts of the lungs could not receive nourishment; nor could the glands of the bronchia separate their liquor, if they were supplied with blood from the pulmonic blood vessels, which is so quickly dispatched through the lungs.

On viewing the membrane that is between the toes of one of the hinder feet of a live frog, after having frequently taken hold of the same leg of that animal, to apply it to the microscope, I found that membrane very transparent, and without any motion of the globules of the blood in it, as if the part had been dead; but while I was looking on it, it was, I confess, not a little entertaining to see the globules creep into it by degrees, and at length the blood move in all the branches of its veins and arteries as before, when no violence had been offered to the part; while the blood is thus leisurely creeping through the vessels, you may plainly see its globules compressed into oval figures, which are made more or less oblong by the resistance those globules meet with, by the contraction of the sides of the vessels they pass through; and this I have more than once observed in the tails of the water newts or lizards; but on examining the blood of these animals with a microscope, and comparing it with the human blood, I found the globules of the lizard's blood more inclined to an oval figure, and were as large again as the globules of human blood, and that of a small fish, which I in like manner viewed at the same time. It is not unlikely that a sudden retrocession of blood from the extremities of its vessels often happens, and its circulation in the same vessels is afterwards carried on without any impediment; as on some passions of the mind, deliquiums by the effusion of blood or otherwise. But if the blood is once become stagnant in its vessels, especially the arteries, the part is in no small danger of a mortification; unless its neighbouring vessels, which enjoy the motion of the blood, drive on the stagnant blood, and it escape by the sides of the vessels that retained it. Experience assures us, that in bruises when the blood is extravasated, it goes off either by transcolation or else causes an abscess; for there seems little reason to suspect that any of the stagnant globules of the blood will be fit to re-unite with the circulating mass. But that the blood after stagnation in its vessels will sometimes pass their sides, appeared to me from the following experiment.

On viewing the mesentery of a dog when living, in which I had before seen the blood passing the extremities of the arteries and veins, I considered how to preserve the blood in its vessels, that I might afterwards at any time see it in their extremities when stagnant; for this end, I caused several parts of the mesentery to be tied on as many pieces of small round pill boxes, cut transversely like little hoops; on which, portions of the mesentery were extended like the head of a drum; and on viewing them afterwards with the microscope I found the extremities and branches of the blood-vessels charged with blood, which before appeared in motion. On laying one of these parts of the mesentery, thus expanded, in water, the stagnant blood in its vessels disappeared; but on just immersing another of those pieces in water, I could with my naked eye see the stagnant blood diffused in the interstices of the blood-vessels, and between the membranes of the mesentery: hence it is evident, that the blood may pass the sides of its vessels after stagnation in them; but whether its globules are broken, or what figure renders them fit to pass those pores that are in the sides of the vessels, I leave to the inquisitive.

As the arteries are known to export the blood, so the veins return it back again to the heart; and here, as in the arteries, we find the common practice of nature, in disposing the branches of veins to discharge the refluent blood into the next adjacent trunk, and so on to the heart. And as the arteries afford abundance of instances of checks given to the velocity of the current of the blood through several parts, so the veins supply us with as many artifices to assist its regular return to the heart, as well as favour those contrivances in the arteries.

The trunks of the carotid, vertebral, and splenic arteries are not only variously contorted, but are also here and there dilated; so the veins that correspond to those arteries are also variously dilated. The beginnings of the internal jugulars have a bulbous cavity, which are diverticula to the refluent blood in the sinuses of the dura mater, lest it should descend too fast into the jugulars. The like has been also noticed by Dr. Lower in the vertebral sinuses. The splenic vein has divers cells opening into it near its extremities in human bodies; but in quadrupeds the cells open into the trunks of their splenic veins.

The spermatic veins do more than equal the length of the arteries of the testes in men; their various divisions, and several inosculations and their valves, are admirably contrived to suspend the weight of the blood, in order to discharge it into the larger trunks of the veins; and were it not that the refluent blood from the testes is a pondus to the influent blood from the arteries, and still lessens its current in the testes; these spermatic veins, like those of other parts, might have discharged their blood into the next adjacent trunk.

Who can avoid being surprised at the art of nature, in contriving the veins, that bring part of the refluent blood from the lower parts of the body; when they consider the necessity of placing the human heart, as well as that of most quadrupeds, so far from the centre of the body towards its upper part? for that end it is necessary that the large trunks of the veins and arteries should not associate with each other; for if all the blood sent into the lower parts, by the descending trunk of the aorta, should return again to the heart by one single trunk, as it is sent out from thence, the weight of so much blood in the ascending trunk of the vena cava would oppose the force the heart could give it from the arteries, and hinder its ascent; for this reason the vena azygos or sine pari, is contrived to convey the blood sent to the muscles of the back and thorax into the descending trunk of the vena cava above the heart; hence it is evident that more blood comes into the heart by the descending or upper trunk of the vena cava, than passes out by the ascending trunks of the aorta. Nor does this quantity of blood, conveyed to the heart by the superior trunk of the cava, seem without some other design in nature, besides transporting it thither to free the inferior trunk from its weight; but perhaps it was necessary so much blood should be ready there to join with the chyle, for its better mixture, before it reaches the right auricle of the heart.

The Explanation of the Figures.—Pl. 17, fig. 1, represents the trunks and large branches of the arteries, dissected from an adult human body, when displayed and dried. Where, 1 is the trunk of the aorta cut from the basis of the heart; 2 that part of it whence the coronary artery of the heart arises; 3 that part of the arteria magna, where the canalis arteriosus of the fœtus terminates, which in an adult becomes a ligament; 44 that part of the axillary arteries, by some called the subclavian arteries; 5 the left carotid artery, which in this subject seems to arise from a common trunk with the right carotid and axillary arteries, as in some quadrupeds; 6 the left cervical artery, in this subject arising from the trunk of the arteria magna, as expressed in a figure given by Bergerus in the Acta Eruditorum, An. 1698, p. 295: but in all the human bodies in which I have hitherto examined these arteries, I have constantly found them as expressed 6, 6, fig. 2; 7 the arteries that carry blood to the lower parts of the face, tongue, adjacent muscles and glands; 8 the trunk of the temporal artery, springing from the carotid, and parting with branches to the parotid gland 9, and temples 10, and parts adjacent; 11 the occipital arteries; 12 the arteries that convey blood to the fauces, gargareon, and adjacent muscles; 13 the trunk of the carotid artery cut off, before it is contorted in passing the skull; 14 the trunk of the artery of the arm, parting with branches to the adjacent muscles and parts: * that part of this artery which is sometimes pricked in letting blood, and causes an aneurism; in which case this trunk of the artery must be bared and firmly tied above the aneurism; and if it afterwards happen, as it has frequently been known, that the flux of blood to the aneurism in the artery is not very much abated, though the artery has been tied above, the operator in that case must make another ligature on the trunk of the artery below its aneurism; these collateral communications of the trunk of the artery at the bending of the cubit, preserve the circulation of the blood in the cubit and hand, though the trunk be totally compressed both above and below, and the same trunk afterwards divided between those ligatures; hence it is, if one ligature made above the wound in the artery is not sufficient, but the blood still pours out from below, the patient will sooner recover the action and strength of the muscles of the cubit, than those in whom the upper ligature proves sufficient; the reason of which is obvious to any who consider, that the communicant branches must be larger where the lower ligature is required, than when the superior ligature only is sufficient; these communicant branches, as I have seen them in some subjects, are here marked out in pricked lines.—While these papers were lying by me, the two following instances happened, in which the communications of the large trunks of the arteries of the cubit and arm were remarkable. The first was, a boy of 13 years of age, who, about 3 weeks before I saw him, received a wound near the middle of the cubit in which the trunk of the artery (marked †) was divided. The surgeon who was first called had frequently bound up the wound, and put a stop to the several discharges of blood, amounting to 6 or 7 quarts at times, but not without a compress on the trunk of the artery, above the wound. On another impetuous flux I was called; but seeing no small quantity of blood discharged, I was contented to let the wound be bound up, in the same manner as it had been done before; omitting the compress on the trunk of the artery above, and adding a piece of deal-board, on which the hand and cubit were fastened, to prevent any motions of those parts, as well as of the fingers; 3 days after, the applications were taken off, and little or no blood appeared; but 2 or 3 hours were scarcely elapsed before I was alarmed with notice of a fresh flux; the by-standers being instructed in that case to compress the trunk of the artery above the cubit, they had thereby prevented no small effusion of blood, which must otherwise have happened; his surgeon being out of the way, I laid the trunk of the artery bare above the wound as expeditiously as I could, being forced more than once to let loose the compress above to discover its orifice by the flux of blood; I passed a needle with strong waxed thread under the artery, and made a ligature on its trunk, which lay concealed in the interstice of the musculus flexor digitorum, and the musculus ulnaris flexor carpi; but notwithstanding this ligature on the trunk of the artery above the wound, the blood still flowed from the lower trunk of the divided artery; yet the velocity of its current was so much abated, that it seemed like blood flowing from a vein; I left the wound with a digestive, and the part without hard bandage; it being now 5 weeks since, I hear the wound is almost cicatrized.—The learned Dr. Harris was present at the other operation, by which the communications of the large trunks of the arteries of the arm were very evident; it was a boy about 8 years of age, who came to town with an aneurism of the left arm, after bleeding 6 weeks before: the tumour was indeed very large in proportion to so small an arm; after laying the aneurism or tumour bare, and making a ligature on the superior trunk of the artery (at * in the fig.—) I found, on loosening the compass on the superior trunk of the artery, very little abatement of the pulsation of the aneurism; I then passed a ligature in like manner on the trunk of the artery below the tumour; but still the pulsation continued, though much abated; I then discovered another trunk of the artery; arising from the lower part of the tumour, on which also I made another ligature, and the pulsation was then taken off; however on cutting off the surface of the cystis, or dilated artery, and clearing it of the coagulated blood, there still poured out some fresh blood, which was soon stopped with a common astringent; I left the part without any other ligature or hard bandage. It is now 18 days since the operation, the ligatures on the arteries are all come off, and the pulsation of the artery of the wrist begins to be very manifest, nor does any symptom appear that threatens mischance.—15 the division of the trunk of the artery of the arm, below the flexure at the cubit; 16 the external artery of the cubit, which makes the pulse, that is commonly felt near the carpus; 17 the arteries of the hand and fingers; 18 the mammary artery; 19, 19 the descending trunk of the arteria magna; 20, 20 the intercostal arteries; 21 the arteria cæliaca; 22 the arteria hepatica; 23 the trunk of the arteria splenica; 24 the arteria epiploica sinistra; 25 a branch of an artery which passes to the bottom of the stomach; 26 the superior coronary branch of the stomach; 27, 27 the superior mesenteric artery: 28, 28 the emulgent arteries; 29 the inferior mesenteric artery; 30, 30 the lumbar arteries; 31, 31 the two spermatic arteries, which in this subject seem to arise at a greater distance from each other than commonly; 32 the iliac artery; 33 the arteria sacra; 34 the internal iliac branch; 35 the external ditto; 36 the epigastric artery; 37 branches of the external iliac artery, passing to the oblique muscles of the abdomen; 38, 38 the arteries that pass to the muscles of the thigh and tibia; 39 the crural artery; 40 the umbilical artery, with those of the penis; 41 that part of the crural trunk that passes the ham; 42 the three trunks of the arteries of the leg; 43 the arteries of the foot and toes.

Fig. 2 represents the trunks, and some of the ramifications of the arteries of an adult human body, filled with wax, to show the variety in nature, and supply the defects of the former figure. 1 is the aorta cut off at the basis of the heart; A the three semilunar valves, as they appear when the heart is in diastole, and hinder the blood coming back from the arteries into the left ventricle of the heart; B a portion of the trunk of the arteria pulmonalis; b b its division before it passes to the right and left lobes of the lungs; c the descending trunk of the arteria magna; D D the internal mammary arteries. 2 The trunk of the coronary cut off; 3 the ligamentum arteriosum, which in the fœtus is the canalis arteriosus, and conveys blood from the pulmonic artery to the great artery; 4 the trunk of the subclavian artery; 5 5 the carotids; 6 6 the vertebrals; 7 7 the arteries which pass to the lower parts of the face, tongue, adjacent muscles and glands; 8 8 the trunks of the temporal arteries arising from the carotids, giving branches to the parotid glands (9 9) and the temples (10 10), &c.; 11 11 the occipital arteries; 12 the arteries of the fauces, gargareon, &c.; 13 13 the contortions of the carotid arteries, as they pass the basis of the skull; these trunks of the carotid arteries in dogs, like those I guess of most quadrupeds, are very much contorted before they reach the basis of the skull; on filling these vessels of that animal with wax, I found those branches of them which pass to the brain, first clipping the hinder parts of the lower jaw, immediately under its condyloid processes, where those arteries are received in two sinuses of that bone, which sinuses may also be seen in the jaw-bones of other quadrupeds, but not in human bodies; 14 14 those parts of their trunks that pass by each side of the sella turcica, whence divers small branches arise, and help to compose the rete mirabile, which is more conspicuous in quadrupeds than in human bodies: 15 15 the contortions of the vertebral arteries, where we find their trunks considerably dilated; 16 the vertebral arteries, as they ascend on the medulla oblongata, towards the annular protuberance or pons Varolii; 17 17 the communicant branches of the vertebral and carotid arteries; 18 18 the arteries of the brain displayed.

Fig. 3 represents one of the trunks of the arteries of the tibia, dissected from the leg after amputation; the patient was in his 67th year when this artery was taken from him, and near 20 years before he lost the use of both his legs, and in that time he had been so persecuted with convulsions in them, that neither leg was free a quarter of an hour together, whether sleeping or waking. At length one of his little toes mortified, which was taken off; not long after more toes of the same foot followed the like fate; the convulsions in that leg becoming stronger and quicker, that part of the foot next the toes became tumid and inflamed, the tumor extending itself above the maleoli: a sinuous ulcer passed by the side of one of the metatarsal bones; the extremity of which bone, whence the toe was taken off, lying bare. In this condition I found the left foot and leg of this gentleman, and finding the leg very chilly, the necessity of parting with it was too evident; on the abscision, which was about 5 or 6 inches below the knee, I was surprised to see so little blood come from the arteries; having examined the ends of the arteries in the leg, I endeavoured to pass my probe into one of them, but meeting with some opposition, I suspected I had mistaken the vein for the artery, and that the valves opposed the passing of the probe that way; but on further dissection I cleared the trunks of both those blood-vessels, and found the veins in their natural state: but the sides of the arteries were grown bony or stony; having cleared two of their trunks, I left one of them at Salisbury, the other I brought to town, and is here figured; A is the upper part of the artery, cut off in the amputation of the leg; from A to B the trunk of the artery, distended and dried to show its canal; C that part of the trunk of the artery which was so contracted by the petrifaction or ossification, that a probe would not pass its canal; from C to D the trunk of the artery opened and expanded; E E the petrifications or ossifications in the sides of the artery; F F their specks in the lower part of the artery, not so large as in the upper part, and placed at greater distances; a a &c. the branches arising from the trunk of the artery; G a portion of the trunk of the artery of the arm above-mentioned; H the sides of the artery very much thickened, by which the diameter of its canal was so diminished that the probe, I, would not pass it.

The ossifications in the coats of arteries have been frequently observed, especially in their large trunks within the cavities of the thorax and abdomen, but I do not remember that the like has been noticed in the limbs; or that such impediments in their canals have been found the cause of mortifications of particular parts, as in the instance above-mentioned, though I doubt not, but the like has often happened in aged people, especially where we find the progress of the gangrene not very swift, and its beginning from no external cause; the consequences of which are commonly found fatal. When the arteries of one leg, or of any other limb, are so affected, we may well suspect the like in those of other parts, which probably happened in the instance I now mentioned; for though no gangrene came on the stump, yet the other foot and toes began to mortify about 6 weeks after the amputation, as did the parts about the hips, which were compressed in lying or sitting, before he expired.

Fig. 4 represents the extremities of the blood-vessels, as they appear while the blood is passing them in the omentum of a live dog, viewed with a microscope. A A are the branches of arteries: and B B the veins which associate;

C C their lesser branches, where they pass from each other, and are united at their extremities.

Fig. 5, the like appearance in the mesentery of a dog when living; D D the areæ, that are here viewed with the microscope, as they appear to the naked eye.

Fig. 6 represents the trunks of the vena cava, with their branches dissected from an adult human body. A A the orifice of the vena cava, as it appears when cut from the right auricle of the heart; a the orifice of the coronary vein of the heart; B A the superior or descending trunk of the vena cava; C C A the inferior or ascending trunk, so distinguished from the motion of the blood in these trunks, which is contrary to their position; D D the subclavian veins; † that part of the left subclavian vein, where the thoracic duct enters it, and discharges itself of its chyle and lympha: b the vena azygos with its branches going to the ribs e e; c the superior intercostal veins; d d the internal mammary veins; E E the right and left iliac branches; F F the internal jugular veins; G G the external jugulars; H H the veins which bring blood from the lower jaw and its muscles; I I the trunks of the internal jugulars cut off at the basis of the skull; f the veins of the thymus and mediastinum; g g the veins of the thyroid glands; h the vena sacra; i the internal iliac branch; k the external ditto; K K the occipital veins; L the right axillary vein; M the cephalic; N the basilic; O the median vein; P the trunk of the veins of the liver; Q the phrenic vein of the left side; R the right phrenic vein; r a large vein from the left glandula renalis and parts adjacent; S the left emulgent vein; T the right emulgent, in this subject very much lower than the left, which is not usual; V V the two spermatic veins; X X two communicant branches between the ascending trunk of the vena cava and vena azygos, by which the wind passes into the descending trunk of the cava when we blow into the ascending at A P C, though the trunk at A, P, and C, is firmly tied on the blow-pipe; * an uncommon branch between the lower trunk of the vena cava and the left emulgent vein; y a vein which brings blood from the muscles of the abdomen into the external iliac branch; z the epigastric vein of the right side; 1 the vena saphena.

The rest of the branches here displayed commonly differ so much in various subjects, that the particular descriptions of them, which none but the operator who dissected them could pretend to be master of, would be perhaps as useless as tedious to repeat; wherefore I pass to those considerable venous trunks which are wanting in this scheme.

Fig. 7 represents some of the large trunks of the veins and their sinuses within the skull, with the beginnings of the internal jugular veins, filled with wax and dried together with the falx, &c. A the extremity of the falx cut from the crista galli; a, its lower limbus that touched the corpus callosum, as it divides the right hemisphere of the brain from the left, where the fifth sinus passes, which is here dried and disappears; B B the second process of the dura mater, which supported the hindmost parts of the lobes of the brain, and defended the cerebellum from being pressed by those parts of the cerebrum; C a portion of the dura mater remaining to the longitudinal sinus; DD several trunks of the veins of the brain, cut off before they enter the longitudinal sinus; EE the longitudinal sinuses; FF the two lateral sinuses; G the fourth sinus; g the veins from the plexus choroides; HH the bulbi, or diverticula, at the beginnings of the internal jugular veins; II the internal jugular veins; KK the trunks of veins, which bring blood from the lower jaw and parts adjacent.

Fig. 8, represents the trunks of the vena portæ, dissected and displayed. AA the branches of the vena portæ, freed from the liver; a the umbilical vein; B the splenic branch; CC the mesenteric branches which are continued from the intestines; b the trunk of the vena pancreatica, which receives branches also from the duodenum; cc the vena gastrica dextra coronaria superior; D the superior coronary vein of the stomach of the left side; E the inferior coronary branch of the stomach of the right side: and F the same coronary vein of the left side, removed from their proper situations; from these last two are continued the vena epiploica superior dextra 1, and the sinistra 2, with the media 3; G the vein called vas breve; d the vena duodeni; H the vena hæmorroidalis, arising from the rectum and anus, in this subject emptying itself into the left mesenteric branch; but in other bodies I find this trunk of the hæmorroid veins ending in the ramus splenicus.

The length of the trunk of this hæmorroid vein, and its progress under the intestines, render it liable to be compressed, and its refluent blood retarded; whence its branches in the intestinum rectum and anus become distended with blood, and cause the hæmorroides cæcæ and apertæ; which are frequently attended with aposthumations in the anus and parts adjacent; which disorders are the more incident, not only because these hæmorroid veins, like the rest of the branches of the vena portæ, are without valves, and the blood has an ascending progress in them together, that the long trunk (H) is not only exposed to the compressions made by the intestines in both sexes, but particularly the uterus in women in time of gestation, especially near the birth, so compresses this trunk, that it is no wonder we find women more afflicted with the hæmorroids at that time, than at any other. Nor are the iliac veins, and the lymphaduct that accompany them, without being exposed to the like incumbrance in women with child, whence the veins of the legs and thighs become varicose, and those limbs are so frequently swoln; which, in a late instance I was acquainted with, when the intumescence proved so great, that at length the abdominal teguments were vastly extended; but the gentlewoman recovered on the happy delivery of two large children.

Abstract of two Letters from Mr. James Cunningham, F. R. S. and Physician to the English at Chusan in China, giving an Account of his Voyage thither, of the Island of Chusan, of the several Sorts of Tea, of the Fishing, Agriculture of the Chinese, &c. N° 280, p. 1201.

On the 31st of August, 1701, we anchored under the Crocodile islands, both to shelter us from the bad weather, which is generally expected on this coast at new and full moon, and also to look for fresh water: these are 3 small islands lying in the latitude of 26°, about 6 leagues from the river of Hock-sieu; on two of which we found very good water, with a convenient watering-place on the south west side of the innermost of the three; and by the assistance of a few Chinese fishermen we procured some fresh provisions from the main land; for we did not think it safe to adventure ourselves thither, lest we should have been brought into trouble by the government there. While we lay here, on the 5th of September, we had a sudden short shift of the monsoon to S. W. the fury of which was felt by others in coming upon the coast of China at the same time. The 8th of September we put to sea again, turning to windward night and day without all the islands, which are very numerous along this coast, to which we were altogether strangers beyond Emuy, and the hydrography thereof is hitherto so imperfect, that there was no trusting to our drafts, which made our navigation somewhat more dangerous: however, on the 1st of October we got into the latitude of 30°, where we came to an anchor near the land, till we found the way by boat to Chusan, about 12 leagues within the islands; from whence we had a pilot, who carried us safely thither on the 11th of October. Upon this island the Chinese have granted us a settlement and liberty of trade, but not to Ning-po, which is 6 or 8 hours sail to the westward, all the way among islands; this being the largest, is 8 or 9 leagues in length from east to west, and 4 or 5 leagues in breadth; about 3 leagues from that point of the main land called Cape Liampo by the Portuguese, but Khi-tu by the Chinese: at the west end of this island is the harbour, very safe and convenient, where the ships ride within call of the factory, which is built close by the shore on a low plain valley, with near 200 houses about it for the benefit of trade; inhabited by men, whose jealousy has not as yet permitted them to let their wives dwell here; for the town where they reside is $\frac{3}{4}$ of a mile further from the shore, environed with a fine stone wall, about 3 miles in circumference, mounted with 22 square bastions, placed at irregular distances, besides 4 great gates, on which are planted a few old iron guns, seldom or never used: the houses within are very meanly built: here the chumpeen or governor of the island lives, and between 3 or 4000 beggarly inhabitants, most part soldiers and fishermen; for the trade of this place being newly granted, has not as yet brought any considerable merchants hither. The island in general abounds with all sorts of provisions, such as cows, buffaloes, goats, deer, hogs wild and tame, geese, ducks, and hens; rice, wheat, calavances, coleworts, turnips, potatoes, carrots, beets, and spinach. But for merchandise there is none but what comes from Ning-po, Hangcheu, Nankin, and the inland towns, some of which I hope to see, when I have acquired a little of the Chinese language. Here also the tea grows in great plenty on the tops of the hills, but it is not in such esteem as that which grows on more mountainous islands.

Pou-to is a small island about 5 leagues in circuit, and about 3 miles distant from the east end of this island, famous for the superstitious pilgrimages made thither for 1100 years: it is inhabited only by Bonzes, to the number of 3000, all of the sect called Hoshang, or unmarried Bonzes, who live a Pythagorean life; they have built 400 pagodes, two of which are large and fine, being lately covered with green and yellow tiles, brought from the Emperor's palace at Nankin, and inwardly adorned with stately idols finely carved and gilded, the chief whereof is the idol Quon-em. To these two great pagodes belong two chief priests, who govern all the rest. They have several ways and avenues cut through the island, some whereof are paved with flag-stones, and overshaded with trees planted on each side: their dwellings are the best I have yet seen in these parts. All which are maintained by charitable devotions; and the junks which go from Ning-po and this place to Japan, touch there both going and coming, to make their offerings for their good success. There is another island called Kimtong, 5 leagues hence, in the way to Ning-po, whither a great many Mandarins retire, to live a quiet life, after they have given over their employments; on that island also are said to be silver mines, but prohibited to be opened. The rest of the circumjacent islands are either desert or meanly inhabited by a few fishing people, but all of them stored with abundance of deer: for it is not long since this island of Chusan began to be peopled.

They have no arts or manufactures here, except lackered ware, a particular account of which I cannot as yet send you. They begin to plant mulberry-trees, to breed up worms for the production of raw silk; and make some tea, but chiefly for their own use. The 3 sorts of tea commonly carried to England, are all from the same plant, only the season of the year and the soil make the difference. The bohe is the very first bud gathered, in the beginning of March, and dried in the shade. The bing tea is the second growth in April; and singlo the last in May and June, both dried a little in tatches or pans over the fire. The tea shrub, being an evergreen, is in flower from October to January, and the seed is ripe in September and October following, so that one may gather both flowers and seed at the same time.

Le Compte is mistaken in saying that the Chinese are wholly strangers to the art of grafting; for I have seen a great many of his paradoxical tallow-trees ingrafted here, besides some other trees. When they ingraft, they do not slit the stock as we do, but cut a small slice off the outside of the stock, to which they apply the graft, being cut sloping on one side, agreeable to the slice cut from the stock, bringing up the bark of the slice upon the outside of the graft, they tie all together, covering with straw and mud as we do.

The commentator on Magalhen seems doubtful in the length of the Chinese che or cubit. Here they have two sorts, one of $13\frac{7}{10}$ English inches, which the merchants commonly use: the other is of 11 inches, used by carpenters, and also in geographical measures. The bean, or mandarin broth, so frequently mentioned in the Dutch Embassy, and other authors, is only an emulsion made of the seed of sesamum and hot water. Their chief employments here are fishing and agriculture. In fishing, they use several sorts of nets and lines, as we do; but because they have large banks of mud in some places, the fisherman, to go more easily on them, has contrived a small frame, about 3 or 4 feet long, not much larger than a hen's-trough, elevated a little at each end, in which he rests upon one knee, leaning his arms on a cross stick, raised as high as his breast, and putting out the other foot often on the mud, he pushes forward his frame, and so carries himself along in it.

As to their agriculture, all their fields, where any thing is planted, whether high or low, are made into such plots as may retain the water on them when they please. They plough up their ground with one buffalo, or one cow. Where they are to sow rice, they prepare the fields very well, by clearing it of all manner of weeds, moistening to a pulp, and smoothing it with a frame drawn across; on which they sow the rice very thick, and cover it only with water for 2 or 3 inches high, and when it has grown 6 or 8 inches long, they pull it up by the roots, and transplant it, by tufts in a straight line, to fields overflown with water; and where a field is subject to weeds, when the water dries up they prevent their growth in overturning the mud with their hands in the interstices where the rice is planted. When they sow wheat, barley, pulse, and other grain, they grub up some superficial earth, grass, and roots, and with some straw they burn all together; this earth being sifted fine, they mix with the seed, which they sow in holes made in a straight line, which thus grows up in tufts as the rice does; the field being divided into beds, and harrowed over, both before and after the seed is sown: this makes them somewhat resemble gardens. Although they meliorate their fields where they sow rice, only by letting the water on them, yet for other grains, where ground requires it, they make much use of dung, human excrements, ashes, &c. In watering their fields here, they use the same instrument mentioned by Martini, in the preface to his Atlas, being all of wood, and the contrivance the same with that of a chain-pump.

Their method in making salt is this: all the shores here being mud instead of sand, in the summer season they pare off the superficial earth, which has been overflown with the salt water, and lay it up in heaps for use; when they are to use it, they dry it in the sun, rubbing it small; then digging a pit, they cover the bottom thereof with straw, at which through the side of the pit they pass a hollow cane that leads into a jar, which stands below the level of the pit's bottom; they fill the pit almost full with the aforesaid earth, and pour salt water on it, till it be covered 2 or 3 inches with water, which thus drains through into the jar, and is afterwards boiled into salt.

Concerning the internal Use of Cantharides. By Mr. James Yonge. N° 280, p. 1210.

A gentlewoman, 54 years of age, who for a long time had been tormented with frequent fits of the stone, and usually brought off many, with the gravel, &c. about a year since grew dropsical, of which being lately cured, she fell into a total suppression of urine, which for many days baffled all remedies. In this desperate condition, I resolved on a desperate medicine, and accordingly about four in the afternoon, the 5th day of the disease, I gave her 5 cantharides, without heads, wings, or legs, weighing 4 grains and a half, and with as much camphire and a little conserve, made them into two pills or boluses. Next morning finding no effect good or bad; but about noon the flood came, and continued above 48 hours, bringing off in that time much more urine than could have been expected from her in the whole time of the obstruction. Some gravel and sabulous matter came away, but no stones, nor did there any thing happen to the stomach, bladder, or other bowels, as usual on the internal use of those insects, but they operated so quietly as if nothing but two doses of lapis prunellæ had been administered.

But in several other cases I have often and successfully given it, and without the dysuria and other painful accidents which attend the internal, and often the external use of this remedy; although I mixed no camphire, but washed it down with large draughts of posset, ptysan, emulsions, or water gruel; which in this lady's case I forbore to use, because of her dropsical disposition, and used only a draught or two of middling ale, impregnated with broom, juniper-berries, daucus seeds, &c.

The form in which I used to administer this fiery insect, is that of a soft pill or bolus, composed of 3 cantharides prepar. troch. e myrrha ℈ß sem. carui gr. vj. rob. cynosb. q. s. This in stubborn suppressions of the lochia and menstrua, in difficult child birth, and retention of the secundines, does wonders, what heat or pain it produces in the neck of the bladder, is much short of what I have a hundred times seen, and sometimes felt, to proceed from applying an epispastic to the back.

Experiments and Observations concerning Vegetation. By the Rev. Mr. Abr. De la Pryme. N° 281, p. 1214.

Some have made experiments on meliorating, fertilizing, and multiplying grain, by steeping them in divers liquors. Digby mentions a plant of barley, that by steeping and watering with saltpetre dissolved in water, produces 249 stalks, and above 18000 grains. And the last edition of Camden mentions a thing very observable, that the corn sown in a field in Cornwall, after a great battle in the civil wars, produced 4 or 5 ears on every stalk. I have tried some such like experiments on several grains, though I have not been so happy as to meet with that increase I expected. They are as below.

Upon the 22d of March, 1699, I laid to steep in brimstone-water, a pea, a barley corn, and a wheat corn: in alum-water, a pea, a wheat, a barley, and an oat corn: and the same in an old solution of salt of tartar: in the caput mortuum of sal amm. dissolved in urine, a pea, a wheat, a barley, and an oat: the same in the solution of the salt of walls: the same also in the solution of saltpetre: the same likewise in nostoc or star jelly: and again the same in urine.

Having steeped them thus for 5 days and 5 nights, and set them in a garden in a good soil against a north wall, full in the sun, on the 27th of the same month, after a rainy night, with a pea, a wheat, a barley and an oat unsteeped.

On the 10th of April following, I went to see them, and found that some were just come up, some not. The pea, the barley, and the wheat steeped in brimstone-water all up together. The pea steeped in alum-water very large and swelled, but not so much as sprouted, but the barley, wheat, and oat above ground. The pea steeped in the old solution of salt of tartar, was half come up, the wheat scarcely sprouted, but the barley and oat quite up. The pea, the wheat, the barley, and oat steeped in the caput mortuum of sal ammoniac dissolved in urine, were all up together; as were also the next row that were steeped in the solution of salt of walls. The pea and wheat steeped in the solution of saltpetre, were about half up, but the barley and oat quite up. Those steeped in nostoc were none of them come up, nor scarcely sprouted. The barley and oat steeped in urine were come up, but the pea and wheat scarcely sprouted. And lastly, to my great surprise, the pea, the wheat, the barley and the oat that were not at all steeped, were all of them as soon up as any of the former, except only the wheat, which was about half up. I set them all a finger deep in the ground, and there was all the time of their growth very fine weather.

From all which I suppose that alum water is against the nature of peas, and retards their growth, but agrees well enough with wheat, barley, and oats. That the solution of salt of tartar is not friendly to the nature either of peas or wheat, but agreeable or concordant to the nature of oats and barley. That the water of saltpetre had not here any of the great power or virtue that I expected, &c. And that these steepings did not further any of the said grains in their growth and coming up, but manifestly and plainly retarded some or most of them.

I then dug them all up, except three spires of barley, which I let stand about a foot and half, or two feet, one from another, which grew and increased so exceedingly, that they had 60, 65, and 67 stalks apiece from their single grain and root, with every one an ear on, and about 40 or somewhat more corns each in them, which increase proceeded perhaps not so much from the grain having been steeped in any liquors, as from the fertility and goodness of the soil, and their competent distance from each other. I observed that new shoots continually struck up from the root; and that, as in the East and West Indies, there are trees that always bear blossoms and flowers, green and ripe fruit, at the same time, so here if the invigorating heat of the sun had not been weakened by the approach of the winter season, there would have continually been new, ripe corn, and empty ears on the same root.

On the Influence of Respiration on the Motion of the Heart. By J. Drake, M.D. F.R.S. N° 281, p. 1217.

Though several accurate treatises on the heart, and its action, have been written by learned men of several nations, especially by two of our own country; Dr. Harvey to whom we owe the discovery of the circulation of the blood;* and Dr. Lower, to whom we are beholden for a complete display of the me-

* For an account of this great discovery, the reader is referred to p. 319, volume i. of this Abridgment.

chanical structure of the heart,* and a most ingenious rationale of its action: yet there remain several doubts and difficulties about it, not sufficiently accounted for; towards the resolving of some of which, I shall offer what my own thoughts have suggested to me, and leave it to the consideration of the reader.

Dr. Lower has so well accounted for the systole, or contraction of the heart, from its mechanical structure, that he seems almost to have exhausted the subject; and had he been as happy in discovering the true cause of the diastole, he had left little room for the industry and sagacity of others about this viscus. But having judiciously and solidly explained the systole, he contents himself with ascribing the diastole to a motion of restitution, which is not satisfactory; because, the systole being the proper, and, as he himself confesses, the only motion of the heart, a state of contraction seems to be its natural state; and consequently, without some external violence, it would have no diastole at all.

This will appear more plain if we consider the circumstances of it, and its motion, as a muscle, with respect to other muscles. That contraction is the proper action, and state of all muscles, is evident from experience of fact, as well as from reason. For, if any muscle be freed from the power of its antagonist, it is immediately contracted, and is not by any action of the will or spirits to be reduced to a state of extention. Whence it is plain, that the muscles have no restitutive motion, but what they derive from the action of their antagonists, by which they are balanced. Thus likewise the sphincters of the gula, anus, and vesica, having no proper antagonists, are always in a state of contraction, and suffer nothing to pass but what is forced through them by the contrary action of some stronger muscles, which, though not properly to be called antagonists, yet on all necessary occasions perform the office of such.

That the heart is a muscle, furnished and provided for motion like other muscles, is demonstrated beyond contradiction, by Dr. Lower and others. And as it is a solitary muscle, without any proper antagonist, and not directly under the power of the will, nor exercising voluntary motion, it approaches nearest to the sphincter kind, which only has these conditions in common with it. But in constant and regular alternations of contraction and dilatation, it differs exceedingly from all the muscles of the body.

This reciprocal æstus of the heart has given much trouble to the learned, who, finding nothing peculiar in the structure, which should necessarily occasion it, nor any antagonist, whose re-action should produce it, have been extremely

* Of Dr. Lower's Treatise on the Heart, an account has been given at p. 330, vol. i. of this Abridgment.

perplexed to find out its cause. Dr. Lower's account of the systole, however solid and ingenious, has something deficient, and his hypothesis of the diastole seems precarious and false; for having by sound arguments, drawn from the structure and mechanism of the heart, established the certainty of its muscular motion, he rests satisfied, without taking notice of any assistance that the heart receives from any other part, except from the brain, by means of the eighth pair of nerves.

Borelli, in his Œconomia Animalis, computes the motive power of the machine of the heart to be equal to, or to surmount, that of the weight of 3000 pounds: the obstacles to the motion of the blood through the arteries he esteems equivalent to 180,000 lb: which is 60 times as much as he rates the force of the heart at: then deducting 45,000 lb. for the adventitious help of the muscular elastic coat of the arteries, he leaves the heart with a force of 3000 lb. to overcome a resistance of 135,000 lb., that is, with 1 to remove 45. This stupendous effect he contents himself with ascribing to the energy of percussion. But had he proceeded in his calculation to the veins, which he allows to contain constantly a quantity of blood, quadruple to the contents of the arteries, and to which this energy of percussion does either not reach at all, or but very languidly, he might probably have seen a necessity for some other expedient, to remove so insuperable a difficulty. But not to insist rigorously on the exactness of this calculation, we may allow a much greater deduction than would be justifiable, without lessening the difficulty, But this account I have taken notice of purely for the sake of the calculation, which may be of use in the sequel; the account itself being in other respects more defective than Dr. Lower's, to which we will return.

The Doctor appears to have overlooked something of very great moment and importance, in the explanation of the action of the heart: for though it should be granted, that the muscular fibres of the heart, acted on by the nerves, are the immediate instruments of its constriction or systole, yet it must not be denied, that the intercostal muscles and diaphragm are of great service to aid and facilitate this contraction, by opening a passage for the blood through the lungs, which denied, would be an invincible obstacle.

Nor do they promote it that way only: the manner in which they farther assist the heart in its contraction, will appear manifestly, if we consider the different posture, situation, and capacity of the blood vessels of the lungs, in the several times of elevation and depression of the costæ. The pulmonary artery rises from the right ventricle of the heart, and runs in one trunk, till it comes to the aspera arteria, where it is divided, and sends a branch along with each division of the aspera arteria, accompanying all the bronchia, in their

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whole progress through the lungs. The pulmonary vein, which empties itself into the left ventricle of the heart, spreads itself on the aspera arteria and bronchia, in the same manner as the artery does. The necessary consequence of this disposition is, that this artery and vein being coextended with, and fastened to, the bronchia, must needs suffer such alteration of superficial dimensions, as the bronchia do in the elevation or depression of the costæ. While the ribs are in a state of depression, whether before communication with the external air or after, the annular cartilages of the bronchia shrink one into another, and by that means their dimensions are exceedingly contracted. In conformity to this condition of the bronchia, the pulmonary artery and vein likewise must either, by means of their muscular coats, contract themselves to the same dimensions, or lie in folds or corrugations; which is less probable. On the other hand, when the ribs are elevated, and the diaphragm bears downward, the air rushing into the lungs, shoots out the cartilaginous rings, and divaricates the branches of the trachea, and by them extends and divaricates the several divisions of the pulmonary artery and veins, and thereby lengthens and enlarges their cavities.

This enlargement of their cavities is very considerable, not only on account of the addition which they thence receive in length, but also on account of their divarication. For when the ribs are depressed, and the lungs subside, the blood-vessels are not only contracted, but their branches, which are exceedingly numerous, approach each other, and lie in juxta-position, by which their cavities are very much compressed and straitened; when the ribs are elevated, and the lungs turgid with air, not only the fibres, by which their coats in the opposite state were contracted, are extended, but those innumerable vessels, which lying before in lines almost parallel on each other, compressed each other, making an acute angle at their junctures, are divaricated and separated from each other, and make an obtuse one, by which their channels are widened. Thus a passage is opened to the blood, from the right ventricle of the heart to the left, through the lungs, to which it could not otherwise pass; and the opposition which the blood, contained in that ventricle, must otherwise necessarily have made to its constriction, is taken off, and the systole thereby facilitated.

Nor is that all: for the diastole being caused by the force of the blood rushing into the ventricles, this ampliation and extension of the pulmonary artery is a sort of check or counterpoise to it, and prevents an endeavour towards two contrary actions at once, which must necessarily frustrate both. For the heart being a springy, compressible body, whose proper action, which is contraction, depends on the influx of certain fluids into its fibres or substance; and besides, containing a fluid in its ventricles, or great cavities, in one of which is the mouth of this artery, the action of this vessel must in a great measure resemble that of a syringe, whose extremity is immersed in water, the enlargement or expansion of the channels of the artery answering to the drawing of the embolus, as the constrictive motion of the muscle of the heart does to the pressure of the atmosphere on the surface of the water, the one making way for the fluid, and the other forcing it to follow, where the resistance is least. In this sense we may allow a sort of attraction to the pulmonary artery, depending wholly on the action of the intercostal muscles and diaphragm, which we must therefore confess is very serviceable and instrumental in promoting the systole of the heart.

But if the learned author be deficient in his account of the systole; that is, if he has not observed all the mechanism and contrivance of nature for the contraction of the heart, much less sufficiently has he accounted for the diastole, or dilatation of it, which he ascribes to a motion of restitution of the overstrained fibres, which yet he confesses are made for constriction only. It is true, he immediately after joins the influx of the blood as a concurrent cause; but from the slight notice that he takes of it, it is plain, that he did not so much as dream of any great share it had in that action.

But, if contraction be the sole action of these fibres, as indeed it is of all muscular fibres, I wonder how so judicious a writer came to slip into such an absurdity, as to call their distension a motion of restitution. For from the nature of those fibres, and their disposition in the structure of the heart, the natural state of the heart appears manifestly to be tonical, and its dilatation a state of violence; and consequently the constriction is the true motion of restitution, and the state to which it will spontaneously return, when the force is taken off, which is the work of the intercostal muscles and diaphragm.

Thus we are left still to seek for the true cause of the diastole, which seems to be the main and most difficult phenomenon, relating to the heart and the circulation of the blood. But in Mr. Cowper's ingenious Introduction to his Anatomy of Human Bodies, I find the share which Dr. Lower hints the blood to have in that action, further prosecuted, and improved into the main instrument of the dilatation of the heart, wherein I agree entirely with him. But as to the manner and reasons of its being so very instrumental, I cannot be so perfectly of his mind. "The heart of an animal," says Mr. Cowper, "bears a great analogy to the pendulums of those artificial automata, clocks and watches, whilst its motion is performed, like that of other muscles, the blood doing the office of a pondus."

By the blood's doing the office of a pondus, I suppose he means, that the blood contributes in the same manner to the motion of the heart, as the weights do to that of the pendulum of a clock. If so the blood, according to him, must be the instrument of constriction, and dilatation must be the natural state, or spontaneous motion, to which it would, when under no violence, return; the contrary of which will hereafter appear.

But if he means, that the blood in its reflux, by gravitating on the auricles and ventricles, dilates and expands them, acting therein as a counterpoise to its contraction as a muscle, I could wish his design had not bound him up to so narrow a compass, and that he had given us an explication at large of so abstruse and so important a phenomenon. Because the specific gravity of the blood seems to me a cause by no means alone adequate to the effect, which it is here supposed to produce. For, if the blood acts only as a weight, by mere gravitation, then that part of it only which descends from the parts above the heart can be employed in that action. This, at the largest computation, cannot amount to 5 lb. weight, and must, according to the computation of Borelli, force a machine that is able to overcome a resistance of 135,000 lb.

But neither does the refluent blood gravitate in any such proportion as I have here assigned: for, to make a true estimate of its gravitation, we must consider the circumstances of the liquor supposed to gravitate; in which, it very much resembles water inclosed in a recurve tube, of which, if the length of the two legs be equal, it may be suspended in the air full of water, with the extremities downwards, without losing a drop, although the diameter of those legs should be very unequal. The case of the arteries and veins is pretty nearly similar to a tube so filled and inverted; for if the arteries and veins be continued tubes, as they appear by the microscope, then supposing their contents to have no other determination of motion than their own weight would give them, the contained fluids must be counterpoises to each other. For the veins and arteries being joined at the smaller extremities, and the larger of both terminating in the same parallel line, it is impossible, according to the laws of hydrostatics, that the contents of either should overbalance the other. How far then must it fall short of forcing the natural power and resistance of so strong a muscle as the heart, by mere gravitation.

The blood indeed has a progressive motion through its vessels, wherein it differs from water in a recurve tube, in the experiment above stated. But if the natural gravitation of the blood contributes nothing to the dilatation of the heart, this progressive motion will be found more insufficient; for, as this motion is derived entirely from the heart's constriction, could the blood be supposed to react upon the heart, with all the force first impressed on it by the heart, it would be insufficient, unless we will suppose the force communicated to be superior to the power communicant, which is absurd.

But when the just and necessary deductions for the impediments, which the blood meets with in its progress through the vessels, shall be made, the remaining force will be found so exceedingly weak, that to propel the blood through the veins, may be a task alone too great for so small a power, without charging it with the additional difficulty of forcing the muscles of the heart.

Borelli calculates the force of the heart, and the muscular coat of the arteries, to be together equal to a weight of 3,750 lb. and allots them a resistance equal to 180,000 lb.; to overcome which, is 45 to 1. To make up for a disproportion, by his own confession, incredible to those who have not considered the matter as he had done, he flings into the scale the additional force of percussion, which he leaves indefinite, and thinks sufficient to force any quiescent finite resistance whatever. But though the hypothesis of Borelli may in this case be found precarious or insufficient, his theory still holds good; at least it ought to be allowed in justice to his great abilities and exactness, till he is convicted of some material error in his calculations, which has not as yet been done by any one that I know of.

Supposing then the force of the heart, and of the muscular coat of the arteries, as likewise of the resistance which they must overcome, to be computed with any degree of accuracy; there remains yet such a prodigious disproportion to be accounted for, as requires some more powerful agent than any yet assigned, to make up the deficiency. What assistance the heart receives from the action of the thorax towards facilitating its contraction, without which assistance there could have been no systole, has been already shown; but neither the intercostal muscles, nor diaphragm, which are so instrumental in that part of its action, can contribute any thing to the diastole, because they serve only to enlarge the cavity of the thorax, and thereby to open a passage to the blood from the heart and promote its constriction.

Whatever therefore the force is, that dilates the heart, and is the cause of the diastole, it must be equal to that of the heart, the intercostal muscles, and the diaphragm: to all which it acts as an antagonist. I take no notice of the serratus major anticus, and other muscles, which have an obscure share in the elevation of the costæ, because as much may reasonably be deducted on the account of the obliquus externus abdominis, and other muscles; which, having their insertions on some of the lower ribs, are as instrumental towards the depression of them, and so balance the account. But the chief use of these is in violent respiration; in ordinary respiration, their share is small.

Such a real power, which may in the least be suspected of any share in this action, is difficult, perhaps impossible, to be found in the machine of any animal body, and yet without some such antagonist it is as impossible that the circulation of the blood should be maintained. All the engines yet discovered within the body conspire towards the constriction of the heart, which is the state of quiescence, to which it naturally tends. Yet we find it alternately in a state of violence, that is, of dilatation; and this upon necessity, because upon this alternation depends all animal life.

Some sufficient external cause must therefore be found out, to produce this great phenomenon; which cause must be either in the air or atmosphere, because we have no constant and immediate commerce with any other mediums. Some great physicians observing this, and that deprived, by whatever means, of communication with the external air, we become instantly extinct, they have imagined, that in the act of inspiration certain purer parts of the air mixed with the blood in the lungs, and were conveyed with it to the heart, where they nourished a sort of vital flame, which was the cause of this reciprocal æstus of the heart. Others, not quite so gross, rejecting an actual flame, have fancied that these fine parts of air, mixing with the blood in the ventricles of the heart, produced an effervescence which dilated it. But these fancies have been long since exploded and condemned on ample conviction, and it is a point yet undetermined, whether any air does mix * with the blood at all in the lungs.

But supposing that some air may insinuate itself into the pulmonary vein, it can no other way dilate the heart, than by an effervescence in the left ventricle; which would not dilate the right. But this opinion is contradicted by autopsy, and too laboriously confuted by others, to be brought upon the stage again here. There remains therefore only the gross body of the atmosphere to be considered, which is undoubtedly the true antagonist to all those muscles, which serve for ordinary inspiration and the constriction of the heart. This will appear more evidently, if we consider not only the power, but the necessity of its action upon animal bodies, as well as the want of other sufficient agents.

The heart is a solitary muscle, of very great strength, and the intercostal muscles and diaphragm, which likewise have no antagonists, are a vast additional force, which must be balanced by the contrary action of some equivalent power or other. For, though the action of the intercostal muscles be voluntary, that does not exempt them from the condition of all other muscles serving for voluntary motion, which would be in a state of perpetual contraction, notwithstanding any influence of the will, were it not for the libration of antagonist muscles. This libration between other muscles is answered by the weight of the incumbent atmosphere, which presses upon the thorax and other parts of the body. And, as in all other voluntary motions, the influence of the will

* The experiments of modern physiologists have placed it out of all doubt that a quantity of air is absorbed by the blood in respiration.

only gives a prevalence to one of two powers before equilibrated, so here it serves to enable those muscles to lift up a weight, too ponderous for their strength not so assisted; and therefore as soon as that assistance is withdrawn, the costæ are again depressed by the mere gravitation of the atmosphere, which would otherwise remain elevated through the natural tendency of those muscles to contraction.

This is plainly proved from the Torricellian experiments, and those made on animals in Mr. Boyle's engine; where, as soon as the air is withdrawn, and the pressure thereby taken off, the intercostal muscles and diaphragm are contracted, and the ribs elevated in an instant, and cannot by any power of the will be made to subside, till the air is again let in to bear them forcibly down.

It were scarcely worth while to take notice here of a mistake of the learned Dr. Willis,* were it not for the great authority of the man, which is almost sufficient to keep error in countenance. The Doctor having observed that the fibres of the external and internal intercostal muscles ran in a contrary order, as it were, decussating each other, takes occasion from thence to fancy, that there was an opposition in their office, and that, as the external served to raise up the ribs, the internal drew them down again; forgetting that, when a contractile body is fastened at the several ends to points unequally moveable, let the contraction happen in what part or manner soever, the more moveable point must be drawn towards the less moveable; by which rule, whether external or internal intercostals be contracted, the lower ribs will be forced to approach the upper, that is, be raised up.

As in the elevation of the costæ, the blood, by the passage that is opened for it, is in a manner solicited into the lungs, so in the depression of them, by the subsidence of the lungs and the contraction of the blood-vessels, both which are consequent to it, the blood is forcibly driven, as it were, with an embolus, through the pulmonary vein, into the left ventricle of the heart. And this, together with the general compression of the body by the weight of the atmosphere, which surrounds and presses on its whole surface, is that power which causes the blood to mount in the veins, after the force impressed upon it by the heart is broken and spent, and which is sufficient to force the heart from its natural state to dilatation.

He who can compute the weight of a column of air, equal to the surface of the whole body, will readily grant it a power sufficient for the effects here ascribed to it. And when he considers, that the bodies of animals are compressible machines, he will find that it must of necessity affect them in the man-

* De Respirationis Organ. et Usu.—Orig.

ner here laid down. But though our bodies be entirely composed of tubuli, or vessels filled with fluids, yet this pressure, how great soever, being equal, could have no effect upon them, if the superficial dimensions were not easily variable; because, being compressed on all parts with the same degree of force, the contained fluids could not any where begin to recede, and make way for the rest to follow, but would remain as fixed and immoveable as if they were actually solid. But by the dilatation of the thorax, room is made for the fluids to move; and by the coarctation of it fresh motion is impressed; which is the main spring by which the circulation is set and kept going.

This reciprocal dilatation and contraction of the superficial dimensions of the body, seem so necessary to animal life, that there is not any animal so imperfect as to want it, at least none to the inward structure of which our anatomical discoveries have yet reached. For though most kinds of fish and insects want both moveable ribs, and lungs, and consequently have no dilatable thorax, yet that want is made up to them by an analogous mechanism, answering sufficiently the necessities of their life. Those fishes, which have no lungs, have gills, which do the office of lungs, receiving and expelling alternately the water, by which the blood vessels suffer the same alteration of dimensions that they do in the lungs of more perfect animals.

The lungs or air vessels of insects are yet exceedingly more different in structure, distribution, and situation, from those of perfect animals, than those of fishes are; and yet in their use and action agree perfectly with both, that is, receiving and expelling the air, and varying the dimensions and capacities of the blood vessels. These having no thorax, or separate cavity for the heart and air vessels, have the latter distributed through the whole trunk of their bodies, by which they communicate with the external air through several spiracula or vent holes, to which are fastened so many little tracheæ, or wind-pipes, which thence send their branches to all the muscles, and viscera, and seem to accompany the blood vessels all over the body, as they do in the lungs only of perfect animals. By this disposition in every inspiration, the whole body of these little animals is inflated, and in every expiration compressed, and consequently the blood vessels must suffer a vicissitude of extension and contraction, and a greater motion must thereby be impressed on the fluids contained in them, than the heart, which does not in these animals appear to be muscular, seems capable of giving.

The only animal that is exempted from this necessary condition of breathing, or receiving and expelling alternately some fluid into and out of the body, is a fœtus. But this, while included in the womb, has little more than a vegetative life, and ought scarcely to be reckoned among the number of animals.

For, were it not for that small share of muscular motion, which it exercises in the womb, it might without absurdity be accounted for as a graft upon, or branch of the mother.

Then follow some observations on the fœtal circulation, and on the hypothesis advanced by some writers, that the placenta supplies the fœtus with air, from the mother's blood; whereas he supposes that "the uterine arteries transmitting their blood immediately* to the umbilical vein, may very easily transmit such nutritious juices or aërial particles as are contained in the blood, along with it, without depositing them by the way."

This opinion (he adds) is favoured by the structure and disposition of the blood vessels on both parts; so there is nothing in it difficult to be conceived, or repugnant to experience. Late discoveries have made it appear, that the arteries and veins are continued tubes, and that the latter contain nothing but what they receive from the former; and no reason appears why we should think this method to be varied in the placenta. On the other hand, if the arteries of the uterus were continued to the veins of the same part, and those of the fœtus in like manner, without communicating with each other, their confluence in the placenta seems to be altogether impertinent, and of no use, and the umbilical arteries and vein framed for no other service or purpose, than to give the blood room for an idle sally.

Thus the reasonableness of this old opinion may be vindicated; but the certainty of it rests upon stronger proof. Mr. Cowper, to whose happy industry we owe the confirmation of many ancient discoveries, and the benefit of some new ones, has the honour to re-establish this old, but long exploded truth. For by pouring mercury into a branch of the uterine artery of a cow, that went into one of the cotyledons of the uterus, he filled those branches of the umbilical veins, which went from that cotyledon to the navel of the fœtus.

It would be a weak objection, to allege that the observation and experiment being made on the uterus of a cow, the inference would not hold from thence to a woman, the one being glanduliferous, and the other placentiferous; since every one of these cotyledons, or uterine glandules, is in all respects a little placenta, and all the difference between them is in number, name, and magnitude. But the great flux of blood which constantly follows upon drawing the placenta from women, is as plain a demonstration to reason of the continuity of the vessels, as Mr. Cowper's experiment is to the eye.†

* It will be pointed out in a subsequent note that the uterine arteries do *not* immediately transmit their blood to the umbilical vein.

† Nevertheless all attempts that have been made in the human subject to inject the umbilical vessels from the uterine, and, vice versa, the uterine vessels from the umbilical, have constantly failed; whence it is to be inferred that there is no continuity of vessels (as Dr. Drake supposes), no *direct* circula-

In noticing the condition of the fœtus in ovo of oviparous animals, the author remarks that "there is at the obtuse end of the egg a small cavity filled with air, which is the succedaneous instrument to the respiratory organs. —Fabritius ab Aquapendente, and, after him, Dr. Harvey, have assigned divers uses to this cavity or air vesicle, the extravagance of which have perhaps deterred others from inquiring so much into the use, as the importance of it required. But though I cannot agree to that perspiration, refrigeration, and respiration, which they make it the instrument of, yet perhaps the air that was inclosed in that cavity, may through the augmentation of the body of the pullus, and its own rarefaction (which is at last so great as to occupy half the shell) break the membrane, which separated it from the pullus, and thus give so much respiration as to form the chirping voice, which is often heard before the breaking of the shell, and with it give an addition of strength to enable it to break the shell. But how it should respire sooner, is to him (he says) inconceivable."

The Description and Manner of Using a late invented Set of small Pocket-Microscopes, made by James Wilson. N° 281, p. 1241.

The late improvements made by magnifying glasses are not so much owing to the make, and the compounding of microscopes, as to the methods of applying objects for the advantage of light. Experience, as well as the authority of Dr. Hook,* assures us, that single magnifying glasses, when they can be used, are preferable to microscopes composed of two or more magnifying glasses.

Mr. Wilson here describes all the parts of his microscopes, with references to engraved figures of the same; and he describes the manner of using them, in viewing different objects, with necessary cautions and directions; such as are to be found in many books expressly treating on such subjects.

Abstract of a Letter from the Rev. Mr. Abraham De la Pryme, F. R. S. concerning a Water-Spout observed by him in Yorkshire. N° 281, p. 1248.

On the 15th of Aug. 1687, about 2 o'clock in the afternoon, there appeared a water-spout in the air, at Hatfield, in Yorkshire. It was about a mile off, coming directly to the place where I was; upon which I took my perspective glasses, and made the best observations on it I could.

tion between the fœtus and mother; but that portion of the placenta next the uterus having its cells filled with blood derived from the uterine arteries, a part of that blood (which is arterial or previously oxygenized) is absorbed by the radicles of the umbilical vein, and by this last, is conveyed to the fœtus. Hence the division of the placenta into the uterine part and fœtal part.

* In the preface to his Micrographia.—Orig.

The season was very dry, the weather extremely hot, the air very cloudy, and the wind pretty strong, and what was remarkable, blowing out of several quarters at the same time, and filling the air with thick and black clouds, in layers; this blowing of the wind soon created a great vortex, gyration, and whirling among the clouds, the centre of which now and then dropt down in the shape of a thick long black tube, commonly called a spout; in which I could distinctly see a motion, like that of a screw, continually drawing upwards, and screwing up as it were whatever it touched. In its progress it moved slowly over a hedge row and grove of young trees, which it made bend like hasel-wands, in a circular motion; then advancing forward to a large barn, in a moment it plucked off all the thatch, and filled the whole air with it. Coming to a very large oak tree, it made it bend like the former, and broke off one of its strongest branches, and twisting it about, flung it to a very considerable distance off. Then coming near the place where I stood, within 300 yards of me, I beheld with great satisfaction this extraordinary phenomenon, and found that it proceeded from a gyration of the clouds, by contrary winds meeting in a point or centre; and where the greatest condensation and gravitation was, falling down into a large pipe or tube, somewhat like the cochlea Archimedis; and which, in its working or whirling motion, either sucks up water, or destroys ships, &c. Having proceeded about a quarter of a mile farther, it was dissolved by the prevalency of the wind from the east.

On the Mischief occasioned by swallowing Fruit Stones, &c. By Mr. Henry Vaughan. N° 281, p. 1244.

A gentleman had eaten above 2 pounds of common prunes, and some time after, about a pound more: a fortnight before he died, he had some symptoms of the stone. He had a violent pain in the neck of the vesica, and about the urethra, with obstructions in his urine, &c. I ordered him a terebinthinate clyster, which gave him ease; but his pains afterwards increasing, a physician was sent for, who prescribed clysters, with diuretics and narcotics, but all to no purpose. After his death, I found on dissection the prune-stones passed into the intestinum rectum, and had there made a perforation into the pelvis. We tied one part of the gut, and cut out a piece, and emptying it there were taken out 128 prune-stones, besides what were left behind in stercore, in the other part of the intestinum rectum. There was also a large polypus taken out of the left ventricle of the heart, &c.

I attended a young man about 30 hours; his case was the iliac passion, very terrible for the time; he was about 14 years of age, of a sanguine constitution. About 3 or 4 hours before he died, I administered a terebinthinate clyster, which gave, during its stay, immediate ease; he continued so about an hour, when his disease returned again as severe as ever: and he soon after died. Some time before he died, he voided some of his clyster by vomit. On dissecting the body, I found the liver only something larger than ordinary; the ventricle was considerably distended, and the excrements had made a breach through the jejunum, and some quantity was evacuated; a considerable part of the ilium was very livid, but not in the least distended: the colon was much like a contused wound about 3 or 4 days old; in the centre it was something fresher, and not so livid as the outside: about the origin of the rectum there was another large rupture, where more fæces were voided.

About 18 months ago I dissected a poor emaciated person, who had died of a dropsy, out of whose body I took about 10 gallons of water. And about a month ago a child, which had an involution of the intestines, commonly called a twisting of the guts.

Some Observations on Coral, large Oysters, Rubies, the growing of a Sort of Ficus Indica, the Gods of the Ceylonese, &c. made in Ceylon. By Mr. Strachan. N° 282, p. 1248.

There is great quantity of a kind of white coral on the shore, between Galle and Matura, and many other coasts in the Indies, of which the Hollanders cause lime to be burnt for building of houses, and the walls of the fortifications. There are large banks of this coral; it is porous, neither so firm or smooth as the upright, which grows in small branches; and when they are come to the full growth, there grow others between them, and then upon these grow others, till it is become like a rock for thickness; these branches are not softer when they are young, than when they are ripe, yet I have observed a slime upon them always when they are under water, which I suppose is the substance which petrifies.

About three leagues from Batavia, I have seen oysters * of a foot diameter; the shell of one of which grew till it was 3 feet broad and a foot thick: after the fish was putrefied, upon these shells lying only 3 or 4 feet under water, I always observed a slime. On the coast between Galle and Gindere lies always os sepiæ; and in the river at Catoene there are found rubies; and if a person search among the sand in the water, he will find above a drop weight of them in an hour's time, but they are very small, for 20 of them will scarcely weigh a grain.

On the sea coast on the sand there lie a kind of small cockles, of the size of

* Chama Gigas. Lin.

oculi cancrorum or crabs' eyes; there is no cavity within, and if pounded, they have the same effect as testaceous powders, and are used instead of crabs' eyes.

Here are several trees, one of which may be above 6 fathoms high, whose root grows as it were above ground, in the following manner; when the twig is about half a foot high, there grows out of the middle of the stem a little knot, inclining downwards, making an angle with the stem of about 30 degrees, till it touch the ground; where it fixes, sending out small sprigs,* which before it touched the ground had neither branch nor leaves, but all over green, even like a shoot. While this shoot grows and the stem becomes higher, it still sends forth other shoots, which always come out of the middle of the tree or trunk; thus it continues shooting forth, till the tree arrives at its full growth; and the higher the tree grows, the knots and the shoots are the thicker and longer; so that one of the shoots which grows last, will be a foot thick in diameter, and 3 fathoms long.

The flower called happumal is found on a tree that grows in the same manner, but only two fathoms high; if planted round an orchard, they make an excellent hedge; for the leaves are thorny, and full of prickles; when the flower decays, it bears a fruit like a pine-apple, but it is of no use.

Mr. Samuel Brown's 7th Book of East India Plants. By James Petiver, F.R.S. These plants were gathered between the 15th and 20th of June, A.D. 1696, in the Ways between Fort St. George and Trippetee, which is about 70 Miles off. N° 282, p. 1251.

An enumeration and description of 67 East India plants, gathered at the places above mentioned. To this catalogue of plants is subjoined a description of 5 shells; viz. 1. Pecten Madraspatan. 2. Mytulus striatus Madraspatan. angustus. 3. Myt. striatus Madrasp. latus. 4. Pectunculus Madrasp. variegatus crassus, striis lateralibus, and 5. Pectunculus Madrasp. crassus, maculis croceis. These shells were sent from Fort St. George, by the Rev. Dr. George Lewis.

Some Thoughts concerning the Ancient Greek and Roman Lyre, and an Explanation of an obscure Passage in one of Horace's Odes. By Dr. Tho. Molyneux, F.R.S. N° 282, p. 1267.

The 3d Ode of the fourth book of Horace, beginning with these words, Quem tu Melpomene, &c. has been esteemed by the most learned critics, one of the most correct master-pieces in its kind that antiquity has left us. This, with another of Horace's Odes, that Julius Cæsar Scaliger, in his Trea-

* Some species of cactus.

tise de Re Poetica, lib. 6, recommends above all the rest, and gives it a most extravagant encomium; declaring he would rather be the true author of this little poem, than absolute king of Arragon, so high an opinion he had of its matchless excellency.

However, after all the extraordinary commendations which the critics have bestowed upon this performance, yet one of the most beautiful passages, and surprising fancies of the ode, seems to have been so overlooked by them, that neither they, nor any of the commentators I have hitherto had an opportunity to consult, have fully comprehended the meaning of the Poet, or the whole scope of his sense; which he expresses in these words,

O testudinis aureæ
Dulcem quæ strepitum, Pieri, temperas!
O mutis quoque piscibus
Donatura cygni si libeat sonum!

Now when I first reflected on these lines, and observed Horace's great heat and vehemency, in his repeated exclamation, on admiring his Muse's power, because she could give when she pleased even to mute fishes, the melodious voice of the swan, I considered entirely the fancy as forced and groundless, founded on nothing that was real or true in nature; and therefore it could pass for no more than a wild rant, or extravagant whim of the poet's. Yet, not being able to reconcile this to Horace's character, as a judge and master in the art of poetry, and so particularly remarked for his propriety of thought, and delicacy of expression; upon second thoughts I was convinced that this was the meaning of the passage, viz. that after he had, in the foregoing verses, acknowledged how much he was indebted to the bounty of his Muse, he here makes a sudden exclamation to extol her great art and mystery, who by mixing various notes, could compose such sweet harmony on the gilded lyre or testudo, and by her surprising power could, when she pleased, give even to mute fishes, or the hollow shells of the testudines aquaticæ, or water tortoises, a sort of fish, of which I imagine they made their lyres, the sweet melody of the swan.

Now on searching among ancient authors, to discover whether the testudo, or lyre of the ancients, was made of the back or hollow shell of the tortoise, as the name seemed fully to import, I found that it was a current piece of history, generally received among the ancients, that Mercury was the first inventor of the lyre, (whence Horace in his 10th Ode of the 1st book stiles him Curvæ Lyræ Parentem,) and that he made it of the shell of a dead tortoise, he accidentally found on the banks of the Nile. I might produce several testimonies to this point, but I think the two following will be sufficient.

The first is from Nicander, an old physician, and a Greek poet, who wrote above 100 years before Horace. In his poem called Alexipharmaca, speaking of the antidotes proper against the poison of the salamander, he recommends both the sea and the mountain tortoise in these words,

'Αμμίγδην ἁλιοιο καθεψηθέντα χελώνης
Γυίοις, ἥ ταχινῆσι διαπλώει πτερύγεσσιν.
'Αλλοτε δ' ουρείης κυτισηνόμε, ἥν τ' ἀκάκητα
'Αυδήεσσαν ἔθηκεν, ἀναύδητον πέρ ἐοῦσαν
Ερμειης· σαρκος γαρ ἀπονόσφισε χελειον
'Αιόλον· ἀγκῶνας δε δύω παρετείνατο πέζαις.

Closely translated by Johannes Gorreus into Latin thus:

Cum curva auxilio veniunt testudine——
Quæ pelagi fluctus velocibus innatat alis.
Aut montana etiam Cytiso quæ vescitur et quam
Reddidit e muta modulanti voce canoram
Mercurius ; picto insontis qui Cortice carnem
Exemit, geminumque Ancona intendit in oris.

The other instance is from one of Lucian's Dialogues, who wrote above 100 years after Horace: whence it is plain that the mechanism of the ancient lyre, and the opinion concerning its first invention prevailed since, as well as before Horace's days. In this dialogue Lucian introduces Apollo and Vulcan talking, after his jocose way, of Mercury, to this purpose:

Απ.—χελώνην πε νεκράν εὑρὼν, ὄργανον ἀπ' ἀυτῆς συνεπήξατο, πήχεις γὰρ εναρμοσας, καὶ ζυγώσας, ἔπειτα καλάμες ἐμπήξας, καὶ μαγάδιον ὑποθεὶς, κατὰ ἐντεινάμενος ἑπτὰ χόρδας, μελοδεῖ πάνυ γλαφυρὸν ὦ Ηφαιςε καὶ ἐναρμόνιον.

Thus translated:

Ap.—Testudinem mortuam alicubi offendens instrumentum ex ea concinnavit ; brachia enim adaptans jugum opposuit, deinde clavos infigens, et hæmisphærium repandum infra subjiciens, septem cordas extendebat, atque modulabatur quiddam valde sonorum O Vulcane et ad musicæ melodiam compositum.

I thought it not amiss to set down Lucian's words at length, not only because they are clear and full in the point, as to what the musical testudo of the ancients was first made of, but because they accurately describe and enumerate all its parts, giving each its peculiar name: so that they as well serve to explain the figure of it, in Mersenne's Harmonics, copied from an antique gem, as manifestly show that it was really taken from a genuine piece of antiquity.

From whence it is plain that the ancients made their lyres of the shells of tortoises; perhaps using promiscuously the land or river tortoise, which occasions Pausanias and Nicander to mention the mountain tortoise, whereas Horace speaks of the river tortoise, of which probably his lyre was made.

Concerning a Plum-stone lodged in the Bowels for 30 *Years. By Mr. James Yonge, F.R.S.* N° 282, p. 1279.

Sarah Swayn, of a thin habit and middle stature, when but 6 years old, was first afflicted with a violent pain, with a large hard swelling on the left side of her belly, which lasted 12 hours, and then went off without using any remedy, or sensible evacuation; but at the end of 3 months it returned, continued, and went off as before. It observed that period for several years, and then it changed its intermission, from 3 months to 3 weeks, and so continued till she was 35 years of age, in which time she married, and bore one child, the pain of which she averred was much less than what these paroxysms gave her. During her pregnancy, her pains and intermissions had no alteration, and in her whole life she found no diet disturbed her, but milk and salt meats. About 9 months before she was cured, the pain and tumour increased to the size of a man's 2 fists: she endeavoured by many remedies to get ease, but in vain, till the torment and watching had so weakened her, that she could not rise out of bed, nor lie down in it.

In this deplorable condition she was advised by a woman to take a dose of powdered jalap: what the quantity was, I could not learn; but it operated violently, and suddenly drove the pain from her side down to the anus, where it resembled a tenesmus, viz. a constant and violent inclination to stools, without being able to force off any thing, and after she had been thus tormented 4 days, her urine also stopped, and 2 days after that the charitable neighbours, who had all along given her their best assistance, craved mine. I perceived by their report of the matter, that something obstructed the passage of the excrements, and soon found it so by a probe; I then anointed the passage with populeum, and taking hold of the substance with a pair of large forceps, made to extract stones from the bladder after lithotomy, I drew it forth. Abundance of wind and fæces gushed out, and continued to flow till her guts were emptied of all the matter, which had been so long retained; after which I ordered her an anodyne clyster, and a composing draught; and ever since, being several years, she has continued well.

The substance extracted was round, somewhat oblong, having on it some such impressions, as men's fingers make on wax or plaister. It weighed then 10 drachms, now scarcely an ounce; it was 5 inches in circumference; and although it felt, and otherwise appeared a stone, it swam on water. To see the inside, I cut it in two with a knife; externally it was black, and smooth as if varnished, and no thicker; next to this thin blackness was a crust of matter like brick, of the thickness of half a crown; within that appeared a substance resembling paste-board, or chewed paper; and within that lay a prune or withered plum, with the stone and kernel cut asunder by my knife. Thus all these surprising symptoms, which so long afflicted this poor woman, were occasioned by this plum-stone, swallowed so many years before; but how those different accretions were made to it in such a place as the intestines? how it ceased to torment her at so many and such different intervals? where it lurked between those fits, and how the pain and tumour observed such exact periods for so many years; at first every 3 months, and afterward every 3 weeks? are questions I am not able to resolve.

Many authors tell us of various stones ejected by stool, and many of them have been found to come out of the gall bladder of persons in the jaundice. I have seen 2 such, larger than any I have read of, one as large as a pullet's egg, which came from a lady in the operation of a strong cholagogue; taken for a jaundice, that had resisted many other remedies; the other of the size of a large nutmeg, voided by the same means from an aged man, languishing under the same distemper; and both these patients, for many days after those stones came away, evacuated large quantities of choler by stool, and were freed of the disorder.

That these two stones were generated in the folliculus fellis or ductus choledochus, appears, if we consider the consequence, and that in colour, taste, weight, and shape, they resembled such as are found in those parts on dissection of jaundiced bodies. I once saw near a handful of them taken out of the gall-bladder of the Portugueze ambassador, who died in London, 1679; and we are lately told by Baglivi, that the famous Malpighi was full of them: they usually are of subcitronous colour, resembling bright myrrh, and seem to be aggregates of small stones, which perhaps are generated singly in the vesicula, and coalesce in the ductus.

The consequence of their coming off shows, that they caused the jaundice in those last mentioned persons, by obstructing the channels through which the bile passes from the common receptacle into the duodenum. It may perhaps seem impossible to some, that substances of that magnitude could pass through a meatus so small as the common duct is. But it has been no wonder to me these 20 years, since I dissected a physician of this place, who died of the jaundice, and found the ductus communis large enough to admit my greatest finger.

The stones which are generated in the guts, are of another sort, and easily distinguishable from the foregoing. Becker, speaking of some stones voided by stool, said he supposed that those stones are generated in the intestines, because they differ from those in the gall-bladder in colour, weight, and figure. Those generated in the gall, cause the jaundice; those in the guts produce colicy, splanchnic, hypochondriacal pains, and sometimes nephritic; all which vanish when they are ejected

Some Instances of other Persons who were hurt by swallowing Plum-stones. By Dr. Sloane, Sec. R. S. N° 282, p. 1283.

The first was a man in Lancashire, who being for many years ill of the colic, and receiving no relief from any medicine, desired he might be dissected after his death, to see what might be the cause of his disease. This was accordingly done, and there was taken out of one of his guts a large ball, 6 inches round, of an ounce and half weight, composed of a spongy matter, which swam in water; and viewed by a microscope, it appeared to consist of very small transparent hairs, or fibres, wrought together, after the manner of the tophus bovinus, found in the maws of oxen. In the middle of it was a common prune or plum-stone, which had been swallowed, and sticking somewhere in the guts, had gathered that substance about it, which resembled the small hairs on the skins of several animals, or the fibres of plants we eat. On cutting it, it was found to consist of a hairy or fibrous substance, in various layers, over a plum-stone, and seems to be of the same substance with that mentioned by Mr. Yonge.

The second instance I saw of these balls, was by the means of Dr. Wm. Cole, who showed me some smaller balls than the two before-mentioned, which had in their centres plum-stones. The person he was consulted for, had the colic to a great degree, and had voided several of them; they were not so spherical, but of a compressed figure, smooth on the outside, and glazed as some of the tophi bovini are ; and seemed within of the same substance with the former in different layers on a plum-stone.

Dr. George Thompson, in his Experimenta Admiranda, p. 67, gives a large account of a ball which had been voided by a patient, after a great fit of illness, of the same size, and in appearance of the same substance with the former: that author tells us it had several plum and cherry-stones in it. These balls seem to be formed something after the manner of bezoars, which generally have some seed for their centre or nucleus, on which coats of another substance are gathered.

These instances are sufficient to show the folly of that common opinion, that the stones of fruit are wholesome: for though, by nature the guts are so defended by the mucus intestinalis, that very seldom people suffer, yet if we consider the various circumvolutions of the guts, their valves and cells: and at the same time consider the hair of the skins of animals we feed on, the wool or down on herbs and fruit, the fibres, vessels, and nerves of plants, which are not altered by the stomach, the same case may very easily happen. I once saw as strange a distemper, and almost as obstinate and long as I ever met with, proceed from a great quantity of strawberry seeds, which had lodged in the guts, and after their discharge the person was eased. And I have heard of many besides those published, who have lost their lives by swallowing a quantity of cherry-stones.

Concerning the Vestigia of a Roman Town lately discovered near Leeds in Yorkshire. By Mr. Thoresby, F. R. S. N° 282, p. 1285.

The vestiges of a Roman town are to be seen on the moor near Adel Mill, 4 miles from Leeds. They were discovered accidentally by a farmer, who ploughing part of his farm, was retarded by a great quantity of stones, immediately below the surface of the earth, which he was obliged to dig up before he could proceed, and has already out of the foundations of houses, which have been traced on both sides the street, got so many stones as has built above 100 rods of walling. At a very little distance is a Roman camp pretty entire: it is above 4 chains broad, and 5 long, surrounded with a single vallum, which from the top of the agger to the bottom of the trench, is still 22 feet deep, in the place I measured. The town seems to have been of considerable note, by the inscriptions, and fragments of statues, pillars, &c. dug up there, all which (as Dr. Lister has truly observed, of most of the Roman monuments in these parts) are made of the common sort of coarse rag, or millstone grit, of which are also the remains of a large aqueduct, in stones of a great length, and about $\frac{1}{4}$ of a yard thick, wherein the passage for the water is about 6 inches broad, and as many deep, almost double to those of clay, found in the Roman burying-place at York.

Some time ago here was dug up a statue, to the full proportion of a Roman officer, with an inscription. There were also discovered two inscriptions: the one is only a fragment, yet has enough to discover it to have been sepulchral, by the H. S. E. for hic situs est, below PIENTISS; the other is almost entire, and is evidently a funeral monument, it begins as usually with Dijs Manibus Sacrum, and ends Vixit Annos X, as it seems to have been by the vacancy; it is one foot thick, 2 broad, and 3 high; the letters are very large, full 3 inches long, some of them interwoven, as AND (AD) and ED (as I apprehend the EↃ to be) in Candiedianæ. The form of the letters, and particularly the A, may perhaps discover the age this Roman station flourished in, viz. in Severus's reign, An. Dom. 194, or before, if the observation of Camden, in his Britanniæ, 808, hold good, and I know none of the modern critics that dissent from it: 'this observation, says he, I have made, that from the age of Severus 'to that of Gordian, and after, the letter A, in the inscriptions found in this 'island, wants the cross stroke, and is engraved thus Λ.

Among the ruins were found 2 or 3 millstones, for grinding corn, which, by the smallness of the size, 20 inches broad, show that the Romans of those, as well as the Egyptians and Jews of former ages, made use of their slaves or captives for that drudgery. Besides this, which is entire, I have a fragment of another millstone, whereon the rows are yet remaining, which being heavier, and almost as thick at the circumference, as the other is at the centre (for they are convex on one side) I suppose might have been the runner.

In traversing the ground, I found the fragments of urns and the other Roman vessels, one of which has been 23 inches, or two feet in circumference; they are mostly of the common red clay; but I have also one of the best coral coloured varnish, and others of a bluish grey; as also a brass ring found in the same place.

The Roman ridge that this town stood upon, comes from the great military road upon Bramham moor, of which Leland, in his MS. Itinerary, affirms, 'I never saw in any part of England so manifest a token as here, of the large crest of the way of Watling-street made by hands. From thence this via vicinnalis passes by Thorner and Shadwell, Street-lane and Hawcaster ridge upon Blackmoor (near which is the Roman Pottery mentioned in some former Transactions) to Adel; thence through Cockridge, over the moors towards Ilkley, a known Roman station: this same ridge is very evident in some part of the grounds of Tho. Kirk of Cockridge, Esq. who showed me the place where a Roman monument in his possession was dug up; it seems to have had a large inscription, but so erased that nothing distinct can be made of it.

END OF THE YEAR 1702 OF THE ORIGINAL.

END OF VOLUME FOURTH.

ERRATA.

Page 319, l. 11, *for* $\overline{MN} - \overline{ME} = \overline{ME}$ *read* $\overline{MN - ME} = ME$.
357, l. 1, *for* livid *read* lurid.

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