MICROGRAPHIA RESTAURATA:

OR, THE

COPPER-PLATES

OF

Dr. *HOOKE*'s Wonderful Diſcoveries

BY THE

MICROSCOPE,

Reprinted and fully Explained:

Whereby the moſt Valuable PARTICULARS in that

Celebrated AUTHOR's

MICROGRAPHIA

Are brought together in a narrow Compaſs;

AND

Intermixed, occaſionally, with many Entertaining and Inſtructive DISCOVERIES and OBSERVATIONS in NATURAL HISTORY.

Rerum Natura nuſquam magis quàm in minimis tota eſt.
PLIN. Hiſt. Nat. Lib. XI. C. 2.

LONDON:

Printed for and Sold by JOHN BOWLES, Printſeller at the *Black Horſe* in *Cornhill*.
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MDCCXLV.

THE

PREFACE.

THE MICROGRAPHIA of Dr. HOOKE being grown extremely ſcarce, and the Price thereof greatly raiſed; it can fall into the Hands of very few who are not ſo lucky to be poſſeſſed of it already; which (ſince a Deſire of ſearching into the minute Wonders of Nature is become almoſt general) muſt be looked on as a great Misfortune, by many, who would gladly inform themſelves what Diſcoveries were made by this *induſtrious Obſerver*, at a Time when *Microſcopes* were very rare, and the Uſe of them but little known.

This Misfortune may, 'tis hoped, be however conſiderably alleviated, by a fortunate Preſervation of nearly all the *Copper-Plates*, which the Doctor, at a great Expence, cauſed to be engraven for the Illuſtration of his *Microſcopical Obſervations*, and which are, perhaps, the moſt valuable Part of the whole Work: for his Deſcriptive Accounts can, without the *Prints*, neither be inſtructive nor entertaining; but any tolerable Explanations may, with them, make a pretty good Amends for the Want of the MICROGRAPHIA.

To render them thus uſeful is the Deſign of this Undertaking; of which, as ſome little Account may reaſonably be expected, it ſhall be given in as few Words as poſſible.

'Tis now ſeventy-nine Years ſince the MICROGRAPHIA was publiſhed; notwithſtanding which, the *Copper-Plates* belonging to it were lately met with, well-preſerved, and excepting a little Ruſt, which was eaſily cleared away, in as good Condition almoſt as ever: no more than one Impreſſion, and that probably of no great Number, having been taken from them. Seven indeed were wanting to make up the whole Set compleat; but thoſe are now ſupplied by exact Copies little or nothing inferior to the Originals.

As theſe were ſome of the firſt *Drawings* of Objects examined by the *Microſcope*, ſo likewiſe are they, without Compariſon, ſome of the beſt that were ever taken in ſo great a Number: here being no leſs than *Thirty-three Plates*, which contain a delightful Variety of Subjects, largely magnified, and curiouſly engraved.

At the Time Dr. HOOKE publiſhed this Work, a verboſe and diffuſed Way of Writing was in faſhion, which ſeems to us at preſent tedious and diſtaſteful; the Doctrine of equivocal Generation, or a ſpontaneous Production of many Species of minute Living-Creatures, as well as Vegetables, without any other Parents than Accident and Putrifaction, prevailed likewiſe almoſt univerſally, and had done ſo for Ages, however abſurd it now appears to us: For which Reaſons it has not been judged convenient to reprint the MICROGRAPHIA, but to give rather ſome ſhort and plain Deſcriptions of its *Pictures*, without meddling at all with its *Opinions* or *Hypotheſes*.

The

The following Sheets are therefore drawn up as an Explanation of theſe *Copper-Plates*, and 'tis hoped they may even make them better underſtood than they could be by the *Doctor's* own Accounts; which muſt be acknowledged (with all due Regard to the Memory of ſo great a Man) to be frequently tedious and obſcure, as well as ſo unmethodical, that to ſeveral *Figures* no Deſcriptions can poſſibly be found, but by turning over the whole Book, there being no Direction at all to guide us to them.

It was neceſſary to form theſe *Explanations* from the Work itſelf whereto the *Plates* belonged, but the Diſpoſition, Stile, and Manner, will be found entirely new: Whatever properly concerns the ſame Subject being here brought together, from the different Places where ſcattered and intermixed throughout the MICROGRAPHIA, and expreſſed with the utmoſt Brevity and Plainneſs of Language.

This renders the preſent *Volume* ſo ſmall: though it really contains the whole Senſe of all that is neceſſary fully to underſtand the following *Plates*. And nearly one half, even of this Little, conſiſts of new *Diſcoveries* or *Obſervations*, made ſince the DOCTOR's Time, on the ſeveral Subjects which the *Figures* repreſent: whereby a great Variety of *Natural Hiſtory* is conveyed to the READER's Hands, in a narrow Compaſs and at a ſmall Expence.---The *Plates* themſelves will be found alſo more inſtructive, by engraving over every *Figure* an Account of what it is, and of the Page where we may look for the Deſcription of it.

Little more is requiſite than to inform the Reader, that the *Microſcope* Dr. HOOKE uſed was of the *Double-Kind*; but much more cumberſome, and leſs convenient, both as to its Structure and Apparatus than what our *Opticians* make at preſent. For this Inſtrument (that new Sort particularly which has very lately been conſtructed on an improved Plan) is brought now to ſuch a Degree of Perfection, that no Obſerver need be apprehenſive he ſhall be unable to diſcover, and that too very eaſily, any of the minuteſt Parts of Objects which the *Doctor* could diſcern with the *Microſcope* he employed.

The *Doctor* ſometimes mentions the comparative Size of Objects when magnified by his Glaſſes; and therefore, as the *Curious* may very naturally enquire by what means he could compute their Bigneſs, it ſeems proper to acquaint them with the Method whereby he took their Meaſure.---Having (he tells us) rectified the *Microſcope*, to ſee the deſired Object through it very diſtinctly; at the ſame time that he look'd upon the Object through the Glaſs with one Eye, he looked upon other Objects at the ſame Diſtance with his other bare Eye: by which means he was able, by the Help of a Ruler divided into Inches and ſmall Parts, and laid on the Pedeſtal of the *Microſcope*, to caſt, as it were, the magnified Appearance of the Object upon the Ruler, and thereby exactly to meaſure the Diameter it appears of through the Glaſs; which being compared with the Diameter it appears of to the naked Eye, will eaſily afford the Quantity of its being magnified.

Plate I.

The Twentieth Part of an Inch magnified

Fig. 1

Point of a small Needle.

a

D

C

b

Small Needle p. 1.

b

a

b

A

Fig. 2.

Printed Dot or Tittle. p. 1.

The Sixteenth Part of an Inch as magnified.

Fig. 3

a

Edge of a Razor. p. 2

Micrographia Reſtaurata, &c.

An Explanation of the First Plate.

FIG. I.

The Point of a ſmall ſharp Needle.

DR. HOOKE begins his Microſcopical Experiments with obſerving, that it is as requiſite, in the Study of Nature, to make ourſelves acquainted with the moſt ſimple and uncompounded Bodies, before we venture to examine thoſe of a more complicated kind; as it is to learn how to make our Letters before we pretend to write: And, in conſequence of this Obſervation, the firſt Object he lays before us, comes the neareſt to a phyſical Point of any artificial thing we are acquainted with; I mean the Point of a ſmall Needle, made ſo ſharp that the naked Eye is unable to diſtinguiſh any of its Parts. This, notwithſtanding, appeared before his Microſcope as in the Figure at *a a*, where the very Top of the Needle is ſhewn above a Quarter of an Inch broad; not round or flat, but irregular and uneven. The Point of a Needle.

The whole Piece we have here the Picture of, (according to the Scale given with it) is little more than the twentieth Part of an Inch in Length, and appeared to the naked Eye exquiſitely ſmooth and poliſhed; but, as ſeen by the Microſcope, what a Multitude of Holes and Scratches are diſcovered to us? How uneven and rough the Surface! how void of Beauty! and how plain a Proof of the Deficiency and Bunglingneſs of Art, whoſe Productions when moſt laboured, if examined with Organs more acute than thoſe by which they were framed, loſe all that fancied Perfection our Blindneſs made us think they had! Whereas, in the Works of Nature, the farther, the deeper our Diſcoveries reach, the more ſenſible we become of their Beauties and Excellencies.

But to return to the Object now before us; A, B, C, repreſent large Hollows and Roughneſſes, like thoſe eaten into an Iron-Bar by Ruſt and Length of Time. D is ſome ſmall adventitious Body ſticking thereto by Accident.

b. b. b. ſhew the End where this ſmall Piece of Needle was broken off, in order to take the better View of it.

As ſharp as a Needle is a common Phraſe, whereby we intend to expreſs the moſt exquiſite Degree of Sharpneſs; and, indeed, a Needle has the moſt acute Point Art is capable of making, however rude and clumſy it appears when thus examined. But the Microſcope can afford us numberleſs Inſtances, in the Hairs, Briſtles, and Claws of Inſects; and alſo in the Thorns, Hooks, and Hairs of Vegetables, of viſible Points many Thouſands of times ſharper, with a Form and Poliſh that proclaim the Omnipotence of their Maker.

PLATE I. FIG. 2.

A Printed Dot or Tittle.

WE have now before us the Repreſentation of a printed *Tittle*, or *Period Point*, as it appeared before the Microſcope. To the naked Eye it was no larger than the Dot in the Middle of the Circle A, perfectly black and round; but through the Magnifier it ſeemed grey, and quite irregular, like a great Splatch of *London* Dirt, about three Inches over. A Dot or Tittle.

This rugged and deformed Appearance is owing to the uneven Surface of the Paper, (which looks at beſt no ſmoother than a very coarſe Piece of Shag-Cloth) added to the

Irregularity of the Type, the rough dawbing of the Printing-Ink thereon, and the Variation made by the different Lights and Shadows. Nor is a Point made with a Pen, or by a Copper-Plate, at all leſs ill-ſhapen and ugly; nor can the fineſt Writing in the World ſtand the Teſt of this Inſtrument, but will appear before it like the bungling Scrawls of a School-Boy, made with Charcoal on a whited Wall.

PLATE I. FIG. 3.

The Edge of a Razor.

The Edge of a Razor.

THIS *Figure* repreſents the Edge (about half a Quarter of an Inch long) of a very ſharp Razor well ſet upon a good Hone, and ſo placed between the Object-Glaſs and the Light, that there appeared a Reflection from the very Edge, which is ſhewn by the white Line *a*, *b*, *c*, *d*, *e*, *f*.

When we ſpeak of any thing as extremely keen, we uſually compare it to the Edge of a Razor; but we find, when examined thus, how far from Sharpneſs even a Razor's Edge appears: That it ſeems a rough Surface, of an unequal Breadth from ſide to ſide, but ſcarce any where narrower than the Back of a pretty thick Knife: That it is neither ſmooth, even, nor regular; for it is ſomewhat ſharper than elſewhere at *d*, indented about *b*, broader and thicker about *c*, unequal and rugged about *e*, and moſt even between *a*, *b*, and *e*, *f*, though very far in any Place from being really ſtraight.

The Side immediately below the Edge, and what the naked Eye accounts a Part of it, *g*, *h*, *y*, *k*, had nothing of that Poliſh one would imagine Bodies ſo ſmooth as a Hone and Oil ſhould give it; but was full of innumerable Scratches croſſing one another, with Lines here and there, more rugged and deep than the reſt, ſuch as *g*, *h*, *y*, *k*, *o*, occaſioned probably by ſome ſmall Duſt falling on the Hone, or ſome more flinty Part of the Hone itſelf.

The other Part of the Razor *L L*, which had been poliſhed on a Grind-ſtone, appeared like a plowed Field, full of Ridges and Furrows.

The irregular dark Spot *m*, *n*, ſeemed to be a little Speck of Ruſt; corroſive Juices generally working in ſuch a manner.

This Examination proves, how rough and unſeemly (had we microſcopic Eyes) thoſe Things would appear, which now the Dulneſs of our Sight makes us think extremely neat and curious: And, indeed, it ſeems impoſſible by Art to give a perfect Smoothneſs to any hard and brittle Body; for *Putty*, or any other ſoft Powder, employed to poliſh ſuch Body, muſt neceſſarily conſiſt of little hard rough Particles, each whereof cutting its Way, muſt conſequently leave ſome kind of Furrow behind it. In ſhort, this Edge of a Razor, had it been really as the Microſcope ſhews it, would ſcarce have ſerved to chop Wood, inſtead of ſhaving a Man's Beard.

N. B. The black Part of this *Figure* is only deſigned to make the reſt more viſible. The Scale is intended to meaſure the *Figure* by.

Fig: 1

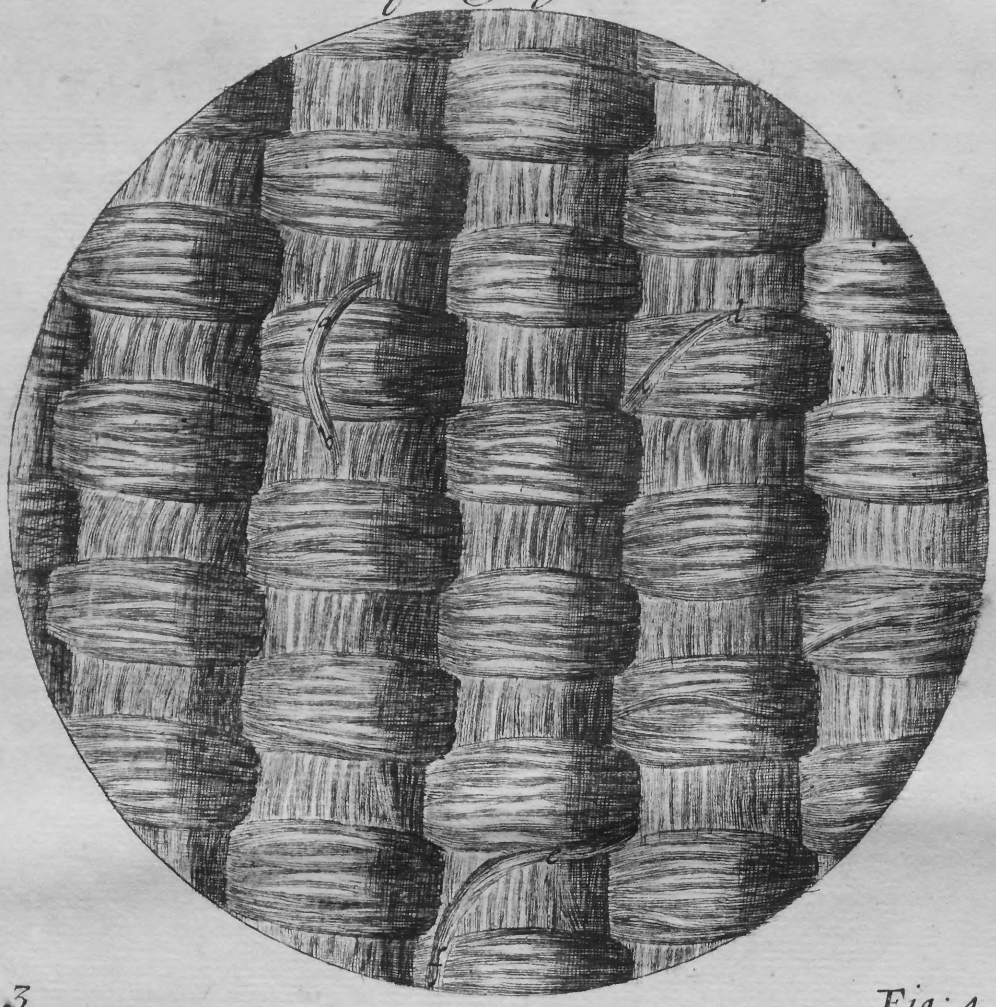
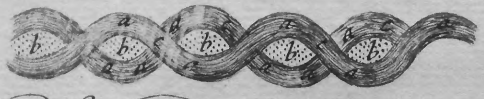


Fig: 3

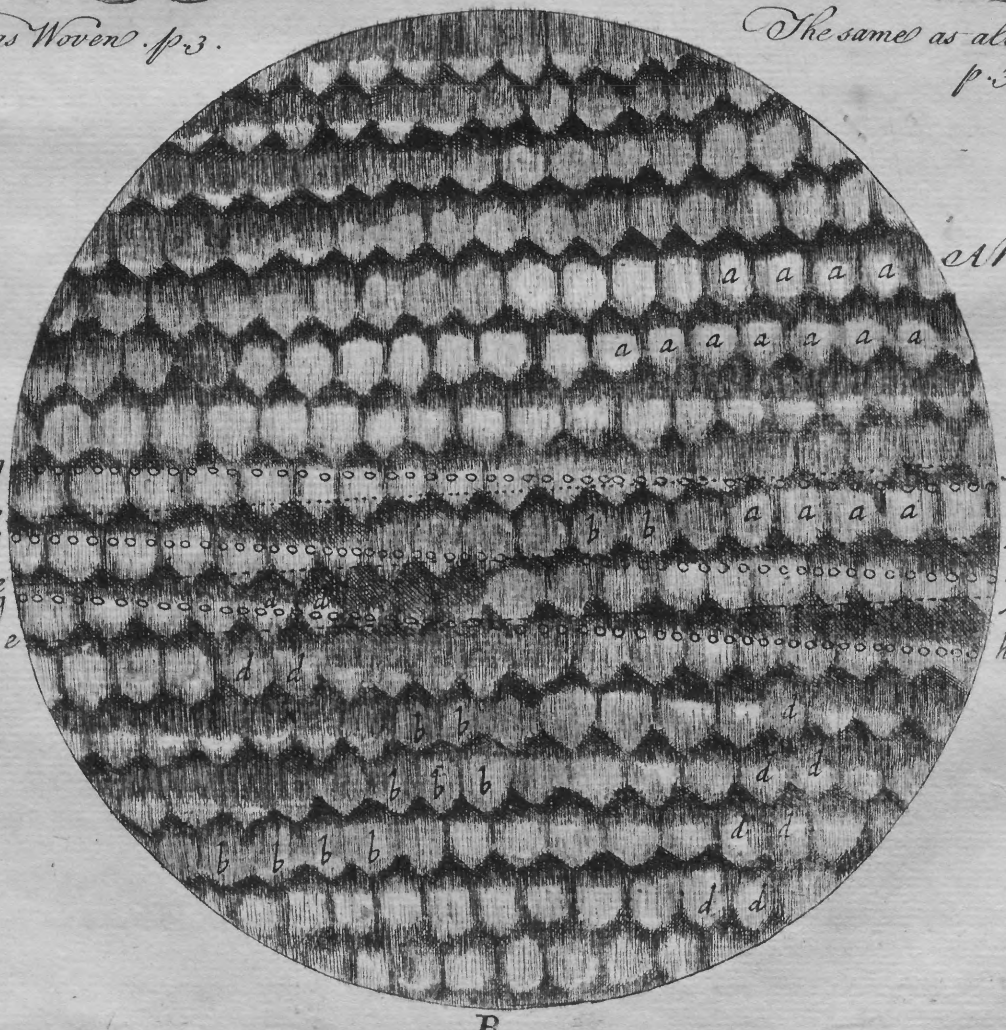


Threads as Woven. p. 3.

Fig: 4

The same as alter'd by Watering p. 3.

A



A Peice of Water'd Silk p. 3.

Fig: 2

An EXPLANATION of the SECOND PLATE.

FIG. 1.

A Piece of fine wheal'd Taffety Ribbon.

A Piece of Ribbon.

THIS Object was Sixpenny broad Ribbon, whoſe Subſtance viewed through the larger Magnifying-Glaſs, appeared like Matting for Doors, or ſuch Baſket-Work as they make in ſome Parts of *England*, for Bee-Hives, *&c.* with Straws a little wreathed or twiſted: for every Filament of the Silk (ſeveral whereof go to the forming one Thread) ſeemed about the Size of a common Straw, as the little irregular Pieces *a b*, *c d*, *e f*, ſhew.

Each Inch of this Ribbon appeared no leſs than twelve Foot ſquare, and an Inch and an half in Thickneſs. The *Warp* or *croſs Threads* ſeemed like Ropes of an Inch Diameter; but the *longitudinal Threads* or *Woof* had ſcarce half that Thickneſs. If the Silk be white, it reſembles Bundles or Wreaths of very clear and tranſparent Cylinders: if colour'd, each Cylinder, in ſome Place or other, affords as lively a Reflection as if it were made of Glaſs; inſomuch that a Piece of red Ribbon exhibited as bright a Luſtre as if coming from many Rubies. But ſuch vivid Reflections are not found in hairy Stuffs or Linens.

PLATE II. FIG. 2, 3, 4.

A Piece of Watered Silk.

A Piece of Watered Silk.

THIS Figure repreſents a Piece of Watered Silk, as ſeen through a Glaſs that magnified but little. A B ſignifies the long Way, C D the broad Way thereof.

This Silk appeared to the naked Eye, waved, undulated, or grain'd all over, with ſo curious though irregular a Variety of brighter and darker Parts as much increaſed its Beauty. So well known a Caſe ſeems to need very little Explication: But few perhaps have conſidered, that thoſe which in one Poſition appear to the Light the darker Parts of the Wave, in another appear the lighter, and *vice verſa*; by which means the Undulations are continually ſhifting, as the Poſition of the Parts to the incident Beams of Light is varied. The Microſcope diſcovers this Effect to proceed entirely from the Variety of the Reflections of Light, which the different Shape of the Particles, or the little Protuberances of the Threads compoſing the Surface occaſion: Thoſe Parts of the Waves that appear the brighter, throwing towards the Eye a Multitude of ſmall Reflections, while the darker afford ſcarce any.

Thus, in the preſent Figure, the brighter Parts of the Surface, denoted by *a*, *a*, *a*, *a*, *a*, &c. conſiſt of an Abundance of large and ſtrong Reflections; the Surfaces of thoſe Threads that run the long Way, being, by the mechanical Proceſs of *Watering*, plaited or angled in another Form than they were by *Weaving*; for, by weaving, they are only turned circularly over and under the warping Threads, but by the Watering they are bent with an *Angle* or *Elbow*.

What is meant hereby will better be explained by the third and fourth Figures; the former of which, *Fig.* 3. *a*, *a*, *a*, *a*, *a*, ſhews the Manner how the long Threads in Weaving are turned over and under the croſs Threads, the Ends whereof are repreſented *b*, *b*, *b*, *b*. Fig. 3.

Fig. 4. ſhews how the ſame Threads are by the Watering bent and alter'd into Angles or Elbows of all imaginable Variety; whereby, inſtead of reflecting the Light from one Point only of the round Surface, as about *c*, *c*, *c*: they now, when watered, reflect its Beams from more than half the Surface, as, *d e*, *d e*, *d e*. Theſe Reflections are alſo varied, as the particular Parts thereof are variouſly bent. Fig. 4.

Dr. HOOKE, to make this fully underſtood, ſubjoins the Method of watering Silks or Stuffs; the Subſtance of which, as being curious in itſelf, and neceſſary for the Explanation of the Figures, we ſhall give with all the Brevity poſſible.

The Piece to be watered muſt be doubled its whole Length, with the right Side inwards, exactly through the Middle, placing the two Selvedges juſt upon one another, and ſo diſpoſing the Wheal or Rib in the doubling of it, that the Wheal of one Side may lie as near as can be parallel with that on the other; for the nearer they come to that Poſition, the greater appears the Watering, and the more obliquely they lie to each other, the Waves become the ſmaller.

The

The Way of folding it for a large Wheal is thus:---They take a Pin, and beginning at one Side of the Piece in any Wheal, direct it towards the End of the ſame Wheal on the other Side, and then place the two oppoſite Ends of the Wheal as near as they can together; and ſo double or fold the whole Piece, repeating this Enquiry with a Pin at every Yard or two. This done, they ſprinkle it with Water, and fold it the long Way, placing a Piece of Paſteboard between every Fold; whereby the Wheals on the wrong Side are flatten'd, and thoſe on the Right become the more protuberant, and the angular Bendings of the Wheals are the more remarkable.

Being folded thus, they preſs it, between Paſteboards, violently, in a Hot-Preſs, and let it remain there till ſtiff and dry; which makes the Wheals of the contiguous Sides leave Impreſſions mutually on one another, as *Fig.* 2. demonſtrates: where it is evident that the Wheal of the Piece A B C D runs parallel between the pricked Lines *e f*, *e f*, *e f*; and Impreſſions being left upon theſe Wheals by thoſe that were preſt upon them, (which lay not exactly parallel to, but a little athwart them, as the Lines *o o o o o o o*, *g h*, *g h*, *g h*, ſhew) they are ſo variouſly and irregularly creaſed, and their Threads ſo ſet to each other, by being put into that Shape when wet, and kept ſo till dry, that the Mouldings will remain almoſt as long as the Silk itſelf.

Hence any one that conſiders the Figure attentively, will be ſenſible, why the Parts of the Wheal *a a a a a a* appear bright, the Parts *b b b b b b* dark or ſhadowed, and ſome ſuch as *d d d d d d* partly light and partly dark. The Variety of which Reflections and Shadows are the only Cauſe of the Appearance we call *Watering* in Silks or Stuffs.

Fine Lawn.

Fine Lawn.

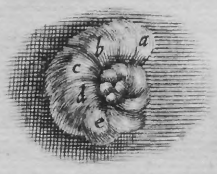
A Piece of the fineſt Lawn, whoſe Threads are ſcarce diſcernable by the naked Eye, appears through the Microſcope coarſer than any Hop-Sack; its Threads ſeeming not unlike, either in Shape or Size, the larger Kind of *Rope-Yarn*, wherewith they uſually make Cables: And its Tranſparency is plainly ſeen to ariſe from a Multitude of ſquare Holes, left between the Threads, which give it the Reſemblance of a Lattice-Window; only here the croſſing Parts are round and not flat. Theſe Threads, however, though as ſmall as in the fineſt Silks, have nothing of their gloſſy, pleaſant and lively Reflections.

A Drawing of this is given, *Plate* XI. *Fig.* 3.

Our Author proceeds no farther in examining the Productions of human Art; Things only deſigned to be viewed by our naked Eyes, and wherein little is diſcoverable but Rudeneſs and Deformity; but applies his Microſcope to behold the minute Works of Nature, which though far removed beyond the Reach of our Sight, are ſo exquiſitely curious, that the more our Glaſſes magnify the more Excellencies appear therein, the more we learn the Weakneſs of ourſelves, and the Omnipotency and infinite Perfections of the Great Creator.

Fig. 4. p.7.

A minute Shell



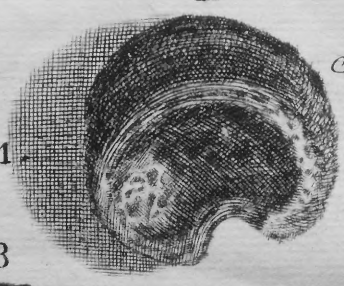


Fig: 1.

Sparks struck from a Flint and Steel. p. 5.

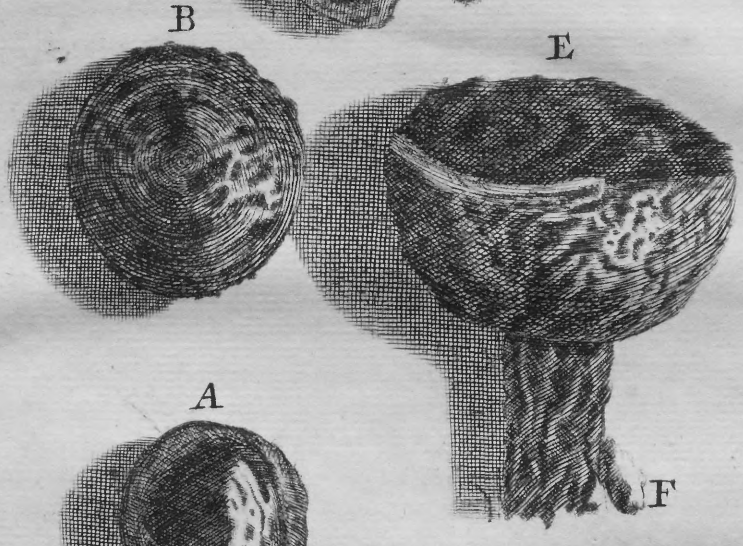
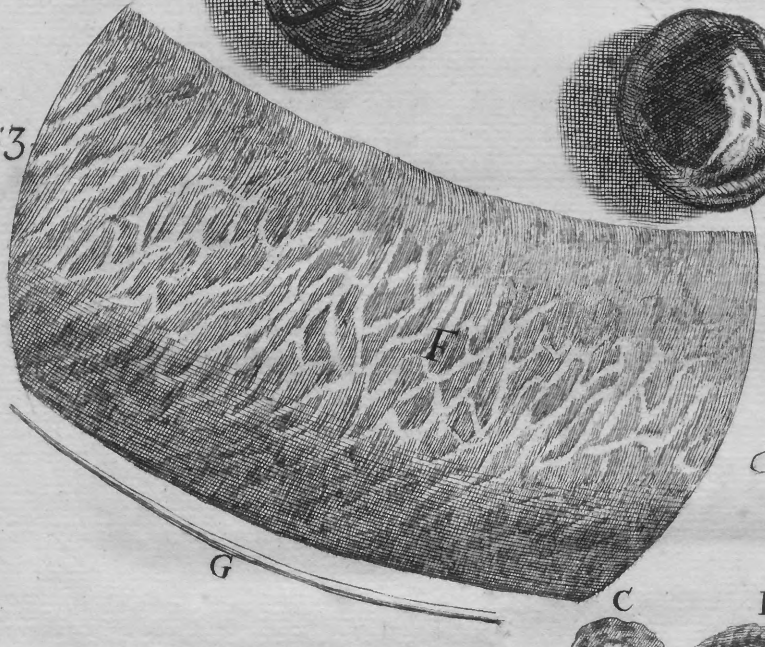
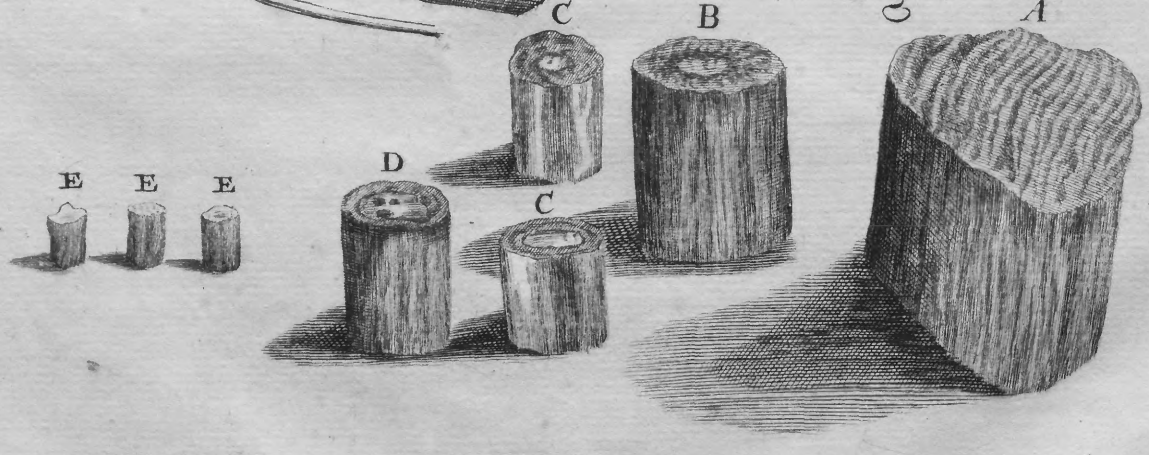


Fig: 3
p. 7.



The structure and configuration of several sorts of Hairs. p. 6.

Fig: 2.



An EXPLANATION of the THIRD PLATE.

FIG. 1.

The Sparks of Fire ſtruck from a Flint and Steel.

IN the common Way of ſtriking Fire with a Flint and Steel, fiery Sparks fly out at every Blow; which Sparks are nothing more than ſmall Pieces of the Flint or Steel, (but uſually of the Steel) broken off by the Violence of the Stroke, and either melted inſtantaneouſly into Steel Globules, or made at leaſt red-hot, and thereby capable of kindling Tinder or Touch-wood. The Heat is likewiſe ſo intenſe ſometimes as even to vitrify the broken Particles. Globules of Steel.

As a Proof of this, Dr. HOOKE ſtruck Fire over a Sheet of very white Paper, and obſerving diligently where the Sparks ſeemed to vaniſh, he diſcovered there certain very ſmall, black, but glittering and moveable Specks, which, when examined with his Microſcope, appeared to be little round Globules; ſome whereof did, from their Surface, yield a very bright and ſtrong Reflection on that Side next the Light, and reſembled Iron-Balls. One of which, whoſe Surface was pretty regular, is ſhewn by the Letter A.

He perceived in this the reflected Image of the Window, and alſo of a Stick, which he moved up and down between the Light and it.

He found others almoſt regularly round, as to the Bulk of the Ball, but with rough unpoliſhed Surfaces; which rendered the Reflection from them much more confuſed and faint. Such are repreſented by the Letters B, C, D, E.

Some were cracked or cleft, as C; others broken and quite hollow, as D; which ſeemed like half the hollow Shell of a Granado, broken irregularly in Pieces. There were other different Shapes; but that in particular, marked with the Letter E, was a larger Spark of Fire than ordinary. It went out on one Side the Flint employed in ſtriking it, and adhered thereto by the Root F. On the Top of its Stem was faſtned half an hollow Ball, with the Mouth of it opening upwards; ſo that it appeared ſomewhat like a Funnel, or a Rummer-Glaſs without a Foot.

The melting of the Particles of Steel, inſtantaneouſly, upon the Colliſion, is very wonderful, and comes up nearly to the Effects of Lightning: Indeed there ſeems to be in Iron or Steel a ſulphureous combuſtible Matter very eaſily put in Action; for either hammering, filing, or rubbing it with Violence, will preſently make it ſo hot as to be able to burn one's Finger: And if the Filings of Iron are only let drop through the Flame of a Candle, (placing a Sheet of white Paper underneath, to catch them for Examination) many of them will be found melted even by that ſudden Tranſit, and appear remarkably ſhining to the naked Eye; and if we view them farther by the Microſcope, we ſhall ſoon be ſatisfied they are exactly ſuch round Globules as are formed by ſtriking Fire with a Flint and Steel.

As obtaining ſuch minute Globules as theſe, of Lead or Tin, and that even in Quantity, eaſily and quickly, may be deſirable by ſome, we ſhall here ſubjoin the Way of forming them, which Dr. HOOKE ſays a learned Phyſician taught him. Globules of Lead or Tin.

Reduce the Metal you would ſhape thus, into exceedingly fine Filings: for the ſmaller your Filings are, the ſmaller will be your Globules. Strew ſome fine and well-dried Powder of Quick-Lime at the Bottom of a Crucible, on which ſcatter ſome of your Filings very thinly; then ſtrew on more Powder, on that again more Filings, and ſo alternately, Stratum ſuper Stratum, till you have filled your Crucible, in ſuch a manner, that, as near as may be, no two Filings may touch each other. Place the Crucible in a gradual Fire, and increaſe the Heat by Degrees, till it be ſufficient to make all the Filings mix'd with the Quick-Lime melt, and no more. For if the Fire be too hot, many of the Filings will join and run together: But if the Heat be duly proportioned, upon waſhing the Lime-Duſt in Water, all thoſe ſmall Filings of the Metal will ſubſide to the Bottom, in a moſt curious Powder, conſiſting of Balls or Globules exactly round; which, if very fine, is excellent for Hour-Glaſſes.

One may, at any time, procure immediately minute Globules of Lead, by only kindling a red Wafer, ſuch as Letters are ſealed with, at a Candle; for as it burns (and it will not go out till it be wholly conſumed) the red Lead employed in the Colouring, melts, and falls down, in regular minute Globules; which, if a Sheet of clean Globules of Lead.

white Paper be placed underneath, may be catched in greater Abundance than can be imagined without Trial.

PLATE III. FIG. 2.

The Structure and Configuration of ſeveral Sorts of Hairs.

Briſtles of an Hog.

THE Briſtles of an Hog were found of a Subſtance hard, tranſparent, and horny, without the leaſt Appearance of Pores or Holes, as was tried by cutting them tranſverſely with a ſharp Razor, and then examining their cut Ends by a Microſcope. This ſhewed many wavy Figures thereon, occaſioned by the Sawing of the Razor to and fro, as we may ſee at the End of the Body A. But notwithſtanding Light was caſt upon them all the various Ways that could be thought on, to make the Pores viſible, none at all could be diſcovered.

They were neither perfectly round, nor ſharp-edged, but priſmatical, with divers Sides and round Angles, *Vid.* A. Bending them in any Part takes away the Tranſparency where the Bending is, makes them look white, and flaws them in that Place.

Whiskers of a Cat.

B repreſents the Whiſker of a Cat cut the croſs Way, in the Middle whereof a large Pith appeared like the Pith of Elder, whoſe Texture was ſo compact that no Pores could be diſcovered in it; for tho' in one Poſition to the Light there ſeemed an Appearance of Pores, that Poſition being alter'd, the Light was manifeſtly reflected from them. Which may ſerve as a Caution never to conclude too raſhly on what we view through Microſcopes, or declare our Opinion till we have examined Things in every Light and Poſition, and by all the Contrivances in our Power.

Horſe Hair.

C C, and D, are Pieces of the long Hairs of Horſes, which appear cylindrical and ſomewhat pithy.

Human Hair.

E E E repreſent three Sections of the Hairs of a Man's Head, which were found generally almoſt round, though ſometimes a little priſmatical. The Part next the Top was bigger than that nearer the Root. They were throughout tranſparent, though not very clear, nor every where of the ſame Colour, being near the Root like black tranſparent Horn, but near the Top-Extremity like Horn that is clear and brown. Their Roots were pretty ſmooth, tapering upwards like a ſmall Parſnep, nor could any Filaments, or other Veſſels, like Fibres from the Roots of Plants, be found.

The Top when ſplit, which is common in long Hair, appeared like the End of a Stick ſhivered with Beating, with ſometimes half a Score Splinters or Diviſions.

Our Author ſays, that as far as he could find, Human Hairs are all ſolid cylindrical Bodies, not pervious like a Cane or Bulruſh, but without any Pith or Diſtinction of Rind; and imagines thoſe who aſſert them to be hollow, have not inſpected them with ſufficient Care.

Dr. POWER *, on the contrary, makes no doubt that every one of our Hairs is hollow, which, though our Glaſſes cannot demonſtrate, by reaſon of their Tranſparency, is palpably evinced by that Diſeaſe in *Poland* called the *Plica*, where Blood drops from the Ends of the Hairs of the Head, and likewiſe iſſues out wherever they are cut; which, he thinks, infallibly proves the tubulous Cavity of them. But to this Dr. HOOKE anſwers; that the Microſcope gives no Encouragement to believe our Hairs are hollow; and that perhaps the very Eſſence of the Diſtemper called the *Plica Polonica*, may be their growing hollow, and of an unnatural Conſtitution.

MALPIGHI aſſerts the Hairs of Animals to be tubular, that is, compoſed of a Number of extremely minute Tubes or Pipes, which he concludes from his Examination of a Horſe's Main and Tail, and the Briſtles of a Boar. Theſe Tubes were moſt diſtinguiſhable near the End of the Hairs where they appeared more open: And he ſometimes could reckon above twenty of them. He perceived theſe Tubes very plainly in the Hedge-Hog's Prickles, (which are of the Nature of Hairs) together with elegant medullary Valves and Cells.

Mr. LEEUWENHOEK tells us, that an human Hair, cut tranſverſely, ſhews a Variety of Veſſels in regular Figures.

* *Power's* Exper. p. 56.

PLATE III. FIG. 3.

Hair of an Indian Deer.

Hair of an Indian Deer.

F Exhibits the Middle Part of the Hair of an *Indian* Deer, and G the Top or Extremity of the ſame Hair, both magnified by the ſame Glaſs; whereby is ſhewn how extremely tapering theſe Hairs are formed, which indeed was obſervable by the naked Eye; for though in the Middle it was thicker than an Hog's Briſtle, it was ſlenderer at the End than the Hair of any other Animal. The whole Belly of it was two or three Inches long, and appeared to the Eye like a Thread of coarſe Canvas that has newly been unravelled, being all bent or waved to and fro, in the Manner of ſuch a Thread: But ſeen through the Microſcope, it ſeemed all perforated from Side to Side, and ſpongy; and reſembled a ſmall Kind of ſpongy Coral, found frequently on the Coaſts of *England*. When cut tranſverſely, no Pores could be diſcerned running the long Way of the Hair.

The Hairs of different Animals are curious Objects for the Microſcope. In ſome tranſverſe, in other ſpinal Lines, ſomewhat of a darker Colour, run from Bottom to Top, in a very pretty Manner. A Mouſe's Hairs are of this Sort: They appear as it were in Joints like the Back-Bone, are not ſmooth, but jagged on the Sides, and terminate in the ſharpeſt Point imaginable. Hairs taken from a Mouſe's Belly are leaſt opake, and fitteſt for Examination *.

Hairs taken from the Head, the Eye-Brows, the Noſtrils, the Beard, the Hand, and other Parts of the Body, appear unlike, as well in the Roots as in the Hair themſelves, and vary as Plants do of the ſame *Genus*, but of different *Species*. They all become lengthened by Propulſion, and are thicker towards the Middle than at either End.

PLATE III. FIG. 4.

A pretty minute Shell found amongſt Sand.

A minute Shell found amongſt Sand.

THIS Shell appeared to the naked Eye like a white Spot, no bigger than the Point of a Pin; but when viewed by the Microſcope, it was found in every Particular to reſemble the flat ſpiral Shell of a Water Snail, and had twelve Wreathings, *a*, *b*, *c*, *d*, *e*, &c. all diminiſhing gradually towards the Middle or Center, where there was a very ſmall, round, white Spot. 'Twas not eaſy to diſcover whether it was hollow or not, but it rather ſeemed to be filled with ſomewhat, and probably might be petrified, as larger Shells are often.

The Object under Obſervation informs us of another *Genus*, where the Almighty Hand of the Maker is amazingly exemplified in the Minuteneſs and Elegance of the Work: For we find hereby that the ſame Power which contrived ſuch minute Inſects as Mites, ſuch minute Fiſhes as the Eels in Vinegar, and ſuch minute Vegetables as Moſs and Mouldineſs, has likewiſe formed a Tribe of ſuch minute Shells as this before us; the Beauty of which could never have been diſcovered without the Microſcope's Aſſiſtance. It was found, accidentally, amongſt ſome White-ſand that was looked at with no other Deſign than to try the Goodneſs of ſome Glaſſes: But many valuable Diſcoveries have been owing to lucky Accident.

* Microſcope made eaſy, p. 245.

An EXPLANATION of the FOURTH PLATE.

FIG. I.

Some curious Forms of ſmall Diamonds, or ſhining Sparks in Flints.

Diamonds in Flints.

BReaking a Flint-Stone by Accident, a Cavity was found therein, all cruſted over with a pretty candy'd Subſtance, A A, *&c.* ſome Parts of which, ſuch as B B B B, on turning them to the Light, reflected its Rays in a very glittering and lively Manner: And bringing it to the Microſcope, the whole Surface of the Cavity appeared beſet with a Multitude of little chryſtalline or Diamond-like Bodies, curiouſly ſhaped and poliſhed, as the Drawing repreſents them.

The vivid Repercuſſions of Light were, on Examination, obſerved to be reflected partly from the plain external Surfaces of theſe regularly figured Bodies, and partly from within the pellucid Bodies themſelves, that is, from ſome Surfaces thereof oppoſite to thoſe Surfaces which were next the Eye.

But theſe Sparks being ſo ſmall, that no certain Experiments could eaſily be made with them, Dr. HOOKE procured ſeveral of the ſhining Stones or Chryſtals found in great Quantities in *Cornwall*, and therefore called moſt commonly *Corniſh* Diamonds; which growing in the hollow Cavities of Rocks, much after the ſame manner as theſe did in the Flint, and having regularly-ſhaped Surfaces nearly of the ſame Form with theirs, he imagined might afford ſome convenient Help towards aſcertaining the Properties of ſuch Kinds of Bodies.

By theſe he found, that the brighteſt Reflections of Light proceeded from within the pellucid Body; that is, the Rays admitted through the pellucid Subſtance, in their getting out on the oppoſite Side, were very vividly reflected by the contiguous and ſtrong reflecting Surface of the Air; ſo that more Rays were reflected to the Eye by this Surface, (though the Ray in entering and getting out of the Chryſtal had ſuffered a double Refraction) than there were from the outward Surface of the Glaſs, where it had ſuffered no Refraction at all.

Sands.

It is proper here to take notice, that our Author mentions his Examination of ſeveral Sorts of Sands with his Microſcope; amongſt which he found divers moſt curiouſly ſhaped, as theſe in the Flint were; and which, he therefore ſuppoſes, not made by the Comminution of larger chryſtalline Bodies, but formed by the Concretion or Coagulation of Water, or ſome other Fluid.

Sand, however, generally ſeems nothing elſe but exceeding ſmall Pebbles, or ſome ſmall Pieces of bigger Stones, angled for the moſt part irregularly, without any certain Shape, and having its little Grains frequently flawed and broken.

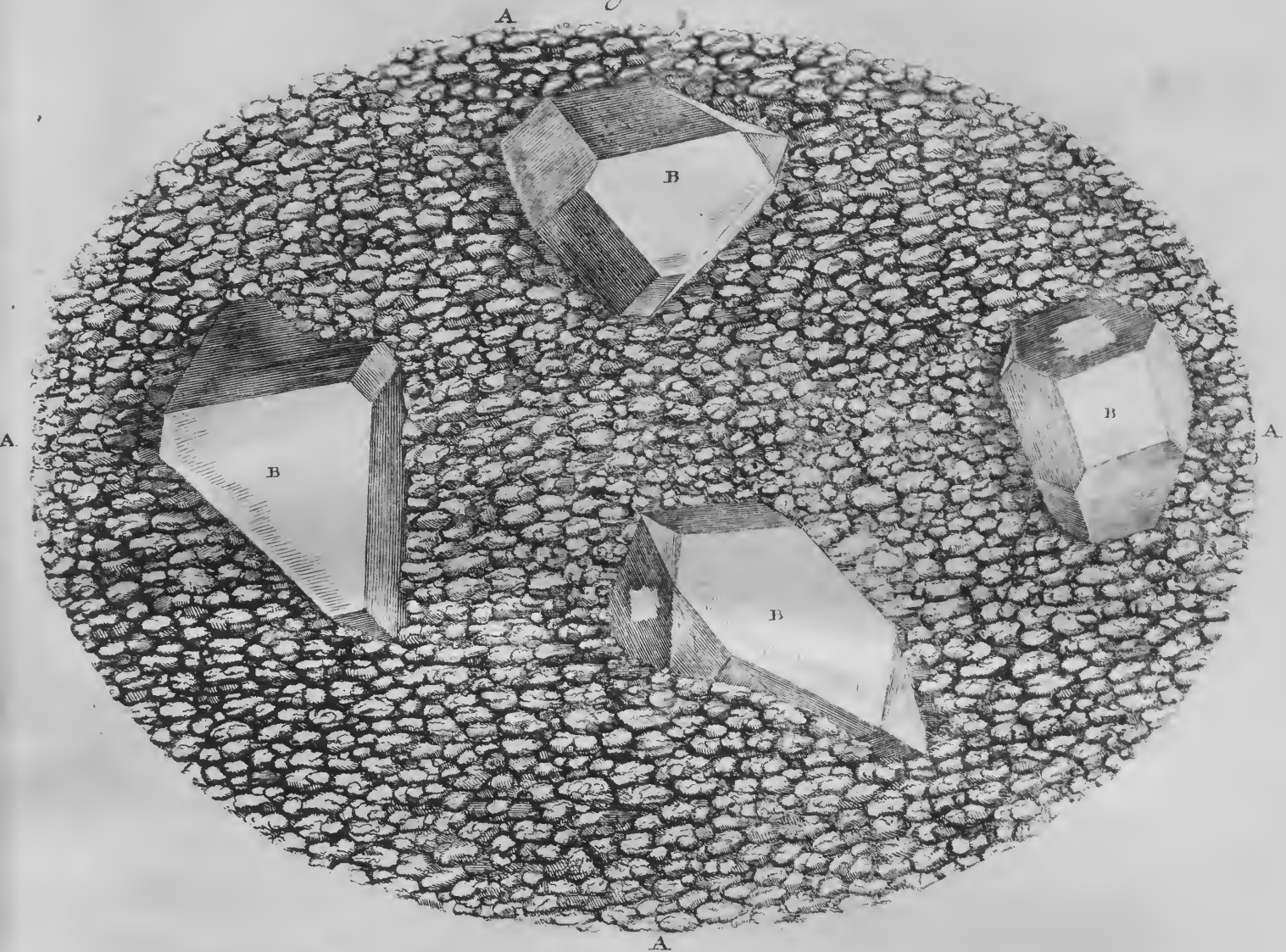
There are many Sorts of Sands, (as many perhaps as there are of Stones) which differ from one another both in Colour, Figure, and Size. And as amongſt Stones ſome are called precious for their Excellency, ſo alſo amongſt Sands, there are ſome that deſerve the ſame Epithet for their Beauty. The Grains of *Sea-Sands* are very large, and afford great Variety of all Shapes and Colours, both opake and tranſparent. *River-Sands* are ſmaller-grained, of different Colours and Forms; and the *Inland* or *Pit-Sands*, vary alſo exceedingly, being ſome white, ſome brown, ſome yellow, *&c.*

The *white*, or *Writing-Sand*, appears through the Microſcope like tranſparent Pieces of *Allum*, *Sal-Gem*, or *Chryſtal*, but moſt commonly irregular. The *coarſer Sands* are uſually more opake, but even amongſt them many Grains may be found both clear and beautiful. Some Kinds of *black Sand* are brought from the *Eaſt-Indies*, and likewiſe from *Virginia* and other Parts of *America*, with poliſhed ſhining Surfaces, many of which will be attracted by the Load-ſtone; and there are certain *reddiſh Sands* (brought from abroad alſo) which preſent a delightful Sight to the Eye, not unlike a Jeweller's Box of Treaſure, wherein you ſee *Rubies* of a Roſe-Colour, others of a deeper Red, *Sapphires*, *Emeralds*, *Hyacinths*, *Topazes*, and in ſhort, all Sorts of tranſparent Stones *.

* Spectacle de la Nat. Dial. XIX.

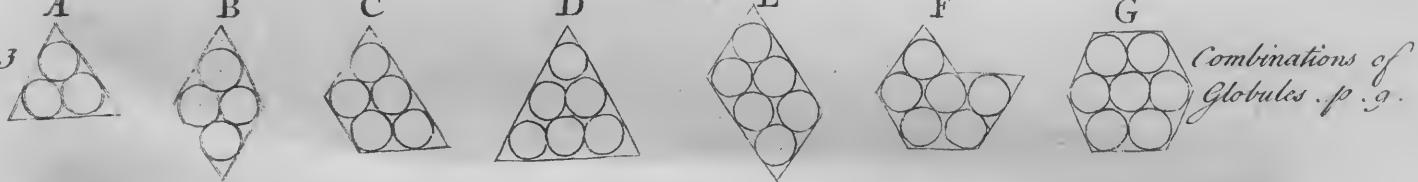
Regularly Figured Chrystal or Diamonds in the Cavity of a Flint Stone

Fig. I.



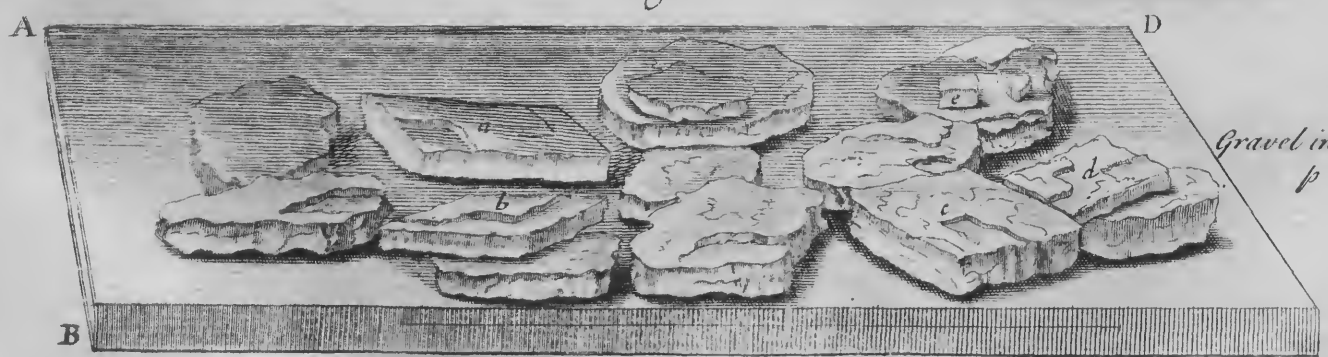
1/16 Part of an Inch magnified.

Fig. 3



Combinations of Globules. p. 9.

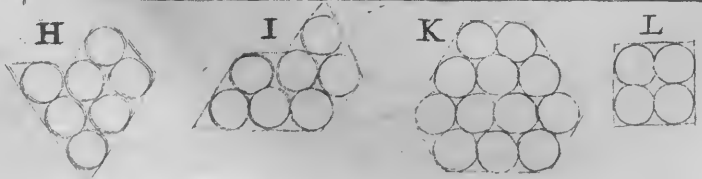
Fig 2.



Gravel in Urine p. 9.

1/32 Part of an Inch magnified.

Fig. 4.



More Combinations of Globules. p. 9.

PLATE IV. FIG. 2.

The Forms of Gravel in Urine.

THE Sand or Gravel of Urine ſeems to be a tartareous Subſtance, generated of ſaline and earthy Matter chryſtalized together, ſticking ſometimes to the Sides of the Chamber-Pot, but more frequently ſinking to the Bottom, and there appearing in the Form of coarſe Sand; the Grains whereof, ſeen through the Microſcope, reſemble a Company of ſmall Bodies, partly tranſparent, and partly opake; ſome white, ſome yellow, ſome red, and others of more brown and duſky Colours. Gravel in Urine.

In Shape they are moſtly flat, after the Manner of Slates, or ſuch-like plated Stones; and ſeem compoſed of ſeveral very thin *Lamellæ*, like *Muſcovy Glaſs* or *Engliſh Spar*; the latter of which they appear nearly to reſemble, having their Sides, as that has, form'd into Rhombs, or Rhomboids, and ſometimes into Rectangles and Squares.

The Figure under our Eye repreſents a Dozen of them, (as examined by the Microſcope, lying on a Slip of Glaſs, A B C D; ſome whereof, as *a*, *b*, *c*, *d*, were more regular than the reſt; and *e*, a ſmall one, ſticking upon another, was a perfect Rhomboid on the Top, and had four rectangular Sides.

Their Bigneſs is ſhewn by the Line E, which was the Meaſure of the Microſcope, and a Scale of the thirty-ſecond Part of an Inch magnified; by this Meaſure it is evident, that none of them exceeded in Breadth, the one hundred and twenty-eighth Part of an Inch.

Oil of Vitriol, *Spirit of Urine*, and ſeveral *ſaline Menſtrua*, diſſolved them in a Minute or two without any Ebullition: *Water* and many other Liquors had no ſudden Effect upon them. Such Fluids as diſſolve them, render them very white at firſt, not ſpoiling but rather rectifying their Figures, and making them more agreeable Objects for the Microſcope.

PLATE IV. FIG. 3, and 4.

A Variety of regular Forms reſulting from various Combinations of Globules.

DR. HOOKE imagines the Chryſtalization of Salts, and all thoſe regular Figures that are ſo remarkably various and curious, and beautify ſuch Multitudes of Bodies, ariſe only from three or four different Poſitions of *globular Particles*; and thoſe the moſt plain, obvious, and neceſſary Conjunctions of ſuch *figured Particles* that can poſſibly happen. So that, ſuppoſing ſuch plain and obvious Cauſes concurring, the *coagulating Particles* muſt, as neceſſarily, compoſe a Body of ſuch a determinate regular Figure, and no other, as a fluid Body encompaſſed with an heterogeneous Fluid muſt be rounded into a Globule or Sphere. And he ſays, he has demonſtrated, only by a Company of Bullets, and one or two other very ſimple Bodies, that merely almoſt by ſhaking them together, he could make them compoſe any regular Figure he had ever met with. Effects of a Combination of Globules.

For Example: If a Number of Bullets be put on an inclining Plane, ſo that they may run together, they will fall, naturally, into a *triangular Order*, compoſing all the Variety of Figures that can be imagined to be made out of *æquilateral Triangles*; ſuch as all the Surfaces of *Alum*, upon Examination, will be found to be; for three Bullets lying on a Plane, as cloſe as they can to one another, compoſe an *æquilateral-triangular* Form, as is ſhewn at A.

If a Fourth be joined to them, as cloſely as it can, on either Side, the four together form a moſt regular *Rhombus*, conſiſting of two *æquilateral Triangles*, as B.

If a Fifth be joined to them on either Side, in as cloſe a Poſition as can be, (which is a Circumſtance always to be underſtood in theſe Experiments) it makes a *Trapezium*, or *four-ſided Figure*, two of whoſe Angles are 120, and the other two 60 Degrees, as C.

On the Addition of a Sixth, as before, it makes either an *æquilateral Triangle*, like D; or a *Rhomboid*, as E; or an *hexangular* Figure compoſed of two primary *Rhombes*, as F.

If we add a Seventh, it makes either an *æquilatero-hexagonal* Figure, as G; or ſome kind of *ſix-ſided* Figure, like H, or I.

And though never ſo many be placed together, they may be all ranged under ſome of theſe before mentioned Forms, with Angles either of ſixty, or one hundred and twenty

Degrees, as the Letter K ſhews, which is an *æqui-angular hexagonal* Figure compounded of twelve Globules: And in the ſame Manner, 25, or 27, or 36, or 42, *&c.* may be combined.

Nor does it hold only in *Superficies*, but alſo in *Solidity*; for 'tis beyond Diſpute, that if a *fourth* Globule be laid on the *third* in this Texture, it compoſes a regular *Tetrahedron*, which is a very uſual Figure amongſt the Chryſtals of *Alum*. And, indeed, amongſt the Variety of regular Shapes into which the ſmooth Surfaces of *Alum* are obſerved to be chryſtalized, there is not one but may be imitated by a ſuch-like Poſition of Globules.

The *cubical* Forms of *Sea-Salt* and *Sal-Gem*, are alſo (our Author ſuppoſes) compoſed of ſuch a Poſition of *Globules*, as the Letter L ſhews. *Vitriol*, *Salt-Petre*, *Chryſtal*, *Hore-Froſt*, &c. have likewiſe, he ſays, all their various Configurations from *Globules* differently combined.

An Explanation of the Fifth Plate.

This Plate exhibits ſeveral Kinds of Figures produced by Freezing, which are extremely curious and wonderful, and deſerve the Attention of all diligent Obſervers of the Works of Nature.

PLATE V. FIG. 1.

One of the Six-branched Figures on the Surface of Urine, when it begins to freeze.

Urine frozen. THESE Figures had uſually a Center, *a*, from whence the Branches extended themſelves: And wherever a Center was, the Branchings from it, *a b*, *a c*, *a d*, *a e*, *a f*, *a g*, were never more nor leſs than ſix, which all iſſued very nearly from the ſame Point or Center *a*, tho' ſometimes not exactly; and inclined to one another, at an Angle of about ſixty Degrees, without any ſenſible Variation; but as the whole ſix Branches compoſed a ſolid Angle, they muſt neceſſarily be ſomething leſs.

The Middle-Lines or Stems of theſe Branches, *a b*, *a c*, *a d*, *a e*, *a f*, *a g*, appeared ſomewhat whiter, and a little higher than any of the intermediate Lines, ſeeming to riſe above the Surface of the Urine: And the Center *a* was evidently the moſt prominent of the whole, reſembling the *Apex* of a ſolid Angle or Pyramid.

The lateral Branchings from the ſix large Stems, ſuch as *o p*, *m q*, &c. were each of them inclined to the Stems from which they iſſued, at the ſame Angle (of about ſixty Degrees) as the ſaid large Stems were to one another; the bigger Branches always riſing higher than the leſs, and the leſs higher than the leaſt, and ſo in proportionate Gradations.

Theſe Side-Shoots were each of them parallel to that great Branch next which it lay; and all the Shoots on one Side were parallel to each other, as well as to the great Branch next them. For Example: The lateral Shoots *p o*, *q r*, are parallel to one another, and are alſo at the ſame time parallel to the large Branch *a b*.

Some of the Stems proceeded ſtrait, and decreaſed in Thickneſs towards the End, as *a g*. Others grew bigger and knotty towards the Middle; and the Side-Shootings, as well as the main Stems, from Cylinders became a Sort of ſemi-circular Planes, in a moſt admirable and curious Order, and exceedingly delicate and regular, as may be ſeen at *a b*, *a c*, *a d*, *a e*, *a f*: (Theſe circular Figures, in the lateral Shoots, were alſo ſtill more remarkable at *h i*.) But towards the End of ſome of theſe Stems, they began again to diminiſh and recover their former Branchings, as about *k* and *n*.

Such lateral Branches as *q m*, had many collateral Shootings, (if we may call them ſo) as *ſ*, *t*; moſt whereof had ſub-collateral ones, as *v*, *w*; which again had others leſs, and thoſe leſſer ones had ſtill minuter Shootings iſſuing from them.

The Branchings from the main Stems were not joined by any regular Line, nor did the Side of one lie over that of the other; but in the ſmall collateral and ſub-collateral Shootings, one Branch lay over the Side of the next that approached to it, as the Feathers do in a Bird's Wing. See the *Figures* 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Many ſuch-like Configurations were obſerved, of different Sizes, from the Bigneſs of a Two-pence, to three or four Foot long, of which ſeveral were pretty round, having all

Starry Flakes of Snow
p. 10.

Fig: 2

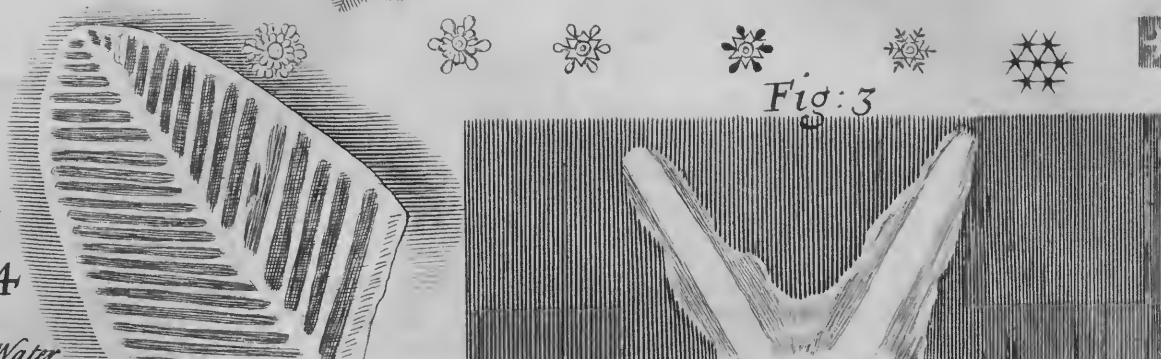


Fig 4

Thin Ice on Water
p. 12.

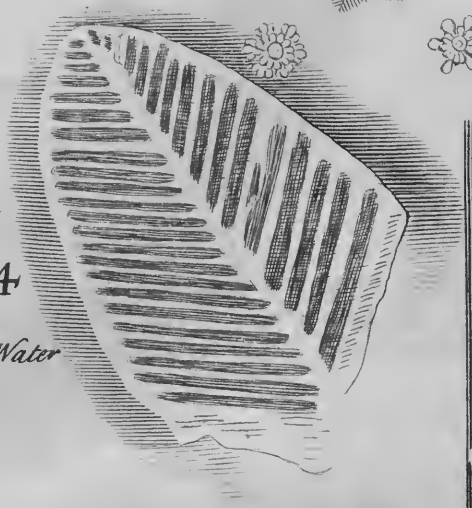
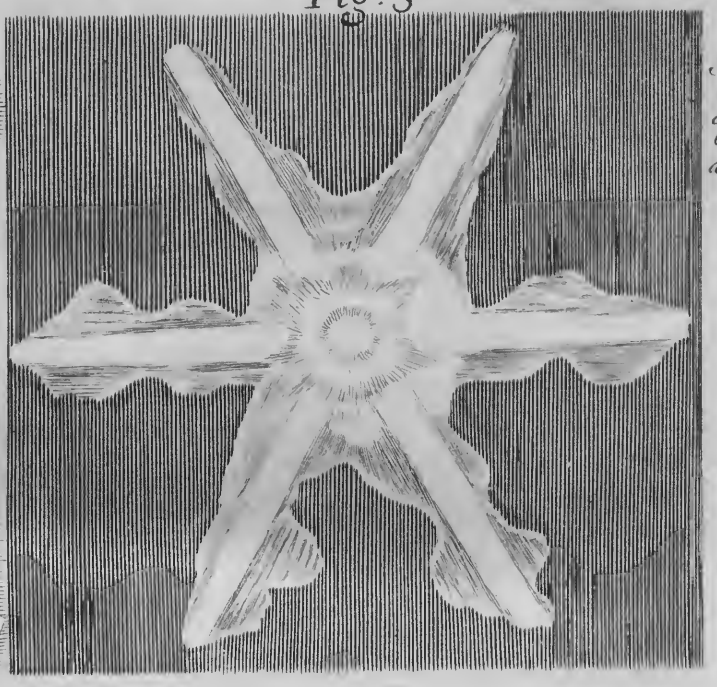


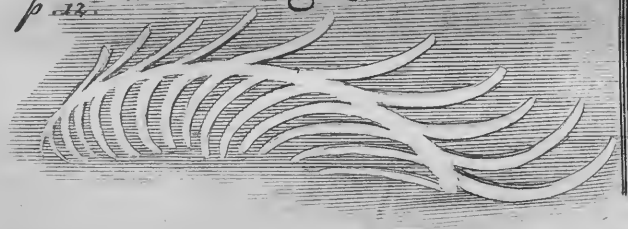
Fig: 3



A Flake of Snow dissolving
p. 11

Water frozen on Marble
p. 12.

Fig: 5



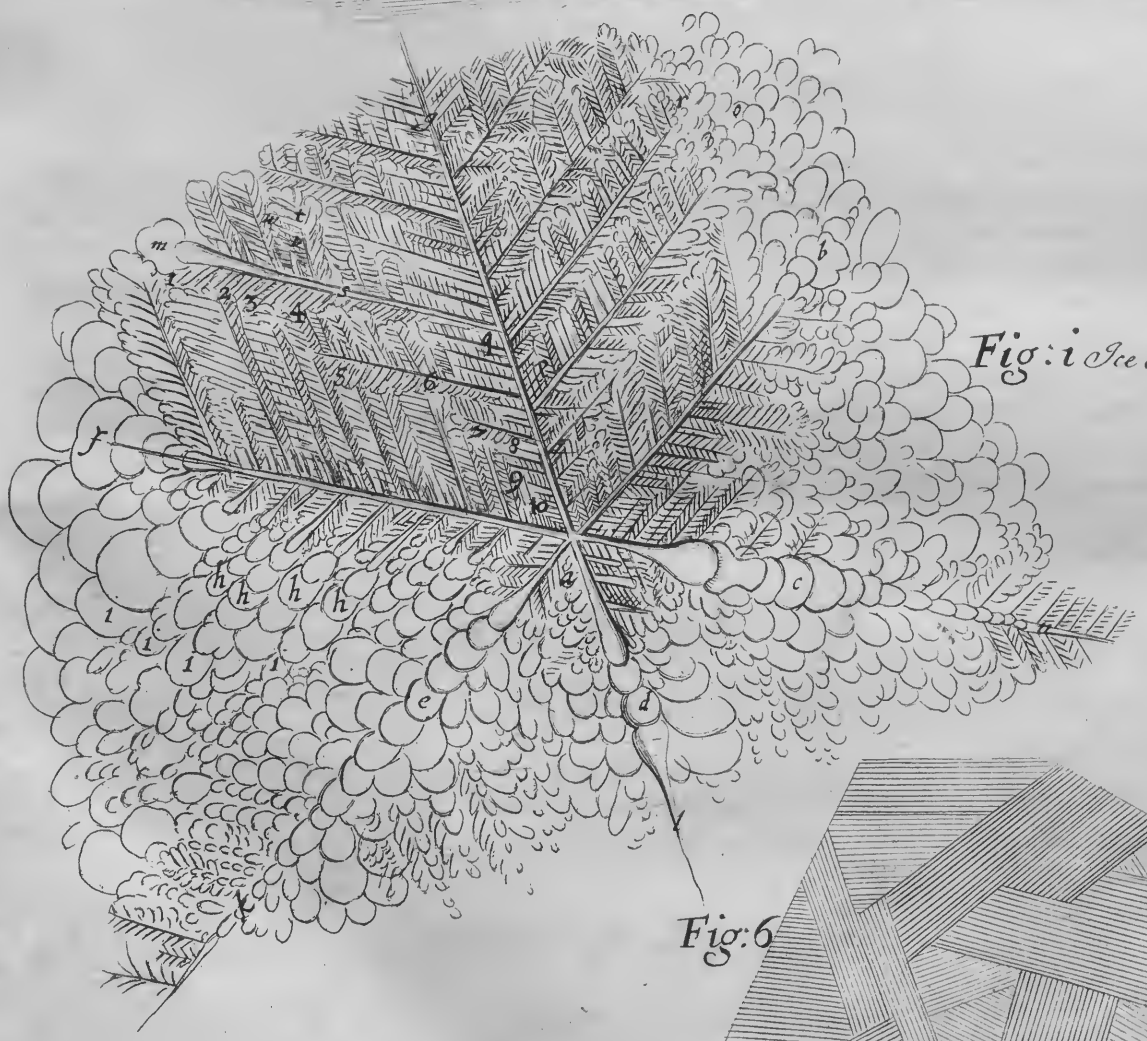
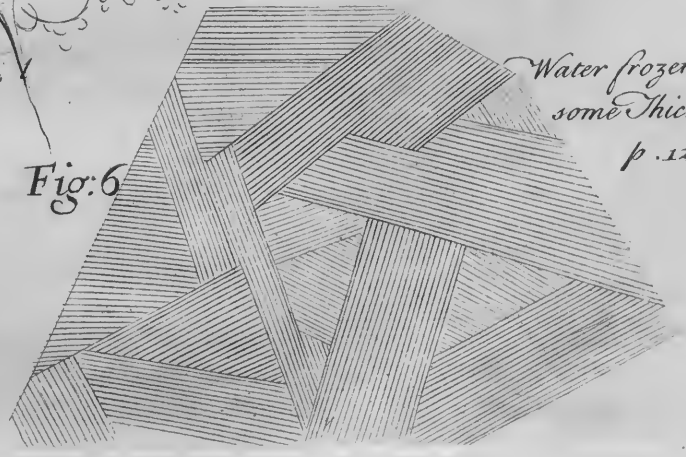


Fig: 1 Ice on y^e^ Surface of Urine.
p. 10.



Water frozen of some Thickness
p. 12.

Fig: 6

their Branches near alike, but others were more extended towards one Side. None, however, had any regular Poſition in reſpect of one another, or of the Sides of the Veſſel; nor did any of them extend exactly every Way from the Center *a*.

It is neceſſary, in the Freezing of Urine for this Experiment, that its Superficies be not diſturbed by Wind, or any other Way; and that it be not frozen too deep, for then the branched Appearance becomes loſt.

If the Inſide of a ſmooth and clear Glaſs be wetted with Urine, and expoſed in a ſharp Froſt, it will be covered with very regular and curious Figures. But an artificial Freezing with Snow and Salt, produces not the natural Shootings in Urine, unleſs the Quantity in the Veſſel be very ſmall.

It is remarkable, that no urinous Taſte was perceived in ſeveral clear Pieces of ſuch Ice, but they ſeemed as inſipid as Water.

Somewhat like this Configuration of frozen Urine, tho' in ſome Particulars much more curious, is obſervable in the *Regulus Martis Stellatus*; but whereas in this *Ice* the Stems and Branchings are all ſtrait, in the *Regulus* they appear regularly bent or wreathed, in a very beautiful Manner. Lead and Arſenic, with ſome other Mixtures, are alſo found to have their Surface, when ſuffered to cool, with Branches not much unlike to thoſe of Urine, but ſmaller a great deal.

Like to Fern.

Dr. Hooke takes occaſion here to ſhew the Reſemblance of the Shootings before deſcribed, in *Urine*, to the Branchings in the Leaves of *Fern*, whoſe Form, he ſays, is the moſt ſimple and uncompounded of any Vegetable, except Mould or Muſhrooms: For the main Stem in *Fern* may be obſerved to ſend forth lateral Branches, from whence collateral ones ariſe, and from them again ſub-collateral ones, after much the ſame Order as the Branchings, Diviſions and Subdiviſions appear in the Figures of *frozen Urine*. He adds, that if both be well conſidered, there ſeems not much greater Need of a *ſeminal Principle* to produce *Fern*, than for the Production of ſuch Forms in *Urine*, or in the abovementioned *Regulus Martis*; ſince as much Beauty and Regularity appears in the one as in the other. And to this he ſubjoins, that notwithſtanding ſeveral have affirmed that *Fern* produces, and is propagated by Seed, he could never find any Part of it to be more ſeminal than another, tho' he had made very diligent Enquiry as to that Particular.

Seeds of Fern.

'Tis a little ſurprizing that our Author was not able, with his Microſcope, to diſcover the Seeds of this Plant, which produces them in the greateſt Abundance on the Backs of almoſt all its Leaves, in Seed-Veſſels that appear to the naked Eye only like a black or brown Scurf; but, when viewed by the Microſcope, reſemble little circular Tubes divided into many Cells, containing Seeds extremely minute. When the Seed is ripe, the Veſſels fly open with a Spring, and ſquirt the Seeds out on every Side, in the Form of Duſt: And if at that Seaſon ſome of the Leaves are put into a Paper-Cone, and that be held to the Ear, the Seed-Veſſels may be heard to burſt with a conſiderable Noiſe. Some of theſe *minute Veſſels contain at leaſt an hundred Seeds, inviſible to the naked Eye.*

One may reaſonably believe our Author never looked for them on the Backs of the Leaves; but finding neither Flowers nor Seeds in the ſame manner as in other Plants, he concluded too haſtily that it produced neither. Such Miſtakes in great Men afford us uſeful Leſſons of being very cautious in giving our Opinions, and never to determine before we have examined fully.

PLATE V. FIG. 2.

The Forms of Falling Snow.

Flakes of Snow.

THE Works of Nature are no leſs admirable for their Variety than their Beauty! Even in ſuch Things as appear the moſt alike, a ſtrict Examination will diſcover to us Differences beyond all human Conception! No two Grains of Sand are exactly ſimilar! Nay, the very Flakes of Snow afford an amazing Variety of Configuration, Beauty and Size, though not one in a Thouſand of thoſe that ſee them fall, either know or imagine any thing worth obſerving in them.

But Dr. Hooke tells us, that catching the falling Snow on a black Hat, or a Piece of black Cloth, he obſerved the curious Figures of its Flakes with the utmoſt Pleaſure; and he preſents us, out of a great Variety, with the ſeveral beautiful Forms under our Eye at preſent.

Every Flake conſiſts of ſix principal Branches or Stems, all of equal Length, Shape, and Make, iſſuing from a Center; and each of them inclining to the next on either Side it in an Angle of ſixty Degrees.

Theſe

These Stems in the same Flake are commonly of the same Make exactly, but different in different Flakes; insomuch that, our Author says, he has observed above an hundred different Forms and Sizes of these Star-like Flakes fallen in a very little Time.

The Branchings out from every Stem in the same Flake are so exactly alike, that only by observing the Configuration of any one Stem, one may know certainly the Figures of the other Side; the Branchings are likewise generally similar to those in frozen Urine before described.

We have here before us six and twenty Representations of the Flakes of Snow, of different Shapes and Sizes, as they appear to the naked Eye. DES CARTES, Dr. GREW, Mr. MORTON, Dr. LANGWITH, and some others, have also given us many of their Star-like Forms; and Dr. STOCKE of *Zealand* lately communicated to the Royal Society several Figures observed and drawn by him, but differing very little from those of Dr. HOOKE *.

PLATE V. FIG. 3.

A Flake of Snow magnified.

A Flake of Snow magnified.

THE Flakes of Snow, examined by a Microscope, do not appear so perfectly regular and exact as might be expected; but, like Works of Human Art, the more they are magnified, the more mishapen and rude they seem; of which the Figure before us is a Specimen. This, however, is not owing to any Defect or Irregularity in their Formation, but to the unequal Thawing, or breaking of them as they fall: for I make no doubt, if it were possible to get a Sight of them through a Microscope as they are generated in the Clouds, and before their *Figures* are prejudiced by external Accidents, we should find them curiously beautiful, exact, and perfect.

PLATE V. FIG. 4.

The Form of Ice on Water.

An Icicle.

FAIR Water being exposed to the Cold in a capacious Vessel of Glass, after a little time, several broad, flat, and thin *Laminæ* or *Plates* of *Ice* were observed on the Surface, crossing the Water and each other very irregularly. Most of them seemed to turn one of their Edges towards that Side of the Glass next it, and to grow as it were inwards towards the Middle of the Vessel.

Some of these *Laminæ* being taken out of the Water on the Blade of a Knife, were found to be figured after the Manner of *Herring-Bones*, or the Branches of *Fern*; having in the Middle one larger Stem, like the *Back-Bone*, and issuing out of it on either Side Multitudes of small Icicles, like the smaller Bones, or the smaller Branches in *Fern*. Each of these Icicles was parallel to all the rest on the same Side, and all of them appeared to make an Angle with the Stem of about sixty Degrees.

PLATE V. FIG. 5.

Ice on Marble.

Ice.

A Little Water exposed to the Cold on a broad flat Marble, exhibited, when frozen, a very pretty Variety of Figures, some like Feathers, others of different Shapes, and many in the Appearance of the Picture here referred to.

PLATE V. FIG. 6.

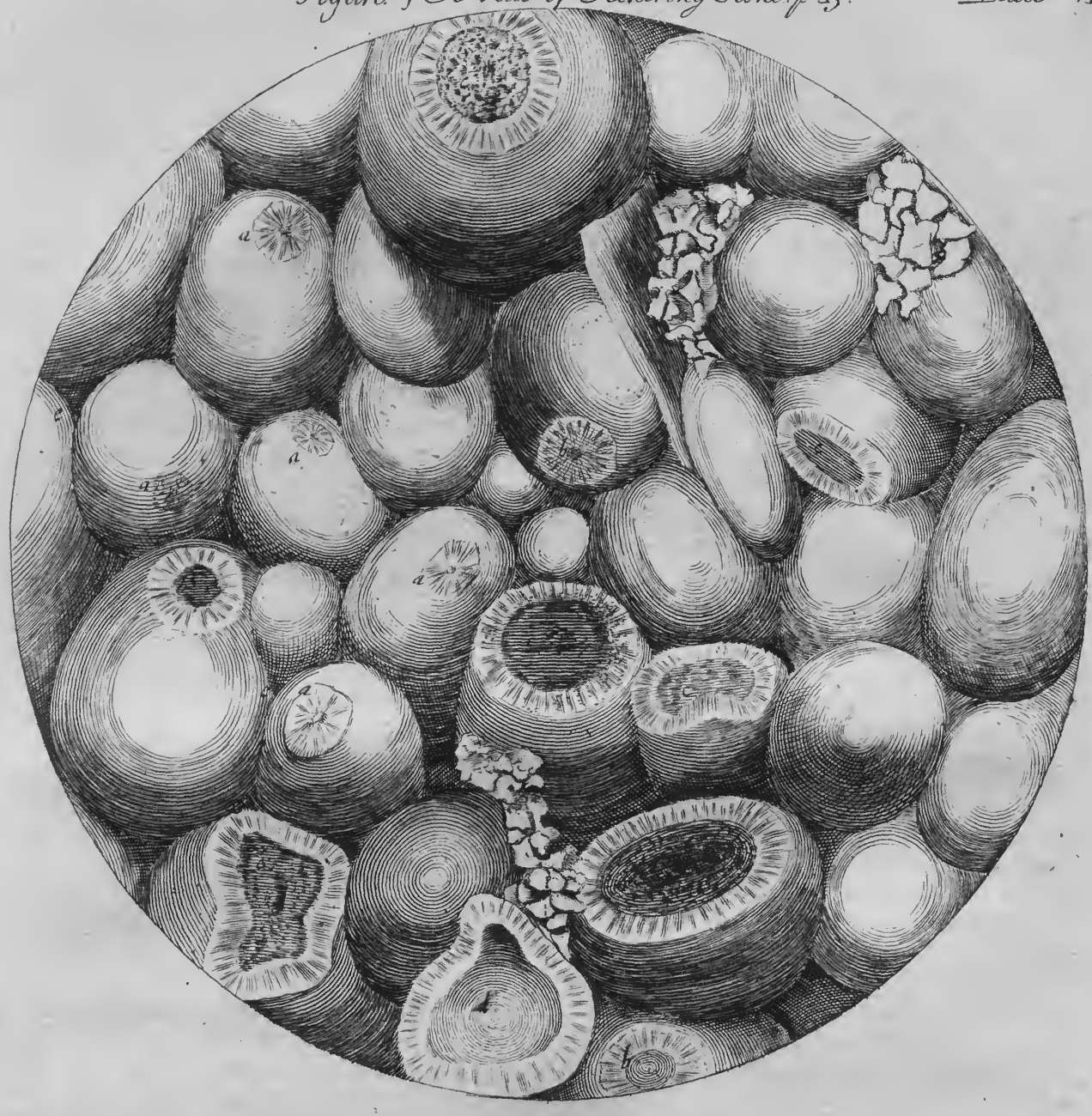
Ice of another Configuration.

Ice.

FLAKES of Ice frozen on the Top of Water to any considerable Thickness, were found, on Examination, to have both their Upper and Under-Sides curiously quill'd, furrow'd, or grained, which the Sun shining thereon shewed to be, as in the Drawing, several strait Ends of parallel Plates, of divers Lengths and Angles to one another, without any certain Order.

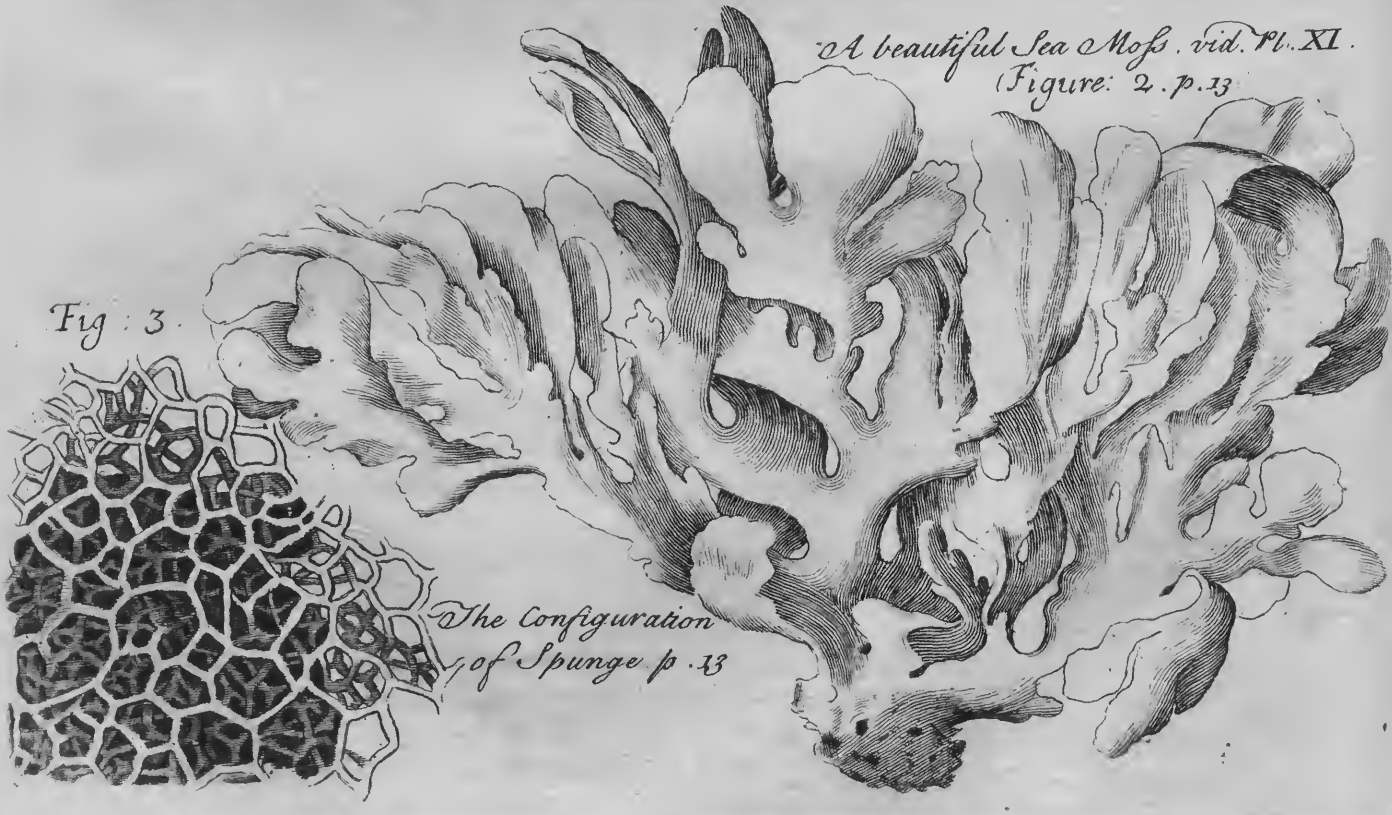
* Some of these Figures are printed in *Phil. Transf.* Numb. 464.

Figure: 1 A Peice of Kettering Stone. p. 13. Plate VI.



A beautiful Sea Moss. vid. Pl. XI.
(Figure: 2. p. 13

Fig: 3.



The Configuration
of Spunge p. 13

An EXPLANATION of the SIXTH PLATE.

FIG. 1.

A Piece of Kettering-Stone.

Kettering-Stone.

THIS Stone, which has a very extraordinary Grain, much different from all other Kinds of Stone, is dug from a Quarry at *Kettering* in *Northamptonſhire*. It appeared through the Microſcope made up of numberleſs little Pebbles, whoſe Figure was nearly globular, though they were not all exactly of the ſame Shape or Bigneſs, ſome exceeding others three or four times in Diameter. They ſeemed, to the naked Eye, like the Ovary or Hard-Row of an Herring, or ſome ſmaller Fiſh; but the little Grains were neither ſo large nor ſo uniform. Their Variation in Shape from perfect Roundneſs looked as if occaſioned entirely by the Preſſure of ſome of the Balls againſt others, whereby the Sides where the Preſſure took place, became a little depreſſed inwards, and the other Parts became protruded proportionably outwards, beyond the Limits of a Globe; in the ſame manner as it would happen, if an Heap of exactly round Balls of ſoft Clay were piled upon one another.

Theſe Grains were ſo firmly united together where they touch each other, that they ſeldom could be parted without breaking an Hole in one or both; which Fractures are ſhewn by *a*, *a*, *a*, *b*, *c c*, &c.

In ſeveral, where the Preſſure had been but light, no more was broken than the outward Cruſt or Shell of the Stone, which appeared of a white Colour, daſh'd a little with a browniſh yellow, and very thin like the Shell of an Egg. Nay, ſome of thoſe Grains were found perfectly to reſemble Eggs both in Colour and Shape. But where the Union of the contiguous Grains was more firm, the Divulſion there occaſioned a larger Chaſm, as at *b*, *b*, *b*.

Some were alſo obſerved broken quite in two, and diſcovered by two different Subſtances, encompaſſing each other in the Manner of a White and Yolk, a nearer Reſemblance ſtill to Eggs, as *c*, *c*, *c*.

What we term the White, was pretty whitiſh near the Yolk, but grew more duſky towards the Shell, and in ſome was radiated like a *Pyrites*. The yolk-like Part was hollow in ſome, but filled in others with a darkiſh brown and porous Subſtance, like a Kind of Pitch, as at *d*.

The *Interſtices* or ſmall Pores between the Globules, *e*, *e*, *e*, *e*, were found, b ſeveral Experiments, to be pervious every Way both to Air and Water; for on blowing through a Piece of this Stone of a conſiderable Thickneſs, the Air paſſed as eaſily as through a Cane: And when another pretty large Piece was covered all over with Cement, except at the two oppoſite Ends, by blowing in at one End, ſome Spittle wherewith the other was wetted, was raiſed into Abundance of Bubbles, and ſerved to prove how porous ſome Bo- ies are which appear ſeemingly compact and cloſe.

The Microſcope diſcovers here a Stone, compoſed of innumerable minute Balls, which merely touch each other, and yet by ſo many Contacts conſtitute a Subſtance much harder than Free-Stone.

The Interſtices between theſe Balls muſt render it very uſeful, when formed into proper Veſſels, for the Filtration of Water or any other Liquors.

PLATE VI. FIG. 2.

A Sea-Moſs.

Sea-Moſs.

THIS Picture repreſents a Kind of Sea-Plant or *Fucus*, called by Mr. RAY, in his *Synopſis*, *Fucus telam lineam: ſericeamve texturâ ſuâ æmulans*. It grows on the Rocks under Water, and ſpreads out into a great Tuft, which branches into ſeveral Leaves of a moſt beautiful and ſurpriſing Structure. But of this we ſhall defer giving any farther Deſcription, till we come to the firſt *Figure* of the Eleventh *Plate*.

PLATE VI. FIG. 3.

A Piece of Spunge.

Spunge.

THE Texture of this Object is diſcovered by the Microſcope to conſiſt of innumerable, ſmall, ſhort, round Fibres, nearly of the ſame Bigneſs, jointed very curiouſly together in a Kind of Net-like Form. The Joints are moſt commonly where only

three Fibres meet, few of them being found compoſed of four: But neither of the three Fibres ſeems the Stock whereon the others grow, all being of the ſame Size, and conducing equally to form the Joint. The Length of the Fibres between the Joints is, however, very irregular and different, the Diſtance between ſome Joints being ten or twelve times more than between others: So that the three Fibres make not equitriangular Figures, but meet in ſuch a manner that their three Angles differ greatly from one another. The Meſhes or Holes of this reticulated Body are likewiſe extremely various, ſome having two, three, or four, others five, ſix, ſeven, eight, or nine Sides. But of all theſe Particulars 'tis hoped the Picture will give a pretty good Idea. Beſides theſe microſcopical Pores which lie between the Fibres, there are Multitudes of round Holes piercing from the Top of the Spunge into the Body thereof, and paſſing ſometimes quite through it to the Bottom.

Dr. HOOKE obſerves, that Spunge is commonly reckoned as one of the *Zoophyts* or *Plant-Animals*; which Opinion the Microſcope confirms, by ſhewing the Contexture of it to be ſuch as has been found in no other Vegetable. Different Ways of Trial prove likewiſe its Reſemblance to Animal Subſtances; for examined chymically, it affords a volatile Salt and Spirit like Hartſhorn; when burnt in a Fire or at a Candle, it affords a fleſhy Smell, not much unlike to Hair: And if we attempt to tear it or pull it aſunder, the Strength and Toughneſs of its reſiſting Fibres prove them like the Fibres of Animals.

BELLONIUS, in the Eleventh Chapter of his Second Book *de Aquatilibus*, informs us, "That *Spunges* in the Sea are extremely different from what they are when dry, ſticking "to the Rocks, as many Species of the *Fungi* do to Trees, two or three Foot ſometimes "under the Sea-Water: tho' now and then not above four Inches. Thoſe Hollows "which we ſee empty in *Spunges*, or in dry *Spunges* waſh'd and wrung out, are filled, "whilſt on the Rocks, with a filthy Liquor, or rather Jelly-like Matter, which ſtinks "enough to make one ſick, even at a conſiderable Diſtance. ARISTOTLE ſuppoſed "them to have ſome kind of Life, from their Manner of fixing themſelves to the "Rocks; whence, ſays he, it is very difficult to pull them away, unleſs they are taken "as it were by Surprize; for at the Approach of any body to lay hold on them, "they contract immediately, and faſten themſelves ſo as not to be removed without a great deal of Trouble: They do the ſame likewiſe whenever there are "Storms and Tempeſts. The naſty Matter before mentioned may be ſuppoſed given "them by Nature inſtead of Fleſh, and the larger Cavities ſeem a Sort of Bowels or "Inteſtines to them. The Part whereby they faſten to the Rocks, is like the Foot-"Stalk of a Leaf, whence a ſlender Sort of Neck begins, which widening upwards, "forms the globous Figure of the Head. On the Upper-Part almoſt all the Paſſages "are hid by being cloſed, but four or five of them are open towards the Bottom, through "which we may ſuppoſe their Nouriſhment is ſucked in."

If a dry Spunge be thoroughly wetted, and then ſqueezing out the Water, it be ſuffered to expand itſelf into its natural Shape and Dimenſions, which it will freely do whilſt moiſt, 'tis very plain that the Mouths of the larger Holes have a kind of Lip or Riſing round about them. 'Tis alſo evident, that each of theſe great Paſſages has many ſmaller ones below that help to conſtitute it, as many little Streams contribute to the making up a large River.

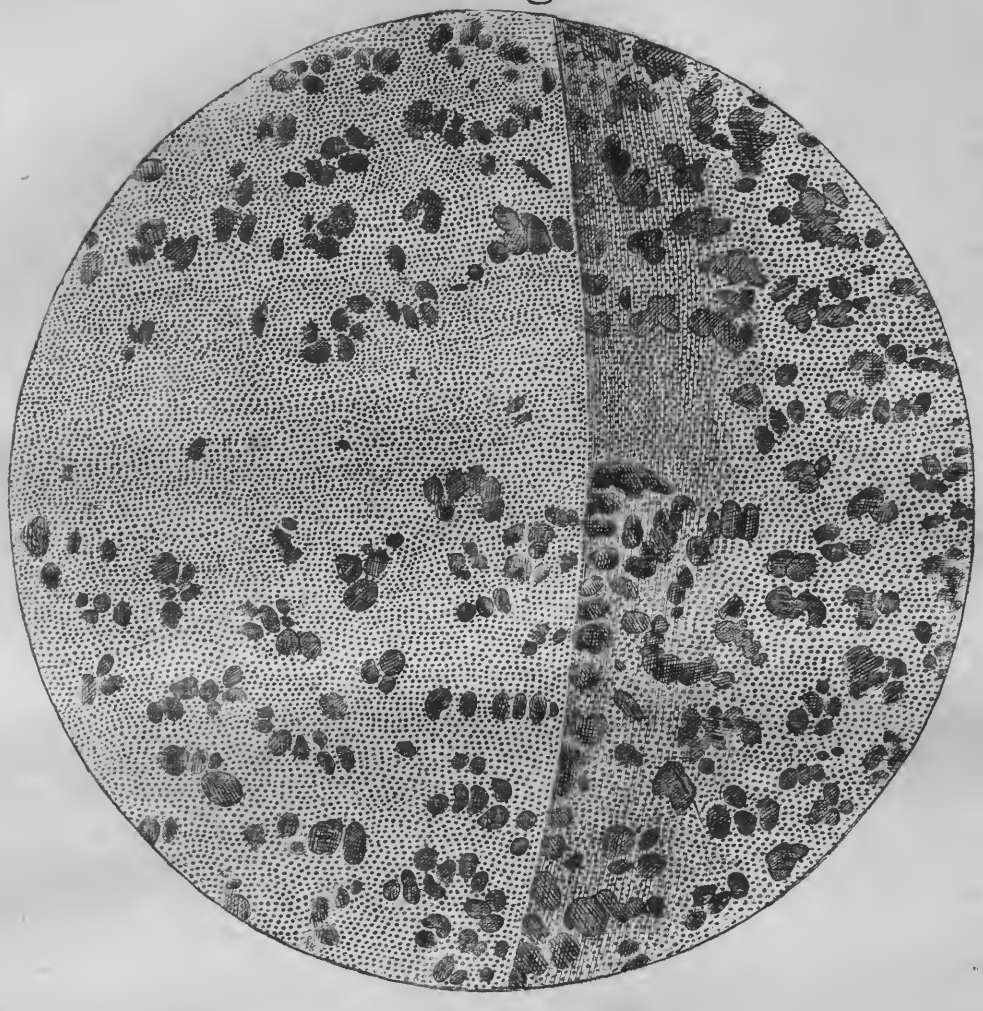
In ſhort, the Texture of *Spunge* is wonderful, and if it be properly examined into, ſeems to promiſe ſome Information of the Veſſels hitherto undiſcovered in Animal Subſtances, by reaſon the Solidity of the interſerted Fleſh in them is not eaſily removed, without deſtroying alſo thoſe interſperſed Veſſels: Whereas the *Parenchyma*, or what ſerves inſtead of Fleſh to *Spunge*, is but a Kind of Jelly, eaſily cleared and waſhed away.

The Natural Hiſtory of this Production is ſo imperfectly known, that we are ſtill uncertain whether it increaſes from little to great like Vegetables, that is, Part after Part; or like Animals, all the Parts growing equally together: Whether it affords *Matrices* or *Neſts* for ſome Kinds of Water-Animals, or is a real Animal itſelf; and alſo, whether at any time it is more ſoft and tender, or of another Nature and Configuration.

As the Diſcovery of the *Polype* has ſet many curious Gentlemen both in *France* and *England* upon a ſtrict Examination of the Waters and their Productions, 'tis to be hoped that all theſe Doubts will ſhortly be cleared up.

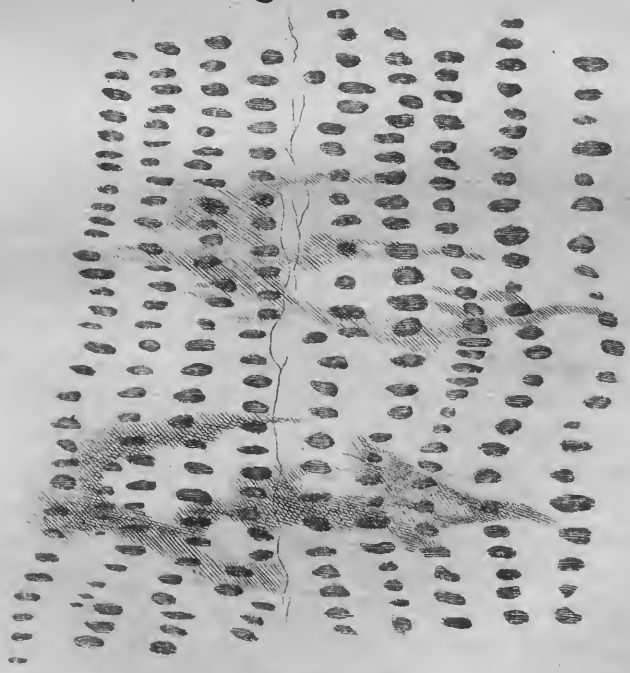
The Pores of Charcoal p. 15.

Fig: 1.



Pores of Petrified Wood. p. 15.

Fig: 2:



An EXPLANATION of the SEVENTH PLATE.

FIG. 1.

A Piece of Charcoal.

A Piece of Stick charred or burnt till it becomes black *, if broke ſhort between the Fingers, appears with a ſhining ſmooth Surface, reſembling the Surface of black Sealing-Wax; which examined by a ſmall Magnifier, exhibits Abundance of ſuch Pores as are viſible to the naked Eye in many Kinds of Wood, ranged round the Pith as well circularly as radiating from a Center. Theſe appear every where in the Subſtance of the Coal, drilling it from End to End, ſo that you may eaſily blow through it. Charcoal.

But beſides theſe many great and irregular Spots or Pores, if a Glaſs that magnifies much be made uſe of, an infinite Number of exceedingly ſmall and very regular Pores will be diſcovered, ſo thick, ſo orderly ſet, and ſo cloſe to one another, that very little Room is left between them to be occupied by a ſolid Body; for the intermediate Partitions of theſe Pores appear ſo thin in ſome Places, that a Honey-comb is not leſs ſolid, tho' in others they are much thicker, in proportion to the Holes.

The exceeding Smallneſs and Cloſeneſs of theſe Pores may be conceived in ſome degree by their Numbers; for no leſs than one hundred and fifty of them were counted in a Line not more than the eighteenth Part of an Inch long; conſequently, a Line of an Inch in Length muſt contain two thouſand ſeven hundred of them: and about five Millions ſeven hundred twenty five thouſand three hundred and fifty of the like Pores muſt be in a *circular Area* of an Inch Diameter. Nay, *Cocus*, *black* and *green Ebony*, *Lignum Vitæ*, *Guajacum*, &c. have their Pores ſtill ſmaller, and more numerous; ſo exquiſite are the Pipes or Sluices whereby the Juices of Vegetables are conveyed!

PLATE VII. FIG. 2.

A Piece of petrified Wood.

THE Pores in this Object were not ſo much bigger than thoſe in the foregoing Figure, as the Draught before us ſhews them; for this was viewed by a Microſcope that magnified ſix times more than what was uſed for the Piece of Charcoal, and the Drawing made in the ſame Proportion. Each Pore, however, was nearly half as large again as thoſe in the burnt Wood, and the Diſpoſition of the whole exactly in the ſame Figure and Order as the ſmall Pores of Charcoal, but there were none of the larger Pipes or Cavities before deſcribed in that. Petrified Wood.

The Subject under Examination ſeemed to have been a Part of ſome large Tree, that had been broken off by Rottenneſs, before it became petrified. And Dr. HOOKE declares, that all he had ſeen of this Kind ſeemed to have been rotten before the Petrifaction began: and that he was confirmed in this Opinion, by examining a vaſt large Oak, which with mere Age was rotten as it ſtood, whoſe Wood in Colour, Grain, and Shape, appeared exactly like this petrified Subſtance. He likewiſe obſerves, that all thoſe *microſcopical Pores*, which in ſappy and ſound Wood are filled with the natural Juices of the Tree, were found in this (when viewed with magnifying Glaſſes) empty, like thoſe of Charcoal, but much larger than any he had ſeen in Charcoal.

Pieces of petrified Wood are however very different in Shape, Colour, Grain, Texture, and Hardneſs; ſome being brown and reddiſh; others grey like an Hone; ſome black, flint-like, hard and brittle; others ſoft like a Slate or Whetſtone.

In this Petrifaction the Parts ſeemed not at all altered from their Poſition whilſt Wood, having the Pores of Wood ſtill remaining, with a manifeſt Difference between the Grain and Bark; but it differed from Wood in Weight, Hardneſs, Cloſeneſs, Incombuſtibleneſs, and Brittleneſs.

Its Weight was to common Water as Three and a Quarter to One; whereas few *Engliſh* Woods, when very dry, are quite equal in Weight to Water.

It

* For the Manner of Charring Coal, *vid.* EVELYN's *Sylva*, p. 100, 101, 103.

It was nearly as hard as Flint, and reſembled the Grain thereof in ſome Parts, would eaſily cut Glaſs, could ſcarcely be ſcratched itſelf by a black hard Flint, and would as readily as any common Flint ſtrike Fire againſt a Steel.

Its Cloſeneſs was evident when placed in ſome Poſitions; for the Reaſon why the Pores appeared darker than the reſt of the Body, was then ſhewn, *viz.* becauſe they were filled with a darker Subſtance, and not becauſe they were hollow.

Though kept ſome time red-hot in the Flame of a Lamp, rendered very intenſe by a Blow-Pipe and a large Charcoal, it loſt nothing of its Subſtance, but appeared as ſolid as before, only ſomewhat darker. 'Twas remarkable that it ſoon grew red-hot, and neither conſumed like Wood, nor cracked and flew like Flint.

Diſtilled Vinegar being dropped upon it, many ſuch Bubbles were raiſed inſtantly, as are obſervable when it corrodes Corals.

It was ſo brittle that one Blow of a Hammer would break off a Piece, and two or three more reduce it to a Powder.

It felt alſo much colder than Wood, and much like other cloſe Stones and Minerals.

An Explanation of the Eighth Plate.

FIG. 1.

The Pores in Cork.

Cork. THE Circular Figure we are now deſcribing, exhibits two of the thinneſt Slices of Cork that could be ſhaved off with a Penknife, made as ſharp as poſſible, in order to diſcover, by the Microſcope, the Texture and Form thereof. And, upon Examination, they were found to be all cellular or porous, in the Manner of an Honey-comb, but not ſo regular. The ſolid Subſtance was alſo very ſmall, in Compariſon of the Cavities; for the Partition between the Cells were near as thin in Proportion to them, as the ſlender Diviſions in an Honey-comb are in Proportion to the Cells they ſeparate.

The Cells of Cork are ranged like ſo many Rays tending from the Center or Pith of the Tree outwards: They are not very deep, but reſemble many little Boxes, made by Numbers of Partitions dividing one long continued Pore, as is ſhewn by the Slice marked B, which being a tranſverſe Section, preſents a View of the Pores opened lengthwiſe.

The Slice marked A, was ſhaved off the long Way of the Cork, and conſequently ſhews all the Pores cut aſunder tranſverſely; but the ſolid Partitions between them appeared not ſo thick as they are here repreſented.

Several of theſe Lines being numbered, about Threeſcore of the ſmall Cells, placed end-ways, were found, uſually, in the Length of the eighteenth Part of an Inch: wherefore the Length of an Inch muſt contain above a Thouſand, a ſquare Inch above a Million, or 1,166,400; and a cubic Inch above twelve hundred Millions, or 1,259,712,000; a thing almoſt incredible, did not our Microſcope aſſure us of it by ocular Demonſtration.

This Contexture, diſcoverable by the Microſcope, proves the Lightneſs, of Cork to proceed, as it does in *Wool*, *Spunge*, *Pumice-Stone*, &c. from its having a very ſmall Quantity of ſolid Matter, extended into exceeding large Dimenſions. It proves likewiſe, that its Unaptneſs to ſuck in, and conſequently its floating on the Surface of Water, is owing to its whole Subſtance being almoſt filled with Air, incloſed in thoſe innumerable little Cells or Boxes above deſcribed, which being full already, are impenetrable to Water or other Air. Its Springingneſs, its Ability of being compreſſed into half the Dimenſions it occupied before, and its Power of extending itſelf into the ſame Space, when ſuffered to act again, may likewiſe be accounted for from the ſame Cauſes. It is alſo probable that the Sides of, and Partitions between the Cells, may have in them an elaſtic Quality, as moſt Kinds of Vegetable Subſtances have, and ſo help to reſtore themſelves to their former Poſition.

Common as Cork is, its Production is known but little, and therefore it may not be unacceptable to give a ſhort Account thereof.

In the South Parts of *France*, in *Spain* and *Italy*, there are ſeveral Species of what they call the *Cork-Tree*. But the broad-leaved Sort, that is ever green, and affords the moſt and beſt Cork, is a pretty tall Tree, bearing Acorns like an Oak, tho' with Leaves much

Pores of Cork in two different Sections. p. 16.

Fig: 1.

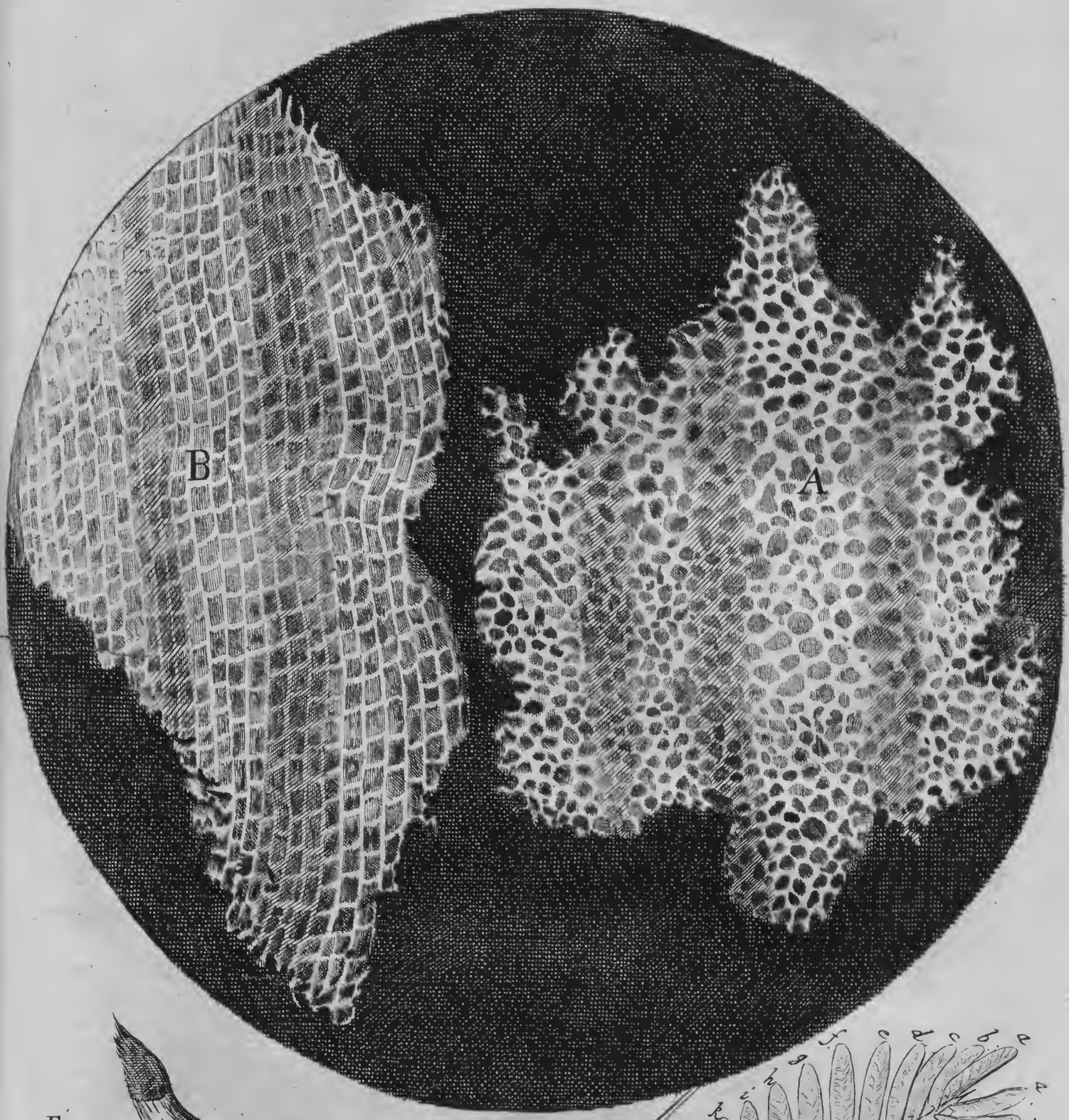
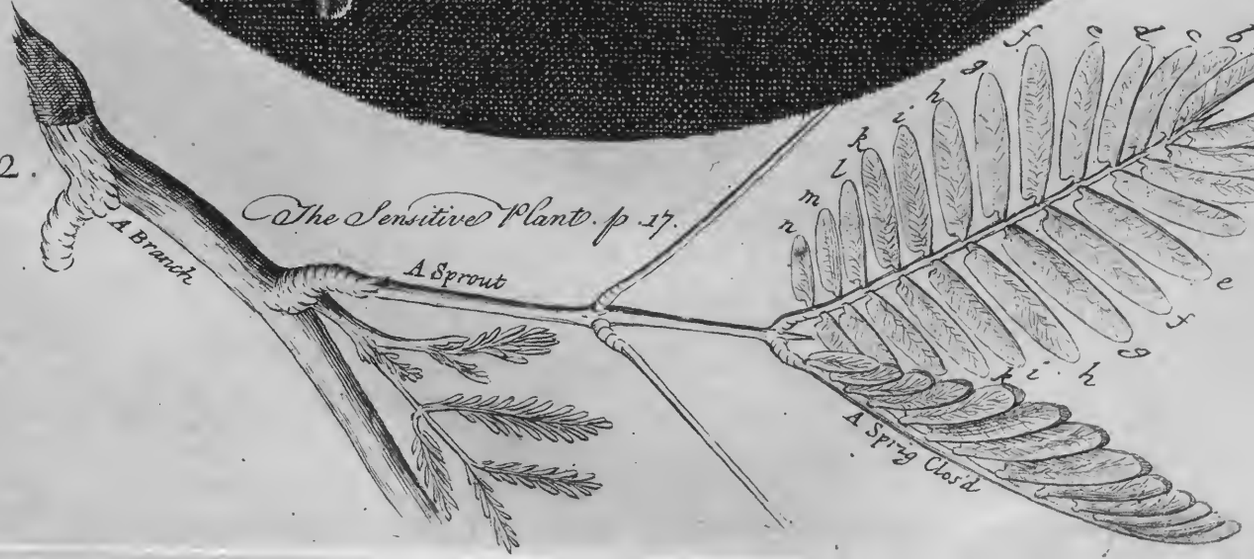


Fig: 2.

The Sensitive Plant. p. 17.



larger and longer, ſofter, and of a lighter green. Its Boughs are fewer, the Trunk bigger in proportion to its Height, and the Bark a great deal thicker, very light, ſpungy, and of an Aſh-colour, inclining towards a yellow; which Bark is the Cork.

Some *Naturaliſts* imagine this Cork to be only an Excreſcence, or Subſtance diſtinct from the Tree itſelf, tho' drawing its Nouriſhment therefrom, like *Ivy*, *Agaric*, and ſeveral Species of *Fungi*; which Opinion they ground on its having two Barks lying under it, in common to all Trees; on the Cork-Tree's being of ſome Growth before this Subſtance comes to be diſcernable; on its cracking, flawing, and cleaving into many great Pieces, while the two Barks underneath remain entire; and on its being ſeparated and removed from the Tree, without doing it the leaſt Injury, but on the contrary rendering it more vigorous and flouriſhing: Whereas, if not taken away in a certain Time, it either cracks and falls off itſelf, or elſe deſtroys the Tree.

People that prepare this Subſtance for Sale, make a perpendicular Inciſion through the Length of the whole Tree, and two Inciſions tranſverſely, one towards the Top, and the other at the Bottom of the Trunk. Then carefully clearing off the Cork, without its being ſhattered, in large and even Pieces, which renders it of more Value, they ſoak it in Water, loading it with Weights to keep it down; and when ſufficiently wetted, lay it over burning Coals (whereby its Outſide becomes blackened) to reduce it to a Flatneſs; and afterwards, to preſerve this Flatneſs, they place it on an exact Level, heaping great Stones upon it. When perfectly dry, it is made up in Bales for Tranſportation. *Johnſton* tells us, that the internal Part of the Cork-Tree is ſo cloſe and ſolid it will not ſwim in Water, and that in three Years after the Cork has been cleared away, it will be overgrown with another ſuch-like Covering.

A Structure ſimilar to this diſcovered by the Microſcope in *Cork*, is likewiſe to be found in the Pith of Elder, or almoſt any other Tree, and alſo in the Stalks of ſeveral other Vegetables, as *Fennel*, *Hemlock*, *Carrots*, *Teaſels*, *Fern*, *Daucus*, *Burdock*, *Ruſhes*, ſome Kinds of *Reeds*, &c. but however with this Difference, that the Pores in theſe are ranged the long Way of the Stalk, whereas in *Cork* they run tranſverſe.

PLATE VIII. FIG. 2.

The Senſible Plant.

THE Figure here given is intended to illuſtrate the Obſervations made by Dr. HOOKE, *Auguſt* 9th, 1661, on the *Humble* and *Senſible Plants* then growing in Mr. CHIFFIN's Garden, St. *James*'s *Park*; in the Preſence of Lord BROUNKER, Sir ROBERT MORAY, Dr. WILKINS, Mr. EVELYN, Dr. HENSHAW, and Dr. CLARK.

There were four Plants of the *Senſitive* Kind, two of which the Doctor diſtinguiſhes by the Name of the *Humble Plant*, becauſe in them, when the Leaves had cloſed themſelves together, either by being gently touched, or if the Sun ſhine very warm, by only taking off the Glaſs that covered them, the tender Sprouts, as if wither'd, hung downwards to the Ground.

They were little Shrub-Plants, having a ſhort Stock, that roſe about an Inch above the Earth; from which ſeveral Branches iſſued, round, ſtrait, and ſmooth, but with a Couple of ſharp thorny Prickles juſt under each of the Sprouts that proceeded from them.

The Diſtance between the Sprouts was uſually ſomething above an Inch; and the End of each Sprout had generally four Sprigs, two at the Extremity, and one on each Side juſt under it. On each of theſe Sprigs, from its uppermoſt Side, about eleven Pair of Leaves grew out, one againſt another exactly, and neatly ſet, in ſuch-like Articulations as when the round Head of a Bone is received into a Socket that affords it an eaſy Motion. The Leaves were placed in the moſt proper Manner to fold together readily; and when they cloſed in Pairs, each Under-Pair folded a little over that above it, as the Picture ſhews, where the Sprig is repreſented cloſed.

Each Leaf, being almoſt an oblong Square, grew out from the Sprig at one of the lower Corners, and received therefrom not only a Spine, (if we may ſo call it) which paſſed through and divided it lengthways, in ſuch a Manner, that the Out-ſide was broader than the Inner; but alſo ſmall Fibres, paſſing obliquely towards the oppoſite broader Side, and ſeeming to render it a little muſcular, in order to move the whole Leaf. All the Leaves and Sprigs were covered with ſmall whitiſh Hairs.

On touching any of the Sprigs, all the Leaves on that Sprig contracted themſelves by Pairs, and joined their upper Surfaces cloſe together.

On letting a Drop of *Aqua-fortis* fall on the Sprig, between the Leaves *f f*, all the Leaves above, as *a*, *b*, *c*, *d*, *e*, ſhut themſelves preſently; thoſe below, as *g*, *h*, *i*, *k*, *l*, *m*, *n*, did the ſame afterwards, by Pairs, ſucceſſively. Soon after the ſame Motion began in

the lower Leaves of the other Branches, which cloſed together in Pairs to the End of each Sprig, with ſome little Diſtance of Time betwixt. But, next Day, all the Leaves were ſpread out again on the other Sprigs; on the Sprig where the *Aqua-fortis* had been dropped, the Leaves, downwards, were alſo expanded, green, and cloſing upon the Touch; though all above *f f*, were dead and wither'd.

One of the Leaves, *b b*, was clipped off in the Middle with a Pair of Sciſſars, as quick as it could be done; whereupon that Pair, and the Pair above it cloſed inſtantly, as did after a little Interval *d d*, *e e*, and all the other Pairs to the Bottom of the Sprig. The Motion then began in the lower Leaves on the other Sprigs, and they ſhut themſelves alſo, by Pairs, upwards; though not with ſuch diſtinct Diſtances.

Theſe Plants were ſo extremely *ſenſible*, that their Leaves cloſed at the *Effluvia* of a ſtrong-ſcented Oil, and likewiſe at the Smoak of Sulphur: The Sun-Beams had alſo the ſame Effect.

On cutting off a little Sprout, there iſſued from the Part whence it was cut, two or three Drops of a clear bright greeniſh Liquor, taſting ſomewhat bitteriſh at firſt, but leaving afterwards a Taſte like Liquorice.

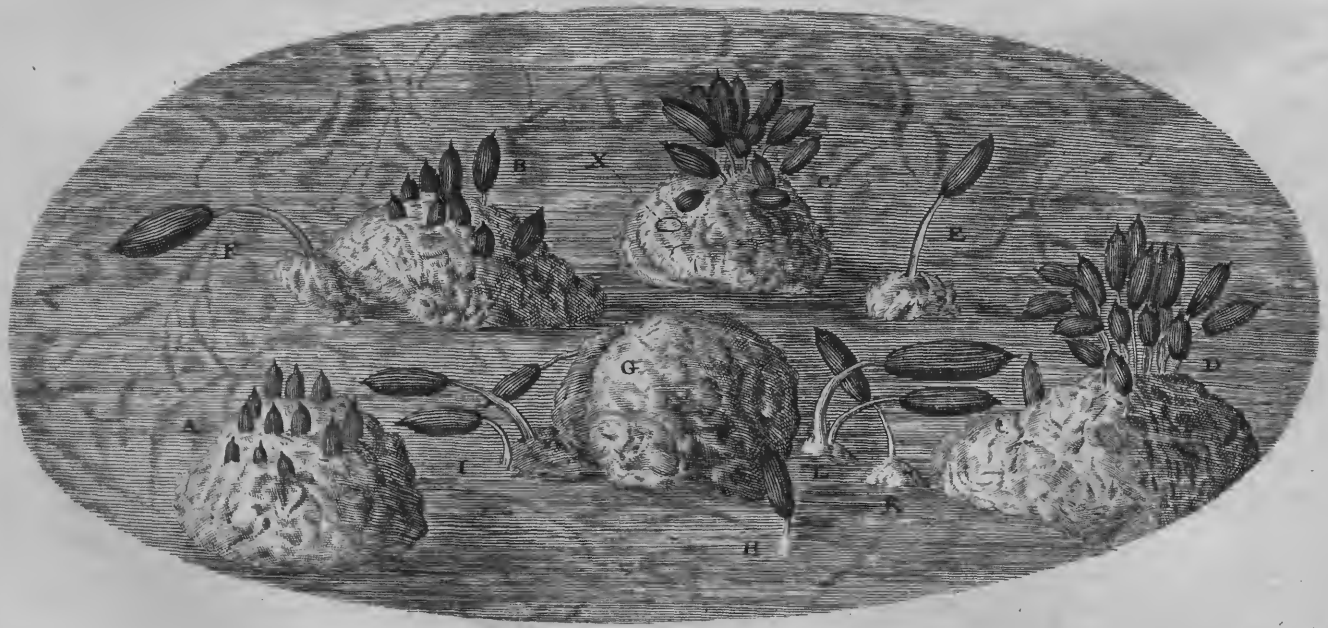
A Sprig whoſe Leaves were all ſhut, being plucked off, with Deſign to obſerve the Liquor ſhould come from it, none, even with preſſing, could be found therein: Whereupon another Sprig, whoſe Leaves were expanded, being pulled off as dexterouſly as poſſible, upon the cloſing of the Leaves, a little of the forementioned Liquor was obtained from the End of the Sprig. This Experiment was tried twice, (which was as often as the Plant could be robbed without Danger of killing it) and ſucceeded both Times in the ſame Manner.

The Doctor imagines a conſtant Communication between every Part of this Plant and its Root, either by a Circulation of this Liquor, or a conſtant Preſſure of its ſubtiler Parts to every Extremity of the Plant; and that the Motion and Cloſing of its Leaves are occaſioned by ſome Impediment, which the Touch of any Thing produces in ſuch Circulation or Preſſure of the more ſubtile Parts of this Liquor. The Manner after which he ſuppoſes this to be effected, is too long and inconcluſive to be inſerted here.

He ſays, the other two Plants never flagged, or hung down their Branches, nor ſhut their Leaves, but upon ſomewhat of a hard Stroke. Their Stalks grew up from the Root, and were more herbaceous, being round and ſmooth, without any Prickles. The Sprouts from them had ſeveral Pair of Sprigs, with ſeventeen Pair of Leaves (much ſmaller than theſe on the *Humble-Plant)* moſt commonly on each Sprig.

There are many Species of the *Senſitive Plant*, that differ much in Size, Figure, and Degree of Senſibility. We are told, that in the Paſſage of the *Iſthmus*, from *Nombre de Dios* to *Panama*, there is a Wood of *Senſitive Trees*, the Leaves of which, as ſoon as they are touched, move with a rattling Noiſe, and cloſe, and twiſt themſelves together into a winding Figure.

1/32 Part of an Inch Magnified.



A Curious Plant on the Leaves of Rose Trees. p. 19

An EXPLANATION of the NINTH PLATE.

FIG. 1.

The Form of Blue or White Mould.

FRUITS, Herbs, Leaves, Roots, Cheeſe, Leather, and many other moiſt Things, are frequently obſerved with hairy Spots upon them, of a blue or white Colour, ſuch as we commonly call *Mouldineſs*. The Figure now before us was a Spot of that Kind, found on the red Sheep-ſkin Cover of a Book, and examined by the Microſcope, which diſcovered it to be a pretty Sort of Vegetable, puſhing out Multitudes of ſmall long cylindrical and tranſparent Stalks, not exactly upright, but bending a little with the Weight of a round white Knob or Ball, that grew on the Top of each. Mouldineſs.

Many of theſe Knobs were very round, and had a ſmooth Surface, ſuch as A A A A A A.

Others were alſo ſmooth, but ſomewhat of an oblong Shape, as B.

Several of them were broken a little, appearing with a few Clefts on the Top, as C.

Others again were ſhattered, or flown to pieces, in the Manner of D D D D.

Their whole Subſtance was very tender, much like that of the ſofter Kind of common white Muſhroom, for the leaſt Touch with a Pin tore them; and though they grew near together in a Cluſter, each Stem ſeemed to riſe from a ſeparate Root, out of a diſtinct Part or Pore of the Leather. Some were ſmall and ſhort, ſeeming but newly ſprung up, with Balls for the moſt part round. Others were taller and larger, being probably of a longer Growth, the Heads of which appeared moſtly broken, and ſeveral of them much waſted, as E.

It was not eaſy to find out what theſe Heads contained, or whether they were Flowers or Seed-Veſſels; but they ſeemed to bear the neareſt Reſemblance to the Heads of Muſhrooms, and were very diſagreeable both to the Taſte and Smell.

The Microſcope diſcovers ſeveral Species of minute Plants, very different from one another, compoſing what we call Mouldineſs, as found on different Sorts of Things, and at different Seaſons of the Year; ſome reſemble Spunge, others Puff-Balls, and others a Thicket of Buſhes, very much branched, and extending much in Length, in proportion to their Thickneſs, like creeping Brambles.

Our Author ſuppoſes that *Muſhrooms*, and the *Microſcopical Plants*, we are now deſcribing, may be generated at any Time, and from any Kind of putrified Subſtance, either animal or vegetable, without Seed; merely by the friendly Concurrence of either natural or artificial Heat and Moiſture: And adds, that he could never find any thing like Seeds in *Muſhrooms*. But later Diſcoveries have proved him greatly miſtaken in this Reſpect, by ſhewing that *Muſhrooms* produce Seeds in prodigious Numbers, as any Body may be ſatisfied who will take the Trouble to examine the Gills of them with good Glaſſes: And tho' it may be impoſſible to diſcern the like on theſe minute Plants, it is not improbable that their round Heads may contain alſo an Abundance of Seeds, which becoming ripe in a few Hours, are ſpirted to ſome ſmall Diſtance round about, where finding a proper Bed, they preſently ſpring up, and ſoon bear Seeds themſelves.

And if ſo, we need no longer wonder at the ſpeedy ſpreading of Mouldineſs over any Body whereon it once appears. It muſt be owned, that Heat and Moiſture, and oftentimes a Degree of Putrefaction in the Subſtance, are requiſite to make theſe little Plants thrive; but that ſuch Principles ſhould be able to create them, muſt, I think, be paſt the Belief of any who have ſtudied Nature by the Help of Glaſſes.

PLATE IX. FIG. 2.

A curious Plant on the Leaves of Roſe-Trees.

TOwards the End of Summer, when the Leaves of *Damaſk-Roſe* Trees begin to dry and turn yellow, they frequently have yellow Specks on their upper Surface; over againſt which, exactly on the Under-ſide, may be found little yellow Hillocks of a gummy Subſtance, with black Specks in the Middle of them, appearing to the naked Eye no bigger than the ſmalleſt Tittle that can be made with a Pen. Plants on Roſe-Tree Leaves.

The Oval Figure O O O O, which is given here, as examined by the Microſcope, was a Piece of *Roſe-Leaf*, about the Size of the little Oval marked X, on the Hillock C. On

this appeared ſeveral Knobs of a yellowiſh red gummy Subſtance, out of which ſprung Multitudes of long Pods, in Shape reſembling thoſe of common Moſs; but, ſo much leſs, that many Hundreds of them would not be equal to one Seed-Pod of Moſs. The Stalks whereon they grew were finely tranſparent, and almoſt like the Stalks of the Plants in *Mouldineſs*, but ſomewhat yellower.

Some of theſe Hillocks appeared barren or deſtitute, without any thing growing on them, as G.

The Pods in others, were juſt ſhooting out their Heads, and ſeemed all pointing directly upwards, as at A.

In ſome, as at B, they were juſt gotten out of the Hillock, with Pods of an indifferent Size, but little or no Stalk.

They were found in ſome beginning to have little ſhort Stalks, as C.

In others, as D, the Stalks were increaſed both in Length and Thickneſs.

Others ſtill, as E, F, H, I, K, L, produced Pods and Stalks that were a great deal larger, and probably at their full Growth: The Stalks were more bulky about the Root, and tapering towards the Top, as F and L moſt particularly ſhew.

No Seeds could be diſcovered in theſe Pods; but as they grew to their full Size they began to bend their Heads downward, in the Manner thoſe of common Moſs do; whereby Nature ſeems to intend the ſame as in many Seed Veſſels of greater Bulk, *viz.* that the Seed, when ripe, ſhould be ſhaken and ſcattered out at the Ends of them, as we ſee it is in the *Columbine*, &c.

If theſe Pods, as is highly probable, contain Seeds, and the Size of thoſe Seeds bears ſuch a Proportion to that of the Pod, as we find between the Seeds and Seed Veſſels of *Pinks*, *Columbines*, *Poppies*, &c. how inconceivably minute muſt each of thoſe Seeds be! The whole Length of one of the largeſt Pods was not the five hundredth Part of an Inch, and in ſome not above the thouſandth Part, certainly therefore many thouſand ſuch Seeds muſt be neceſſary to conſtitute a Bulk viſible to the naked Eye; and, if each of theſe contains the Rudiments of a young Plant of the ſame Kind, what muſt we think of the conſtituent Parts, Sap-veſſels, and Pores thereof?

An Explanation of the Tenth Plate.

Small Wall-Moſs.

Wall-Moſs. THIS Plate exhibits the different Parts of a ſmall and beautiful, but very common Species of *Moſs*, as they appeared before the Microſcope.

The Root A reſembles a ſeedy Parſnep, furniſhed with ſmall Strings and Fibres, finely branched, like the Roots of much larger Vegetables. From this the Body of the Plant ſprings up, of a Shape ſomewhat quadrangular, moſt curiouſly fluted with little Hollows running parallel all its Length. Its Sides are cloſely ſet with a Multitude of large, fair, well-ſhaped Leaves, ſome rounder, and others longer, according to their Age, as B, C.

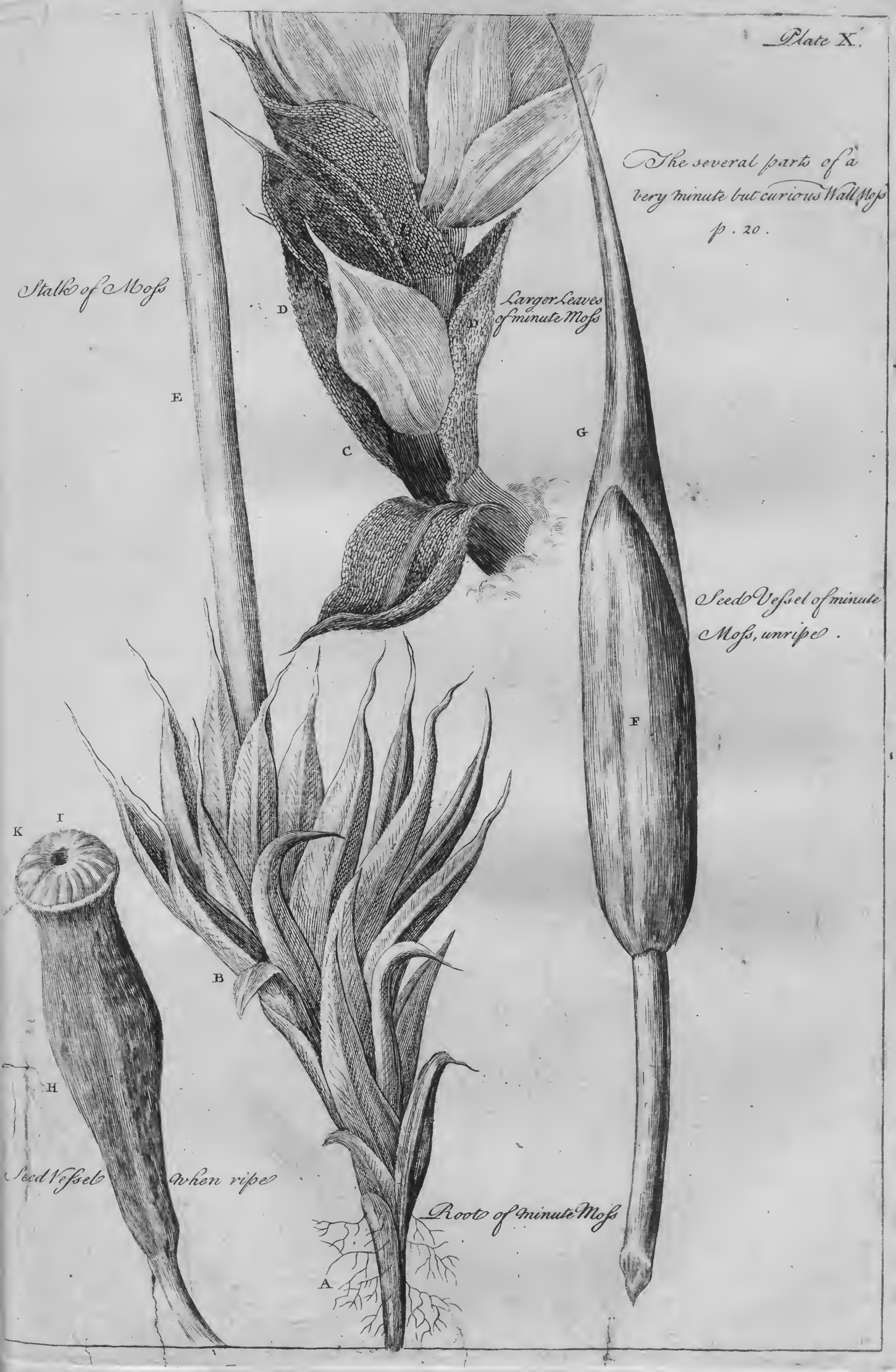
When this Plant is young, and ſpringing up as C, 'tis not unlike to *Houſeleek*; having ſuch kind of thick Leaves, folding over one another; but when they grow longer, the Surface on each Side of them becomes beautifully covered with little oblong tranſparent Bodies, as the Leaves D, D, D, expreſs.

There ſhoots out between the Leaves, a ſmall white tranſparent hair-like Body, which becomes in time a long, round, and even Stalk, as E; which being cut tranverſely, when dry, was found to be a ſtiff, hard, and hollow Cane or Reed, without any kind of Knot or Joint, from its Bottom, where the Leaves ſurrounded it, to the Top where a large Seed-Caſe grew.

F repreſents the Seed-Veſſel or Caſe, cut off from the Stalk E, and covered with a thin whitiſh Skin G, terminating in a long thorny Top. This skinny Membrane at firſt incloſes the whole Seed-Veſſel, but as that ſwells within it, the skin breaks by degrees, and at length falls off with its thorny Top, leaving the Seeds to ripen, and be ſcattered from an Opening, to be deſcribed preſently, which before was covered by it.

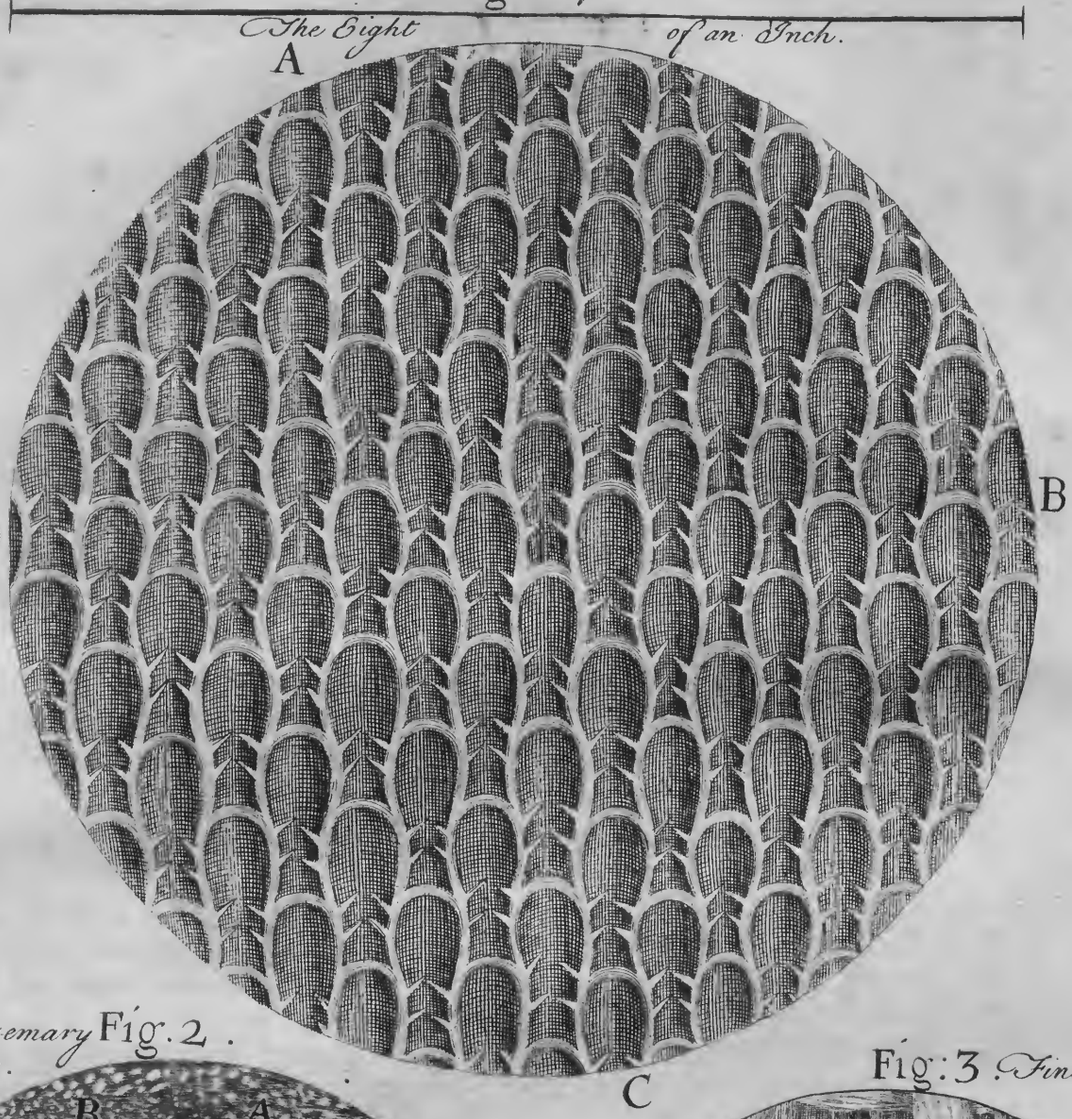
H ſhews the Seed-Veſſel, when ripe, without its membranous Covering G. The Top hereof before the Seeds are ripe appears like a flat barr'd Button I, and has no Hole or Opening; but as they ripen, the Button grows bigger, and a round Hole K opens itſelf exactly in the Center, through which the Seed is ſhed: And for the more readily effecting

Plate X.


The several parts of a very minute but curious Wall Moss p. 20.
Stalk of Moss
D
D
Larger Leaves of minute Moss
E
C
G
Seed Vessel of minute Moss, unripe.
F
K
I
B
H
Seed Vessel when ripe
Root of minute Moss
A

The Configuration of a beautiful Sea Moss, whereof the whole Figure is given. Plate VI.

Fig: 1. p. 21.



Peice of Rosemary Leaf. p. 21. Fig. 2.

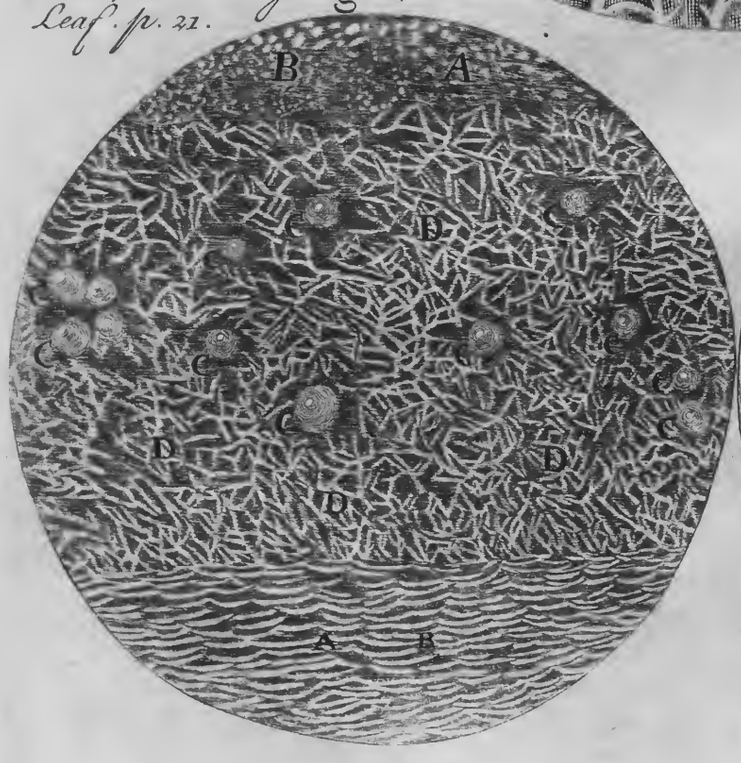
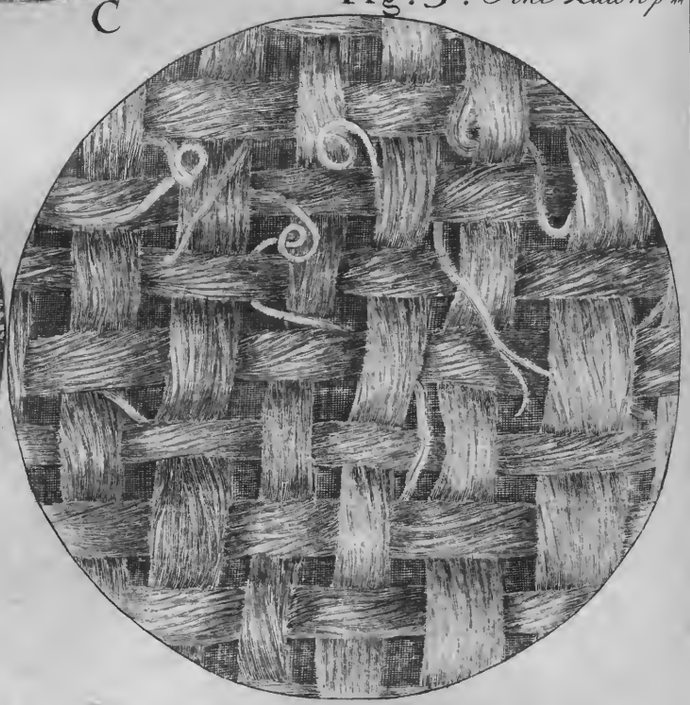


Fig: 3. Fine Lawn p. 22.



this, Nature wonderfully diſpoſes this End of the Caſe to bend itſelf downwards, as the Ears of Wheat and Barley uſually do when ripe.

On opening ſome of theſe Caſes, when dry and red, they were found quite empty; but being cut aſunder with a ſharp Pen-knife, while green, a ſmaller round Caſe was diſcovered within the other, with a Multitude of ſtringy Fibres, occupying the Space between the two Caſes, the innermoſt whereof was full of exceedingly minute white Seeds, as in the Seed-Veſſel of a *Carnation*, after the Flowers have been a few Days fallen off.

Our Author compares the Thickneſs of this little Vegetable, with that of ſome Trees we have Accounts of in the hot Climates of *Guinea* and *Brazil*; (the Bodies of which are, they tell us, twenty Feet in Diameter, whereas the Body of this Moſs is, commonly, not more than the ſixtieth Part of an Inch); and finds, by Calculation, that the Thickneſs of the one exceeds that of the other 2,985,984 Millions of Times. He then ſuppoſes the Production on a Roſe-Leaf, juſt now deſcribed, to be a thouſand Times leſs bulky than this Moſs; and, conſequently, that one of theſe Trees muſt exceed the Bulk of that a thouſand Times the Number above given. So prodigiouſly various are the Works of the Creator! and ſo all-ſufficient his Power to perform what to Man would ſeem impoſſible.

An EXPLANATION of the ELEVENTH PLATE.

FIG. 1.

A Piece of Sea-Weed.

THE Subject under our Eye at preſent, is a ſmall Piece, (the eighth Part of an Inch only in Diameter) of a moſt beautiful *Fucus* or *Sea-Wrack*; a large Tuft whereof is given, *Fig.* 2. *Plate* VI. very little bigger than its natural and common Size; but the Piece we are now deſcribing, A, B, C, D, is magnified a great deal. The whole Surface of this Plant appears covered with a moſt curious Kind of carved Work, conſiſting of a Texture much reſembling Honey-comb, and ſeems every where full of innumerable Holes, no bigger than what the Point of a ſmall Pin would make, ranged in the Manner of a *Quincunx*, or like the pearled Rows in the Eye of a Fly, which are exactly regular which way ſoever they are obſerved. Sea-Weed.

Theſe little Holes, which the naked Eye would imagine circular, are ſhewn by the Microſcope to be of quite a different Figure, having nearly the Shape of the Sole of a round-toed Shoe, the hinder Part whereof ſeems covered, as it were, by the Toe of the next that follows it. Each Hole is edged about with a very thin and tranſparent Subſtance, of a pale Straw-Colour; from which four ſmall tranſparent Thorns, of the ſame Colour, iſſue, two on each Side, and almoſt meet acroſs the Cavity. But no Words can give ſo good a Notion of ſuch a wonderful and uncommon Structure as the Picture now before us.

This Species of Sea-Weed is called by Mr. RAY, *Fucus telam lineam ſericeamve texturâ ſuâ æmulans*; by others, the *broad-leaved horned Wrack*. It is found here and there, thrown by the Sea upon the Shores; but as no body has ever ſeen it growing, it is probably produced in the deepeſt Parts thereof.

The Sea affords an endleſs Variety of Corals, Corallines, Spunges, Moſſes, *&c.* every Part of which is a delightful Object for the Microſcope.

PLATE XI. FIG. 2.

A Piece of Roſemary-Leaf.

THE Under-ſide of the Leaf was what Dr. HOOKE examined, and what, he ſays, exhibited to him a ſmooth and ſhining Surface. A B, is a Part of the Upper-ſide of the Leaf, but by a kind of Doubling turns down and covers ſome of the Under-ſide, looking like a quilted Bag of green Silk, or like ſome very pliable and tranſparent Membrane filled out with a green Liquor. Several other Plants have Leaves, whoſe Sur- Roſemary.

faces are ſmooth like this, and as it were quilted, in the ſame manner. Rue, or Herb-graſs, is poliſhed, and all over indented or pitted.

The Part that might properly be called the Under-ſide of the Leaf, had a downy Surface, which appeared through the Microſcope much like a Thicket of Buſhes.

The Leaves and Stalks of moſt Vegetables are covered with Down or Hair, and there ſeems as great a Variety in the Shape, Size, and Growth of theſe ſecundary Plants, (if we may ſo term them, being ſomewhat analagous to the Hairs in Animals) as there is between ſmall Shrubs. They conſiſt uſually of ſmall tranſparent Parts, ſome in the Form of minute Needles, as on the *Thiſtle*, *Cowage*, *Nettle*, &c. Others are like Cats-Claws, as the Hooks of *Clivers*, the Beards of *Barley*, the Edges of ſeveral Sorts of *Graſs*, *Reeds*, &c. And on many Plants, ſuch as Colts-foot, Roſe-Campion, Poplar, Willow, and all the downy Kinds, they grow in the Form of Buſhes, but much diverſified in each particular Plant.

A Multitude of ſmall round Balls, exactly globular, and much reſembling Pearls, were obſervable amongſt the little Buſhes or Down, as they are repreſented, C C C C C, *&c.*

Infinite Numbers of ſuch as theſe may be diſcerned on *Sage* and ſeveral other Plants; which was probably the Reaſon why KIRCHER ſuppoſed them covered with Spiders Eggs, though in truth theſe are nothing elſe but a kind of gummy Exſudation, and not the Eggs of any Inſect; as may be concluded from their being found upon them all the Year, and ſcarce changing their Magnitude at all.

D D D repreſent the irregular Diſpoſition of the downy or buſh-like Subſtance.

PLATE VI. FIG. 3.

Fine Lawn.

Fine Lawn.

THIS Object is a Piece of the fineſt *Lawn*, as it appears before the Microſcope. It ſeems introduced by Miſtake into this *Plate*, and belongs properly to *Plate* II. where *Ribbon*, *Taffaty*, and Things of its own Kind are examined. A Deſcription of it is therefore given where that Plate is explained, *Page* 4, to which we refer the Reader.

An EXPLANATION of the TWELFTH PLATE.

FIG. 1.

A Piece of Stinging Nettle.

Stinging Nettle.

A Piece of *Stinging Nettle*, as enlarged by the Microſcope, is the Object now before us.

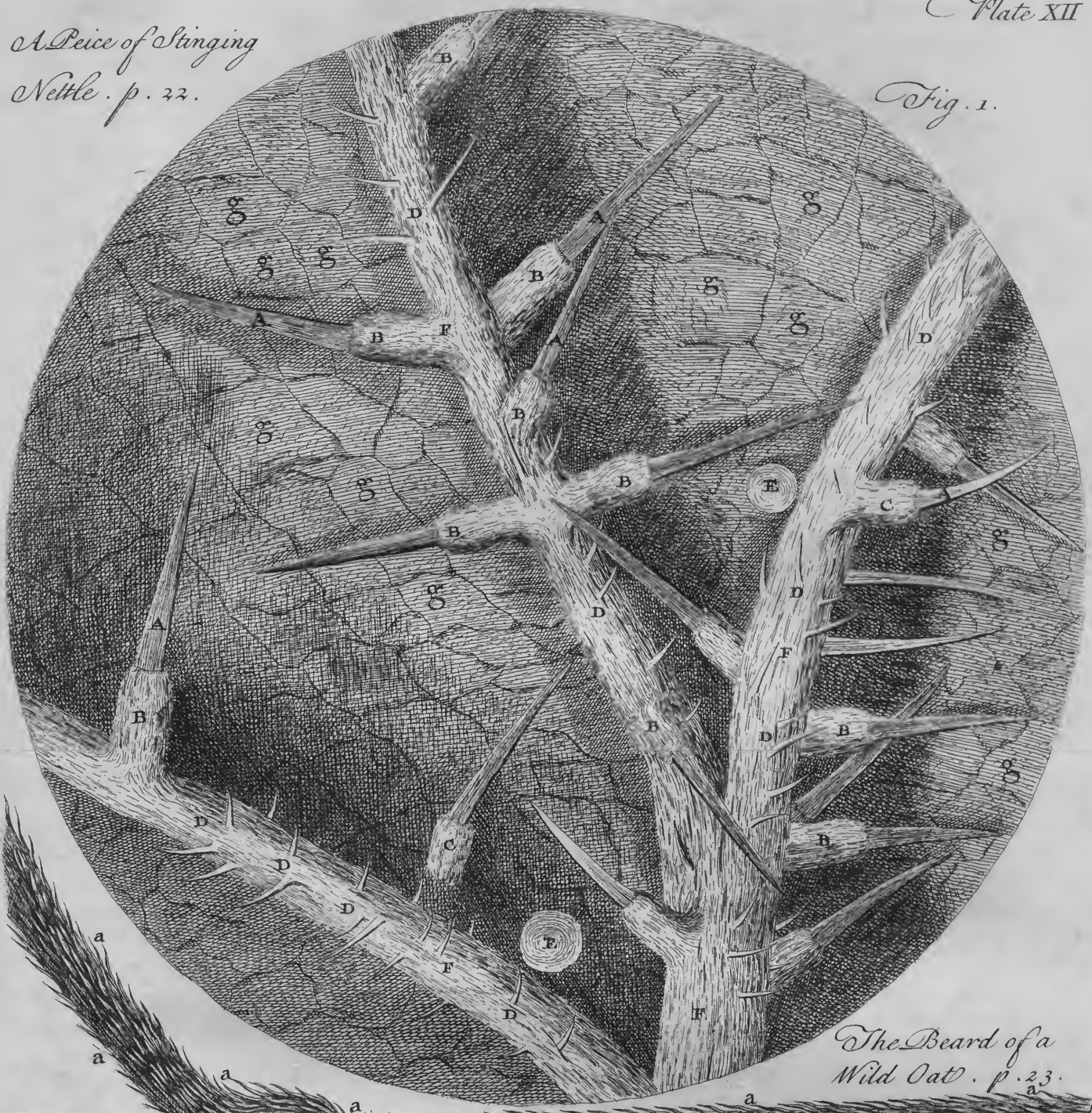
The whole Surface of the Leaf is ſet thick with ſharp Thorns or Prickles, which are juſt viſible to the naked Eye; but when magnified by Glaſſes, their Form is diſcoverable as at A B, A B, *&c.* Each of theſe conſiſts of two Parts, different in Shape and Quality. The Part A reſembles a round Bodkin, tapering from B, till it ends in a very ſharp Point. Its Subſtance is hard and ſtiff, exceeding tranſparent, and hollow from Top to Bottom, as has been found by many Trials. The lower and thicker Part B, which is as it were the Baſis whereon the Prickle ſtands, and of a much more pliable Conſiſtence, in Shape reſembles a wild Cucumber, and is evidently a little Bladder, or Veſſel filled with a limpid Liquor, always in Readineſs to be ejected through the Cavity of the Prickle, when any thing preſſes hard upon it.

This Configuration enables us to account for the Effects of what we call the *Stinging of a Nettle*; the Manner of which the Doctor fully diſcovered by the following curious Experiment.

Having provided a ſingle Glaſs, whoſe *Focus* was at the Diſtance of about half an Inch, faſten'd in a little Frame, that it might be managed eaſily, he perceived by the Help thereof, that on thruſting his Finger gently againſt the Ends of a Nettle's Prickles, they did not bend in the leaſt; but he could diſcern a Liquor riſing towards the Points thereof,

A Peice of Stinging Nettle. p. 22.

Fig. 1.



The Beard of a Wild Oat. p. 23.

Fig. 2.

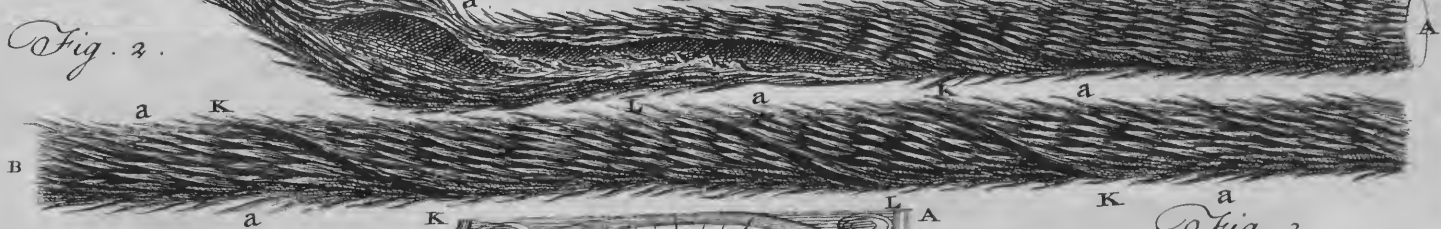
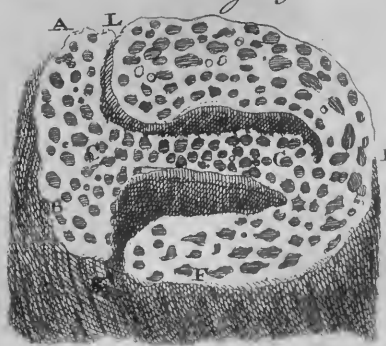
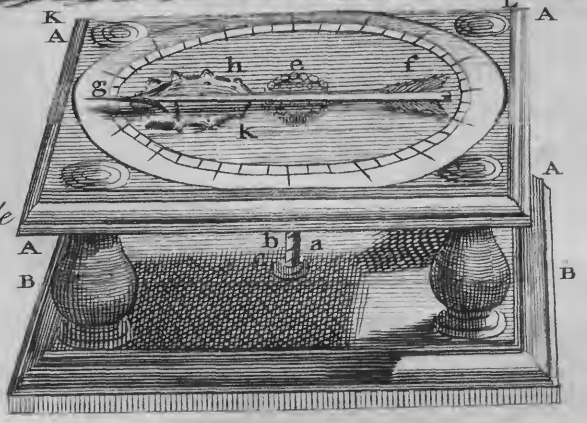


Fig. 3.



A Transverse Section of the Wild Oat-Beard p. 24.

Fig. 4.
An Hygrometer made of a Wild Oat-Beard
p. 24.



thereof, or ſinking in them, according to the Degree of Preſſure; and on taking away his Hand, he could ſee it ſubſide entirely into the little Bladder at the Bottom, and that as plainly as he had ever ſeen Water aſcend and deſcend in a Tube of Glaſs.

A Prickle thus preſſed upon, and the Liquor riſing in it, is repreſented by the Letter C.

Hence it is evident to a Demonſtration, that the burning acute Pain, Swelling and Inflammation that follow immediately on thruſting theſe Prickles into any Part of the Body, are owing to an Injection, at the ſame Inſtant, through the Cavities of theſe Prickles, of a corroſive or poiſonous Juice, lodged in Bags or Bladders at the Roots of the ſaid Prickles, and forced to aſcend in them by their being preſſed down on the ſaid Bags or Bladders.

Such a Structure and Effect are exactly ſimilar to the Sting of a *Scorpion*, *Waſp*, *Bee*, *&c.* and the Conſequence of being ſtung thereby. For the Sting of theſe Animals, like the Thorn of a Nettle, is an exceeding ſharp-pointed Tube, which entering the Skin or Fleſh ſerves to convey a poiſonous Liquor into the Wound, that by irritating the nervous and ſenſible Parts occaſions all the enſuing Uneaſineſs and Miſchief: And this Liquor, as in the Nettle, is prepared and contained in a little Bag at the Root or Bottom of the Sting. Nor is the Difference very great as to *Vipers* and other *Serpents*, whoſe Bite is dangerous; for the Wounds their Teeth make would be very harmleſs, were they not hollow, and a Venom ſquirted through them into the Wounds they give.

D, D, D, D, *&c.* are a Kind of Thorns or Prickles without any viſible Bladders of Liquor at their Roots, and a great deal ſmaller, as well as more numerous, than thoſe that have ſuch Veſſels. Theſe probably may be no farther hurtful than to occaſion a little Itching.

E, E, a Sort of Pearl-like Globules, perfectly tranſparent, that are here and there interſperſed on both Sides the Leaf of this Plant, and grow to it much after the Manner as *Oak-Apples* grow on the Leaves of an Oak.

F, F, F, the Ribs or large Sap-Canals, whence all the Prickles iſſue, and the Bladders at their Roots are conſtantly ſupplied with the pungent Juices they contain.

g g g g g g, *&c.* are the intermediate and thinner Parts of the Leaf, which are almoſt ſmooth, and afford little remarkable, but an irregular Ramification of very ſmall Veſſels or Fibres.

PLATE XII. FIG. 2.

The Beard of a Wild-Oat.

THE Beard of a Wild-Oat, cut aſunder at the Ends A and B, is repreſented by the two long prickly Figures we are now about to examine. Wild-Oat Beard.

This little Production of Nature is wonderfully remarkable, on account of its making an exceeding good *Hygrometer*, or Inſtrument for diſcovering the *Dryneſs* or *Moiſture* of the Air; being extremely ſenſibly of, and viſibly affected by the leaſt Alteration as to thoſe Particulars. A Deſcription of it muſt therefore be an inſtructive as well as entertaining Amuſement.

To the naked Eye it appears very inconſiderable, being only a ſmall black or brown Beard or Briſtle, growing from the Side of the Inner-huſk that covers the Grain of a Wild-Oat. In *July* and *Auguſt*, when the Grain is uſually ripe and dry, this Beard is bent ſomewhat below the Middle almoſt to a Right-Angle; and the under and thicker Part is writhed or twiſted round down to the very Bottom, making three Revolutions in ſome, in others more or leſs, according to the Bigneſs and Maturity of the Grain whereon it grew, together with the Dryneſs or Moiſture of the ambient Air. It is very brittle when dry, and eaſily broken from the Huſk from which it proceeds.

If it be put in Water, and viewed with a Magnifying-Glaſs, it ſeems like a twiſted *Withe*, having a Couple of Clefts or Channels along it; the ſmall bent Top will then move round, the Under-Part untwiſt, and the Knee or Angle gradually become quite ſtrait, in which Condition, being at full Length, it extends ſometimes to an Inch and an half. When taken out of Water, and ſuffered to dry again, it by Degrees twiſts itſelf round as it was before, and bends again near the Middle into its former Poſture.

The Superficies of this little Body appears, by the Microſcope, adorned with little Channels and interjacent Ridges, ſtrait where the Beard is not twiſted, but writhed where it is. Theſe Ridges are thickly beſet on each ſide with Prickles, not unlike the Quills of *Porcupines*, (as are ſhewn by *a a a a a a*) all the Points whereof are directed upwards towards the Top of the Beard; which is the Reaſon it ſticks and grates againſt the Skin, if one endeavours to draw it between the Figures the contrary Way. The Manner of growing, Number, Cloſeneſs to each other, and Size of the Prickles, in proportion to the Beard, the Figure will alſo ſhew.

K K, in the upper Figure, repreſent the two Channels or Clefts opened, which reach from the Bottom to the Angle C, all along the writhed Part, and are twiſted round with it, as at the Letters K K, *&c.* L L, *&c.* in both the Figures. Theſe Channels are filled up with a kind of ſpungy Subſtance.

PLATE XII. FIG. 3.

A tranſverſe Section of the Wild-Oat Beard.

ON cutting the twiſted Part acroſs, to examine its Pith, with the Form and Diſpoſition of the Pores thereof, the Appearance was as A B C C E F.

K L repreſent the two Clefts or Channels, which as it were divide the Beard, its whole Length, into two unequal Parts, they wind very oddly in the inward Part of the Writhe.

C C ſhew the Pores or Sap-Veſſels running the long Way.

PLATE XII. FIG. 4.

An Hygrometer made with a Wild-Oat Beard.

A A, B B, is a Kind of Box or Frame, the Top and Bottom Plates whereof are held together only by four ſmall Pillars, that a free Paſſage for the Air between them may no ways be obſtructed.

C is a ſmall Hole in the Middle of the Under-Plate B B, into which Hole the Bottom of the Oat-Beard is fixed, upright, with ſoft *Bees-Wax*, in the Manner of *a b*; while the Upper-End thereof paſſes through another Hole exactly oppoſite in the Top-Plate A A A A.

On the Top of the Beard at *e*, a ſmall and very light *Index*, *f g*, made of a thin Slip of *Reed* or *Cane*, muſt be faſtned with a Piece of fine Silk, or a Touch of hard Wax or Glue.

This Inſtrument is ſo extremely ſenſible of the leaſt Alteration in the Conſtitution of the Air, as to Dryneſs or Moiſture, and does ſo certainly twiſt or untwiſt itſelf in proportion thereto, that it will frequently untwiſt, and thereby turn the *Index* a whole Round, only by breathing on it, or twiſt and thereby turn it as much the contrary Way by letting it approach the Fire, or placing it in the Sun-ſhine.

And becauſe, in Times of great Dryneſs or Moiſture, the *Index f g*, moves ſometimes twice or thrice round, and may thereby make it difficult to form a right Judgment of it, the following Contrivance has been employed with good Succeſs, to know certainly what Number of Revolutions have been made.

The *Index f g* being raiſed to ſome Diſtance above the Surface of the Plate A A, a ſmall Pin *h*, was fixed downwards pretty near the Middle of it, in ſuch a manner that it might almoſt touch the Surface of the Plate A A. And then another Pin being alſo fixed in a convenient Part of the ſaid Plate, whereon a ſmall Piece of Paper, ſhaped like the Figure *i k*, was placed, by making a Hole through its Center; which Paper having a convenient Number of Teeth, every Turn or Return of the Pin *h* moved its little indented Circle a Tooth forwards or backwards; whereby, as the Teeth were marked, it was eaſy to aſcertain how many Revolutions the *Index* made.

This little Circle may be made of thin Paſtboard, Vellum, or Parchment, as well as Paper; but great Care muſt be taken that it be exceeding light, and move very eaſily upon the Pin, otherwiſe the whole Operation will be ſpoiled. The Box may be made of Braſs, Silver, Iron, Wood, or Ivory, and Degrees marked upon it as every one chuſes: and the *Index* may be contrived various Ways, to ſhew not only the Number of Revolutions, but the minute Diviſions of each.

BAPTISTA PORTA informs us, in his Book of *Natural Magic*, that ſome *Jugglers*, by Means of the Beard of a Wild-Oat, (which, to make it the more ſurprizing, they called the Leg of an *Arabian* Spider or an *Egyptian* Fly) uſed to make a ſmall *Index*, *Croſs*, or the like, to move round, by putting a Drop of Water to it privately: though they pretended it was in Obedience to certain Words they muttered.

Twiſted Cord, *Cat-Gut*, and ſome other Things may be contrived to ſhew the Changes as to Drought or Moiſture in the Air, as well by ſtretching and ſhrinking, as by untwiſting and twiſting: But theſe are not near ſo ſenſible or exact; their varying Property alſo gradually diminiſhes. The Beards of *Geranium Moſchatum*, and alſo of ſome other Species of *Cranes-Bill*, are at leaſt as eaſily affected as that of the *Wild-Oat*: And it is farther obſervable, that the ſmaller the writhing Subſtance the quicker its Senſibility of every little Change.

Seeds of Thyme. p. 25

Seeds of Venus-Looking Glass, or Corn-Violet. p. 25.

An Explanation of the Thirteenth Plate.

This *and the Three following* Plates *preſent to us the Pictures of different* Seed, *as they appear when enlarged by the* Microſcope.

Seeds of the Corn-Violet.

Seeds of the Corn-Violet.

THOSE under our Inſpection, at preſent, belong to the *Corn-Violet*, or *Venus-Looking-Glaſs*; whoſe Seed is ſmall, black and ſhining; and when ſeen by the naked Eye, reſembles a little Flea; but magnified by Glaſſes, appears in the Form before us, covered with a thick, tough and ſhining Skin, ſhrunk or pitted, as it were, irregularly, inſomuch that no two of them can be found alike exactly.

The Seeds of Plants (even thoſe whoſe Shape and Structure, by reaſon of their Smalneſs the Eye is unable to diſtinguiſh) are adorned with ſuch a Variety of Carvings and Ornaments, that much Pleaſure ariſes from the Examination of them. Their Surfaces are ſome curiouſly wrought, others ſmooth and poliſhed; ſome are covered with Hairs, ſome with a kind of Shell, and ſome with both. Their mere outward Form renders them delightful Objects; but if we proceed farther, and by Diſſection gain a Knowledge of their internal Structure, we ſhall find ourſelves loſt in a new World of Wonders. Dr. James Parsons, Fellow of the *Royal Society*, is at preſent engaged in theſe Diſcoveries, which he propoſes to lay before the Public; and as his Pencil is well qualified to delineate whatever his Eye obſerves, there is great Reaſon to expect from him an honeſt and judicious Deſcription of whatever is moſt remarkable therein.

An Explanation of the Fourteenth Plate.

Seeds of Thyme.

Thyme-Seeds.

NINE of the minute Seeds of *Thyme* are ſhewn here, as they were magnified, and in different Poſitions both to the Eye and the Light. There appeared a great Variety in their Bulk and Figure; but every one of them nearly reſembled a Lemon or Orange dried, and that as well in Colour as Shape. Some were a little rounder, and more like an Orange, as A, B, each whereof has a remarkable Part whereto their Stalks were joined; and on A a little Piece of Stalk is ſtill remaining. The oppoſite End of theſe Seeds has a Knob or Prominence, ſuch as Lemons uſually have, which is ſhewn by D, E, and F.

They all ſeemed a little wrinkled or ſhrivell'd, but the Seed H was moſt remarkably ſo.

The Seed G had an irregular Ridge or Riſing, expreſſed by the white Lines thereon.

I repreſents a Seed nearly of an oval Shape.

An EXPLANATION of the FIFTEENTH PLATE.

Poppy-Seeds.

Poppy Seeds. THE Seeds of Poppy, when viewed by the Microſcope, appear in Form very like a Kidney, with a pretty Kind of Net-work on them, riſing in orderly Ridges above the Surface, and making hexagonal and pentagonal little Hollows, with Sides and Angles that are nearly regular.

They differ in Colour according to the Poppy producing them; ſome Sorts are white, others of a dark-browniſh red; and the Seeds of a foreign Poppy commonly given to Birds by the Name of *Maw-Seed*, are very remarkable for being of a lightiſh-blue, which is a Colour found, perhaps, in no other Seeds.

" A Duſt may be ſhaken from amongſt the Seeds of Poppies, which looks very " agreeable when brought before the Microſcope, having almoſt the ſame Appearances as " the Surfaces of the Seeds, with the Advantage of being tranſparent *. This Duſt is " really the fine Membranes that lay between the Seeds; which, by the Preſſure of the " Seeds againſt them, have received Marks correſponding to the Ridges and Hollows on " the Seeds themſelves."

The Poppy-Heads, wherein the Seeds grow, are alſo well deſerving our Obſervation, being round and regularly formed Bodies, with a moſt beautiful Crown on the Top of each, under the indented Projections whereof there are ſeveral Openings, when the Seeds become ripe, out of which they are ſcattered round about, as often as theſe Seed-Veſſels are ſhaken by the Winds, or any other Accident.

The Seeds are diſpoſed in many little Cells, divided each from other by fine Membranes, which reach, in an upright Poſition, from the Bottom of the Head to the Crown at its Top, all meeting at the Center: By which means every Cell is ſhaped like the Clove of a *China-Orange*, having at the Upper-End an Opening for the Seeds to ſcatter out at.

We ſhould not ſhew a proper Regard for the Poppy, or pay a due Acknowledgment to the All-wiſe Diſpenſer of every Good, ſhould we paſs it over without taking notice of its ſingular Virtues. For this only, amongſt all the Productions of Nature, is capable of alleviating the racking Agonies of Pain, and producing comfortable and refreſhing Sleep, when the Brain is overheated and the Spirits agitated almoſt to Madneſs. This therefore is one of the great Bleſſings Providence has beſtowed on Man; and we greatly undervalue it, when we prefer the Grape, or any other Fruit or Plant before it; ſince, in many Caſes, this and this only can give Eaſe, without which not all the Mines of *India* can give Happineſs.

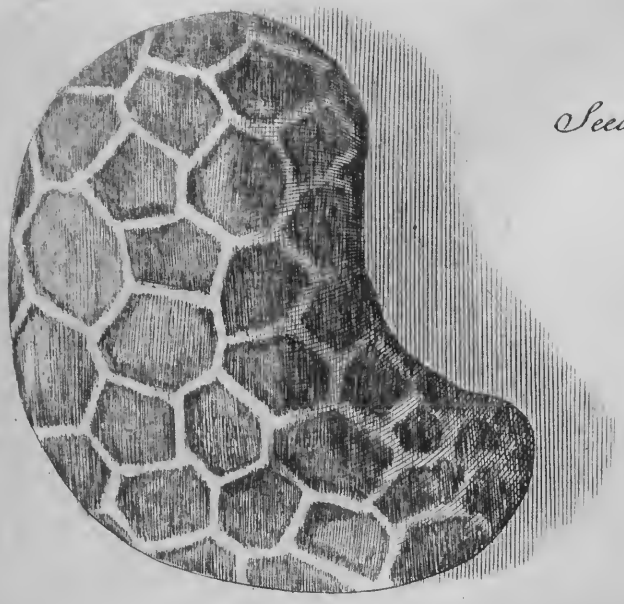
Opium. In ſhort, the milky Juice which flows from the green Heads or Seed-Veſſels of the Poppy pretty freely upon cutting, after it becomes inſpiſſated, is *Opium:* A Drug eſteem'd in the higheſt Manner in *Turky*, *Perſia*, *India*, and all the Eaſtern Parts of the World, as it not only removes Grief and Pain, and produces an inexpreſſible Serenity and Satisfaction of Mind; but by the Help thereof the People of thoſe Countries find themſelves enabled to undergo the greateſt Fatigues, and even to ſubſiſt without Food for ſeveral Days together.

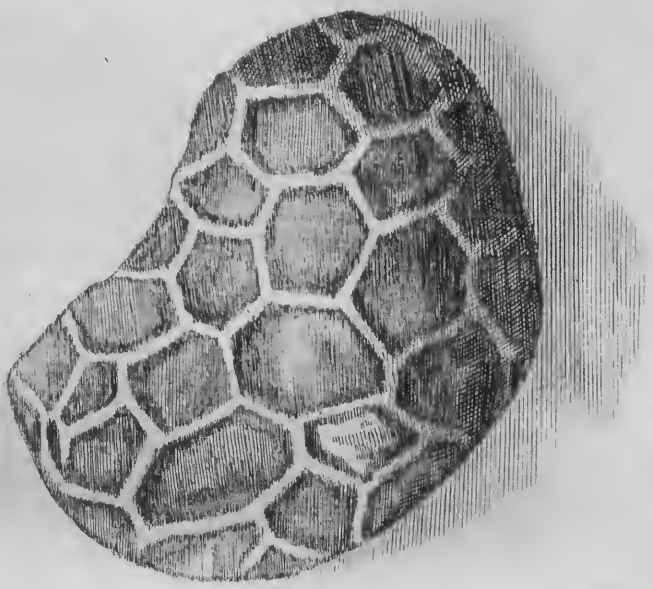
The Goodneſs of Providence is therefore further obſervable in the Care it has taken for the abundant Propagation of this ineſtimable Vegetable; the Seeds whereof it has made ſo ſmall as not to exceed the thirty-ſecond Part of an Inch in Diameter; whereas the Diameter of the Seed-Veſſel is oftentimes two Inches; ſo that it is capable of containing near two hundred thouſand Seeds; and always does contain a prodigious Number. Every Root alſo produces ſeveral of theſe Seed-Veſſels, the Contents of which together muſt amount to Millions. This Plant is likewiſe found almoſt in every Country, and tho' its Virtues come far ſhort in the colder Climates of what they are in the hotter, it may every where be made uſe of to good purpoſe.

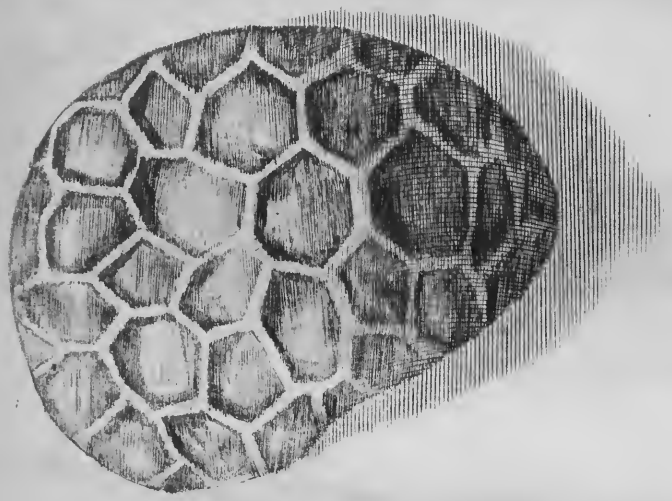
The Knowledge of *Opium*, and the Effects thereof, are probably of great Antiquity; for HOMER, the oldeſt Writer in the World except MOSES, deſcribes HELEN preparing a Cordial called by him *Nepenthes*, whoſe Qualities and Effects agree admirably with what

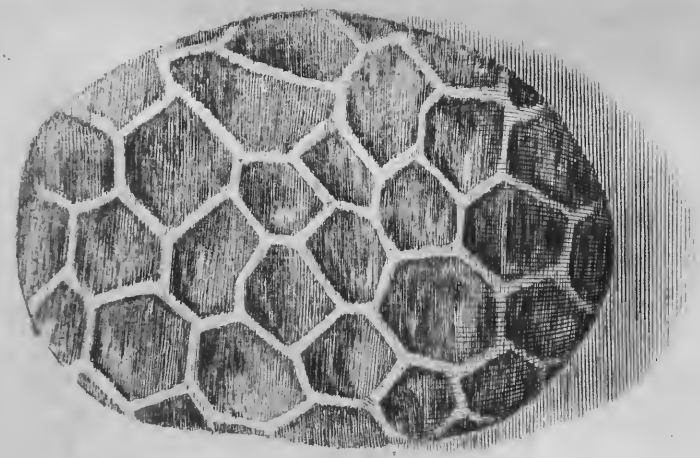
* *Microſcope made eaſy*, p. 254.

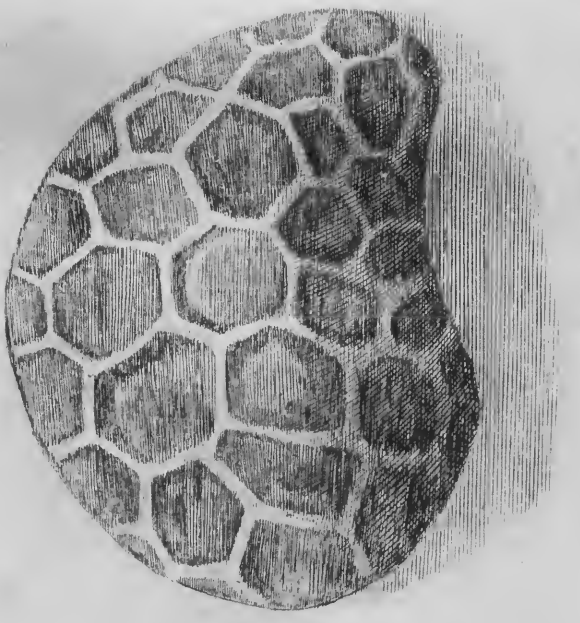
Seeds of Poppy. p. 26.



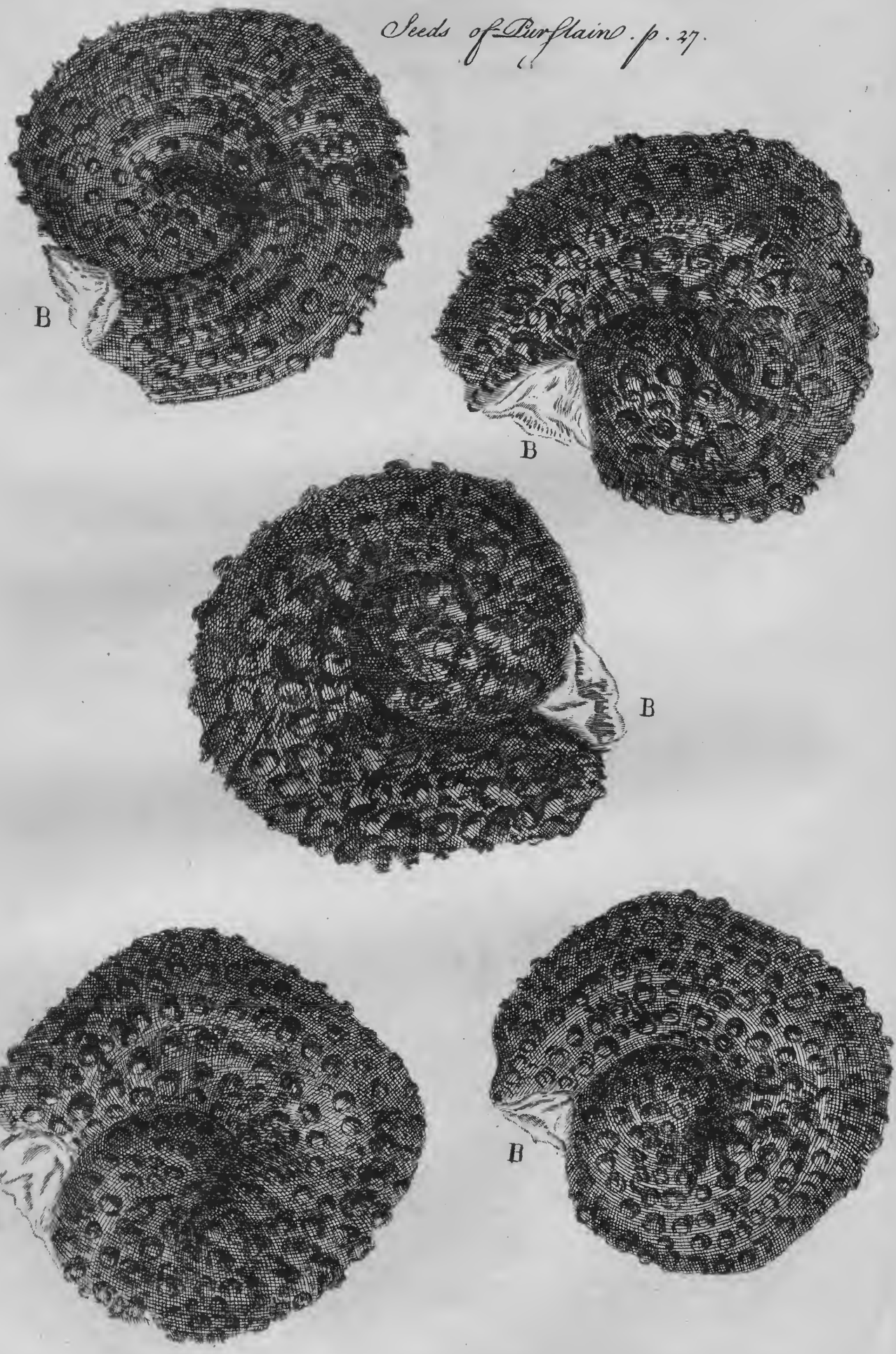








Seeds of Purslain. p. 27.



what we know of OPIUM. We ſhall therefore ſubjoin Mr. POPE's excellent *Tranſlation* of that Paſſage from the Fourth Book of the ODYSSEY, *Line* 301.

- - - - with genial Joy to warm the Soul
Bright HELEN *mix'd a Mirth-inſpiring Bowl:*
Temper'd with Drugs of ſov'reign Uſe, t' aſſwage
The boiling Boſom of tumultuous Rage;
To clear the cloudy Front of wrinkled Care,
And dry the tearful Sluices of Deſpair.
Charm'd with that virtuous Draught, th' exalted Mind
All Senſe of Woe delivers to the Wind.
Tho' on the blazing Pile his Parent lay,
Or a lov'd Brother groan'd his Life away,
Or darling Son oppreſſed by Ruffian-Force
Fell breathleſs at his Feet, a mangled Corſe,
From Morn to Eve, impaſſive and ſerene,
The Man entranc'd would view the deathful Scene.

In order to account in ſome Degree for theſe Effects mechanically, Mr. COWPER examined a Solution of *Opium* with the Microſcope, and found its diſſolved Particles in the Shape of fringed Globules. Whence he concludes, that ſuch Particles circulating in the Maſs of Blood, may be ſo intangled in its Serum, or thicken it in ſuch a manner, as to retard its Velocity when over-violent, and render its Motion calm and equal, whereby all painful Senſations will be taken off. And from the ſame Principles it is eaſy to deduce all its other Effects, and become ſenſible how too great a Number of ſuch fringed Globules muſt cauſe a total Stagnation of the Blood, and conſequently kill.—*Vid. Phil. Tranſ.* N° 222.

An EXPLANATION of the SIXTEENTH PLATE.

The Seeds of Purſlain.

THE beauteous and orderly Configuration of theſe little Seeds makes them a very pleaſant Object for the Microſcope. They reſemble a good deal in Shape the *Nautilus* or *Sailor-Shell*, being curled round in the Manner of a Spiral; at the larger End whereof, which repreſents the Mouth or Opening of the Shell, there appears a ſmall white tranſparent Subſtance, like a Skin, as repreſented by B B B B B. The whole Surface is covered over with Abundance of little Protuberances, very regularly diſpoſed in ſpiral Rows, each of which ſeems nearly to reſemble the Wart on a Man's Hand. The Inſide, when cut open, appears filled with a whitiſh-green pulpy Subſtance. Purſlain-Seeds.

There are divers Kinds of Seeds which imitate the Shape of much larger Bodies: The Seed of *Scurvy-Graſs* nearly reſembles the Form of a *Concha Venerea*, or Sort of *Porcelain Shell:* Thoſe of *Sweet-Marjoram* and *Pot-Marjoram* repreſent Olives. *Carrot-Seeds* are like the Cleft of a Cocoa Nut Huſk: The Seeds of *Succory* like a Quiver full of Arrows: Thoſe of the *Amaranthus* are delicately formed, ſomething like the Eye; and the black ſhrivell'd Seeds of *Onions* and *Leeks* are granulated all over in the manner of a Seal-ſkin. The Mention of theſe is ſufficient to excite Curioſity to examine farther; and a little Examination will diſcover numberleſs more Reſemblances.

It is wonderful to obſerve by what various Means Providence guards and ſecures the Seeds of Vegetables from Danger and Deſtruction, in order to propagate, and, as it were, eternize every individual Species. Some, as the Kernels of Apples and Pears, are placed in the Middle of a large Pulp, whoſe Subſtance both infolds and nouriſhes them: Others, beſides the ſurrounding Pulp, are incloſed in thick Shells of Wood, as Plumbs, Peaches, Nectarines, Apricocks, *&c.* Walnuts are guarded with a bitter Rind as well as a woody Shell; and Almonds, Cheſnuts, *&c.* have a Covering armed with ſharp Prickles, to preſerve them from Injury till they arrive at Maturity. Peaſe, Beans, Lentils, *&c.* grow in Pods: The Seeds of Mulberries, Raſpberries, *&c.* are placed in the little pulpy Grains of their Berries; and amongſt the moſt minute Seeds, ſome are covered with a Skin, others with a kind of Shell, and others ſtill with both.

Notwithſtanding the extreme Minuteneſs of many Kinds of Seeds, ſuch as *Fern*, *Harts-Tongue*, *Maiden-Hair*, and particularly of the *Puff-Ball*, which growing within it, ſeems, when the Ball is cruſhed, only like a Smoke or Vapour, but examined by the Microſcope, appears to be an infinite Number of Globules, whoſe Axis is not above the fiftieth Part of the Diameter of an Hair: So that a Cube of an Hair's-Breadth in Diameter, would be equal to an hundred and twenty five thouſand of them, each with a little Stalk or Tail. I ſay, notwithſtanding this extreme Minuteneſs, it is thought not an unreaſonable Suppoſition, that a little *Plantula*, or all the Parts of a perfect Plant, are folded together and included in every one of theſe little Grains; where, on being diſpoſed in Earth, or ſome other proper Bed, the Parts become unfolded and expanded, gradually, by a ſlow and progreſſive Inſinuation of Fluids adapted to the Diameters of their Veſſels; until, being ſtretched to the Bounds allotted them by Providence at their Formation, they reach their State of Perfection, or, in other Words, arrive at their full Growth.

MALPIGHI, LEEUWENHOEK, GREW, and ſeveral others, have diſcovered minute Plants, not only in the larger Seeds, ſuch as the Walnut, Cheſnut, Acorn, Beech-Nut, Seed of the Lime, Cotton-Seeds, *&c.* but alſo in the ſmaller of Radiſh, Hemp, Chervil, Scurvy-Graſs, Muſtard, *&c.* And we find in the *Philoſophical Tranſactions*, N° 457, an Account delivered to the *Royal Society*, by Mr. HENRY BAKER, Fellow of the ſaid Society, of a perfect Plant, found by Diſſection, in a Seed of the *Gramen tremulum*, with its Root and two Branches iſſuing from it, each of them producing ſeveral Leaves or Blades of Graſs: All which he preſented in a Slider, to be preſerved in the *Society*'s Repoſitory; together with a Drawing of them, which is printed in the ſaid *Tranſaction*. As therefore we have Demonſtration that ſuch minute Plants are to be found in many Seeds, we may reaſonably believe they really exiſt in all, however they may be concealed from our View, either by their Smalneſs, or the Manner of their fine Branchings or Ramifications amongſt the farinaceous or woody Parts of the Seed, which perhaps we never can develop; for Nature is uniform in all her Works, and ſeldom or never deviates from her general Plan.

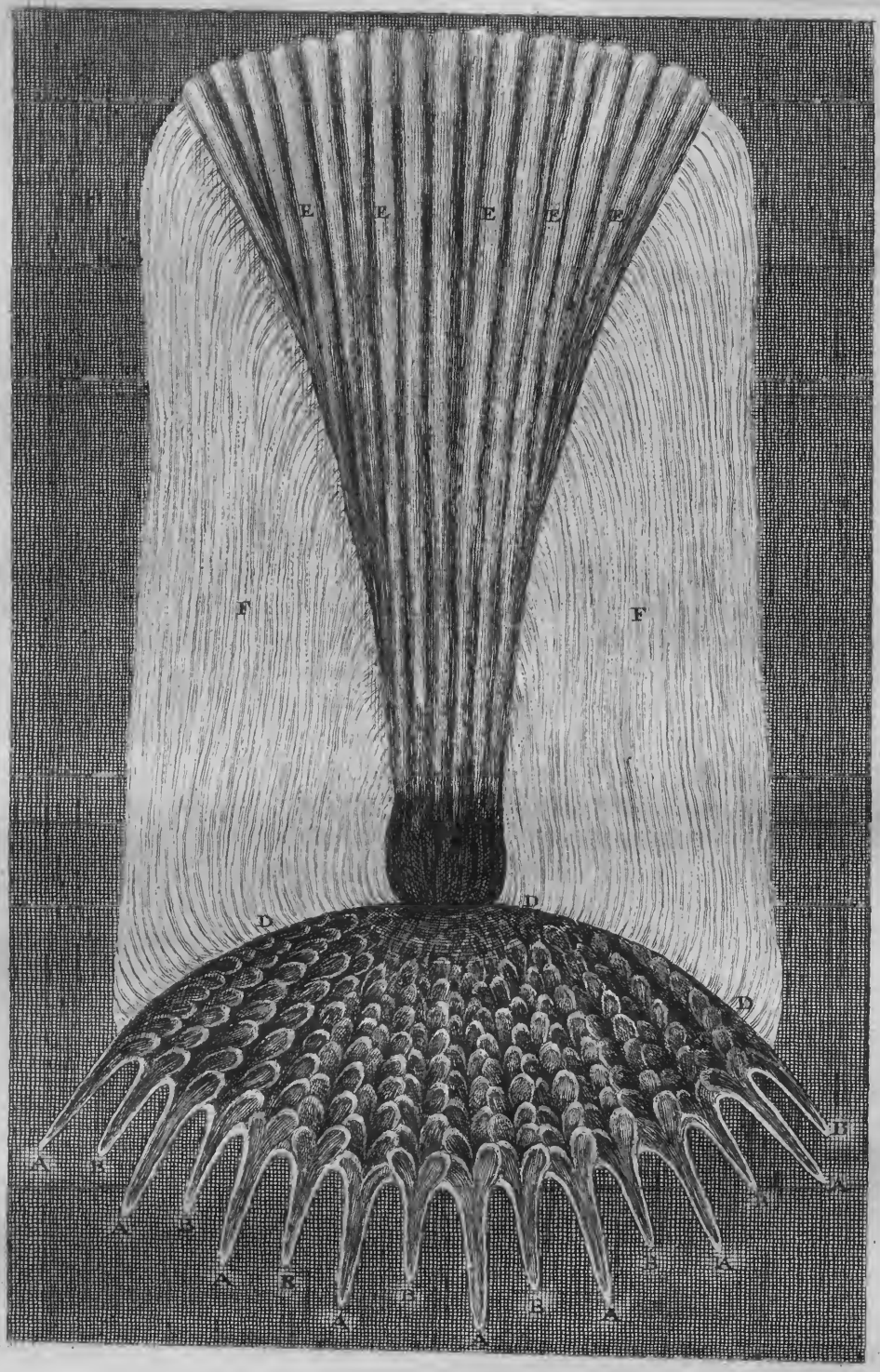
Mr. BAKER juſt now mentioned, in a *Poem* of his called the UNIVERSE, publiſhed ſome Years ago, has ſome Lines ſo pertinent to this Subject, that we ſhall take the Liberty to ſubjoin them here.

Each Seed includes a Plant: that Plant, again,
Has other Seeds, which other Plants contain.
Thoſe other Plants have all their Seeds, and, Thoſe,
More Plants, again, ſucceſſively, incloſe.
Thus, every ſingle Berry that we find,
Has, really, in itſelf whole Foreſts of its Kind.
Empire and Wealth one Acorn may diſpenſe,
By Fleets to ſail a thouſand Ages hence:
Each Myrtle-Seed includes a thouſand Groves,
Where future Bards may warble forth their Loves.
So ADAM's *Loins contain'd his large Poſterity,*
All People that have been, and all that e'er ſhall be.
Amazing Thought! what Mortal can conceive
Such wond'rous Smalneſs!----Yet, we muſt believe
What Reaſon tells: for Reaſon's piercing Eye
Diſcerns thoſe Truths our Senſes can't deſcry.

An

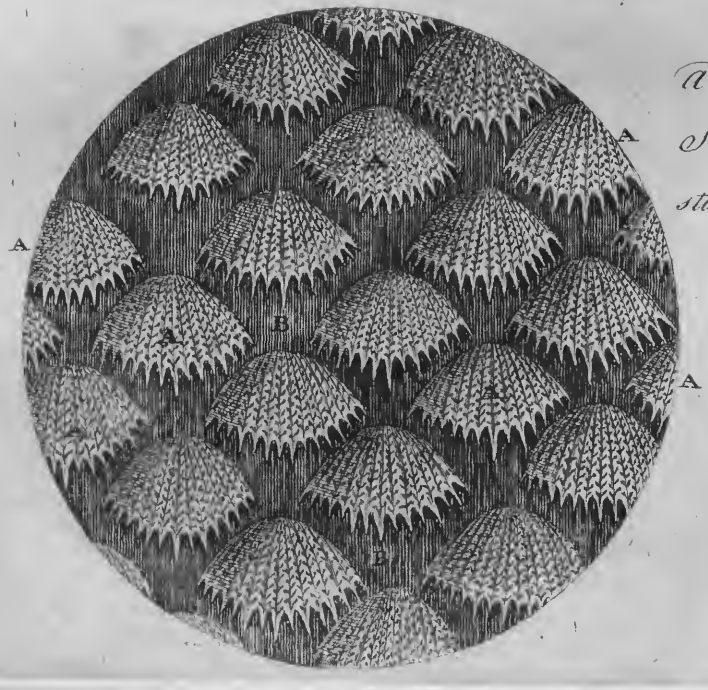
Plate XVII

Fig. 1.
The Scale of a Soal Fish
p. 29.



Four Times the Natural Bigness.
p. 29.

Fig. 2.



A Peice of the Skin of a Soal Fish with the Scales sticking therein. p. 29.

An Explanation of the Seventeenth Plate.

FIG. 1.

The Scale of a Soal.

Scale of a Soal.

ON drawing the Finger along the Skin of a Soal, from the Tail upwards, we ſhall feel a Roughneſs that ſomewhat reſiſts its Motion; the Cauſe of which will be explained by the Object now before us.

This Figure repreſents the Scale of a Soal, plucked from the Skin, and viewed through a pretty large Magnifier. Its Shape is a Sort of oblong Square; that End within the Skin terminating circularly, and the other which comes out being armed with ſeveral ſharp Prickles; every other of which A A A A is much longer than the intermediate ones B B B B.

Theſe Prickles are ſtrong and ſharp, and of a tranſparent Subſtance, having waved and indented Ridges running from them, with Furrows or Channels between thoſe Ridges, appearing extremely pretty. The two outermoſt Prickles on either Side, *c c*, extend wider than the Scale; and the ſemicircular Line, from their Points round by the Letters D, D, D, deſcribes all that Part of it which riſes out of the Skin, the other and much greater Part ſticking faſt and being buried in it. The Number of Prickles differs according to the Place whence the Scale is taken.

From the Middle of the Part above deſcribed, to the End of the Part within the Skin, are a Number of ſmall Quills or Pipes, E E E E, which probably convey Nouriſhment to the whole. Theſe diminiſh gradually in Length on either ſide towards the Extremity, but ſpread, in Width, and form thereby a kind of fan-like Figure, which ſeems as it were fluted.

The two Sides F F, conſiſt of a more fibrous Texture, having numberleſs little Ridges and Furrows, alternately, running parallel to each other, in a Curve-Direction at either End, though nearly ſtrait about the Middle. The whole Scale appears griſly and tranſparent, but more particularly ſo in the little Channels between the Ridges: and all the Scales are pretty much like this, but not exactly ſo; for thoſe growing on different Parts of the Fiſh differ from one another as well in Size as in many other Particulars unneceſſary to mention here. G ſhews this ſame Scale about four times its natural Bigneſs.

PLATE XVII. FIG. 2.

A Piece of the Skin of a Soal.

Soal's Skin.

THE Skin being flead off from a pretty large Soal, and afterwards expanded and dried, the Inſide thereof appeared to the naked Eye very like a Piece of Canvas; but the Microſcope diſcovered that ſeeming Texture to be nothing elſe but the inner Ends of thoſe curiouſly ſcallop'd Scales, which have been juſt now deſcribed in the former Figure: that is, the Ends of the Scales about E E E E were plainly viſible by that Inſtrument, on the Back-ſide of the Skin, lying over one another like the Tiles upon an Houſe.

The Outſide of the Skin preſented nothing more to the naked Eye than the uſual Manner of arranging the Scales in a triangular Order; but ſeen through a Microſcope, it exhibited a moſt curious and ſurpriſing Appearance; the Scales A A A A A, being deeply faſtened in the Skin B B, as the Figure before us ſhews.

As no Object is more common than the Scale of a Soal amongſt thoſe prepared in Sliders, and ſold by the People that make Microſcopes, it is known almoſt by every Body; and the ſharp prickly End is almoſt as generally imagined to be what ſticks within the Skin, and the other what comes out of it; the quite contrary to which is here demonſtrated to be true.

The Skin and Scales on the Belly of a Soal are white, but on its Back of a greyiſh or Lead-Colour: The general Structure of the Scale is, however, the ſame on both Back and Belly, tho' there are particular Differences needleſs to be mentioned here; but the lead-colour'd ones on the Back are ſpeckled very prettily with great Numbers of black minute Specks.

The Scale of a *Perch*, tho' of a different Figure, has a Number of ſharp Prickles ſtanding out like thoſe on the Soal's Scale.

There is almoſt an infinite Variety in the Scales of Fiſhes, which ſeem analogous to the Feathers of Birds, and can't fail to afford Abundance of Entertainment and Satisfaction to thoſe who will take the Pains attentively to examine them.

An EXPLANATION of the EIGHTEENTH PLATE.

FIG. 1.

Couhage, or Cow-Itch.

Cow-Itch.

THE *Phaſiolus ſiliqua hirſuta*, or *Hairy Kidney-Bean*, called in the *Eaſt-Indies* where it grows *Couhage*, is a Plant producing Pods like the common *French* Bean, but cluſter'd more together, and covered all over with ſhort brown Hairs; ſome of which being rubbed on the Back of one's Hand, or any other tender Part, cauſe a kind of painful Itching, troubleſome for a Time, but going off without any farther Miſchief. Theſe Hairs, wherewith waggiſh People divert themſelves ſometimes at the Expence of their Companions, by ſtrewing them on their Shirts or between their Sheets, are by Corruption uſually called *Cow-Itch*.

One of theſe Pods, about three Inches long, having ſix Beans in it, Dr. HOOKE ſays was given him by a Sea-Captain. The whole Surface thereof was covered over with a thick and ſhining brown Down or Hair, which was very fine, and ſtiff for its Size. Rubbing ſome of this Down on the Back of his Hand, he found little or no Trouble therefrom at firſt, though he was ſenſible many of the ſharp Points were made to penetrate pretty deeply into the Skin; which made him doubtful whether it was the true *Couhage*. But ſoon after his Hand began to itch, and ſmarted in ſome Places, as if ſtung with a Flea or Gnat. This continued a pretty while, and by Degrees the Skin ſwelled with little red Puſtules: but enduring it without either ſcratching or rubbing, the Pain abated gradually, and was quite gone within an Hour, as were likewiſe the little Puſtules.

He then examined this Down by his Microſcope, and found it to be a Multitude of ſmall ſlender Bodies much reſembling Needles, ſuch as are repreſented by A B, C D, E F. They appeared very tranſparent, and ſeemed to be not hollow, tho' of that the Doctor could not be quite certain. Their Extremities A A A were very ſharp, ſtiff and hard, like the Subſtance of ſome Kinds of Thorns, and therefore being exceedingly minute they muſt eaſily by rubbing be thruſt into the tender Parts of the Skin, and occaſion quick and pungent, though not a violent Pain, which is the very Senſation we call Itching, and what even Horſe-Hairs ſhred ſmall, and ſtrewed between the Sheets will produce.

There may probably be more than one Sort of the *Couhage*, or perhaps the *Doctor* did not examine his with any conſiderable Magnifier: for having ſome of it at this preſent time under one of the greateſt Magnifiers, in order to give a juſt Deſcription thereof, (which is the Method taken as often as the Objects can be got, to render theſe Accounts exactly agreeable to Truth) there are many minute *Spiculæ* plainly to be diſcerned on every Side of the little Hairs, pointing backwards like the Beards of a Javelin; by which Conformation when once they enter they cannot eaſily be withdrawn.

We have in our own Gardens ſome Species of the *Phaſioli*, the Pods whereof are covered like the *Couhage* with brown Hairs; which if rubbed on the Skin, when the Pods are full ripe, and the Hairs themſelves grown ſtiff and hard by being dry, produce nearly the ſame Effects; though when green and moiſt they are ſoft and pliable, and entirely harmleſs. Of this Nature are the *Lupines*, yellow, blue, and white, and likewiſe the *ſweet-ſcented* or *perfumed Peaſe*.

PLATE XVIII. FIG. 2.

The Sting of a Bee.

Sting of a Bee.

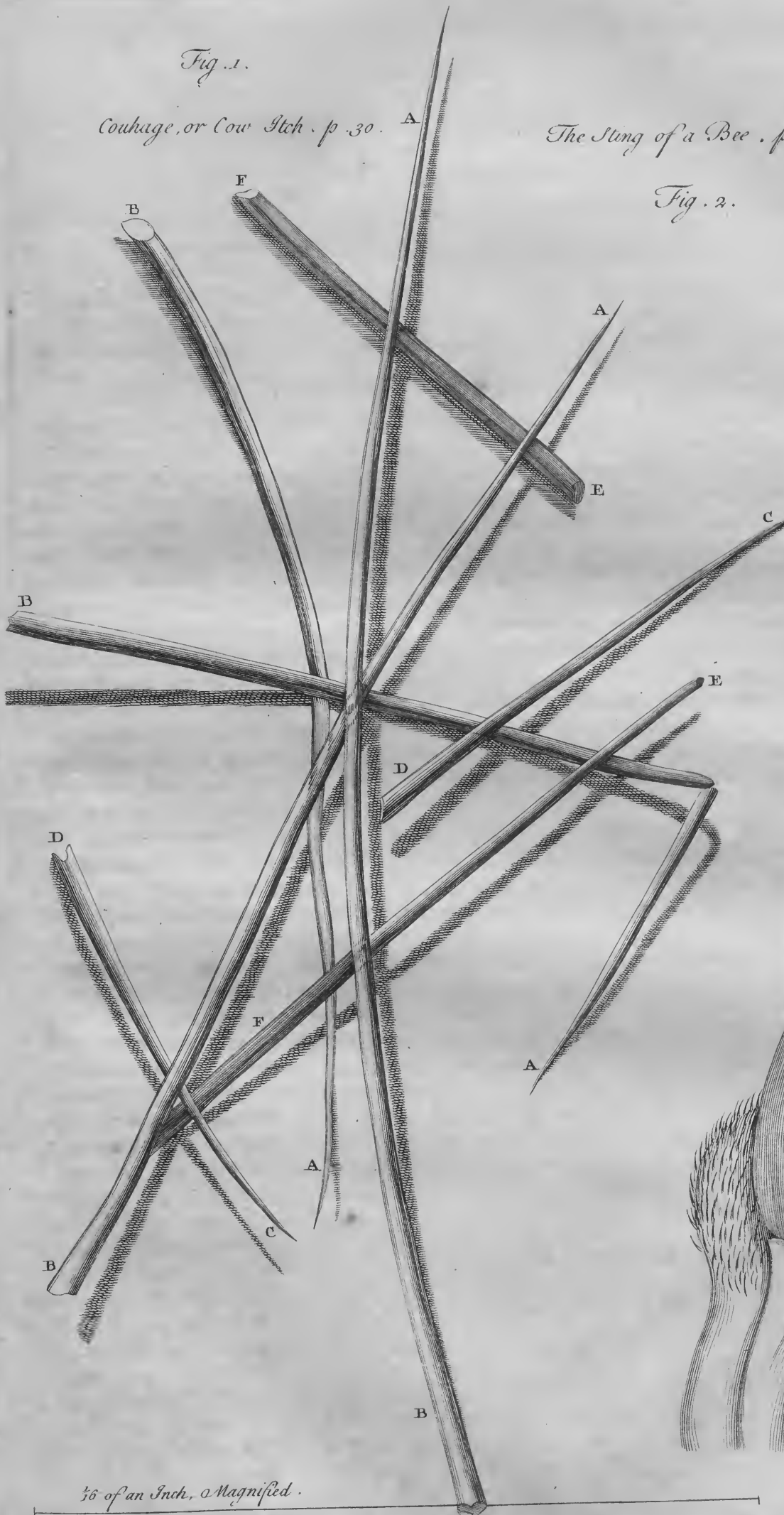
A Bee's Sting, the Doctor tells us, appears through the Microſcope to be a Sheath without a Chape or Top, in Form like the Holſter of a Piſtol, beginning at *d*, and ending at *b*; which Sheath he plainly diſtinguiſhed to be hollow, containing a Sword or Dart within it, together with a poiſonous Liquor, which being conveyed into the Wound it makes, occaſions a moſt ſevere Pain.

This Sheath or Caſe appeared to have ſeveral Joinings marked 1, 2, 3, 4, 5, 6, 7, and was armed near the Top on both ſides with ſeveral ſharp tranſparent Thorns, Hooks or Beards, growing out of little Protuberancies, as repreſented *p p*, *q q*, *r r*, *ſ ſ*, *t t*, *v v*: Which Hooks the Creature ſpreads out, or draws in, occaſionally, as a Cat does her Claws.

The Sword or Dart which is lodged within the Sheath, appeared as in the Figure, with its ſharp End *a b* protruded beyond the ſaid Sheath like a Sword in a Scabbard without

Fig. 1.

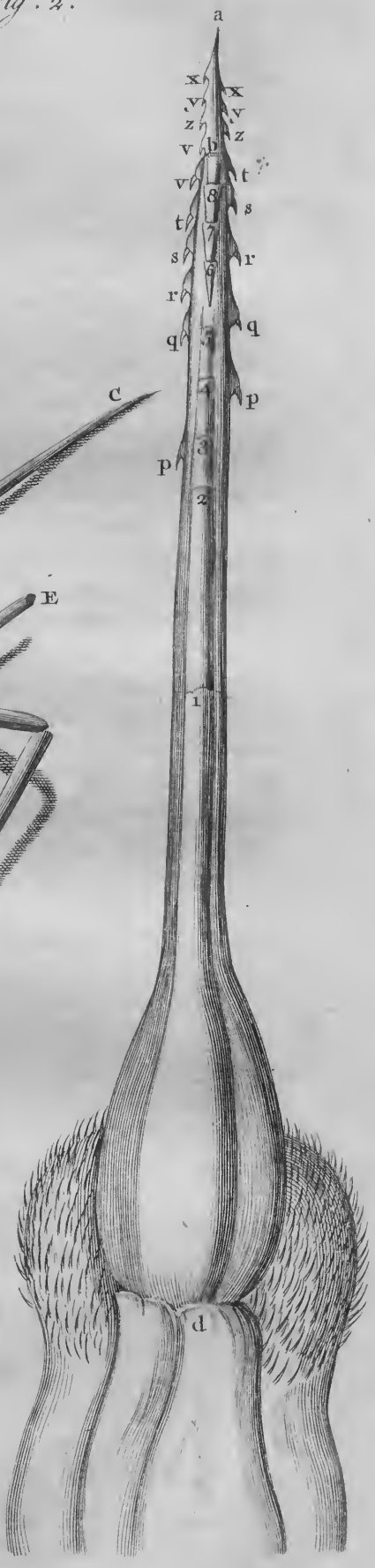
Couhage, or Cow Itch. p. 30.



1/16 of an Inch, Magnified.

The Sting of a Bee. p. 30.

Fig. 2.



without a Chape. This Point was likewiſe armed on both ſides with Thorns or Hooks, *x x*, *y y*, *z z*, exactly like thoſe before deſcribed; which can alſo be extended or pulled in juſt as the Creature pleaſes.

Such a Structure ſhews the Uſe of the Hooks to be very conſiderable towards thruſting in the Sting as well as fixing it. For the Point, which is extremely ſharp, being thruſt eaſily into the Skin of any Animal, the Bee (when once 'tis entered) by endeavouring to pull it back into the Sheath (whilſt its Hooks on either Side lay faſt hold on the Skin) draws the Top of the Sheath into the Skin after it; and then the fixing of the Hooks on both Sides the Sheath, *p p*, *q q*, *r r*, &c. into the Skin, not only keeps the Sheath from ſliding back, but furthers its Paſſage inwards; and thus, by an alternate and ſucceſſive retracting and emitting of the Sting in and out of the Sheath, the little angry Creature can penetrate by Degrees even the tough Hide of a Bear, one of its moſt deadly Enemies. This Sort of Motion to and fro, does alſo perhaps pump up the poiſonous Juice, and make it hang in a Drop at the End of the Sheath *b*. And theſe Hooks are probably the Reaſon why a Bee, when haſtily driven away upon ſtinging, frequently leaves its Weapon ſticking in the Fleſh, thereby cauſing the painful Symptoms to be greater and more laſting.

We ſee here the Subſtance of what Dr. *Hooke* ſays concerning a Bee's Sting; but later Obſervers have found ſome Miſtakes in his Account, for no Beards are really to be diſcovered on the Sheath or Caſe, which on the contrary is perfectly ſmooth and poliſhed; neither has it any Joints, or is parted in two, as his Figure makes it; nor does it terminate in a bluntiſh Point, but a very ſharp one: Neither is the bearded Weapon always ſticking out beyond the Sheath, as he repreſents it, nor indeed does it ever come out at the very Extremity, but at an Orifice below it, and that only in the Act of ſtinging. This Part alſo is greatly miſrepreſented, for a Couple of *bearded Spears* or *Darts* are included within the Sheath, whereas he ſuppoſes no more than one; the Beards too are placed only on one Side of each Dart, and not all round them. But as a full and true Deſcription may be deſired by ſome Readers, 'tis hoped what follows, taken from the *Microſcope made eaſy*, will not be thought ſuperfluous.

" The Sting of a Bee is a horny Sheath or Scabbard that includes two bearded Darts. " This Sheath ends in a ſharp Point; near the Extremity whereof a Slit opens, through " which, at the Time of Stinging, *two bearded Darts* are protruded beyond the End of " the Sheath; one whereof being a little longer than the other, fixes its Beard firſt; but " the other inſtantly following, they penetrate alternately, deeper and deeper, taking hold " of the Fleſh with their Hooks, till the whole Sting becomes buried in the Wound; " and then a venomous Juice is injected through the ſame Sheath, from a little Bag at " the Root of the Sting; which occaſions an acute Pain, and a ſwelling of the Part, " continuing ſometimes ſeveral Days. This is beſt prevented by enlarging the Wound " immediately to give it ſome Diſcharge."

" Mr. *Derham* ſays, he counted in the Sting of a Waſp, eight Beards on the Side " of each Dart, ſomewhat like the Beards of Fiſh-Hooks, and the ſame Number has been " obſerved in that of a Bee. When theſe Beards are ſtruck deep in the Fleſh, if the " wounded Perſon ſtarts before the Bee can diſengage them, ſhe leaves her Sting behind, " ſticking in the Wound: But if he has Patience to ſtand quiet till ſhe brings the Hooks " cloſe down to the Side of the Darts, ſhe withdraws her Weapon, and the Wound " becomes much leſs painful.

" To view the Sting of a Bee by the Microſcope, cut off the End of its Tail, and " then touching it with a Pin or Needle, it will thruſt out the Sting and Darts, which " may be ſnipt off with a Pair of Sciſſars for Obſervation. Alſo, if you catch a Bee in " a Leather Glove, its Sting will be left therein, being unable to diſengage its Hooks " from Leather: And when it is quite dead, which it will not be till after ſeveral Hours, " you may by Care and Gentleneſs extract it with its Darts and Hooks. By ſqueezing " the Tail, pulling out the Sting, and preſſing it at the Bottom, you may likewiſe force " up the Darts: But without ſome Practice this will be a little difficult."

The Bag containing the poiſonous Juice may eaſily be found at the Bottom of the Sting, being commonly pulled out with it.

An EXPLANATION of the NINETEENTH PLATE.

The Figures in this Plate *ſhew the Conſtruction of the Feathers of Birds.*

FIG. 1.

A minute Part of a Gooſe's Feather.

A Gooſe's Feather.

A Middle-ſized Gooſe-Quill being examined by the naked Eye, it was eaſy enough to diſtinguiſh, that the main Stem ſent forth on either ſide about three hundred little *Arms:* Thoſe on the one ſide being longer and more downy; thoſe on the other much more ſtiff and ſhort. Many of the downy longer *Arms* being viewed with an ordinary Microſcope, were found each of them to have along one of its upper Edges near twelve hundred ſmall *Branches*, (if we may ſo call them) ſuch as E F; and on its other Edge, the ſame Number as L, I.

'Tis here proper to take notice, that each of the little *Arms* is of a tapering Shape from its iſſuing out of the Stem to its Extremity, where it ends in a fine Point; that it is not a round Body, but reſembles the Half of a long Cone, being concave on one ſide, and on the other convex, its Breadth making an acute Angle with the Length of the Stem: That the middle or moſt convex Part is fine and membranous, its Under-Edge being an extremely ſmooth and thin *Film*; but the *upper* and *outer Edge* ends flat, and thereby forms two other *hairy Edges*, each having a different Sort of *Hairs*, laminated, or ſomewhat broad at Bottom, but ſlender and bearded upwards.---*Note*, The Concavity of the Arms makes them readily fall into one another.

The flat upper Edge, and the two Edges made thereby, are ſhewn by a tranſverſe Section I N O E, and the two Kinds of *Hairs* or little *Branches* by E F, L I.

Each of the *Branches* E F ſeemed to have ſixteen or eighteen Joints, out of which ſmall long *Fibres* or *Tendrils* iſſued, gradually longer or ſhorter than one another, according to their Poſition along the Branch E F; thoſe on the Under-ſide, *viz.* 1, 2, 3, 4, 5, 6, 7, 8, 9, *&c.* being much longer than thoſe directly againſt them on the Upper, and ſeveral of them as 3, 4, 5, 6, 7, 8, 9, were terminated with ſuch ſmall Hooks, as are viſible to the naked Eye on the Seed-Buttons of the Bur-dock.

The Fibres on the other Edge L I appeared with near as many knotted Joints, but without any Tendrils or Hooks, each of them about the Middle K ſeeming to divide into a Kind of Fork; one Part whereof, namely K L, was nearly the ſame Length as K I; the other M was very ſhort.

PLATE XIX. FIG. 2.

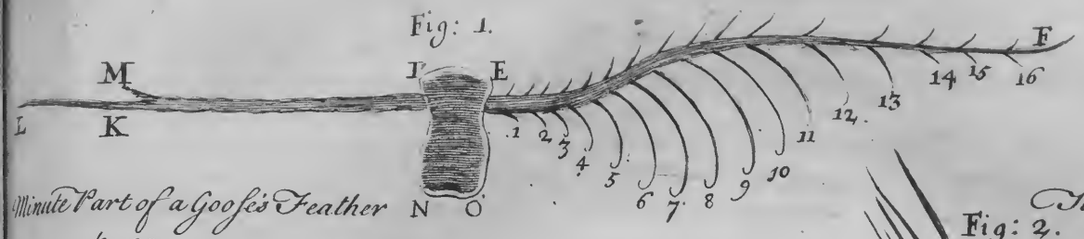
Two Parts of a Gooſe's Quill.

THE wonderful Structure of the Parts juſt now deſcribed, deſerves the moſt ſerious Attention and Conſideration as to their Uſe: In order to explain which the more readily, the Figure under our Eye was given.

We ſee here two Pieces of the downy Arms I N, E O, placed, as to one another, in the ſame manner as they appear upon the Quill, at the Diſtance of I F, or ſomewhat more. The collateral Branches *a a a a*, *b b b b*, are ſo ranged that they lie upon and croſs over one another; by which means the hooked Ends of the Tendrils on the Branches of one Arm, getting between the naked Branches of the Arm next to them, which are full of Knots, the Hooks of the Tendrils claſp round thoſe Knots, and faſten all the Parts ſo cloſely and admirably together, as to hinder even the Air from paſſing through them. And though the Thickneſs of one of theſe Tendrils amounts not to the five hundredth Part of an Inch, they all together form ſo ſtrong a Texture, that the exceeding quick and violent beating of them againſt the Air by the Strength of the Bird's Wing, is unable to disjoin them.

The Contrivance and Fabrick of the numberleſs little Parts which conſtitute a Feather, taken either ſeparately or together, ſtrongly prove the Wiſdom of Providence, and its Care of all its Creatures, even in the minuteſt Matters; for their Contexture is ſuch, that if the component Parts ſhould be violently disjoined by any external Injury, (ſeveral of which Separations would prevent the Bird from flying) they for the moſt part, by a kind

Fig: 1.



Minute Part of a Goose's Feather p. 32.

Two Parts of a Goose's Feather. p. 32

Fig: 2.

The Construction of Feathers. p. 32.

Minute Peice of a Peacocks Feather p. 33.

Fig: 3.

Fig 4.

Minute Parts of a Feather

Fig: 5.

$\frac{1}{32}$ of an inch

kind of Springineſs or Elaſticity readily come together of themſelves, and re-unite. Or elſe by the Birds ſtroaking the Feather, or drawing it through its Bill, they all become ſettled and woven into their former and natural Poſture. In ſhort, there are ſuch an infinite Company of hooked Tendrils ready to catch hold of the jointed Fibres, that they muſt neceſſarily hang together whenever they come to meet; and though the Square Holes, which they form by croſſing over one another, and which are viſibly open and pervious, appear by the Microſcope to be more than half the Surface of the Feather, it ſeems reaſonable to believe, however extraordinary, that the Air does not paſs through them.

PLATE XIX. FIG. 3, 4, 5.

Parts of a Peacock's Feather.

A Peacock's Feather.

'TIS plain, by the naked Eye, that the Stem of each Feather in the Tail of a Peacock, ſends out Multitudes of *lateral Branches*; and that each of theſe *lateral Branches* has innumerable little *Sprigs*, *Threads* or *Hairs*, iſſuing on either Side of it, from End to End.

The Figure before us ſhews about the thirty-ſecond Part of an Inch in Length of one of theſe *lateral Branches*, as examined by the Microſcope.

A, B. Point out the middle or ſtem-like Part cut off at both Ends.

CD, CD, CD, Repreſent the *Hairs* or *Threads* iſſuing therefrom, each of which appears to be a long Body, of ſome Breadth, with a Multitude of bright reflecting Parts, whoſe Form and Shape cannot eaſily be determin'd, ſince they change continually, and ſeem very different in different Poſitions to the Light: nay, only interpoſing one's Hand between them and the Light, or even putting up or pulling down a Saſh very much changes their Appearance. However, by frequent Examinations, compared with one another, 'tis hoped the true Figure is here determin'd.

Theſe Threads are found, therefore, to conſiſt of Rows of ſmall *Laminæ* or *Plates*, ſuch as EEEE: each of which is ſhaped much like *Fig.* 4, *a b c d:* where the Part *a c* being a Ridge or little Stem, and *b*, *d*, the Corners of two ſmall thin Plates growing from the ſaid Stem in the Middle, make together a Kind of little Feather. Theſe little Plates or Feathers lie cloſe to, and partly over one another, like a Number of ſloping ridge or gutter Tyles. They grow oppoſite to one another, on each Side of the Stem, by two and two, from Bottom to Top; the Tops of the lower covering the Roots of the next above them, in the Manner repreſented *Fig.* 5.

Each of theſe laminated Bodies is on the under Side of a very opake Subſtance, that ſuffers very few Rays to be reflected; but their upper Sides, conſiſting of exceeding thin Plates, lying cloſe together, do thereby, like Mother of Pearl, not only reflect a very bright Light, but tinge that Light in a moſt curious Manner; and, by means of various Poſitions in reſpect of the Light, they reflect back now one Colour, and then another, and that moſt vividly. And hence we may account for all the gaudy and beauteous Colours which adorn the Feathers of this and many other Birds: Namely, from the exceeding Smallneſs and Fineneſs of the reflecting Parts.

An EXPLANATION of the TWENTIETH PLATE.

FIG. 1.

The Foot of a Fly.

A Fly's Foot. THE Foot of a Fly is the Object now before us, conſiſting of three Joints, two Talons, and as many Pattens, Soles, or Spunges, as they are called by ſome: By the wonderful Contrivance of which Inſtruments this Creature is enabled to walk perpendicularly upwards, even againſt the Sides of Glaſs; nay to ſuſpend itſelf, and walk with its Body downwards, on the Ceilings of Rooms, and the under Surfaces of moſt other Things, with as much ſeeming Facility and Firmneſs, as if it were a kind of *Antipode*, and had a Tendency upwards: but the quite contrary is evident from its being unable to ſuſpend itſelf on the under Surface of a clean and well-poliſh'd Glaſs.

The two Talons are handſomely ſhaped, in the Manner repreſented A B, and A C, and are very large in Proportion to the reſt of the Foot. The bigger Part of them from A to *d d*, is briſtled or hairy all over, but from thence towards C and B, the Tops or Points which turn downwards and inwards, are ſmooth and very ſharp. Each Talon moves on a Joint at A, whereby the Fly is able to ſhut or open them at Pleaſure: So that the Points B, and C, having enter'd the Pores of any Thing, and the Fly endeavouring to ſhut its Talons, they not only draw againſt, and by that means faſten each other, but alſo pull forwards all the Parts of the Foot G G, A, D D: and at the ſame Time the Tenters or ſharp Points G G G G (whereof a Fly has two at every Joint) run into the Pores, if they find any, or, on a ſoft Place, make their own Way.

Somewhat of this Kind may be diſcerned by the naked Eye in the Feet of a *Chafer*, and if it be ſuffered to creep over the Hand or any tender Part of the Body, its Manner of Stepping will be as ſenſible to the Feeling as to the Sight.

But as the *Chafer*, notwithſtanding this Contrivance to faſten its Claws, often falls when it attempts to walk on hard and cloſe Bodies, ſo likewiſe would the Fly, had not Nature furniſh'd his Foot with a couple of Pattens or Spunges D D, which we are now going to deſcribe.

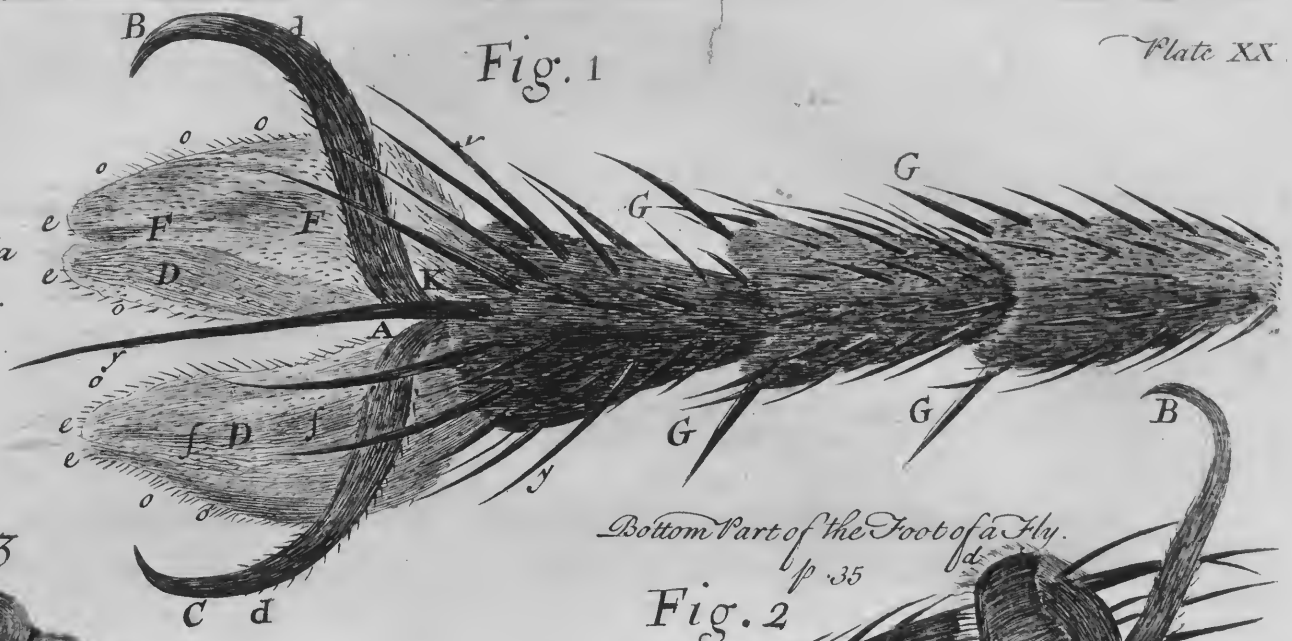
From the Bottom or under Part of the laſt Joynt of the Foot K, two ſmall thin plated horny Subſtances proceed, each conſiſting of two flat Pieces D D. Theſe, about F F, *f f*, ſeem to be flexible like the Covers of a Book; whereby the two Sides *e e*, *e e*, do not always lie in the ſame Plane, but may ſometimes ſhut cloſer, ſo that each of them can take a little hold. But this is not all, for the Bottoms of theſe Spunges are every where beſet with ſmall Briſtles or Tenters, like the Wire Teeth in a *Wool-Card*, with all their Points inclining forwards: by which the two Talons drawing the Foot forwards, as before deſcribed, and the Spunges being applyed to the Surface of the Body the Fly walks upon, with the Points of all their Briſtles looking forwards and outwards, as expreſſed in the Figure *o o o o o*; if the Surface of the Body has any Irregularity, or gives Way in any Manner, the Fly can ſuſpend itſelf, or walk thereon very eaſily and firmly. And its being able to walk on Glaſs, proceeds partly from ſome little Ruggedneſs thereon, but chiefly from a Kind of Tarniſh or dirty ſmoky Subſtance, which adheres to the Surface of that very hard Body; ſo that although the ſharp Points on the Spunges cannot penetrate the Surface of Glaſs, they may eaſily enough catch hold of the Tarniſh it has contracted.

Some indeed have ſuppoſed theſe Spunges filled with an imaginary Glew, which fixes the Fly, in ſuch a Manner as to prevent its falling; but if there was ſuch a ſticky Matter, 'tis not eaſy to conceive how the Feet could ſo readily again be looſen'd, and and move ſo nimbly forwards. And as our Senſes can furniſh us with a rational Way of performing this by the curious Mechaniſm of the Parts employ'd, 'twould be wrong to introduce unintelligible Explications.

y y y are ſome very long, ſtiff, ſharp-pointed Hairs or Briſtles.

Fig.

Fig. 1



The Foot of a Fly. p. 34.

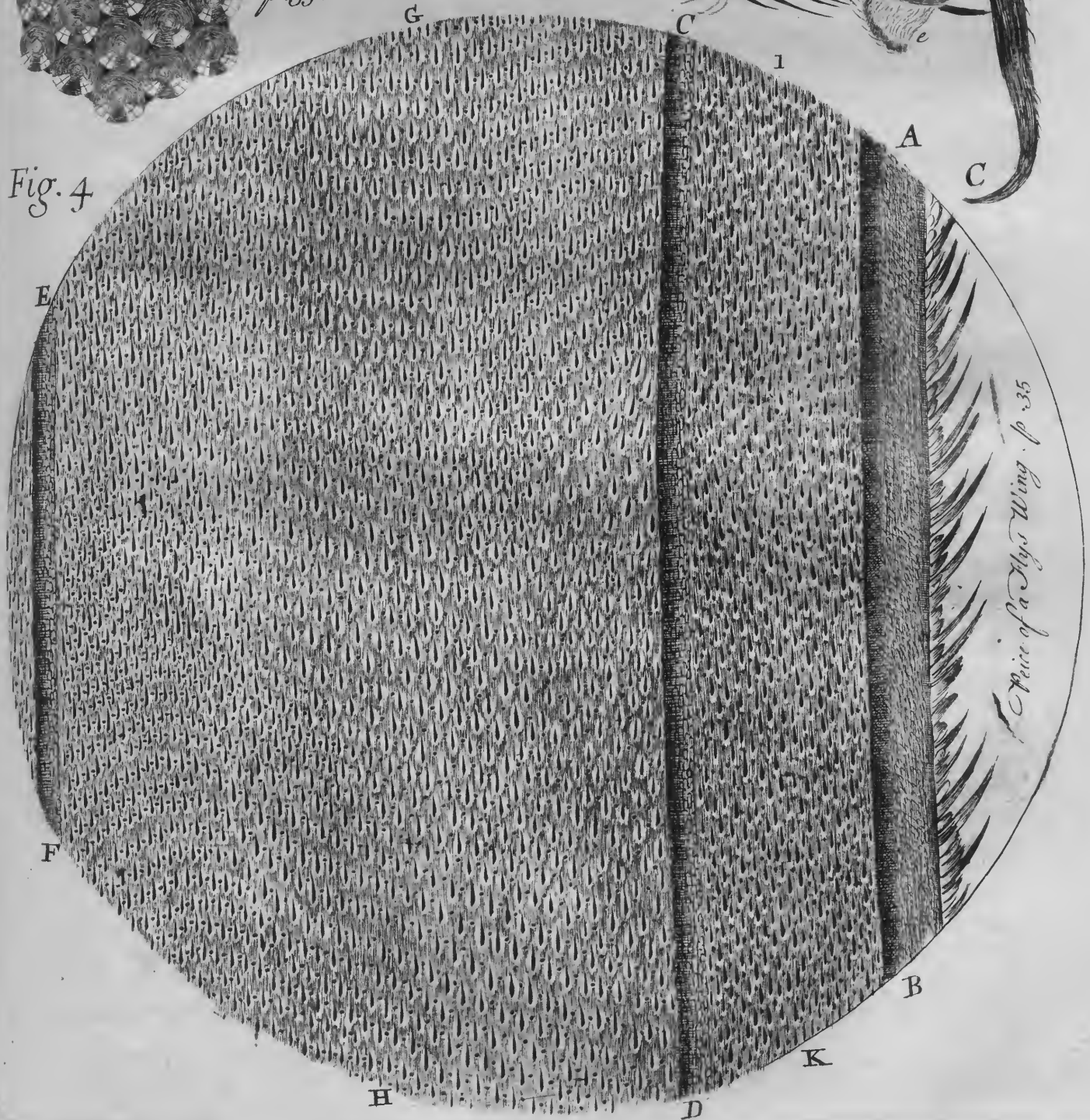
Fig. 3

Part of the Eye of a Fly p. 35.

Bottom Part of the Foot of a Fly. p. 35

Fig. 2

Fig. 4



Pair of a Fly's Wing. p. 35

PLATE XX. FIG. 2.

Another Foot of a Fly.

A Fly's Foot.

THIS ſhews us only the Bottom Joint of the Foot, with the Talons having their hooked Point B C extended, and the Spunges *d e* bending inwards, in order to take hold of any Thing. We ſee alſo more plainly in this Figure the Joints whereby the Talons perform their Motions.

The Foot is likewiſe ſhaded with a Growth of Hairs, which like a Bruſh ſerves to clean the Fly's Wings and Eyes, an Office ſhe employs it in very frequently. And indeed it is a pretty Amuſement to ſee her perform this Exerciſe; for firſt ſhe cleans her Bruſhes, by rubbing her Paws one againſt another, then draws them over her Wings, and afterwards under them; and at laſt concludes with bruſhing her Eyes and Head: by which means ſhe cleans away all little Particles of Duſt or Smoke, that may cloud her Eyes, or ſettle on her Wings.

PLATE XX. FIG. 3.

Part of a Fly's Eye.

Pea of a Fly's Eye.

THIS little Piece of the pearled Eye of a Fly, conſiſting of nineteen Pearls or Hemiſpheres (a particular Deſcription whereof will be given in the next Plate) is here introduced, as it appeared before the Microſcope, to ſhew how perfectly the Images of Objects are reflected from their ſmooth and poliſhed Surfaces, inſomuch that Houſes, Trees, and Landſcapes of every Thing within a certain Diſtance, may be diſcovered on them, in the ſame manner as on the ſmall Balls of Quickſilver, but not near ſo lively. The Reflection from theſe being ſomewhat languid, as it is from Water, Glaſs, Chryſtal, and ſuch-like Bodies.

The Image of two Windows in the Chamber where they were examined, is expreſſed on each of theſe. More will be ſaid in the next Plate concerning the Eyes of Inſects.

PLATE XX. FIG. 2.

Part of a Fly's Wing.

Part of a Fly's Wing.

A Whole Wing (of which this is only a Part) is exhibited *Plate* XXII. *Fig.* 2. to expreſs its Form in general. But the Piece here before us is magnified a great deal more, to afford a clearer Notion of its wonderful Structure and Materials.

It conſiſts plainly of a fine thin tranſparent Skin or Membrane, variouſly folded, platted and diſtended over the whole Area; and ſeveral Bones, Ribs, or Stems, diſpoſed with great Regularity and Contrivance, ſo as to ſtrengthen and ſupport the Wing, and determine its proper Figure.

A B, C D, E F, are the Bones or Ribs of the Wing; each of which is manifeſtly covered with Multitudes of little Scales; and A B, in particular, which is the largeſt Bone of the whole Wing, and may properly enough be called the *Cut-Air*, being that which terminates and ſtiffens the foremoſt Edge of the Wing, is not only covered with Scales lying regularly one over another; but its Fore-Edge is armed with great Numbers of little Briſtles, all the Points of which are directed towards the Tip of the Wing: And even the whole Edge all round the Wing is covered with a ſmall Fringe, conſiſting of ſhorter and more ſlender Briſtles.

G H, I K, The fine Membrane extended between theſe bony Ribs, if examined by the firſt or ſecond Magnifier, and in a clear and proper Light, will be ſeen thickly ſtuck with innumerable minute ſharp-pointed Hairs or Briſtles, ranged in the moſt regular Rows, over its whole Surface; and intermingled with theſe may be perceived a like Number of little Pits or black Spots, which ſeem to be the Roots of the Hairs growing on the other Side.

In ſeveral other Flies, there are infinite Numbers of ſmall Fibres which cover both Sides of this thin Membrane, inſtead of minute Hairs: And on moſt Moths and Butterflies, they don't only reſemble the Feathers of Birds in the Manner of their Arrangement, but are variegated with the ſame kind of curious and lively Colours which the Feathers of Birds exhibit.

An EXPLANATION of the TWENTY-FIRST PLATE.

The Eye and Head of a Drone-Fly.

Face and Eyes of a Drone.

THE Object we are going to describe is the Face-Part (if it may be called so) and Eyes of a grey *Drone-Fly*; whose Head being cut off, and fixed with the Face or Fore-part upwards, before the Microscope, appeared as in the Figure under our View at present.

This Insect is remarkable for having a larger Head in proportion to its Body, and bigger Clusters of Eyes in proportion to its Head, than any of the small Flies: It has also a greater Variety in the Balls or Pearls of each Cluster than Flies commonly have, and therefore was thought the propereſt Subject for Examination as to the Eyes of such-like Creatures.

The greatest Part of the Head consisted of two large semicircular and regular Protuberances or Eyes, A B C D E; the Surfaces of which were covered all over with, or shaped into Multitudes of minute Hemispheres, disposed in a triagonal Order, and in that Order forming exact and equidistant Rows, with little Trenches or Furrows between each.

These Hemispheres were of different Sizes in different Parts of each Eye; the lowermost Half of them looking downwards, *viz.* C D E, C D E, being a great deal smaller than the Half A B C E, A B C E, looking upwards, fore-right, sideways and backwards; a Variety unobserved in any other small Fly.

Every one of these Hemispheres seemed very near the true and exact Shape of an half Globe, with a Surface exceeding smooth and regular; and reflected the Images of Objects, as described before, *Plate* XX. *Fig.* 3.

There were fourteen thousand *Pearls* or *Hemispheres* distinguishable in the Clusters of this Fly, as was computed by numbering some Rows of them several Ways, and casting up the whole Amount; for each Cluster was thereby found to contain about seven thousand Pearls, *viz.* three thousand of the larger Size, and four thousand of the smaller, whose Rows were more thick and close.

Now that each of these *Pearls* or *Hemispheres* is a perfect Eye, there can be little reason to doubt; each being furnished with a *Cornea*, with a *transparent Humour*, and with an *Uvea* or *Retina*: The Figure of each is also very spherical, exactly polished, and exceeding lively and plump, when the Fly is living, as in greater Animals; and likewise, as in them, dull, shrunk, and flaccid, when the Fly is dead.

One of the Clusters being cut from the Head, and opened, a clear Liquor, tho' exceeding little in Quantity, was discovered by the Microscope, immediately under the outward Skin or Covering, which Covering seemed perfectly to resemble the *Cornea* of a Man's Eye; and when a darkish Matter that lay behind was removed, appeared transparent, with as many Cavities within-side, and ranged in the same Order as the little Hemispheres on its outer Surface.

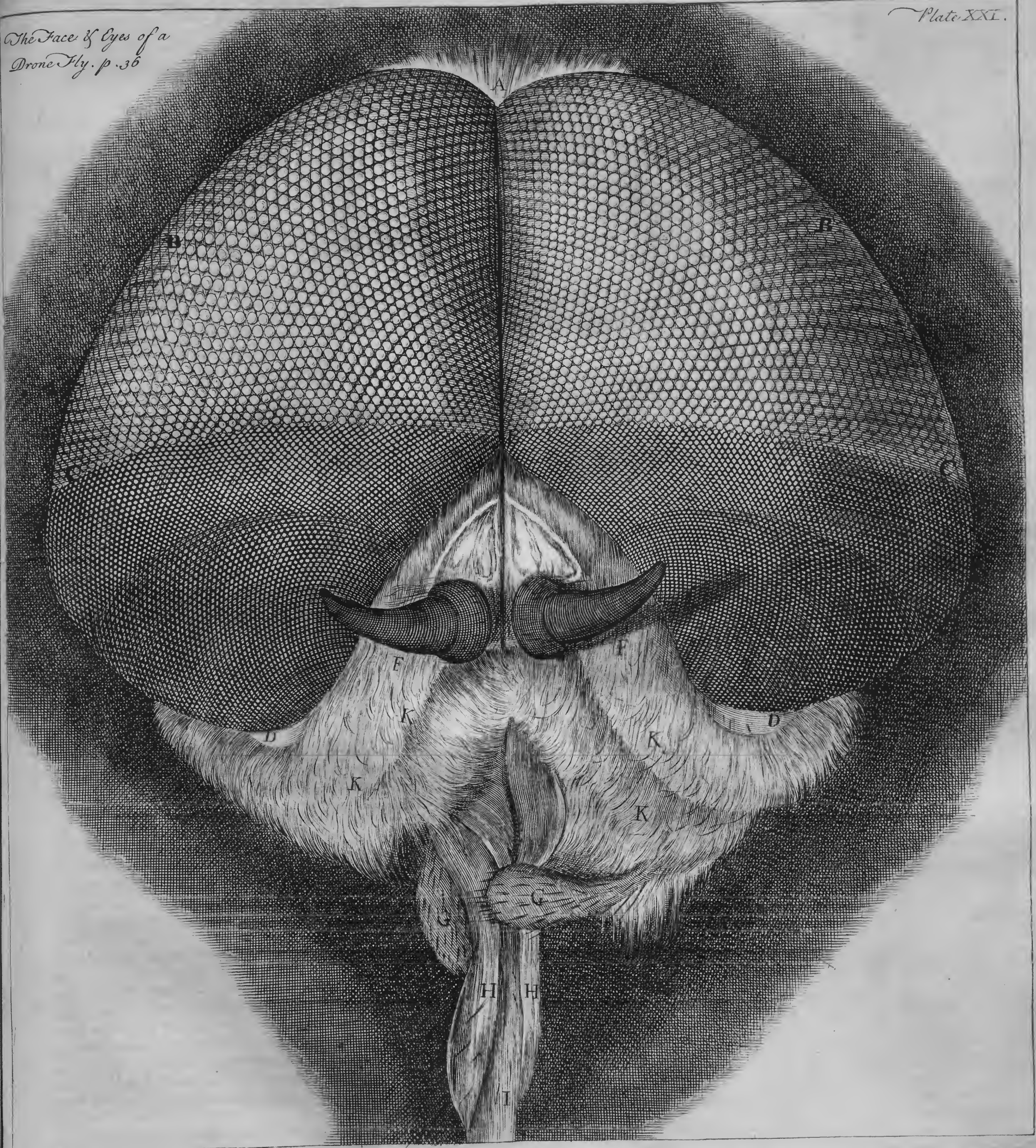
Thus, each of these Pearls or Hemispheres being covered with a transparent protuberant *Cornea*, and containing a Liquor correspondent to the watery or glassy Humours of the Eye, must necessarily refract all the parallel Rays falling on it, into a Point not far within, where probably the *Retina* is placed; which *Retina*, in all likelihood, is that dark opake Matter just now mentioned, appearing by the Microscope to be placed a little more than the Diameter of the Pearl below or within the *Tunica Cornea*. And if *so*, there is in all probability a little Picture or Image of external Objects, painted at the Bottom, upon the *Retina* of every one of these Hemispheres to which such Objects happen to be opposite. But, as in a Man's Eye, though a Picture or Sensation is impressed on the *Retina* of all the Objects lying almost in an Hemisphere, some very few Points only placed in, or near the *Optic Axis*, are discerned distinctly; so Multitudes of Pictures of an Object may be made in as many Pearls, and yet no distinct Vision be produced but in one, or some very few, that are directly, or almost directly opposite to the Object. And notwithstanding it has pleased God to give these Sorts of Creatures such Multitudes of Eyes, 'tis very likely their observing Faculty is employed only about some one Object, for which they have most Concern.

The most remarkable of all the Insects we know for its fine pearled Eyes, is the *Libella* or *Dragon-Fly*. Mr. LEEUWENHOCK reckons twelve thousand five hundred forty four *Lenses* in each Eye of this Creature, or twenty five thousand eighty-eight in both, placed in an hexangular Position; each *Lens* having six others round it. He observed likewise in the Center of each *Lens* a minute transparent Spot brighter than the rest, and

supposed

Plate XXI.

The Face & Eyes of a Drone Fly. p. 36



ſuppoſed to be the *Pupil* through which the Rays of Light are tranſmitted upon the *Retina*. This Spot had three Circles ſurrounding it, and ſeemed ſeven Times leſs than the Diameter of the whole *Lens*. He alſo numbered ſix thouſand two hundred thirty-ſix Pearls or Hemiſpheres in a *Silkworm*'s two Eyes, when in the Fly State: three thouſand one hundred eighty-one in each Eye of a *Beetle*, and eight thouſand in the two Eyes of a *common Fly*.

The Author of *Spectacle de la Nature* finely obſerves, * that the Eyes of other Creatures are as it were multiplyed by Motion: whereas thoſe of a Fly are fixed and immoveable, and can only ſee what lies directly before them; they are very numerous therefore, and are placed in a round Surface, ſome in a high, others in a low Situation, to inform the Fly of every Thing wherein ſhe may be intereſted. She has a Number of Enemies, but, with the Aid of theſe Eyes that ſurround her Head, ſhe is enabled to diſcover whatever Danger threatens from above, behind, or on either Side, even when ſhe is in full Purſuit of a Prey directly before her.

Theſe *Eyes* or little *Hemiſpheres* are placed, in all Kinds of Flies and aerial Animals, in a moſt neat, regular, and admirable Ordination of *triangular* Rows, ranged as near to one another as poſſible, and leaving the leaſt Pits or Furrows between them that can poſſibly be. But in *Crabs*, *Lobſters*, *Shrimps*, and ſuch Kinds of *cruſtaceous Water Animals*, (whoſe Eyes are leſs pearled,) the Pearls are ranged in a quadrangular Order, the Rows interſecting at right Angles, by which Diſpoſition their Number on equal Surfaces muſt be leſs: but to make them a Recompence for this, kind Nature has formed their Eyes a little moveable, whereas thoſe of flying Inſects are all fixt.

The Goodneſs of Providence is particularly diſtinguiſhable in the Formation and Situation of the Eyes of different Animals, in a Manner moſt ſuitable to their different Neceſſities and Ways of Living. In *Hares* and *Rabbets*, whoſe Safety depends on flight, they are very protuberant, and placed ſo much towards the Sides of their Heads, that their two Eyes take in nearly a whole Sphere: whereas in Dogs (that purſue them) the Eyes are ſet more forward in the Head, to look that Way more than backward.

In *Cats* the Pupil being erect, and the ſhutting of the Eye-Lids tranſverſe thereto, they can ſo cloſe the Pupil, as to admit, as it were, one only ſingle Ray of Light: and, on the contrary, by throwing all open, they can take in all the fainteſt Rays. Which is an incomparable Proviſion for Animals that have Occaſion to watch and way-lay their Prey both by Day and Night. But beſides this, ſome nocturnal Creatures have a certain Radiation or darting out of Rays of Light from their Eyes, enabling them to catch their Prey in the Dark: and this moſt People have been Witneſſes of in Cats.

Notwithſtanding ARISTOTLE, PLINY, ALBERTUS MAGNUS, and ſeveral other Writers were of Opinion that *Moles* are blind, the greater Diligence of the Moderns in Diſſections and Experiments have found them to have Eyes moſt excellently fitted for their ſubterraneous Way of Life: not indeed much bigger than a large Pin's Head, but which, it is ſuppoſed they have a Faculty of withdrawing, if not quite into the Head, yet more or leſs within the Hair, as they have more or leſs Occaſion to employ or guard them †.

The Eyes of *Snails* are placed at the Ends of their Horns, and are thruſt out at ſome Diſtance, or drawn quite within the Head as the Animal thinks proper.

Thoſe of the *Camelion* turn backwards, or any Way elſe, like a Lens or convex Glaſs in a verſatile globular Socket, without any Motion of the Head; ‡ and it is very extraordinary to ſee one of the Eyes of this Creature moving, whilſt the other remains fixt: one turning forwards at the ſame Time the other looks behind, or perhaps one looking up to the Sky, when the other turns itſelf downwards towards the Ground.

Several Opinions have prevailed amongſt the Anatomiſts about the Reaſon why Man having two Eyes ſees not an Object double. GALEN and his Diſciples thought this to ariſe from a Coalition or Decuſſation of the optic Nerves; but do not well agree whether they decuſſate, coaleſce or only touch one another. The BARTHOLINES aſſert they are united, ‖ not ſimply by Contact, or Interſection, but by a total Confuſion or Commixture of their Subſtance. VESALIUS and ſome others have found a few Inſtances of their being diſunited, but ſay it is generally otherwiſe. Dr. GIBSON tells us, § they are united by the cloſeſt Conjunction, but not Confuſion of their Fibres. DES CARTES, and ſome beſides, judge this to be not from any Coaleſcence, Contact, or croſſing of the optic Nerves, but from a Sympathy between them. For, ſays DES CARTES, the *Fibrillæ* conſtituting the medullary Part of thoſe Nerves being ſpread in the *Retina* of each Eye,

* Dialogue VIII. of Anat. at Par. p. 22.
† Derham's *Phyſ. Theol.* p. 94.
‖ Bartholini Anat. lib. 3. c. 2.
‡ Vid. *Phil. Tranſ.* N° 137. Mem. for a Nat. Hiſt.
§ Gibſon's Anat. lib. 3. c. 10.

have

have each of them correſponding Parts in the Brain: ſo that when any of thoſe *Fibrillæ* are ſtruck by any Part of an Object, the correſponding Parts of the Brain are thereby affected, and the Soul thereby informed. The Archbiſhop of *Cambray* ſays, we never ſee an Object double, becauſe the two Nerves that are ſubſervient to Sight in our Eyes, are but two Branches that unite in one Pipe, as the two Glaſſes of a Pair of Spectacles unite in the upper Part that joins them both together. And laſtly, our great Sir ISAAC NEWTON, with his uſual Modeſty, hints to us his Opinion by the Way of Query. Are not the Species of Objects (ſays he) ſeen with both Eyes, united where the optic Nerves meet, before they come into the Brain, the Fibres on the right Side of both Nerves uniting there *&c*? For the optic Nerves of ſuch Animals as look the ſame Way with both Eyes (ſuch as of Men, Dogs, Sheep, Oxen, *&c*.) meet before they come into the Brain: but the optic Nerves of ſuch Animals as do not look the ſame way with both Eyes, as of Fiſhes, and of the Camelion, do not meet, if I am rightly informed *.

After this Digreſſion, which 'tis hoped may be excuſable on ſo curious a Subject, we ſhall return to finiſh the Explanation of this Plate, wherein

F F ſhew the Horns.
G G the Smellers or Feelers.
H H and I the Proboſcis.
K K K K the Hairs and Briſtles.

All which will be deſcribed in explaining the following Plate.

An EXPLANATION of the TWENTY-SECOND PLATE.

FIG. 1.

A Blue-Fly, or Fleſh-Fly.

Blue-Bottle Fly.

WE ſee here the *Blue-Bottle* or *common Fleſh-Fly*, enlarged by the Microſcope, in ſuch a Manner, as to ſhew diſtinctly all its particular and minute Members and Ornaments.

A A, Its protuberant and pearled Eyes, which make a conſiderable Part of the Head, though much ſmaller than thoſe of the *Drone-Fly*, deſcribed in the laſt Plate. Theſe Pearls or Hemiſpheres were ranged in the ſame triangular Order as in that Fly, but without any ſuch Difference in Size.

B B, A ſcaly prominent Front between the Eyes, adorned and armed with large tapering ſharp black Briſtles, which growing on either Side in Rows, and bending towards each other near the Top, form a Kind of Arch of Briſtles, that almoſt covers the Front B B.

C, a Projecting Part at the anterior End of this Arch, and about the Middle of the Face, on which grow D D, two little oblong Bodies, not unlike the *Apices* or *Pendants* in Lillies, each having one ſmall Joint where it unites to C, and another that joins it to the Front Part B.----- Theſe in the Head of the *Drone-Fly* are called Horns, from the great Reſemblance they bear to the Horns of ſome Kinds of Beaſts.

E E, Bruſhy Briſtles or Feathers, ſomewhat like the Tufts of a *Cock-Gnat*, growing from the upper Part and Outſides of the Horns, D D.

F F, Four ſtrong Briſtles, placed two and two, and bending towards each other, juſt above the Opening of the Mouth.

G H I, The Fly's *Proboſcis* or *Trunk*, coming out from the Middle of the Mouth. It ſeems to be a hollow Body, and by means of ſeveral Joints is moved to and fro, thruſt out or pulled in at pleaſure. There's a Knee or Bending expreſſed at H, which from thence to the Extremity is ſlit, as it were, into two Lips, H I, H I, which on their outer Sides are covered with pretty large Hairs; though the Hairs on the upper Part of the *Proboſcis* are very ſmall. Theſe Lips open or ſhut eaſily, and ſerve to hold or take in little Pieces of ſolid Food; but when the Fly ſucks any thing from the Surface of a Body, ſhe ſpreads them open, and applies their hollow Part perfectly cloſe thereto; in which Condition they become a kind of Pump, to draw up the Juices of Fruits or other Liquors.

2

* Newton's Opt. Q. 15.

The Blew Bottle or Flesh Fly
p. 38.

Fig: 1.

Fig: 2.

The Blew Bottle's Wing
p. 40

K K, Two little hairy oblong Bodies, growing within the Mouth from either Side of the *Proboſcis*. Theſe Parts are differently ſhaped, and much larger in the Head of the *Drone-Fly*, where they are marked G G. Dr. HOOKE imagines theſe may probably be its Organs of Smelling.

The Middle-Part or *Thorax* of this Fly is cruſtaceous, and ſtrongly made; rounded on the Top, and covered with large long black Briſtles, ſtanding like the Quills of a Porcupine, in parallel Order, all pointing towards the Tail. From the hinder and under Part grow out three large Legs on each Side, (as repreſented in the Figure) all covered with a ſtrong hairy Shell, and reſembling the Legs of a Crab or Lobſter. Each Leg is jointed, and made up of eight Parts, 1, 2, 3, 4, 5, 6, 7, 8; on the eighth of which grow the *Soles* or *Spunges*, and *Claws*, deſcribed before in the *Twentieth Plate*.

Of theſe ſix Legs ſhe ſeldom employs any more than four to walk with, the two foremoſt ſerving inſtead of Hands, to take up any thing to eat, to clean her Mouth, Eyes, Wings and Body, and for many other Purpoſes.

L L, The two Wings, faſtned with ſtrong Joints to the upper Part of the *Thorax*. Many Particulars of their Contexture have been already given, *Fig.* 4. *Plate* XX. and ſomething further will be ſaid concerning them in the next Figure of the preſent Plate.

The hinder or Tail-Part is of a moſt lovely ſhining Blue, looking exactly like poliſhed Steel, brought to that curious Colour by annealing, and ſeems like a kind of Armour, thickly beſet with ſuch-like Briſtles as grow upon its Back.

In this and moſt Kinds of Flies, the Female is furniſhed with a moveable Tube at the End of her Tail, by extending of which ſhe can convey her Eggs into convenient Holes and Receptacles, either in Fleſh or ſuch other Matters as may afford the young ones proper Nouriſhment. From the Eggs come forth minute *Worms* or *Maggots*, which after feeding a while in a voracious manner, arriving at their full Growth, become transformed into brown *Aurelias*, whence after ſome time longer they iſſue perfect Flies.

Upon opening a Fly, numberleſs Veins may be diſcovered diſperſed over the Surface of its Inteſtines; for the Veins being blackiſh, and the Inteſtines white, they are plainly viſible by the Microſcope, though two hundred thouſand times ſlenderer than the Hairs of a Man's Beard. According to Mr. LEEUWENHOEK †, the Diameter of four hundred and fifty ſuch minute Veins were about equal to the Diameter of a ſingle Hair of his Beard: And conſequently two hundred thouſand of them put together would be about the Bigneſs of ſuch a Hair.

This Creature is extremely nimble and quick-ſighted, ſo that it will commonly eſcape, though you approach it ever ſo cautiouſly and ſwiftly. On ſeeing any thing it fears, it ſquats down, to be the readier for its Riſe; and is very vigorous in its Motions, as well as impudent; for it will return ſeveral times to the ſame Place after being driven away.

Was it not from a prepoſterous Humour in Mankind, that conſtantly inclines us to deſpiſe and overlook whatever is continually before us, we ſhould often divert ourſelves with obſerving the pretty Actions of this little familiar Animal, which are very well worth our Notice. To ſee it, like a little Bird, taking its Flight about us, and when it thinks fit to ſettle, uſing its Fore-feet to clean its Body, Head and Wings, and afterwards rubbing them backwards and forwards one againſt the other, to clear away any Dirt they may have contracted in making the other Parts clean: To ſee its Manner of feeding, the Motions of all its little Members, and the delicate Structure and Contrivance of them: To ſee all this, I ſay, and conſider how many Veins, Arteries, Nerves, and Muſcles, muſt be employed to give Motion to, and furniſh all theſe Parts with animal Spirits and circulating Fluids, and reflect on the Contexture and Delicacy of Veſſels ſo inconceivably minute, muſt fill the Mind with Delight and Admiration.

As corrupting Animal Bodies afford the moſt kindly Nouriſhment to its Young, it is endued with a wonderful Capacity, either by its Smell, or ſome other Way, of finding out ſuch Bodies, and laying its Eggs among them.

All the Winter it lies torpid in ſome Hole or Corner, whence it creeps out at the Return of Spring: But no Cold, nor even being frozen, kills it; for when thawed gently by a Fire, or in the Sun-ſhine, it revives again: If put into Spirit of Wine, it ſeems quickly dead, but on taking it out, letting it lie three or four Hours, and then bringing it to a gentle Fire, or putting it in the Heat of the Sun, it will again appear alive.

* *Microſcope made eaſy*, p. 220.

† *Arc. Nat.* Tom. II. p. 77.

PLATE XXII. FIG. 2.

A Fly's Wing.

A Fly's Wing. WE are ſhewn here the whole of a Fly's Wing, of which we examined the particular Compoſition in the *Fourth Figure* of the *Twentieth Plate*, whereto we therefore ſo far refer the Reader; only obſerving farther on its general Appearance before the Microſcope, that it ſomewhat reſembles a *Sea-Fan*, with black Ribs or Fibres diſperſed and branched through it; between which a fine Membrane or Film like a thin Piece of *Muſcovy Talc* extends.

It grows from the *Thorax*, a little more towards the Head than the Center of the Body's Gravity: But this Excentricity is wonderfully balanced by its expanded Area, and the Center of its Vibration lying much more towards the Tail than the Root of the Wing is.

Our Author tells us, (having made many Trials to find out after what manner the vibrative Motions of a Fly's Wings are performed) that the extreme Limits of the Vibrations were uſually about the Length of the Body diſtant from one another, tho' often ſhorter, and ſometimes longer: That commonly the foremoſt Limit was a little above the Back, and the hinder ſomewhat below the Belly; between which two Limits, if one may gueſs by the Sound, the Wing ſeemed to move backwards and forwards with an equal Velocity: And theſe Vibrations between the two Limits are ſo ſwift, that 'tis very likely it makes many hundreds, if not thouſands, of Vibrations in a Second of Time; ſo that probably the Wing of a Fly is one of the quickeſt Vibrations in the World.

Who that conſiders this can forbear admiring the extreme Vivacity of the *governing Faculty* or *Anima* of the Inſect, which is able ſo to actuate and regulate the Animal Spirits, as to cauſe each peculiar Organ to move or act not only with ſo much Quickneſs, but at the ſame time with ſuch exact Regularity.

M is a little Body, like in Appearance to a long hanging Drop of ſome tranſparent viſcid Fluid. This is one of the Ballances or Poiſes which moſt Kinds of Flies that have only two Wings are furniſhed with. It grows out juſt under the hinder Part of the Root of the Wing, and may be obſerved conſtantly to move before it. The Uſe of theſe Poiſes is undoubtedly to keep the Body ſteady and upright in flying; for if one of them be cut off, the Inſect will fly as if one Side was over-balanced, and ere long tumble to the Ground; and if both be taken away, its Flight is aukward and unſteady, manifeſting the Want of ſome neceſſary and eſſential Part.

The Jaw Bone & Teeth of a Snail p. 41

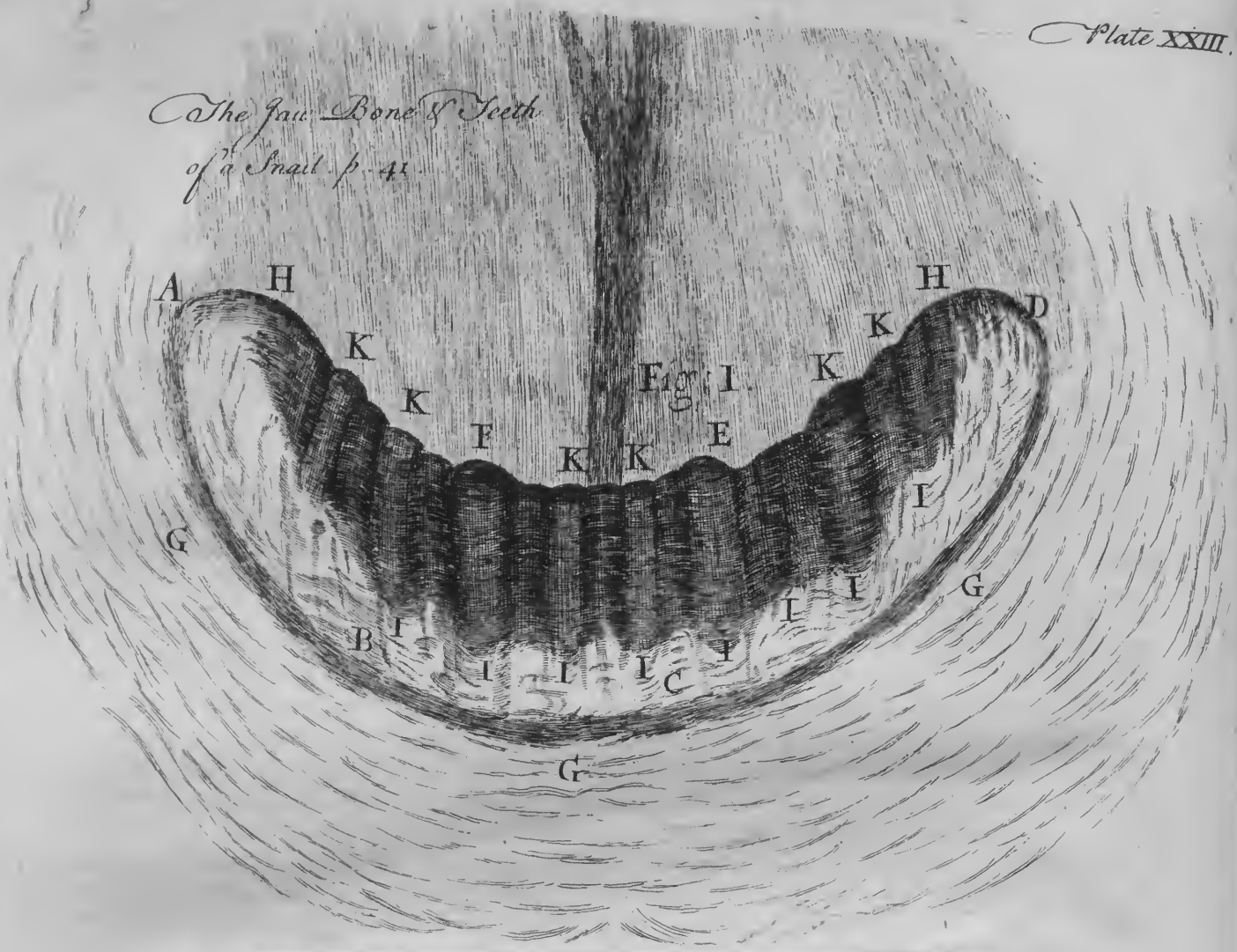


Fig: 1.

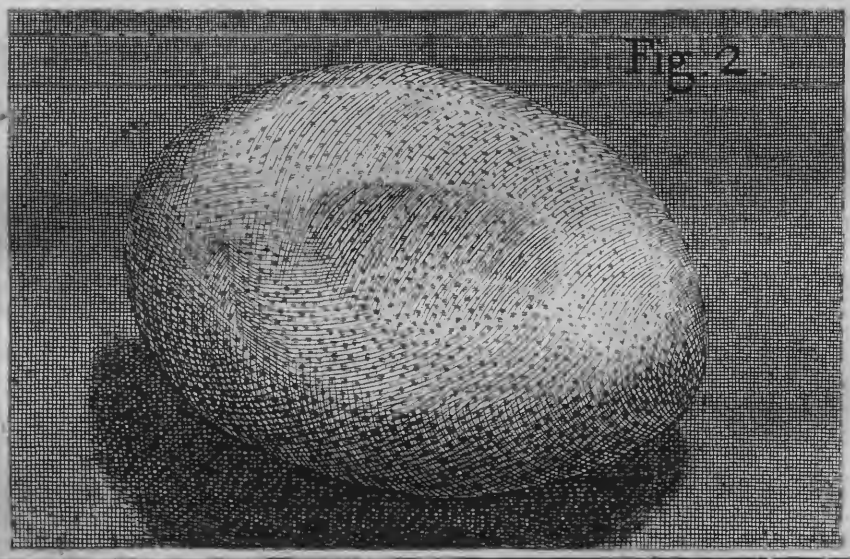


Fig: 2.

A Silk Worms Egg p. 42.

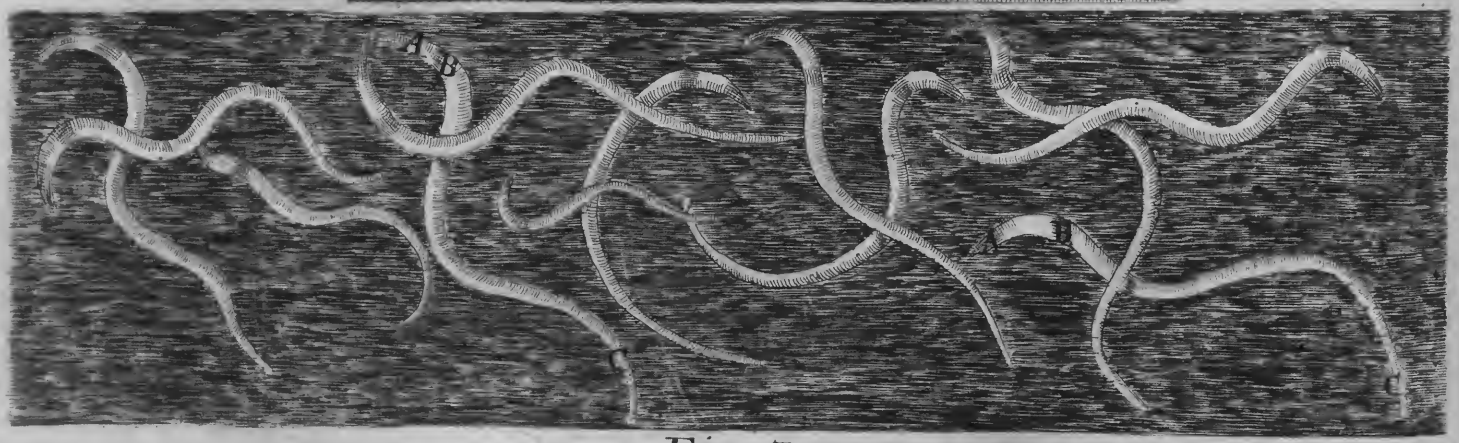


Fig: 3.

The Eels in Vinegar. p. 45.

An EXPLANATION of the TWENTY-THIRD PLATE.

FIG. 1.

The Teeth of a Snail.

THE upper Jaw-Bone and Teeth of a Garden-Snail are here magnified for our Obſervation. Snail's Teeth.

The whole was a ſmall bended hard Bone, the Teeth all joining together like the Teeth of a *Rhinoceros*; which perhaps is the only known Animal beſides that has them in that manner.

The Part A B C D, which grew out of the upper Chap of the Snail G G G, was found to be much whiter and leſs furrowed, than the lower and blacker Part of it H I I H K K H, which was ſhaped exactly like Teeth; the Bone growing thinner and tapering towards an Edge at K K K. It ſeemed to have nine Teeth or prominent Parts, ſome ſmaller than others, but all joined together by thinner interpoſing Parts of the ſame Bone.

This very Snail, juſt before its Diſſection, was ſeen feeding on a Roſe-Leaf, and biting out half round Pieces, not unlike the Figure of a Capital C, nor much differing from it in Bigneſs.

Though a Snail is known to every Body, there are ſome Particulars belonging to it may not be amiſs to mention. Its Way of moving from place to place, though deſtitute of Feet, is effected by two large muſcular Skins, that are lengthned by letting out; after which, their Fore-part is ſhortned into Folds, and the hinder Part falls into the ſame Contraction: Then the Fore-part extends, and draws along the Shell. A glutinous Slime emitted from the Body, enables it, at the ſame time, to adhere firmly and ſecurely to all Kinds of Surfaces, which is an Advantage few Animals that have Feet can pretend to.

Snails are oviparous, but their Way of Coupling is extraordinary. They are all Hermaphrodites, each poſſeſſing the generative Parts of both Sexes, which are employed mutually *in Coitu*. Theſe Parts are ſituated on the Left-ſide of the Head, and are only diſcoverable when they are generating, which uſually engages them about twelve Hours, and from which they can hardly be ſeparated without hurting the Parts.

The Manner of their coming together, as related by Dr. LISTER, is very extraordinary.---When they are diſpoſed to approach each other, they ſignify their mutual Inclinations in a Manner peculiar to themſelves. One launches againſt the other a kind of little Dart, which has four Wings or minute Edges. The Weapon flies from the Animal who ſhot it, and either lodges in the other, or falls down by him, after making a ſlight Wound; upon which, this Creature in his turn diſpatches another Dart at the Aggreſſor: But this little Combat is immediately ſucceeded by a Reconciliation. The Subſtance of the Dart is like Horn, and the Animals are ſtocked with them at the Seaſons when theſe Approaches are made, and which happen each Year thrice in ſix Weeks, or once every fifteen Days. Some Days after, each makes its Way into the Earth, and lays its Eggs in Knots of about thirty in Number, near four Inches deep. The Place they chuſe is commonly moiſt and ſhady. In about a Month the Eggs are hatched, and the young Snails appear above Ground, with their Shells compleatly formed, of a Minuteneſs proportionable to their little Bodies and the Dimenſions of the Eggs that incloſed them. * Theſe Shells increaſe from time to time by the Addition of new Circles, but continue always to be the Center even when the Animals are arrived at their full Growth. If they are broken by any Accident, a ſlimy Exſudation from the Body repairs them again in a few Days.

'Tis ſaid no Cold either of Nature or Art can freeze the Juice of Snails, which perhaps is owing to its Viſcoſity, as we find the Berries of *Miſletoe*, whoſe Juices are of that Quality, are ſo far from being frozen by, that they ripen in the coldeſt Weather.

A Snail's Heart may be found juſt againſt a round Hole near its Neck, which opens and ſhuts as it either ſtands ſtill or moves, and is ſuppoſed by Dr. HARVEY to be the Place of its Reſpiration: It will ſometimes beat a Quarter of an Hour after Diſſection: But without that Trouble it may be ſeen by the Microſcope through the tranſparent Shell of a new-hatched Snail performing its Contractions and Dilatations with the utmoſt Regularity.

* *Malpighi Anat. de Colch. Memoires de l'Academie des Sciences*, 1709.

The Guts are of a pure green Colour after feeding, and appear branched over with little capillary white Veins. It has alſo Liver, Spleen, Stomach, Mouth, and Teeth (which have been juſt now deſcribed) and ſemi-ſpherical Eyes at the Tips of the Horns, which if cut off and examined look like large blue Beads.

PLATE XXIII. FIG. 2.

The Egg of a Silk-Worm.

Silk Worm's Egg.

THE minute Egg of this little Animal, when magnified by Glaſſes, exhibits an Appearance well worthy our Admiration; for innumerable Cavities or Hollows, extremely ſmall, with Riſings interpoſed, ſomewhat reſembling thoſe on a Poppy-Seed, overſpread its whole Surface: But the Cavities and Ridges here are leſs an hundred times than thoſe on the Seeds of Poppy, and not diſtinguiſhable without a good Inſtrument and a good Light.

Shell.

When the Young is hatched, and the Shell broke, it ſeems no thicker, in proportion to its Bigneſs, than the Egg-ſhell of a Gooſe or Hen. It looks then of a pure white, and ſo tranſparent, that none of the little Pits on its Surface can be diſcerned, without great Difficulty: But a moſt delicate thin Film may be diſcovered lining its Inſide, in the manner of large Eggs; the Shell itſelf is very brittle.

The Figure of theſe Eggs is not exactly round, but ſomewhat flatted both on the upper and under Side; and the included Inſect may be diſcovered lying coiled near the Edges of it. But ſeveral other Sorts of Moths lay Eggs exactly globular, with Surfaces perfectly ſmooth and poliſhed; and there is no leſs Variety in the Eggs of Inſects than in thoſe of Birds.

Theſe Eggs hatch ſooner or later in the Spring, according to the Warmth of the Weather; and may be forwarded very much by keeping them in a certain Degree of Heat. The young Brood appears at firſt to be a Number of black hairy little Catterpillars, bearing not the leaſt Reſemblance to the Forms they afterwards aſſume. As therefore the Manner of their Changing is wonderful, and many may be deſirous to ſee it with their own Eyes, ſome ſhort Directions how to feed and manage them, though not altogether requiſite in this Place, will not, 'tis hoped, be judged impertinent.

Directions how to breed Silk-worms in *England*.

IN *China*, *India*, and ſome other hot Countries, the Silk-worms live abroad in the open Air, upon Mulberry-Trees propagated in great Abundance for their Reception. On theſe they feed, expatiating in full Liberty, till they incloſe themſelves in Balls of Silk, curiouſly faſtned to the Branches, and appearing like golden Apples amidſt the beautiful Green that embelliſhes and contraſts them. Here too they affix their Eggs on Parts of the Tree proper for their Preſervation, with a Sort of Glew beſtowed on them by Providence for that purpoſe; where they remain ſecure all the Autumn and Winter-Seaſon, nor begin to hatch till the young expanding Leaves afford them abundant Suſtenance.

But in our cold Climate, theſe Creatures muſt be treated in a quite different manner, and preſerved in Houſes with a great deal more Care and Trouble. As ſoon as they are hatched, which is commonly ſome time in *May*, and before the *Mulberry* Leaves come out, the Papers on which the Eggs are laid with us, are to be placed in a Sheet of ſtiff Writing-Paper, (turned up on every ſide in the Faſhion of a Dripping-Pan) laying lightly upon them the young tender Leaves of *Lettice*. On theſe they will crawl and feed; and a freſh Supply muſt be given them as often as the Leaves grow withered; taking care to help ſome of them off the withered Leaves by the Aſſiſtance of a Pin; without which many will be thrown away or deſtroyed. For a Thread which iſſues from their Mouths, and by ſticking to whatever it touches, preſerves them from the Danger of falling, ſometimes binds them down ſo faſt to the old Leaves, that they become unable to quit them without a little Aſſiſtance.

In a few Days, the little Catterpillar that was black at firſt, approaches nearer to an aſhen Grey: Its Coat appears ragged, the Animal caſts it off, and is ſeen in a new Habit. It increaſes in Bigneſs, and grows whiter, with a little Tendency to green. Some Days after this, it forbears eating, and ſleeps almoſt two Days, at the End whereof it ſeems agitated and convulſed, and grows almoſt red with the Violence of its Struggles: The

Skin

Skin wrinkles, ſhrinks into Folds, and by little and little the Inſect gets it off him with his Feet.

It appears now in its third Habit; and ſo different are its Head, its Colour, and its whole Form, that one would take it for another Creature. It feeds again ſome Days, and is then ſeized with a new Lethargy and Convulſions, and flings off another Skin; after which its Appetite returns, and it feeds voraciouſly, growing continually larger and whiter, with a delicate Smoothneſs and Tranſparency of its Skin, which foretells the Time of its Spinning being near at hand. It then leaves off feeding for the Remainder of its Life, and ſeeks ſome Corner where it begins to form its Web.

But to return to our feeding them with *Lettice*-Leaves, which muſt be their Proviſion till the *Mulberry* Trees ſhoot out. Care muſt be taken that the Leaves be perfectly dry when put to them; (for any Moiſture does them Harm;) and that they be not given in too great Quantity at once, but freſh and often.

As the Creatures grow they muſt be divided into two or more Dripping-pan-formed Papers, in proportion to their Number; obſerving, during the whole Courſe of their Changes, never to crowd Multitudes of them together; for doing ſo breeds an Infection ſometimes amongſt them, that carries off a great many.

When they begin to feed on Mulberry-Leaves, (which ſhould be given them as ſoon as ſuch Leaves can be got) they will thrive much faſter than before. But then they muſt never be left without Food, for as they live but a ſhort Period before they begin to ſpin, and after that live almoſt as long without eating any thing, they make the beſt Uſe of their Time, and are feeding continually till their Changes come. A great deal of their Welfare depends likewiſe on keeping them perfectly clean and ſweet, by clearing the Papers of their Dung and the Remains of their Leaves, as often as there is Occaſion.

When they arrive at their full Growth, and forſaking their Food begin to ſpin in ſome Corner of the Dripping-Pan, each of them muſt be put in a little Paper-Cone of about an Inch and half Diameter at its open End. Theſe Cones ſhould be ſewed together in Couples, and hung acroſs a Pack-thread Line, or faſtned to it ſingly, as your Number or Fancy ſhall direct.

The Silk-Worm's Manner of making Silk.

LET us now behold this induſtrious Animal at work, a Sight which muſt fill the attentive Obſerver with an equal Mixture of Delight and Wonder. After ſurveying the Dimenſions of her Paper-Cone, ſhe begins to form her Web, applying her Mouth to different Parts of the Paper, and then pulling her Head away with a ſlow but equal Motion. To explain the Meaning of this, it is neceſſary to take notice, that immediately below her Mouth are a Couple of little Holes, which are the Outlets of a long and ſlender Bag filled with a kind of yellow viſcid Juice or Gum. Wherever the little Creature applies theſe two Openings, the viſcid Juice adheres, and when the Head is drawn back, continuing to flow through them, receives their Form (as Wire does from the Hole it is pulled through) and lengthens into a double Thread, which inſtantly loſing the Fluidity of the Juice compoſing it, obtains the Conſiſtence of Silk. Theſe two Threads ſhe unites in one, glewing them together with a Sort of Fingers on her Fore-Paws; and at the Beginning of her Work faſtens them here and there as it were at random, and ſoon encompaſſes herſelf with a looſe and haſty Covering, juſt ſufficient (was ſhe abroad) to defend her from the Rain. Within this ſhe weaves another Caſe, made of the fineſt Silk, diſpoſed with the utmoſt Regularity, and rendered ſo perfectly compact as to prevent any Admiſſion of the Air. Nor is ſhe contented with theſe two Coverings, but forms within them both a kind of Shell, compoſed of Silk and Glew, and reſembling a very ſtrong Stuff, which not only can repel Water and Air, but be a good Security againſt the Rigour of the ſevereſt Froſts.

Thus defended from Danger, ſhe undergoes a moſt amazing *Metamorphoſis*, relinquiſhes intirely her former Figure, and appears, if taken out of theſe Caſes, a cruſtaceous Acorn-like Body, having neither Head, Legs, Eyes, or any diſtinct Part, and but very few Signs of Life. In ſhort, ſhe becomes a *Nymph* or *Chryſalis*.

She continues thus, ſeemingly dead and intombed, for a Fortnight, three Weeks, or ſometimes a longer Time, when ſhe obtains a glorious Reſurrection, and comes out provided with four beauteous Wings, of a Cream-Colour, almoſt white, with regular and uniform Lines of a very light grey on each, and covered all over with delicate downy Plumes. She has two fine Eyes, a Pair of Horns exquiſitely branched, and her Body and ſix Legs are every where adorned with Hairs and Feathers of a moſt curious Structure,

and as different from one another as the Feathers on the different Parts of the Bodies of Birds are. In ſhort, ſhe becomes a very pretty Butterfly or Moth.

But it may be enquired how this tender Animal is able to force a Paſſage through its three Coverings, *viz.* the Shell, the Silk, and the looſer Web juſt now deſcribed; and indeed its Proviſion and Forecaſt for this Purpoſe deſerve our Attention and Admiration. Theſe Coverings are faſhioned like a Pigeon's Egg, ſharper at one End than the other; and towards this Extremity, the Worm, as if conſcious here muſt be its Paſſage out, neither interweaves its Silk, nor applies its Glew, as in every Part beſides. Oppoſite to this Point the Head is conſtantly placed in its *Nympha* State; and as ſoon as its Formation into a Butterfly is compleated, its Horns, Head and Feet extend themſelves againſt this Part, which not being cemented, gradually gives Way, and affords an Opening for its coming out.

This is their natural Courſe; but as they conſtantly diſcharge from their Bodies, a large Quantity of a reddiſh-brown Liquor, when they firſt appear in the Fly-State, which ſtains and damages the Silk; thoſe that keep them either for Profit or Amuſement, uſually prevent this, either by winding off their Silk before they are ready for this Change, or if that cannot be done, by expoſing them to the intenſe Heat of the Sun, or a Fire, for ſome Hours, to kill them in their Caſes: reſerving only ſome few for Breed.

How to wind off Silk.

THE Pods may eaſily be wound off, if after pulling away the looſe outward Covering, (which may be ſpun like Flax for ordinary Purpoſes) they be put into warm Water; for that diſſolves the Gum, and ſets the Silk at liberty to be unravelled from End to End; and ſome Spirit of Wine added to the Water makes the Gum diſſolve ſtill more readily. Ten or a Dozen Threads of as many Pods may be wound off together very conveniently either in Skeens or Balls, till we come to the innermoſt Covering or Shell, which is of a whiter Colour, much more gummy, and a Sort of Silk but of little Uſe or Virtue. It is therefore commonly the Way to cut them open, and take out the included *Nymphæ*, which being then naked ſhould be laid on dry freſh Bran till they become Butterflies.

Some Ladies pull away the looſe Silk, cut out the *Nymphæ*, and dye the Pods of all Colours in great Variety of Shades, after which they compoſe with them moſt beautiful Noſegays of artificial Flowers.

The Largeneſs of its Size diſtinguiſhes the Female even in its *Nympha* State; but that Diſtinction is ſtill more evident after they appear as Flies. The Males are exceeding lively and ſalacious, endeavouring continually, by their noiſy Flutterings and wanton Motions, to raiſe Deſire in the Females. The Coitus continues ſometimes ſeveral Hours, during which the Body of the Female may be obſerved to ſwell and enlarge: ſoon after ſhe begins to depoſite her Eggs, and perhaps goes on to do ſo from time to time till ſhe has laid above five hundred.

As ſoon as they become Butterflies, 'tis beſt to put them in ſuch Paper Dripping-Pans as when they were Catterpillars, for they will rarely get over the Sides of the Paper, and it is very convenient for them to ſtick their Eggs to. The Females are full of Eggs even in the *Nympha* State, and will lay, though no Male comes near them; but ſuch Eggs are unprolific. When firſt the Eggs are laid, their Colour is a Pale-Lemon; but they ſoon grow darker, and after a Week or two appear of a Lead-Colour. Thoſe that continue yellow will never produce any thing.

Their Semen full of Animalcules.

UPON gently ſqueezing the Tail of a *Male-Fly* for a little while, a ſmall Drop of a whitiſh brown Liquor will be ſquirted from it, which diluted with a little warm Water, and examined by the Microſcope, appears crowded with Animalcules, four times as long as broad, with Backs thicker than their Bellies, like the Shape of a Trout *. But this muſt be done before the Male has been coupled with the Female, for nothing is to be got from it afterwards.

After the Females have done laying they grow languid and die in a Day or two, and the Males do not long ſurvive them. The Papers whereon the Eggs are laid may be folded up and kept in any ſafe Place till the following Spring, when they will certainly be hatched, ſooner or later, according to the Warmth of the Seaſon.

The

* *Vid. Leeuwenh. Arc. Nat. Tom.* I. *P.* II. *p.* 422.

The exquiſite Fineneſs of the Silk ſpun by this little Creature, well deſerves our Notice. A Pod being wound off, was found to contain nine hundred and thirty Yards: But it is proper to obſerve, that as two Threads are glewed together by the Worm through the whole Length of the Silk, it really makes double the above Number, or one thouſand eight hundred and ſixty Yards; which being weighed with the utmoſt Exactneſs, were found no heavier than two Grains and a half.

The whole *Butterfly* and *Moth* Tribe undergo the ſame Changes as the *Silk-worm* does, though with ſome Variation, as to Time, and Place, and Manner. Some ſpin ſilky Caſes like them; others wrap themſelves up in Leaves, which they cement together by a gummy Exſudation from their own Bodies; ſome deſcend into the Ground, form Caſes of Earth, and wait their Changes there; and others again only hang themſelves by the Tail in ſome ſhelter'd Corner, where from Catterpillars they become *Aurelias*, and from *Aurelias*, *Butterflies*. There is likewiſe a conſiderable Difference as to Time, ſome paſſing through all their Changes in a few Weeks, and ſome taking up above a Year. But they all agree in proceeding from the Egg a *Caterpillar*, and becoming afterwards a *Nymph*, *Chryſalis*, or *Aurelia*, and at laſt a *Moth* or *Butterfly*.

Some few Lines from a Poem before quoted, called the UNIVERSE, expreſſive of this wonderful Change, will not, 'tis hoped, be thought improper here.

See, to the Sun the Butterfly *diſplays*
Its glitt'ring Wings, and wantons in his Rays:
In Life exulting, o'er the Meadows flies,
Sips from each Flower, and breathes the vernal Skies.
Where Love directs, a Libertine, it roves,
And courts the Fair Ones through the verdant Groves;
While its rich Plumes, in graceful Order, ſhow
The various Glories of the painted Bow.

How beauteous now! how chang'd ſince Yeſterday!
When on the Ground, a crawling Worm it lay,
Where every Foot might tread its Soul away.
Who rais'd it thence, and bid it range the Skies?
Gave its rich Plumage, and its brilliant Dyes?

'Twas GOD:----Its GOD and thine, O Man! and He
In this thy Fellow-Creature lets Thee ſee,
That wond'rous Change which is ordain'd for Thee!

Thou too ſhalt leave thy reptile Form behind,
And mount the Skies, a pure ætherial Mind,
There range among the Stars, all bright and unconfin'd.

PLATE XXIII. FIG. 3.

Eels in Vinegar.

THESE little Animals wherewith Vinegar is ſometimes abundantly ſtored, very much reſemble an Eel in Shape, and in the Nimbleneſs of their Motion; with this Difference, however, that the wriggling Motion of their Bodies ſeems to be upwards and downwards only; whereas that of Eels is only ſideways: Their Noſe is likewiſe ſomething ſharper than the Eel's, and more opake than the reſt of the Body, as is ſhewn at A. Eels in Vinegar.

Dr. HOOKE obſerved alſo a dark Part at B, which he imagined to be the Gills, as it appeared at a ſmall Diſtance from the Noſe: And from this Part the Body grows continually tapering to the Tip of the Tail C.

The progreſſive Motion of theſe Creatures in the Vinegar is exceeding ſlow, notwithſtanding the continual waving and wriggling of their Bodies, which may reaſonably be imputed to the Reſiſtance of the Fluid, as the Superficies of their minute Bodies is ſo very great in proportion to their Bulk.

Theſe Animals immediately die if the Vinegar be a little heated, but they do not ſuffer much by Cold; for Dr. POWER * ſays, he froze artificially a Glaſs Jarr-full of Vinegar replete with them, into a Maſs of Ice; yet when it was thawed, they all appeared as briſk as ever: Nay, he adds, that having expoſed them a whole Night to a keen Froſt, upon thawing the Ice next Morning, they ſeemed to have received no manifeſt Injury, notwithſtanding that long and ſtrong Conglaciation.---He tells us likewiſe, that he filled an Eſſence-Glaſs half with the ſaid Vinegar, and half with Oil which floated on it; and obſerved in froſty Weather, when the Vinegar was congealed, that all the little Eels ran up into the ſuper-incumbent Oil, and would not return till ſome Warmth was applied to the Vinegar; but if that was a little warmed, they immediately deſcended into it again.

Some Experiments on freezing Vinegar, with theſe Eels in it, were made about a Year ago, and communicated to the *Royal Society* by Dr. HENRY MILES, F. R. S. the Reſult whereof was, upon ſeveral Trials, that the greateſt Number were found irrecoverably dead, tho' many endured the being frozen, recovered after a little while, and appeared as briſk as ever.

Dr. HOOKE ſays, that a Quantity of Vinegar, replete with theſe Eels, being included in a ſmall Phial, and ſtopped very cloſe from the ambient Air, all the included Worms in a ſhort time died, as if they had been ſtifled: But this is not conſtantly the Caſe; for the ingenious Obſerver juſt now mentioned, had a Couple of Tubes, (of the Sort employed to behold the Circulation of the Blood) both which were full of Vinegar, well ſtocked with theſe Eels, and as well ſtopped with Cork as they could be, the Liquor too reaching ſo near the Top as juſt to touch the Cork; and though theſe were not opened once in a Month, yet they lived, increaſed greatly, and were ſurpriſingly briſk. The Tubes always ſtood in a Cup-board juſt over the Fire-Place, and ſo near it, that they were ſenſibly warm, there being a conſtant Fire.

The Eels in Paſte ſeem nearly of the ſame Kind as thoſe in Vinegar: The Manner of producing which, and the Way of examining them, may be found in the 81ſt Page of the *Microſcope made eaſy*.

* *Power's Obſerv.* p. 35.

The Nympha Vermiculis of a Gnat. p. 47.

Fig: 3 of Apiarium Marinum. p. 48.

Fig: 4.

Fig: 1.

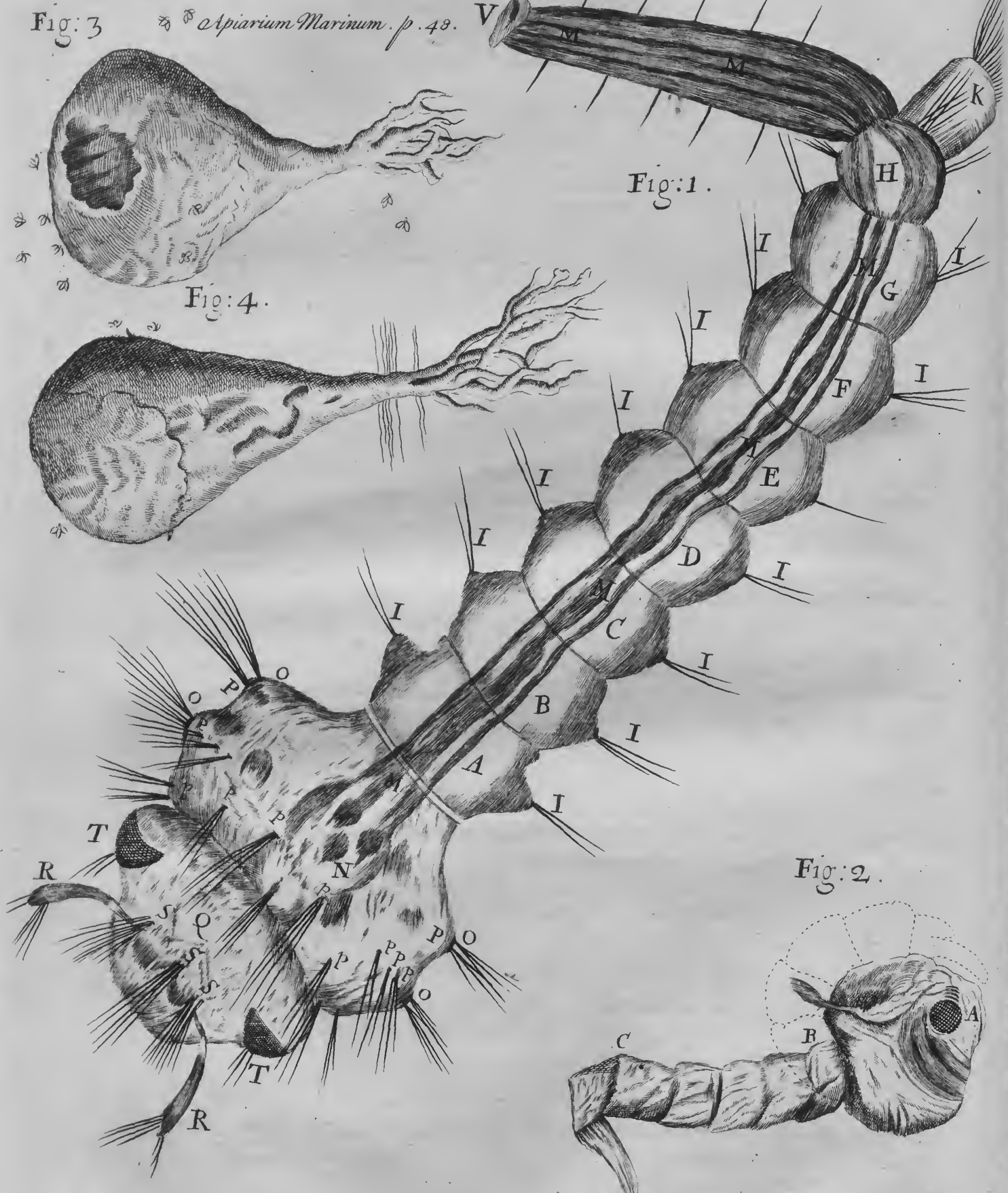


Fig: 2.

The Nympha or Aurelia of a Gnat. p. 48.

An EXPLANATION of the TWENTY-FOURTH PLATE.

FIG. 1.

The Nymph-Worm of a Gnat.

Nymph-Worm of a Gnat.

IT may be requiſite towards the better underſtanding of this Figure, to premiſe a ſhort Account of the Generation of a Gnat, and the Changes it undergoes.

The Female depoſites its Eggs upon the Surface of the Waters, by dipping down its Tail, and emitting a Quantity (large in Proportion to the Fly) of a Spawn or Jelly-like Subſtance, which it conſtantly faſtens to ſome Weed, or ſuch like kind of Thing. In this Jelly, which is tranſparent, and at firſt floats upon the Water, the minute Eggs are ranged, ſometimes in ſingle, and ſometimes in double Rows, not ſtrait, but waving, though very regular and exact.

Theſe Eggs become hatched after ſome Time, and produce ſmall reddiſh Maggots, which ſinking to the Bottom of the Water with ſome of the Slime wherein they were envelop'd, faſten to Stones or other Bodies, and make themſelves little Caſes, which they can creep out of or retire into as they find Occaſion.

When they have continued thus as long as Providence has appointed, they become changed into the Figure under Examination (which we term the *Nympha Vermiculus)* are very active, and ſwim about the Water with briſk jerking Motions.

From this they change into the State repreſented by the next Figure in this Plate, which may be called the *Aurelia* or *Nymph*, and out of that they proceed *Gnats*.

Authors are a little obſcure in their Accounts of the Changes this Creature undergoes, and not quite conſiſtent with one another. SWAMMERDAM gives two Figures anſwerable to the two we find in this Plate, calling the firſt the *Worm*, and the other the *Nympha* of the Gnat, but mentions not the real *Worm*, which 'tis therefore probable he had not obſerved. On the other Hand, our ingenious Countryman DERHAM is very full as to the *Worm*, but evidently confounds together into one the *two States* deſcribed and pictured by both SWAMMERDAM and Dr. HOOKE, and ſpeaks only of three States; whereas the Progreſſion of the Gnat from the Egg is, firſt, into a *Worm*, which may be called its *Vermicular-State*; then into the Figure before us, or its *Nympha Vermicular-State*; thirdly, into the ſecond Figure of this Plate, not improperly its *Aurelia* or *Nympha-State*; and laſtly, into the *Gnat*, or its *Mature State*.

The Way being thus cleared before us, we come to deſcribe this *Nympha-Vermiculus*, a Creature frequently met with in Ponds, Ditches, Ciſterns, and all Repoſitories of Water during moſt of the Summer Seaſon. Its general Form will beſt be underſtood by the Picture we are going to examine, wherein A B C D E F G H repreſent the Belly-Part, conſiſting of eight diſtinct Diviſions, from the midſt of each whereof iſſue out on either Side two or three little Hairs or Briſtles, I I I I, *&c.*

The Tail is compoſed of two Parts, of a very different Figure and Uſe. The Part K, whoſe End is covered with Hairs, ſerves both as Oars and Rudder, enabling this little Creature, together with the friſking and bending of its Body nimbly too and fro, not only to move about with great Agility, but to ſteer itſelf whither it pleaſes.

L ſhews the other Part of the Tail, which ſeems to be a Continuation of, and may be term'd a ninth Diviſion of its Belly. Many ſingle Briſtles grow from it on every Side; and quite to the Extremity thereof V, from that orbicular Part of the Body N, which appears to be the Stomach, a Gut extends along through the whole Belly. This Gut is of a darkiſh Colour, and diſpoſed in the Manner diſtinguiſhed by the Letters M M M, *&c.* A periſtaltic Motion therein agitated a Kind of black Subſtance, very remarkably, upwards and downwards from the Stomach to the Anus. Lice, Gnats, and ſeveral other tranſparent Inſects may be obſerved to have the like periſtaltic Motion.

O O O O the Cheſt or Thorax, ſhort, thick, ſhelly, and pretty tranſparent, within which the Beating of the Heart (which is white, as is alſo the Blood of this and moſt other Inſects) and ſeveral other Motions may be diſcerned by the Microſcope.

The Cheſt is ornamented and defended, in ſeveral Places, with Tufts of ſtrong Briſtles, *p p p p p*. Q ſhews the Head, broad, ſhort, and cruſtaceous, having three Tufts of the ſame kind of Briſtles on its Forehead or upper Part, S S S.

T T are two fine large black Eyes, whoſe Surfaces are ſmooth, and without the leaſt Appearance of being pearled or granulated, as we ſhall find them in the next Figure and Change of this Animal.

R R a Pair of Horns reſembling thoſe of an Ox inverted, with Briſtles at their Tops, and ſeeming to be hollow. Theſe are moveable every Way, and may probably be of conſiderable Service to the Inſect.

Its Mouth is pretty large, in the Faſhion of a Crab's or Lobſter's, and it may frequently be ſeen feeding on ſome minute Subſtances in the Water.

This Creature moves in the Water with its Tail forwards, jerking itſelf along by the Friſking to and fro of the Tuft growing out from the Stump thereof. It has alſo another Motion, more reſembling that of other Animals, and with its Head foremoſt; for by the opening and ſhutting of its Jaws, it ſinks gently towards the Bottom of the Water, and preſently afterwards ſeems as it were to eat its Way up again.

When the Body ceaſes to move, the Tail being higher than the Water wherein it ſwims, or than any other Part of the Inſect, preſently buoys it up to the Surface of the Water, where it hangs ſuſpended with its Head always downwards; for the Bruſh at the Tail being ſmeared over with an oily Fluid, ſerves like a Cork to keep it above Water; and if that Oil begins to dry, the Creature by drawing the Tail through its Mouth ſheds thereon a new Supply, and enables it to hang to the Top of the Water, or ſteer where it pleaſes, without being wetted or damaged by it.

PLATE XXIV. FIG. 2.

The Nympha or Aurelia of the Gnat.

Nymph of the Gnat.

THE Animal juſt now deſcribed, after about three Weeks, aſſumes a Form very different from what it had before, and agreeable to what we ſee before us. The Head and Body become larger and deeper, but not broader; the Belly and hinder Parts appear more ſlender, and ſeem coiled about the Body in the Faſhion repreſented by the pricked Lines in the Picture.

In this new State, the Head and Horns, which before hung downwards in the Water, riſe uppermoſt to the Surface; and what is very remarkable, the Inſect becomes now ſuſpended from the Top of the Water by its Horns *, as it was lately by its Tail. The whole Bulk of the Body is alſo evidently higher; for when by being frighted it friſks out its Tail, as B C repreſents, and thereby ſinks below the Surface and towards the Bottom, it re-aſcends much more ſwiftly than in its former State.

If its Progreſs be now obſerved from Time to Time, its Body will be found gradually to inlarge; Nature fitting it by Degrees for that Element of which it muſt quickly be an Inhabitant. The Microſcope alſo ſhews, that its Eyes are now pearled like the Eyes of Gnats (*vid.* A) not ſmooth as they were before: And that this Club Head really contains the Thorax and Wings of the future Gnat. A little longer Obſervation will ſhew it ſwimming partly above and partly below the Surface of the Water; and though it may then be made to plunge down by touching it with any Thing, it inſtantly comes up again, and appears in its former Poſture.

And now, if we have Patience to watch it narrowly, we ſhall be rewarded with the Satisfaction of beholding the Head and Body of a Gnat beginning to ſhew themſelves above the Surface of the Water: We ſhall ſee its Legs gradually drawn out, firſt the two foremoſt, then the others; and ſoon after, its whole Body will appear riſing out of the Huſk or Caſe perfect and intire: We ſhall ſee it diſengage itſelf from this Caſe, and ſtand on its Legs upon the Top of the Water; there by Degrees try the Activity of its Wings, and in a few Minutes fly away a compleat Gnat.

PLATE XXIV. FIG. 3. and 4.

Apiarium Marinum.

Apiarium Marinum.

THESE two Figures are given from Piso's Natural Hiſtory of *Braſil*, in the ſecond Chapter of his fourth Book; where ſpeaking of Sea Productions that bear a near Reſemblance to Productions upon Land, he tells the Story of a Fiſherman, whoſe Hook being entangled contrary to his Expectation, on a rocky Shallow not far from *Paranambuque*, brought up with it, on his pulling it out of the Water, Spunges, Corals, and Sea-weeds, inſtead of Fiſh.

He

* Vid. *Swammerd. Hiſt. Gen. des Inſects.* 4to. p. 105.

The Tufted or Brush-horn'd Gnat. p 49.

He took Notice, amongſt the reſt, of a little odd-ſhaped Plant, about half a Foot in Length, with a ſoft, ſpungy, roundiſh Body, enlarging from the Bottom upwards after the Faſhion of a Pear; and having ſhort Roots, which had faſtened it to the Rock. The Inſide of it was compoſed of wonderful little Cells and Hollows, and its Surface was all over covered with a tenacious ſticky Matter, reſembling the Glew of Bees. On the Top was a wide and deep Opening or Entrance (as is ſhewn in the third Figure) ſo that it might properly be called *Apiarium Marinum*, or a *Sea-Bee's Neſt*; for as ſoon as it was brought to Land, it ſwarmed with little b'ewiſh Worms, which by the Heat of the Sun were changed afterwards into ſmall black Flies, or rather Bees; but they flying all away, nothing can be aſſerted as to their making Honey. However, as the little Cells or Combs and waxy Matter of Bees were evidently there, without doubt the Subſtance of the Honey itſelf, or whatever elſe is contained within them, will be diſcovered by the Divers, when they ſhall obſerve theſe Bees-Neſts more curiouſly, and thoroughly examine them at different Seaſons of the Year, in the Places where they are produced.

This is the Subſtance of Piso's Account, which the two Figures before us repreſent; and from thence Dr. Hooke takes Occaſion to enquire, "Whether the Hulk or Caſe "was a Plant, growing before of itſelf at the Bottom of the Sea, out of whoſe Putri- "faction theſe ſtrange Kind of Maggots might be generated? or whether the Seed "of certain Bees, ſinking to the Bottom, might there naturally form itſelf that vege- "table Hive, and take root? or whether it might not be placed there by ſome diving "Fly? or whether it might not be ſome peculiar Propriety of that Plant whereby it "might ripen, or form its vegetable Juice into an Animal Subſtance? or whether it "may not be of the Nature of a Spunge, or rather a Spunge in the Nature of this?"

An Explanation of the Twenty-fifth Plate.

The tufted or Bruſh-horned Gnat.

Bruſh-horned Gnat.

HAVING treated ſo fully on the Generation and Changes of a Gnat, in deſcribing the firſt Figure of the laſt Plate, there is little to do here but to ſhew the ſeveral Parts of that Animal in its perfect State, as its Picture now lies before us.

Dr. Derham ſays *, he obſerved near forty diſtinct Species of Gnats about *Upminſter* in *Eſſex*, and doubtleſs there are many Sorts beſide; but none amongſt them all is perhaps more beautiful or remarkable than the Gnat we are now ſurveying, which is the Male of one of theſe Species.

The Head A is extremely ſmall in Proportion to its Body, and compoſed chiefly of two Cluſters of pearled Eyes of a greeniſh Colour, one of which Cluſters is ſhewn at B, whoſe Pearls or little Eyes are curiouſly ranged like thoſe of large Flies.

Juſt over, and ſomewhat between theſe Eyes, on the Forehead of the Animal, are a Couple of ſmall black Balls, whereof one is expreſſed at C, out of which iſſue two long Horns D, tapering and jointed like the Horns of a Lobſter: From the ſeveral Joints of theſe Horns Multitudes of ſmall ſtiff Hairs iſſue on every Side, in a very regular and beautiful Order, making the Whole appear like the Plant *Equiſetum*, or *Horſe-Tail*. There are alſo two other jointed and briſtled Horns or Feelers, ſtanding before the others, and projecting forwards, ſuch as E E, under which lies the Proboſcis F, being a Caſe covered with long Scales, and concealed under the Gnat's Throat when not made uſe of. Its Side opens, and four Darts are thruſt out thence, occaſionally, one whereof, though exceedingly minute, ſerves for a Sheath to the other three. The Sides of them are extremely ſharp, and they are barbed towards the Point, whoſe Fineneſs is inexpreſſible, and ſcarcely to be diſcerned by the greateſt Magnifier. When a Gnat finds any tender Fruits or Liquors that it likes, it ſucks them through the outer Caſe, without employing the Darts at all; but if it meets with Fleſh, or any Body whoſe Contexture denies Admittance to the Caſe, it ſtings very ſeverely, then ſheaths its Weapons in their Scabbard, and through it ſucks up the Juices flowing from the Wound.

This ſmall Head with the Ornamental and other Parts thereto belonging, is faſtened by a ſhort Neck G, to the Middle of the Thorax, which is large in Proportion to the

* Derham's *Phyſ. Theol.* p. 387.

Animal, and of the Shape repreſented H I K: It is perfectly cruſtaceous, and beſet with little ſtiff Hairs or Briſtles, inſtead of Feathers; and from the under Part thereof proceed ſix hairy Legs L L L L, *&c.* each having ſix Joints, and at the End two little Claws. Theſe Legs are very long and ſlender, and could not therefore be given in the Drawing: Their Feet are all over feathered, in a Manner reſembling a Fiſh's Scales, with Abundance of little black Hairs interſperſed, and appearing ſtubborn like Hog's Briſtles.

From the upper and poſterior Part of the Thorax grow out a Pair of tranſparent, ſlender, oblong Wings *m m*, whoſe Edges are ſurrounded with a Fringe of Feathers; and under each Wing appears a Poiſe or Ballance N, having a round Knob at its Extremity, which leſſens by Degrees into a ſmall Stem, and again grows bigger near its Inſertion under the Wing. Theſe little Bodies vibrate to and fro very nimbly when the Creature moves its Wings, and move ſometimes even when the Wings are quiet, but commonly foretel the Motion of the Wings to follow. As to their Uſe, ſee p. 40.

The Belly or Tail-part is long in Proportion to the Animal, and compoſed of nine *Annuli*, or Partitions, ſhelly, and armed with ſhort Briſtles, as well as adorned with Feathers, moſt curiouſly diſpoſed in Rows. Six of the Diviſions O P Q R S T are tranſparent, and in them the periſtaltic Motions of the Inteſtines are very diſtinguiſhable. A ſmall, clear, white Part is alſo more particularly remarkable at V, which may be ſeen beating like the Heart of ſome larger Animal.

The other three Diviſions W X Y are opake; and in the laſt of them are ſhewn the Figure and Situation of the *Anus*.

An Explanation of the Twenty-Sixth Plate.

The Great-bellyed or Female Gnat.

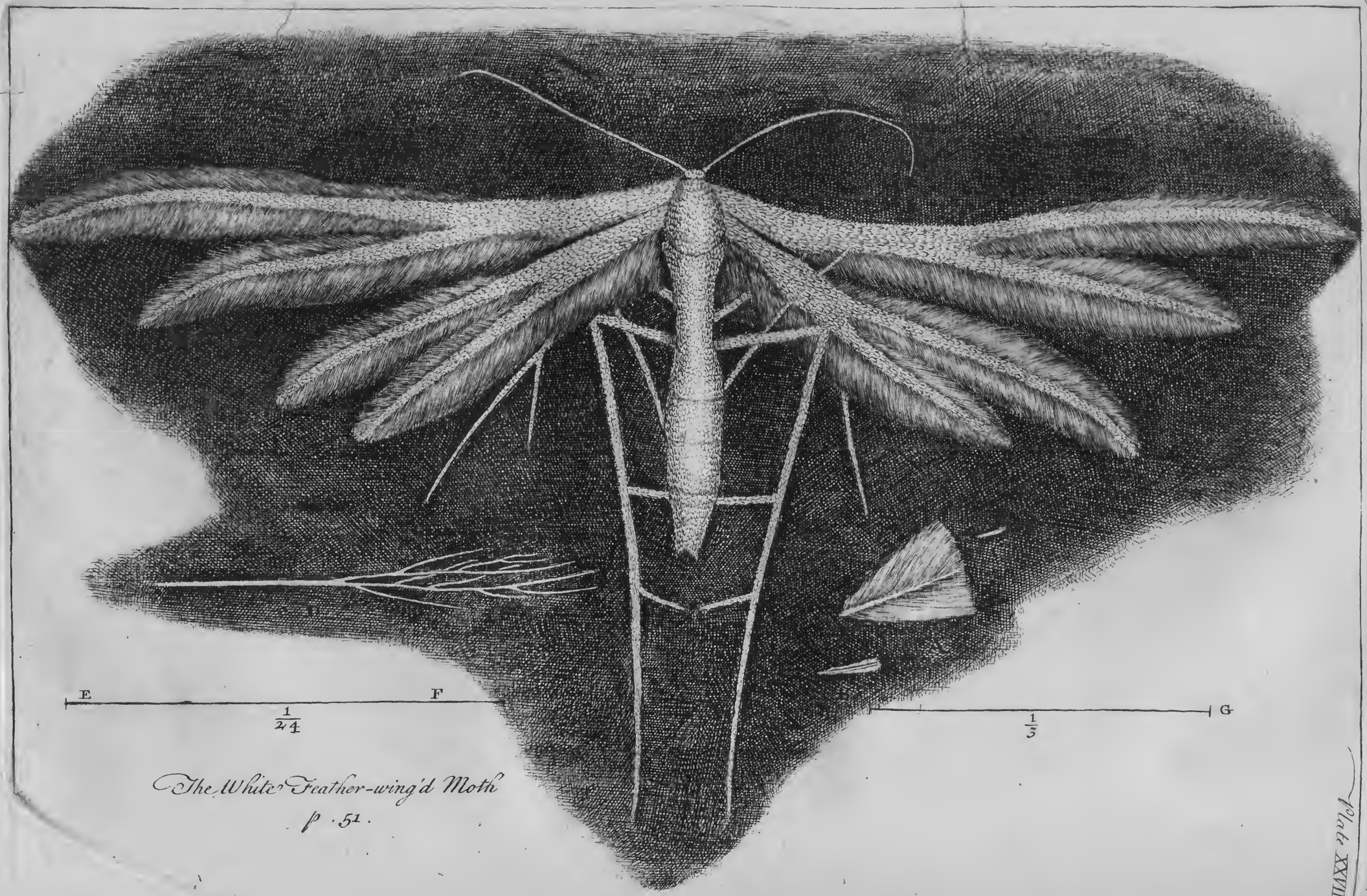
Great-bellyed Gnat.

THE Shape of this Gnat is very different from the preceding, and its Belly, Cheſt, Wings, and every other Part larger, as is commonly the Caſe of the Female in all the Tribes of flying Inſects. Two Pair of Horns appear on the Head of this as well as of the Male, but both Pair here are nearly of the ſame Length, whereas in that the bruſhy Horns are much longer than the other two; and theſe Horns which in the Male are bruſhy and full of Joints, are in the Female only beſet with ſhort ſtrong Briſtles, and have much fewer Articulations.

The Thorax Part of this, as well as of the other, has a very ſtrong and ſhelly Back-piece, which reaches alſo on either Side its Legs: Several jointed Pieces of Shell-work are likewiſe curiouſly and conveniently diſpoſed about its Wings, and ſerve at the ſame Time to give them both Strength and Motion.

Dr. Hooke permitted one of theſe Inſects to penetrate the Skin of his Hand with its Proboſcis, and ſuck out thence as much Blood as it could poſſibly contain, whereby it became red and tranſparent; and all this was done without his ſuffering any Pain, except while the Proboſcis was making its Entrance; which the Doctor uſes as an Argument to prove, that theſe Creatures do not wound the Skin and ſuck the Blood out of Enmity and Revenge; but through mere Neceſſity, and to ſatisfy their Hunger.

The great-bellyed, or female Gnat.
p. 50.



The White Feather-wing'd Moth
p. 51.

Plate XXVII

An EXPLANATION of the TWENTY-SEVENTH PLATE.

The white Feather-winged Moth.

THE pretty Object now under Obſervation was a ſmall white Moth, of a Kind found ſometimes upon the Nettle. It had four Wings, each whereof appeared to conſiſt of two long ſlender Feathers, very elegantly fringed on either Side with exceeding fine and ſmall Hairs, proportionable to the Stems out of which they grew, much like the long Wing-feathers of ſome Birds; their Stems were likewiſe (as in ſuch Feathers) inclined backwards and downwards, in a Manner which the Drawing ſhews. Each Wing in the hindermoſt Pair was about half an Inch in Length; and the foremoſt Pair out-meaſured them by near a Third. Feather-wing'd Moth.

This whole Animal, even to the naked Eye, appeared faſhioned and contrived with exquiſite Regularity and Beauty; but when brought under Examination before the Microſcope, every Part of it exhibited an Elegance beyond Deſcription. The Body, Legs, Horns, and Stems of the Wings were covered all over with Feathers of different Shapes and Sizes, appropriated to the particular Places where they grew. On the leaſt Touch they came off upon the Fingers, and ſtuck like a white Powder between the little *Rugæ* of the Skin, and being view'd by a Glaſs that magnified a great deal (of which E F repreſenting the twenty-fourth Part of an Inch, is the Scale; as G, which repreſents no more than one Third of an Inch, is of a leſſer Magnifier) many of them, and eſpecially thoſe interſperſed among the Hairs of the Wings, were found to conſiſt of a Stalk or Stem in the Middle, and a bruſhy Part on each Side, reſembling the Figure A.

Underneath theſe Feathers the pretty Inſect was covered over with a cruſted Shell, extreamly thin and tender.

Surveying its Wings with the greateſt Magnifier, the Tufts or Hairs which fringe them as it were along the Edges, appeared to be nothing elſe but thick-ſet Rows of little Twigs or Branches, reſembling the peeled or whitened Sprigs of Birch wherewith Whiſks are made for bruſhing Beds and Hangings. The Form of them is ſhewn at D.

The Stems of the Wings, and the greateſt Part of the Body, are covered with Feathers, bruſhy on both Sides like thoſe of a ſmall Bird, as we ſee at the Letter B. The Horns and ſmall Parts of the Legs were adorned with another Sort, which appeared through the ſame Microſcope of the Shape C.

'Tis uncertain whether the component Parts of theſe Feathers are the ſame as thoſe of Birds; but the contrary is moſt probable, ſince Providence ſeems to alter its Method in the Fabrick and Faſhion of the Wings of flying Inſects, compoſing ſome of thin, extended Membranes, as we ſee in the *Libella* or *Dragon-Fly*; and ſuch Membranes are thick beſet with ſhort Hairs or Briſtles in others, as the *Fleſh-Fly*, *&c.* The Wings of *Moths* and *Butterflies* are covered with ſmall Feathers, both on the upper and under Side, diſpoſed with the utmoſt Regularity, almoſt like the Tyles on an Houſe, and adorned with moſt lovely Colours. The Wings of the preſent Subject we ſee divided into four large Feathers: The little *Grey Plume-Moth* has eight or ten ſuch Diviſions, each branched ſomewhat like a Herring-Bone, or a thin-haired Peacock's Feather with the Eye cut off; theſe ſhut together, or open Fan-Faſhion, all lying under one another when cloſed, and by each other's Side when expanded. The Beetle Kinds have *Elytræ* or *Caſe-Wings*, which are hollow Shells in the Form of Butchers Trays; and under them moſt commonly a Pair of fine filmy membraneous ones are folded up, and ſecured from being injured by the Earth, wherein theſe Creatures frequently reſide.

Now 'tis greatly worth obſerving, that wherever a Wing conſiſts of diſcontinued Parts, the Interſtices between ſuch Parts are ſeldom much larger or ſmaller than what we find between theſe Bruſhes; which ſeems to intimate, that the Particles of Air will not eaſily, if at all, paſs through them; and if ſo, they ſerve the Animal as well, nay perhaps better than if they were extended Membranes. Our Author remarks alſo, that *Bats*, *Dragon-Flies*, *Scarabs*, and ſuch other Creatures as have undivided and ſmooth Wings, are furniſhed with ſtronger Muſcles, and move their Wings with much more Strength and Velocity than thoſe *Birds*, *Moths*, and *Butterflies* whoſe Wings are covered with Feathers; and ſuppoſes, "The little Ruggedneſs thereby occaſioned may "help their Wings ſomewhat, by taking better Hold of the Parts of the Air, or not "ſuffering them ſo eaſily to paſs by any other Way than one."

An EXPLANATION of the TWENTY-EIGHTH PLATE.

FIG. 1.

The Back of the long-legg'd Spider.

Long-legg'd Spider.

THE Spider we are about to deſcribe is that found frequently in Fields and Gardens in the Summer and Autumn Seaſons, having eight Legs, extremely long and ſlender, wherewith it ſtrides at a great rate over the Graſs and Herbs. Its Body is very ſmall in proportion to its Legs, in the Center of which it is lifted up on high, as it were on ſo many Stilts. It appears flattiſh, of a grey Colour, and nearly round or oval to the naked Eye; but the Microſcope ſhews the Shell of its Back to be heptangular and ſpeckled. Many know it by the Name of the *Carter*, *Shepherd-Spider*, or *Field-Spider*.

This Spider is moſt remarkable for its Eyes and its long Legs; of both which an Account will be given in due Order. The Number of Eyes in Spiders differs according to their different Species; ſome having eight or ten, ſome ſix, and others no more than four placed in their Fore-part or Head, which is without a Neck; but this under Examination has only a ſingle Pair, and thoſe too not ſituated upon the Fore-front, as in other Sorts, but on a Protuberance (which perhaps may be the Head) riſing out of the Middle of the Top of its Back, as in the Figure B B.

PLATE XXVIII. FIG. 2.

The Eyes of the long-legg'd Spider.

Eyes of the long legg'd Spider.

IN order to give a more ſatisfactory View of theſe Eyes, and their extraordinary Situation, another Drawing is preſented, where the two Eyes B B are placed, back to back, with the tranſparent Parts or Pupils looking on either ſide, but rather forwards than backwards, fixed on the Summit of the Neck C, which is an Eminence on the Middle of the Protuberance D D, and making therewith ſomewhat more than the Height of the tranſverſe Diameter of the Eye.

The Structure of theſe Eyes reſembles that of larger *binocular* Animals, having a Cornea very ſmooth and circular, with a black Pupil in the midſt thereof, incircled with a kind of grey *Iris*. The Eyes of other Spiders are immoveable, nor is it poſſible theſe can be turned about in any manner, as the Neck whereon they ſtand is covered and ſtiffened with a cruſty Shell; but this Defect is probably ſupplied by the Roundneſs of the *Cornea*, and the Height of their Situation above the Body, whereby 'tis likely each Eye may perceive, though not diſtinctly, nearly a compleat Hemiſphere; and that having ſo ſmall and round a Body on ſuch long Legs, it is able ſo to wind and turn it as to ſee every thing diſtinct.---All Spiders are without Eyelids, or any Pearling in their Eyes.

The beſt Way of coming at a proper Sight of this wonderful Object, is by breaking off all the Legs, as in *Fig.* 1. and then placing it before the Microſcope.

PLATE XXVIII. FIG. 3.

The Belly of the long-legg'd Spider.

Belly of the long-legg'd Spider.

WE ſee the ſame Spider turned here with its Belly upwards, to ſhew in what manner the Legs are joined on to the Under-Part of the Thorax: And this is all could be given of them in the Figure, their enormous Length rendering it impoſſible to bring them into any ſizeable Drawing, as they appeared magnified by the Microſcope; each Leg of the preſent Spider being above ſixteen times the Length of its whole Body; and there are ſome that have them much longer in proportion. Its Legs are jointed like thoſe of a Crab, but all the Parts of them are prodigiouſly more lengthned out: The End of each, where inſerted under the *Thorax*, is a hard protuberant conical Caſe or Shell, and ſomewhat in the Shape of a Muſcle-Shell, as will better be underſtood by viewing the Parts, B B B B, *&c.*

The Middle of the *Thorax* riſes very much at M, making a kind of blunt Cone, whereof M may be ſuppoſed the *Apex:* About which greater Cone of the Body, the

Fig: 2.

The Eyes placed on an Eminence Back to Back p. 52.

Fig: 1

The long Legged Spider, with its Back uppermost, to shew its curious Eyes. p. 52.

Plate XXVIII

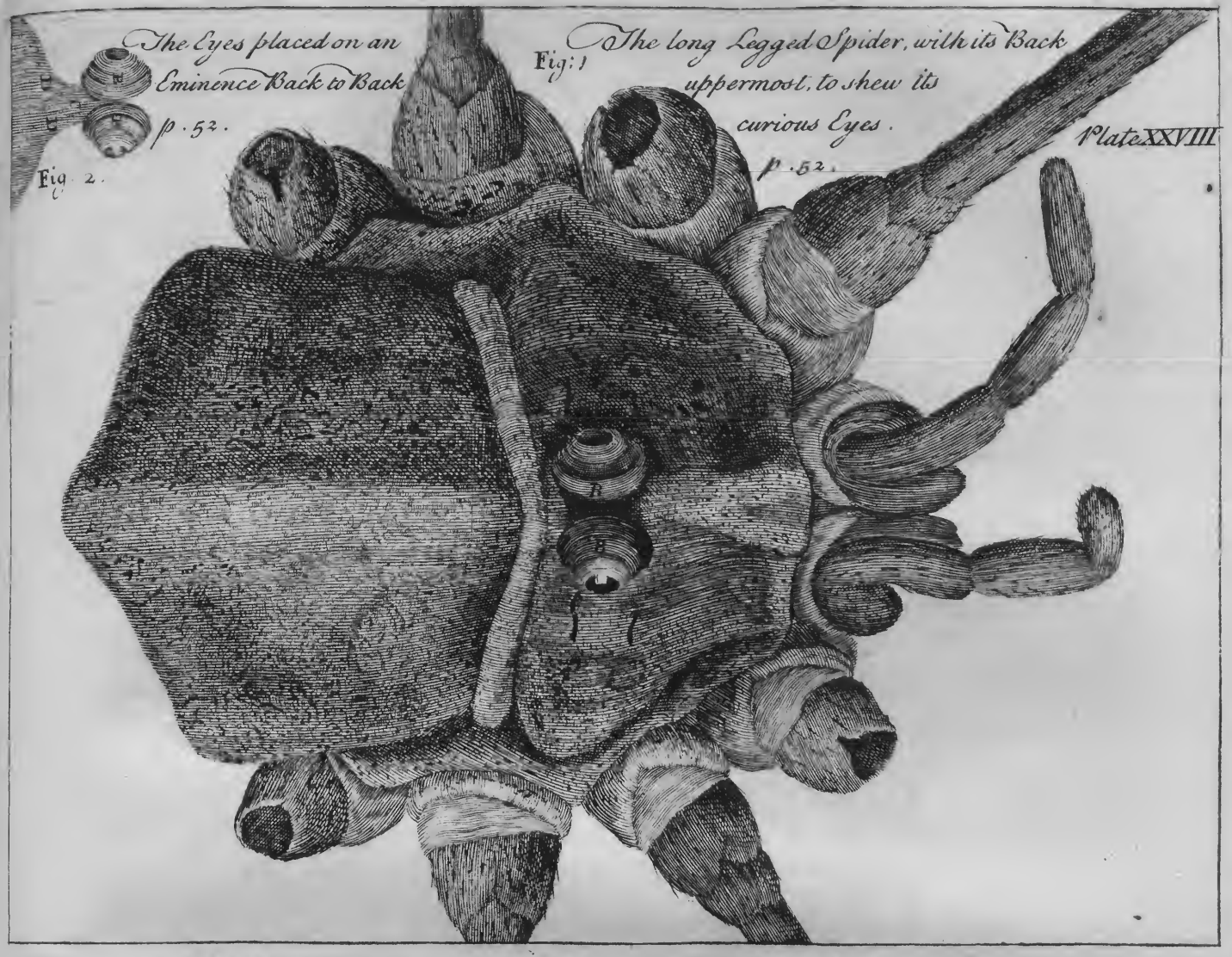
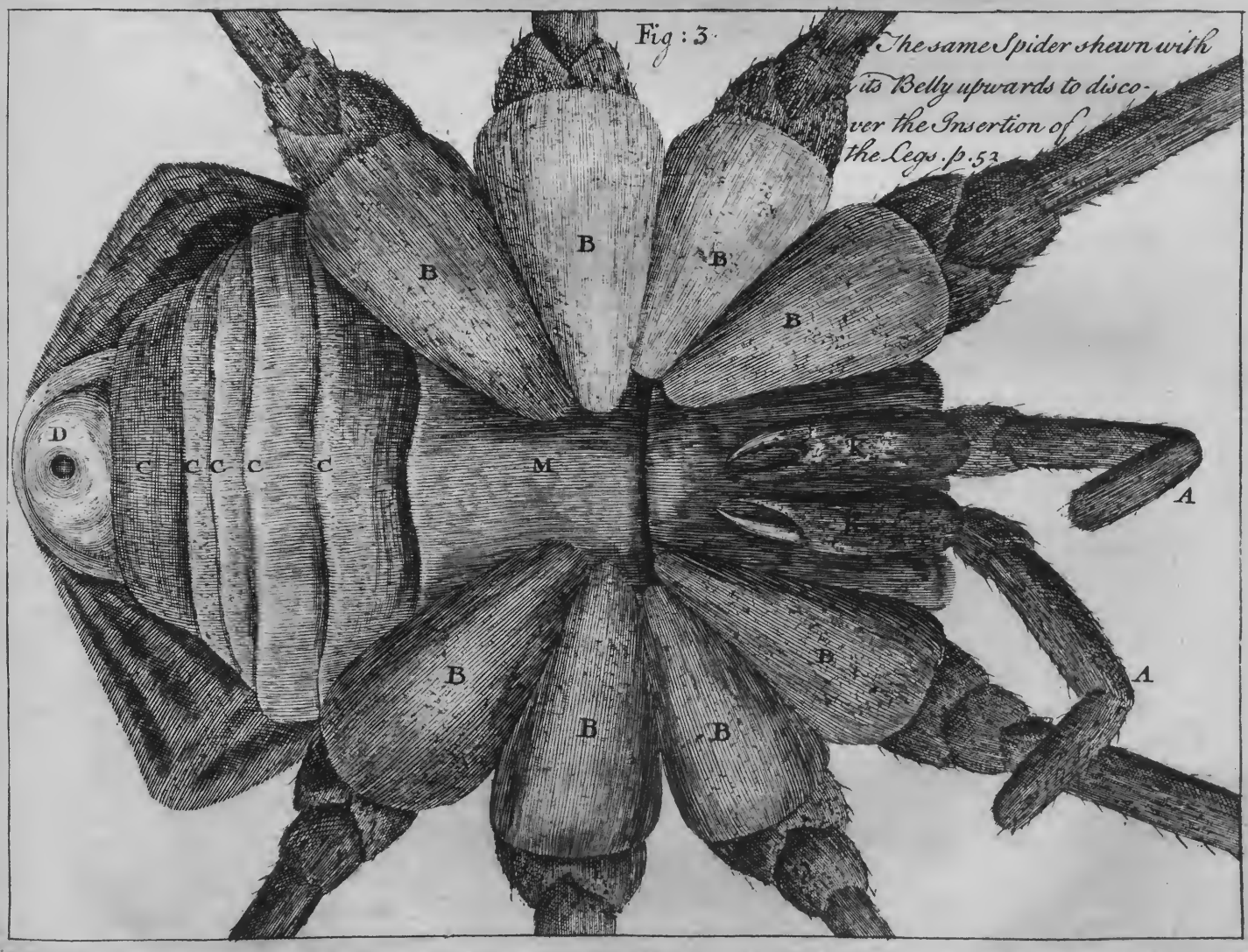


Fig: 3

The same Spider shewn with its Belly upwards to discover the Insertion of the Legs. p. 53



ſmaller Cones of the Legs are placed, and extended almoſt to its Top, in ſuch a wonderful manner, as does not a little manifeſt the Wiſdom that contrived them ſo. For theſe long Levers the Legs having no counter-acting long Body on the contrary Side of the Centers whereon they move, muſt neceſſarily require a vaſt Strength to give them Motion, and keep the Body ballanced and ſuſpended: inſomuch that if a Man's Body were to be ſuſpended by ſuch a Contrivance, an hundred and fifty times the Strength of a Man would be unſufficient to ſupport it and keep it from falling. To ſupply theſe Legs, therefore, with proper Strength, each is furniſhed with a large ſhelly Caſe, which includes a very large and ſtrong Muſcle; whereby this little Creature is enabled, not only to ſuſpend its Body on two or three of its Legs, but to move it very ſwiftly over the Tops of Graſs and Leaves.

Beſides its eight Legs, this, like all other Sorts of Spiders, has two very ſhort Limbs coming out before, which may be called its Arms; ſince the Uſe of them is not for walking, but to hold and turn its Prey. Each of theſe has three ſhort Joints, is thickly covered with Hairs, and commonly appears bending as in the Figure A A.

The Picture ſhews us likewiſe two double Claws K K in the Fore-part of its Head, reſembling very much thoſe of a Scorpion, but differing a great deal from the Pincers or Claws in moſt Kinds of Spiders, which ſtand horizontally, and ſerve to ſeize and wound their Prey, and which when not made uſe of, are concealed in two Caſes contrived for their Reception, whereinto they fold like a Claſp-Knife, and lie between a double Row of Teeth. Theſe Claws before us are undoubtedly for the ſame purpoſe, though particularly adapted to the Manner of this Creature's taking its Prey, which it does by throwing its Body at once upon it, inſtead of catching it with its Arms.

C C C C C, are certain Foldings in the Belly or Tail-Part of the Spider. Thoſe on the upper Side are all covered and defended by a ſtrong Shell, as may be ſeen in the firſt Figure.

D, the Anus, whence little round Fæces or Pellets are excluded.

There are many Species of Spiders varying from one another in Size, Colour, Figure, Way of Living, and many other Particularities, which would be tedious and improper to mention in this Place; but the *Hunting-Spider* is ſo extraordinary, that ſome little Deſcription of it, with an Account of Mr. Evelyn's Obſervations on its Cunning and Dexterity, may, 'tis hoped, at leaſt not diſoblige the curious Reader.

Hunting-Spider.

IT is a ſmall grey Spider, with Spots of Black over its whole Body, which are found by the Microſcope to be made up of Feathers like thoſe on the Wings of Butterflies: Its Motion is very nimble, ſometimes running, leaping at other times almoſt like a Graſhopper; then ſtopping ſhort, turning round on its hinder Legs with great Agility, and ſeeming to face every way. It has ſix Eyes; two in Front, looking directly forwards; two by the Sides of theſe, pointing both forward and ſideways; and two others on the Middle of its Back, which are the largeſt of all, and look backwards and ſideways. They are all black, ſpherical, and finely poliſhed. Hunting-Spider.

Theſe Spiders are a Sort of *Lupi*, which ſpin little or no Webs, but find a Harbour in Chinks and Crevices of Walls and Houſes. Mr. Evelyn ſays, he frequently obſerved ſome of them at *Rome*, which eſpying a Fly, at three or four Yards Diſtance, upon the Balcony where he ſtood, would not make directly to her, but crawl underneath the Rail, till being got exactly againſt her, it would ſteal up, and ſpringing on her, ſeldom miſs its Aim. But if it chanced to want any thing of being directly oppoſite to the Fly, after having peeped, it would immediately ſlink down again, and taking better Notice, would come the next time directly on the Fly's Back. But if the Fly happened not to be within its Leap, the Spider would move towards her ſo ſoftly, that the Motion of the Shadow on a Dial is ſcarcely more imperceptible. However, if the Fly moved, the Spider would move alſo in the ſame proportion, either forwards, backwards, or on either ſide, like a well-managed Horſe, without turning its Body at all; keeping the ſame juſt Time with the Fly's Motion as if the ſame Soul animated the Bodies of them both. But if the capricious Fly took Wing, and pitched upon ſome other Place behind the Spider, it would whirl its Body round with all imaginable Swiftneſs, pointing its Head always towards the Fly; tho' ſeemingly as immoveable, as if it had been a Nail driven into the Wood. Being got within a due Diſtance, by ſuch undiſcernable Approaches, it would then make a Leap, ſwift as Lightning, upon the Fly, and catching him by the Pole, never afterwards quit its hold till its Belly was quite full, when it would carry the Remainder home.

He has likewiſe ſeen them inſtructing their young ones how to hunt, and correcting them for Non-obſervance: And when any of the old ones chanced to miſs a Leap, they would run away, as if aſhamed, into their Crannies, and not come out again for four or five Hours.

Theſe Spiders are to be found with us on Garden-Walls, in the Spring, when the Weather is very hot, but they are not near ſo eager of hunting as they are in *Italy*.

All Spiders are Creatures of Prey, though they have different Ways of catching it; ſome by leaping, as the Sort juſt now deſcribed; others by running on it as the *Shepherd-Spider*; but the greateſt Number, by weaving Nets or Cob-webs, wherein they lie in Ambuſh till Flies or other Inſects are entangled, and then ruſh out and ſeize them.

Spiders that make Webs have five little Teats or Nipples near the Extremity of the Tail, from whence a gummy Liquor iſſues, which adheres to any thing it is preſſed againſt, and being drawn out, hardens inſtantly in the Air, becoming a String or Thread ſtrong enough to bear five or ſix times the Weight of the Spider's Body, and yet of an amazing Fineneſs.

They all lay Eggs, depoſited in Bags, which they brood over, and guard with the utmoſt Solicitude, and run away with at any Approach of Danger *. The Bags of ſome are round white Balls carried under their Bellies; thoſe of others appear like a little leathern Cap, faſtned to a Leaf, or againſt a Wall: Others again have two Bags of a reddiſh Colour ſuſpended in ſome Cranny by a Couple of Threads, with dry Leaves properly diſpoſed to ſhelter them; and there are ſtill other Varieties.

When hatched, the *little Spiders* come out compleatly formed, and run about very nimbly; ſome Kinds being then exceeding hairy, and others perfectly ſmooth. They ſhed their Skins ſeveral times, and increaſe in Size, but never change their Shape at all.

An Explanation of the Twenty-Ninth Plate.

The Ant, Emmet, or Piſmire.

Ant. THE Ant here delineated was of a large Kind, more than half the Bigneſs of an Earwig, of a dark-brown or reddiſh Colour, and extremely nimble. A numerous Colony of them was diſcovered under the Root of a Tree, whence they would frequently ſally out in large Parties, and after doing much Miſchief amongſt the Fruits and Flowers, and foraging over the whole Garden, would very readily find their Way back to the Neſt again.

This Inſect is naturally divided into the Head-Part, the Thorax or Breaſt, and the Belly or Tail; each of which joins to the other by a very ſlender Ligament.

A A, The Ant's large Head; in which appear a Couple of globular and prominent black Eyes, moſt curiouſly pearled, B B. Out of the Noſe or Snout iſſue two pretty Horns C C, each having twelve Joints.

Its Jaws are Saw-like or indented, with little Teeth that exactly tally, opening ſideways, and capable of gaping very wide aſunder, D D. By the Help of theſe it is frequently ſeen graſping and tranſporting Bodies of three or four times its own Bulk and Weight.

The Thorax ſeemed to conſiſt of three riſing Parts E F G, and from theſe Parts three Legs, O O O, *&c.* ſhaped like the Legs of a Fly, come forth on either ſide.

The Belly or Tail-Part, I I I, was larger than the other two, and joined to the Thorax by a very ſmall conical Veſſel H, which ſeemed a diſtinct Part of the Animal, like a kind of looſe Shell interpoſed to keep the Thorax from the Belly.

Two Circles of a lighter Colour went round the Tail-Part, as ſhewn K K.

There are ſeveral Species of Ants, differing both in Size and Colour: This given by the Doctor ſeems to be the large Wood-Ant. Towards the End of Summer many of them are ſeen having four Wings. Thoſe Swammerdam ſays, are Males.

The

* *Memoires de l'Acad. des Scien. Mr. de Reaumur*, 1710.

Plate XXIX.

An Ant, Emmet, or Pismire magnified.

p. 54.

The Tail of theſe Creatures is armed with a Sting, which they uſe however only when provoked: but then a poiſonous Liquor is conveyed into the Wound, occaſioning Pain and Swelling. The whole Body is caſed over with a kind of Armour, ſo hard as ſcarce to be penetrated by a Lancet, thick-ſet with Multitudes of ſmall white ſhining Briſtles; the Legs, Horns, Head, *&c.* are alſo full of Hairs, but ſmaller and darker.

This Kind of Ant, our Author ſays, would ſtand up on its hinder Legs, and raiſe its Head as high as poſſible, in order ſeemingly to enable it to ſee the farther:----And putting his Finger towards them, they at firſt would all run to within a little Diſtance of it, where they would ſtand round at Bay, and ſmell, and conſider, as it were, whether any of them ſhould proceed farther; till one more daring than the reſt venturing to climb it, all the others would have followed immediately, had he not prevented them. They are ſtrong, vigorous, indefatigable, and very tenacious of Life; for a Trial of which one of them was put into Spirit of Wine, where after ſtruggling for a pretty while, ſome Bubbles iſſued from its Mouth, and it remained quite motionleſs. It was left notwithſtanding for above an Hour in the Spirit, when being taken out it ſeemed dead for about another Hour; but then on a ſudden, like one that wakes out of a drunken Sleep, it revived and ran away. It was plunged again in the Spirit of Wine, where all the ſame Appearances were repeated, and on being taken out, after ſome time it came to Life in the ſame manner as before. On this it was the third time immerged in the ſame Liquor, (which is almoſt inſtant Death to moſt other Inſects) and ſuffered to lie therein ſome Hours: But, notwithſtanding, when it was taken out again, and had lain in a dry Place for three or four Hours, it recovered Life and Motion.

Ants live together in Colonies like Bees, and ſeem to have amongſt them the ſame Kind of regular Government and Order. They have been famous in all Ages for their Induſtry in Summer, and their provident Care to lay up Stores of Suſtenance againſt the Winter Seaſon. There are none idle among them, but all of them are continually employed for the Utility of the Commonwealth. † We ſhall ſee one loaded with the Kernel of ſome Fruit, another bending beneath the Weight of a dead Gnat; and ſometimes ſeveral together labouring to drag along the Carcaſs of ſome larger Inſect. What can't be removed they eat upon the Spot, and thereby ſave ſo much of their own Stores, but carry home all that is capable of being preſerved.

The whole Colony is not permitted to make Excurſions at random. Some are detached as Scouts to gain Intelligence, and according to the Tidings they bring, all the Community are upon the March; which, as well as their Return, is under certain Regulations.

All the Ancients mention their amaſſing Stores of Corn and other Grain that will keep, and their gnawing away the Germen of every Grain, to prevent its ſhooting up; and indeed we ſhall ſee ſometimes Ants carrying or puſhing before them Grains of Wheat or Barley much larger than themſelves. ALDROVANDUS alſo aſſures us, that he has ſeen their Granary; but as many of the Moderns, after diligent Search, have been unable to diſcover it, we have ſome reaſon to apprehend there may poſſibly be a Miſtake as to this Particular, and that the *Nymphæ* which they often run about with in their Mouths, and which are ſometimes of a yellow Colour, may have been taken for Corn without Buds, and ſwelled out by Moiſture.

During the Winter-Seaſon they conceal themſelves in their Burrows under ground, where 'tis probable they lie torpid or buried in Sleep, like Multitudes of other Inſects, and conſequently eat very little. Their Induſtry, therefore, in ſtoring up Proviſions, is not ſo much intended to guard againſt the Winter, as to ſupply their young ones during the Harveſt with neceſſary Suſtenance. For they are regarded as Children of the State, and nouriſhed as ſoon as they leave the Egg with an Aſſiduity that employs the whole Nation.

The Eggs of an Ant are of an oblong oval Figure, about the Size of Grains of Sand. From theſe little Worms are hatched, which after receiving their Food brought to them in common, and diſtributed in equal Proportions, leave off eating, wrap themſelves up in a white Web, and ſometimes in one that is yellow, and become *Aureliæ*; under which Form many People fancy they are the Eggs of Ants.

Whilſt in the *Aurelia* State, they are guarded with the utmoſt Care, and removed from time to time, as the Circumſtances of Things require. For the Ants either raiſe them towards the Surface of the Earth, or ſink them to a Diſtance from it, as the Seaſon is warm or cold, rainy or dry.

† *Spectacle de la Nat.* Dial. VIII.

'Tis

'Tis with incredible Care and natural Affection, ſays SWAMMERDAM, that Ants nouriſh and defend their *Aureliæ*, carrying them almoſt conſtantly about with them in their Mouths, leſt any Miſchief ſhould happen to them. He tells us, that keeping ſome of them with their young ones in his Study, incloſed in a Glaſs-Veſſel filled with Earth, he obſerved, with great Delight, that as the Superficies of the Earth grew dry, they carried their young ones deeper: And when he poured on ſome Water, 'twas amazing to behold with how much Affection, Solicitude, and Eagerneſs, they employed their utmoſt Endeavours to remove them to ſome ſafer and drier Place. He often ſaw, after they had wanted Water for ſome Days, that upon wetting the Earth a little, they would bring their young ones to that Place, where he could diſtinctly ſee them move and ſuck in the Moiſture. He tried frequently to bring up ſome *Aureliæ* himſelf, but was always unſucceſsful; for though he took them when full of Nouriſhment, no artificial Heat he could contrive was capable of making them come forth without the Aſſiſtance of the Ants themſelves.

Sir EDWARD KING, who was very curious in examining the Generation of theſe Creatures, obſerves *, that in a Summer-Morning they bring up their *Aureliæ* towards the Top of the Bank; ſo that from Ten o' Clock till Five or Six in the Afternoon, you may find them near the Top, and commonly on the South-ſide. But towards Seven or Eight at Night, if it be cool, or likely to rain, you may dig a Foot before you come at them †.

But nothing can be a ſtronger Proof of the paternal Affection of theſe Creatures towards their Young, than what is ſo very common that there are few People of the leaſt Obſervation who have not ſeen it with their own Eyes: What I mean is, their running away with them in their Mouths whenever their Burrows are dug up or diſturbed; bearing even Blows, and loſing their own Lives, rather than they will leave them in any Danger.

An EXPLANATION of the THIRTIETH PLATE.

FIG. 1.

The Wandering Mite.

Wandering Mite.

THE little Animal preſented to us in this Picture is called by Dr. HOOKE, who was the firſt Diſcoverer of it, by the Name of the *Wandering Mite*, from its Likeneſs both in Size and Shape to that very minute Inſect. In *September* and *October* 1661, he perceived ſeveral of this Species wandering too and fro over the Glaſs-Squares of his Chamber-Window at *Oxford*; and in the ſame Months of the Year 1663, he obſerved many of the ſame Creatures creeping on a Glaſs-Window at *London*; and examining the ſubjacent Wall without the Window, he found Multitudes of them there alſo, running about among ſome ſmall Tufts of green Moſs, as well as amongſt a curious blue and yellow minute Species of *Muſhroom*, or *Jews-Ear*, which grew upon the Wall.

This Creature appeared to the naked Eye to be a ſort of black Mite, tho' nimbler and ſtronger much than thoſe found in Cheeſe; but when viewed by the Microſcope, it was found to be finely cruſted, or, as it were, caſed over with Armour.

The Belly Part A, which was very large in proportion to the reſt of the Animal, ſeemed a protuberant oval Shell, thickly pitted with ſmall Hollows, and covered all over with little white Briſtles, whoſe Points were directed backwards.

The Middle-Part or *Thorax* was extremely ſmall in Compariſon either of the Head or Belly, being only what we ſee covered by the two Shells B B, though ſpreading ſomewhat larger underneath.---It is wonderful to conſider with what Variety Nature proportions the Head, Thorax, and Belly of different Animals, in a manner unaccountable to us, but doubtleſs exactly ſuited to the Way of Living and Happineſs of every diſtinct Species.

* Vid. *Phil. Tranſ.* N° 23. † *Swammard. Epil. ad Hiſt. Inſect.* p. 153.

Cloth Worm or Nympha of the Cloaths Moth. p. 58

A

A

B

B

Fig: 3.

C

c

c

c

Wandering Mite. p. 56.

Fig: 1.

D D

C

B B

A

Crab-like Insect. p. 57

Fig: 2.

B

E E

a

a

D F D

a

G

G

H H

H H

H H

H H

H H

H H

a

a

a

a

a

C

a

B

The Head was ſhaped ſomewhat like a Mite's, having a long Snout in the manner of a Hog's, with a knobbed Ridge along the Middle of it, C. This Ridge was beſet on both ſides with many ſmall Briſtles all pointing forwards. Two very large and long Briſtles or Horns, D D, proceeded alſo from the Top of the Head, juſt above the Eyes, and pointed the ſame way.

Its Legs were eight in Number, iſſuing from the Thorax, and each of them armed with a very ſharp Talon or Claw at its Extremity, which in walking faſtned into the Pores of any Body it went over. Theſe Legs were furniſhed at every Joint with great Numbers of ſmall Hairs, all directed and pointing towards the Claws.

Our Author tells us, that by finding theſe Inſects, he apprehended he had diſcovered the Vagabond Parents of ſuch Mites as we meet with on Cheeſes, Meal, Corn, Seeds, muſty Barrels, muſty Leather, and many other Bodies; which little Creatures wandering about at random, and finding an agreeable Paſture, might ſpend their Lives and leave a plentiful Offspring behind them on different putrid Subſtances; and that the new Generations, by ſuch Alteration in their Habitation and Diet, may, like Colonies brought from the Southern into the Northern Countries, or *vice verſa*, after ſome Deſcents, change both their Shape and Colour.

We leave the Probability of this Suppoſition to be conſidered by the Curious, who will better be enabled to paſs their Judgment, by comparing this Figure with that of the *Cheeſe-Mite*, which is given in the next Plate.

PLATE XXX. FIG. 2.

The Crab-like Inſect.

Crab-like Inſect.

DR. HOOKE informs us, that obſerving, one Day in *September*, a very ſmall Inſect creeping ſlowly over a Book he was reading, he placed it before his Microſcope, and found its Form ſo unuſual that he made a Drawing of it.

Its Size was about the Bigneſs of a large Mite, but ſomewhat longer. It had ten Legs, eight whereof, *a a a a a a a a*, terminated with exceeding ſharp Claws, and were thoſe upon which it walked: They appeared much like the ſmall Legs of a Crab, both as to their Hairineſs and the Number of their Joints; and this Inſect reſembled a Crab in many other Particulars. For the two foremoſt and largeſt Legs B B, which appeared to grow from the Head, where the Horns of other Animals come out, were formed exactly in the manner of a Crabs larger Claws, being ſhaped and jointed as in the Picture, and furniſhed with Pincers C C, which the Animal opened and ſhut at pleaſure. It ſeemed to employ theſe two Horns or Claws both as Feelers and Holders; for in its Walking it carried them aloft and extended forward, moving them too and fro, as a Man blind-folded would do his Hands to feel out his Way before him; and if a Hair was put to them, they would readily catch hold of it, and ſeem to hold it faſt.

D D were two black Spots, which, by their Form and the bright Reflections from them, ſeemed to be the Eyes.

E E, two Pair of Forceps placed near its Mouth, in Readineſs to catch or hold its Prey, and convey it thither.

The whole Inſect was caſed over with ſhelly Coverings, like other cruſtaceous Animals. The Head F appeared a kind of ſcaly Shell, and ended in a ſharp Snout like that of a Lobſter. The Thorax G G conſiſted of two ſmooth circular Shells or Rings, and the Belly of eight more, thickly covered with little Knobs or Protuberancies.

Whether any Wings were concealed under theſe laſt Shells could no way be diſcovered; but from its Number of Legs the contrary is moſt probable; for ſcarce any winged Inſect is found with eight Legs, whereas ſuch whoſe Legs are no more than ſix, are uſually ſupplied with Wings.

This Inſect is rarely found.

PLATE XXX. FIG. 3.

Cloth-Worm, or Moth.

Cloth-Worm. THIS pretty Inſect is the *Tinea Argentea*, or *Cloaths-Moth* in its Worm-State, tho' called the *Book-Worm* by Dr. HOOKE, from his having often ſeen it running amongſt Books and Papers. It is of a white-ſhining Silver or Pearl-Colour, is commonly found lurking in Holes or Crannies, and whenever it is diſturbed, ſcuds away very nimbly to ſeek ſome other Hiding-Place.

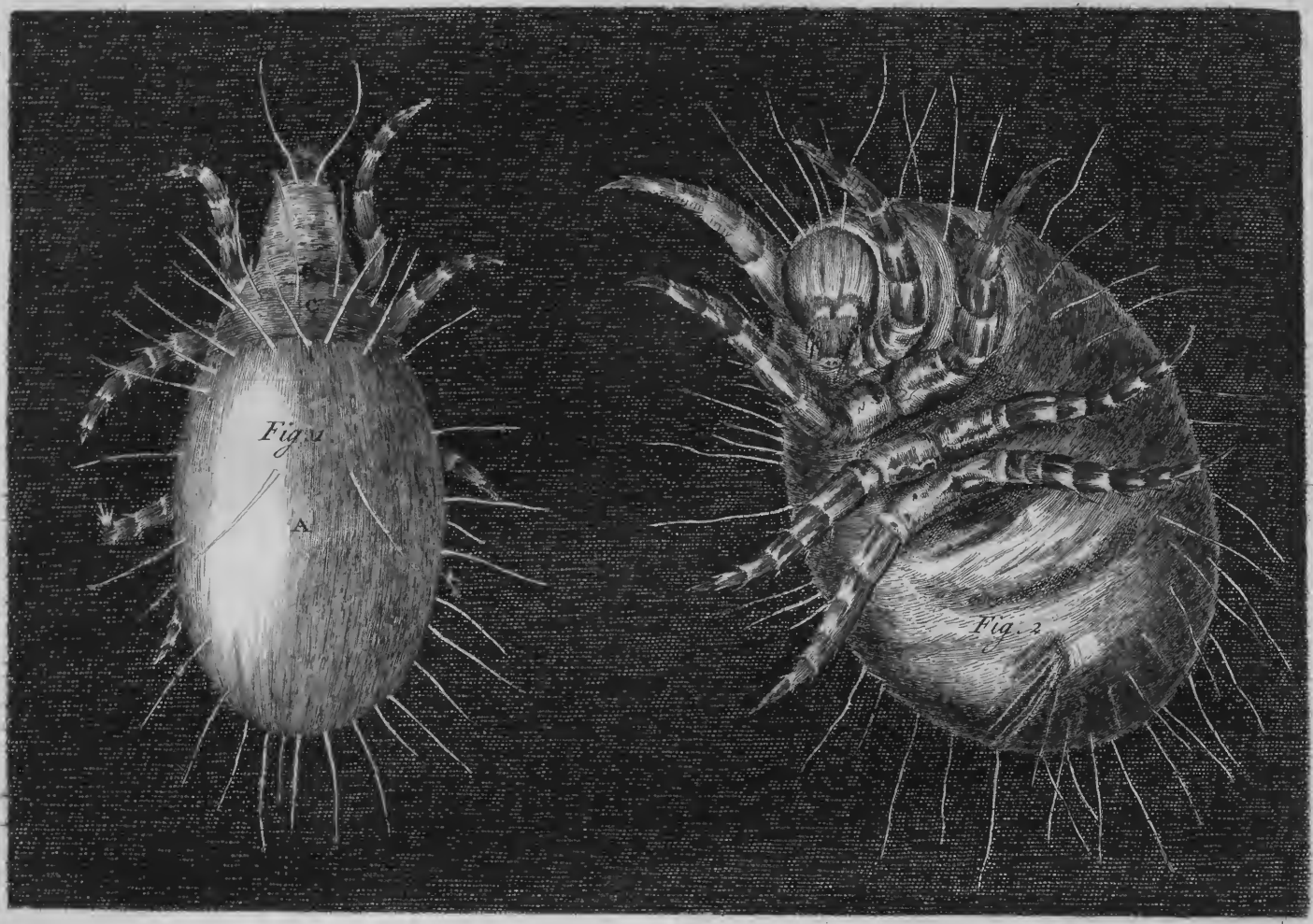
The Head-Part to the naked Eye appears with a blunt End, with a Body growing ſmaller and ſmaller, and tapering towards the Tail; but when the Microſcope is employed, the little blunt Head of this Inſect is found furniſhed on either ſide with a Cluſter of pearled Eyes; though the Pearls are fewer than in other Inſects whoſe Eyes are thus conſtructed. Each Eye is ſurrounded with a Row of ſmall Hairs, much like the *Cilia* or Hairs of the Eyelids, and perhaps may ſerve for the ſame purpoſe: It has two long ſtrait Horns, A A, tapering towards the Top, moſt curiouſly jointed, with Rings or Circles of Hairs iſſuing from and encompaſſing each Joint, and ſeveral larger Briſtles interſperſed here and there amongſt them. Beſides theſe, it has alſo two ſhorter Horns or Feelers B B, jointed and incircled with Hairs like the former, but without any Briſtles, and ending with blunted Points.

The conical Body of this Creature conſiſts of fourteen ſeveral Shells or Shields, folding over each other like jointed Pieces of Armour, and covering the whole Body; and each of theſe is again tiled over, as it were, with a Multitude of thin tranſparent Scales, which, from the great Number of their reflecting Surfaces, make the whole Animal appear of a Pearl-Colour. Its Sides are armed with many long, ſharp and ſtrong Briſtles. From the hinder Part three Tails proceed, C C C, reſembling in all reſpects, the two longer Horns growing from the Head.

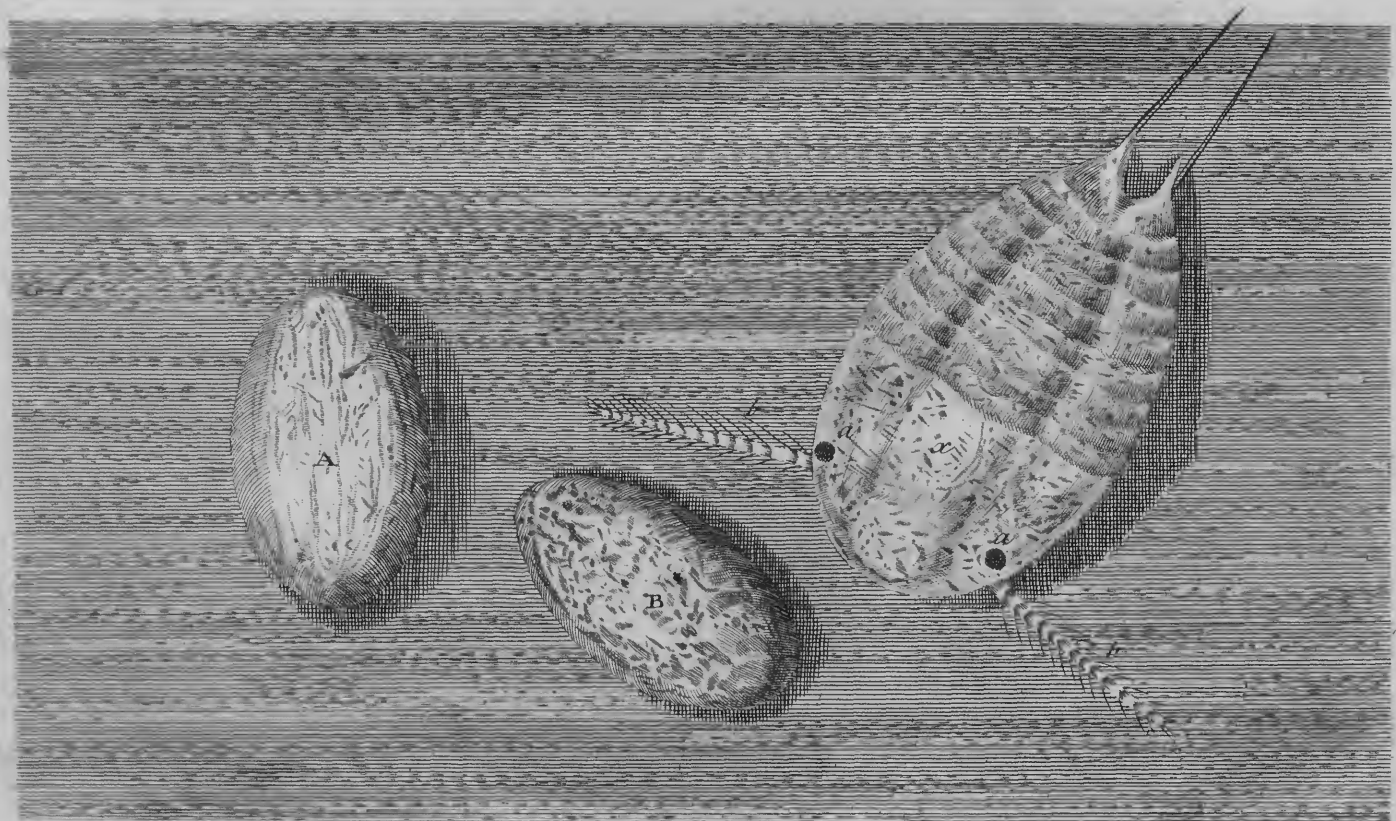
Notwithſtanding the Suppoſition of our Author, that this Creature feeds upon Papers and the Covers of Books, and makes the Holes that are oftentimes found therein, Mr. ALBIN aſſerts it to be the very Animal that eats Cloths or Stuffs made of Woollen; and ſays, it is produced from a ſmall grey ſpeckled Moth, that flies about in the Night, creeps in among woollen Things, and there lays her Eggs; which after a time are hatched by the natural Heat of the Woollen, and the little Brood feed thereon till they change into flying Moths like their Parent.

As for the Holes in Books and Papers, they are probably made by the ſame little nimble minute Inſect which eats Holes of a like Size and Form in Picture-Frames, Chair-Frames, and other Things made of Wood, and which, from its Reſemblance in Shape and Bigneſs, is called the little *Wood-Louſe*.

A Cheese Mite with its Back, & another with its Belly uppermost. p. 59. Plate XXXI.



A Small Creature hatched on a Vine. p. 60.



An Explanation of the Thirty-First Plate.

FIG. 1.

A Cheeſe-Mite with its Back uppermoſt.

Cheeſe-Mite on its Belly.

THERE are ſeveral Species of minute Creatures, which from their extreme Smallneſs and ſome Reſemblance in Form, are called by the general Name of *Mites*. One Sort of theſe was ſhewn and deſcribed in the *Plate* immediately preceding, and there called the *Wandering-Mite*, from its being found abroad, and rambling as it were at large.

The Figure under our Eye at preſent is one of the Mites found in Cheeſe, placed in a crawling Poſture with the Back-Part uppermoſt. The Shape is a kind of Oval, but more obtuſe at the Tail-End. It has three Regions or Parts as in larger Inſects. The hinder Part or Belly A ſeems covered with one intire Shell, ſo curiouſly poliſhed, that, as in a convex Looking-Glaſs, it ſhews the Pictures of all the Objects round about. The Middle, or Cheſt, ſeems divided and covered with two Shells B C, which running one within the other, the Mite is able to draw in or thruſt out as it finds Occaſion; and it can do the ſame with its Snout D.

The whole Body is cruſtaceous, of a Pearl-Colour, and pretty tranſparent; ſo that divers Motions of the Inteſtines may be diſcerned within it. Several long white Hairs grow out from it in different Places, ſome of which are longer than the whole Animal, though in the Drawing they are not ſo repreſented. They all appear pretty ſtrait and pliable, excepting two that iſſue from the Head-Part, and ſeem to be the Horns.

PLATE XXXI. FIG. 2.

A Cheeſe-Mite with its Belly upwards.

A Mite on its Back.

THIS ſecond Figure ſhews a Mite that was ſomewhat larger than the former, fixed on the Back-Part of its Tail, by means of a little *Mouth-Glew* rubbed on the Object Plate, with Deſign to exhibit the Inſertion of the Legs, and ſuch other Particulars as eſcaped the firſt Examination.

To the ſmall End of the oval Body the Head is faſtned, (very little in proportion to the other Parts) where a Pair of Eyes may be diſtinguiſhed, appearing like two dark minute Specks. The Mouth reſembles that of a Mole, opening and ſhutting occaſionally, and when open appearing red within. It has little Briſtles at the Snout, and if one has the good Luck to view it at a proper Time, one ſhall ſee it munching and chewing the Cud like a *Guinea-Pig*.

It is furniſhed with eight well-ſhaped and proportioned Legs covered with a very tranſparent Shell: Each Leg has eight Joints, fringed as it were with ſeveral ſmall Hairs. The Structure of the Joints ſeems the ſame as in the Legs of Crabs and Lobſters, and each Leg is armed with a very ſharp Claw or Hook at its End, in the ſame manner as theirs are. Four of theſe Legs are ſo placed as to move the Body forwards: The other four, by being diſpoſed in a quite contrary Direction, draw it backwards when there is Occaſion.

Mites appear to the naked Eye merely like Duſt in Motion; nor is the ſharpeſt Sight able to diſtinguiſh their Parts, unleſs aſſiſted by Glaſſes. They are Male and Female. The Females lay Eggs, from which very ſmall Mites are hatched, of the ſame Shape with their Parents: for theſe Creatures ſhed their Skins ſeveral times, and increaſe in Bigneſs, but never change their Form. A Mite's Egg is not more than a four or five hundredth Part of the Size of a well-grown Mite; and ſuch Mites are not much above one hundredth of an Inch in Thickneſs: So that, according to this Way of reckoning, no leſs than a Million of full-grown Mites may be contained in a cubic Inch, and five times as many Eggs.

The various Sorts of Mites, to be met with up and down in divers putrifying Subſtances, are very different in Shape, Colour, Size, and ſeveral other Properties, according, perhaps, to the Nature of the Subſtances whereon they are nouriſhed. Thoſe found on ſome Bodies are longer, on others rounder; ſome more hairy, others ſmoother: In this nimble, in that ſlow; here pale and whiter, there browner, blacker, more tranſparent, *&c.* But they all agree in being exceedingly voracious.

PLATE XXXI. FIG. 3.

A ſmall Creature hatched on a Vine.

DURING moſt part of the Spring and Summer, a ſmall, round, white, Cobweb-like Subſtance, about the Bigneſs of a Pea, may be found ſticking, very cloſe and faſt, to the Stocks of Vines nailed againſt a warm Wall.

When examined attentively, it ſeems covered, on the upper Side, with a ſmall Huſk, not unlike the Scale or Shell of the *Wood-Louſe*, *Millepes*, or *Sow*, (for by all theſe Names is the Inſect called which is often found in rotten Wood, and on being touched rolls itſelf up into the Size and Shape of a Pepper-Corn.) Several of theſe being ſeparated from the Vine-Stock, the Doctor found them, by his Microſcope, to conſiſt of a Shell, which ſeemed likely to be the Huſk of a *Millipes*, and the Fur or Cobweb conſiſted of Abundance of ſmall Filaments. He often diſcovered in the Middle of all great Numbers of ſmall brown Eggs, ſuch as A and B repreſent. They were about the Bigneſs of the Eggs of Mites, and were uſually hatched about the End of *June* or Beginning of *July*, producing Multitudes of ſmall Inſects exactly ſhaped like that marked *x*.

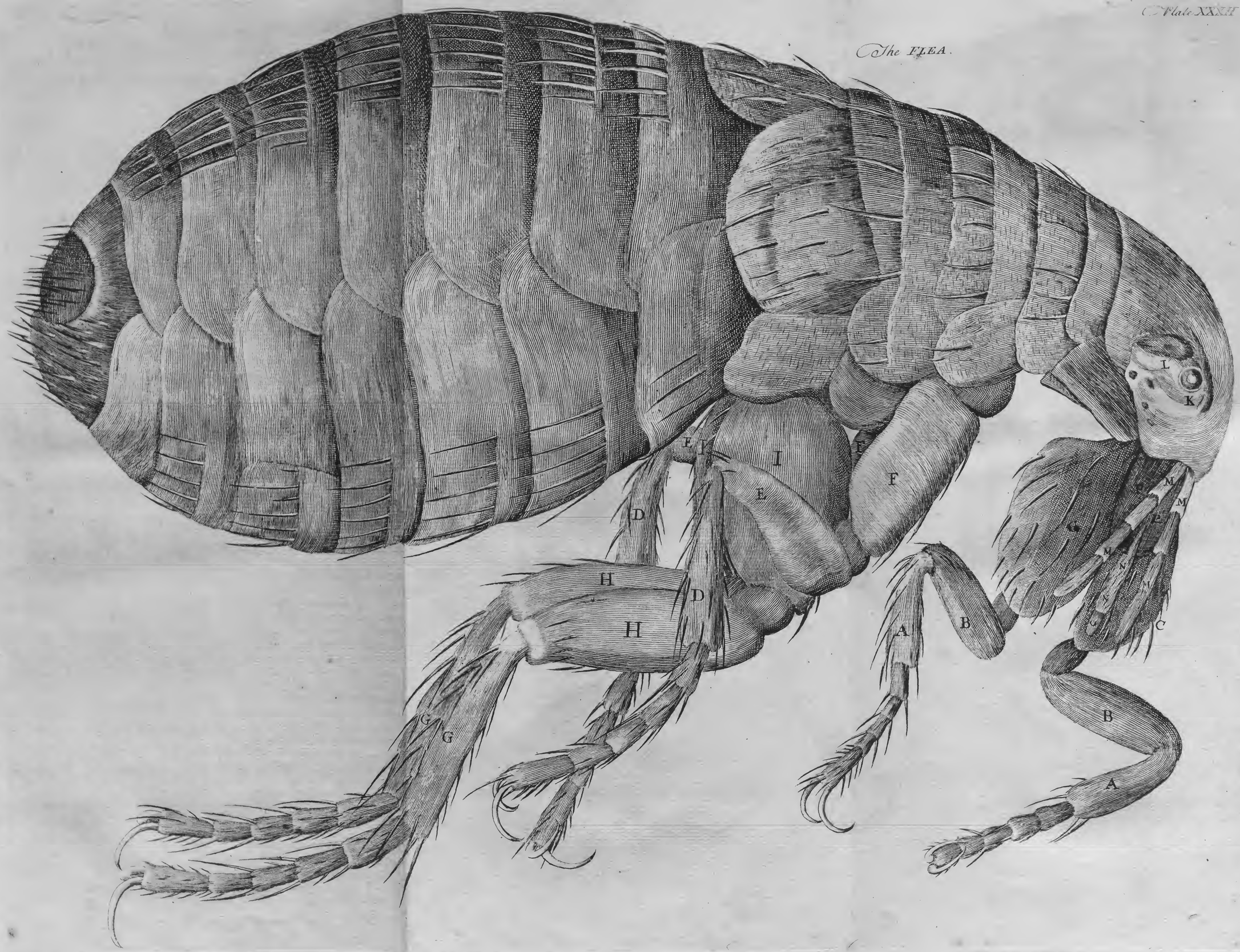
The Head of this Creature was very large, being almoſt half the Bigneſs of its Body, as is uſual in the *Fœtus* of moſt Animals. It had two ſmall black Eyes *a a*, and two long, ſlender, jointed and briſtled Horns *b b*. The hinder Part of its Body ſeemed to conſiſt of nine Scales, and the laſt ended in a forky Tail, much like that of a Wood-Louſe, out of which iſſued two long Hairs.

They ran to and fro very briſkly; moſt were about the Size of a common Mite, but others leſs: The longeſt of them, however, ſeemed not the hundredth Part of an Inch, and the Eggs uſually not above half as much. They appeared to have ſix Legs, though none are ſhewn in the Picture, the Legs being commonly drawn under the Body, and almoſt hid thereby.

Our Author obſerves, that if theſe little Creatures are *Wood-Lice*, (as he is inclined to think, from their Shape, Frame, and the Skin or Shell upon them) they afford an Inſtance of a ſurpriſing and more than ordinary Increaſe in Bigneſs, from their preſent Minuteneſs when newly hatched, to the Size they attain when fully grown. For a common *Wood-Louſe* of half an Inch long, is no leſs than an hundred and twenty five thouſand times bigger than one of theſe.---Some Sorts of Spiders have alſo nearly the ſame Proportion to their young ones when newly hatched.

What the Huſk and Cobweb of this little white Subſtance ſhould be, our Author cannot imagine, unleſs the old one, when impregnated with Eggs, ſhould fix itſelf on the Vine and die there, after which its Body rotting away by degrees, nothing appears remaining but the Huſk and Eggs only.

The FLEA.



An Explanation of the Thirty-Second Plate.

The Flea.

THOUGH this little Creature is almoſt univerſally known to be a ſmall brown ſkipping Animal, very few are acquainted with its real Shape and Figure, with the Structure, Strength and Beauty of its Limbs and Parts, or with the Manner of its Generation and Increaſe; Circumſtances which could never have been diſcovered but by the Aſſiſtance of the Microſcope. The Flea.

The Body of this Creature is of an oval Form, compoſed of ſeveral ſhelly Scales or Diviſions moſt curiouſly jointed, and folding over one another; thoſe that cover the Back meeting thoſe that cover the Belly on each Side of the Body, and lying, alternately, over one and under another of them.

Its Neck is finely arched, and much reſembling a *Lobſter*'s Tail in Shape; moving too like that, very nimbly, by means of the jointing and folding over of the Scales that cover it.

The Head is ſmall and ſhelly, having on each ſide a quick, round, and beautiful black Eye K, in the Middle whereof may be ſeen a round blackiſh Spot, which is the Pupil of the Eye ‡, encompaſſed with a greeniſh glittering Circle or *Iris*, as bright and vivid as the Eye of a Cat.

Behind each Eye a ſmall Cavity appears at L, wherein a certain thin Film, beſet with many ſmall tranſparent Hairs, may be obſerved moving to and fro, which our Author imagines may probably be the Ear.

From the Snout-Part proceed the two Fore-Legs, and between them are two long ſmall Feelers (or Smellers, as our Author ſuppoſes) M M. Each of them has four Joints and Abundance of little Hairs. Juſt below and almoſt between theſe Horns, lies the *Proboſcis* or Peircer N N O, conſiſting of a Tube N N, and a Tongue or Sucker O, which can be put out or drawn in at pleaſure. It has alſo two Chaps or Biters P P, ſhaped ſomewhat like the Blades of a Pair of round-top'd Sciſſars, and ſeeming to open and ſhut after the ſame manner. The Flea with theſe Inſtruments penetrates the Skin of living Creatures, and leaves a round red Spot behind it, which we commonly term a *Flea-Bite*.

All the Shells and ſcaly Coverings of this pretty Inſect are moſt exquiſitely poliſhed, and in Colour reſembling fine Tortoiſe-Shell; the Scales on the Back and Belly have each of them along its Middle a Row of ſtrong ſharp Briſtles pointing towards the Tail, like the Quills of Porcupines, and as large as they in proportion to the Animal. The Neck and Shoulders are likewiſe armed in the ſame manner, and great Numbers of Briſtles are placed about the Tail.

But the curious Structure and Contrivance of its Legs are more particularly deſerving our Examination and Praiſe; being ſuch as have not been diſcovered in any other Creature, and are adapted peculiarly to the Exigencies of this; for as it lives by ſucking human Blood, or the Blood of other living Animals, which cannot be obtained without inflicting Wounds and cauſing Pain, which muſt neceſſarily produce Reſentment, and a Deſire of Revenge, it was abſolutely requiſite the little Invader ſhould have ſome ready Means of Eſcape; ſince every Meal muſt otherwiſe be paid for with its Life. As therefore it has no Wings, its Safety muſt be entirely owing to its Legs; and indeed they are moſt excellently fitted for this purpoſe, by folding ſhort one within another, and then ſtretching out to their whole Length with a ſudden Spring or Jerk, whereby they commonly deliver the little Animal from the Danger of a Purſuit.

The Parts A A, of the Fore-Legs, lie within the Parts B B, and thoſe again within the upper and ſtronger Parts C C, parallel to, or ſide by ſide with each other. But the Parts of the two next Legs are diſpoſed directly contrary to theſe; for in them the Parts D D are placed without the Parts E E, and the Parts E E are likewiſe more outward ſtill than the Parts F F. In the hinder Legs the Parts G, H, and I, bend one within another, like the Limbs of a double-jointed Ruler; or like the Foot, Leg and Thigh of a Man. When the Flea intends to leap, he folds up theſe ſix Legs together, then ſprings them all out at the ſame inſtant, and thereby exerting his whole Strength at once, carries his little Body to a conſiderable Diſtance. His Legs have three principal and larger ſtrong Parts, and below them many ſmall Joints or Diviſions as in the Legs of a Fly: From every Joint proceed long Hairs or Briſtles, and each Foot is furniſhed with a Pair of long-hooked

‡ Vid. *Power*'s *Obſerv.* p. 1.

Claws or Talons, that in his Leaping he may faſten and cling the better to what he lights upon.

Fleas are produced of Eggs, which the Females ſtick faſt by a kind of glutinous Moiſture to the Roots of the Hairs of Cats, Dogs, and other Animals, and alſo to the Wool in Blankets, Ruggs, and other ſuch-like Furniture. Of theſe Eggs a Female lays ten or twelve a Day, for ſeveral Days ſucceſſively, and they hatch in the ſame Order, about four or five Days after their being laid.

From the Eggs come forth not perfect Fleas, but little whitiſh Worms or Maggots, whoſe Bodies have annular Diviſions, and are thinly covered with long Hairs. They adhere cloſely to the Body of the Animal, on whoſe Juices they feed; or they may be kept in a Box, and brought up with dead Flies, which they eat with Greedineſs. They are very briſk and nimble, and crawl like Catterpillars, with a lively and briſk Motion.

After eleven Days from the Time of their being hatched, they forbear eating, and lie quiet, ſeemingly, as if dying; but if viewed with a Microſcope, they will be found weaving a Covering or Bag round them with a Silk or Web emitted out of their Mouth. In this Bag they put on the *Chryſalis* or *Aurelia* Form, and become milk-white. They continue nine Days under this Appearance; their Colour darkens by degrees; they acquire Firmneſs and Strength, and as ſoon as they iſſue from the Bag are perfect Fleas, and able to leap away. They are immediately capable of Coition, and lay Eggs in three or four Days; after which they ſoon die, as all other Creatures that undergo theſe Changes do.

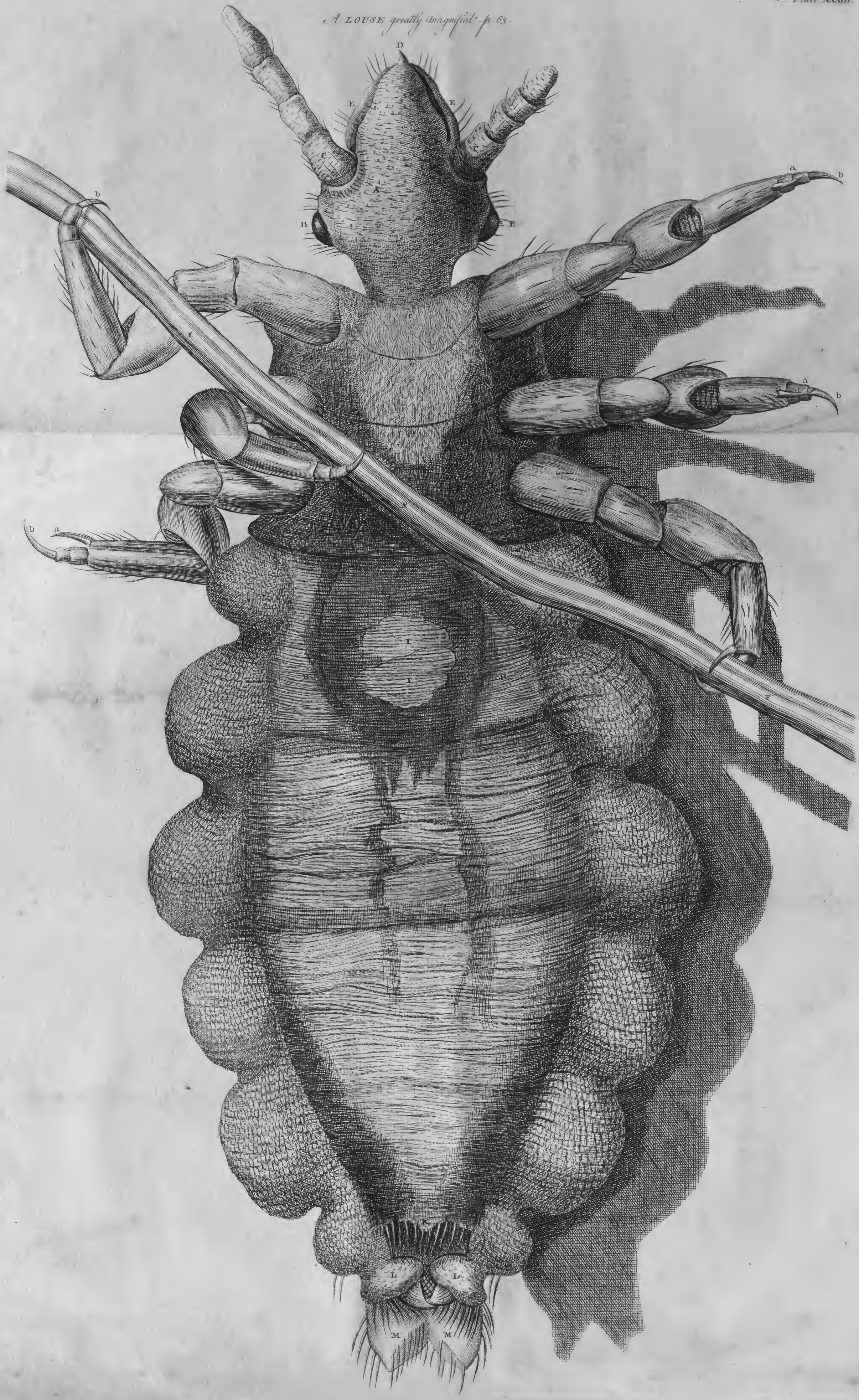
The great Agility and Strength of this Inſect are exceedingly remarkable; it being able to leap farther in proportion to its own Length, than perhaps any other Creature that has not Wings to help it. And its Strength is ſo well known, and ſo extraordinary in the ſame proportion, that ſeveral curious Artiſts, whoſe Dexterity has been ſhewn in the making Curioſities of an uncommon and ſurpriſing Smallneſs, have employed this little Animal to aſſiſt in exhibiting their Works, and proving the Nicety and Lightneſs of them. Dr. POWER ſays *, he ſaw amongſt TREDESCANT's Rarities, a golden Chain of three hundred Links, though not above an Inch long, that was both faſtened to and drawn away by a Flea. MOUFET ſome time before this, mentions ſuch another of a Finger's Length, made by one MARK an *Engliſhman* †, whereto a Flea was faſtned by a Collar of a moſt exquiſite Minuteneſs, with a Lock and Key adapted to it. This Chain the Flea dragged after him with Eaſe; the Flea, Chain, Lock and Key, not exceeding altogether the Weight of a ſingle Grain. He adds further, that he had been informed by People of undoubted Credit, that a Coach made of Gold with all its Furniture of the ſame Metal, had a Flea chained to it, which drew it along without the leaſt Difficulty; thereby teſtifying at the ſame time the Dexterity of the Workman, and the Strength of this little Creature. Nor is there any Room to doubt the Truth of theſe Accounts; for one BOVERICK, a Watchmaker in the *Strand*, has lately made and ſhewn to vaſt Numbers of People, not only a Chaiſe having four Wheels and all its proper Apparatus, together with a Man ſitting therein, the whole formed of Ivory, and drawn along by a Flea; but likewiſe a *Landau* that opens and ſhuts by Springs, with ſix Horſes harneſs'd thereto, a Coachman ſitting on the Box with a Dog between his Legs, four People in the *Landau*, two Footmen behind it, and a Poſtilion riding one of the Fore-Horſes. This Equipage a Flea is faſtned to, and pulls very eaſily along. He has alſo made a Chain of Braſs, about two Inches in Length, containing two hundred Links, with a Hook at one End, and a Padlock and Key at the other; all which together weigh leſs than the third Part of a Grain. Here too a Flea is made uſe of to draw the Chain, which it does very nimbly, and with as little Trouble as can be well imagined.

Fleas thus employed are preſerved alive and vigorous, by putting them upon the Arm, or the Back of the Hand to feed, once or twice a Day.

But however pretty they may be in the Microſcope, or for theſe ingenious Purpoſes, they are certainly very troubleſome Bedfellows, and eſpecially to Women and Children, whoſe Blood they are particularly fond of. They hide themſelves in the Woolineſs of the Blankets all the Day; but as ſoon as People begin to be warm in their Beds at Night, which they are ſenſible of either by their Smell or ſome other Way, they creep between the Sheets, and penetrating the moſt tender Parts of the Body, ſuck out the Blood and Humours. They have likewiſe the Sagacity to retire at Day-break to their lurking Holes again, as if afraid of being caught: And in this they are imitated by the *Punices* or *Bugs*, which

* *Power's Obſerv.* p. 3. † *Mouſeti Inſectorum Theatr.* p. 275.

A LOUSE greatly magnified. p. 63.



which are Animals much more naſty and miſchievous, having ſomewhat poiſonous in their Bite, as the Swelling that follows upon it ſhews. The Smell of theſe is alſo extremely offenſive, and that as it ſhould ſeem even to Fleas; for where there are many *Bugs* Fleas are but ſeldom ſeen.

Many Sorts of Herbs, if placed about the Bed, are ſaid to deſtroy, or at leaſt drive away Fleas; ſuch as *Elder*, *Fern*, *Penny-Royal*, *Rue*, *Mint*, *Hops*, *Laurel*, *Walnut*, *Arſmart*, *Hellebore*, &c. alſo the Seeds of *Staves-Acre*, *Coriander*, *Flea-Wort*, &c. but without doubt the moſt effectual Remedy is Cleanlineſs.

If you attempt to catch them, remember always to wet your Thumb and Finger with Spittle.

An Explanation of the Thirty-Third Plate.

The Louſe.

The Louſe.

THIS laſt Plate ſhews us the Figure of a Louſe magnified to a very great Degree, that every Part thereof may be perfectly known and diſtinguiſhed: And indeed this Creature is ſo tranſparent, that the internal Structure, Diſpoſition, and Motion of its Bowels, and their Contents, may be diſcerned therein much better than they can in moſt other Inſects.

It is repreſented in this Picture with its Belly upwards, graſping a Hair between its Claws.

The Head A, ſomewhat reſembles the Faſhion of a Cone, but is a little flatted on the upper and under Part. On each Side, juſt where the Head is wideſt, a large ſhining black Eye appears, very protuberant, and encompaſſed with a Number of ſmall Hairs. Theſe Eyes B B, are ſituated a little behind the Head, in the Place where the Ears of other Creatures ſtand; and where one would expect to find the Eyes, a Couple of Horns come out C C, extending themſelves in ſuch a manner, that they defend its Eyes from being injured by the Hairs through which it paſſes.

Our Author ſays, each of theſe Horns has four Joints, fringed as it were with ſmall Briſtles; and the Picture C C ſhews no more than that Number of Diviſions; but Swammerdam reckons five Joints to each Horn of the Louſe he deſcribes *; ſo that either the Lice theſe two Obſervers examined, were of a different Species, or one of them muſt be miſtaken.

The Head grows round and tapering from where the Horns come out to the Top of the Snout D, which ends in a ſharp Point, and ſeems to be a tubular Inſtrument whereby the Louſe ſucks in the Blood of the Animal it feeds on; it is likewiſe probably the Sheath of a Peircer that ſerves to penetrate the Skin and make a Wound for the Blood to iſſue out.

In the Poſition before us, there ſeems to be a Reſemblance of Chaps or Jaws, as at the Letters E E; yet when placed in another View thoſe Lines or Appearances are not diſcernable. Swammerdam ſays, it has no Mouth that opens; and our Author obſerves, that having kept ſeveral of them in a Box for two or three Days, whereby they were become extremely hungry, upon letting one creep on his Hand, he found that it immediately fell to Sucking; and though it neither ſeemed to thruſt its Noſe very deep into the Skin, nor to open any kind of Mouth, he could plainly diſcern a ſmall Current of Blood paſſing directly from its Snout into its Belly; and there appeared about A ſome Contrivance like a Pump, Pair of Bellows, or Heart, which by a very ſwift and alternate Dilatation and Contraction drew up the Blood from the Noſe and forced it into the Body. Though he viewed it very attentively while ſucking, he could not perceive that any more of its Noſe was thruſt into the Skin than the very Snout D; nor did it give him the leaſt Pain, notwithſtanding the Blood ran through its Head very quick and freely: Which fully proves that Blood-Veſſels are diſperſed into every Part of the *Skin*, nay, even into the *Cuticula*; for had its whole Snout been thruſt in from D to C C, it would not have amounted to the ſuppoſed Thickneſs of that Tegument, the Length of the whole Noſe not being more than the three hundredth Part of an Inch.

The Thorax or Breaſt is covered with a thin, tranſparent, horny, or ſhelly Subſtance, which did not ſink or become ſhrivelled by the Creature's faſting, as the Covering of the Belly did. Through this our Author could plainly diſtinguiſh that the Blood ſucked from his

* *Swammerd. Hiſt. Gener. des Inſect.* p. 174.

his Hand was variouſly diſtributed and moved to and fro; and about G there appeared a pretty large white Subſtance moving within the *Thorax*. This ſomewhat reſembled a Bladder, contracting and dilating upwards and downwards from the Head towards the Tail. Acroſs the Breaſt were many ſmall milk-white Veſſels running between the Legs, and ſending to them innumerable minute Branchings, which no doubt are Veins and Arteries; for in moſt Inſects the Juices analogous to Blood are white.

The Louſe has ſix Legs, which are ſtrongly joined to the *Thorax*; and for each Pair a kind of Diviſion appears thereon, as *e e e*. They are covered with a very tranſparent Shell, and jointed exactly like the Legs of a Crab or Lobſter. Each of them is divided into ſix Parts, having ſeveral ſmall Hairs iſſuing therefrom, and Ends with two Claws, of unequal Lengths, very properly adapted to the particular Exigences of this Animal, which has Occaſion to walk either on Skin or Hair. For the leſſer Claw *a* being ſo much ſhorter than the other Claw *b*, when it walks on Skin the ſhorter Claw touches not, and then the Feet are the ſame as thoſe of a *Mite* and many other Inſects: Whereas, when amongſt Hairs, the longer Claw can bend itſelf round by means of its ſmall Joints, and meeting with the ſhorter, can both together take hold and graſp a Hair, as with a Thumb and Finger, after the manner repreſented in the Figure, where F F F, the Hair of a Man's Head, is ſo graſped and held faſt by this Creature, that it is in no danger of falling from it.

The Belly is likewiſe very tranſparent, but its Covering bears the Reſemblance of a Skin rather than a Shell, being grained all over juſt like the Skin of a Man's Hand, and when the Belly is empty, growing very flaccid and wrinkled.

H H ſhew the Stomach placed in the upper Part of the Belly.

The white Spot I I, may poſſibly be the *Liver* or *Pancreas*, which, by the *periſtaltic* Motion of the Guts, is moved a little to and fro, not with a *Syſtole* and *Diaſtole*, but rather with a thronging or juſtling Motion.

After one of theſe Creatures had faſted two Days, all the hinder Parts appeared lank and wrinkled; the white Subſtance I I, ſcarcely moved; moſt of the white Branchings diſappeared, as did alſo the Redneſs or ſucked Blood in the Guts, the *periſtaltic* Motion whereof was hardly to be diſcerned; but upon ſuffering it to ſuck, the Skin of the Belly, and the ſix ſcalloped Emboſſments on either ſide, were quickly filled out; the Stomach and Guts ſeemed quite crammed, and Multitudes of white Veſſels appeared replete and turgid; the *periſtaltic* Motion grew quick, and ſo did alſo the juſtling Motion of the Subſtance I I.

The Animal was ſo voracious, that notwithſtanding it could contain no more, it continued ſucking as greedily as ever, and at the ſame time emptied itſelf as faſt behind. And its Digeſtion muſt needs be very quick, for though the Blood, when ſucked, appeared thin and black, it ſoon became in the Guts of a lovely Ruby-colour, and that Part of it which was carried into the Veins was evidently white: Whereby we alſo find, that a farther Digeſtion of Blood may make it Milk, or at leaſt of a milky Colour.

Near the Bottom of the Belly appears the Anus K, beſet with Hairs or Briſtles; juſt below are two little Parts L L, ſomewhat of a ſemicircular Figure, whoſe Inſides are covered with a Down, and which ſerve, occaſionally, to cover and cloſe the Aperture of the Anus. At the Extremity of the Tail are a Couple of Bodies M M, reſembling the Rumps of Fowls, from whence iſſue a Number of ſharp Hairs.

Dr. Power takes notice, that having placed a Louſe on its Back, in the Poſition here before us, there were two bloody darkiſh Spots diſcernable; the greater in the Midſt of the Body, and the leſſer towards the Tail. In the Center of the larger Spot there is (ſays he) a white Film or Bladder, which continually contracts and dilates itſelf upwards and downwards; and always, after every Pulſe of this white Particle or Veſicle, there follows a Pulſe of the great dark bloody Spot, in which, or over which this Veſicle ſeems to ſwim. This he obſerved two or three Hours together, as long as the Louſe lived; for pricking the white Veſicle with a ſmall Needle, which let out a ſmall Drop of Blood, and then viewing it again with the *Microſcope*, no Signs of Life or Motion could be perceived.

Lice proceed from Parents of their own Kind, and not (as formerly was ſuppoſed) from certain Juices or Humours of human Bodies; which may ſerve indeed to nouriſh, but can never breed them. The Females lay Eggs, or Nits, which they faſten to the Hairs of the Head, or to other hairy or woolly Subſtances, by a glewy Matter wherewith

they are provided: From theſe, *young Lice* come forth perfect in all their Members, and undergo no other Change but an Increaſe of Size.

Mr. LEEUWENHOEK diſcovered, that the Males are armed with Stings in their Tails, which the Females have not; and as he felt little or no Pain from ſeven or eight Lice that were feeding on his Hand at once, he imagines the ſmarting Pain they ſometimes give muſt ariſe from their Stinging, when made uneaſy by Preſſure or otherwiſe; for if roughly treated, they may be ſeen to thruſt out their Stings.

MOUFET † makes a Difference between the Lice of the Body and thoſe of the Head: The latter (he tells us) are larger, longer, flatter, and more nimble; the former fatter, rounder belly'd, ſlower, and of a whiter Colour, with ſome blackiſh Lines or Streaks. He alſo informs us, that if Lice are rubbed gently between the Thumb and Finger, they feel as if they were ſquare, and ſomewhat harder than Fleas; from which, by ſo doing, they may be diſtinguiſhed even in the dark.

Having now deſcribed and explained all the Plates Dr. HOOKE has left of Objects examined by the Microſcope, with ſuch Brevity and Plainneſs, as may, 'tis hoped, be uſeful and agreeable; and added thereto many Obſervations on the *Subjects* he has laid before us, in order to make this Work more valuable: We ſhall take leave of the *Reader*, with this ſingle, but neceſſary Reflection: That whenever we behold, in any of the Operations of Nature, whether great or ſmall, a *Contrivance*, a *Regularity*, a *Beauty*, that both delights and ſurprizes, we ſhould not paſs it over without Conſideration as a Matter of mere Amuſement, but take Occaſion from thence, to raiſe our Thoughts from the *Creature* to the *Creator*, and therein contemplate and adore the Almighty Power, the Incomprehenſible Wiſdom, and the Infinite Perfections of the *Deity*.

† *Mouſet. Inſect.* p. 200.

F I N I S.

ERRATA.

Pag. 7. *l.* 15. inſtead of *other ſpinal*, read, *others ſpiral*. *Pag.* 22. *l.* 23. inſtead of *Plate* VI. read, *Plate* XI. *Pag.* 25. *l.* 3. inſtead of *Seed*, read, *Seeds*. *Pag.* 35. *l.* 26. inſtead of *Fig.* 2. read, *Fig.* 4. *Pag.* 48. in the Running-Title, after, *the Gnat*, place a full Point.

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TIMES
Dec 16 1949

THE TIMI

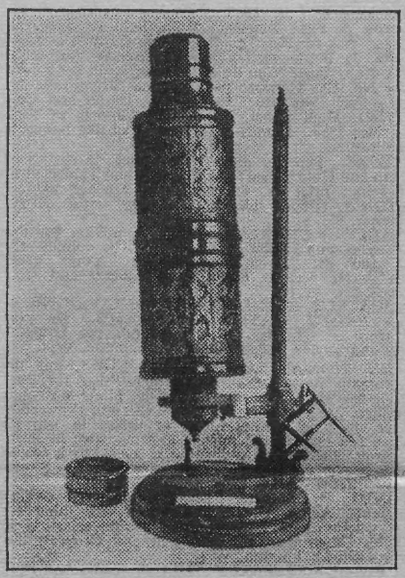
A PIONEER OF SCIENCE

ACHIEVEMENTS OF ROBERT HOOKE

The great scientific achievements of Robert Hooke were the subject of the Wilkins Lecture delivered by Professor E. N. da C. Andrade to the Royal Society yesterday.

Dr. Andrade described Hooke, who was born in 1635 at Freshwater, in the Isle of Wight, as probably the greatest inventive genius the world has known in the matter of scientific instruments and one of the most versatile and far-sighted of scientists. He invented the anchor escapement, still used in practically all ordinary clocks, and, almost certainly, the balance wheel of watches; the first form of almost all the instruments used in meteorology, including one for measuring the moisture of the atmosphere and the first wind gauge; an instrument for recording automatically meteorological data; astronomical instruments with telescopic sights, astronomical measurements having been made until his time with instruments like old-fashioned rifle sights.

His other inventions included the clock-driven telescope, instruments for sounding the sea and taking samples of sea water from great depths, the universal joint (often still called Hooke's joint), the iris diaphragm and many other devices not generally ascribed to him. His form of microscope was celebrated for its excellence and with it he made discoveries of prime importance, including the cellular structure of plants. He was, in fact, the first to use the word " cell " in its biological sense.



An early Hooke microscope, *circa* 1675.

Hooke was the first to propound the law connecting stress and strain which is at the basis of all mathematical work on the elasticity of bodies, and his scientific generalizations were daring and much in advance of his time. He published before Newton a clear indication of the lines along which the problem of the motion of the planets was to be solved, but, lacking Newton's mathematical genius, he was unable to bring the matter to a successful proof, in the way that Newton did. Since he could not know that the secretive Newton had anticipated his general conclusions Hooke thought that he ought to have received some credit, which Newton was unwilling to give him. This led to ill-feeling between the two great men, fomented by Oldenburg, then secretary of the Royal Society. Hooke came nearer to the true theory of combustion and of breathing than any of his contemporaries, saying that there was a substance present in the air which was used up in burning or respiration, and that this substance was copiously present in saltpetre. To-day, this was called oxygen.

ASTONISHING THEORIES

He was the first to realize the nature of fossils and that they are a record of the past history of the earth—that a " rotten shell," as he said, might testify accurately as to the remote life of our planet. His general theories were astonishing: he was clear that heat was a mode of motion and he had some modern ideas about crystal structure. Perhaps his scientific speculations were most astonishing: he said that what hindered flying was the weakness of man's muscles, for it would be easy to contrive wings and in fact he tried to make artificial muscles. He said that there must be a way to make " an artificial glutinous composition " that could be drawn into threads that would be as good as, or better than, silk. He ranged through the whole of science with brilliant originality and stimulating speculation, but seldom gave enough time to any one subject to perfect his ideas. He was also a very good architect, and acted as Wren's lieutenant in the rebuilding of London after the great fire.

In person he was, according to those who have left a record, thin, crooked and ugly: no portrait exists. Pepys said that he " is the most and promises the least of any man in the world that ever I saw." He was always a sick man, subject to violent headaches and indigestion, but of extraordinary industry and activity. He seemed to have been irritable and to have had much to irritate him, but the legend that he was mean and penurious had no foundation. Christopher Wren and many others were his friends and he was one of the glories of the Royal Society, which he served faithfully, and of English science.