

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 ... / [Robert Hooke].

Contributors

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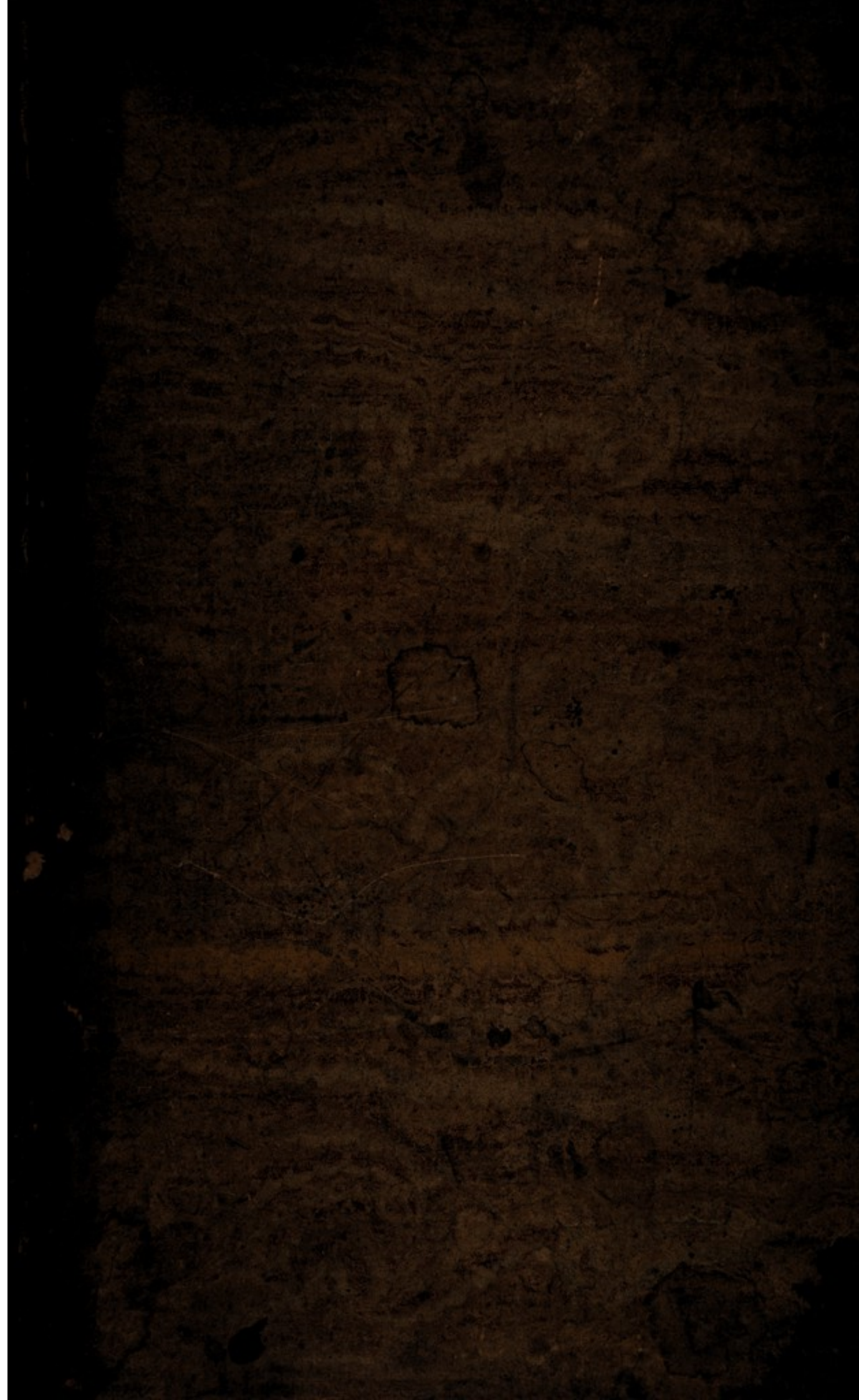
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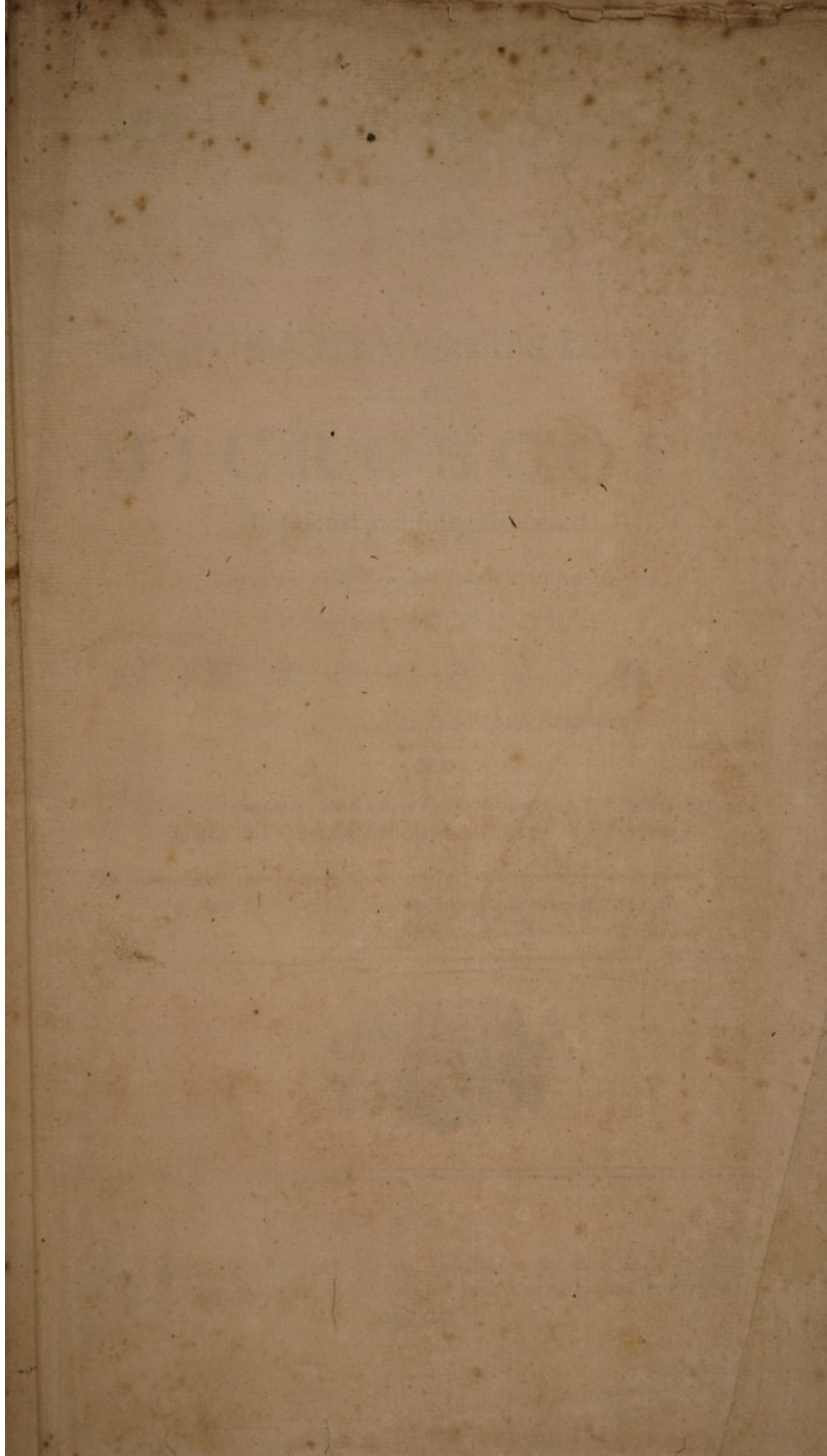
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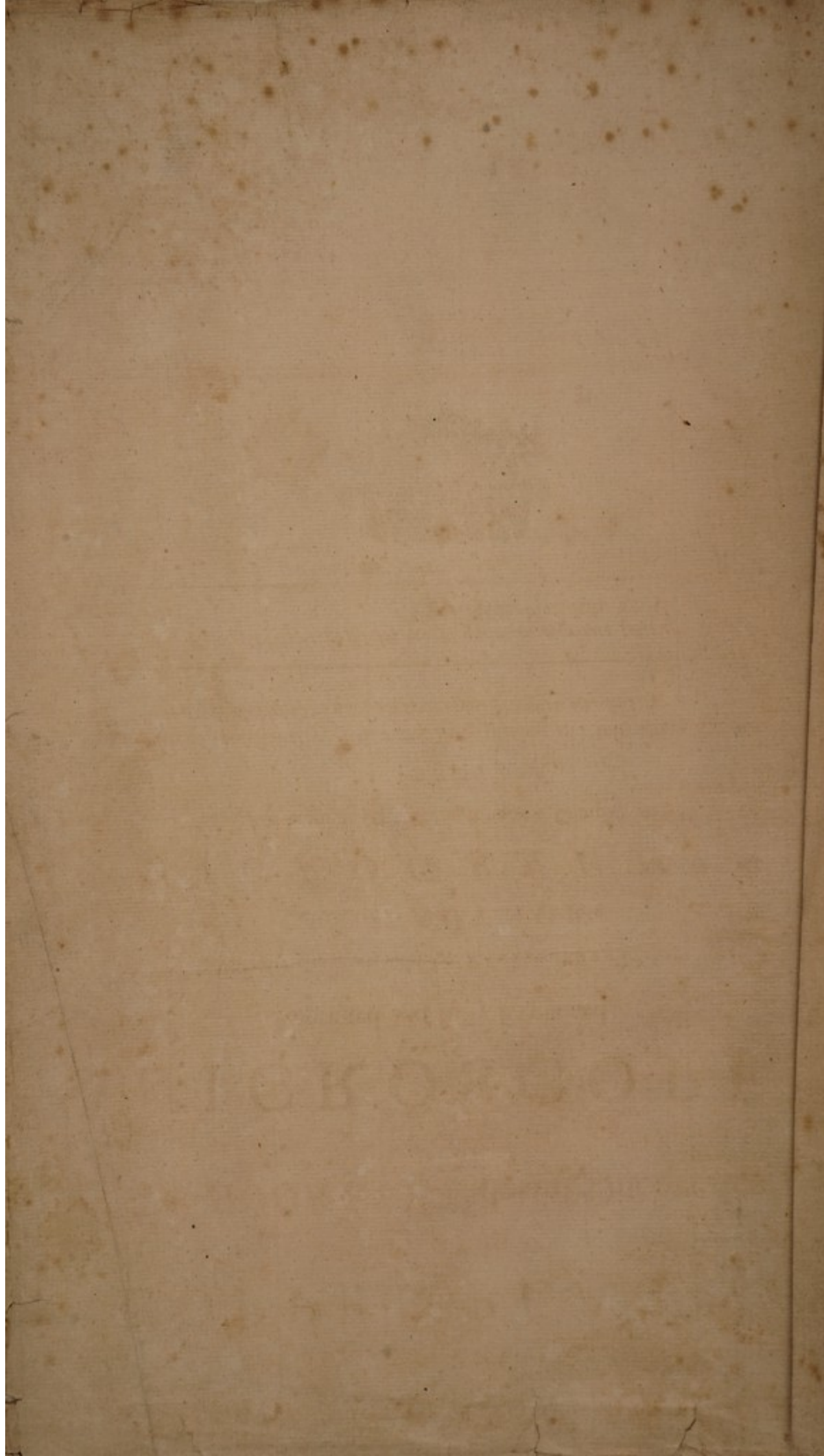
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MICROGRAPHIA RESTAURATA:
OR, THE
COPPER-PLATES
OF
Dr. HOOKE's Wonderful Discoveries
BY THE
MICROSCOPE,

Reprinted and fully Explained:

Whereby the most Valuable PARTICULARS in that

Celebrated AUTHOR's

M I C R O G R A P H I A

Are brought together in a narrow Compass ;

A N D

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.



L O N D O N :

Printed for and Sold by JOHN BOWLES, Printfeller at the *Black Horse* in *Cornhill*.
Sold also by R. DODSLEY, in *Pallmall*, and JOHN CUFF, Optician, in *Fleetstreet*.

MDCCXLV.



T H E

P R E F A C E.

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 Comparifon, 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 PREFACE.

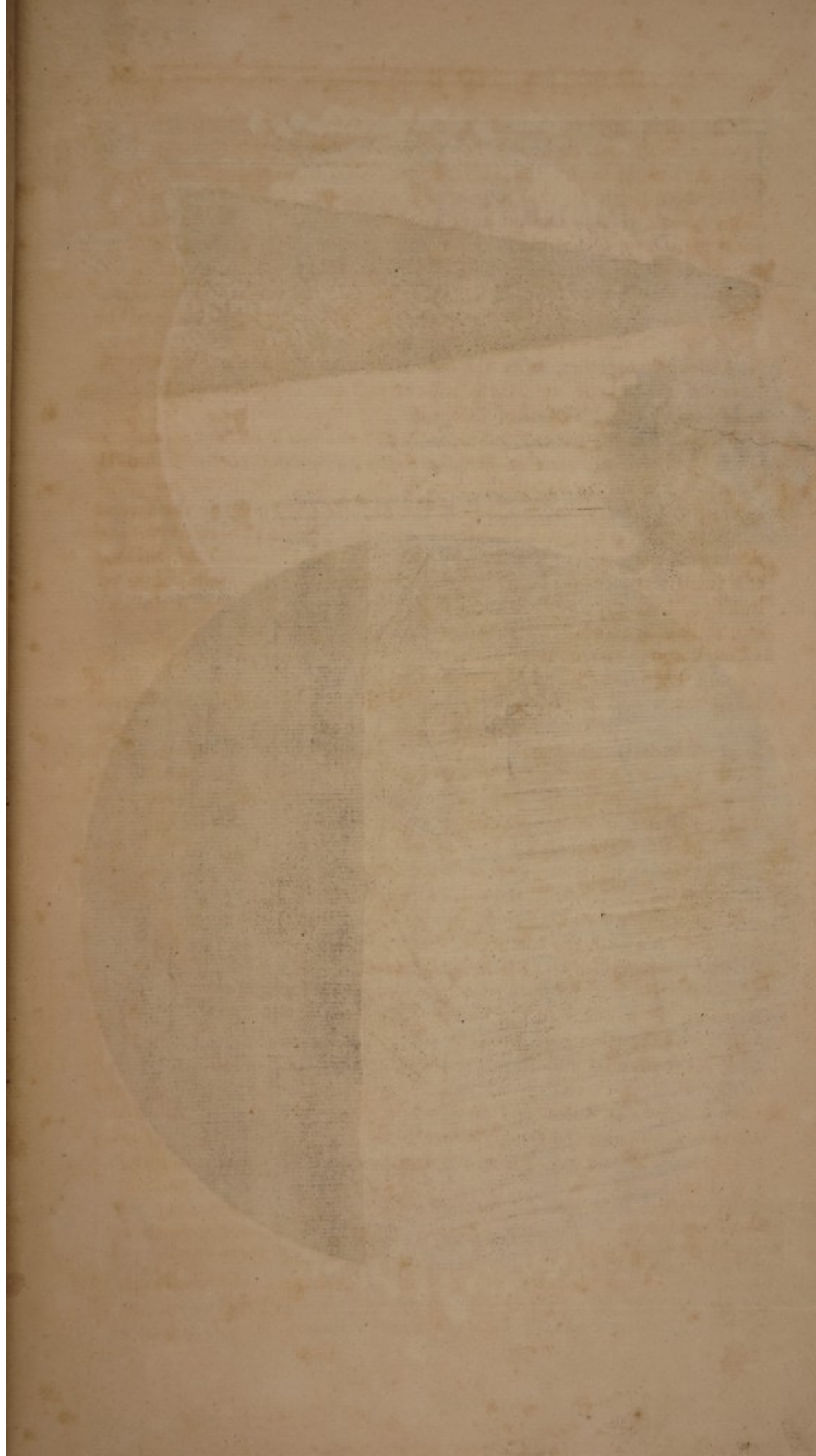
The following Sheets are therefore drawn up as an Explanation of these *Copper-Plates*, and 'tis hoped they may even make them better understood than they could be by the *Doctor's* own Accounts; which must be acknowledged (with all due Regard to the Memory of so great a Man) to be frequently tedious 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 where-to 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.



The Twentieth Part of an Inch magnified

Plate I.

Fig. 1



Fig. 2.
Printed Dot or Fiddle. p. 1.

The Sixteenth Part of an Inch as magnified.

Fig. 3



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 *aa*, 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

B

Irre-

The Edge of a Razor.

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 whitened 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.

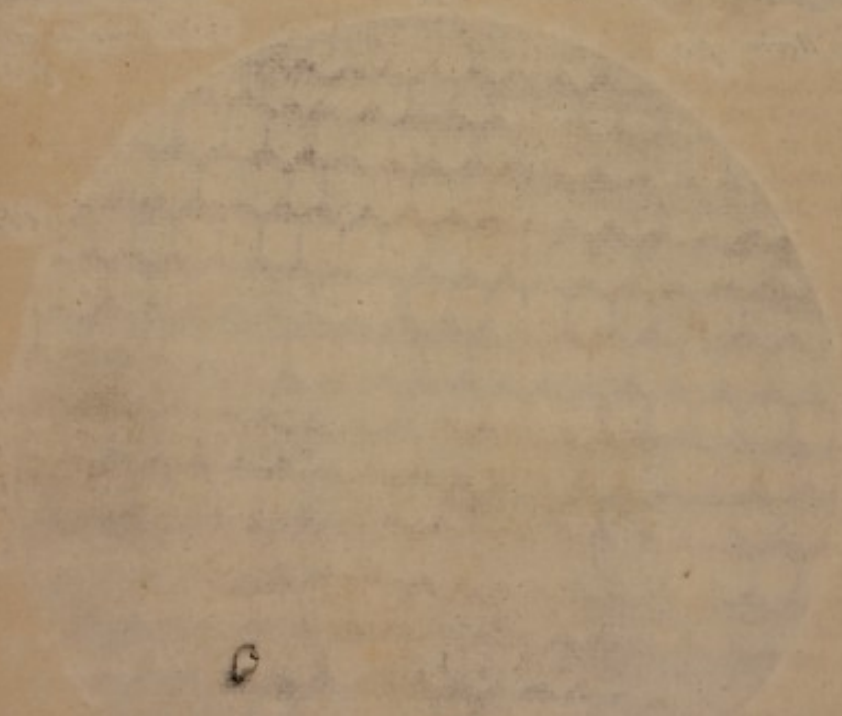
The other Part of the Razor *L L*, which had been polished on a Grind-stone, appeared like a plowed Field, full of Ridges and Furrows.

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.





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AN EXPLANATION of the SECOND PLATE.

FIG. 1.

A Piece of fine wheal'd Taffety 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.

A Piece of Ribbon.

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 *Weof* 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.

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.

A Piece of Watered Silk.

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. 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.

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.

Watered Silk. Fine Lawn.

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 Pafteboard 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 prefs it, between Pafteboards, violently, in a Hot-Prefs, 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 *ef, ef, ef*; 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 *oooooo, gb, gb, gb*, 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 *aaaaaa* appear bright, the Parts *bbbbbb* dark or shadowed, and some such as *dddddd* 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.



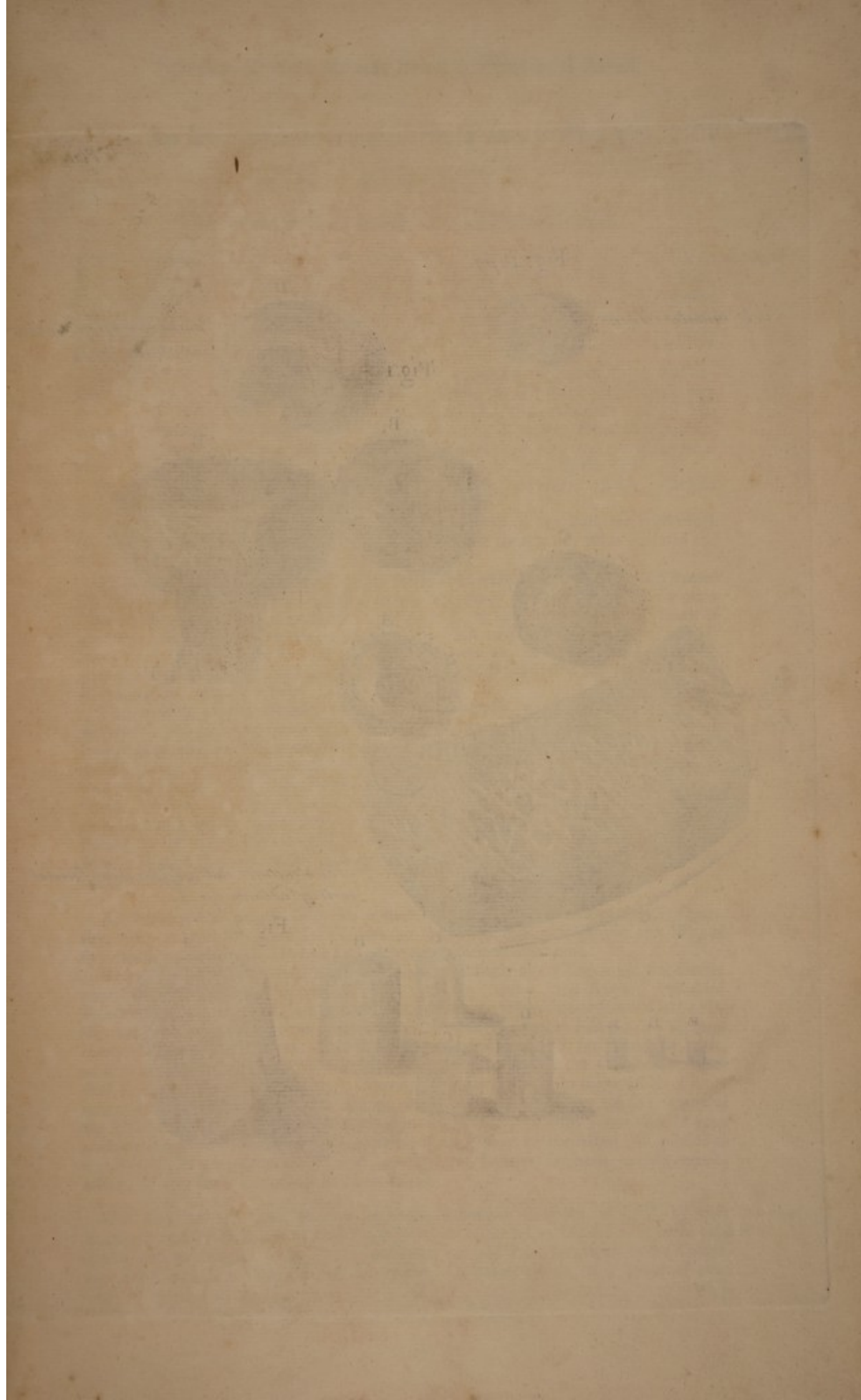


Fig. 4. p. 7.

A minute Shell



Fig. 1

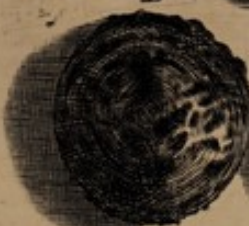
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Sparks struck from a Flint and Steel. p. 5.



B

E

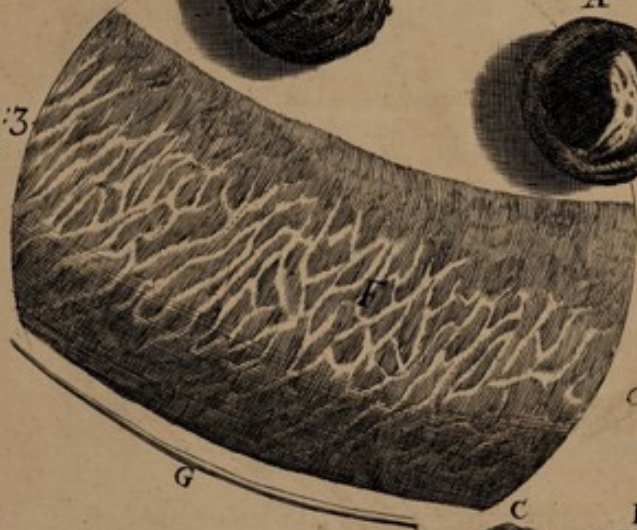


C

A



Fig. 3
p. 7.



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

Fig. 2.

A

B

C

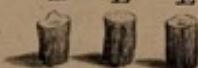
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AN EXPLANATION of the THIRD PLATE.

FIG. I.

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.

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.

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

white Paper be placed underneath, may be caught 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.

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

Human Hair.

EEE 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.

P L A T E III. F I G. 3.

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 opaque, 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.

P L A T E III. F I G. 4.

A pretty minute Shell found amongst Sand.

T HIS 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 crufted 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.

Fig. I.



10 Part of an Inch magnified.

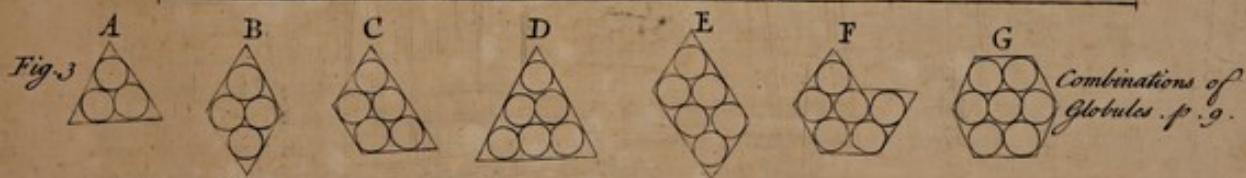
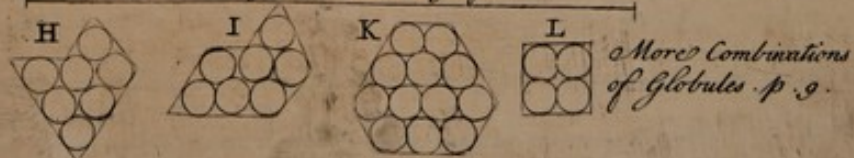


Fig. 2



1/2 Part of an Inch magnified.

Fig. 4.



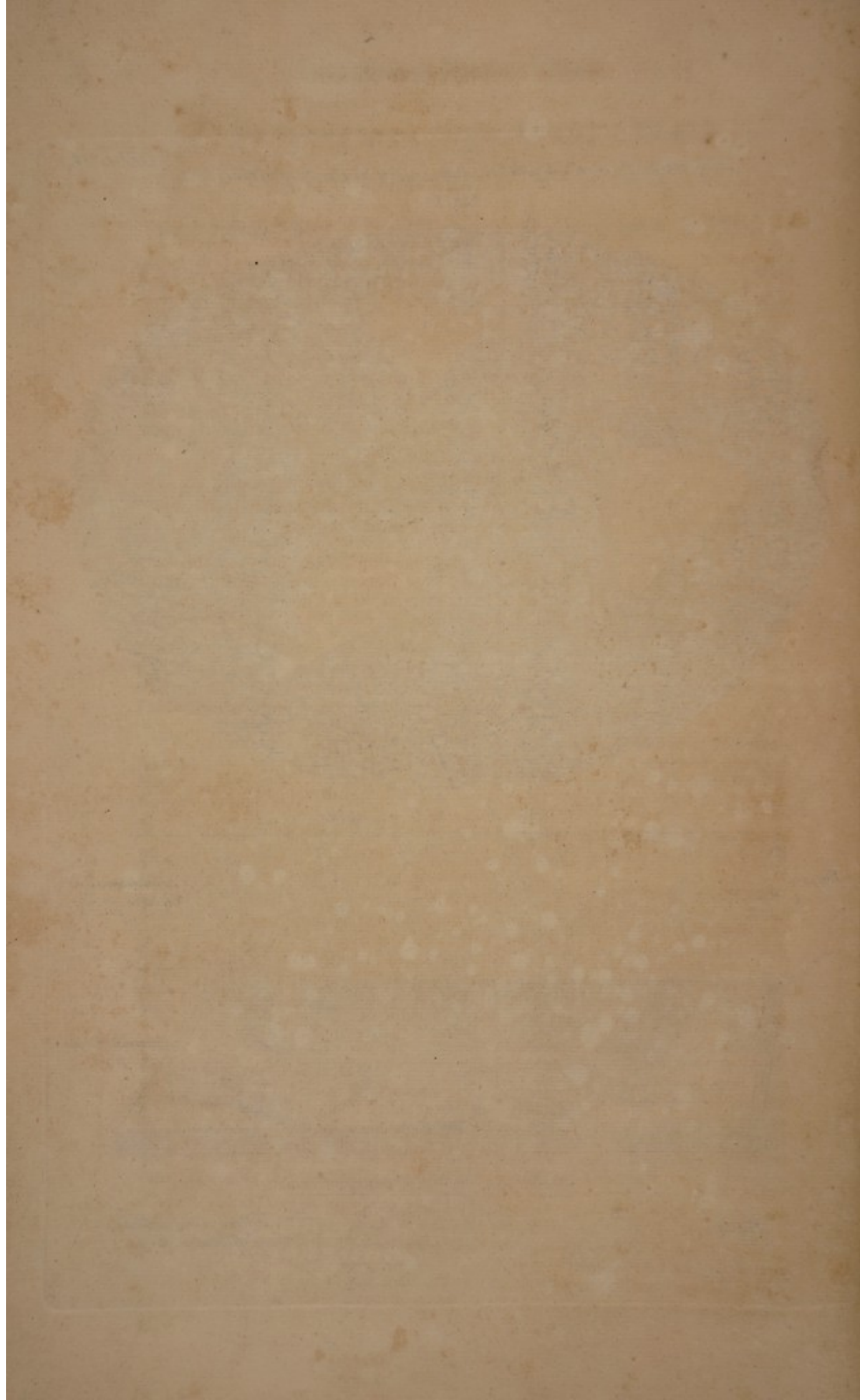


PLATE IV. FIG. 2.

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 opaque; some white, some yellow, some red, and others of more brown and dusky Colours.

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, ABCD; 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.

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, *ab*, *ac*, *ad*, *ae*, *af*, *ag*, 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, *ab*, *ac*, *ad*, *ae*, *af*, *ag*, 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 *op*, *mq*, &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 *po*, *qr*, are parallel to one another, and are also at the same time parallel to the large Branch *ab*.

Some of the Stems proceeded strait, and decreased in Thickness towards the End, as *ag*. 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 *ab*, *ac*, *ad*, *ae*, *af* : (These circular Figures, in the lateral Shoots, were also still more remarkable at *bi*.) 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 *qm*, had many collateral Shootings, (if we may call them so) as *f*, *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 their

Starry Flakes of Snow
p. 10.



Fig: 2

Fig 4

Thin Ice on Water
p. 12.

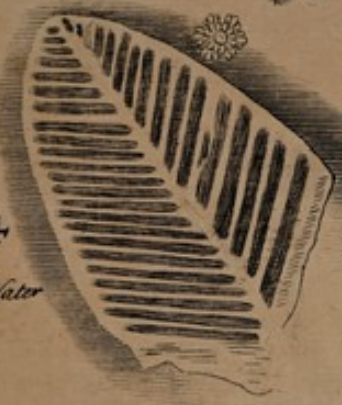
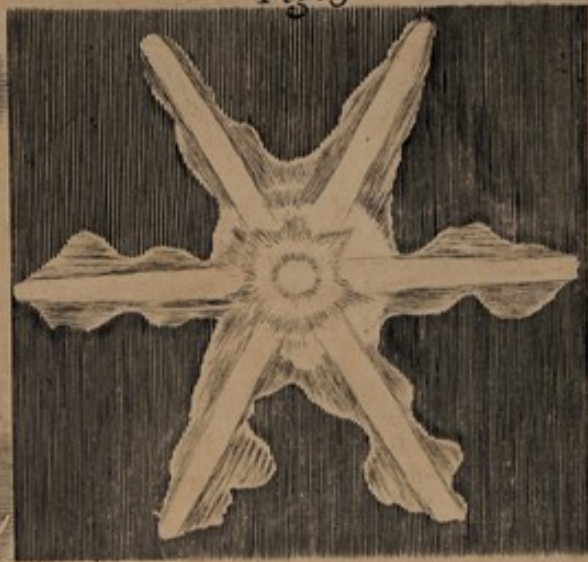


Fig: 3

A Flake
of Snow
dissolving
p. 12



Water frozen on Marble Fig: 5
p. 12.



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

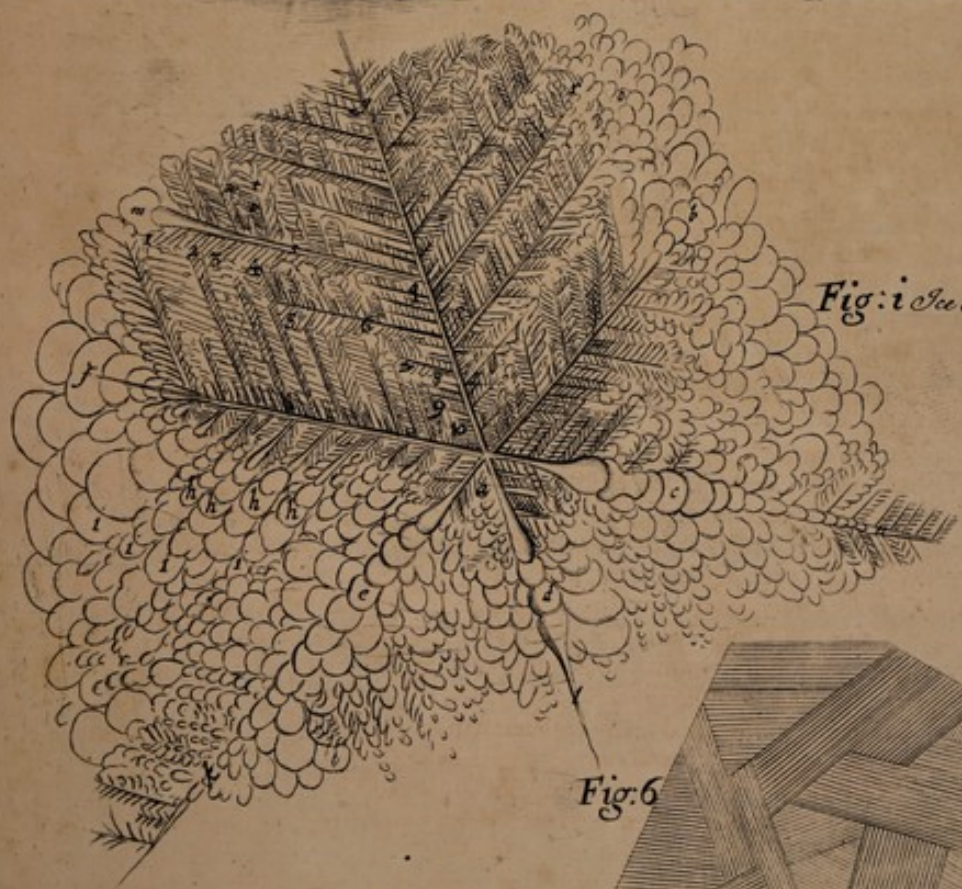
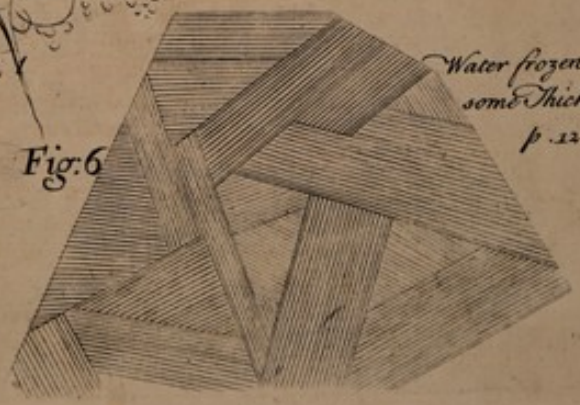
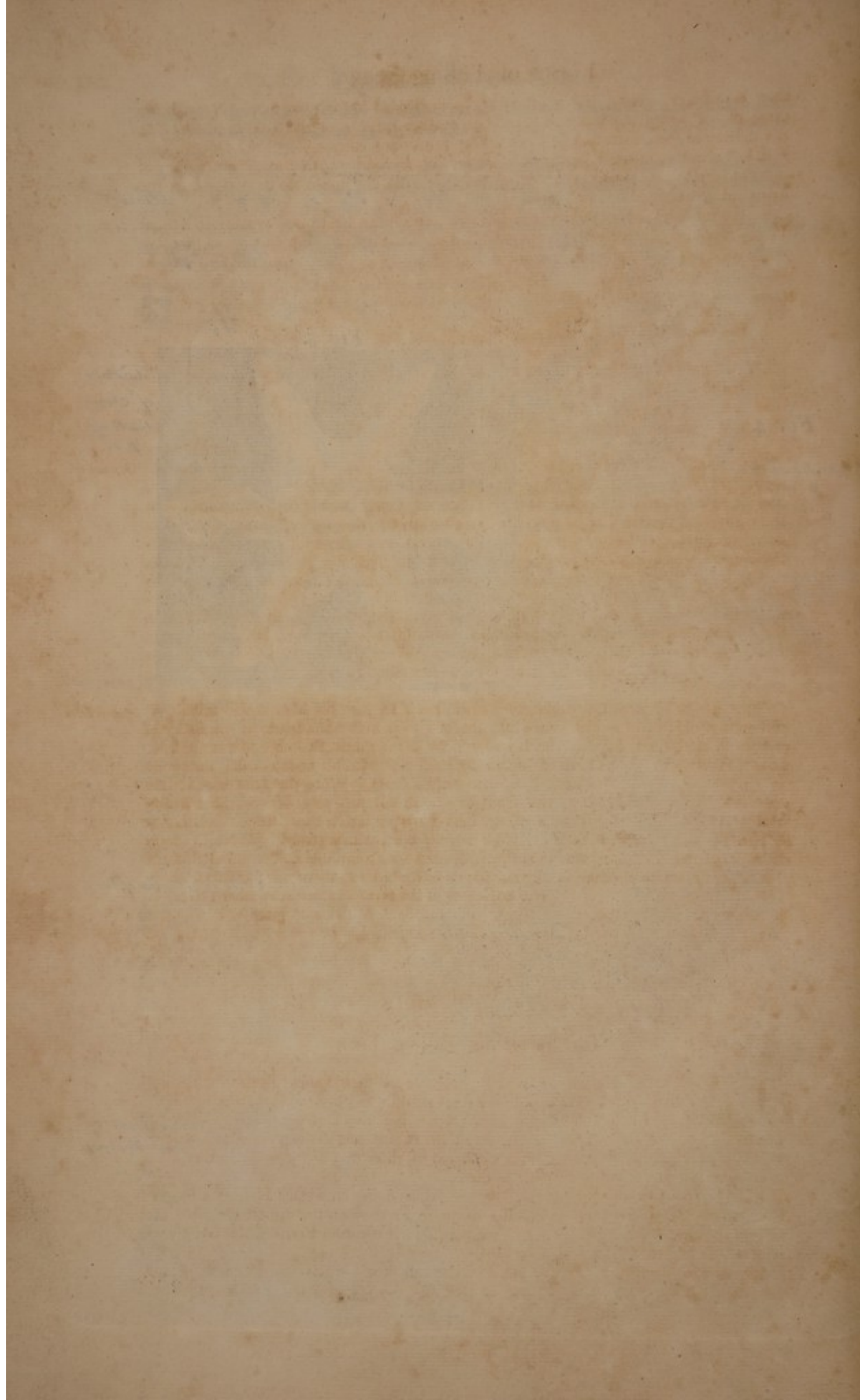


Fig: 6

Water frozen of
some Thickness
p. 12.





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.

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 *feminal Principle* to produce *Fern*, than for the Production of such Forms in Urine, or in the above-mentioned *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 feminal than another, tho' he had made very diligent Enquiry as to that Particular. Like to 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. Seeds of Fern.

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.

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. Flakes of Snow.

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

Configurations of Snow and Ice.

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*.

P L A T E V. F I G. 3.

A Flake of Snow magnified.

A Flake of
Snow mag-
nified.

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.

P L A T E V. F I G. 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.

P L A T E V. F I G. 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.

P L A T E V. F I G. 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.

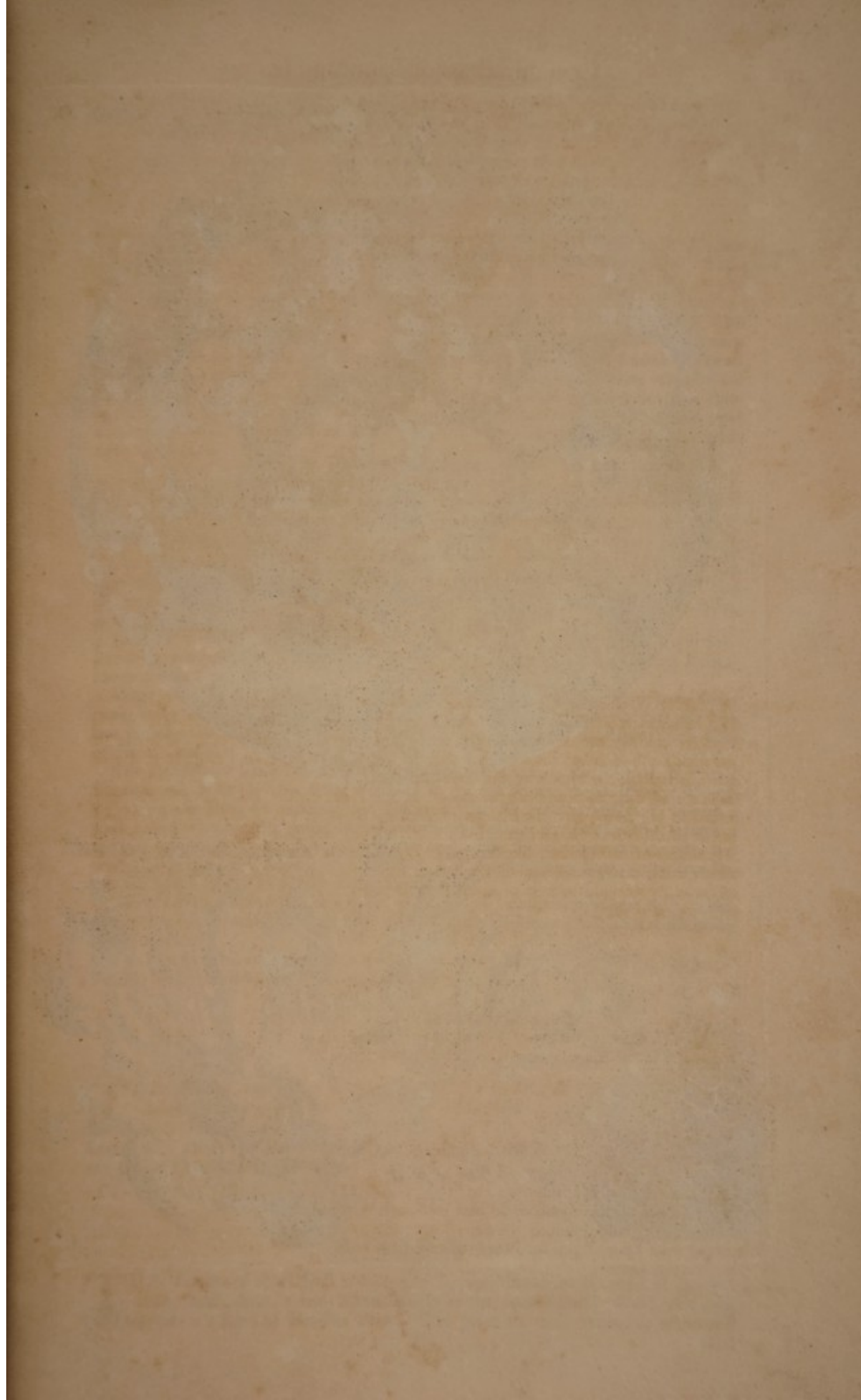


Figure 1 A Piece of Kettinging Stone. p. 33.

Plate VI.



A beautiful Sea Moss. vid. Pl. XI.
(Figure: 2. p. 33)



AN EXPLANATION of the SIXTH PLATE.

FIG. 1.

A Piece of 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 *e, e, e.*

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, by 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 Bodies 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.

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 Sponge.

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

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 conducting 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 Sponge into the Body thereof, and passing sometimes quite through it to the Bottom.

Dr. HOOKE observes, that Sponge is commonly reckoned as one of the *Zoophytes* 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.

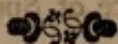
BELLONIUS, in the Eleventh Chapter of his Second Book *de Aquatilibus*, informs us, "That *Spunges* in the Sea are extremely different from what they are when dry, sticking to the Rocks, as many Species of the *Fungi* do to Trees, two or three Foot sometimes under the Sea-Water: tho' now and then not 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 Surprise; 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."

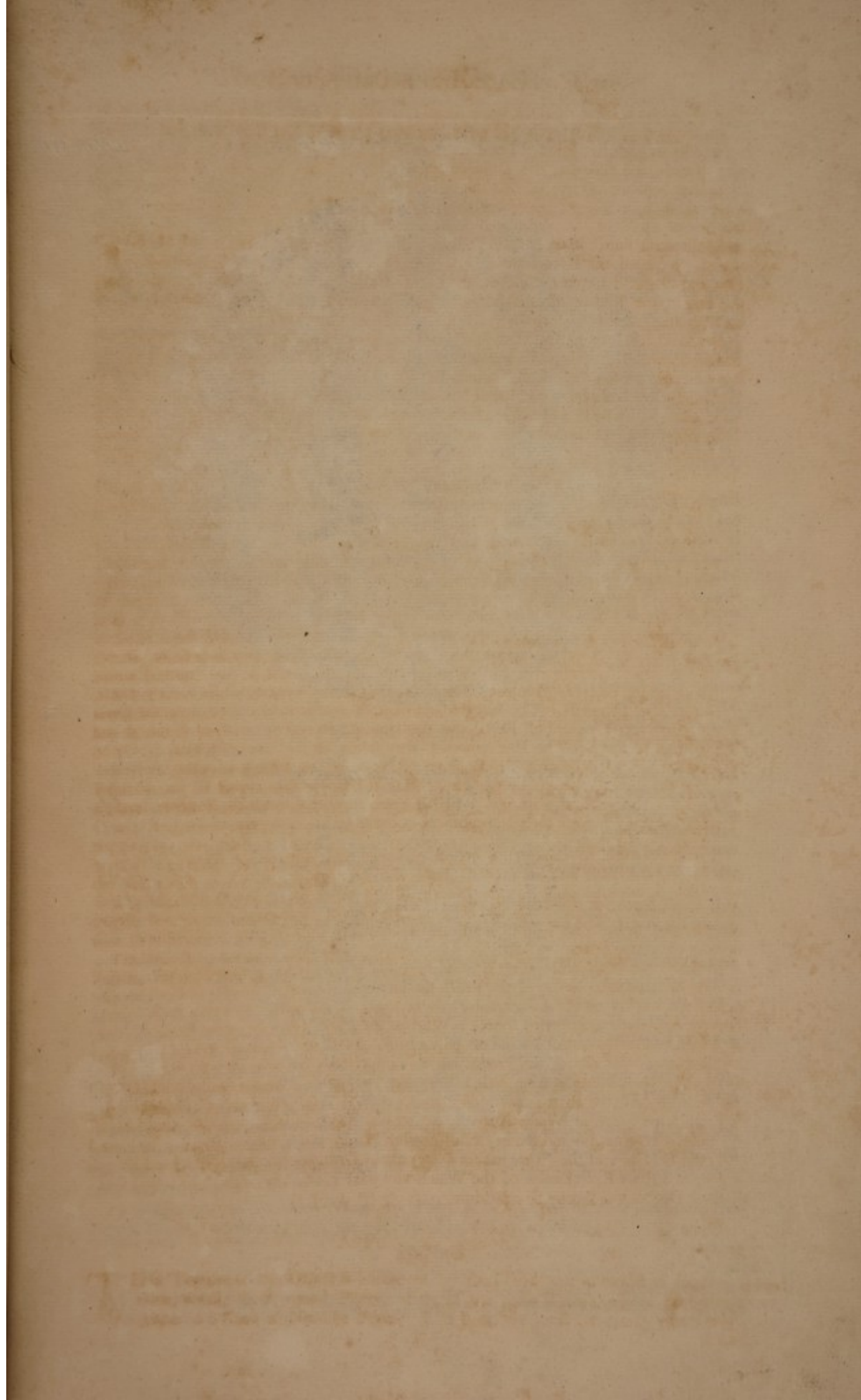
If a dry Sponge be thoroughly wetted, and then squeezing out the Water, it be suffered to expand itself into its natural Shape and Dimensions, which it will freely do whilst moist, 'tis very plain that the Mouths of the larger Holes have a kind of Lip or Rising round about them. 'Tis also evident, that 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 *Sponge* 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 *Sponge*, 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.



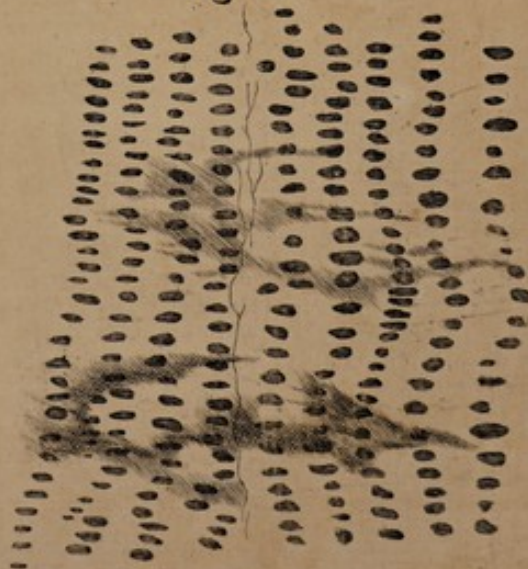


The Pores of Charcoal p. 15.
Fig. 1.

Plate VII.



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.

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 Vita*, *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.

The Subject under Examination seemed to have been a Part of some large Tree, that had been broken off by Rotteness, before it became petrified. And Dr. HOOKE declares, that all he had seen of this Kind seemed to have been rotten before the Petrification 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 Petrification 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, Incombustibility, 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.

* 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. I.

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*, *Sponge*, *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 Springiness, 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 larger

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

Fig: I.



Fig: 2.



The Sensitive Plant. p . 17 .



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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, spongy, and of an Ash-colour, inclining towards a yellow; which Bark is the Cork.

Some *Naturalists* imagine this Cork to be only an Excrecence, 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, flaving, 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 *ff*, 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 *ff*, were dead and wither'd.

One of the Leaves, *bb*, 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 *dd, ee*, 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.

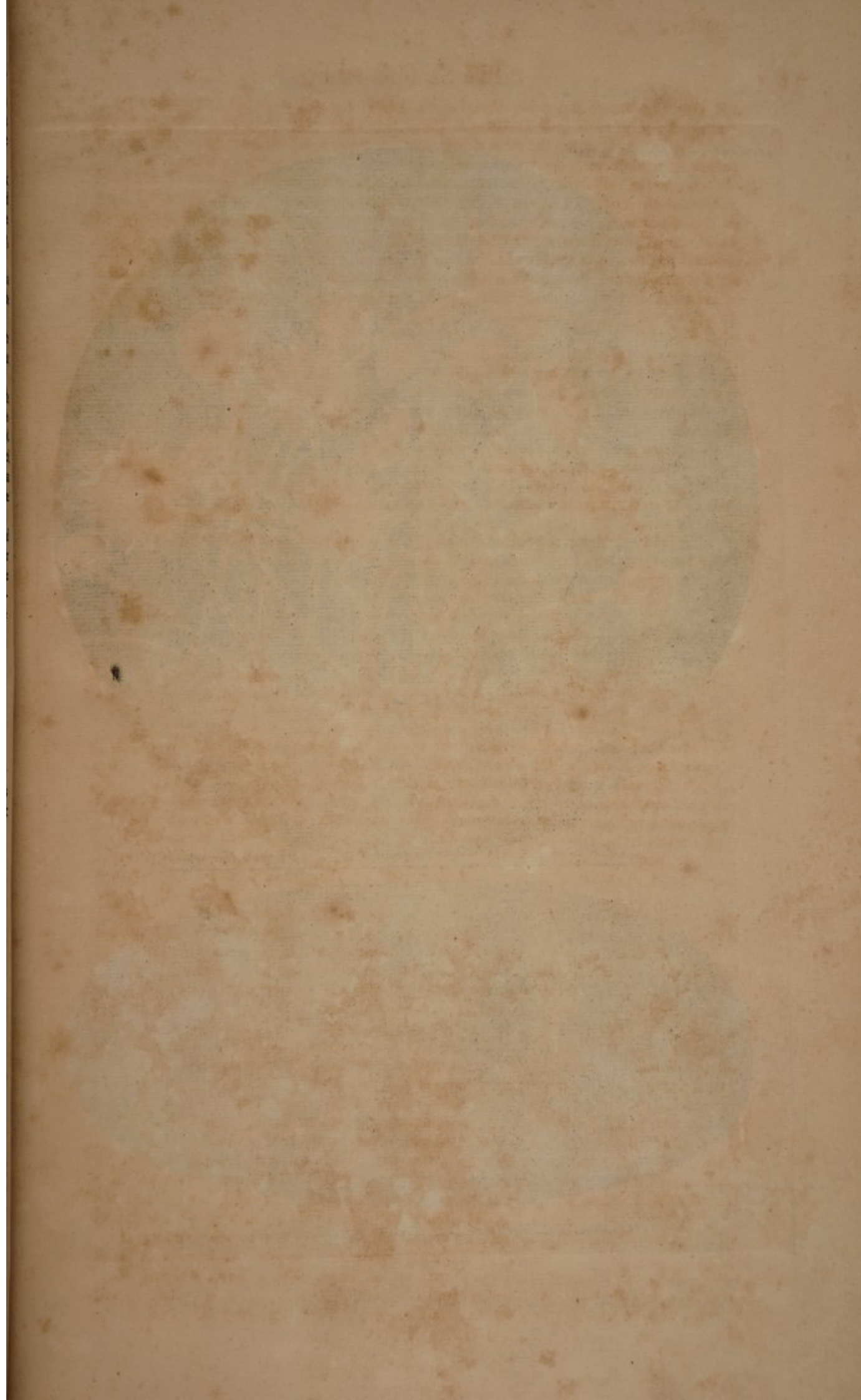
A Sprig whose Leaves were all shut, being plucked off, with Design to observe the Liquor should come from it, none, even with pressing, could be found therein: Whereupon another Sprig, whose Leaves were expanded, being pulled off as dexterously as possible, upon the closing of the Leaves, a little of 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 subtiler 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 flagg'd, 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.







1/2 Part of an

Inch Magnified.



A Curious Plants 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 Mouldiness. 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.

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

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

Form of small Wall-Mofs.

this appeared several Knobs of a yellowish red gummy Substance, out of which sprung Multitudes of long Pods, in Shape resembling those of common Mofs; but, so much less, that many Hundreds of them would not be equal to one Seed-Pod of Mofs. 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 Mofs 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-Mofs.

Wall-Mofs. **T**HIS 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.

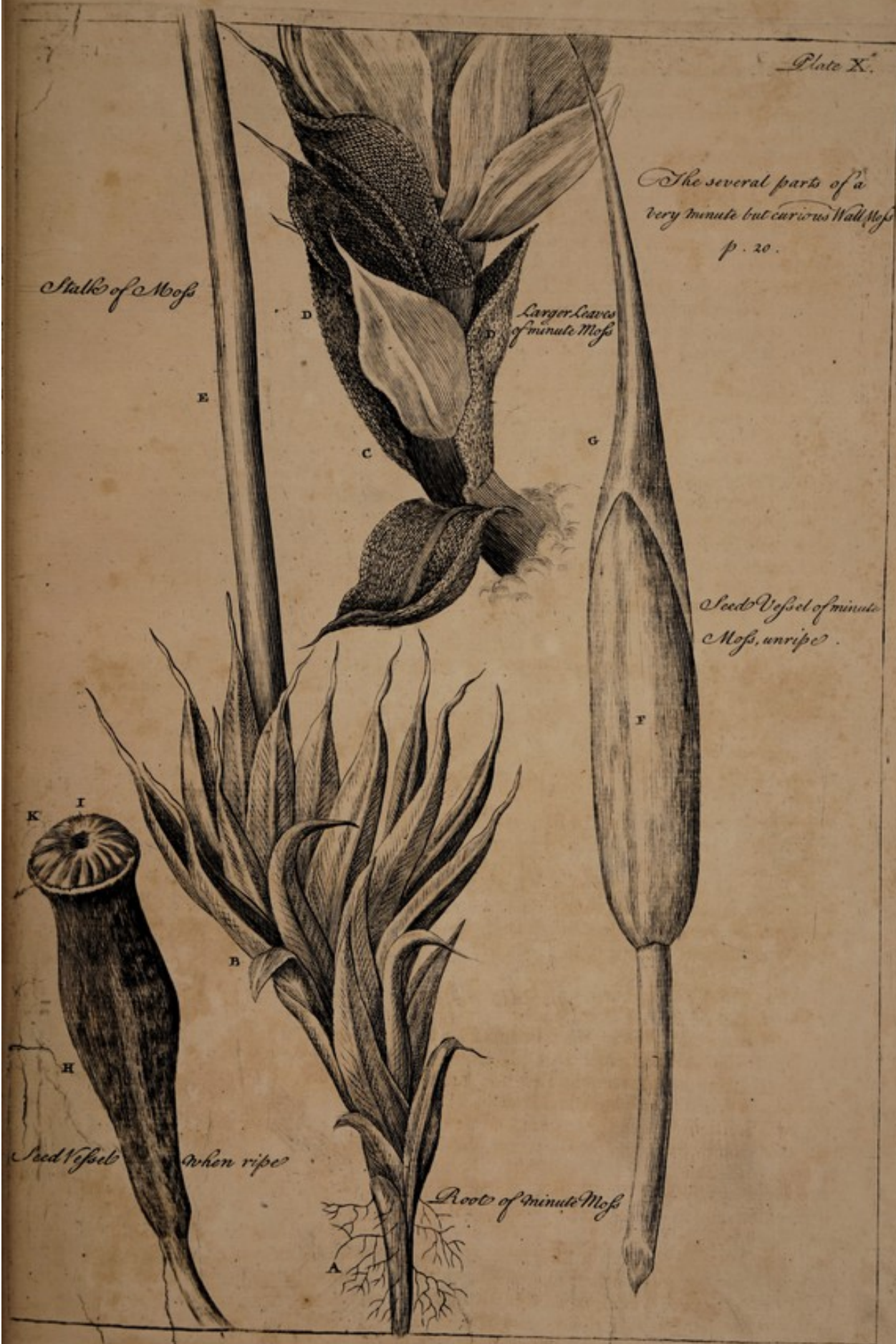
When this Plant is young, and springing up as C, 'tis not unlike to *Houfeleek*; having such kind of thick Leaves, folding over one another; but when they grow longer, the Surface on each Side of them becomes beautifully covered with little oblong transparent Bodies, as the Leaves D, D, D, express.

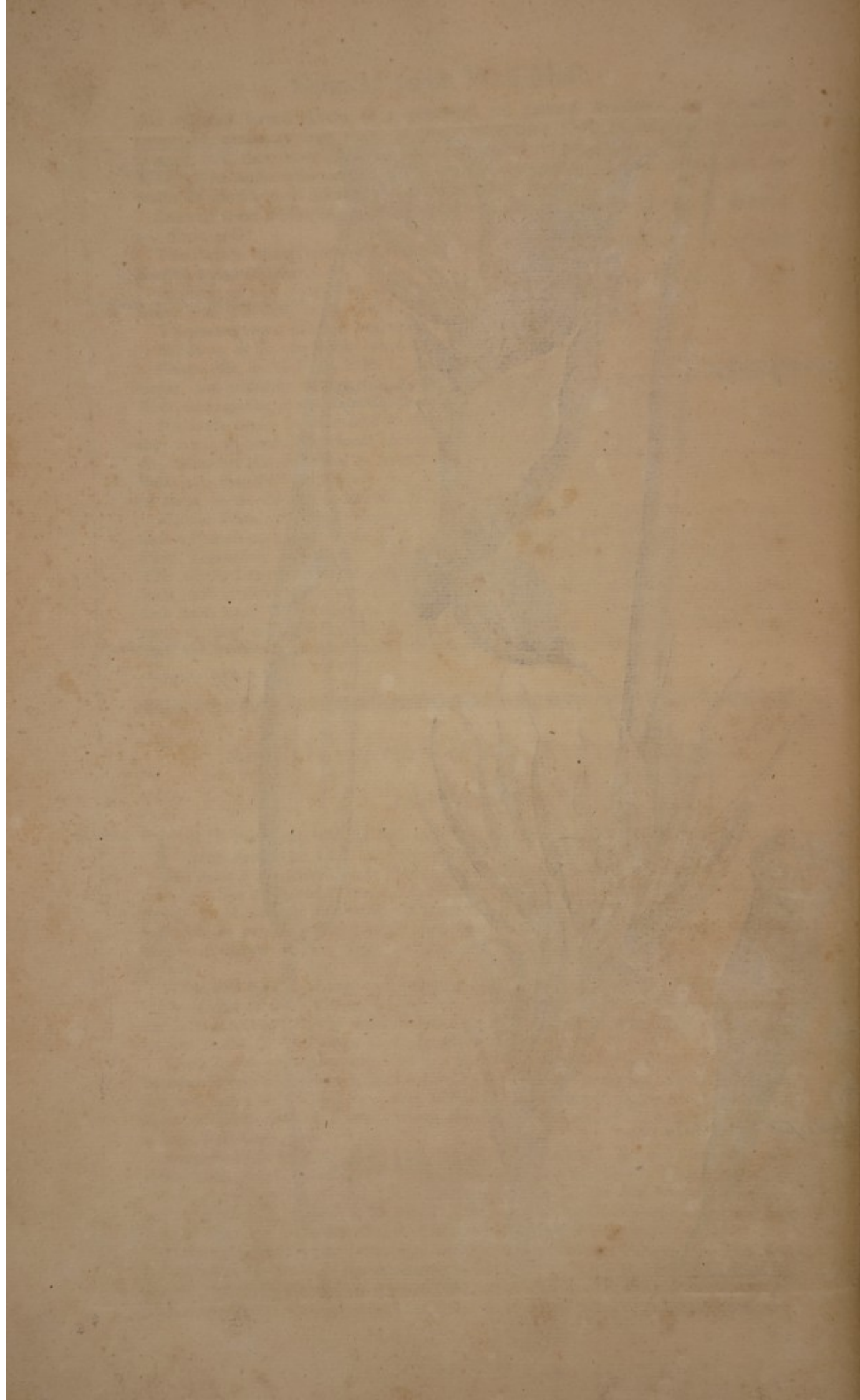
There shoots out between the Leaves, a small white transparent hair-like Body, which becomes in time a long, round, and even Stalk, as E; which being cut tranversely, when dry, was found to be a stiff, hard, and hollow Cane or Reed, without any kind of Knot or Joint, from its Bottom, where the Leaves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

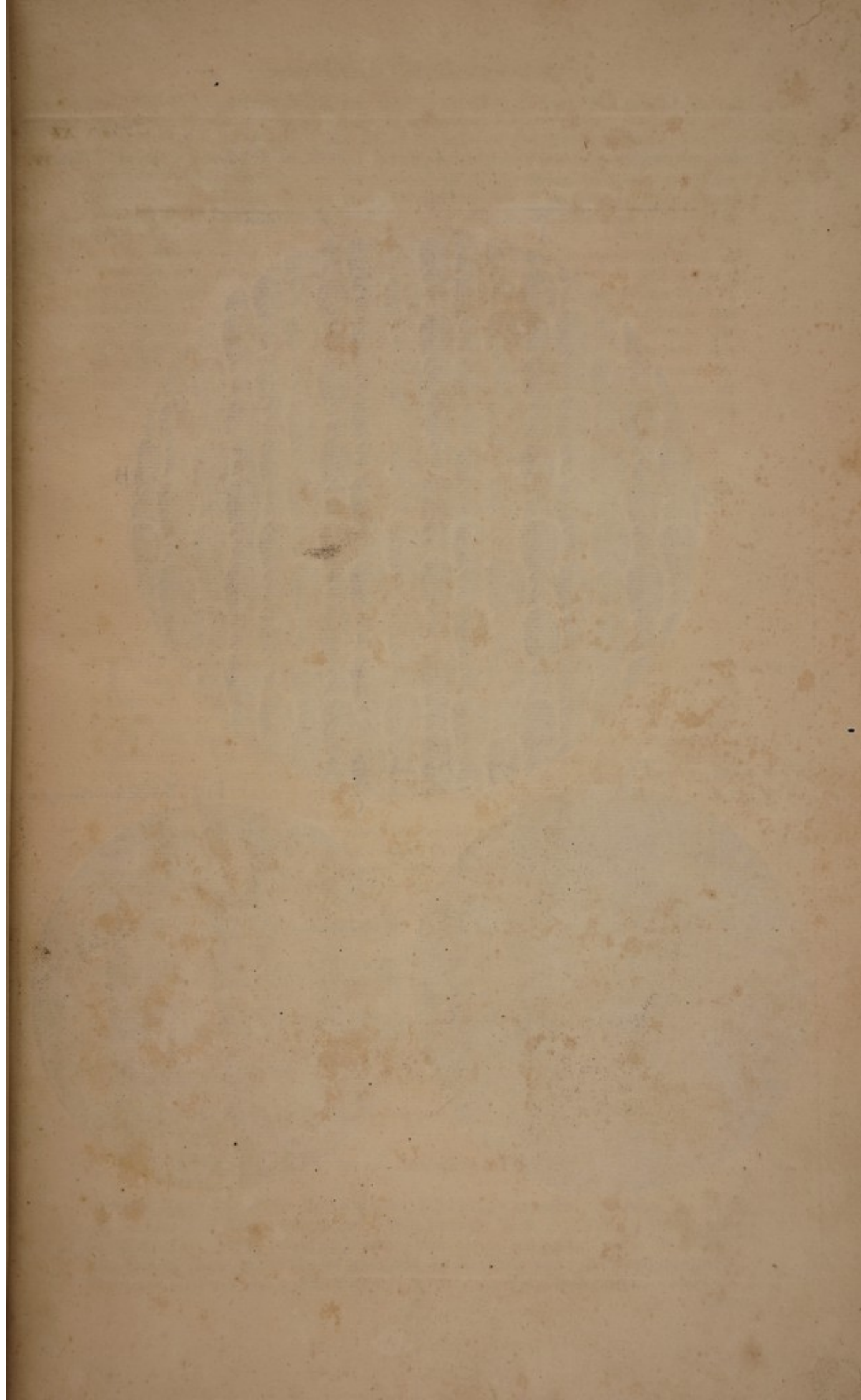
F represents the Seed-Vessel or Case, cut off from the Stalk E, and covered with a thin whitish Skin G, terminating in a long thorny Top. This skinny Membrane at first incloses the whole Seed-Vessel, but as that swells within it, the skin breaks by degrees, and at length falls off with its thorny Top, 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

The several parts of a
very minute but curious Wall Moss
p. 20.



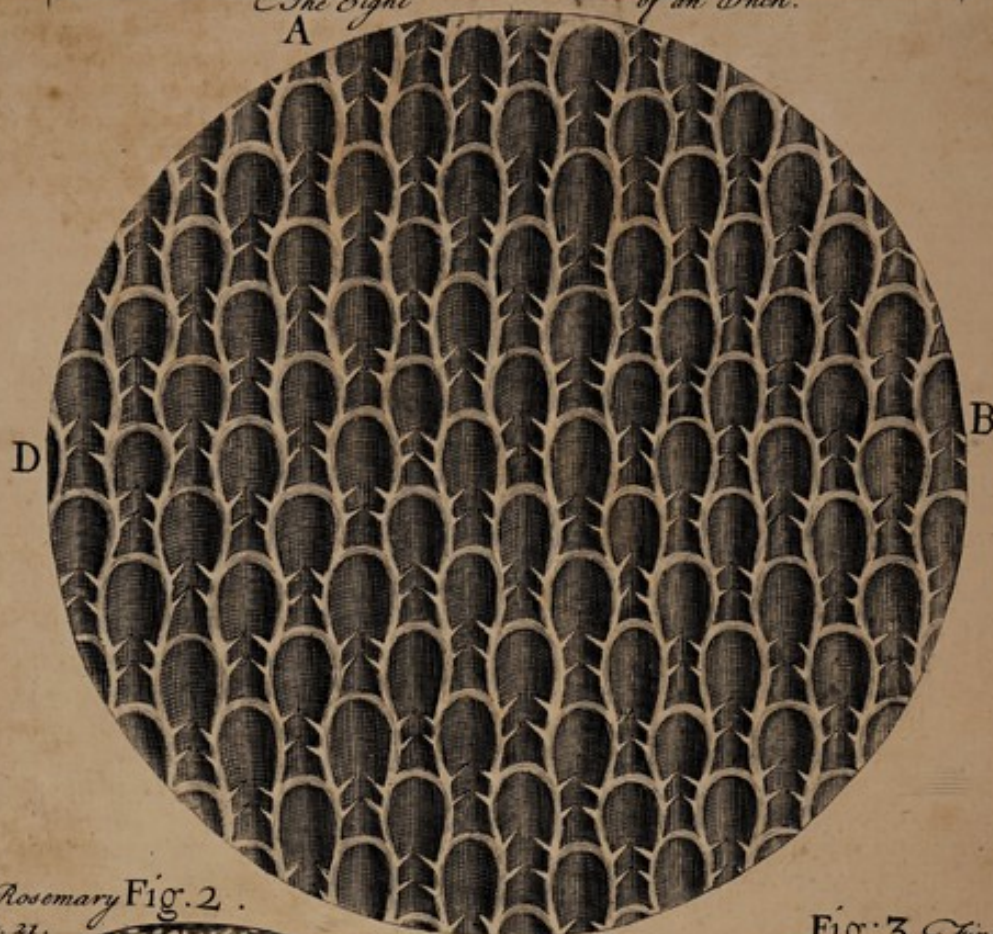




The Configuration of a beautiful Sea Moss, whereof the whole Figure is given Plate VI.

Fig: I . p. 21.

The Eight of an Inch.



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



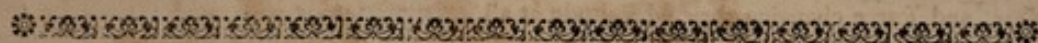
Fig: 3 . Fine Lawn p. 22



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

On opening some of these Cafes, when dry and red, they were found quite empty; but being cut asunder with a sharp Pen-knife, while green, a smaller round Cafe was discovered within the other, with a Multitude of stringy Fibres, occupying the Space between the two Cafes, 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 Sea-Weed. 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.

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 sua 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, Sponges, 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, *Rosemary.* 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-
faces

A Piece of Stinging Nettle.

faces are smooth like this, and as it were quilted, in the same manner. Rue, or Herbrgrass, 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 secondary 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.

P L A T E VI. F I G. 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.

F I G. 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 Glas, 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 Piece of Singing
Nettle. p. 22.

Plate XII

Fig. 1.



The Beard of a
Wild Oat. p. 23.

Fig. 2.

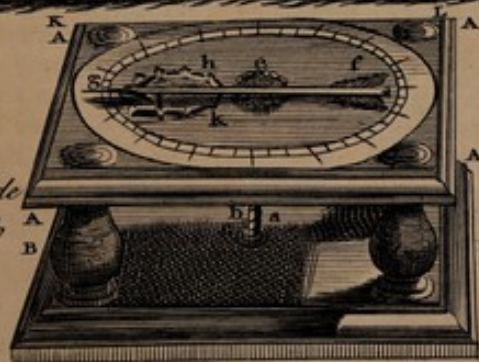


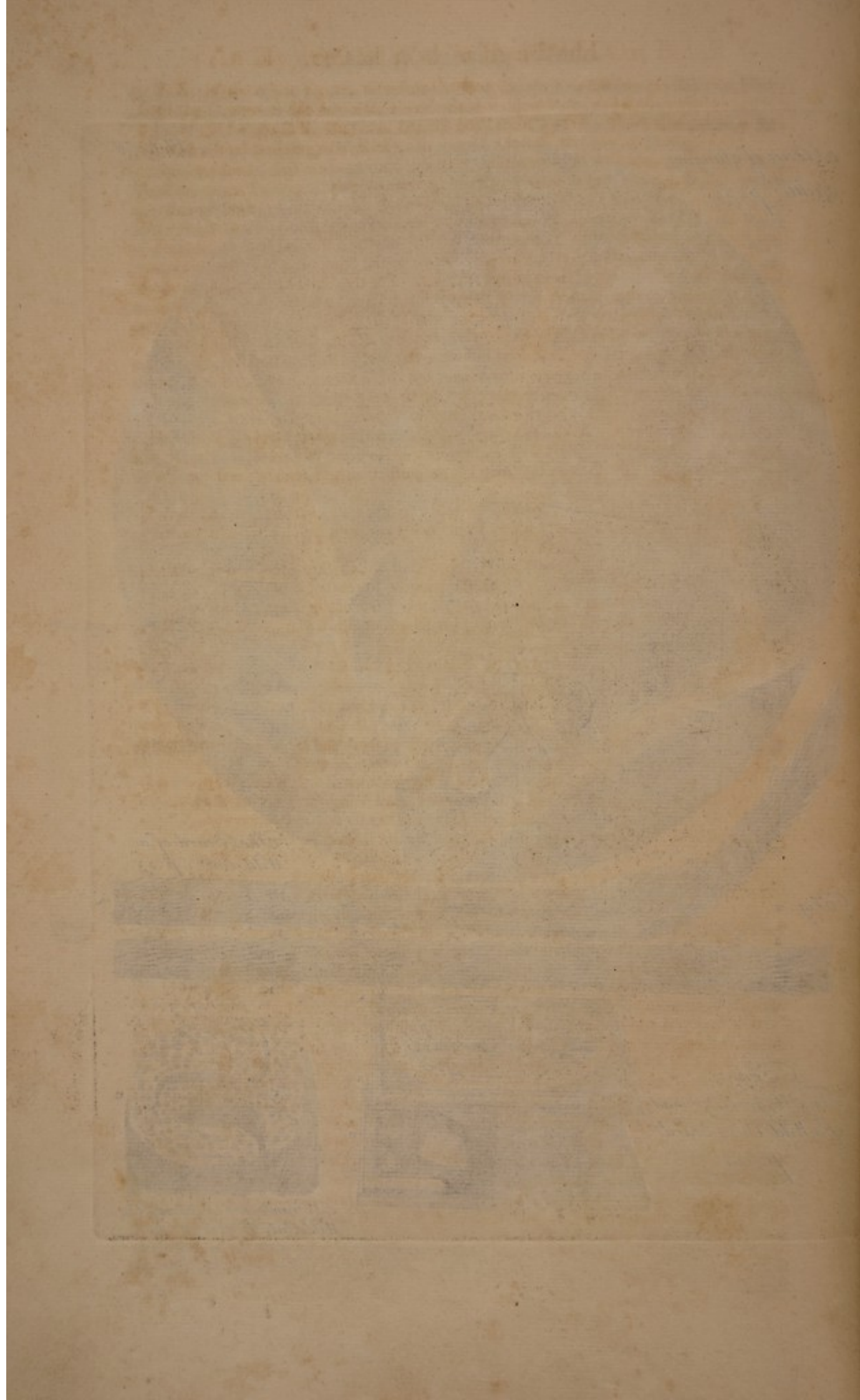
Fig. 3.



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, &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 *Witbe*, 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) 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.

An Hygrometer made with a Wild-Oat Beard.

KK, in the upper Figure, represent the two Channels or Clefs 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 KK, &c. LL, &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 ABCCEF.

KL represent the two Clefs 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.

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

PLATE XII. FIG. 4.

An Hygrometer made with a Wild-Oat Beard.

A BB, 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 BB, 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 AAAA.

On the Top of the Beard at *e*, a small and very light *Index*, *fg*, 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 fg*, 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 fg* being raised to some Distance above the Surface of the Plate AA, a small Pin *b*, was fixed downwards pretty near the Middle of it, in such a manner that it might almost touch the Surface of the Plate AA. 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 *ik*, was placed, by making a Hole through its Center; which Paper having a convenient Number of Teeth, every Turn or Return of the Pin *b* 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.

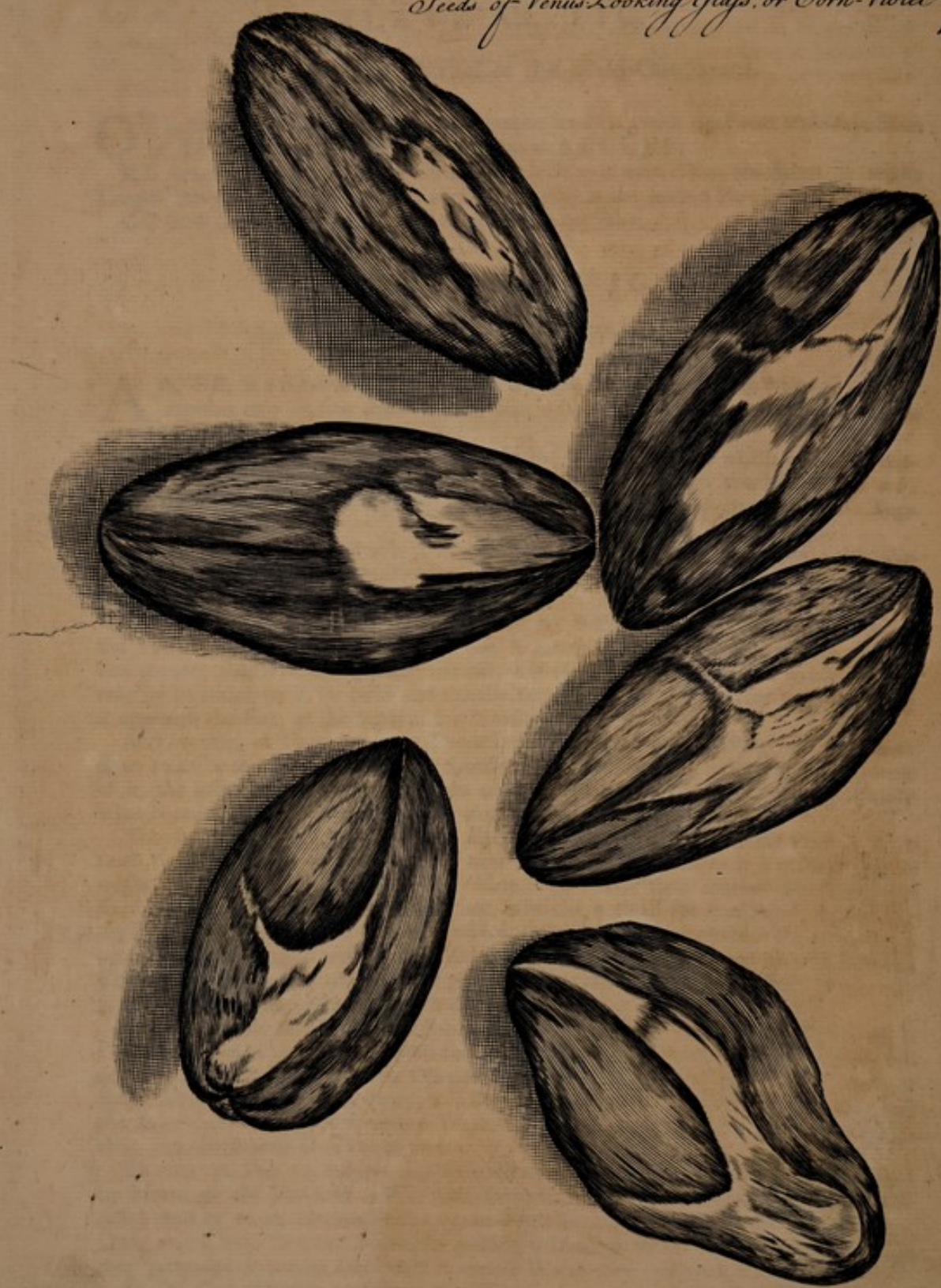
This little Circle may be made of thin Pastboard, Vellum, or Parchment, as well as Paper; but great Care must be taken that it be exceeding light, and move very easily upon the Pin, otherwise the whole Operation will be spoiled. The Box may be made of Brass, Silver, Iron, Wood, or Ivory, and Degrees 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.

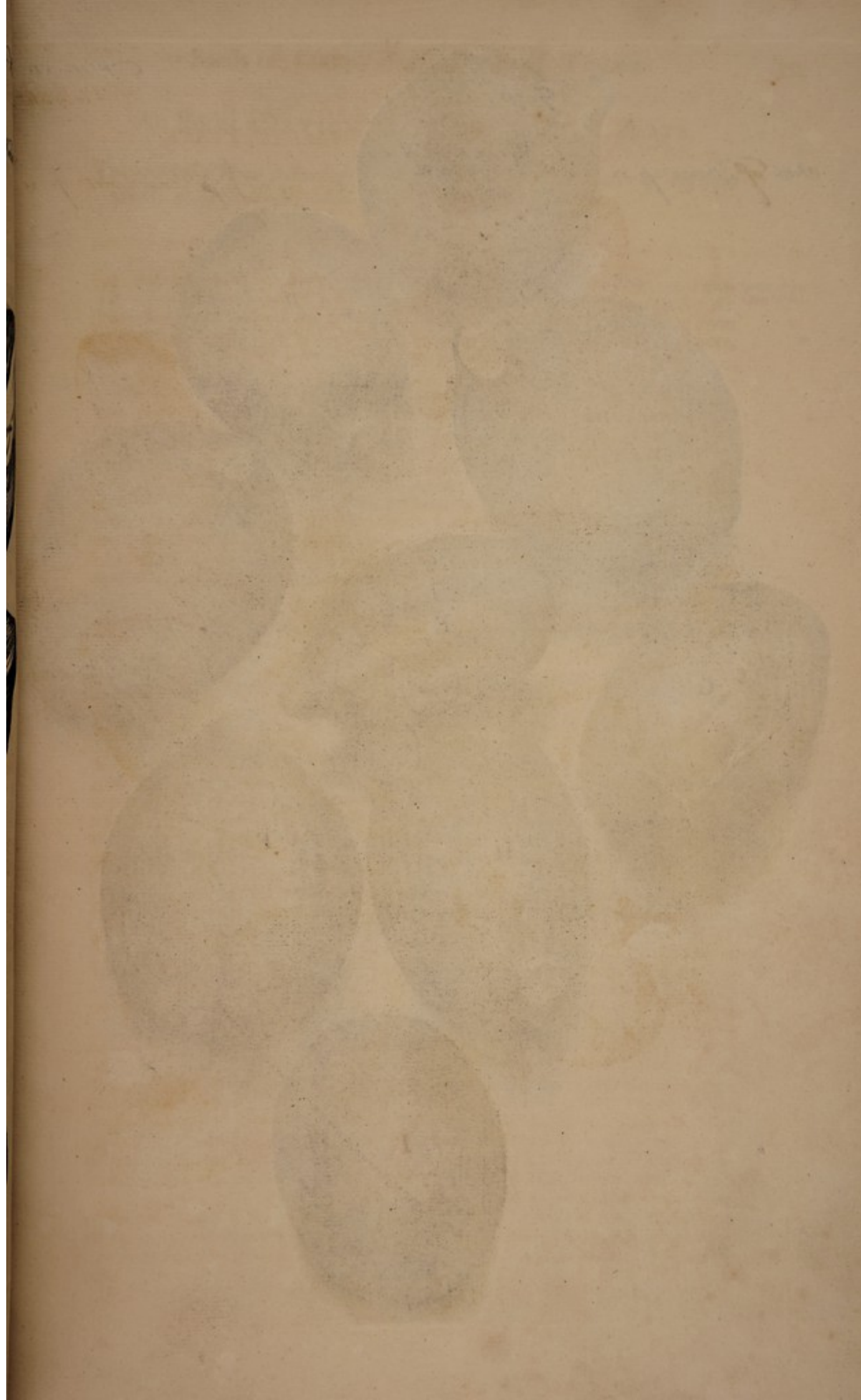
BAPTISTA PORTA informs us, in his Book of *Natural Magic*, that some Jugglers, by Means of the Beard of a Wild-Oat, (which, to make it the more surprizing, they called the Leg of an *Arabian Spider* or an *Egyptian Fly*) used to make a small *Index*, *Cross*, or the like, to move round, by putting a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

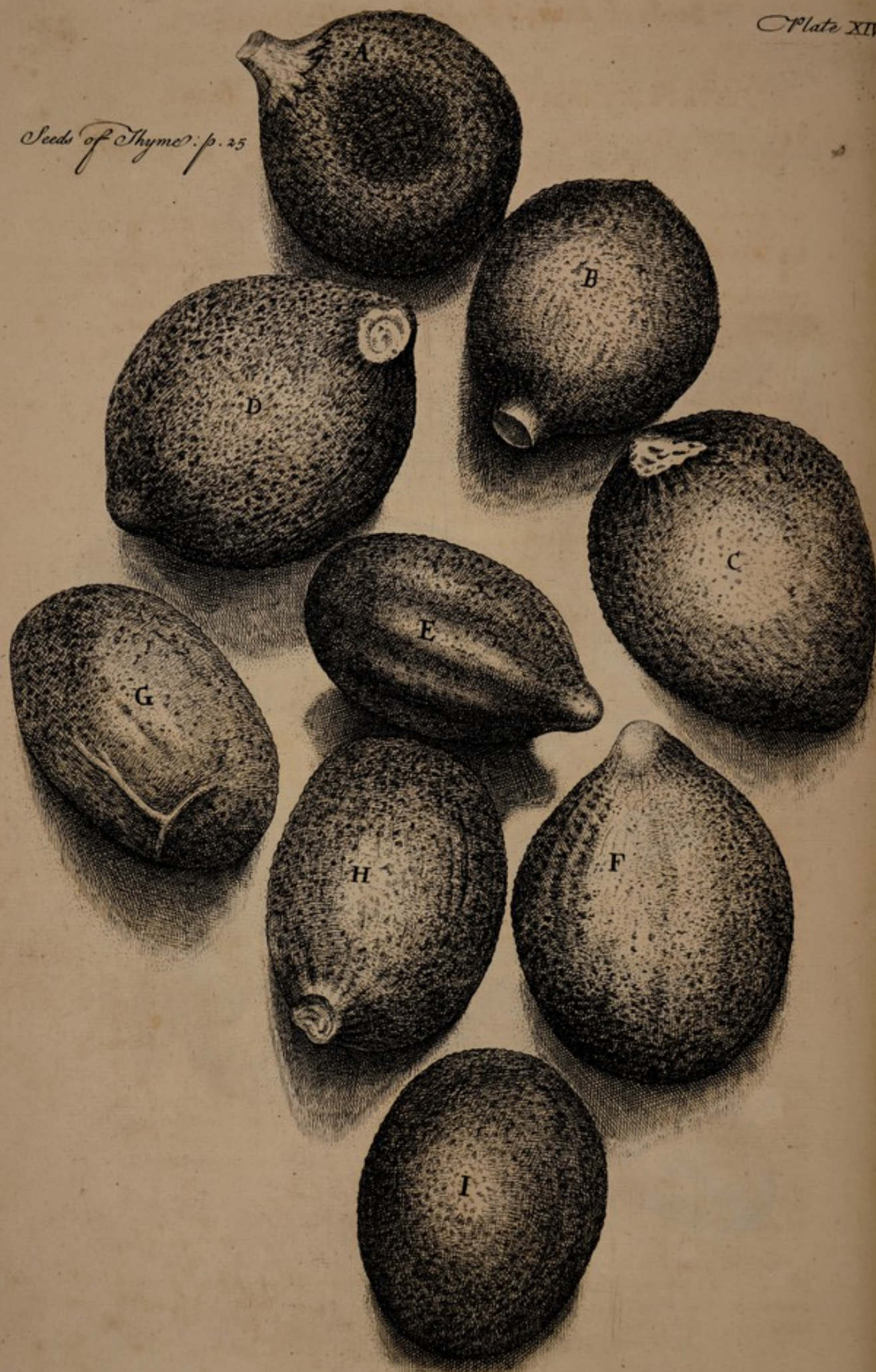


Seeds of Venus Looking Glass, or Corn-Violet. p. 25.





Seeds of Thymus: 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.

THOSE under our Inspection, at present, belong to the *Corn-Violet*, or *Venus-^{Seeds of the} 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, inasmuch that no two of them can be found alike exactly.

The Seeds of Plants (even those whose Shape and Structure, by reason of their Smallness 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.

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.

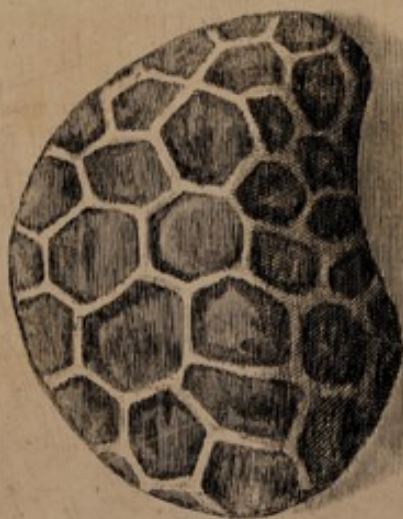
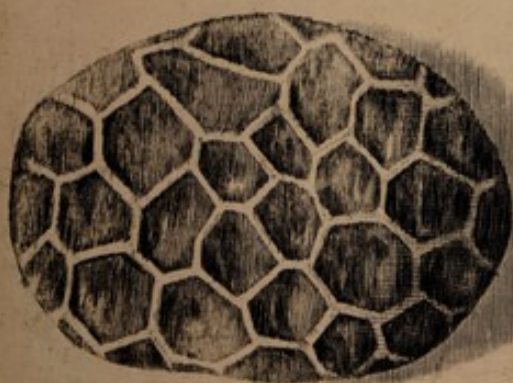
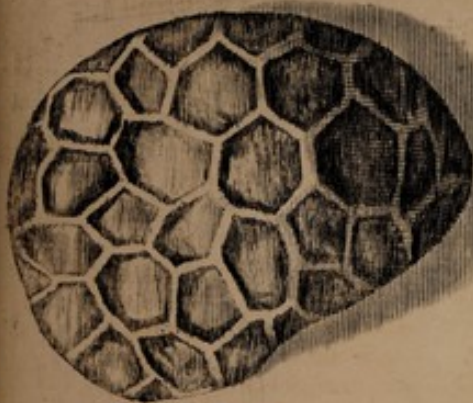
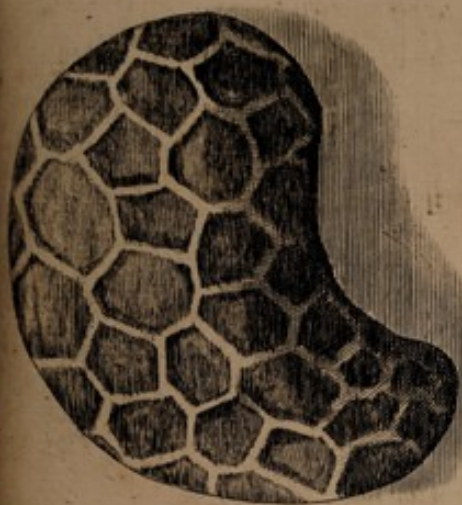
In short, the milky Juice which flows from the green Heads or Seed-Vessels of the Poppy pretty freely upon cutting, after it becomes inspissated, is *Opium*: A Drug esteem'd in the highest Manner in *Turky*, *Persia*, *India*, and all the Eastern Parts of the World, as it not only removes Grief and Pain, 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.

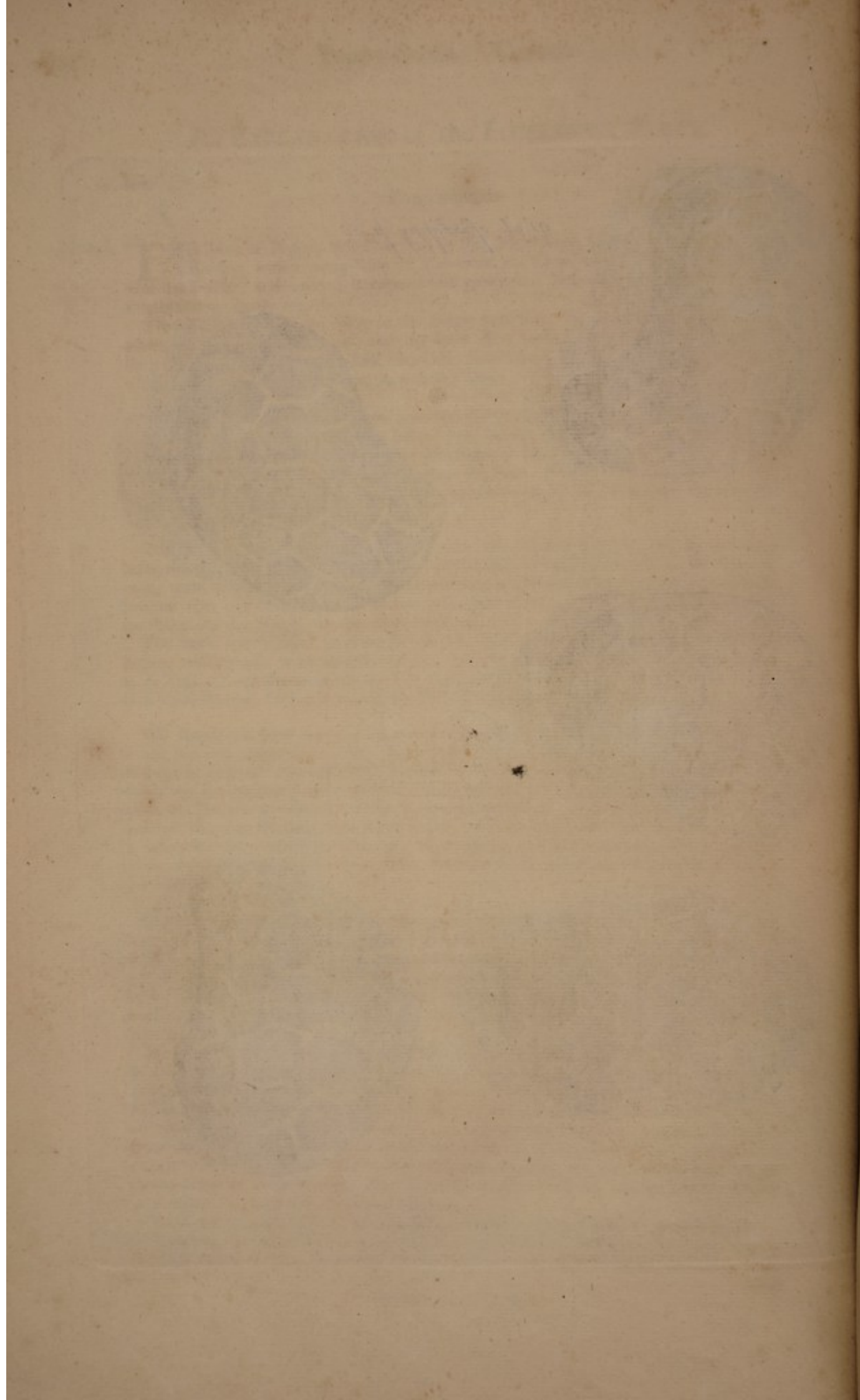
The Goodness of Providence is therefore further observable in the Care it has taken for the abundant Propagation of this inestimable Vegetable; the Seeds whereof it has made so small as not to exceed the thirty-second Part of an Inch in Diameter; whereas the Diameter of the Seed-Vessel is oftentimes 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.

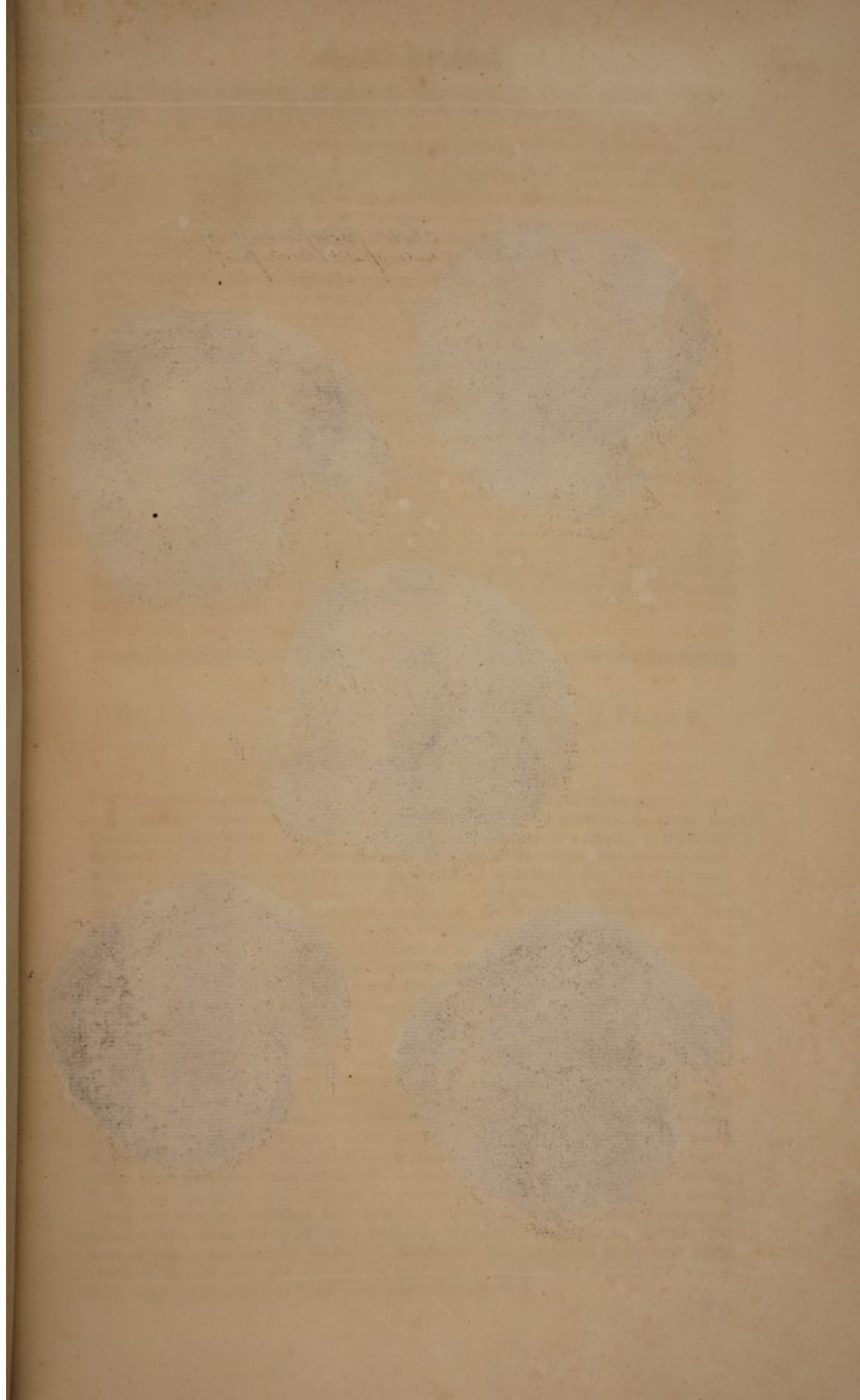
The Knowledge of *Opium*, and the Effects thereof, are probably of great Antiquity; for HOMER, the oldest Writer in the World except MOSES, describes HELEN preparing a Cordial called by him *Nepenthes*, whose Qualities and Effects agree admirably with what

* Microscope made easy, p. 254.

Seeds of Poppy. p. 26.







Seeds of Burflain. 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' assuage
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 oppress'd by Russian-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^o 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.

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, Chefnuts, &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 Infusion 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, Chestnut, 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^o 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.*

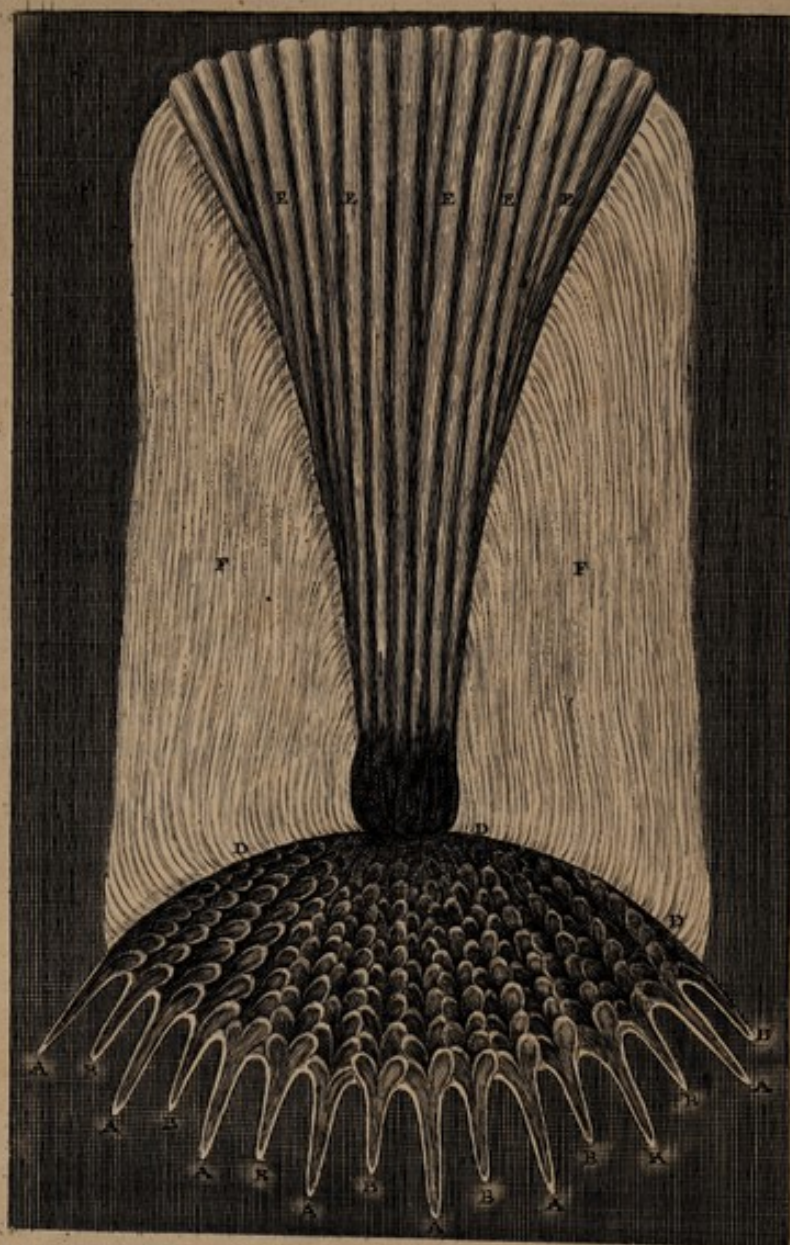
*Thus, every single Berry that we find,
Has, really, in itself whole Forests of its Kind.
Empire and Wealth one Acorn may dispense,
By Fleets to sail a thousand Ages hence:
Each Myrtle-Seed includes a thousand Groves,
Where future Bards may warble forth their Loves.
So ADAM's Loins contain'd his large 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.*



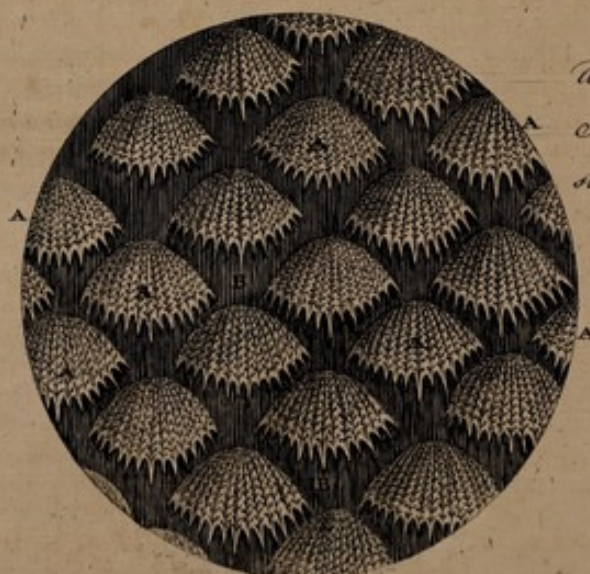


Fig. 1.
The Scale of
a Soul Fish
p. 29.



Four Times
the
Natural Bigness.
p. 29.

Fig. 2.



A Piece of the Skin of a
Soul Fish with the Scales
sticking therein. p. 29.

AN EXPLANATION of the SEVENTEENTH PLATE.

FIG. 1.

The 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. Scale of a Soal.

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.

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. Soal's Skin.

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, 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.

Coughage, or Cow-Itch.

Cow-Itch.

THE *Phasolus filiqua hirsuta*, or *Hairy Kidney-Bean*, called in the *East-Indies* where it grows *Coughage*, 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 *Coughage*. 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 *Coughage*, 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 *Phasoli*, the Pods whereof are covered like the *Coughage* 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 *pp*, *qq*, *rr*, *ss*, *tt*, *vv*: 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

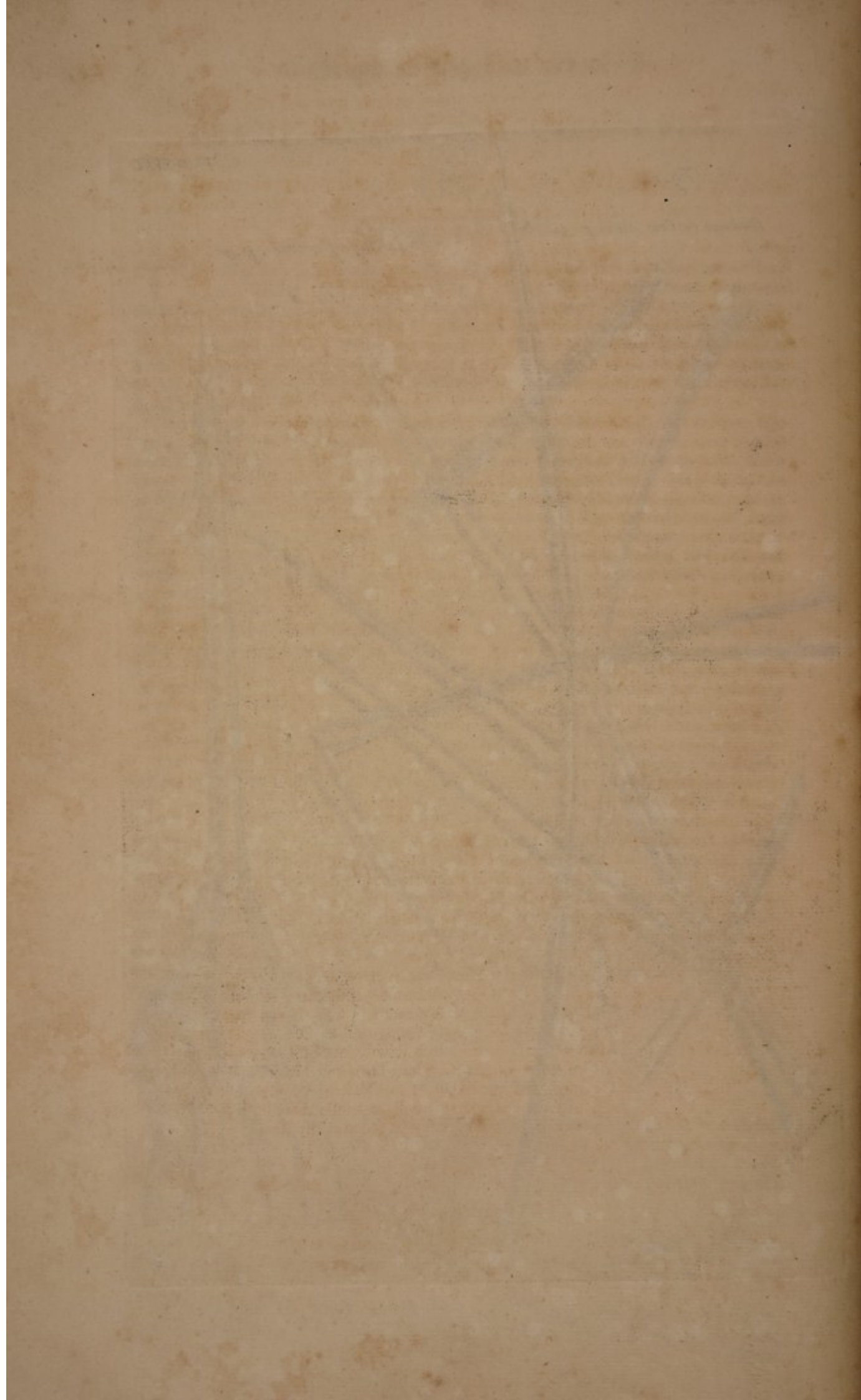
Fig. 1.

Couhage, or Cow Itch, p. 30.

The Sting of a Bee, p. 30.

Fig. 2.





without a Chape. This Point was likewise armed on both sides with Thorns or Hooks, xx, yy, zz , 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, pp, qq, rr , &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



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

The Construction of Feathers. p. 32.

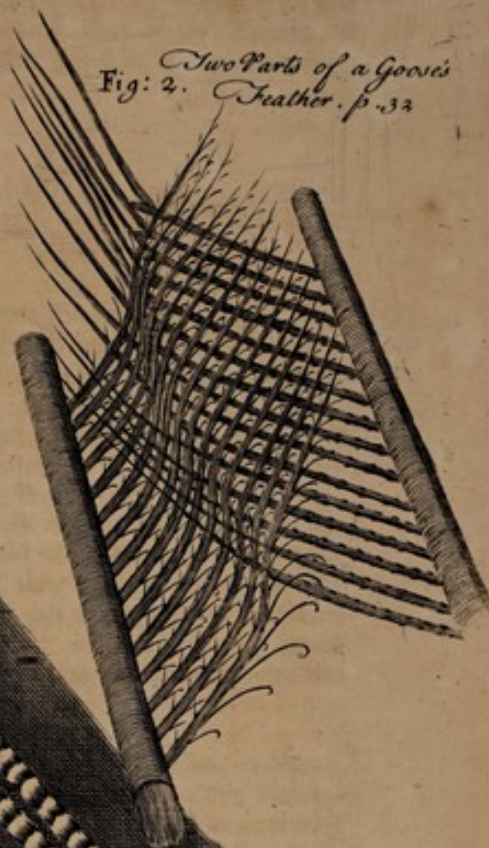
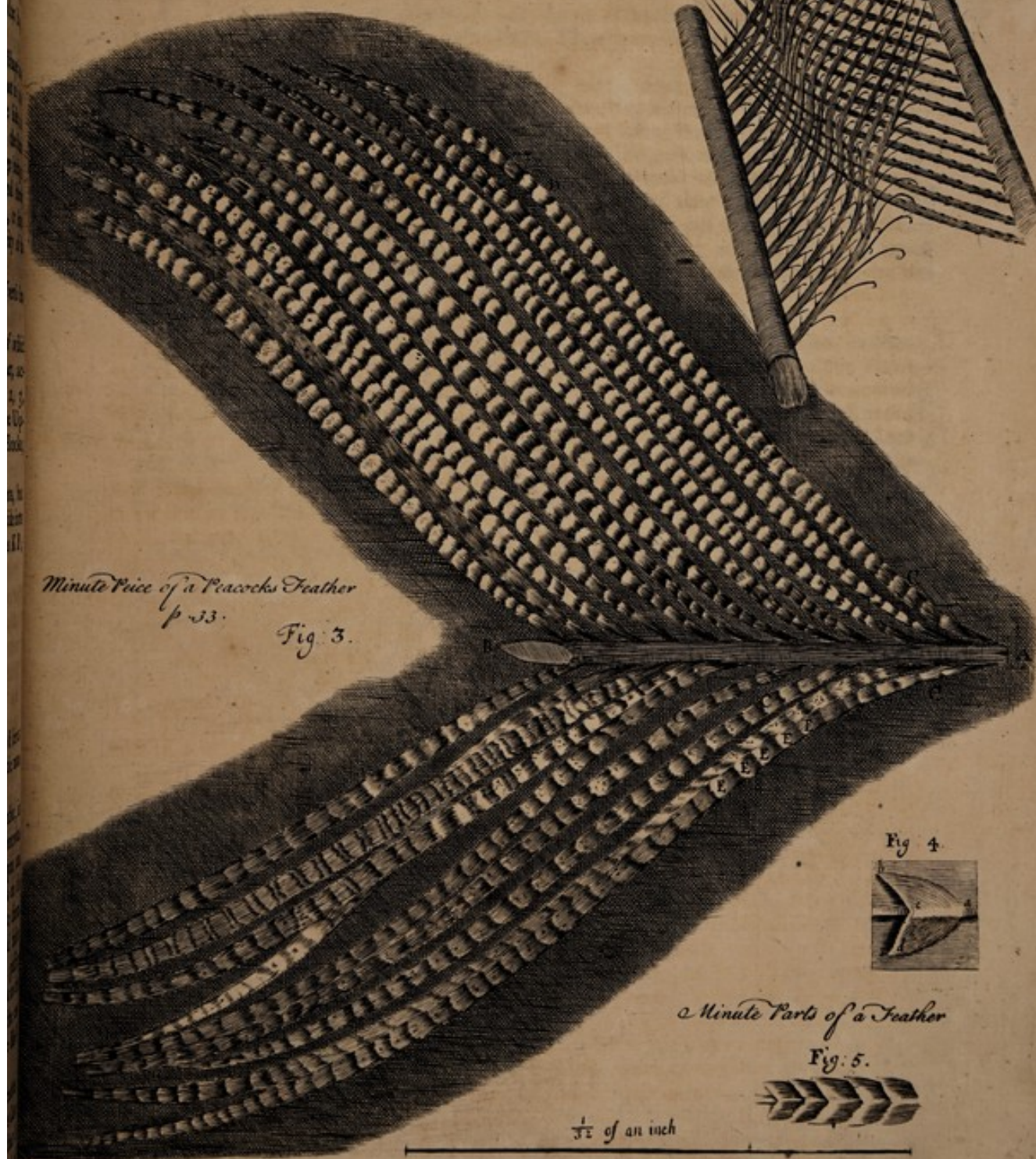


Fig. 2. Two Parts of a Goose's
Feather. p. 32



Minute Piece of a Peacock's Feather
p. 33.

Fig. 3.



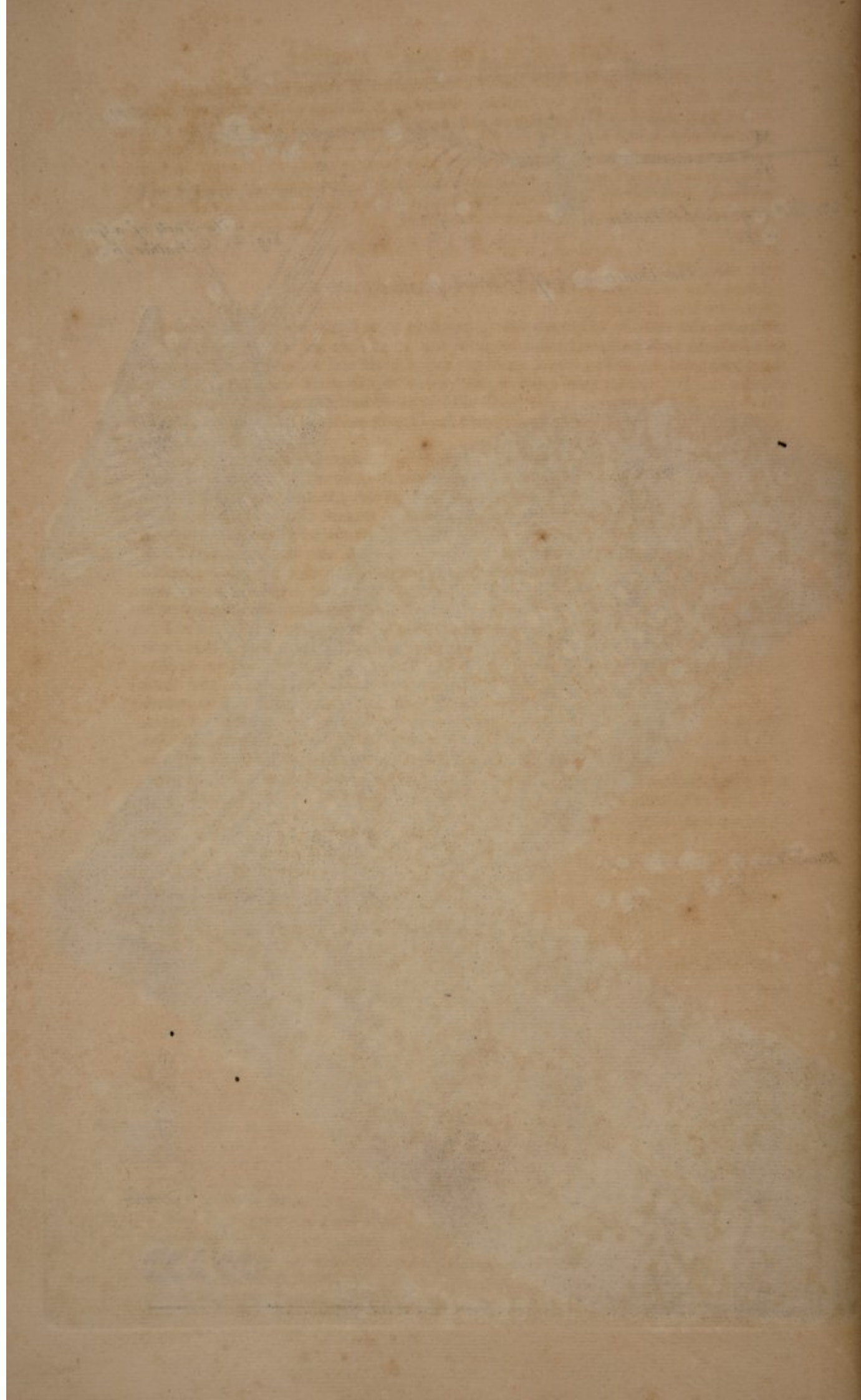
Fig. 4.

Minute Parts of a Feather

Fig. 5.



$\frac{1}{12}$ 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.

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 *Laminae* 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 Tiles. 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 opaque 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. **T**HE 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 Glafs; 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 Glafs.

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, 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 Glafs, 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 Glafs, 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 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. 1

The Foot of a
Fly. p. 34.



Fig. 3



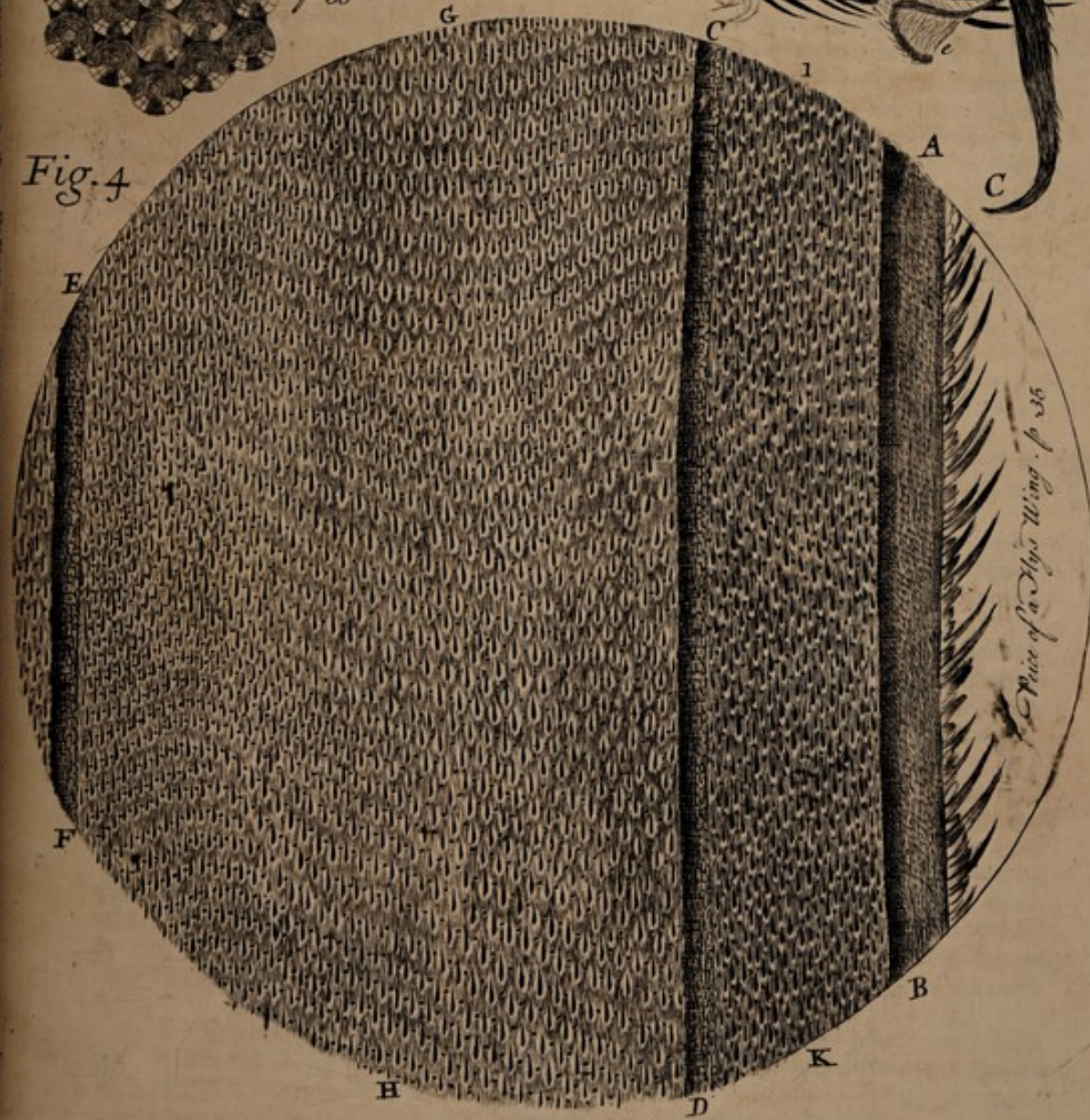
Part of the Eye of a Fly
p. 35.

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

Fig. 2



Fig. 4



Piece of a Fly's Wing. p. 35

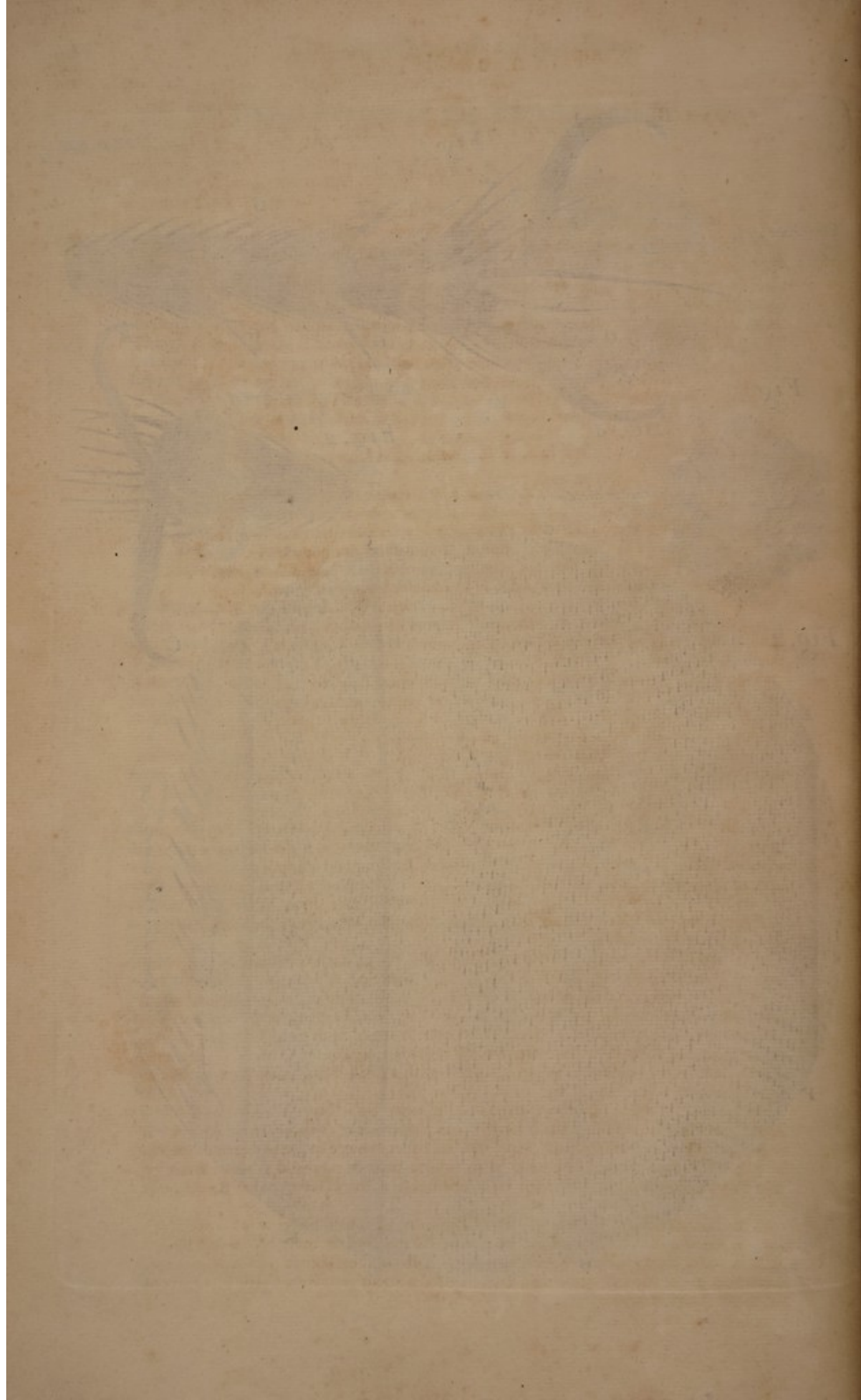


PLATE XX. FIG. 2.

Another Foot of a Fly.

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. A Fly's Foot.

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 fettle on her Wings.

PLATE XX. FIG. 3.

Part 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, inasmuch 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. Part of a Fly's Eye.

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.

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. Part of a Fly's Wing.

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 triangular 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.

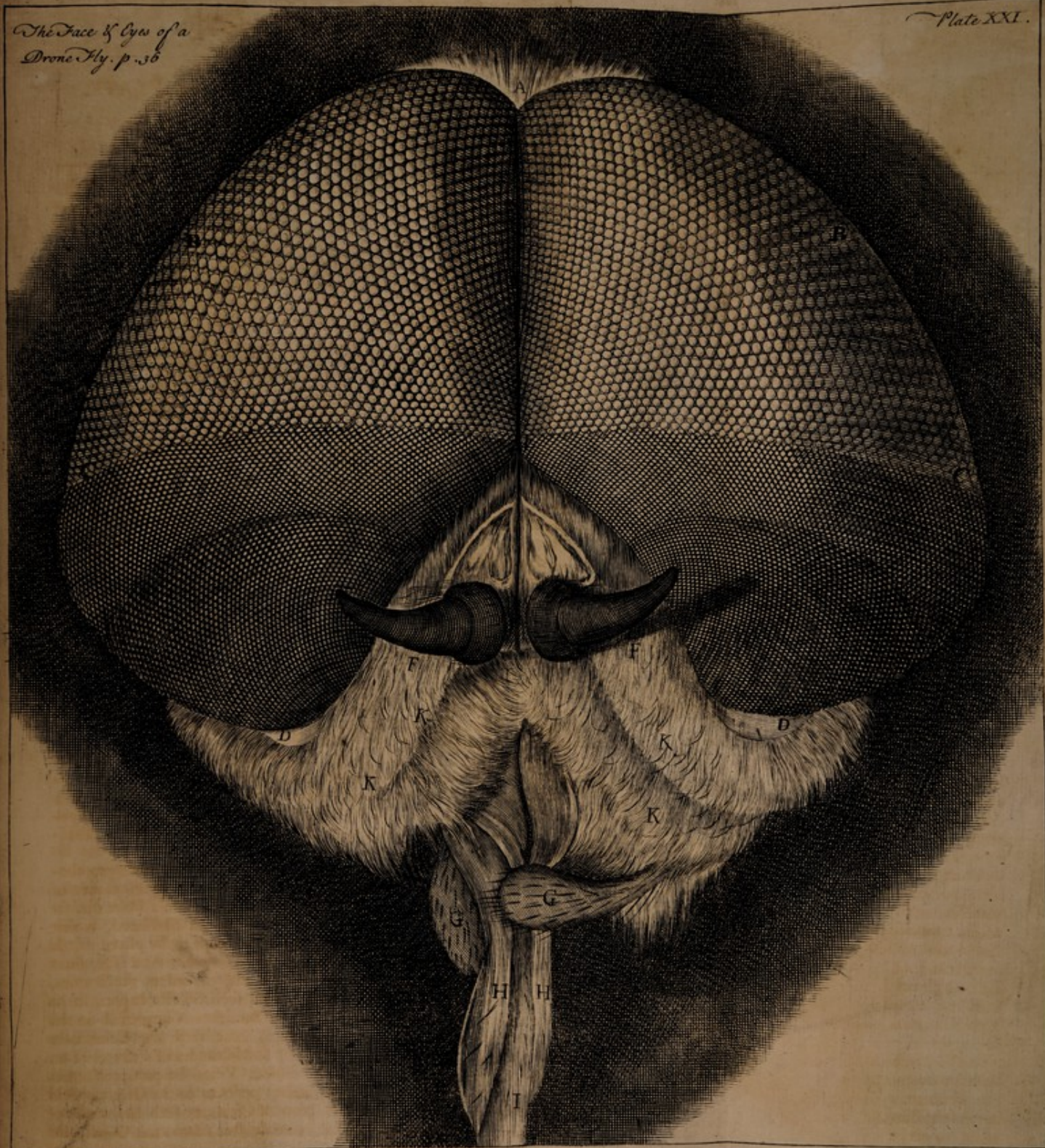
Thus, each of these *Pearls* or *Hemispheres* being covered with a transparent protuberant *Cornea*, and containing a Liquor correspondent to the watery or glassy Humours of the Eye, must necessarily refract all the parallel Rays falling on it, into a Point not far within, where probably the *Retina* is placed; which *Retina*, in all likelihood, is that dark opaque 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.

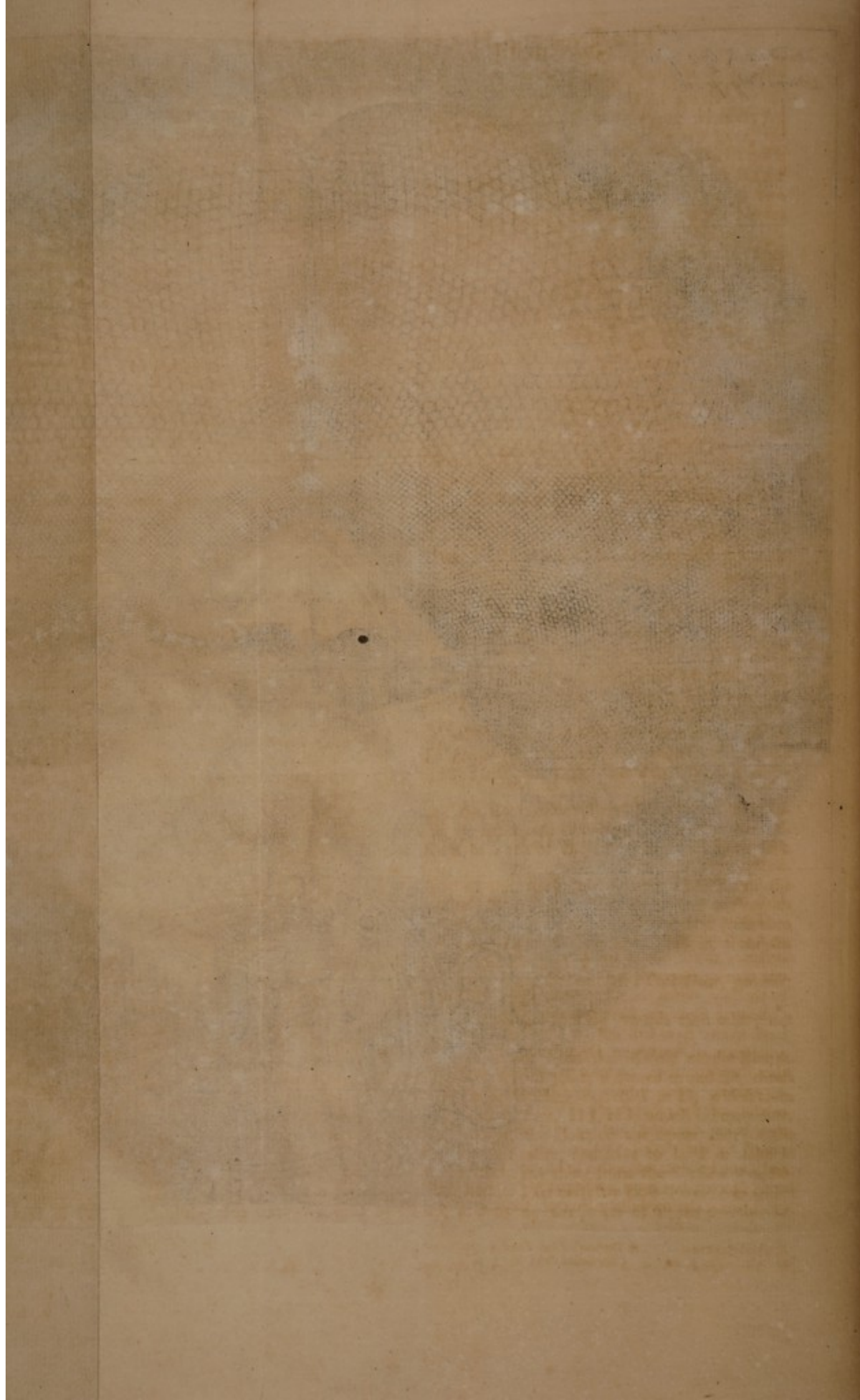
The most remarkable of all the Insects we know for its fine pearled Eyes, is the *Libella* or *Dragon-Fly*. Mr. LEEUWENHOCK reckons twelve thousand five hundred forty four *Lenses* in each Eye of this Creature, or twenty five thousand eighty-eight in both, placed in an hexangular Position; each *Lens*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

supported

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

Plate XXI.





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 *Speſtacle de la Nature* finely observes, * that the Eyes of other Creatures are as it were multiplied 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*, *Sbrimps*, 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 *Camel* 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 Fibrille 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. Transf.* N^o 137. Mem. for a Nat. Hist.
§ Gibson's *Anat. lib.* 3. c. 10.

A Blue-Fly, or Flesh-Fly.

have each of them corresponding Parts in the Brain: so that when any of those *Fibrille* 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 *Cambrai* 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

FF shew the Horns.

GG the Smellers or Feelers.

HH and I the Proboscis.

KKKK 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.

AA, Its protuberant and pearly 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.

BB, 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 BB.

C, a Projecting Part at the anterior End of this Arch, and about the Middle of the Face, on which grow DD, 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.

EE, Brushy Bristles or Feathers, somewhat like the Tufts of a *Cock-Gnat*, growing from the upper Part and Outfides of the Horns, DD.

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

GHI, 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, HI, HI, 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.

KK,

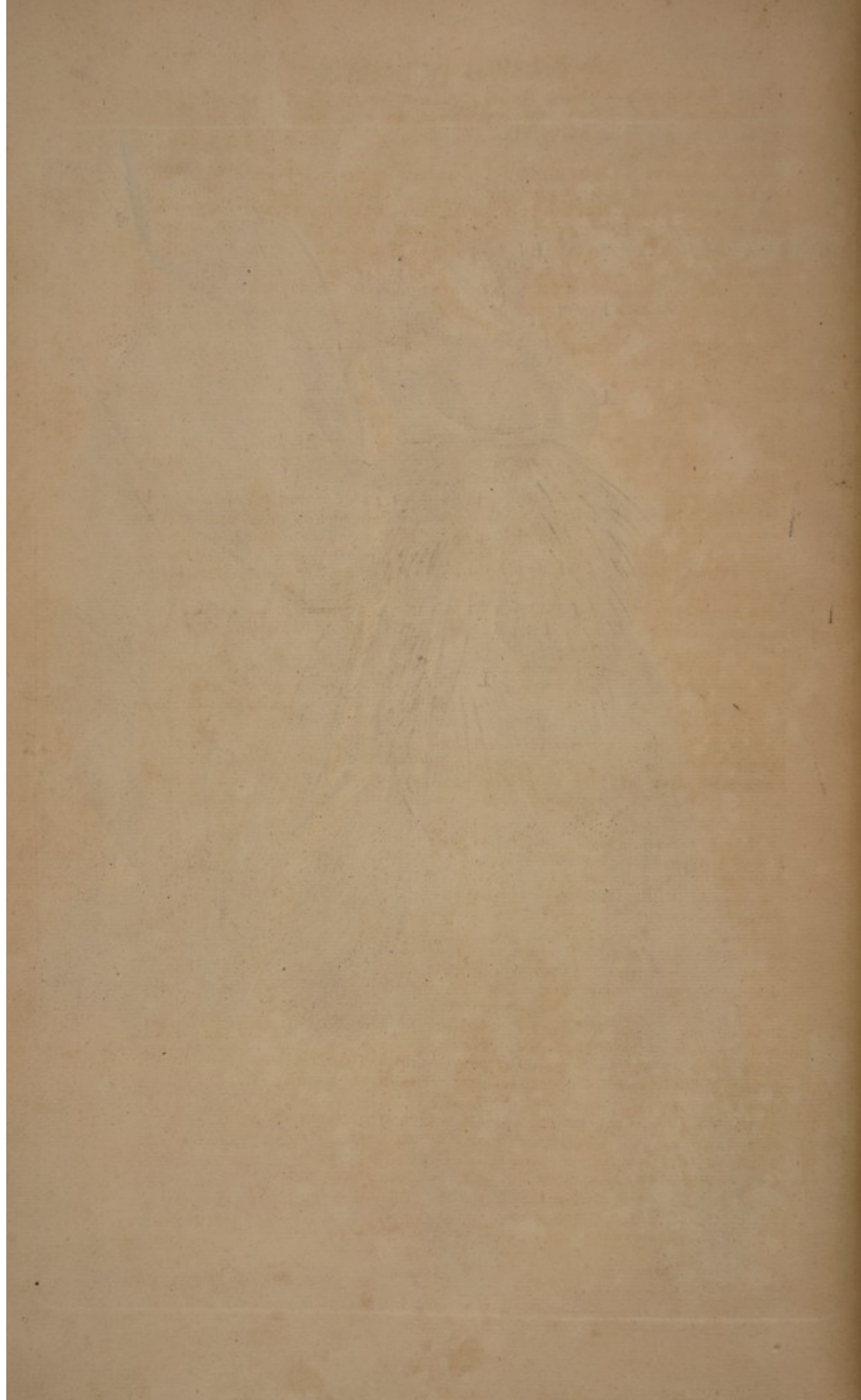
The Blew Bottle or Flash Fly
p. 38.

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.

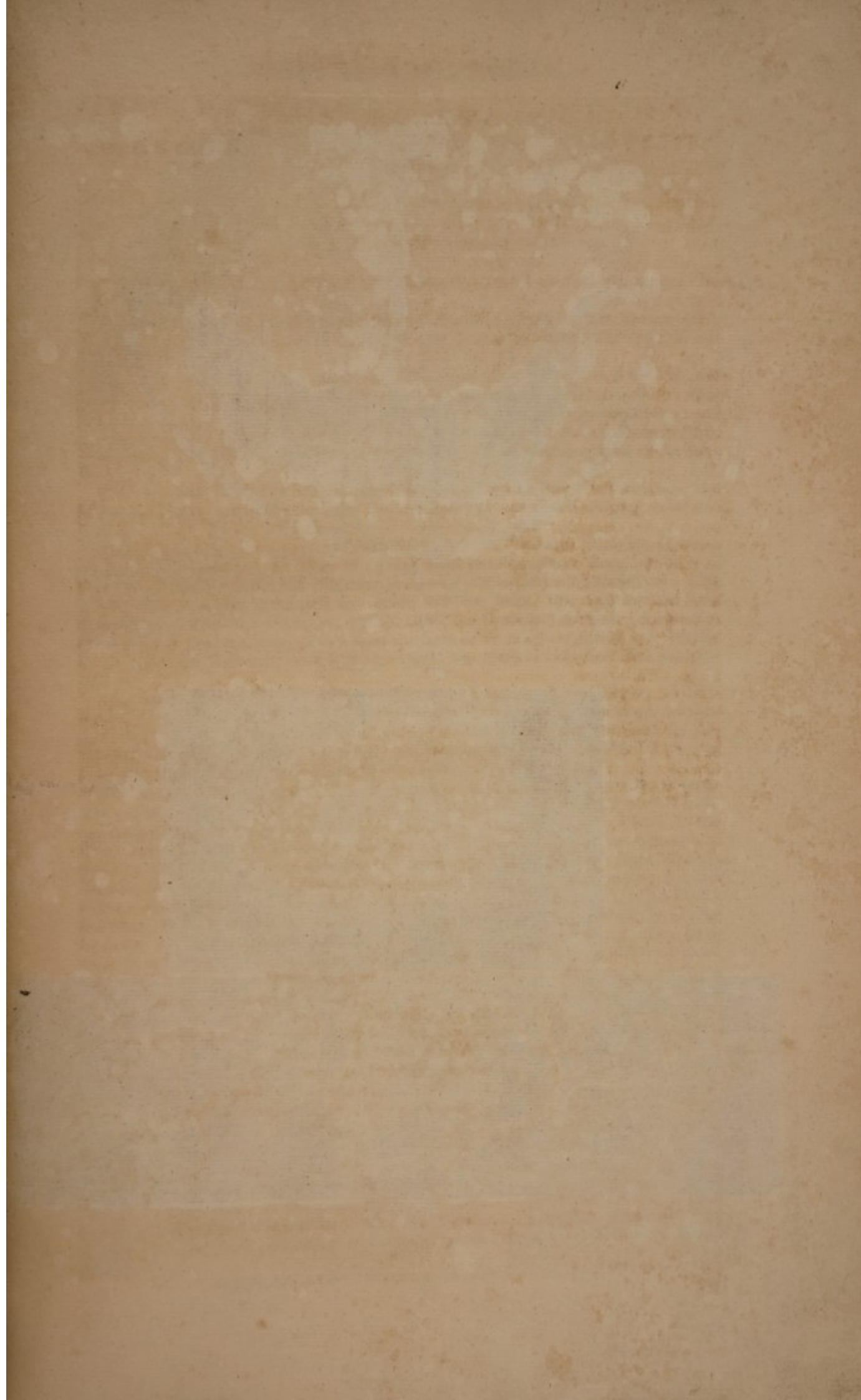
It grows from the *Thorax*, a little more towards the Head than the Center of the Body's Gravity: But this Excentricity is wonderfully balanced by its expanded Area, and the Center of its Vibration lying much more towards the Tail than the Root of the Wing is.

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.

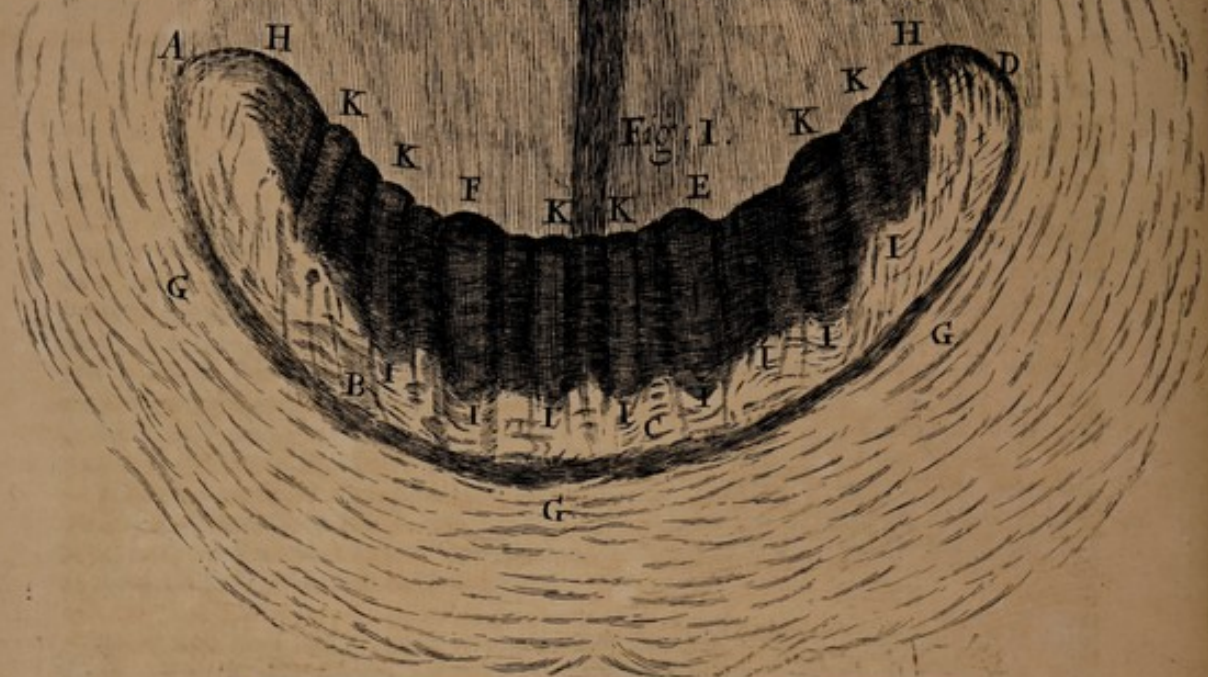


Fig. 2.



A Silk Worms Egg.
p. 42.



Fig. 3.

The Eggs 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 *Mistletoe*, 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 Calch. 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.

P L A T E XXIII. F I G. 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 flattened 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

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 completed, 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

* *Fid. Læwenh. 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*, *Cbrysalis*, 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 opaque than the rest of the Body, as is shewn at A.

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.

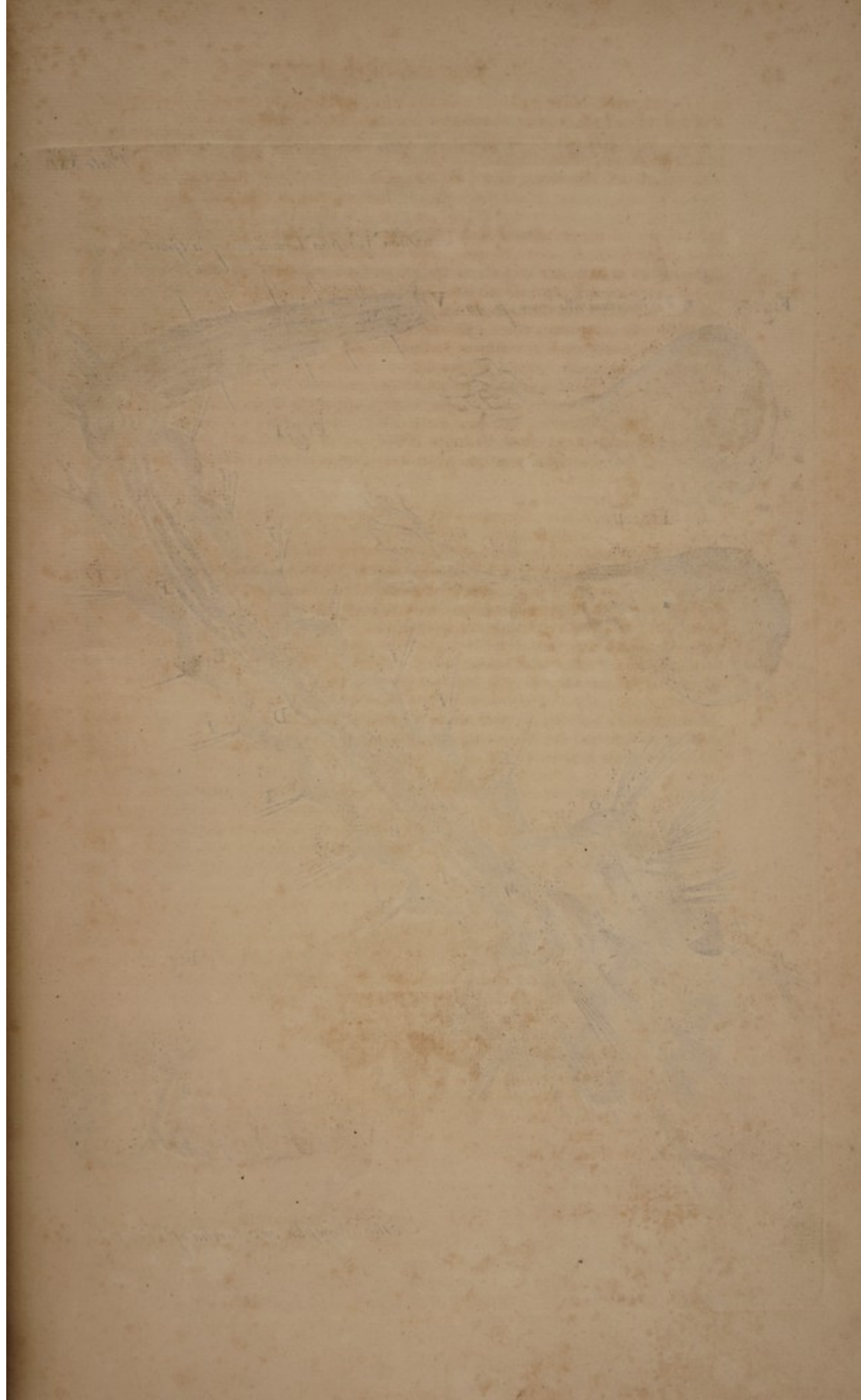
Some Experiments on freezing Vinegar, with these Eels in it, were made about a Year ago, and communicated to the *Royal Society* by Dr. HENRY MILES, F. R. S. the Result whereof was, upon several Trials, that the greatest Number were found irrecoverably dead, tho' many endured the being frozen, recovered 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 Vermiculus of a Gnat. p. 47.

Fig: 3

Apicarium Marinum. p. 48.



Fig: 4.



Fig: 1.

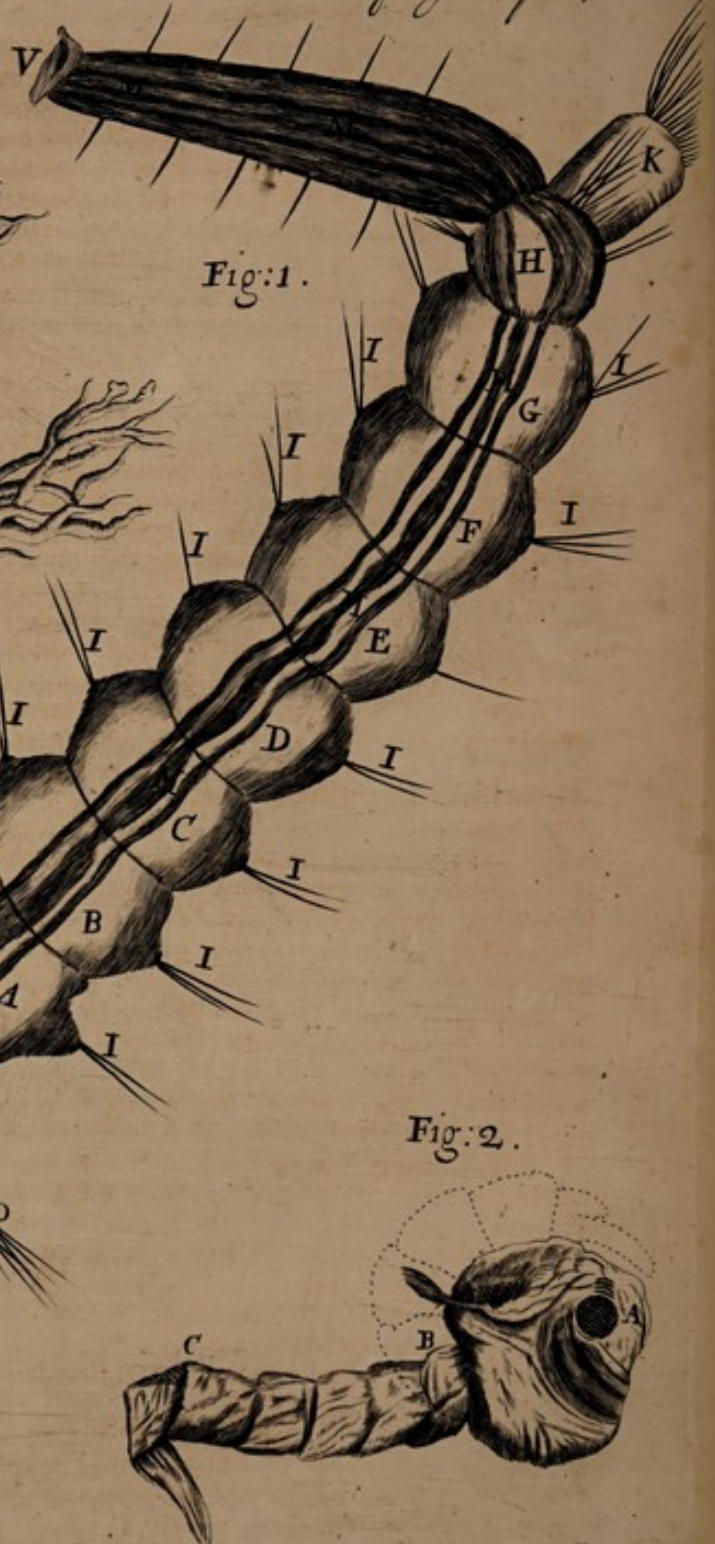


Fig: 2.



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

An EXPLANATION of the TWENTY-FOURTH PLATE.

FIG. I.

The 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. Nymph-Worm of a Gnat.

The Female deposits 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.

The Gnat *Apiarium Marinum*.

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.

P L A T E 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 frightened 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 enlarge; 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 pearly 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.

P L A T E XXIV. FIG. 3. and 4.

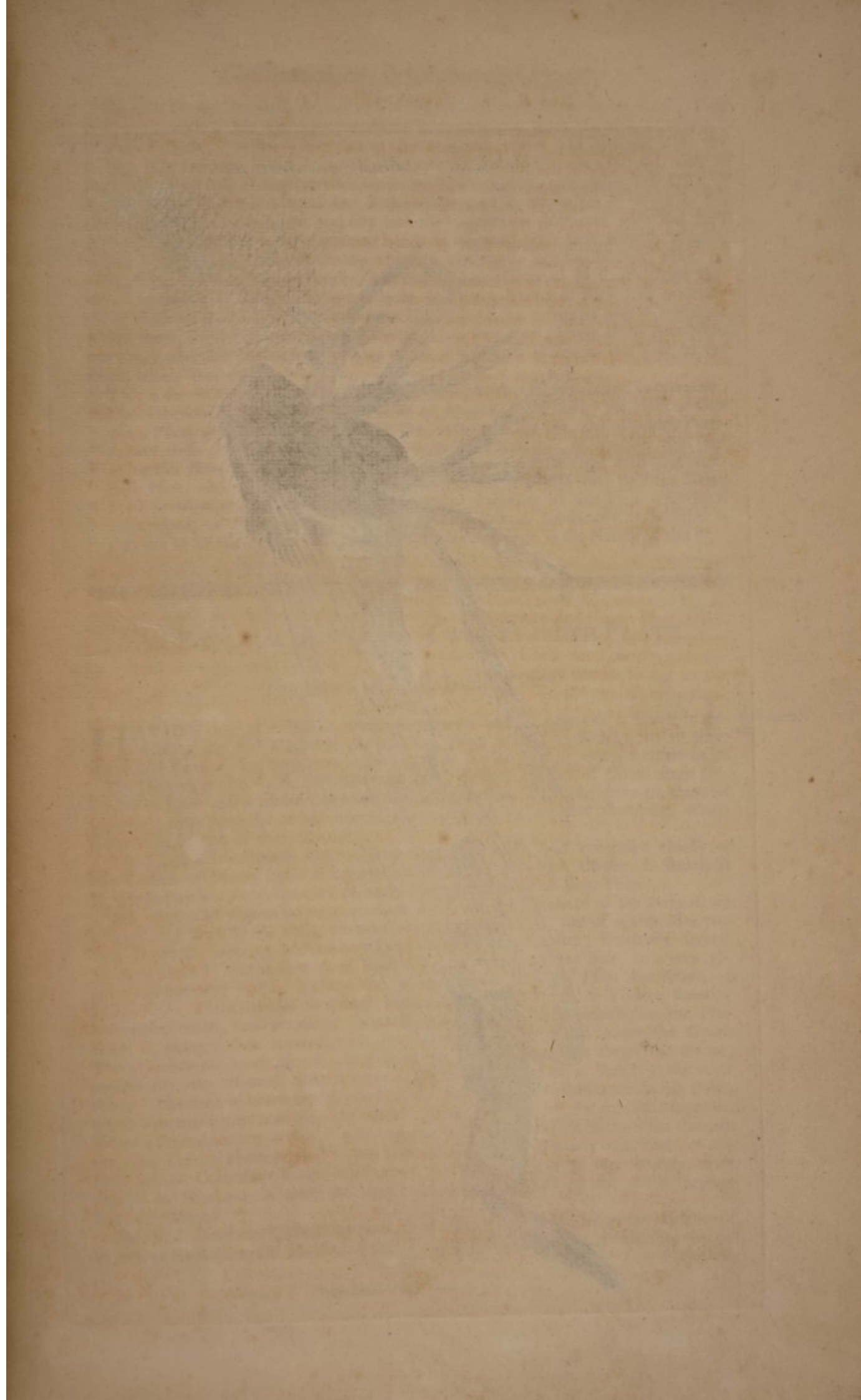
Apiarium Marinum.

*Apiarium
Marinum.*

THESE two Figures are given from PISO's Natural History of *Brazil*, 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

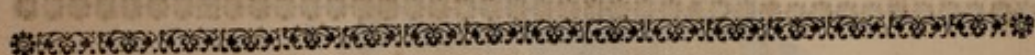
* Vid. *Swammerd. Hist. Gen. des Insects.* 4to. p. 105.





He took Notice, amongst the rest, of a little odd-shaped Plant, about half a Foot in Length, with a soft, spongy, 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 Putrifaction 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 vegetable 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 Sponge, or rather a Sponge in the Nature of this?"



AN EXPLANATION OF THE TWENTY-FIFTH PLATE.

The tufted or 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 *Uppingham* 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 Animal,

* 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 opaque; and in the last of them are shewn the Figure and Situation of the *Anus*.



AN EXPLANATION of the TWENTY-SIXTH PLATE.

The Great-bellied or Female Gnat.

Great-bellied
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.

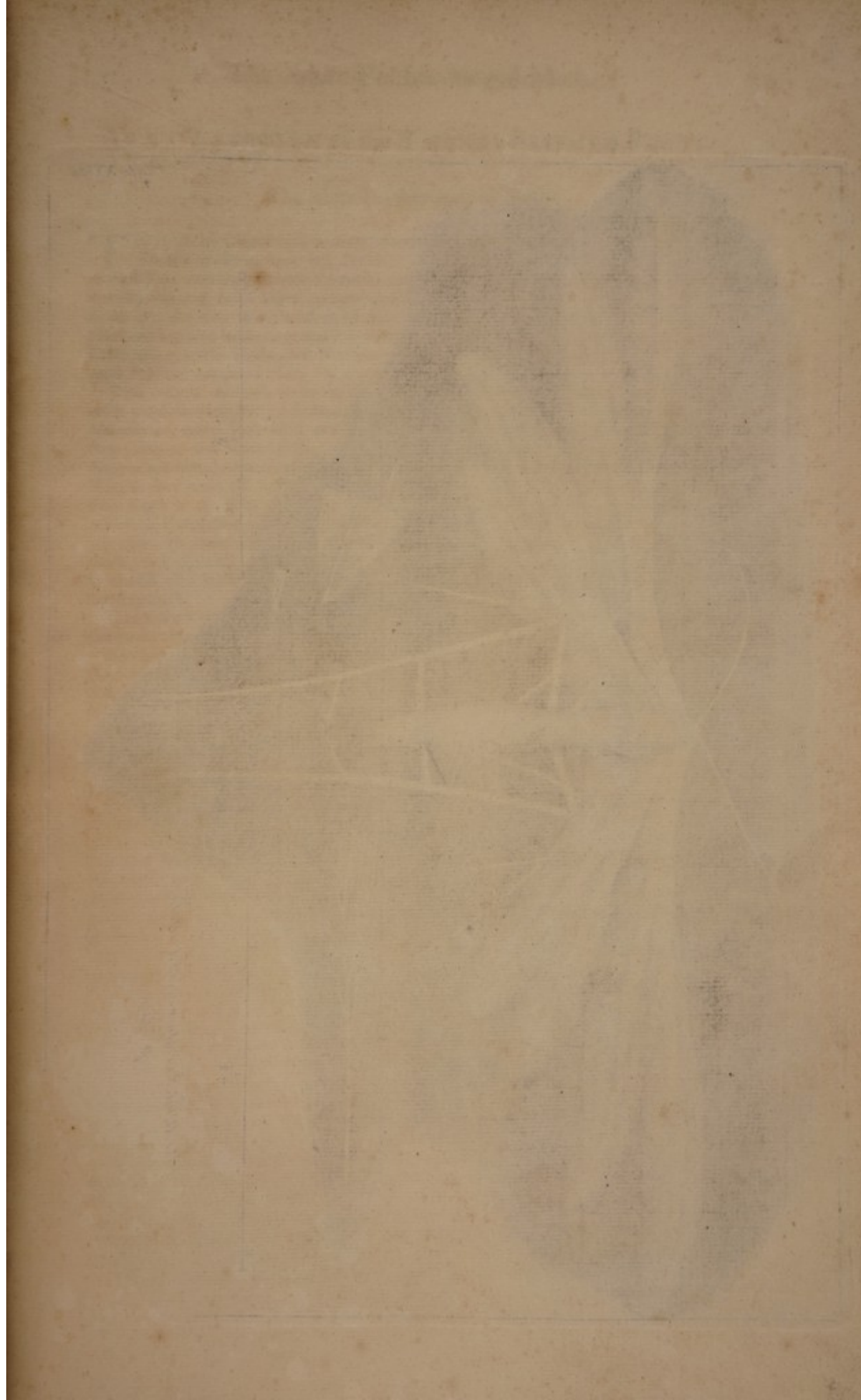


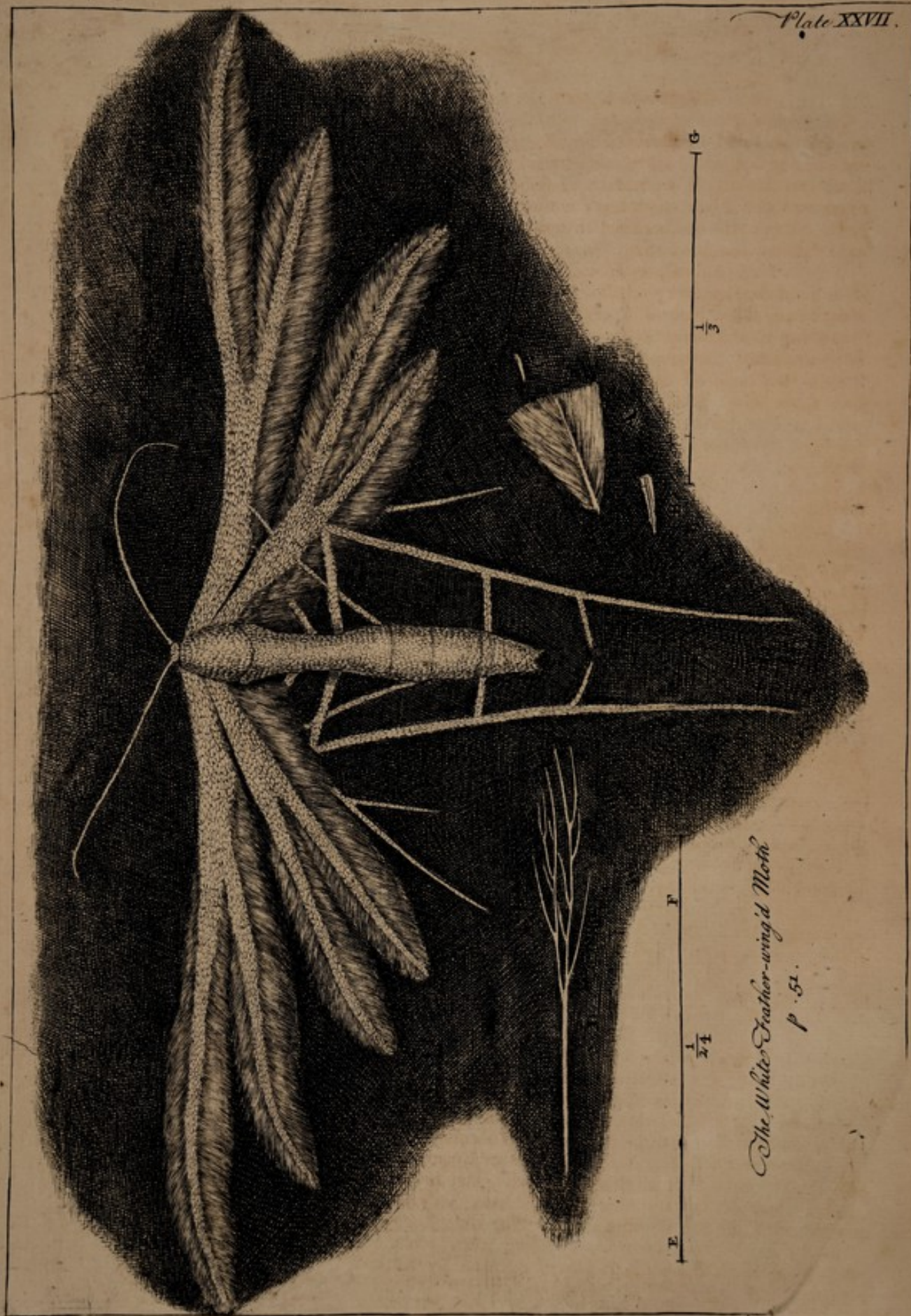
Plate XXVI.



*The great-bellied, or female Gnat.
p. 50.*







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

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 hindmost Pair was about half an Inch in Length; and the foremost Pair out-measured them by near a Third.

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 crufted Shell, extremely 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 Tiles 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 *Elytra* 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.

P L A T E 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.

P L A T E 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 smaller

The Eyes placed on an Eminence Back to Back
p. 52.
Fig. 2.

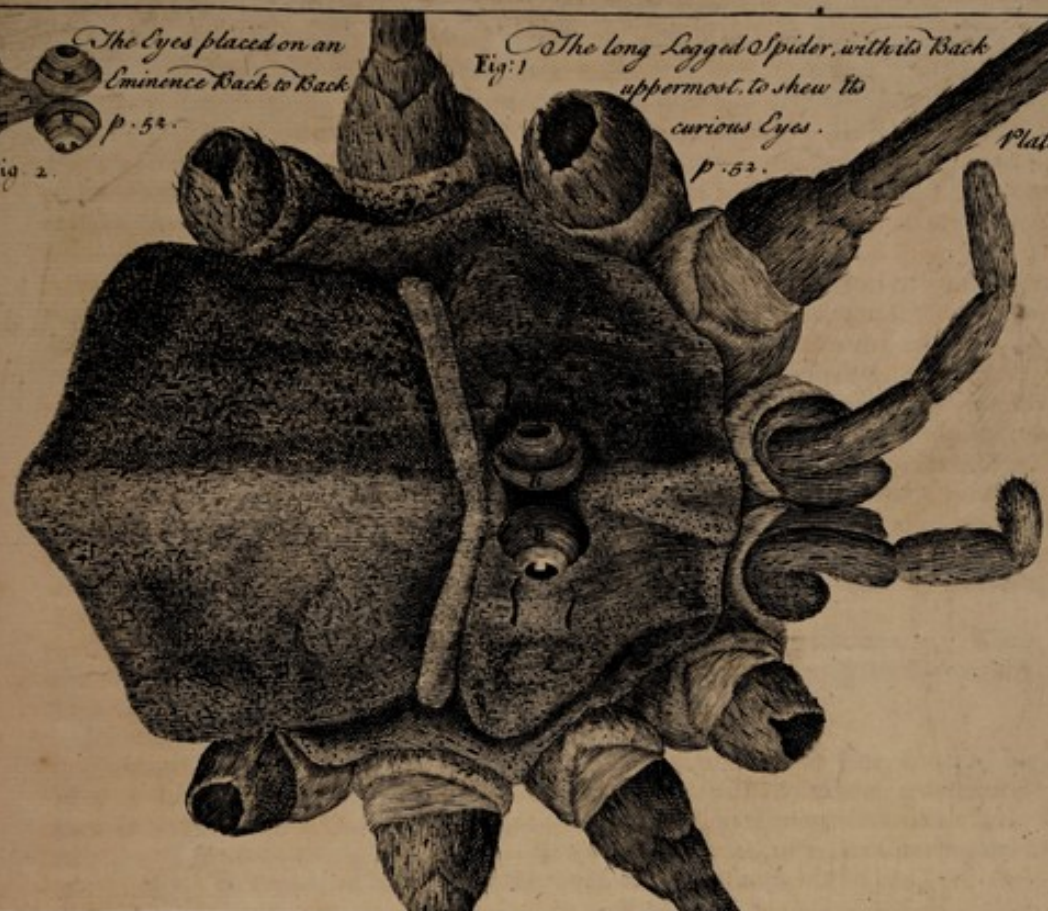
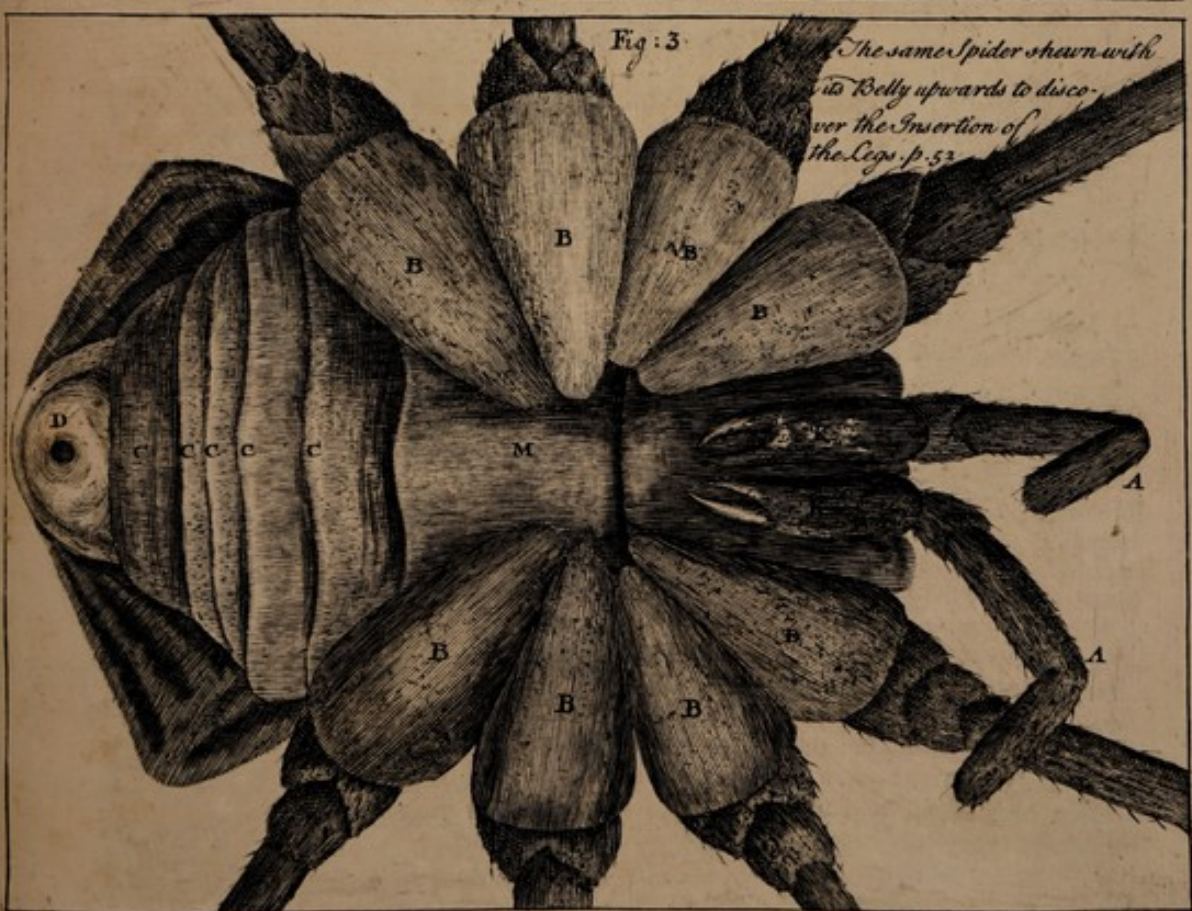
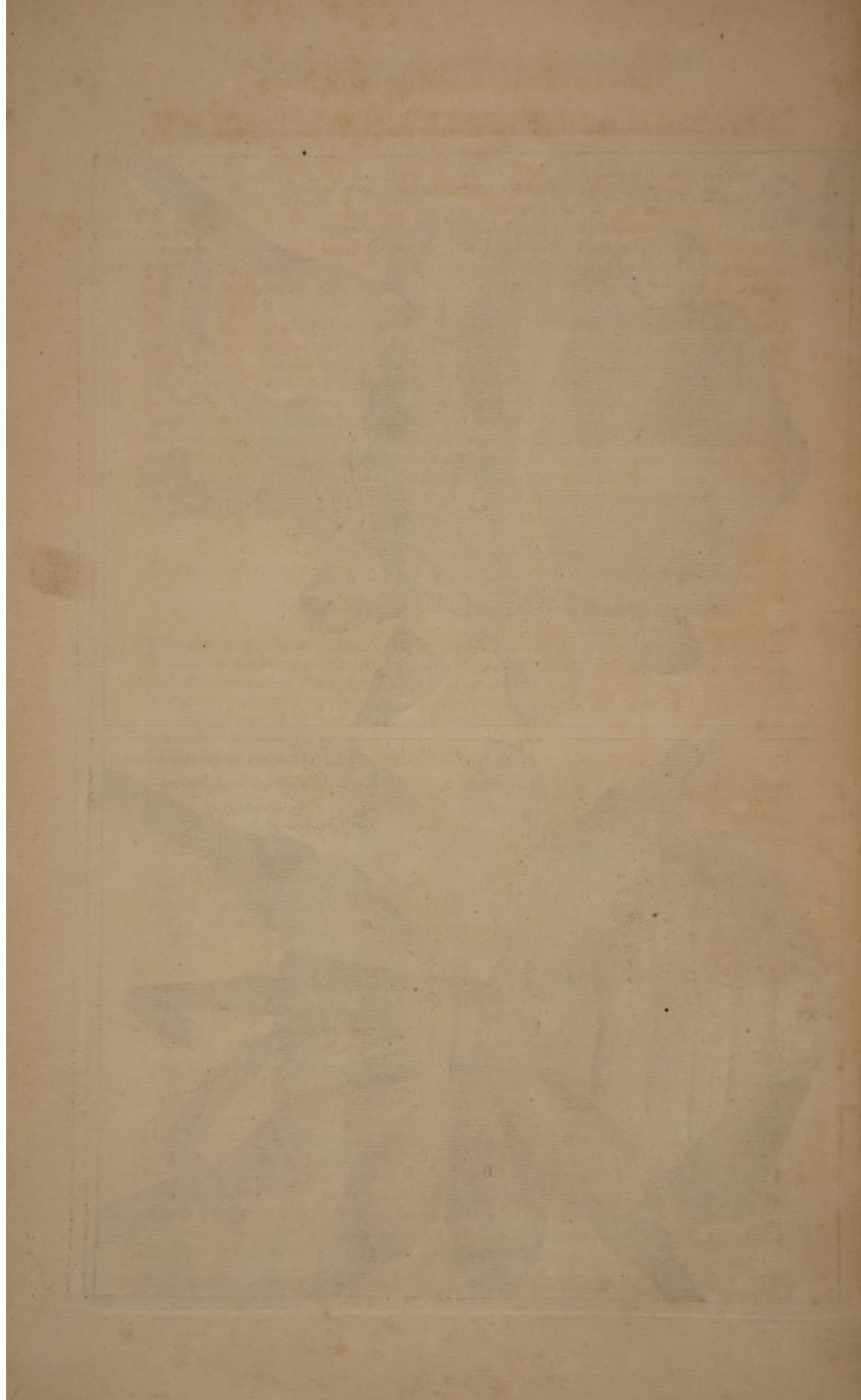


Fig. 1 The long Legged Spider, with its Back uppermost, to shew its curious Eyes.
p. 52.

Fig. 3.

The same Spider shewn with its Belly upwards to discover the Insertion of the Legs. p. 52.





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 insufficient 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 Faces 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 Grasshopper; 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.

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 sink 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 Swiftnefs, pointing its Head always towards the Fly; tho' seemingly as immovable, 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.

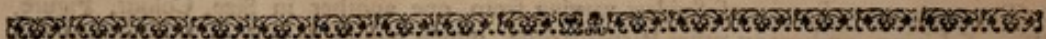
These Spiders are to be found with us on Garden-Walls, in the Spring, when the Weather is very hot, but they are not near so eager of hunting as they are in *Italy*.

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 Solitude, 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 fall 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.

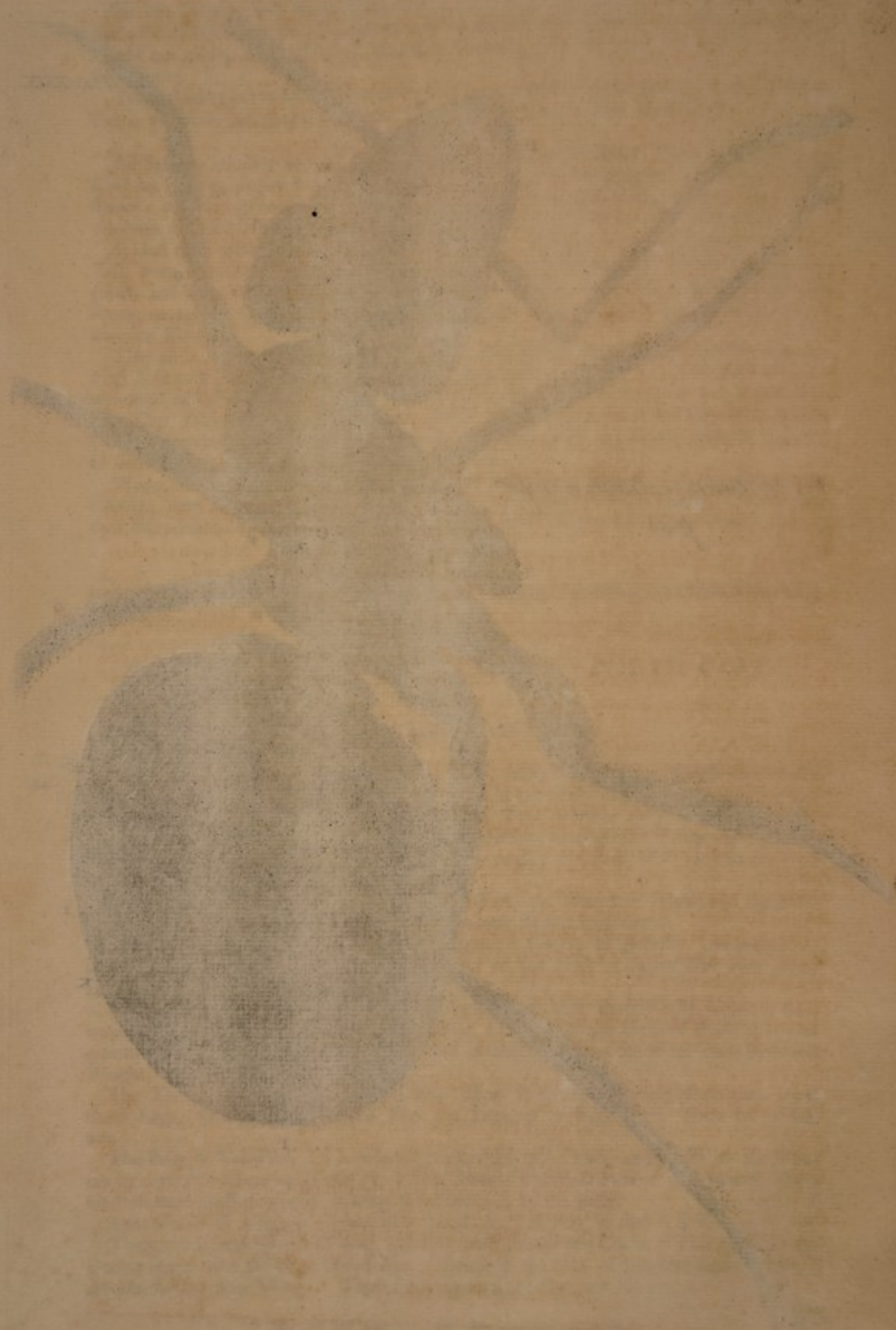
The

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



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 cas'd 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 seem'd 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 immersed 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 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 Mischiefe should happen to them. He tells us, that keeping some of them with their young ones in his Study, inclosed in a Glas-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, Solitude, 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 Glas-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 Glas-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, cas'd 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. Transf.* N^o 23.

† *Swammerdam, Epil. ad Hist. Insect.* p. 153.

*Cloth Worm or Nympha
of the Cloaths Moth. p. 53.*



Fig: 3.

Wandering Mite. p. 56.

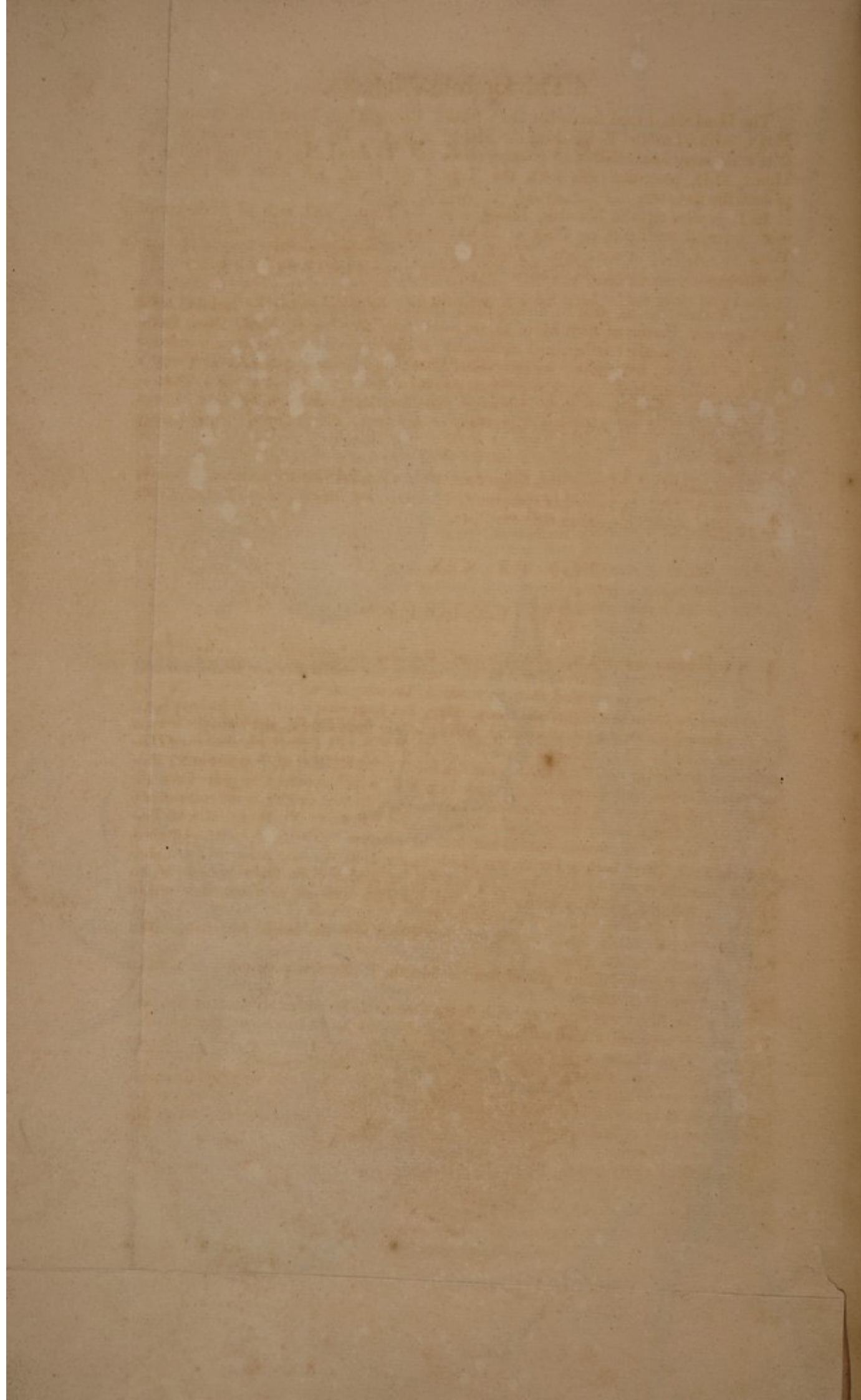


Fig: 1.

Crab-like Insect. p. 57



Fig: 2.



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 fastened 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.

P L A T E XXX. F I G. 2.

The Crab-like Insect.

DR. HOOKE informs us, that observing, one Day in *September*, a very small Insect Crab-like 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.

P L A T E XXX. F I G. 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.

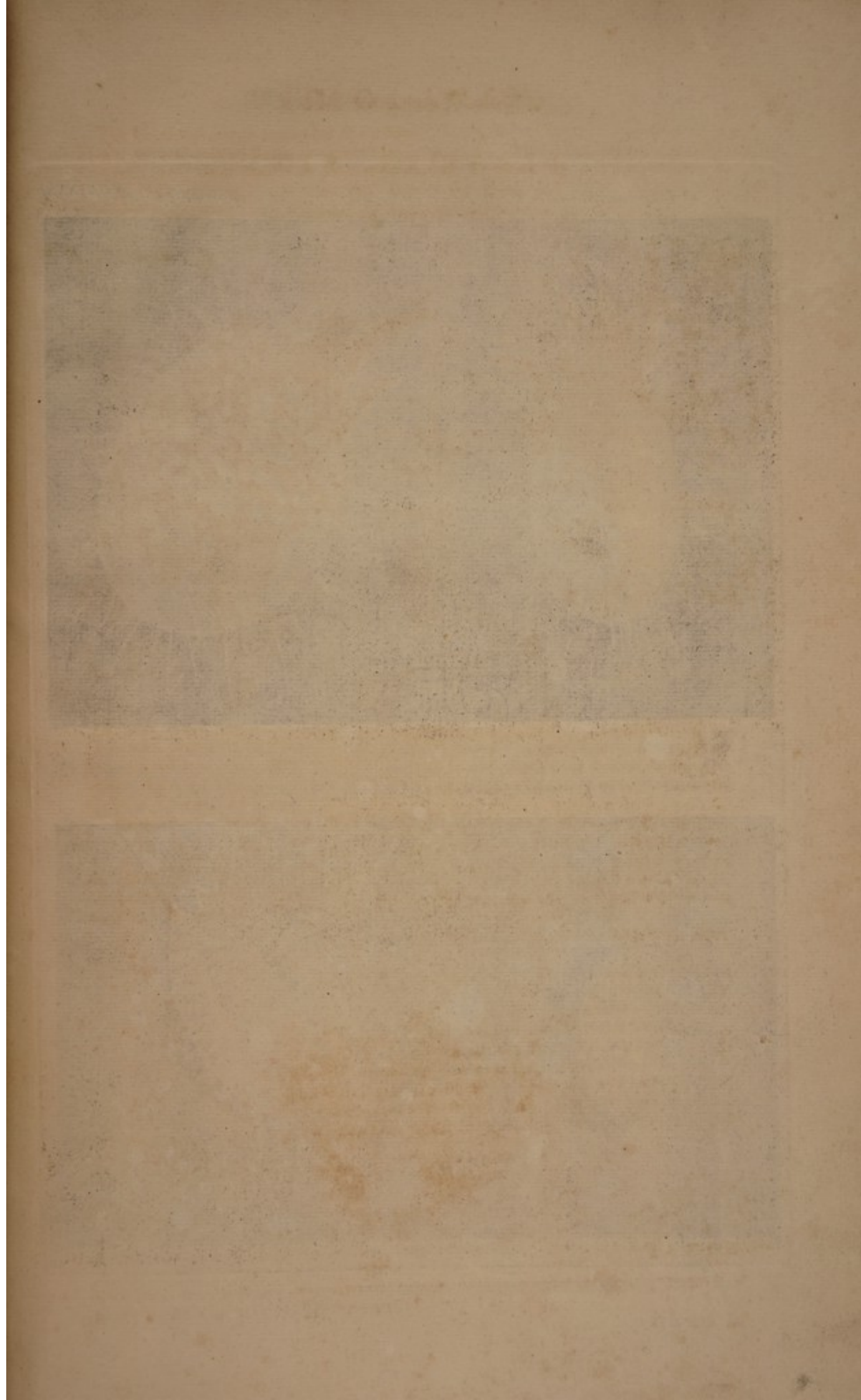
The conical Body of this Creature consists of fourteen several Shells or Shields, folding over each other like jointed Pieces of Armour, and covering the whole Body; and each of these is again tiled over, as it were, with a Multitude of thin transparent Scales, which, from the great Number of their reflecting 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.

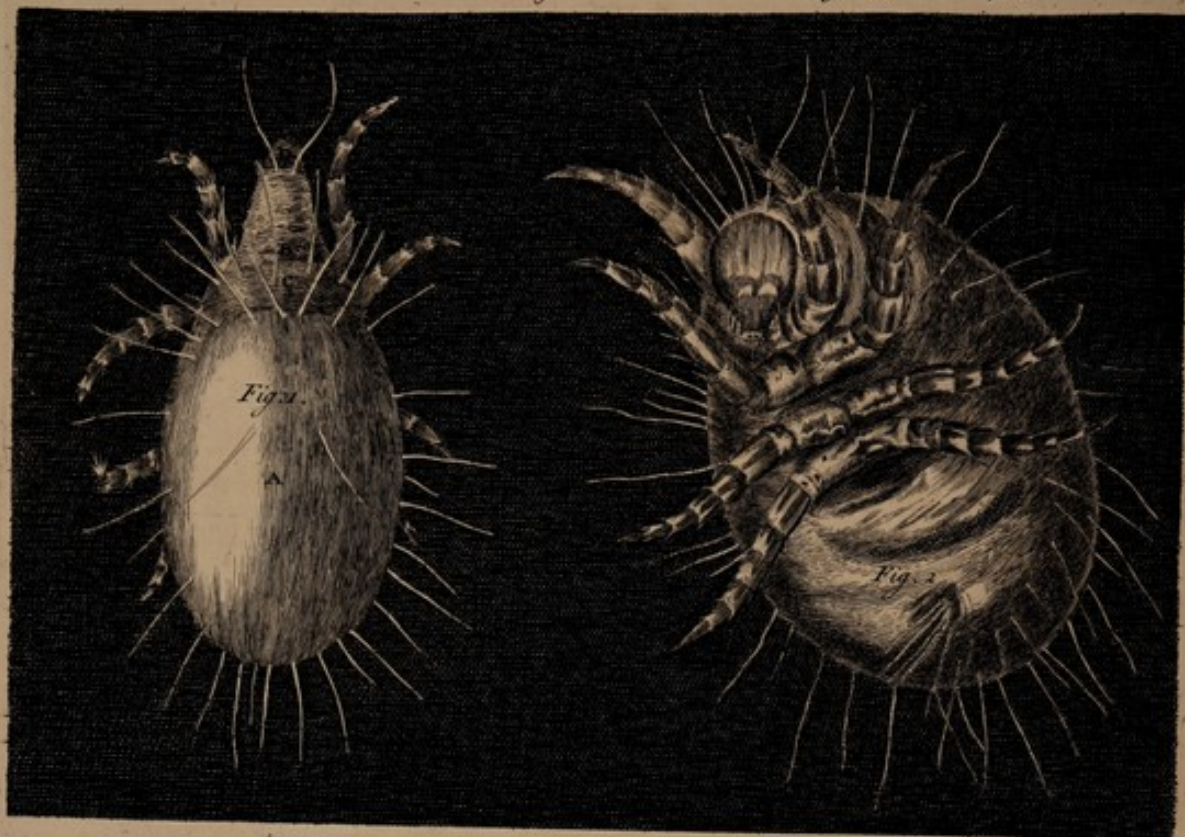
As for the Holes in Books and Papers, they are probably made by the same little nimble minute Insect which eats Holes of a like Size and Form in Picture-Frames, Chair-Frames, and other Things made of Wood, and which, from its Resemblance in Shape and Bigness, is called the little *Wood-Louse*.



P L A T E



A CheeseMite 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.

THESE 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 BC, 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.

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.

P L A T E XXXI. F I G. 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.

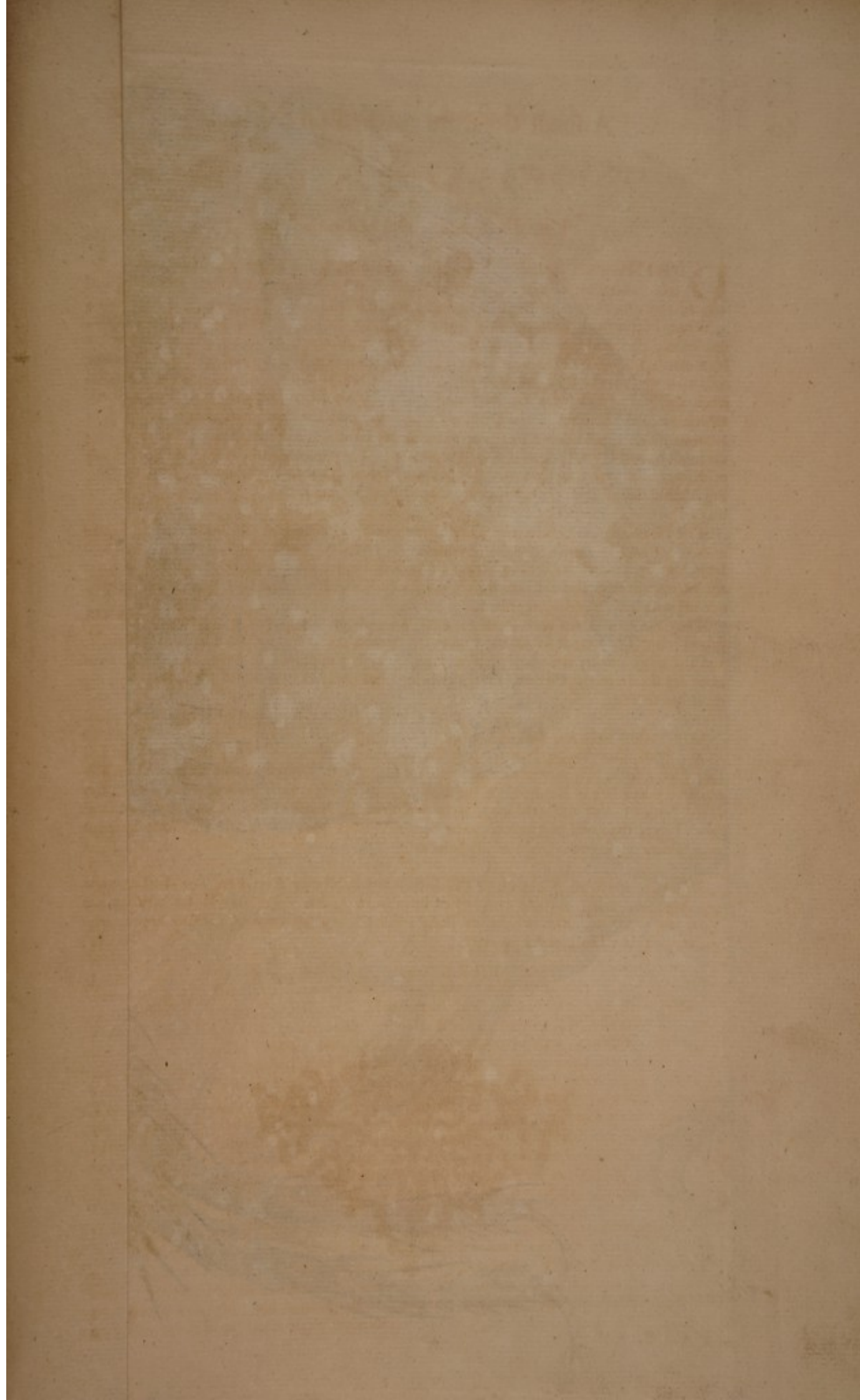
The Head of this Creature was very large, being almost half the Bigness of its Body, as is usual in the *Fætus* of most Animals. It had two small black Eyes *a a*, and two long, slender, jointed and bristled Horns *b b*. The hinder Part of its Body seemed to consist of nine Scales, and the last ended 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.

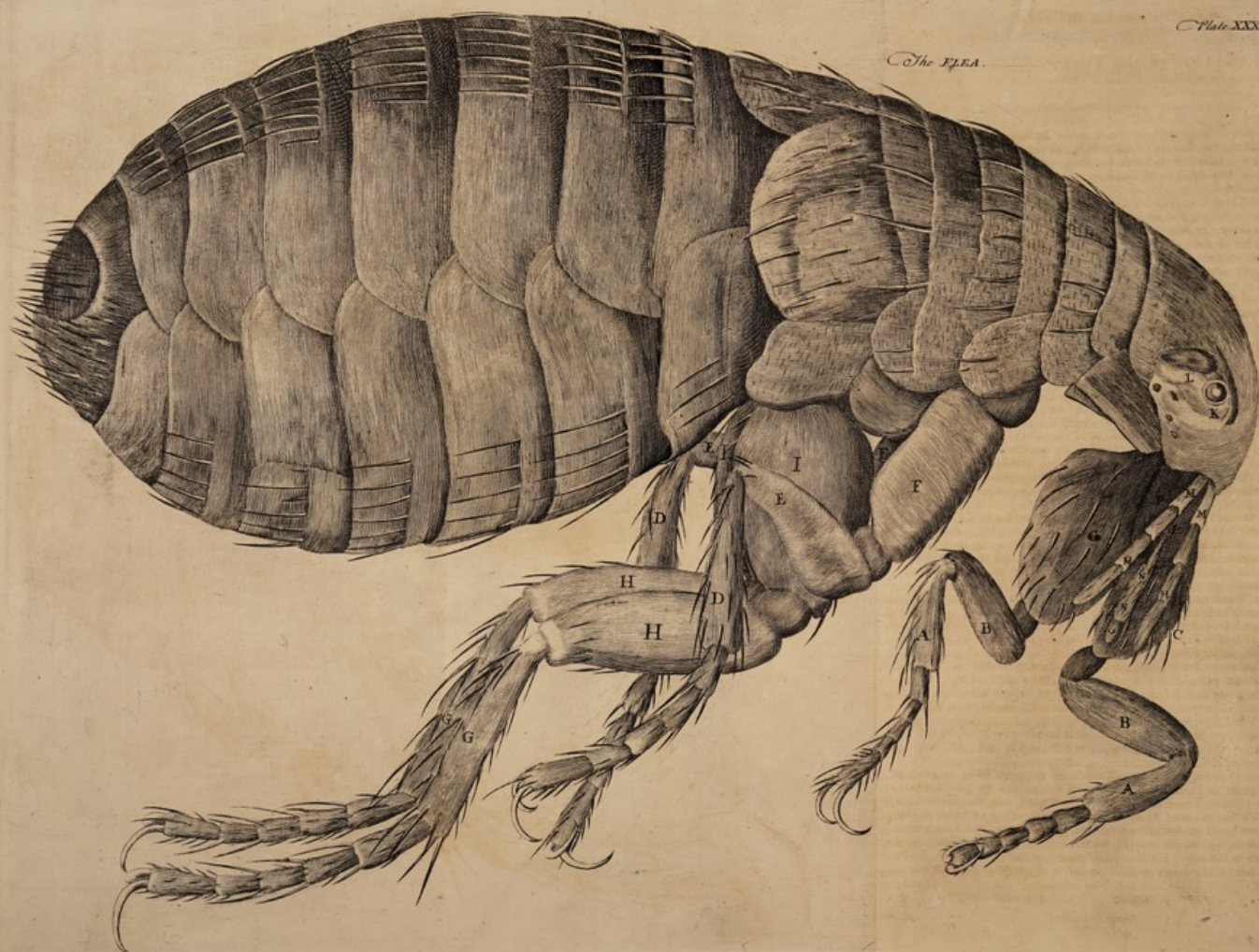
Our Author observes, that if these little Creatures are *Wood-Lice*, (as he is inclined to think, from their Shape, Frame, and the Skin or Shell upon them) they afford an Instance of a surprising and more than ordinary Increase in Bigness, from their present Minuteness when newly hatched, to the Size 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 The Flea. 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 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 Piercer 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

R

Claws

† Vid. *Pewer'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 Caterpillars, 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 *Corysalis* 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 harnessed 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.

† Moufeti *Insectorum Theatr.* p. 275.

...the Trinity ... the Father ... the Son ... the Holy Spirit ...

An Explanation of the Trinity-System ... The Father ... the Son ... the Holy Spirit ...

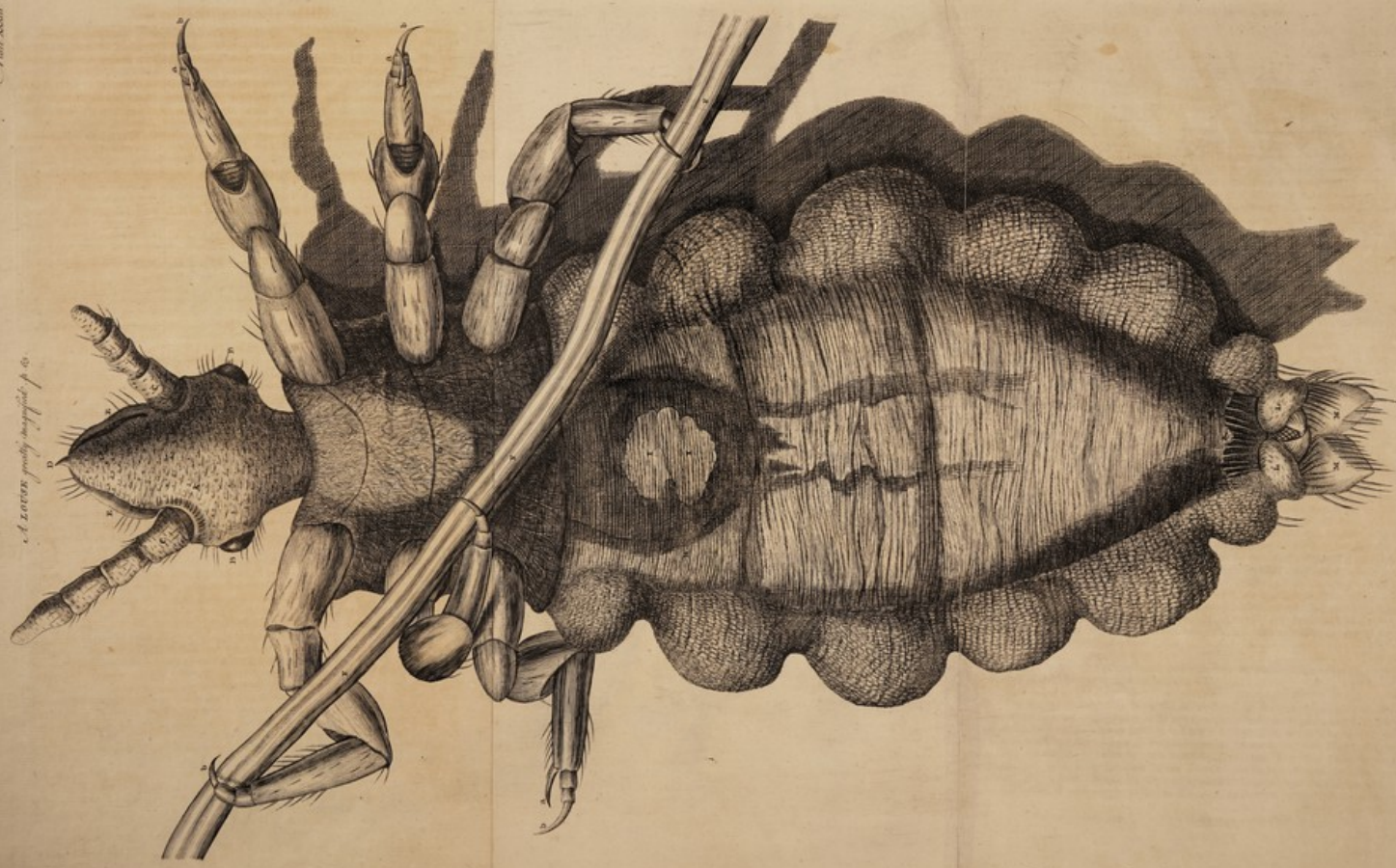
THE ... the Father ... the Son ... the Holy Spirit ...

...the Father ... the Son ... the Holy Spirit ...

...the Father ... the Son ... the Holy Spirit ...

...the Father ... the Son ... the Holy Spirit ...

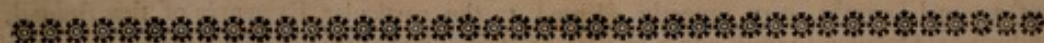
A. ZOOEUS, quatuor magnitud. p. 46.



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*, *Ars-mart*, *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.

THIS last Plate shews us the Figure of a Louse magnified to a very great Degree, The Louse. 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 *eee*. 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 jostling 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 jostling 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 Infides 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

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*.

† *Moufet. Insect. p. 200.*

F I N I S.



E R R A T A.

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.

THE HISTORY OF THE
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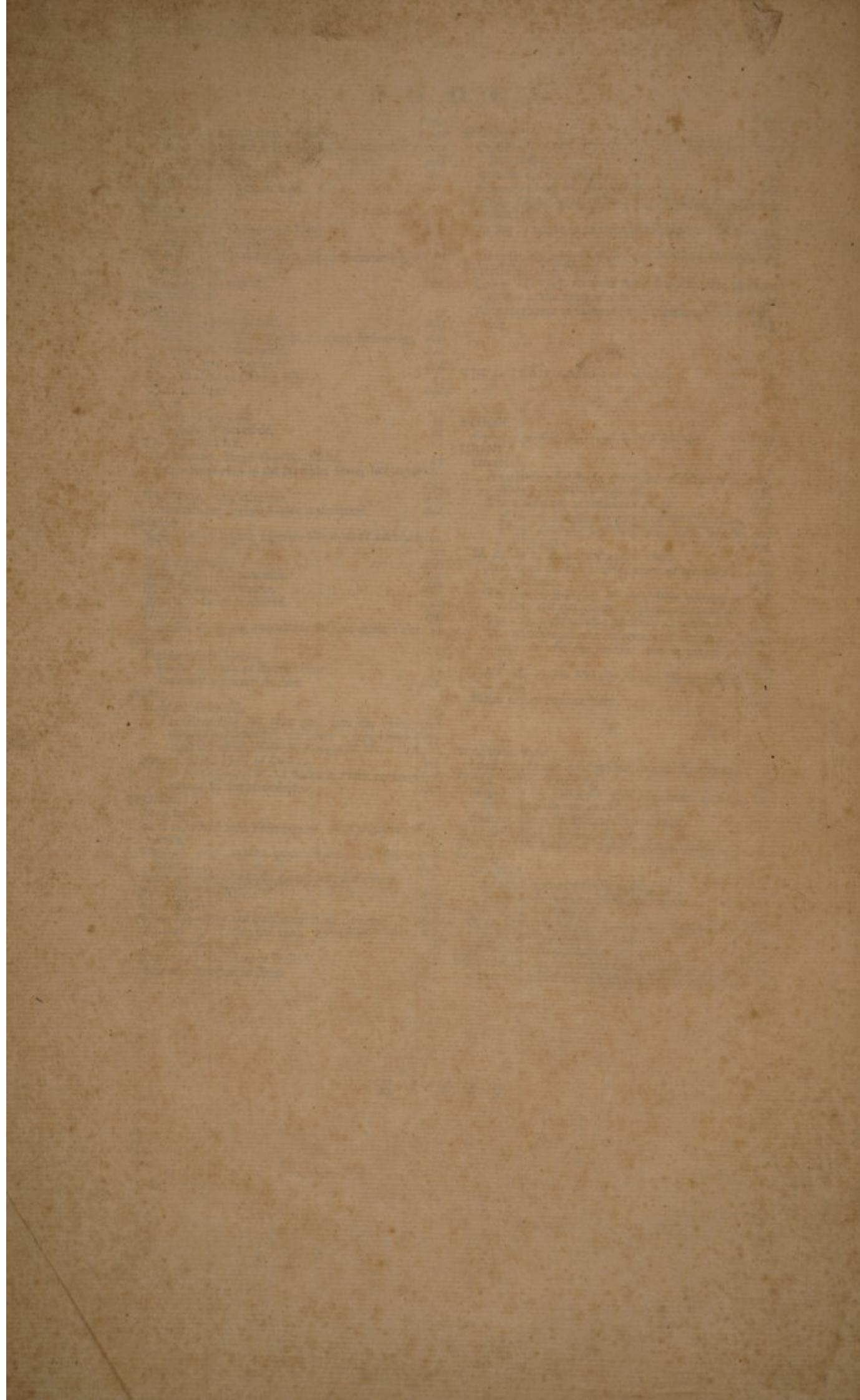
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On Leather.	19	The Holes in, of the Form of the Sole of a round toed Shoe, each beset with small Thorns.	<i>ibid.</i>
A Number of minute Vegetables bearing Balls almost like Mushrooms.	<i>ibid.</i>	SEEDS,	
On many different Bodies and at different Seasons of the Year.	<i>ibid.</i>	Of Mushrooms may be found between the Gills.	19
Of various Forms.	<i>ibid.</i>	Of the Corn-Violet.	25
These and Mushrooms, according to Dr. <i>Hooke</i> , produc'd from Putrefaction without Seeds.	<i>ibid.</i>	Cover'd with a tough shining Skin with irregular indentings therein.	<i>ibid.</i>
MUSHROOMS,		Of Thyme,	
Suppos'd by our Author not to bear Seed.	<i>ibid.</i>	Resemble dry'd Oranges or Lemons both in Shape and Colour.	<i>ibid.</i>
Seeds of, may be found between the Gills by the Assistance of a good Glass.	<i>ibid.</i>	Of Poppy,	
N.		Appear by the Microscope in the Form of a Kidney, with Hexagonal and Pentagonal Indentings all over the Surface.	26
NATURE, Works of,		Of Purslain,	
Admirable for their Minuteness.	7	In the Form of the Nautilus, curl'd in the manner of a Spiral.	27
for their Variety.	12	Of Scurvy Grass,	
NEEDLE, Point of,		Like a Porcelane Shell.	<i>ibid.</i>
Nearest to a physical Point.	1	Of Marjoram,	
When view'd by the Microscope how irregular and uneven.	<i>ibid.</i>	Resemble Olives.	<i>ibid.</i>
Many visible Points much sharper.	<i>ibid.</i>	Of Carrot,	
O.		Like the Cleft of a Cocoa Nut Shell.	<i>ibid.</i>
OPIUM,		Of Succory,	
What,	26	Like a Quiver of Arrows.	<i>ibid.</i>
Great Virtues of,	<i>ibid.</i>	Of Amaranthus,	
The Knowledge of, probably of very great Antiquity.	<i>ib.</i>	Represent the Eye.	<i>ibid.</i>
Mention'd by <i>Homer</i> under the Name of <i>Nepenthe.</i>	<i>ibid.</i>	Of Onions and Leek,	
The dissolv'd Particles of, appear'd in the Microscope to be fring'd Globules.	27	Granulated like Seal Skin.	<i>ibid.</i>
Sleeping Quality of, accounted for,	<i>ibid.</i>	How variously guarded by Providence from Danger and Destruction.	<i>ibid.</i>
P.		The minutest, even those that can be discover'd only by the Microscope suppos'd to contain <i>Plantulae</i> of their own Kind.	28
PAPER, magnify'd appear'd like Shag-Cloth.	1	Of the Gramen tremulum,	
PETRIFIED WOOD,		A compleat <i>Plantula</i> discover'd in.	<i>ibid.</i>
The Pores of, larger than those of Charcoal.	15	SENSIBLE PLANT,	
The Parts of, not differing from what they were when Wood.	<i>ibid.</i>	Description of.	17
Weight of,	<i>ibid.</i>	Experiments on,	<i>ibid.</i>
Lost nothing of its Substance when heated red hot.	16	Conjecture concerning the Reason of its Motion.	18
Bubbles rais'd in by Vinegar.	<i>ibid.</i>	Liquor,	

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Liquor, proceeding from, when cut.	18	SPONGE,	
None to be found when the Leaves were clos'd even with pressing.	<i>ibid.</i>	Consists of many short round Fibres jointed in a Net-like Form.	13
Many different Kinds of.	<i>ibid.</i>	Account of, by <i>Bellonius</i> ,	14
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SILK,		STEEL, Globules of, formed instantaneously by striking against a Flint	5
Filaments of,		Surface so bright as to reflect the Image of the Window.	<i>ibid.</i>
Seem'd like Cylinders of Glass.	3	Some broke and hollow like the Shell of a <i>Granado</i> .	<i>ib.</i>
Afford lively Reflections.	<i>ibid.</i>	STINGING NETTLE,	
Water'd, the Threads bent in Angles form an undulatory Appearance.	<i>ibid.</i>	Leaves of, thick set with sharp Needles and Bladders similar to the Sting of a Bee.	22
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The Males, very salacious.	<i>ibid.</i>	The natural Branches of each Stem parallel to each other, and also parallel to the next main Stem.	<i>ibid.</i>
Animalcules in their Semen masculinum.	<i>ibid.</i>	The collateral Branches divided, <i>ad infinitum</i> .	<i>ibid.</i>
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