

Fig: 1.

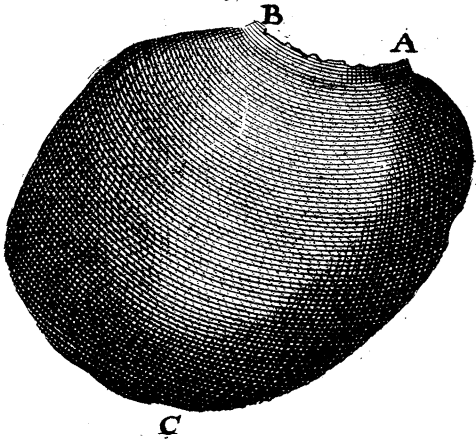


Fig: 2.

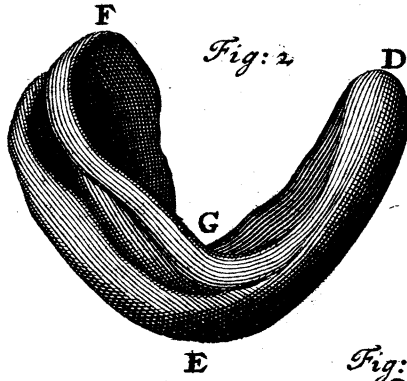


Fig: 4.

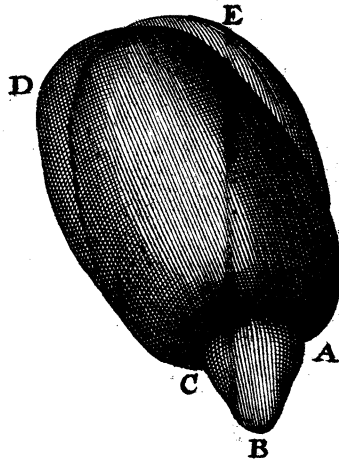


Fig: 3.

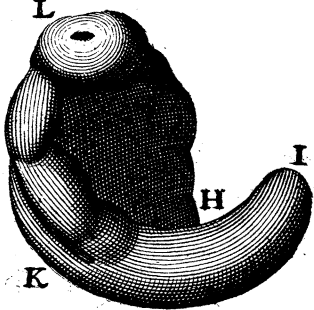


Fig: 5.



Fig: 8.

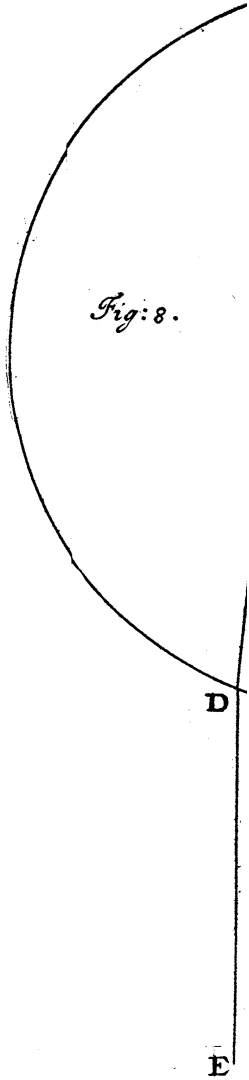
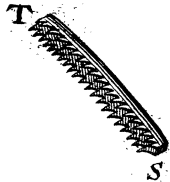
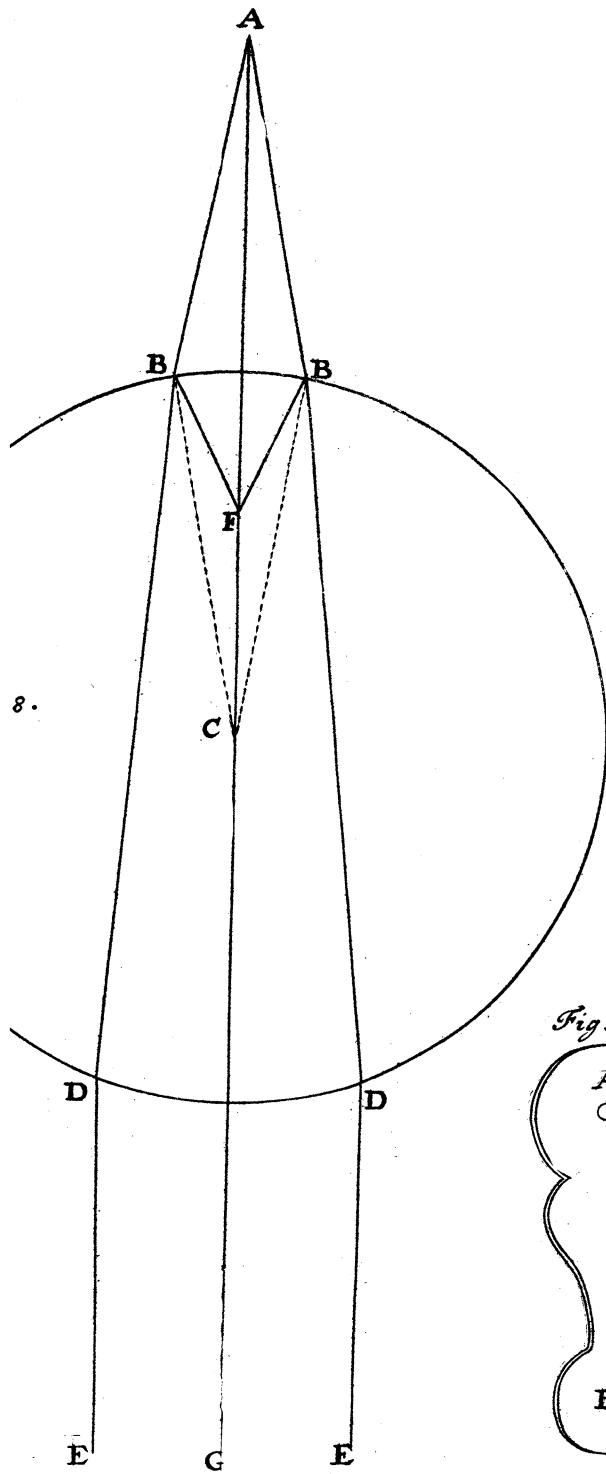


Fig: 6.





8.

Fig: 7.

II. *An Extract of a Letter from Mr. Leewenhoek, Dated the 10th of July, An. 1696. Containing Microscopical Observations on Eels, Mites, the Seeds of Figs, Strawberries, &c.*

I Must tell you, Gentlemen, that when I had written of the Engending of Eels, and did send the Print thereof to Mr. *Chr. Huygens* of *Zuylighem*, he did Answer me from his Country-house, called *Hofwyk*, on the 20th of *October*, 1692. to this purpose:

I have been hindered by divers Businesses and Accidents, from reading your last Communicated Observations, until now ; I have found in them great Satisfaction and Pleasure, &c.

I am very much pleased, that the longer the plainer you prove the Generation of Animals by Seed and not Corruption, and I am also of the same Opinion.

Concerning the Generation of Eels, It seems to me very strange, that their young ones are found by you in the Womb, without any Sign of Life ; neither do you make any mention of Male kind of Fishes, which perhaps, may by Microscopes be found to be Living Seed, but we should be long to ask you every particular, there being still left innumerable Discoveries behind. We ought highly to commend and admire your Labour and Diligence in these you Communicate, whereby natural Knowledge is daily augmented and mended, so do I among the rest remain

Tours, &c.

It was Signed

Chr. Huygens.

Ss

And

And since this time the said Gentleman has been several times at my House, and I at his, yet our Discourses hitherto have never been of the Generation of Eels.

I cannot omit to tell you, that when I was Anatomizing of Eels, as well as *Palingers* or Silver Eels, which I did procure when I was a Writing of them; and to this very day, I never found a Male Eel nor *Palinger*, or Silver Eel, that I could call so; for all these that I did Dissect were provided with a Womb.

Now if there be no Male Kind amongst the Eels and *Palingers* as I have found, that little Animals of different sorts, that were found in great Numbers on the Leaves of Currants, Cherries, Plumbs and Roses, which some call Lice, after they are found on the Trees, the Bodies of these Animals were all over beset with young ones, and each of them produce their kind, although I could not discern any Male Kind of them, neither could I find the least sign of Copulation among them.

Now whether this Engendring hath also place in the Eels and *Palingers*, ought to be enquired into; or whether every Eel and *Palinger* are provided with Masculine Seed, and so are Hermaphrodites as we do fancy; as by Copulation which we sometime see, for some *Fetus's* are thus provided: that I have not said heretofore, that I have discovered in all Eels and *Palingers* their Womb, that I did conceal on purpose, that in time I might inform and satisfy my self better.

I have now in the Winter dissected again some *Palingers*, none of those which were lockt up all the Winter long, that they might be sold the dearer in *Lent*; but such as I have been very well satisfied of, that they were fresh caught: and now again, in the latter end of *April*, I have Examined several of them, that I might, if possible, the better be satisfied; yet notwithstanding all these

these Observations, I learned no more then I told you before.

On the 10th day of *June*, when some little Boys went down into the Town Ditch, and were busie to fetch up some green Herbs, and to find small Eels among them of several bignesses, I desired them to bring me a pot full of the smallest of them to my House, which they did accordingly, that I might search them very narrowly, to try whether I could see any more concerning the Circulation of the Blood, then I had discovered before in greater ones.

The smallest sort of these they brought to me, were about two Inches and an half long, and their Bodies were in proportion smaller then that of the great ones.

The rest were of several lengths, and the biggest of them about five Inches long.

I took several of the least sort, and put them into my small Tube (partly filled with Water) so that they could but just go into it.

When I fixed these small Eels before the Glass, and fixed my Eye upon the Fin near the Tail, I saw with greater admiration then ever I did in my Life before, the Circulation of the Blood, and that in so many Sundry places; so that if I should delineate the little space compos'd thereof, it would not seem credible to most Men: And when I came to contemplate the end of the Bone, I saw, that very near to the jointing of the last Joint, many very small Veins did meet together, and make there one great one, when I took it for granted, that there was a *Valvula*, for there was a strange and quick pushing forwards, after such a manner, as if we saw our Blood pusht forwards in an Artery before our Eyes: Nay, this pushing forwards was so quick one after the other, that with our Mouth we could not so quickly pronounce one Syllable after an other: In short,

this Contemplation did far exceed all the strange and pleasant ones, that ever mine Eye did behold before.

If I turned my Eye towards the Fins, near the head, it was also very pleasant, to see the Blood run in many sorts of Vessels, and also underneath the Head, between the Jaw-bones.

After this I did look upon the place where the Heart is, where I saw with no less Admiration, the quick Motion of the Heart, as well in the Sístole as Diástole, whereby the Heart was pushed forward.

When I did look upon the red Parts, which all Fishes have almost about the Head, which parts in our Town are called *Cons*, the motion whereof did look very strange to me; for I did not only see, how two rows of these *Cons* were bended roundish one against the other, but also that the ends thereof did come to touch one another, and then did turn back again; so as if we did fancie that a pair of Bellows did open and shut again; in short, I had in this Contemplation as much pleasure, as if I had been seeing a Chamber full of Collections of Rarities, where there was several sorts of rare Horns, Shells, Sea Corals, &c.

I did write in my Letter of the 10th of *July*, 1695. of my discovery concerning the Procreation or Engendering of Mites, which are very small and despicable Animals, and yet for all that does a great deal of Mischiefe; for by their Numberless Procreation they consume Flowers, Seeds, Flesh and Bacon, and chiefly that which is smoaked and dryed; and all sorts of dryed Fruit, *viz.* Figs, Raisins, Prunes, &c. when in the latter end of the Winter I was at a loss for want of Mites, I went to a Grocers Shop, where I took up some French Barley, in hopes of finding some Mites among the Flower thereof, and therein I was not deceived, for there I found some. When I came home, I saw with

with Admiration, that some of these Mites were quite of another make, then what I had seen before, for they had on their Back some brownness, and their Bodies had not so long Hairs on them as our common ones, and their hind part of the Body was of another Shape, they had also eight Paws, and before, by their Head, were two Tools, much thicker then their Paws, but not half so long, and these were divided towards their ends, into Finger-like Joints, which were instructed with Nails like Claws, one Joynt whereof, that was the thickest, had at one side, extremely small Teeth, like unto a Saw.

It hath also happened, that these Mites have joined the Finger-like Joints that were on the end of these Tools, near their Heads, over their Head together, just as we put our Hands over our Heads together, and fold them, by joining our Fingers with one another, as if by our Arms and Hands we would Defend our Head from any thing that would offend it; so that I found these Mites to be of a more Artificial make in my Eyes, then ever I had seen before.

Besides these I saw still a second sort of Mites, that at first seemed to be like these, but if you compared them with the former, you would see that they were of another kind, that were sprung forth by mixing with a peculiar sort of Mites. But yet of these two sorts of Mites, there was but a small Number in Comparison to our Common Mites, which I came to find in the Flower like Stuff.

By this Discovery I am to consider, whether these Mites might not be of another Country, and of another Off-spring; and that these I found at the Grocers were brought with his Wares, may be from *France, Spain, Italy*, or perhaps with the Almonds from *Barbary*.

To satisfy my self in this matter truly, I caused some Figs to be bought, and ordered such to be taken that lay close to the Staves of the Barrel, and that of the worst sort; when I looked upon these Figs, I saw several Mites creep about them, and when I fixed them before my Microscope, I judged them to be somewhat differing in the Shape of their body, being somewhat rounder and shorter then our Mites are that I have seen before.

Among the rest, I opened one Fig which I thought to be good and well tasted, and in it I saw some Hundreds of Mites creep about, that did crawl in the inside of the Fig; so that when we eat Figs, we send, unknown to us, many Thousands of these little Animals into our Stomachs.

I have said before, that I have taken a great deal of Pains, to see the Plant in the Seed of a Fig, yet that I could never accomplish it, for it did seem to me that the Figs were not perfectly Ripe, when they were pulled off and Tunned up, to be sent beyond Seas.

When I did thus search after these Mites, I judged, that several Figs that came to my Hands were pulled when they were Ripe, and therefore I took many Seeds of these Figs before me to Dissect them; and after I had cut or broak the hard husk of them, I fetched out of several of them, their Kernel or Pith perfect; and after I had taken or pulled off of them the Film, or small and thin Skin, and had separated the Stuff wherein the young Plant was laid, I saw the perfect Plant, consisting of two Leaves, and of that part that is to make the Roots and Stem.

I have also thought convenient to give a Cut of this young Plant of this small Seed, whereof we know there is a great Number in a Fig, because I have heard some say, that the eating many Figs doth create Lice in our Stomachs,

Stomachs, and others say, (whereof one is a Man of great Fame) that if we eat too many Figs we grow Loufie: Must not we Laugh, when we hear such silly Assertions, and conclude, that this saying doth only proceed from the great number of small Seeds wherewith a Fig is loaded? Which parts not one in a Thousand doth know to be Seeds, and much less, that such a Perfection is hidden or contained in every one of these Seeds, which in time would become to be a compleat Fig-tree. Let us then perswade our selves, that they compare the small Seeds that are in the Figs unto Lice; and that they therefore assert, that Figs can make Lice grow.

Fig. 1. *A. B. C.* doth show the Pith or Kernel that is taken out of the hard Husk, whereof we see a great many in a Fig.

A. B. Represents that part of the Pith or Kernel, whereby it was nourished, did grow and was fastned by the String.

Now that part that is to grow into a Root and Stem, is expanded from *A* to *C.* and the leaves of this young Plant do lye from *C* to *B.*

Every one of these said small Seeds of a Fig, are distinct from one another, and are surrounded by a Membrane, so that we must imagine, that every Seed, so as it lyeth in the Fig, has two Strings to nourish it, *viz.* one that nourisheth the Husk, and another that nourisheth the Pith or Kernel.

Fig. 2. *D. E. F. G.* does shew the young Plant taken out of a Fig Seed; wherewith *E. F. G.* are represented the two Leaves thereof, and *G. D. E.* is that part that grows into the Root and Stem.

You must not imagine, that this young Plant makes up the whole Kernel or Pith, but you must think, that the young Plant (the membrane of the Pith being set aside)

afide) does partly lie furrounded with a certain stuff, whereof the young Plant receives so long its Nutriment and Growth, until the Root has received so much Nourishment and Encreasing, that it can subsist in the Earth, which agrees with the Male Animals of Eggs of Birds, or the Nourishment of the Animals in their Womb, as is often here before said, for the whole in *Fig. 2.* of *F. D. G.* is filled up with the said Stuff.

When we did Contemplate the Film or Membrane attentively, which does surround the Pith, we did not only see a great many very small Vessels, but we saw also in it an incredible number of little Balls shortly, if we could penetrate into all the Secrets that lye included there: What should not we see? for certainly in this small Plant is concluded every thing that does belong to a Fig-tree.

After I had laid some of these Seeds for two or three hours in Water, and did then Dissect them, I could see as well in that part that was to make the Root, as also in the Leaves a great many of the Vessels, besetted with Hair as Shutters; but as soon as the moisture was gone, the Vessels did also disappear.

Fig. 3. *H. I. K.* doth represent the same Plant as *Fig. 2.* only with this difference, that as *Fig. 2.* is so delineated that you see it leaves sideway, whereby you cannot see the breadth of them; wherefore the same Plant in *Fig. 3.* is so fixed before the Magnifying Glass, that you may see the breadth of the Leaves of the young Plant.

If I am desired to resolve my Position concerning the Procreation of Animals by the Seed of the Males, which is done often by Persons of Quality that come to visit me, then they put me to mind why there is so many small Animals in a very small quantity of Seed, considering (as they say) that Nature has created nothing in
vain.

To

To this Objection I often come to Answer, and direct them to the multiplicity of Seeds wherewith a Tree is charged, as I have often said heretofore.

Now if we see that a common Fig has between four and five Hundred Seeds, and that one Tree doth Yearly produce many Figs, and that every ripe Seed of a Fig can produce a whole Tree; and consequently, if a Country was planted all over with Fig-trees, it may produce so many Fig-trees in a Year, that we might not only Plant a whole Kingdom all over with Fig-trees, that all these Seeds might produce, but also the whole earthly World; and that this doth not only succeed in Fig-Trees, but many other: Then I think, with Submission, we ought no more to ask why so many Animals are created in the Seed of Males.

We have reason to lay our Hand upon our Mouth, and think that the Almighty has thought this convenient, for the Procreation of all that has moving and growing; and thus all our Reason is but guessing, and that the true Reason is to us incomprehensible.

When I once was eating of Strawberries, and fixed my Eyes upon the little Apices we see on a Strawberry, I did conclude that every one of them was a Seed; and to confirm my Opinion I took a Strawberry, one of the biggest and ripest, and there I found a great many Seeds, after I had taken off the Film wherein they were wrapt up, and found, that every Seed of them had also a string whereby they were nourished.

I opened several of them, by taking off their hard Husk, and saw, that every one of them had the stuff we call a Pith: Having separated this Pith from its ancient Film, I took out the Plant which I also caused to be delineated, that we might see how many Seeds we send together into our Stomach, when we eat but one Spoonful of Strawberries; for when I did divide one of the big-

gest into four equal Parts ; I found in one of these parts about Fifty Seeds, and according to this, did this Strawberry contain Two hundred Seeds, and another that was much less I did guess to contain One hundred and twenty.

Fig. 4. A. B. C. D. E. does delineate the Plant taken out of a Seed of a Strawberry.

A. B. C. is that part that is to grow into the Root, and *C. D. E. A.* are the two Leaves which generally lye very near one upon another ; but being that they were a little displaced in taking them out, I ordered the design to follow it so, that you might see the two Leaves the better.

Now if we consider that a young Plant of Strawberries doth shoot in a Year (for I never heard that they Sow Strawberries) into several Shoots over the Ground, which take Roots, and grows all up into Plants, and bear the next Year ; and that besides this, each Plant does produce many Strawberries, each whereof has as many Seeds as is before said : We must again lay our Hand upon our Mouth, and be astonished at the encreasing and great multiplicity of Seeds of this Plant.

When I observe any remarkable things on small Creatures, then I make it my whole business to consider of the greater ones, which entirely do agree with the lesser ones ; When some Years ago I did fancy to see that subtle Hair, which the Flies have in great abundance about the end of their Feet, which are delineated by several ; by the help of which Hair the Flies can run up on any smooth Body or Glass, that every one of these Hairs had a Hook-like part on their end, wherewith they could hold themselves more firm to the Glass, which Hook-fashioned parts on each little Hair I could never see, although they were mentioned by others.

When

When I did pursue this Enquiry, I came to think of the great Lobsters (although there is no likeliness between them and Flies in their shape) which, as I am informed, are catched on Rocks near the Seas in *Norway*, and they are now and then brought to us for Sale, their Feet are also surrounded with many Hairs; to see, how these Hairs, and chiefly those on the hindermost Feet where Constituted, because these Feet have no Claws or Nippers to take hold of any thing as the other Feet have, and each of them is only furnished with a small Claw standing exactly or streight forwards, and with many small and short Hairs.

When I brought these Hairs before the Magnifying-Glass, I saw, with great Admiration, that many Hairs were furnished with two Rows of many Teeth like parts, which stood in very neat Order one by the other, just as if we did imagine that the back of a Knife, was on each side wrought out into a row of small Teeth.

I had, a great while ago, caused such a little Hair to be delineated, that you might see how strangely the shape of such a Hair is formed; hereupon I do imagine, that when this Lobster doth run up against the Rocks, his Feet cannot slip out, being upheld by the multiplicity of these Teeth like parts.

Fig. 5. M. N. O. P. Q. R. does shew one of the before mentioned Teeth like parts, which here you come only to see on one side, which are the Teeth like parts in the middle, and running from *Q.* to *P.* and also from *Q.* to *R.* the longer the less.

Fig. 6. S. T. sheweth but one part of the said small Hair, whereon both the Rows of Teeth, as I have said that every one of them has, are to be seen.

I should have sooner answered to your very acceptable Letter, had not my design to Dissect some Eels more then once, and also to send a Cut thereof with this hindered me.

In the mean time I remain

Tours, &c.

III. *Several Microscopical Observations and Experiments, made by Mr. Stephen Gray.*

HAVING not long since attempted to make some of these Microscopes, which Mr. *Butterfield* describes and instructs to make, in the Philosophical Transactions, N^o 141. P. 1026. of the manner then lately brought out of *Holland* by Mr. *Hugens*; but for want of such a Lamp, as the before-named Person mentions, I proceeded after a somewhat different Method.

Experiment. 1. I took a small Particle of Glass, about the bigness I designed my Globule, and laying it on the end of a Charcoal, I could, by the help of a blast Pipe, with the Flame of a Candle, soon melt it into a Spherule, and by this means I could make them indifferently clear, and the smallest very round, and I could make them much larger, then by the unassisted heat of the Candle; but these latter were attended with an inconvenience, they were on that side that rested on the Coal flated, and received a rough Impression from it; nor were they without those Improperities (for which, or rather) to Remedy which, the ingenious Person above-said, substituted his spirituous Lamp, for a Wax or Tallow-Candle, *viz.* small Specks or Opacous Particles lodged

