

III. *Part of a Letter of Mr Anthony Van Leuwenhoeck, F. R. S. concerning Excrescencies growing on Willow Leaves, &c.*

Delf in Holland, Jan. 28. N. St. 1701.

I Took the Leaves of Willow Trees, such as were much larger and greener than the rest, and open'd the Knotty part which are found in some of them, wherein I frequently discover'd more than one sort of Worms; but none of them being full grown, I cut some of those Knots off the Leaves, and opening one a little, I saw there was a Worm in it, and shut it together again; I put several of these Knots into a great glass Tube, to the end that the Worms might attain their full growth, but I could not find that any of them did so. I observed at the same time, that several of those Knots had no Worms in them, but were almost full of the Excrements of the Worms that had been in them, and were dislodged thro a small hole, which I could perceive in the Knots.

Fig. 1. ABCDE represents the Leaf of a Willow Tree, in which are seven Knobs or Tumors, some of them with holes in them, as FGH, another, as K, shows the Posture of the Worm, as it lay in that Knob which I dissected.

I observed farther, that several of the Worms lay dead in the Knobs, and musing with my self what should be the reason of it, I was at last aware that there was a small Worm fast linkt to the great one, which small Worm had no conveniency of getting out, being at
both

both ends of a pointed Form, but chiefly in the hinder part; his mouth was screw'd into the body of the great Worm, from whence he seem'd to me to fetch his Nourishment, and by the same means to occasion t'others Death.

I fancied to my self, that if Nature had not made this sort of Provision for these Creatures, they could not subsist, for she has not furnisht them with Feet or Claws proper to hold fast on the Leaves of Trees.

How these last Worms got into the Cavities of those Tumours, is to me unknown, and almost a riddle; but let us suppose that the first or great Worm is produced from an Egg, which a certain Fly has laid on a Willow Leaf, and that Worm having gnawn thro' the Vessels of those Leaves, a sort of a flowing viscous matter issued from those Vessels, which irretiated the Worm, and being dried up together, produced such Knobs in the Leaves, and inclosed the Worms in them; now some time after a lesser sort of Fly happen'd to pitch upon the same Knob, and made a hole therein, and laid his Eggs in it, from whence proceeded the above-mention'd little Creature, which devour'd and liv'd upon the great Worm.

In the middle of *July* I cropt several Willow Leaves, in which were such like Knobs; with these I proceeded as with the former, and discover'd several Worms, that were very near arriv'd at their full Growth.

After that these Knobs or Tumours had been in the glass Tube about 8 days, I open'd one of them, and saw that the Worm was turned into a *Tonneken* or *Aurelia*, then I opened others, and took out 13 or 14 more *Tonnekens*.

In some of the said Knobs I found those little Devouring Worms before-mention'd; I call them Devouring, because they prey upon a Worm that is at least 50
H h h h h c 2 times

times bigger than themselves ; they were so far advanced in growth, that without using any more Food, they were ready to be changed into Flying Creatures ; I put them also into the glass Tube.

I imagin'd that these *Tonnekens* were of the same make or contexture with those of our ordinary Flies ; that is, when any of those Worms are near their change, their Skins are contracted or turn'd into other Skins that are shorter, and stick closer to their bodies, which we call a *Tonneken*, without making any Web, as happens to some sorts of Flying Creatures.

These *Tonnekens* were of a darkish red colour, when I open'd one of them, I found the Worm lying entire as it was, tho' it had been shut up in its shell above 14 days ; and when I had placed some part of the *Tonneken* before my Microscope, I found that I was deceiv'd in my meaning, and that it did not consist either of the Web or Skin of the said Worm, and was inclin'd to believe that it was rather a part of the Leaf it self : For my Glass represented the Parts thereof like Branches, from whence proceeded smaller Sprigs ; and further, tho' I open'd several of those Knobs before-mentioned, I did not find one *Tonneken* therein, except in those which I put into my glass Tube, notwithstanding I have described by Fig. A a *Tonneken* lying in such a knob.

After some weeks, I perceiv'd certain black Flies proceeding from those *Tonnekens*, the hinder parts of their Body being of an oblong shape, and fashion'd like a Hook ; others could not arrive to their maturity, but having made a small opening in their Shell, just put their Heads through and so died. From these same *Tonnekens* proceeded a second sort of Fly, that were lesser than the former, and not so picked at the end. I saw two of those small Worms (which, as I said before, used to devour the great ones) endeavouring to shut themselves up into a Web, but by reason of the large
space,

space, wherein they lay, they could not bring it quite round them, and only made it on one side, by which means I was in hopes I should have the better view of them. But, contrary to my expectation, their Change happen'd in so short a time, that I could not make my Remarks thereon, and as the Moths, Silk-worms, &c. lye very regularly in a sort of a Skin or Membrane, with their Legs and Wings, after their change, so lay also the Horns and Feet of these little Creatures, each in a particular Skin, but separate from the Body, and after the same manner lay the hinder part of their Body, which was shaped much like a Hook.

These *Tonnekens*, which at first were white, after a few days turned blackish, and at last produced that kind of Fly with the afore-mention'd Instrument, like a Hook in the hinder part of it, which in length amounted to near two thirds of the whole Body.

Fig. 1. represents the aforesaid Fly just as it appear'd to the naked Eye, C D shews the long, slender and hooked part, which we judg'd to be *Agel*.

When I brought this little Instrument before my Microscope, it seem'd nothing less than a sort of Hook, for it was covered with a great number of fine Hairs, as you may see in Fig. 2. and it appear'd to me to be hollow. Thereupon I thought with my self, whither this might not rather be the case for a Hook, and endeavouring to split it, the Hook itself appeared; whereof I have only delineated the Point, jagg'd with Teeth like a Saw. Fig. 3. E. F. The more I viewed this Hook, the more I fancied that there was another inclos'd in it, nor was I mistaken, for I split the first Hook, and took out of it two other distinct Hooks, but of one and the same shape. I have describ'd a small part of one of them by Fig. 4 G H, each Hook was fortified with Teeth like Saws, which I observ'd was proper to them, and did not belong to Fig. 3. After I had taken
th eſ

these Hooks out of Fig. 3, I was convinced, that that which I took for a Hook, was only a second Case or Sheath for the other two, as you may see by Fig. 5. I. K. wherein likewise the Hollowness does plainly appear. Now as we have prov'd the second Case to be hollow, there is also a Cavity to be seen in Fig. 4. Of which we were considering whether it might not contain a sharp Liquor, that we commonly call Poyson.

From this Discovery, 'tis easy to conceive that such Flies don't only lay their Eggs on the Leaves of Trees, but that they do also make an opening in the Skin of the Leaf, and convey an Egg into it, from whence comes the Worm, which gnawing the Vessels for its sustenance, occasions the Sap to flow out of them, and to coagulate into that knotty substance.

Moreover, one little Fly, produced one of those small Worms, whose hinder part was also hooked, much like that sort of Flies that come from the Lice or Worms on Currant Trees.

I took out two *Tonnekens* from the before-mention'd knobs in Willow Leaves, that were no bigger than Corns of course Sand, that I might describe the shape of such a small Creature, but three hours after I missed them, and concluded, that in that time they were turned to Flies, and got away.

I have taken dead Worms out of the said knobs, without being able to find the lesser sort of Worm that uses to devour the other, but I observed two longish white things upon the dead Worm, which were so very small, that they escaped my naked Eye; I fancy'd that they were Eggs, for I could see nothing of them that was like a Worm; and the third day there plainly appear'd two Worms exactly of the same size and shape of those little Worms which I have said do devour the greater

More-

Moreover, I took a small devouring Worm from a greater that lay dead by it, and from whence it took its nourishment, and put it upon a living Worm, immediately it fastened its Snout in the said living Worm, which at the same time used all its might, with bending, stretching, contracting and winding its Body to free itself from its troublesome guest, but in vain, the other keeping his hold. This devouring Worm, as I call it, when it is arrived at his full growth, is exactly as Fig. 6. represents it ; I placed such a Worm, after its change into a *Tonneken* before the Microscope, and gave it the Painter to design.

Fig. 7. A B C D E F represents a *Tonneken*, which the evening before had been a Worm, and which had cast a very thin skin, and as the body of the Worm consisted of so many Rings or Circles, so likewise did the *Tonneken*.

In this Creature I did not only observe the Feet, but even the Joynts thereof. C G and D G shews its two horns, and tho they were inclosed in a thin Membrane, yet I could clearly see all the Joynts of them, and they were loose from the Body, excepting only at the Head. This Worm, before and after its change into a *Tonneken*, is very white, and some days after the Eyes appear full of many sights, and of a brownish colour. I have often endeavour'd to watch the change of these Worms, but it is so sudden, I could never do it.

I formerly acquainted you that the Mites in Cheese turned into *Tonnekens*, and from thence into Flies. I can't omit adding, that when the Mites were turned into *Tonnekens*, the same lay inclosed in a thin transparent Membrane.

Now this Skin that covers the *Tonneken*, is a great defence for the Worm within it, which being not able to shut itself up into a web, as many other Creatures do,
before

before their approaching change, that they may not be devoured of their Enemies, without such a skin would certainly become a prey to the Maggots that swarm in Cheefes.

About the time that I writ of these Cheefe-worms being turned into Flies, I observed some of the said Flies, which I kept in a Glafs in my Study, and put Cheefe into them to live upon, after they had eat thereof, they coupled, and soon after all of them laid Eggs of an Oblong form, and then died.

From these Eggs came young VVorms which also fed on the Cheefe, and when I judged them to be at their full growth, and the weather began to be cold, I took six of the biggest and carried them about me, and after a few days I observed that 4 were chang'd into *Tonnekens*, that 2 Worms were dead, and 2 Flies were skipping about the Glafs. I try'd the same thing in *January*, and had the same success; whilst I kept them in the cold there was little or no sign of life and motion, but as soon as I put them into my Pocket they were as brisk as in Summer. I open'd a *Tonneken* that had produced never a Fly, and found a dead one within, which had been making its efforts to get out, but was not rong enough.

