

III. *A Letter from Mr Anthony Van Lewenhoek, F. R. S. concerning his further observations on the animalcula in Semine Masculino.*

I Observed in the month of *July* that the young Rams made several attempts to couple with the Ewes, tho they were but four months and a half old, and tho they are not ripe for Copulation till about 3 months after.

Observing these motions of the young Rams, I thought with my self, that the Worms, or little Creatures, which are found in the Male Seed might be living and moving.

I order'd a Butcher to send me the Testicles of the next young Ram which he should kill, which he accordingly did on the 24th of *June*; I presently open'd the *Vasa Deferentia* of the Testicles, and took out the matter therein contain'd, and making my observations with my Microscope, I perceiv'd a great many of those Worms, but none living; which was not strange, when I found afterwards that the Ram had been kill'd near 30 hours before they brought me the Stones.

Hereupon they kill'd another Ram the 27th of *July*, in the evening, and sent me the Testicles immediately, whereof the Butcher having taken off the first Skin, I presently stript off the second Membrane, that I might lay the *Vasa Deferentia* naked before my Eyes. First, I open'd the Seminal Vessel that lies without upon the Testicle, from whence I took the Seed out, which to the naked eye appear'd white, and looking upon it with my Glafs, I observ'd such an unspeakable number of

Living Creatures therein, that none would believe but an eye-witness, swimming in the liquor in vast shoals together, some steering the same course, then by thousands at a time breaking off from one company, and joyning themselves to another ; in a word, the strange and wonderful swimming of these Creatures is impossible to be describ'd.

Moreover, I plac'd some of the Seminal Vessels before the Microscope, to discover, if possible, the Creatures living therein, but I could not discover any thing of it.

I follow'd the *Vasa Deferentia* till I brought them to their joyning with the *Adferentia*, in which Vessels I found a mighty number of these Worms, but none living.

Next, I open'd the Testicle into which these Vessels went, but could not discover in the least any of these Creatures in the Seed, but instead thereof I saw a great many Bubbles or Bladders, some as big as those Worms, and some less.

The next morning early I open'd again some of the Seminal Vessels, near the place where I had open'd the others the day before, and found them as lively as at the first time ; but when I continu'd the same Observations about noon, I could not perceive that any of the Worms were living.

On the 30th of *July* in the morning I got the Testicles of another young Ram, of about the same Age with the former.

Hereupon I sent to three of my friends, to come immediately to my house, because I had something Curious to impart to them.

The first thing I did was to squeeze the Seed out of the *Vasa Aderentia* of one of the Rams Stones, and setting the same before the Microscope, I made them look upon it one after another, and they own'd to me that
they

they saw an unspeakable number (that was their expression) of living Creatures swimming and hovering like Clouds over one another.

Afterwards I open'd the Seminal Vessels within the Testicle, where they lay interlaced, and as it were in a bundle shut up in a Membrane, and the number of Worms was not less in those Vessels than in the other.

There is a certain Gentleman, who glories that he was the first that ever discover'd these Creatures, by the help of a Microscope; but herein he is much mistaken, for whereas he owns that his first Discovery was in the year 1678. I did not only give the Royal Society an account of the same, by my Letter of *Novemb.* 1677, but even 3 or 4 years before, at the request of Mr *Oldenburg*, I had made an enquiry into those matters.

Now I am speaking of this same Author, it may not be improper to send you a Draught of the Worm in the Male Seed, just so as he represents it; whereby you may judge that either his Microscopes are not fine enough for these uses, or that he himself is not sufficiently qualify'd to make such exact and minute observations.

Fig. 1. A B C represents the Worm as he drew it, A B shews the Body, and A C the Tail. As for my part, I can't conceive that there is any such Creature in the world; for such a Creature is contrary to that Perfection which we observe in all Creatures; for allowing that these Worms in the Male Seed are shaped for Swimming, as we always observe, such a shape as is now delineated is exceeding improper for that use, because the very tip of the Tail at C is thicker than A, and that the further part of it is of an equal Thickness, whereas we find in all Creatures, and especially in those that use the Water, and are provided with Tails, that their Tails are always very sharp or pointed at the end, to the intent that the Water after the

more convenient manner may fill the place which they leave in moving.

Now the Tails of these Worms are thickest next their Bodies, and proportionably grow less and less, till at last the very end of all, if the matter in which they swim be thicker than ordinary, escapes the sight, agreeing, as to their Tails with all sorts of Fishes, and the same is in Land Animals, whose Tails are proportion'd to their Bigness, and always grows less towards the end.

Having observ'd with my Microscope many of those Creatures which I took out of the Testicles of the Ram, a little before the writing of this, I caus'd several of them to be drawn as follows.

Fig. 2. D E F shews one of these Worms lying dead, without that moisture in which they swim whilst living; in this, as in all the rest, you may observe that the Tail is thickest next the Body.

In the Body of the said Creature at D and E are two round Bubbles, which are clearer and more transparent than the rest of the Body.

As the Painter had several of these Worms before his eyes at once, I order'd him to draw one of them whose Tail was more curv'd than the others. Hereupon the Painter drew that Worm which is describ'd by Fig. 3. G H I K. He delineated some parts of the Body which do not agree with those of Fig. 2. but that ought not seem strange to us, when we consider that their different Site or Position is sufficient to make them appear different; for if sometimes the Belly be oppos'd to our sight, and sometimes the Back or Sides, their Intrails, which are cover'd with a thin clear Membrane in their Bodies, must needs appear of a different Contexture; so that in short the same Worm might be represented to our sight in 18 or 20 several postures.

Amongst the different Windings and Inflexions of the Tails of these Worms, I order'd the Limner to take that which is represented by Fig. 4. L M N O, in the Body of which we observ'd a dark and longish Plek.

Near the afore-mention'd Creature lay another, describ'd by Fig. 5. P Q R S, of which as well as he could he drew the parts of the Body P Q, as also the crooked bending Tail P R S.

Then I saw two other Worms near these, which a Credulous person would have said were two Creatures with one Tail, but I assur'd my self that a part of the Tail was hid under the others, and that it was impossible to distinguish them, and besides they were too big for one Tail; in another place I saw two other Worms lying much after the same manner, but I could perceive distinctly their two Tails. Fig. 6. T V W X shows you the two Worms last mentioned, and W X their joynd Tails.

I have often seen 8 or 10 of these Creatures lying so close to one another that many would have believ'd it was but one Body; but I, that am no Credulous person, stood gazing on them so long, till at last I could distinguish not only their several Bodies, but also their Tails.

By Fig. 7. A B C D the 'aforesaid Author describes the Worms of his observing, of which A B C is the Body, which must needs appear so long, if one uses such a sort of a Glass bubble as he says he did, and when the Rays of Sight of his Glass fall upon the upper part of the Body; but if he will look deeper into it, the Body will appear much Broader.

As for the Tail of his Worm, how can the All perfect Being Create such a thing as the end of that Tail D appears; and if it were so shaped, it would be impossible for the Worm to move so nimbly in such a slimy matter, neither could they strike it out, as they always do in swimming; To

To which we may add, that these Creatures swim in such vast shoals in their liquid matter, that, to judge of them better, and of the Proportion they bear to the slimy matter in which they live, you may compare them to a pound of Barley mixt with two pounds of Water ; for as the Barley-corns are to the Water, so are these Creatures to their Liquor ; now this being so, how is it possible that Creatures with such forked Tails, and crowd'd together in such mighty numbers, could swim about without touching, but even without hurting one another.

If this Author has such Microscopes, and as small as can be grinded, he must examine the Object a little closer the next time ; then he will find his mistake ; but if he be not sharp-sighted enough, what shall one say when he comes to speak of a whole Man.

I have lookt thro hundreds of Microscopes, and some of them so fine that I could use them by day light, tho the weather were cloudy, but I could never spy any such Tail as is describ'd by Fig. 7. D, but on the contrary, of millions and millions that I have seen myself and shewn to others, it has often happen'd that the ends of their Tails were so small that they escap'd our sight.

It is well known to many, that my Hypothesis is, that every one of these Worms includes a Lamb, yet after they are nourisht and enlarg'd in the Belly of the Female, they soon put on the same shape.

But this is not strange, as we find by experience in a Worm or Maggot, in which, after it is come to its full growth, whither we dissect it, or examine the outside only, we find none of its parts like those of a Fly ; and that all these Creatures, a little before their Transmutation, lye as still as if they had no life in them, and a few hours after their Change they shut themselves up in a Skin or Shell, which we call a *Popje* or *Tonneken*,
some

some of which are so thin and transparent, that I have often seen their Limbs distinctly within, and their numerous eyes, of which more hereafter.

Now if this Figure and parts of a Fly were not actually included in the Worm, such a Transmutation would have been unconceivable ; so it is also with the Creature in the Male Seed, but it is impossible for any man to penetrate into the secret parts of such a wonderful minute Animal.

If we should consider the Tail of one of those aforementioned Creatures, we must needs be astonished at the incomprehensible Number and Smallness of its Parts, especially if we conclude that such a very little Tail is provided with as many Joynts in proportion as the Tails of larger Animals, otherwise it could not move nimbly on every side as it ought to do ; and again, that every one of these little Joynts consists not only of Muscles, but also of Arteries and Veins, which derive the Nourishment down to it : I say, if we consider this, and the smallness of all the other parts of the Body, we cannot sufficiently admire the wonderful works of God.

In the Summer I observed the Seed of young Cocks that were not arrived at their full growth ; but I intend to enlarge my Observations before I say any thing more of that matter.

As I aim at nothing but Truth, and so far as in me lies, to correct the Errors of other men, I hope that in so doing no body will take offence, tho I freely Censure his Faults ; and if others will take the same freedom with me, and point out the Mistakes that occur in my Observations, I shall esteem it a service ; and the rather, because it is the way to attain to a greater Accuracy and Exactness in these sort of Speculations.

I shall conclude with my earnest entreaty, that my most humble service may be presented to the Noble Members of the Royal Society, and remain

Honour'd Sir,

Your Humble Servant,

Anthony Van Leeuwenhoek.

IV. Reverendi D. Johannis Craig, *Epistola ad Editorem continens solutionem duorum problematum.*

Ad Eruditissimum Virum Dominum H. Sloane, M. D.
& R. S. Secretarium.

Mitto tibi, vir clarissime, solutiones, duorum Problematum; quibus solvendis operam dederunt (& etiamnum dant) Celebrissimi hujus ætatis Mathematici. Prius est de inveniendò Solido Rotundo, quod minimam in fluido patiatur resistantiam, ab incomparabili viro D. H. Newtono jam olim solutum; quod denuo nuper aggressi sunt, Illustrissimus Marchio Hospitalius, & Celeber. Jo. Bernoulli, ulterius exponere; quoniam Analysin suam suppressere voluit Dignissimus Newtonus. Posterius autem Problema est de invenendâ Lineâ celerrimi descensûs; quod ante hos quatuor annos omnibus (ut nosti) Europa Mathematicis à clariss. Jo. Bernoulli proponebatur, & jam sæpius solutum fuit. Ad meas solutiones quod attinet: Eas jam publici juris facio (non quod me quicquam magni momenti præclaris eorum laboribus addere posse sperem, sed) ut majori easdem res tractandi varietate, ad majora Scientiæ illæ incrementa promoveantur. Et quamvis seriùs prodeat mea de Curvâ celerrimi descensus Analysis; magnâ tamen ejus simplicitate mora (ut spero) compensabitur. Qualem alii adhibuerint, nescio; cum nulla hujus solutio (nec quæ in vestris, nec quæ in Lipsicis Actis eduntur) ad manus meas adhuc pervenerit, præter Newtonianam, quæ Analysin, non exhibet. Si inter selectas tuas Collectiones Philosophicas, tenues etiam hæc nostræ loco aliquo dignæ videantur, habebis tibi devinctissimum,

Gillingham, 21 Dec. 1700.

JO. CRAIG

fig: 8.





