

I. *Observations on the Seed-Vessels and Seeds of Polypodium. In a Letter from Mr Anthony Van Leeuwenhoek, F. R. S.*

Delft in Holland, April 24, 1705.

When I was a few years ago at a place where *Polypodium* grew, I viewed the Seed Vessels, that were in great numbers upon its Leaves; and when I placed some pieces of a Leaf before a Microscope, I observed, as did several others that were with me, the Seed Vessels appearing like so many round Globules; and that soon one and soon another of them burst before our Eyes, which spectacle seem'd exceeding strange to us. And lately, in the middle of the last Winter, there fell into my hands two Leaves of Fern, that grew upon the stump of an old Willow Tree, and were almost wither'd; the which Leaf we call Oak Fern.

This Leaf had a great deal of Seed in it, but the Seed Vessels thereof were much larger than the Seeds of the Fern that grow in the Country.

I observed several little Bundles or Parcels of these Seed Vessels, sometimes thirteen of them lying in a row by one another.

Having never taken notice before, how large the Plant called the Oak Fern grows upon the Trees, I betook myself in the month of *February* last to a certain place, where there were old Willow Trees growing upon the Banks of a Canal, the which Trees were no taller than the length of a Man: The Boughs or Branches of which had been
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lopt off for four or five years together ; which are mostly used by the Boors to make Hedges or Fences for their Grounds and Dwelling places ; a great many of which Willow Trees, by the Lopping of their Branches, perish : And upon the rotten Wood of such Trees grows the *Polypodium* or Fern.

From three or four of those Trees I pull'd off the Fern, and I observed in all those that I meddl'd with, the Plant was no larger than a single Leaf.

These Leaves were of different sizes, some ten times larger than others, and some of them were not above two fingers broad, yet they also had Seed in them.

From these Observations, I infer, that the great Leaves had grown several years before they arrived at their present bigness ; and the more, because the Rose-like parts were not near so large upon the little Leaves as they were upon the great ones ; and consequently the Seed Vessels fewer in number upon the one than the other.

Among that Fern that I brought home with me, I planted eight or ten that had thick short Roots ; and from which Roots there came new small Branches, and mostly two such Branches sprung out of one Root : But I had one from whence four proceeded. I planted them in a Flower-pot, with fitting Earth about them, that I might pursue my Observations as often as I found myself disposed to it.

I caused my Painter to draw the greatest part of one of the largest Plants, to shew you the many Seed Vessels that are upon the same, together with the unspeakable number of small Seeds that are shut up in each Vessel.

Fig. 1. A B C D E F represents the largest part of an Oak Fern Plant, which I call a Leaf, because it has no Root, but only a Stalk ; and forasmuch as part of the Leaf was divided into seventeen Branches, whereof A B C is one, we may conclude that the whole Leaf consisted of a great many more.

Now

Now I have often counted in one Branch only of such a piece of a Leaf, and in one row only of such a Branch as described by A B, 13 of those little Particles, which to the naked Eye appear like Roses; and consequently in the whole Branch A B C, six and twenty of the same in two Rows, which I shall call Seed Vessels; and when I separated one of these Seed Vessels from the rest, I observed that all of them had very short kind of Stalks, whereby they were fastened to the Leaf, and by which they received their Increase, but to the Eye appear'd no bigger than a Point, and the Leaf seem'd clearer or more transparent there, in which place I judge there was a Canal or Vein of the Leaf.

Having separated one of these Rose-like parts from the Leaf, and also as well as I could the Seed Vessels of which it was composed, from one another, I found that the number of those Seed Vessels amounted to 149.

But in observing others I did not find the number so great, which was at sometimes 120, at others 130.

Almost all the Seed Vessels were open, and in some of them not the least appearance of any Seed.

This openness seem'd at first very strange to me, because I could not perceive in any of them that it was occasion'd by any bursting or breaking in pieces; but when I consider'd the matter better, I fancied to my self that Nature had ordered it so in those Seed Vessels, that as soon as the Seed was ripe, and received no further Nourishment, the Seed Vessels should open of course.

Fig. 2. H I K L M represents one of those Seed Vessels, that was open'd more than the rest, and whereby the Seeds, as I imagine, were thrown out, as it always happens in those Seed Vessels that open of themselves; for I could not perceive at the Orifice the least Rent or Breach: The said Orifice is represented by L M.

In the said Figure, between H and O, you may observe 8 Screw-like parts; and of this Configuration are all the Seed Vessels.

Let us suppose now that when the Seed is ripe, and receives no further Nourishment, it, and particularly its Shell or Vessel, which for the most part is composed of a thin Membrane, shrinks in, by reason that its moisture in dry weather is all exhal'd; now this shrinking in is greater in the 8 Screw-like parts, that are described between H and O, than in any other part of the Seed Vessel, because that the Screw-line parts are there of more than an ordinary thickness, in comparison of the other parts of the Seed Vessel; by which extraordinary shrinking the Seed Vessels are forc'd open, and the inclosed Seed thrown out.

I have met with some of the said Fern Leaves, in which the Seed Vessels had not been yet open'd, and consequently had shed none of their Seeds.

I have opened several of these Seed Vessels, and view'd the Seeds with a Microscope, it being impossible for me to see them with my naked Eye, or even with common Spectacles: I have counted above 50 Seeds in one of those Seed Vessels, the which Seeds appeared thro the Microscope like these 3, which I have caus'd to be drawn Fig. 3. P. Q. R.

I plac'd some of those Seeds before a Microscope, that was more magnifying than the last, and charg'd the Painter to draw it just as big as it appear'd to him thro the same Glass, as you may see in Fig. 4. S T. and forasmuch as the same Seed seem'd much greater to my Eye, I caus'd it to be so drawn, or rather smaller than it really appear'd to me, as in Fig. 5. V W.

And tho the Seeds did appear as small as in Fig. 3. yet one might perceive the Spotted Particles wherewith the Seeds were adorned.

Now if we turn our thoughts upon the Stalks of these Seed Vessels, as they are represented in Fig. 2. NH, and if we let them wander beyond our sight, which can penetrate no farther than into the Internal Canals or Vessels, of which there lye an unspeakable number in the said Stalks, we may safely affirm, not only that the Seed Vessels are produced and fed from the same, but also that in such Seed Vessels there may lye 50 or more Seeds, each of which may be indued with particular Canals or Vessels; and have moreover a Shell or Membrane without, and a Plant within; all which lye in so exceeding small a Compass, and have such an unspeakable number of Vessels in them, that one can hardly form any manner of Idea of them.

I caused the Painter to draw another Seed Vessel, which was not open as the former: And whereas in Fig. 2. the Screw-like parts of the Seed Vessel are placed opposite to the sight, in this last the same parts appear sideways.

Fig. 6. A B G represents the Stalk thereof, B C D E F G the Seed Vessel itself, and E F the opening of that Vessel whereby it discharges its Seed.

I caused also another Seed Vessel to be drawn, that had not yet open'd itself, and consequently in which the Seeds are still shut up.

Fig. 7. HIM shews the Stalk, and I K L M the Seed Vessels, in which the Skrew-like parts are intercepted from the sight; and it is so placed that you can't at all perceive whereabouts the opening shall happen.

In the said Seed Vessel you may observe the wonderful Fabrick of the Membrane whereof it is composed, and the exact Order and Regularity of the Seams or Ribs thereof; but when I shew'd a certain Gentleman the same Order and Uniformity in another Creature, he ask'd me to what end it was so Created, since it was never to be seen by the naked Eye.

The Shell or Skin of these Seeds is composed of so exceeding a thin Membrane, that the Wind, or even the Seeds themselves that are enclosed by it, would easily break it, were it not fortified or stiffned by those parts that I call the Ribs or Seams thereof, the which are much thicker than the rest of the Membrane, and thereby both the Seed and the Vessels themselves are preserved.

When I shew'd a certain Gentleman, by the help of a Microscope, one of these Seed Vessels, as also the Seeds that I had taken out of it, he was very desirous to know of what substance those Seeds were composed; but I thought 'twas impossible for me to satisfy him by Dissecting one of those Seeds; yet, having further consider'd of his Request, I found out a means of breaking one of these small Seeds so cleverly, that no foreign Matter should intervene, or be mixt with it.

In doing this, I was mightily surpriz'd to find a great deal of Oyl coming out of one of them; and as each of these Seeds was of a Yellowish Colour, so was the Oyl also, where 'twas a little thick; but where it was thinner, it was as clear as any Water; the other Particles, that lay in and about the Oyl, were of an exceeding smallness.

I made but one little Hole or Breach in the Seed, whereby to squeeze out the Oyl, and the other Particles wherewith it was filled; which having done, I observed that the Skin or Membrane of the Seed had no Colour at all in it; and then I could see a great many more Figures in the said Membrane, than were distinguishable in it before: As all Seeds, that are viewed with any exactness, may be discover'd to have two Membranes, so it is not improbable that these have two likewise.

Now when we consider the exceeding smallness of the abovemention'd Seeds, 'tis easie to conceive how the same, after that they are full ripe, may be scatter'd

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abroad with a brisk Wind, and some of 'em consequently may fall upon old Rotten Trees, and from thence receive their Nourishment and Increase.

I mention'd before, how the Seed Vessels upon the Leaves of Fern, open'd themselves (whilst I was observing them) in order to shed their Seed.

For my further satisfaction in this matter, I took a Fern Leaf, in which the Seed Vessels being quite ripe, were for the most part open, and had discharged their Seed, and put it into boyling hot Water; in this expectation, that the hot Water insinuating itself immediately into the Screw-like parts, as they are represented in Fig. 2. between H and O, would so extend or swell out those parts, that the Seed Vessels would resume the same figure or appearance as when they were full of Seed; and this Experiment I repeated several times, and always observed that almost all the Seed Vessels shut up themselves, just after the same manner as they were before they discharged their Seed; and when I spread those Seed Vessels abroad, and let them dry again, they were all of them as open as that which is represented by Fig. 2.

fig: 1

