

Fig. II.

The inferior Surface of the same Petrified Body, after the Membrane that inclosed it was taken off.

a The Hole by which it was discover'd to be hollow.

B. The *Fissure* by which it was divided, to shew its inside exprest.

Fig. III.

C. Its *Petrified Cells* that contained the *Hydatides* of various Sizes and Figures, exprest at D when taken out.

V. *Microscopical Observations on the Structure of the Spleen, and the Proboscis of Fleas.* By Mr Anthony Van Leeuwenhoek, F. R. S.

Delft, June 1. 1706.

Amongst other things it has been observed, that the Spleen is compos'd of a spongy sort of Flesh:

And having examined the Spleens of several Sheep, I found that the many Fibrous parts, of which it generally consists, and which many suppose to be Arteries and Veins, are in reality no Veins, but are united to, and draw their Nourishment from the Membranes in which they are radicated, and spread themselves into many Branches, and joia with the Fibrous parts, which likewise appear with Roots and Branches growing out of the opposite Membrane, that I could not forbear viewing them with astonishment; imagining that all the innumerable Fibrous parts were constituted to no other end, than to protrude the Blood which is conveyed into them by the Arteries; which Blood in great quantities is contain'd in the Veins, as may appear in great measure in those
Veins

Veins which resemble Arteries; for the Spleen can have no Blood conveyed into it, but what is brought to it from the Heart by the Arteries.

Now this Blood which is carried through the Arteries that are joyned to the Veins, and make the same Sangui-nary Vessels, being transported into the great and large Veins of the Spleen, cannot, in my opinion, be carried back again into the Heart with such a force, because the Blood that issues out of the Spleen, is not carried first to the Heart, but immediately to the Liver.

This being granted, I conceive that there is a necessity of a 2d motion, to protrude the Blood out of the Spleen into the Liver, consisting herein, that as the Spleen in Sheep is in great measure joyned by a Membrane to the Diaphragm and partly to the Stomach, as often as the Breath is drawn in, the Diaphragm is extended, whereby the Spleen is compressed, and the Blood thereby so forced into the great Vessels, that it carries part of it to the Liver, and when the Breath exhales, then those Fibrous parts are freed from that Pressure which they underwent by the drawing in thereof, and so by the extension of the said Fibrous parts, they more easily imbibe the Blood out of the Arteries.

Now if the Spleen had not such a continual motion, the Blood contain'd in it would be very little agitated, because (as I suppose) that the Blood in the Veins of the Spleen, is at least twenty times more than that which is contained in the Arteries.

Which motion sufficiently prevents the Blood from stagnating in the Veins, though the course of it be somewhat slow, for the Globules of the Blood, as far as I can discover, do always coagulate in order to effect a Stagnation of the Blood.

They also say, that the Spleen does purify the Blood, that it may cause no obstruction in the Liver, but those Opinions seem strange to me, and I would ask the People

ple that are of that opinion, where that foul Blood can remain, since there are no other Passages in the Spleen but two, *viz.* one Artery to bring the Blood into the Spleen, and one Vein to carry it out.

Moreover, I inserted a Glass Tube into the great Vein of the Spleen, and having bound with a Thread the Orifice of the Vein, I blew into the Tube, and wonder'd to see how much the Spleen swell'd with it, and when I forbore blowing, the Wind return'd upon me, and the Spleen sunk; which Experiment I tryed several times with like success.

This Experiment is much like the blowing Wind into the Lungs of any Animal, which when one leaves off returns back again: But forasmuch as in the Spleen by accident there was a little Hole, we could not produce that effect without stopping the Hole with one of our Fingers; and this Experiment I have not only repeated in the Spleen of Sheep, but also of Oxen and Cows.

They say that the Spleen consists of a spongy Flesh. I must own I could not discover that; for I allow of nothing to be Flesh, but where the Parts are extended in length, and lye in a regular order by one another, and so compose a Muscle, and the ends of these Flesh Particles are joyn'd in a Membrane, or make a Tendon of a Muscle; whereas the parts of a Spleen (at least as they appear to me) setting aside the Fibrous Parts, the Arteries and Veins, are compos'd of very small Particles, which were so exceeding fine, that I could give you no Figure of them; and it seem'd to me, that as the said Fibrous Parts, spread themselves out into an unspeakable number of very small Branches, the said very small Particles are depending on the Fibrous Parts.

One cannot so separate these small Particles of the Fibrous Parts, in order to set them before the sight, but one must break and dissolve not only the very small Branches of the Veins of the said Fibrous Parts, but also of the
Veins

Veins and Arteries themselves, the more because that the Arteries are conveyed into the Membrane only by the very small Branches: Yet it happened to me once, that I cut a Slice of the Spleen at the thinnest end of it, one part of which remain'd fastened to the said Spleen, in which I observed an Artery, with several of its Branches, lying across the said fibrous Part, without being joyned to it, only the extream Parts or Branches thereof, as far as I could discover, insinuated themselves into the Membrane.

Now that this was really an Artery, and no Vein, I was fully satisfied, partly because the Tunick or Coat thereof was very thick, and partly that it was a Blood Vessel, because the Cavity where it was cut off appeared very plain to me, which I could trace almost through the whole length of it; besides I imagine that the Veins, by reason of the thinness of their Tunicks, could not undergo so many Motions or Postures as I was obliged to put them into, in order to expose the Fibrous Parts plainly to the sight.

Thus far had I brought my Observations, which I had made only in order to review them at any time, but being informed that a certain Gentleman having writ something about the Spleen of a Man, had amongst other things affirm'd, that the said Spleen was not compos'd of Particles of Flesh; and moreover, I having been very free in delivering my Thoughts about the Contexture and Motion of the Spleen, I thought fit to place a small Particle (as I had prepared it) of the Spleen of a Lamb that was about a year old before a Microscope, and to cause a little part of it to be Painted, concluding that the Spleen of a Man, an Ox, or a Sheep, are of much the same Nature one with another, though perhaps their Figure either in length or thickness is something different; thus declaring that I shall not depend upon the Discoveries of any other Person.

Tab. II. Fig. I. Represents a very thin and small Slice that I had cut off the Spleen of a Lamb, from the thinnest part of it; for if I had cut off a piece from that part which was much thicker, it would have made too large a Figure.

In the said Fig. 1. is represented by A. B. C. D. E. a small Particle of the Membrane of the Spleen, like other Membranes, but exceeding thick and cover'd with another that was thinner; from the innermost Membrane does proceed the Fibrous Parts that lye between B. H. and G. F. and seem to be torn off from the small parts of the same.

The opposite Membrane is represented by O. P. having also other Fibrous Parts fastened in it at Q. R. S. T. from whence it plainly appears, that the Fibrous Parts are one and the same, tho' they proceed from two opposite Membranes; and forasmuch as the Spleen has none of those Flesh Particles of which the Muscles are compos'd, and which are the instruments of all Motion, these Fibrous Parts, I conclude, perform the same Uses as the Muscles.

Here we may see how wonderfully the Fibrous Parts, that are already describ'd between B. H. and F. G. spread themselves into Branches, and are again united in H. L. and M. L. from whence again they are multiplyed into many more small Sprigs; and I have seldom observed that any Membrane, how thin soever I had dissected it, was provided with so few Branches as are here represented between B. H. and G. F.

In the Fibrous Parts that lye between L. M. N. and Q. R. S. T. there are abundance of exceeding small Particles, very great Numbers of which were broken by me and cast away; all which I conclude are compos'd of exceeding small Particles which make the Spleen, and which small Particles I imagin to proceed out of the Fibrous Branches, which upon account of their smallness appear to me to be little small Globules.

The Fibrous Branches represented by V. V. V. are those that were cut off with a Knife.

Forasmuch as it was not easie to discover with the Eye, how the said Fibrous Parts, with their Branches and Roots, did proceed out of the Membrane, I caused the Painter to view a small Particle of the same thro the Microscope, just as 'twas fasten'd in the Membrane, as may be seen in Fig. 2. which Membrane is there represented by A. B. as are also three Branches by C. D. . D. E. and E. F. All which are united in the Fibrous Branch C. H. I. and then we saw how each of the three said Branches, with those Parts thereof that I call Roots, were proceeding out of the Membrane, as is here shown in Fig. 2. between F. K. . E. L. . D. M. . and C. N. inso-much that the Painter said to me, that he never in his life saw more Roots with his naked Eye growing out of a Tree that was thrown down with the Wind, than he saw in this Figure.

That we may have a more exact Idea of the structure of the Spleen, I handled some parts thereof much more gently than I had done the greater, that I might lay the Fibrous Parts naked ; after which I placed a small Particle thereof before a Microscope, and caused the Painter to describe the same as well as he could.

Fig. 3. A. B. C. D. E. F. G. H. I. represents a little piece of the Spleen, which to the naked Eye was no larger than a course Grain of Sand. In which Figure between A. B. and A. J. you don't only see the small Branches that shoot out of the Fibrous Part, which are also compos'd of much smaller Parts themselves, but one discovered also in the said small Particle, that it self in the length of it did also consist of long Particles like Fibres. Then who knows, but each of those fine Particles are Tubes or Vessels, to convey that very thin Juice or Liquor which they receive out of the Membrane.

In the said Fig. between B. C. D. H. I. are represented the exceeding small Branches, with their several small Parts issuing out of the said Branches; and between E. F. and G. there lay a Branch that was almost single, upon which the Painter has also represented the round Particles growing upon the same. From which Sight we may very well conclude how the Fibrous Parts represented in Fig. 1. are composed, setting aside the Veins and Arteries which run through the same.

A few weeks ago there came two *English* Gentlemen to my House, who askt me some Questions about the Sting of a Flea; but tho I could not then show them the same, yet afterwards it happened, that in dissecting of a Flea, in order to take the Heart out of the Body, the Sting of the said Flea appear'd to me much more plainly than I had ever seen it before; and the more by reason that I had broke off the two Fore-legs, which are as it were join'd to the Head, and then plac'd the fore part of the Flea before the Microscope just as if it lay upon its Back; by which means the Sting of the Flea appear'd so distinctly, that I my self could discover an Orifice in the extrem part of the same, and moreover it appear'd to me that it had a Cavity throughout; but that which surprized me most was, that the Sting of the said Flea had a Scabbard or Sheath, in which the Flea shut up his Sting when he did not use the same, and to preserve it from any hurt; and I imagin that the Flea could so order his Sting with the Case thereof, as to place it between his Legs, that it might not be entangled in his Hair or Wool when he run along.

This Scabbard of the Flea is divided into 2 parts, and each of them has a Cavity like a Canal, in order to contain the Sting when those Parts are close shut together; but that which was most remakable to me was, that each of those hollow Parts, that compose the Sheath or Scabbard, was compos'd of Parts like the Teeth of a Saw. These
Teeth,

Teeth, I conclude, are so made as to indent one within another when the Sting is in the Sheath, in order to hinder the opening of the same at any other time than when the Flea would make use of it: Yea, that which is more, we discover'd at the end of each of the Scabbard's 3 Teeth standing out, which I judge was for no other end than to shut within one another.

I caus'd the Sting with the Sheath thereof, so as they appear'd through the Microscope, to be drawn by my Painter, to the end, that one may comprehend the better the wonderful Figure of this Instrument in so despicable a Creature as a Flea is.

In Fig. 4. L. M. shows the half of the Scabbard of the said Sting, as also the Cavity therein, and the Teeth-like Saws, and the 3 Teeth at the end of it described by M. In the said Fig. 4. N. O. represents the other part of the Sheath, that is likewise adorn'd with the same sort of Teeth. Q. P. is the Sting itself, plac'd between both the Parts of the Scabbard, and P. represents the little Orifice or Hole in it.

Now if we suppose that each of the Parts of this Sheath, as also the Sting it self, are furnished with divers Muscles and Fibres necessary to produce all the motions that belong to them, the said Sheath and Sting may be deemed great Instruments in comparison of those Muscles that produce their Motion: But then if we remove our Thoughts to those *Animalcula* that many millions smaller than a Flea, and consider also their respective Instruments for motion, &c. we cannot but be exceedingly amazed at the thoughts thereof.

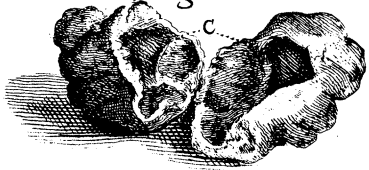
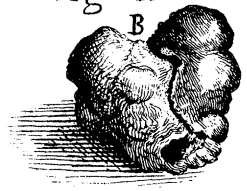
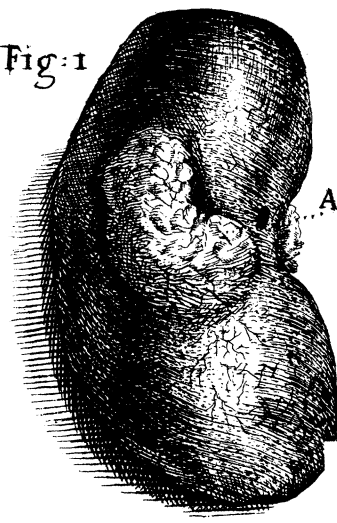
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Tab: i.

Fig: 1

Fig: II

Fig: III



Tab: 2.

