

II. *A Letter from Mr Anthony Van Leeuwenhoek,
F. R. S. concerning the Barks of Trees.*

Delft in Holland, March 27, 1705.

ALtho I have been many years fully convinc'd in my own particular, that the Bark of Trees was produced from the Wood, and not the Wood from the Bark, as many have affirmed; yet I find that some, and those persons of good Learning, do maintain the same Hypothesis; and so especially did a certain Gentleman, that was lately at my House. This induced me to make a nicer Enquiry into the Barks of Trees, in order, if it were possible, more fully to convince the World than I have yet done, that the Bark of Trees does always proceed from the Wood. I had a piece of Cinnamon Wood, about the bigness of a Quill that's used for writing, which had its Bark still upon it; I judg'd that this piece of Cinnamon Wood would be the most proper to prove that the Bark is made out of the Wood, because that the Horizontal Vessels of that Wood were of the same Colour with the Cinnamon itself. But as nicely as I dealt with this Wood, I could not cut it into pieces across, so as to keep the Bark and the Wood united, but the Bark would always be separated from the Wood, of which I could not understand the meaning, till I call'd to mind that the Island of *Ceylon* is situated between the 5th and 10th Deg. of Northern Latitude; so that the Fruits, Wood and Bark are of a continued whole years Growth, whereby new Saps and Juices are always carried up between the Wood and the Bark, in order to make the new Wood and the new Bark. For this is the reason that the Bark of Cinnamon is so easily separated

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from the Wood.—Wherefore, not finding my account in this Experiment, I turn'd my thoughts upon the Bark of Cherry, Plumb, Beach-tree, &c. the Vessels of which Barks are not extended lengthways, but circularly about the Wood ; and in order to demonstrate the same, I cut off this small Twig of a Cherry-tree.

Fig. 1. ABCDE represents a thin Twig of a Cherry-tree, in the Wood of which the Canals or Vessels of the Bark, by which the same is fed, are not extended lengthways, but circularly about the Wood ; for which reason the Bark of the said Wood can't be stripp'd off longways, but only circularly, contrary to some other Woods, as in the aforesaid Figure ; where by CFGG, a small piece of the same Bark, as it is stripp'd off, is represented ; in which you may observe, that the Canals or Vessels, of which it is compos'd, run from C to F, or from D to G.

I have asserted formerly, that in all Countries where there is any Winter, so far as to put a stop to the Growth of Trees, at all times as long as the Growth endures the Bark grows thicker, and that the New Bark does protrude that which was made before further and further from the Wood ; insomuch that in the Barks of Old Trees, one may cut a Fingers Breadth in Depth before one can come at any thing like Greenness or Sap : And if one consider those Barks with care, one shall discover what part of the Bark from time to time is deprived of its Nourishment, and consequently what part of it is quite dead.

By these my last Observations, I have discovered in a Twig of a Cherry-tree of one years Growth, that the Bark does consist of at least six thin Membranes, whose exceeding thin Vessels or Fibres extended themselves circularly about the Wood, and those Membranes were very closely united to one another.

I placed one of these Membranes, that was as nicely separated from the rest, as it was possible for me to do, before

before a Microscope, and caused the Painter to draw it as it appear'd to him, as you may see in Fig. 2. H I K L, where you may observe the Vessels or Canals do not run longways, but circularly about the Wood ; which being so, the said Vessels can't remain long whole, but must from time to time be broken in pieces.

When I cut cross the Wood of a Cherry Tree, which was about a year old, in order to shew the Painter the Horizontal Vessels that are derived from the Wood to the Bark, and whereby the Bark receives its Growth and Nourishment, the Bark, by reason of the Softness and Flexibility of those parts that lay next the Wood, did always yield so much, that it was impossible for me to shew him the said Vessels.

Upon this I turn'd my Thoughts upon the Beach-wood, because the greatest part of that Wood is cloathed with a Red Bark, which sticks close to the Wood, and grows yearly thicker ; and upon the outside of that Bark there is produc'd a Whitish sort of Bark several times in a year, which falls off from the Wood as if 'twas pill'd ; but this only happens in Beach Wood of an ordinary thickness ; for in the thickest Wood this Peeling or Scaly sort of Bark is not produc'd, and then the Bark grows exceeding thick ; but the most part of such Bark is thrust away, and remains as it were without Nourishment ; and in such there is no outermost Scaly sort of Bark produced.

I steep'd this last mention'd Wood in Water, because it was very dry, that I might the better cut it through with a sharp Knife, whereby the Ascending and Horizontal Vessels or Canals might receive the least damage in cutting.

Fig. 3. LMNOPQR represents a small particle of the last mentioned Wood, as it were cut across, in which the Ascending Vessels or Canals, both great and small, are easily seen, and between which run the Horizontal Vessels, which receive their Juices from the Ascending ones.

After several cuts made with a sharp Knife, I found the Bark of the Wood to be exceeding hard; and this was mostly occasion'd, as I imagin'd to my self, by a Coagulated Whitish Matter, which one would take to be Rosin; the hardness of which hindred me from cutting the Wood and the Bark so easily together, as not to hurt the Horizontal Vessels which were continued from the Wood into the Bark in a Right Line; for the Bark being much harder than the Wood, always yielded to my Knife.

Wherefore I cut off as well as I could a small piece of Wood and Bark at one cut, and placed the said piece before a Microscope, that the Painter might view the Wood and Bark together.

In the said Fig. 3. by QUTSR is represented a Particle of the abovementioned Bark, in which the Horizontal Vessels, as they lye in the Wood, and are continu'd on to the Bark, and from whence the Bark is produced, are shown by NMOP, of which N and O do not go quite throughout into the Bark, by reason of that hard Matter which we mention'd before, and which you may see in X.

But the Horizontal Vessels, that are described by MRS, and PQU T, go throughout the Wood into the Bark, so far as to preserve the Bark from any Mortification.

Now as the Bark of the Beach Tree, or rather its Vessels or Canals, run circularly about the Wood, I could not at first conceive how those Canals could be produc'd out of the Horizontal Vessels; but at last I discover'd that as the Horizontal Vessels are continued from the Wood into the Bark, so there spouted out from every side of those Vessels exceeding small Canals, which run circularly about the Wood, and so for the most part produced the Bark of that Wood.

In the said Fig. 3. I have represented by PQU T one of those Horizontal Vessels, as they are continued from the Wood, and carried on into part of the Bark, which
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is described by QUT, and between Q and U I shew a few of those Vessels which sprout out of the said Horizontal ones, and run circularly about the Bark; and how nicely soever I observed them, I could not discover one Ascending Canal, which must needs run lengthways up the Bark, in case the said Bark had its Rise from the Root of the Tree.

I placed also a thin Scaly Particle of the Bark of the said Wood before a Microscope, which I caused likewise to be drawn as in Fig. A 4. ABCD, the Vessels or Canals of which run also horizontally from A to B, or from C to D.

But you must not imagin that this and the preceding small Particle of Bark is so open as is here represented, but conclude, that the Vessels which run circularly about the Wood are only describ'd, and that these Vessels at first lay close to each other, but as the Wood grew greater, they were separated more and more from one another.

Fig. B 4. WXYZ. shews also a little Scale of the Bark of the Twig of a Tree, in which the Vessels describ'd by WX or ZY do also run circularly about the Wood, but I have forgot to what Tree it belong'd, it having been some time drawn before I took any notice of it.

After these Observations, I remembered that I had lying by me a piece of the Bark of a Cinnamon Tree, which was given me by an Officer that had been a Prisoner at *Candi* in the Island of *Ceylon*.

This piece of Cinnamon Bark was near 8 inches long, a small part of which is represented by Fig. 5. EFGH.

I judged by the division, which I observ'd between I and G, and which was the thickness of the Bark, that the Cinnamon Tree to which this belonged, was very near 12 years old, and according to the same remarks, that the Tree was about 6 inches diameter.

I have several times examined the outside of this Bark, and always found it was so weak or brittle as if it were partly

partly corrupted or perished, and when I cracked those brittle Particles between my Teeth, I could perceive no taste of Cinnamon in them, so that I was forced to pare away two third parts of the outside of the Bark before I could come to the strong and true Taste of the Cinnamon.

I have moreover enquir'd into that part of the Bark that lyes next, and is as it were join'd to the Wood, and in cutting it to pieces have satisfy'd my self more than before, that the Cinnamon, otherwise call'd the Bark, receives both its Nourishment and Increase alone from the Wood, and not from the Root; for when I divided this Bark into small parts, I could discover no Ascending Vessels in it; but on the contrary, so many Horizontal Vessels coming out of the Wood, and those too so large, that I don't know that ever I have discover'd so many Vessels in the Barks of any other Trees.

Fig. 6. L M N O P Q R S, represents a very small Particle of the Bark of a Cinnamon Tree, in which the Horizontal Vessels lye by one another in such Order, as is here represented between L M N R S, or between N O Q R, in which they are all cut across.

Many of these Horizontal Vessels are stopp'd or fill'd with an inclos'd reddish Matter, which in some Vessels is not so high colour'd as in others, some of them being almost yellow.

You may observe the Painter has represented these Horizontal Vessels in a manner Hexangular, as they indeed appear'd to him, which is also the most perfect Figure that Nature could bestow on 'em, in order to prevent any *Interstitia*, or Vacuities among them.

We also see that about the said Horizontal Vessels there lye longish Parts, that run into a Point at both ends, which Parts described by L M N lye together, and some of them are bigger than the others; we may observe also how the said Parts do surround the Horizontal Vessels.

We see moreover, that the aforesaid Parts have often contained in 'em a Matter of different colours, which colours are wholly separated from each other, and appear as in N R S, and where no colours are to be perceived in the said Figures, there they are Transparent.

These long Transparent Parts, as also those that are colour'd, together with the Horizontal Vessels, which are almost all of 'em filled with a colour'd Matter, are in my Opinion the sole Ingredients of the abovementioned Bark or Cinnamon.

In the said Fig. 6. O P Q represent but a part of the Horizontal Vessels, that lye by one another.

All the said long Particles, which in a great measure compose the Cinnamon Bark, are not incurvated, as in Fig. 6. but a great many of 'em are extended in Right Lines, as you may see in Fig. 7. A B C D E F G, which represents a very small Particle of the abovemention'd long Parts, which likewise incloses some Horizontal Vessels; and wherein you may see at A how regularly the sharp Points are ranged by one another, as also between B F and C E, between which the Horizontal Vessels are to be seen in that order in which they always lye.

That sharp and pointed Particle that is represented by F H, seems to be out of its place; and I fancied that in dividing it from the other Parts, I might have broke it off at F.

I also placed 3 other long sharp pointed Particles before a Microscope, as in Fig. 8. I K L M, in which you may also see in how regular an order the pointed parts appear, as in K M for instance; from whence we may conclude, that all the other parts of the like Nature are disposed in the same manner.

I moreover caus'd the Painter to draw another Pointed Particle, that was exceedingly incurvated; which, I suppose, might be occasion'd by its having surrounded two several Divisions of the Horizontal Vessels. See Fig. 9. N O P.

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We may pretty easily conceive how one Canal is produced (or comes out) from another, but how the said long sharp pointed Particles, represented by Fig. 6, 7, 8 and 9 are produced, is, as well as a great many other *Phenomena*, past my Understanding.

I have moreover examin'd into the Nature of the Bark of a thick Lime Tree, the rather because I know no other Barks of Trees whose parts are so easily separated from one another, either in length or breadth; insomuch that they make thereof in *Muscovy* Mats for Packing, and Rope-work, which is very strong, and if I am rightly informed, is not easily subject to rot, tho' it should lye long wet.

This Bark I also cut across, in order to discover the Bent or Run of the Horizontal Vessels that come out of the Wood.

Fig. 10. A B C D E F G H I represents a small Particle of the Bark of a Lime Tree, as it was cut across, where, by A B C are shown the Horizontal Vessels that come out of the Wood, and consequently these Vessels are cut lengthways.

These Vessels, altho at their first coming out of the Wood they lye close to one another, as from A to B, and from B to C, yet they don't remain always so close, but as the Tree grows thicker and bigger, the Horizontal Vessels are more divided from one another; as for instance, that which at B is but one Bundle or Collection of Vessels, with the Increase of the Tree divides itself into two, and the Separation grows larger and larger, as in B M K and B M L.

Now, that there may remain no Interstice or Vacuity between the said Horizontal Vessels, there are other Vessels produced from those, as you may see between M I D, which new Vessels produce a Matter that fills the Place of M L K.

These Parts are Roundish, but so interlinkt with one another, that they serve for Canals; they appear'd so
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small to the Painter, that if he had not drawn 'em bigger than they were, you could not have made any Judgment of them.

These Horizontal Vessels don't run through the thickness of the old Bark, for in some places the Bark dies sooner than in others for want of Nourishment, insomuch that you may perceive in the Bark of a Lime-Tree of an ordinary thickness, three distinct Crufts lying one upon another; the outermost of which being destitute of Nourishment, by little and little become dry and wither'd.

I shall never suffer my self to be perswaded that the great number of descending Vessels which are discovered in the Bark of a Lime Tree can proceed from the Root of the said Tree, but depend on the horizontal Vessels of the same, which by reason of their exceeding smallness are hardly visible in Fig 10. For if the Nourishment of the Bark does proceed out of the Root, the Bark would never perish unless the Tree did also, whereas we see that in some Trees the greatest part of the Bark is dead or wither'd.

I took a small slice of the said Bark and cut it across, and placed it before a larger Microscope, and caused the Painter to draw it as well as he could, who affirmed to me 'twas impossible for him to describe all the small Holes or Orifices which he saw.

Fig. 11. N O P Q R S represents a very small Particle of the Bark of a Lime-Tree, wherein are shown partly the mouths of the Canals that lye lengthways in the Bark, and are here cut across, but chiefly to give you a view of the horizontal Canals, as they are cut in their length, as at N S or P Q; the which horizontal Vessels are represented in Fig. 10. by A I H, B M L G, B M K F and C D E.

These Canals, or Vessels, described by N S or P Q are not of a continued Hollowness throughout, but rather seem to consist of Oval Particles linkt to one another.

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I have been thinking with my self whether each of the aforesaid Oval Particles were not provided with a Valve, which Valves make them appear like so many Oval Figures; and the use of which Valves might be to hinder the Juices or Saps, which by the force of the Sun are raised up into those parts, falling down or descending, after the Sun set; especially if we consider, that by the said Canals there must be caused so strong a Protrusion, in Spring time, as not only to thrust away and separate the Bark from the Wood, but also to burst the outermost parts of the Bark, that are already hard, dry and wither'd.

I have said before, that the Horizontal Vessels or Canals in Cinnamon are Hexangular, which Figure is the most perfect, and takes up the least room or space; from whence I conclude likewise that the Horizontal Vessels in Fig. 11. are likewise Hexangular, tho I did not see them lying in the same order; for when I examin'd into the Horizontal Vessels or Canals of the Cinnamon, I found that they were of the same Configuration as in Fig. 11. NS and PQ, viz. that they consisted of Oval Figures.

I had placed before a Microscope a little bit of a Lime-Tree, which was cut off of the Wood lengthways, and the Horizontal Vessels cut across, to the end that you may see how those Horizontal Vessels or Canals lye in the Wood; the which Vessels are also continued into the Bark, so far as it is alive, and serve for the feeding and increasing of the same.

Fig. 12. ABCDEFG represents a little slice of the Lime-Tree Wood, in which you may count in 9 several places the Horizontal Vessels or Canals that are cut across, and which Canals are situated between the small ascending Vessels, which for the most part do nourish the Wood. Now between the Horizontal Vessels and Canals in the Wood and in the Bark there is no difference, but in the Ascending Vessels and the Bark there is a difference; for they

they are of such a Disposition as the Horizontal Vessels which are in the Wood and the Bark ; and thus they agree with those Vessels described in Fig. 11. by N S or P Q.

Now if we find that the Horizontal Vessels or Canals, as well in the Wood as in the Bark, are of one Texture, and that the Ascending Vessels in the Bark of a Lime-Tree are also of the same, we may more firmly conclude, that the Bark is produced from the Wood, and not from the Root.

I have moreover turned my thoughts again upon the consideration of Cork, which is said to grow as the Bark of a Tree upon a certain sort of Oak in *Spain* ; which if it be so, I imagine that the Burning which we perceive in the Leaves of Cork, is done by 2 hot Iron Plates, in order to make it flat and strait.

I took then one of those pieces of Cork which are cut into Stoppers for Bottles, as is described by Fig. 13. A B C D E F.

In this piece you must suppose that B G is the part that lay next the Tree, and that E was the outside of the same.

In the said piece of Cork, between G H I K E, I observ'd five distinct Divisions, running across from F to D, which is the part that surrounded the Tree ; and from whence I conclude, that the Cork was arrived to such a thickness in 5 years time, for each Streak denotes the growth of that year.

I observ'd also 4 distinct dark strokes, of which G I is the middlemost ; I supposed they were great Canals, but could not conceive to what end they were made ; but I concluded from thence, that in case these great Canals had not been so cut through lengthways, the Cork would not have been so thick.

We must likewise conclude, that the length of all Corks (in order to prevent either Moisture or Air from

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passing thro them) must be consonant to the length of the Cork as it grows upon the Tree, and so that part of the Cork represented by A B C was the lowermost part, and D E F G was the uppermost or near the uppermost, according to its situation upon the Tree.

Now for my own and others satisfaction, I cut a little piece of a Cork as from G, where you may suppose that it was joyn'd to the Tree, that is to say, I cut it after such a manner, that the cut of the Knife went from G to H; and having placed the said piece before a Microscope, I perceived all the Canals so placed as if they come out of the Wood, without discovering in the least any ascending Vessels, tho I cut it never so often; from whence I must conclude again, that the growth of the Cork proceeded from the Wood.

Now to give you a better Idea hereof, I have caused the Painter to draw a small Particle of the Cork.

Fig. 14. L M N-a O P Q b, shews a small Particle of a Cork, as it was cut off between G and H, of which L M N we must suppose to be the part next the Tree, and so the Vessels or Canals, by which it receives its Increase, run horizontally, as from L to Q, from M to P, and from N to O; but I could not find one single Canal that was perpendicular, or can be said to proceed from the Root.

These forementioned Canals have no thorough passage, and it seems to me that in each Canal there are so many Valves as there are Horizontal Vessels in them.

In the said Figure by a b, is represented a Line running quite across and something incurvated, the which Line is that part of the Cork, where, the Season of the year being over, a stop was put to the growth thereof.

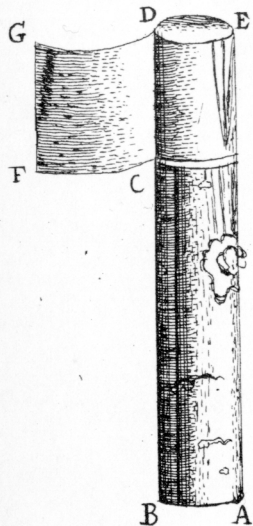
For further satisfaction, I cut another piece of a Cork after the same manner, that whereas in the foregoing Figure, the Horizontal Canals were described in the length, now the same Canals were cut across.

Fig. 13. R S T V represents a little piece of Cork, as it appeared thro a Microscope, that was more magnifying than the former in Fig 14. this piece of Cork was cut off from Fig. 13. between B and G, and was that part that was next, or that was united to the Tree, and from whence it receiv'd its Increase, and consequently then were those Canals which in Fig. 14. were cut long ways, but now across.

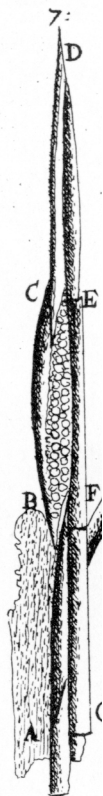
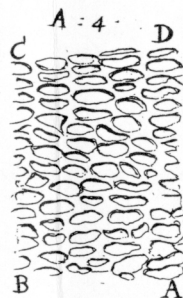
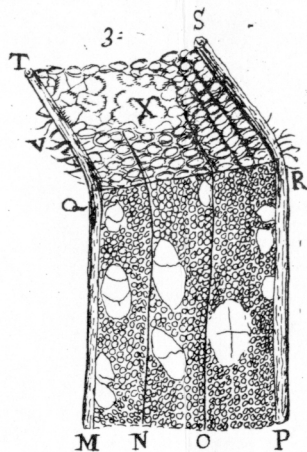
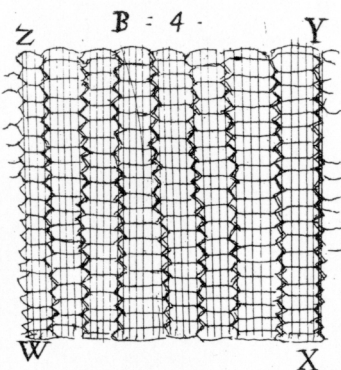
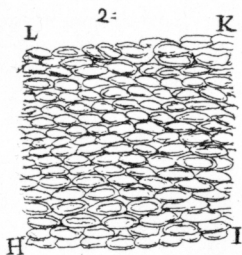
In the said Fig. 15. you may perceive that almost all those parts that were cut across did not consist of round Canals, but of hexangular ones, which is agreeable to the most perfect order, because it prevents all the vacuities between them; and I imagin to my self, that in case one could procure a piece of Cork, before it had been made strait and flat, after the abovementioned manner, we should see the Canals so cut across, as in Fig. 15, between R S T U, much more perfectly than we now do. Whereas by the bending it to make it strait, a great many Canals are displaced and disordered; as in the cutting of it with a Knife the exceeding fine Membranes, of which the Canals are compos'd, are often torn and broke to pieces.

This is what I have thought fit to trouble you with about Cork, but if I were Master of that Wood which produces it, I should receive greater satisfaction; whereas I cannot now conceive how the vast number of Horizontal Vessels which are seen in the Cork, and of which the whole Cork consists, can be produced by the Wood thereof.

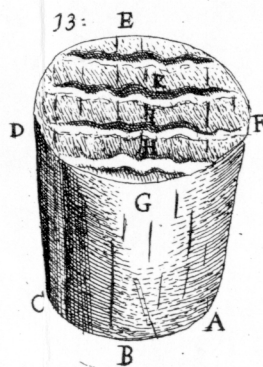
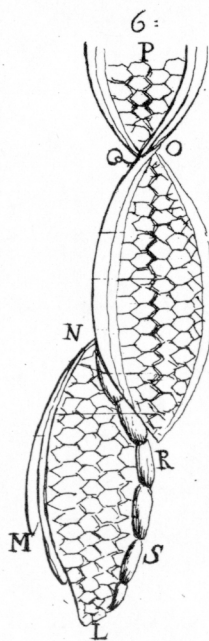
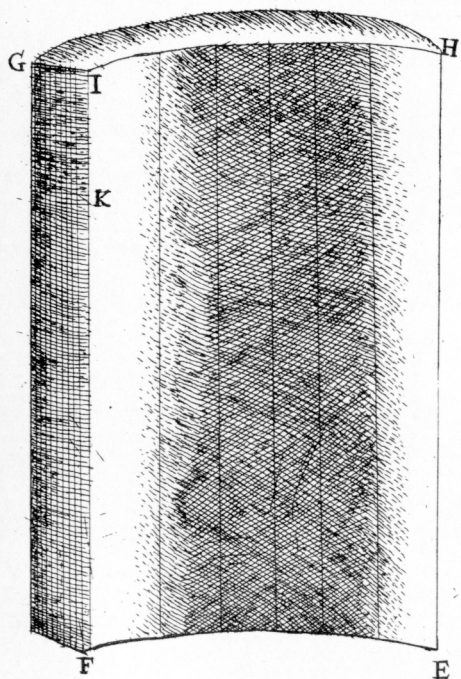
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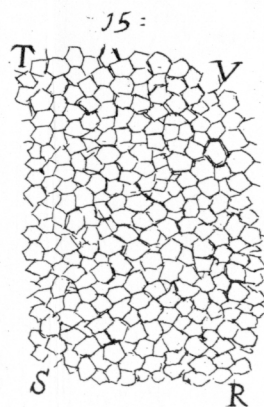
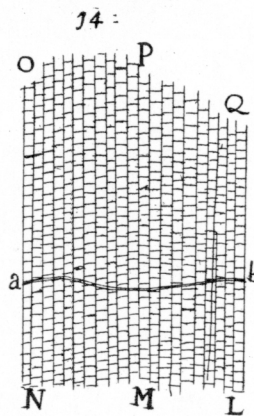
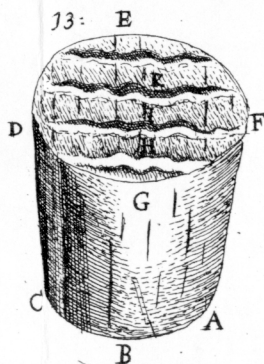
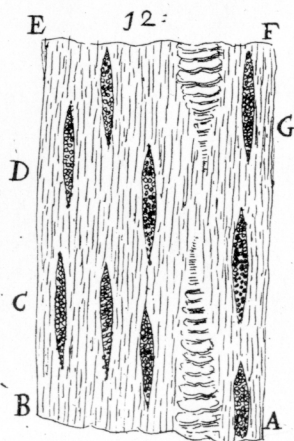
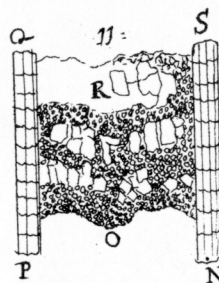
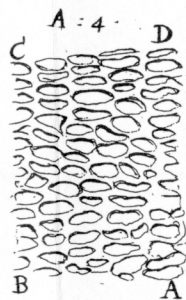
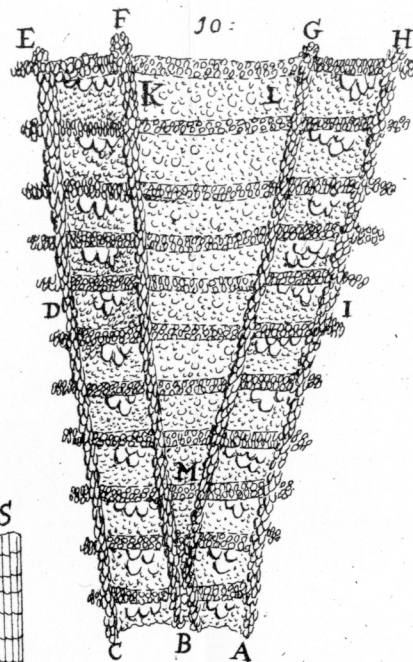
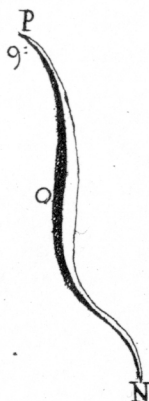
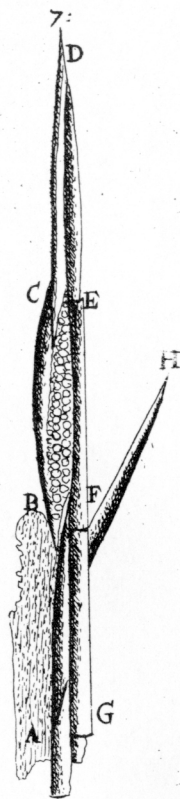
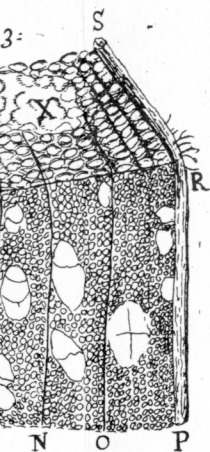


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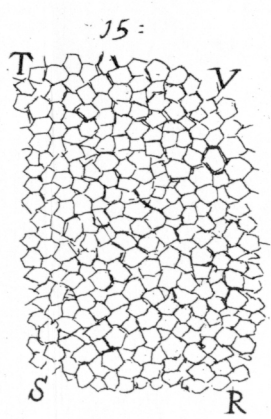
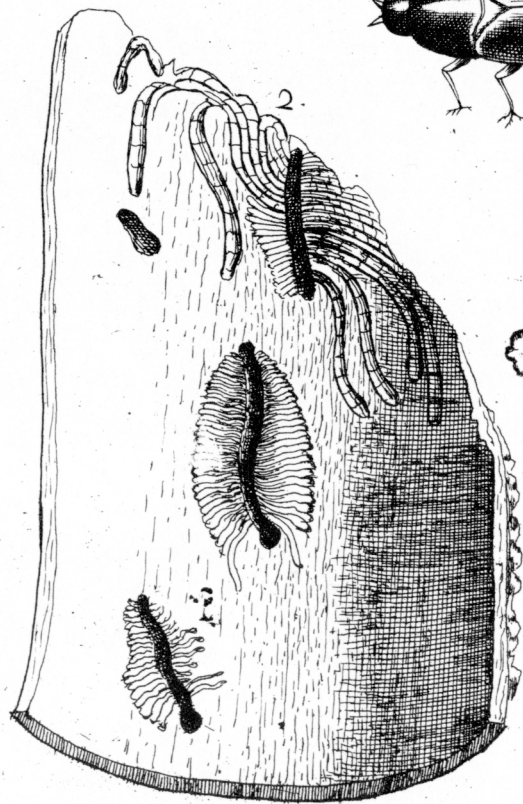
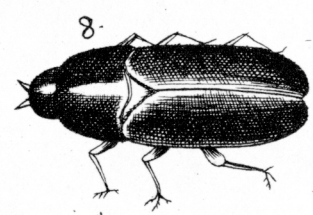
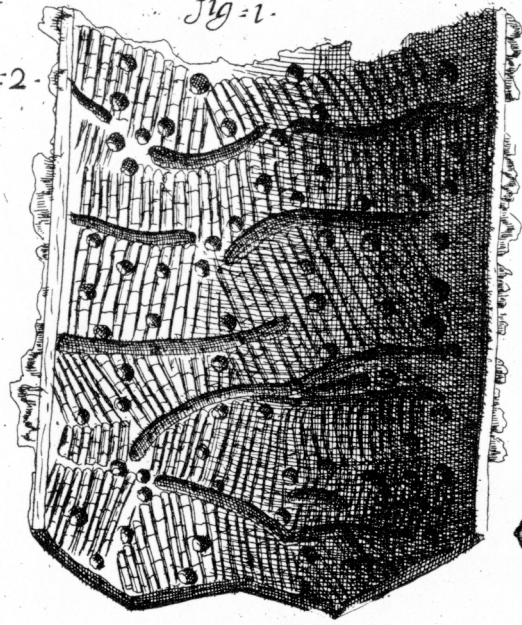
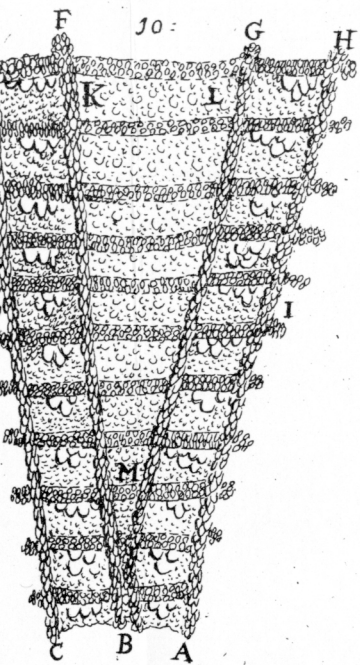
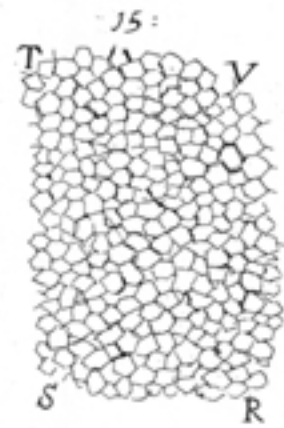
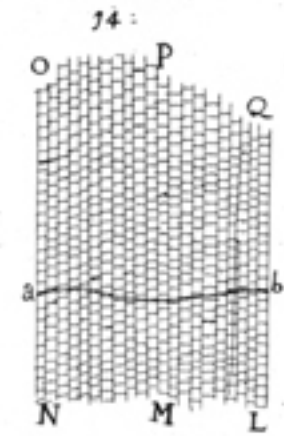
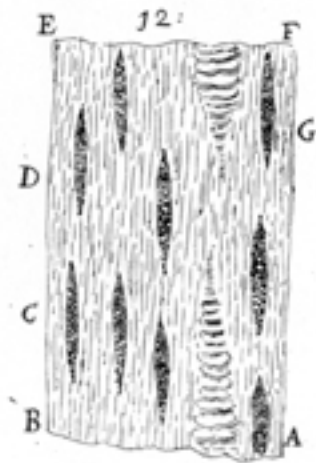
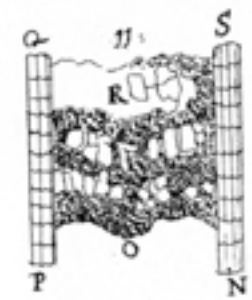
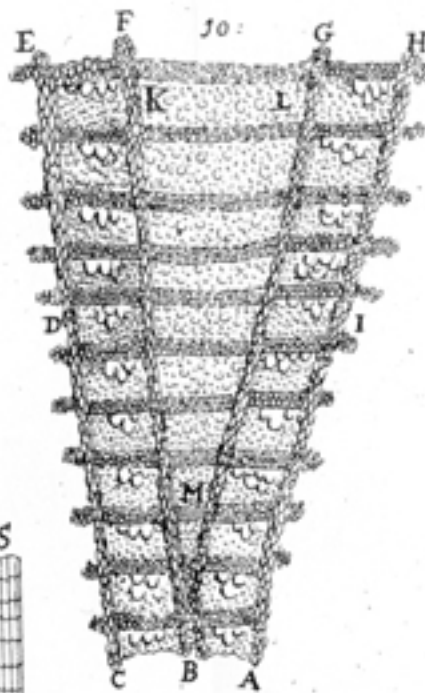
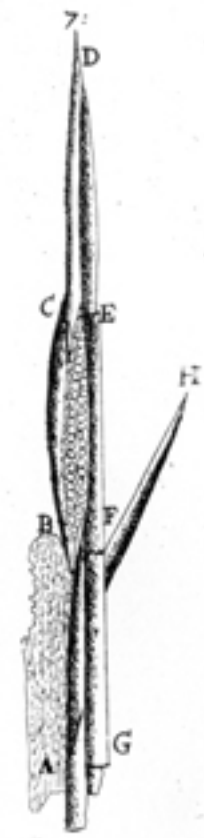
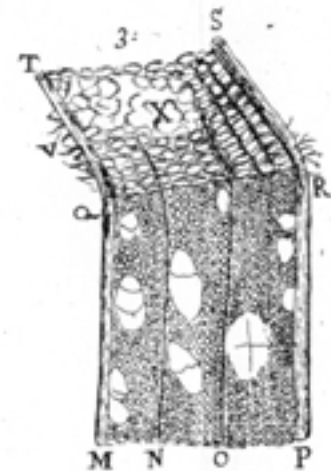
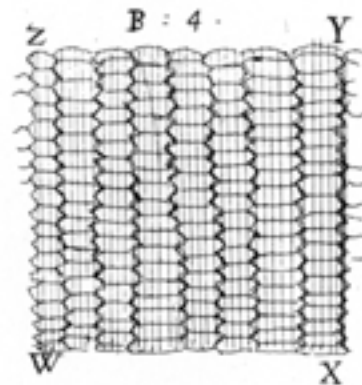
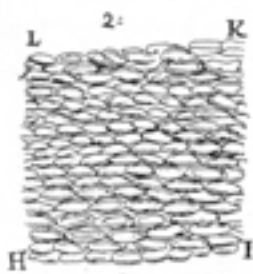


fig. 1.



Tab: 1.



Tab: 2.

fig. 1.

