

( 1740 )

Something thicker and shorter also in the middle, and some of 'em not so even or smooth as in the said Fig. 2.

The said *Heer Hottot* sent me also a little Plant of Dragons Blood, in *Latin*, *Lapathum Sanguineum*; in which I view'd the Stalk of the Leaf after I had cut it across, and discover'd at the same time several particular Colours of a light and of a deeper Red, more than one, could imagine to see at one view: and I did observe in the said Stalk little places in which I could perceive no Colour; but when I cut the same Stalk lengthwise I could then see that those places were Canals, through which I concluded the Red Sap pass, and that those many Colours which lay in those Canals were a sort of Bladders, that contain'd the Sap in them, and that those several Colours were wholly produced by the Sap that ouz'd thro the sides of the Canals, and so made the whole Stalk Red.

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V. *A Letter from Mr Antony van Leeuwenhoek, F. R. S. to John Chamberlain, Esq; S. R. S. concerning Tobacco ashes.*

*Delft, Octob. 3. 1704.*

**I** Take the Liberty to acquaint you, that soon after I had communicated to you my Poor Observations about a Tooth which was thought to have Worms in it, &c. I again examin'd the Ashes of Tobacco; and since the Remarks upon that subject are fallen into my hands within these few Days, I have taken the Liberty of sending 'em to you; hoping there may be something in em which may serve to divert you: The said Remarks are as follows. For

For my Satisfaction I desired a certain Gentleman, who I knew Smoked every day, to save me a little of the Tobacco-ashes, as they came out of his Pipe, but none such as were thoroughly burnt ; my Friend gave me about 2 Thimble full of the said Ashes, of which I put part into a Glas Tube, and pour'd Rain-water upon it, and when I had mingled it well with the Water, and that the Ashes were subsided, the Ashes took up one part of the said Tube, and the Water stood above it two parts more.

Altho these Ashes were of a Grey colour, and had all the Particles thereof appear'd to the naked Eye to be entirely burnt, yet I could perceive, after the mixing of the Water together, that there were remaining some exceeding small Particles of Tobacco, that were not turn'd into these Grey Ashes.

After that the Water had stood 24 hours upon the said Ashes, I took a little of the same, which to the sight appear'd very clear ; but when I observ'd it with my Microscope, I saw that it was impregnated with a great many small Particles, which were about the same Weight and Heaviness with the Water, for they did neither subside to the bottom, neither did they emerge to the Superficies of the Water.

I view'd this Water with five Distinct Microscopes, to see what Salt Particles would come to light, after that the Water was evaporated.

Tab. 3. Fig. 1. A B C represents three distinct Salt Particles, which, tho they were Hexangular, and so Transparent, as if they were made of Glas, yet their Sides rose into Pyramids, just like Cristals grinded into six Sides, ending all in sharp Points, only with this difference, that the Superficies of Fig. A. appear'd with six equal sides, but tho there could be no Superficies discover'd in B and C, yet that which appear'd but one Point, was, I doubt not, Hexangular also.

( 1742 )

Amongst, and about these Salt Particles there lay a great many others, in which, by reason of their exceeding smallness, the Form or Shape was not to be discover'd, excepting some of the biggest of 'em, which I could just perceive to be Hexangular; and such Salt Particles as these have I in all my Observations discover'd amongst divers sorts of Salts.

I saw also other Salt Particles lying that were Hexangular too, but quite Flat, of which I have seen but few, as they are here represented by Fig. 2. EF; near which there lay another kind of a Salt, that appear'd to the Painter like Fig. 3. GH.

I also observ'd several Salt Particles like Fig. 4. IK, only with this difference, that they had two sharp Points at I.

I took notice likewise of several regular Square Salts, and one also that I lookt upon at first to be of the same Figure, but viewing it narrowly, I found it had two Blunt, or Pared off Angles. See Fig. 5. LM.

There were several other Salts, which one would take for Quadrangular Figures, as seeming to have 2 long, and 2 short sides, but viewing 'em more nicely, I found 'em also to be Hexangular, as Fig. 6. NO.

Other Salts appeared like equilateral Triangles, the Angles of which were cut off, but those cut off Angles were in one Salt Particle, Fig. 7. PQ represented bigger than in others.

The Painter observed one Salt Particle representing an Oblong quadrilateral Cube like Fig. 8. RS.

I saw also several Salt Particles, of which some were much bigger than others, as indeed all the rest of the Salts were, which appear'd like Fig. 9 and 10. VW.

There were some Salts too, but very few, that were Quadrilateral, and at one end the Angle was Acute, at the other Obtuse; as in Fig. 11. XY.

( 1743 )

I saw likewise several Long and Slender Salts, that appear'd like Fig. 12. ZZ; the which Salts were so closely linkt and joynd to each other, that one would be apt to take 'em for one long and slender Particle, but viewing them more narrowly they appear'd to be severallinkt together.

Moreover, I try'd these Ashes three several times in a Strong Fire, (having kept them in a small clean Wooden Box) to see what Volatile Salts could be extracted from them; and always observed that first a very clear Liquor did exhale from the Ashes, which at the last Evaporation was accompany'd with a Yellowish Oyl, and which Oyl was coagulated after such a manner, as if they were mingled with Salts.

I saw also a great many small Watery parts, which one might call a Spirit; and an extraordinary great number of little Bubbles, which I judg'd to be really Oyl, of which some of them were so much smaller than others, that they almost escaped the sight through a good Microscope.

There were moreover on the sides of the Glafs some very small Particles, that were neither Water nor Oyl, which I imagin'd to be Volatile Salts, but not being able to discover in 'em any exact form, I can say nothing certain of them; and I have also always observed that when I brought the Glafs where it was cover'd with the Tobacco Ashes, to such a strong Fire, that it was put into Fusion, the Ashes, or rather the Salts thereof, united themselves with the Glafs, and the Glafs ascended with Air bubbles, and with a stronger Fire there was caused a Hole in the Glafs.

I have several times, for my Curiosity only, taken a small piece of our *Delft* Earthen Ware, which was but once baked, and consequently not Glaz'd; and made a small Cavity in it, so that it served me for a Test or Shell, such as the Refiners with Bone Ashes use, and put into the same.

( 1744 )

same a little bit of Gold or Silver, together with some Lead.

I set this Shell upon a large piece of lighted Charcoal, such as I judged sufficient for my purpose, and blowing the Flame of a Lamp through a Pipe, I caused the Lead to evaporate, but the Gold stay'd behind; yet it has so happen'd sometimes, that the Melted Gold or Silver has made such a deep Pit in the Earthen Shell, that I have been forced to make use of a second, if I would clear it of all the Lead.

After I had evaporated the above-mention'd Lead, I put a little Tobacco Ashes into one of these Earthen Shells, and in the space of two minutes, with a strong Flame of a very thick Tallow Candle, most of the Ashes was turn'd into small Globules, and the remainder was in a manner nothing but Salt.

After this I took 3 parts of a certain small Weight of the said Tobacco Ashes, and proceeded therewith as I had done before, and after the space, as I judged, of a little more than two minutes, I took off the Shell from the Fire, and found that the remaining Ashes weigh'd a very little more than two parts, and that the Shell, on that side that was most exposed to the Fire, was turn'd into a Glassy Substance.

The Ashes thus prepar'd, which rather lookt like a Petrify'd Matter than Ashes, I put into a Clean Glass, and pour'd Water upon 'em; and stirring it about with a Copper Wire several times, I let it stand 24 hours, and then decanted off that which was settled and clear to the sight, of which having put a very small quantity upon a clean Glass Plate, and view'd it thro several Microscopes, I always observ'd, in a little time after, a great many Salt Particles coagulated, that were neither Flat nor Slender, but most of 'em as thick as they were Long, and almost each of 'em of a particular shape, which it was very pleasant to see; and tho I lookt upon a great many of the  
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( 1745 )

the said Salts, I found none that agreed with Fig. 1. A B C, Fig. 2. E F. or Fig. 5. L M.

Among these Salt Particles there lay some so very small, that I could not discover their exact form, tho I used never so large Microscopes, yet I was well enough satisfy'd that they were Salt particles extracted from the Tobacco Ashes.

I observ'd also, that upon some Ashes that were not mixt with the Water there lay a white substance, which I imagin'd to have sunk and descended leisurely, because it lay higher in the middle than next the sides of the Glas; and I took this White Matter to be coagulated Salts, which being heavier than the Water, had subsided upon the rest; and so I found it to be, for when I took it out of the Water, and view'd it with the Microscope, I had the pleasure of seeing a vast number of Salt particles, each of 'em of a particular figure, and as clear as Cristal; tho they appear'd less to my sight than those which I caus'd to be delineated.

For my farther satisfaction, I prepar'd exceeding thin and flat little Glasses, which I plac'd so clean before the Microscope, that I suffer'd them not to be touch'd with any hand, to the end, that there should not appear the least spot or mist upon them.

Moreover, I took a new blown Glas Tube, and put into it a little of the last mention'd Water, and viewing it with my Microscope, I saw two Particles therein, which I judg'd to be Salts, whereupon, I pour'd out of the Tube a drop of Water no bigger than a large grain of Sand, which spread it self so much upon a Glas Plate, that there did not remain above a fourth part of it that was capable of being seen, in which I discover'd, to my great satisfaction, several long Particles, which I can liken to nothing better than the Hair of one's Beard of two or three days growth after shaving; and these Particles I discover'd, according to my computation, in the space of

( 1746 )

a minute, whereas I saw nothing before but a fluid clear Water ; and after the space of another minute, the said Particles were encreast to the number of thirty, some of which were floating up and down in the little moisture, and were grown thicker and broader, especially such as lay at some distance from the rest ; and some were so thick and broad, that they far exceeded the others in largeness ; and when the Water was almost all exhal'd, I saw a great number of very small Particles, in which I could discover no figure, and then my agreeable prospect was at an end, because all the Salt particles were surrounded with a Watery Humour which did not evaporate, the cause of which was, the Rainy Weather, with a Foggy Air and a South Wind.

I have endeavour'd to see this agreeable sight more than once, but could not obtain a distinct view of the Salts.

I did not succeed in my last Observation till after the Water had stood 3 days upon the Tobacco Ashes.

Moreover, I took the Glass in which the Tobacco Ashes were that I had reduced to a Petrify'd Substance, and held it over the flame of a Candle till the Water boyl'd, for the space of two minutes, and the said Substance was several times lifted up in the Water, expecting that by the said Heat the Salt particles should be dissolv'd, and incorporated with the Water, which, as I said before, lay coagulated like Cubes in the Water, to the end that I might make some new Observations ; but I could not bring it to bear, forasmuch as almost all the Salts lay in the Water coagulated and linkt by hundreds together, subsiding in the bottom, or else sticking to the Glass.

All these Coagulated Salts were so small, that let me use what Microscope I wou'd, I could not fully discover their figure, which however I took to be Hexangular, and the more because I took them all to be of the same big-

bigness; neither could I, as before, see one Salt particle in so great a number, that was bigger than the rest, tho the Water had stood some days upon the Ashes.

Thereupon I pour'd out the Water and the Ashes together from the Tube, and caus'd the Water to evaporate leisurely over the Fire, and laying the remaining Ashes upon a piece of Earthen Ware, I made it red hot, and after it was cold, I crumbled it to pieces between a Paper, and then putting it into a new Glass, and pouring a little Water upon it, I expected to find that the Salt particles by the force of the Fire were dissolved, and would be united to the Water, whereupon I renew'd my Observations, pouring the Water leisurely, to the end that the multitude of Salt particles, in the evaporating of the Water, should not coagulate too fast, and so hinder an exact view of them; and I saw several times, to my great satisfaction, that the Salt particles (tho unspeakably small) were Hexangular, as in Fig. 2. EF, but some of 'em longer than others, and some much larger; and some again so slender, that by reason thereof I could not have seen them, had not the circumference of them been thicker and brighter than the rest.

Hereupon I took again a little Water of the Ashes of Tobacco, as clean as they came out of the Pipe, and mixt the same with pure Rain water, and found the same effect in the Coagulation of the Salts as before.

Altho among the aforementioned Figures of Salt I discover'd several others, I concluded that all those Salt particles that were not Hexangular were of another form, by reason of the Coagulation, or Inclination of the Salts to one another, which happens more in some places of the Water than in others, whereby the Salts assume a Figure that is not proper to 'em.

After that the Water had stood six hours upon the Tobacco Ashes, which I had twice put into a glowing

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Heat,

( 1748 )

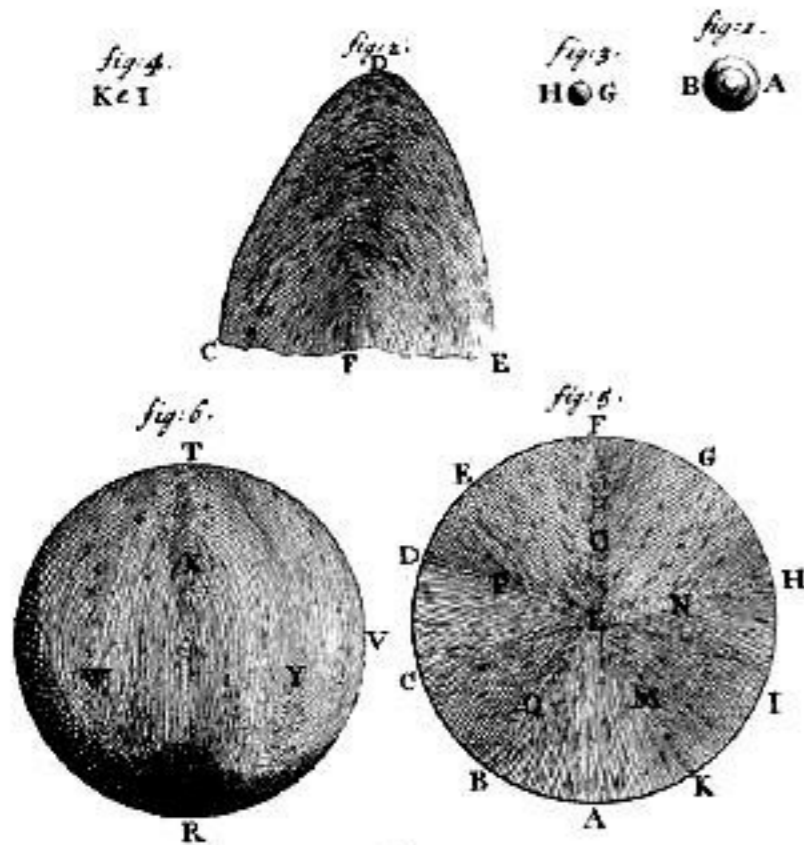
Heat, I observed a great many Cubical Salts of several figures, that were coagulated in the Water, whereas I could see but two such Salt particles in the Water that was pour'd upon the Tobacco Ashes just as the same came out of the Pipe.

This last experiment of mine was made in very moist weather, in which the Salt particles did not only coagulate, but they were also so tenacious of their figure, that I scarce ever observed any Salts extracted from burnt Matter so stubborn and strong as these.

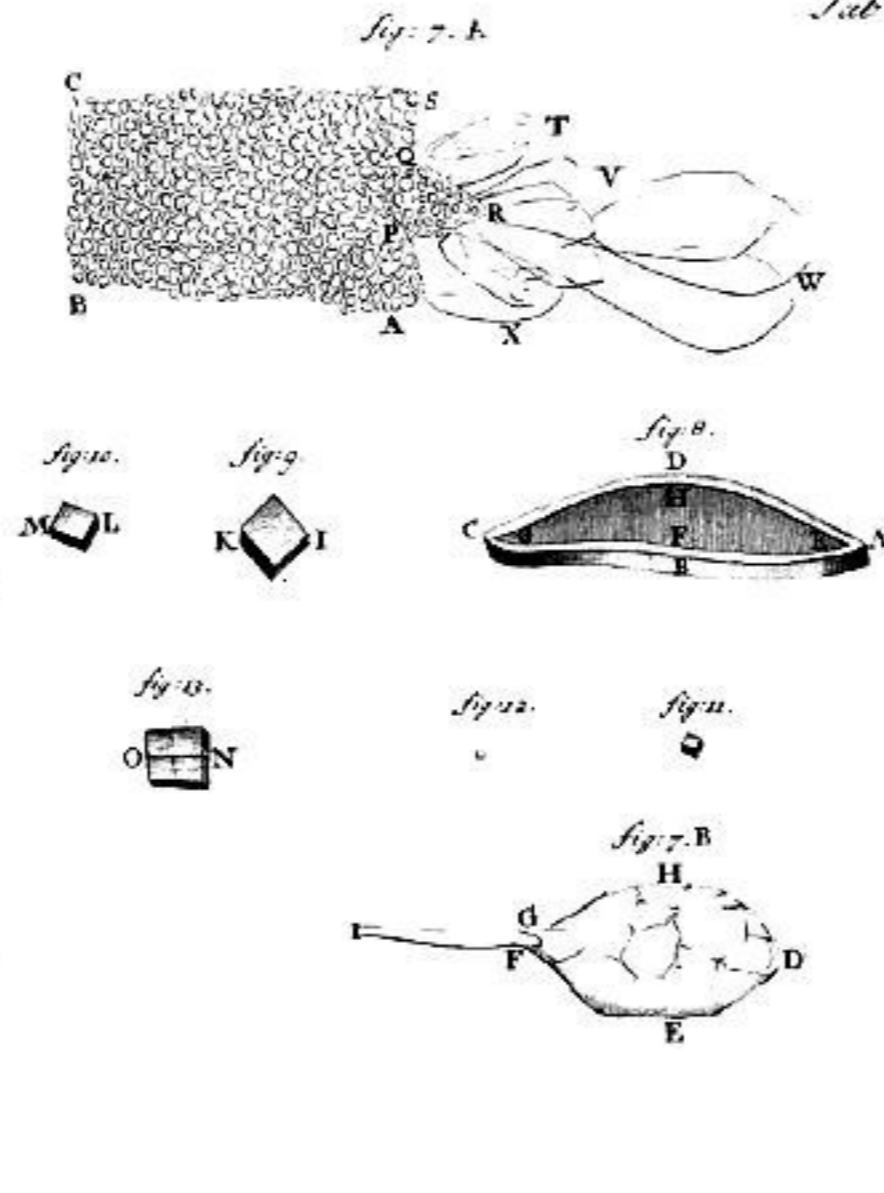
I put the Glas a second time over the flame of a Candle till the Water actually boyl'd, and then viewing it, I saw some Great Particles that were very dark, and surrounded with abundance of very small Particles, of which I could not discover any figure, no more than of several other small Particles, which I lookt upon to be Salts.

These are my Observations and Experiments upon this subject, which I thought fit to communicate to you.

Tab: 1.



Tab: 2.



Tab: 3.

